

ORIGINAL

## From non-problematic smartphone use to smartphone addiction: Impulsivity-based profiles

### *Del uso no problemático a la adicción al móvil: Perfiles de impulsividad*

ANA SÁNCHEZ-KUHN<sup>\*#</sup>, JORGE L. PUGA<sup>\*\*\*</sup>, PILAR FLORES<sup>\*</sup>, ANA MARÍA RUIZ-RUANO<sup>\*\*\*</sup>.

# Both authors contributed equally to the development of the manuscript.

\* Department of Psychology and Health Research Centre (CEINSA-UAL), University of Almería, Almería, Spain.

\*\* Department of Personality, Evaluation and Psychological Treatment, Faculty of Psychology, University of Granada, Granada, Spain.

\*\*\* Department of Developmental and Educational Psychology, Faculty of Education, University of Granada, Granada, Spain.

#### Abstract

Problematic smartphone use (PSU) is an uncontrollable behavior that impedes the ability to stop using it despite potential negative consequences. This excessive behavior has been considered in the research field as a behavioral addiction, as literature has shown common characteristics with behavioral addictions, including its impulsivity-driven factor. However, impulsivity is a multidimensional construct whose specific traits lead differently to each addiction. Hence, the present study aimed to address the different existent PSU profiles depending on their individual impulsivity personality traits. To this end,  $N = 412$  adults (average age 31.91,  $SD = 11.70$ , including 108 men and 304 women) were recruited to explore their daily smartphone usage, level of smartphone addiction (SAS-SV) and impulsivity profile across the five impulsivity personality traits (UPPS-P). Cluster analysis revealed the existence of three different profiles: one without PSU; one showing an excessive impulsively but almost no addictive smartphone use, expressing only a loss of control symptomatology; and one showing excessive impulsively but also addictive smartphone patterns, driven mainly by the impulsivity personality traits of negative urgency, positive urgency and lack of premeditation. Therefore, this study showed the impulsivity personality traits that differentiate excessive from addictive smartphone use, which is valuable information for the development of more precise prevention and interventions programs.

**Key words:** problematic smartphone use, excessive smartphone use, smartphone addiction, impulsivity, cluster analysis.

#### Resumen

El uso problemático del móvil (PSU, por sus siglas en inglés) es un comportamiento incontrolable que dificulta la capacidad para detenerlo, pese a las potenciales consecuencias negativas. Este comportamiento excesivo ha sido considerado en el campo de la investigación como una adicción conductual, ya que la literatura ha demostrado características comunes con otras adicciones conductuales además de que está mediado por la impulsividad. Sin embargo, la impulsividad es un constructo multidimensional cuyas dimensiones específicas se relacionan de modo diferencial con los distintos tipos de adicción. Por consiguiente, el presente estudio pretende explorar los perfiles de uso del móvil dependiendo de las dimensiones de impulsividad. Para ello, se registró el uso diario del móvil, el nivel de adicción al móvil (SAS-SV) y el patrón de impulsividad a través de los cinco rasgos de personalidad impulsiva (UPPS-P) de 412 adultos (con una media de edad de 31,91 años,  $DT = 11,70$ , incluyendo 108 hombres y 304 mujeres). El análisis de clúster mostró la existencia de tres tipos de perfiles: uno sin PSU; uno con impulsividad excesiva, pero sin uso adictivo del móvil, presentando solo sintomatología de pérdida de control; y otro con impulsividad excesiva y patrones adictivos al móvil, caracterizados principalmente por los rasgos impulsivos de urgencia negativa, urgencia positiva y falta de premeditación. Por tanto, este estudio muestra las dimensiones de personalidad impulsiva que diferencian un uso excesivo del adictivo al móvil. Esta información es útil para el desarrollo de programas de prevención e intervención mejor adaptados a estos perfiles de comportamiento.

**Palabras clave:** uso problemático del móvil, uso excesivo del móvil, adicción al móvil, impulsividad, análisis clúster.

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■ Enviar correspondencia a:

Ana María Ruiz-Ruano García. Facultad de Ciencias de la Educación, Universidad de Granada, Campus Universitario Cartuja, 18011, Granada.  
E-mail: amruano@ugr.es

**P**roblematic smartphone use (PSU) is broadly defined as an excessive behaviour that hinders the ability to stop using the device besides the possible negative consequences it could lead to (Busch & McCarthy, 2021). PSU is a novel construct that has been gaining attention in the research field as its prevalence is augmenting being nowadays an emerging public health issue (Billieux, Maurage, Lopez-Fernandez, Kuss & Griffiths, 2015). A recent meta-analysis showed that PSU is increasing across the world, showing China and Saudi Arabia the highest rates while Germany and France the lowest (Olson et al., 2022b). Moreover, the social restrictions caused by the COVID-19 pandemic have boosted PSU, mediated by factors such as isolation, anxiety and fear of missing out (Elhai et al., 2021; Elhai, Yang, Rozgonjuk & Montag, 2020; Li, Zhan, Zhou & Gao, 2021; Ratan, Zaman, Islam & Hosseinzadeh, 2021). Besides social media access, PSU can be also motivated by other engaging activities such as online gaming, shopping, gambling or pornography. In this sense, the smartphone device is acting as a facilitator of the gratifications received from these activities (Niedermoser et al., 2021; Panova & Carbonell, 2018; Yang & Gong, 2021). Currently, the number of active mobile devices is larger than the total world population, and the new variety of functions that these devices offer (e.g., working, information seeking, social networking, health, and leisure-related activities) have increased the dependency (Konok, Pogány & Miklósi, 2017). Excessive smartphone use (ESU) has been linked to lower academic performance (Amez & Baert, 2020), lower work productivity (Duke & Montag, 2017), a poorer quality of life (Kliesener, Meigen, Kiess & Poulain, 2022), social interaction anxiety (Kuru & Çelenk, 2021), materialism (Lee, Son & Kim, 2016), higher perceived stress (Samaha & Hawi, 2016), sleep disturbances, anxiety and depression (Demirci, Akgönül & Akpınar, 2015; Elhai, Yang, McKay & Asmundson, 2020). In this sense, there is a raising interest in developing interventions oriented to reduce PSU and its consequences (Olson, Sandra, Chmoulevitch, Raz & Veissière, 2022a).

PSU is also referred to as smartphone addiction (SA) (Busch & McCarthy, 2021) for its similarity with other behavioural addictions such as pathological gambling, internet, gaming, shopping, sex and exercise addiction; as all of them share an uncontrolled psychological dependency manifested with craving (Wilcockson, Osborne & Ellis, 2019), withdrawal symptoms (Eide, Aarestad, Andreassen, Bilder & Pallesen, 2018) and anxiety (Cheever, Rosen, Carrier & Chavez, 2014) when its use results restricted. However, within the clinical field it is still not recognized as an addiction, as can be seen in the behavioural addiction section of the DSM-5, that includes so far only pathological gambling (American Psychiatric Association [APA], 2013) and of the ICD-11, that recognizes only gambling and

gaming disorders (World Health Organization, 2019). Within the research field, the concept of SA has been mainly accepted and increasingly gaining importance, with studies focusing on the variety of its antecedents and the severity of its consequences (e.g., Alhassan et al., 2018; Anshari, Alas & Sulaiman, 2019; Beison & Rademacher, 2016; Dhamayanti, Dwiwina & Adawiyah, 2019; Geng, Gu, Wang & Zhang, 2021). In this sense, advances have been made in the assessment of SA, such as with the development of a reliable and valid SA diagnose tool: the smartphone addiction scale (SAS) that measures addiction to smartphones providing a cut-off value for distinguishing smartphone addicted from non-addictive individuals (Kwon et al., 2013b), allowing the opportunity to develop studies describing SA vulnerability factors.

Similar to other addiction processes, PSU has shown to be based on impulsivity mechanisms (Contractor, Weiss, Tull & Elhai, 2017). Impulsivity is not a categorical, but rather a continuous construct: to one extent it is defined as the ability to take quick decisions and actions without much hesitation, which can be actually advantageous depending on the context. But on the other extreme, when impulsivity results exacerbated in an individual, it can lead to risky and maladaptive actions followed by negative consequences, which is represented in pathologies including addictions (Dalley & Robbins, 2017; Moreno et al., 2012). Moreover, considerable research indicates that impulsivity is a multifaceted construct, separable in different personality traits that are also each uniquely related to addictions (Mitchell & Potenza, 2014). One of the most established subdivisions is defined by the five impulsivity traits self-reported measure: UPPS-P, that distinguishes negative and positive urgency, lack of premeditation, lack of perseverance and sensation seeking (Whiteside & Lynam, 2001). Known the relevance of impulsivity in addictive processes, previous studies have been consistently finding relationships of high impulsivity personality traits with ESU or SA (Grant, Lust & Chamberlain, 2019; Jo, Euihyeon & Kim, 2017; Kim et al., 2016; van Endert & Mohr, 2020).

Hence, PSU is a construct that is growing in literature and rising interest for its increasing incidence, however, the limits between ESU with an actual SA are not clear yet. Moreover, although the relationship between impulsivity and PSU has been established and replicated, the involvement of each impulsivity personality trait in the different levels of PSU has not been described to date. Thus, the present study aims to draw the different PSU profiles and to describe to what extent each specific impulsivity personality trait is present in each group. To focus on individual differences within PSU is necessary for a better understanding of this problematic behaviour and consequently, for the development of more precise and individualised evaluation, prevention, and intervention programs.

## Method

### Participants

The present study involved a total sample of  $n = 412$  full aged Spanish participants (age range: 18-89 years old; average age 31.91,  $SD = 11.70$ , including 108 men and 304 women). The educational level of the participants was: primary school (0.24%), secondary school (5.34%), pre-university (20.63%), medium professional degree (2.91%), high professional degree (12.86%), university degree (34.47%), master's degree (21.60%) and PhD. degree (1.94%).

### Procedure

The sample was composed by volunteers who completed an online survey distributed via snowball sampling procedure, initially using social media and e-mail. Inclusion criterion was full aged individuals who were informed about the study and voluntarily consented to participate in the study.

### Materials

*Daily smartphone usage and Smartphone Addiction Scale-Short Version (SAS-SV)*

Daily smartphone usage was registered through the online survey requesting the mean smartphone daily usage hours. The SAS-SV is a validated scale that measures smartphone addiction (original from Kwon et al., 2013a, Spanish version from López-Fernández, 2017). It is the most cited and used measure of ESU to date (Olson et al., 2022b). It is composed of 10 items in Likert scale format, where 1 is "strongly disagree" and 6 "strongly agree", where the highest score means the highest presence of smartphone addiction. The cut-off point to distinguish addictive smartphone users is located at 32, according to López-Fernández (2017), not distinguishing between genders, as no differences were found between genders in the Spanish population in the SAS-SV. The SAS-SV provides scores for each smartphone addiction symptom: loss of control (LC), cognitive disturbance (CD), ignoring negative consequences (IC), withdrawal (WD) and tolerance (TOL). The scale showed content and concurrent validity and internal consistency with Cronbach alpha .88 (López-Fernández, 2017). In this research, non-parametric bootstrapped internal consistency coefficients and corresponding 95% confidence intervals were considered acceptable ( $\omega = .86$ , 95% CI [.81, .87],  $\alpha = .86$ , 95% CI [.83, .88]).

*Short UPPS-P Impulsivity scale*

The UPPS-P scale (original from Whiteside & Lynam, 2001, short Spanish version from Cándido, Orduña, Perales, Verdejo-García & Billieux [2012]), was designed to measure impulsivity differentiating the five involved impulsive personality traits: negative urgency (NU) that refers to the tendency to act rashly in response to negative affective states, positive urgency (PU) implies impulsive responses to positive affective states, lack of premeditation

(LPREME), which is the propensity to make quick decisions without considering the consequences, lack of perseverance (LPERSE) and sensation seeking (SS), and it consists of 20 items. Among other problematic behaviours, this scale has been traditionally used to study the impulsive component of addictive behaviours such as pathological gambling (Savvidou et al., 2017), compulsive buying (Claes & Müller 2017), food addiction (Murphy, Stojek & MacKillop, 2014) and problematic practice of physical exercise (Kotbagi, Morvan, Romo & Kern, 2017). The Cronbach alpha extracted from this scale ranged from .61 to .81, suggesting acceptable internal consistency for the five subscales (Cándido et al., 2012). In this research, non-parametric bootstrapped internal consistency coefficients and corresponding 95% confidence intervals for the whole scale were considered acceptable ( $\omega = .85$ , 95% CI [.81, .87],  $\alpha = .86$ , 95% CI [.83, .87]). The non-parametric bootstrapped estimations of internal consistencies for each subscale were also considered appropriate for negative urgency ( $\omega = .79$ , 95% CI [.75, .83],  $\alpha = .79$ , 95% CI [.76, .82]), lack of premeditation ( $\omega = .81$ , 95% CI [.77, .85],  $\alpha = .81$ , 95% CI [.76, .85]), lack of perseverance ( $\omega = .83$ , 95% CI [.79, .86],  $\alpha = .81$ , 95% CI [.77, .87]) and sensation seeking ( $\omega = .84$ , 95% CI [.81, .87],  $\alpha = .84$ , 95% CI [.81, .86]). The lower estimates were observed for positive urgency subscale ( $\omega = .68$ , 95% CI [.63, .73],  $\alpha = .67$ , 95% CI [.61, .72]) but it was even higher than the minimum reported by Cándido et al. 2012.

### Statistical analysis

Clusters were generated including the total score for smartphone addiction (SAS-SV - total score) and the five impulsivity personality traits to characterize each group: negative urgency, positive urgency, lack of premeditation, lack of perseverance and sensation seeking. The variables were standardized before performing the clustering analysis. The optimal number of clusters was determined with R (Version 4.0.2) using the NbClust package (Version 3.0) (Charrad, Ghazzali, Boiteau & Niknafs, 2014). The similarity measure selected for the NbClust was Euclidean distances. The  $k$ -means procedure was executed with the Hartigan-Wong algorithm (Hartigan & Wong, 1979) limiting the number of interactions to 25 and using 25 random seeds. As data was non-normally distributed according to the Kolmogorov-Smirnov normality test, clusters were compared in each variable using with Kruskal-Wallis test and Mann-Whitney  $U$  post-hoc test with IBM SPSS (Version 24). All contrasts were bilateral, significance was set up at  $p \leq .05$  and effect sizes were interpreted according to Cohen's classification (Cohen, 1988, 1992): small ( $\eta^2 \geq .01$ ), medium ( $\eta^2 \geq .06$ ), and large ( $\eta^2 \geq .14$ ); and small ( $r \geq .01$ ), medium ( $r \geq .06$ ), and large ( $r \geq .14$ ). The dataset of the current study is available under the following source: [https://osf.io/374jp/?view\\_only=89d2c2d94f564b25b51beb3626188f7f](https://osf.io/374jp/?view_only=89d2c2d94f564b25b51beb3626188f7f).

### Ethics

Participants were informed about the study and all provided informed consent. The present work was approved by the Bioethics Commission in Human Research of the University of Almeria and all data was protected under the Spanish Organic Law 3/2018 of 5 December, on the Protection of Personal Data and Guarantee of Digital Rights. The study procedures were carried out in accordance with the ethical principles for medical research involving human subjects from the 64th World Medical Association (WMA) General Assembly, Fortaleza, Brazil, October 2013 (World Medical Association, 2013), updated from the original Declaration of Helsinki.

## Results

The best fit for the cluster analysis identified three groups of participants. Each cluster was labelled for its PSU properties from now on defined as: cluster 1: non-problematic smartphone use (NPSU) ( $n = 147$ ), cluster 2: excessive smartphone use (ESU) ( $n = 158$ ) and cluster 3: smartphone addiction (SA) ( $n = 107$ ). Table 1 shows the demographic characteristics of each group:

Results showed a main effect of cluster on daily smartphone usage ( $H(2) = 16.32, p < .001, \eta^2 = .02$ ) (Figure 1). Post-hoc analysis indicated that the SA group showed significantly more daily smartphone usage compared to the

NPSU group ( $U = 5606.00, p < .001, r = .02$ ), and the ESU group showed significantly more daily smartphone usage compared to the NPSU group ( $U = 9781.50, p = .016, r = .14$ ).

Figure 2 shows the number of individuals displaying smartphone addiction, according to Kwon et al. (2013a) (scoring above 32 in the total score of the SAS-SV scale). There was a main effect of cluster in the percentage of participants classified as smartphone addicts ( $H(2) = 141.52, p < .001, \eta^2 = .31$ ). Post-hoc analysis revealed that in the SA group, there were more participants with smartphone addiction compared to the ESU ( $U = 3646.50, p < .001, r = .59$ ) and the NPSU group ( $U = 3341.50, p = .001, r = .58$ ). No significant differences were found between the ESU and the NPSU group ( $U = 11537.50, p = .88, r = .01$ ).

The comparison of the groups in the five different symptoms of smartphone addiction measured through the SAS-SV (Figure 3) revealed a main effect of the clustering group for all dimensions: LC ( $H(2) = 102.66, p = .001, \eta^2 = .29$ ), CD ( $H(2) = 81.52, p < .001, \eta^2 = .22$ ), IC ( $H(2) = 43.94, p < .001, \eta^2 = .13$ ), WD ( $H(2) = 69.94, p < .001, \eta^2 = .19$ ) and TOL ( $H(2) = 61.19, p < .001, \eta^2 = .17$ ). Post-hoc analysis indicated that the SA group scored higher in all dimensions of smartphone addiction compared to the ESU and the NPSU groups ( $p < .001$  for both cases in all variables). The ESU group scored significantly above the NPSU group in loss of control ( $U = 8742.00, p < .001, r = .13$ ).

**Table 1.** Shows the number of participants ( $n$ ) located in each of the three clusters and demographic characteristics of each group.

Cluster		1: NPSU	2: ESU	3: SA
$n$		147	158	107
% of woman		70.7%	73.4%	78.5%
Age (Mean [ $SD$ ])		34.73 (12.13)	31.07 (11.17)	30.47 (10.16)
Educational level (% of participants located in each level)	Primary school	0.0%	0.6%	0.0%
	Secondary school	4.1%	4.4%	8.4%
	Pre-university	17.7%	19.0%	27.1%
	Medium professional degree	2.0%	3.2%	3.7%
	High professional degree	15.6%	11.4%	11.2%
	University degree	27.9%	45.6%	27.1%
	Master's degree	29.9%	14.6%	20.60%
PhD. degree		2.7%	1.3%	1.9%

**Note:** NPSU: non-problematic smartphone use, ESU: excessive smartphone use and SA: smartphone addiction.

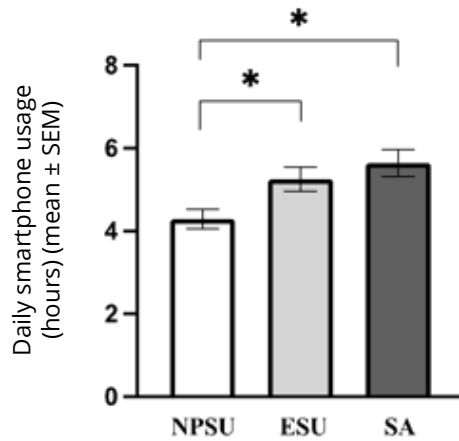


Figure 1. Mean score  $\pm$  standard error of the mean (SEM) obtained by each of the three groups (NPSU, ESU and SA) in the daily smartphone usage (hours per day). NPSU: non-problematic smartphone use, ESU: excessive smartphone use and SA: smartphone addiction.  $*p \leq .05$ .

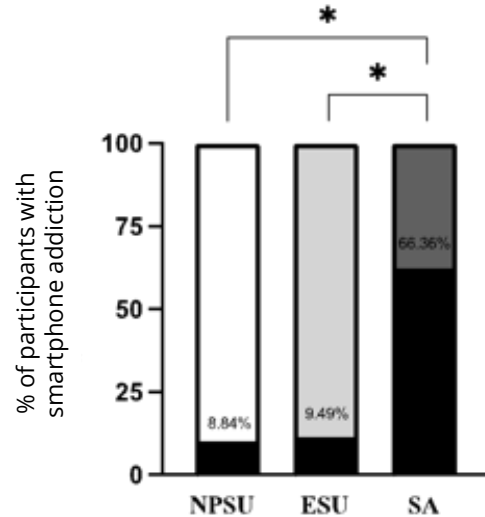


Figure 2. Percentage of participants scoring as smartphone addicted users according to the total score in the SAS-SV scale. NPSU: non-problematic smartphone use, ESU: excessive smartphone use and SA: smartphone addiction.  $*p \leq .05$ .

Finally, the comparison of the three groups in the five different impulsivity personality traits measured through the UPPS-P scale (Figure 4) displayed a main effect of the clustering group for all traits: NU ( $H(2) = 188.00, p = .001, \eta^2 = .42$ ), PU ( $H(2) = 146.62, p < .001, \eta^2 = .36$ ), LPPRE ( $H(2) = 159.99, p < .001, \eta^2 = 0.41$ ), LPPERSE ( $H(2) = 88.40, p < .001, \eta^2 = 0.21$ ) and SS ( $H(2) = 88.40, p < .001, \eta^2 = .21$ ). Post-hoc analysis showed that the SA group scored significantly higher than the ESU and the NPSU group in all traits ( $p < .001$  for both cases in all variables). SA participants scored significantly above ESU participants

in negative urgency ( $U = 6771.00, p = 0.005, \eta^2 = .67$ ), positive urgency ( $U = 4583.00, p < .001, \eta^2 = .42$ ) and lack of premeditation ( $U = 2428.50, p < .001, \eta^2 = .59$ ).

We found no statistically significant differences between men and women in daily smartphone usage ( $t(410) = 1.20, p = .23, d = 0.12, r = .06$ ), SAS-SV scores ( $t(410) = 1.00, p = .32, d = 0.10, r = .05$ ) or UPPS-P scores ( $t(410) = 0.85, p = .40, d = 0.08, r = .04$ ). Negative statistically significant correlations were found between age and daily smartphone usage ( $r = -.14, p = .004$ ), the SAS-SV ( $r = -.14, p = .004$ ) and the UPPS-P scores ( $r = -.180, p < .001$ ).

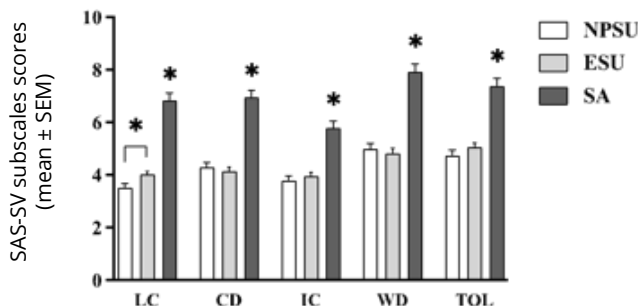


Figure 3. Mean score  $\pm$  standard error of the mean (SEM) obtained by each of the three groups in the SAS-SV subscales. LC: loss of control, CD: cognitive disturbance, IC: ignoring negative consequences, WD: withdrawal, TOL: tolerance, NPSU: non-problematic smartphone use, ESU: excessive smartphone use and SA: smartphone addiction.  $*p \leq .05$ .

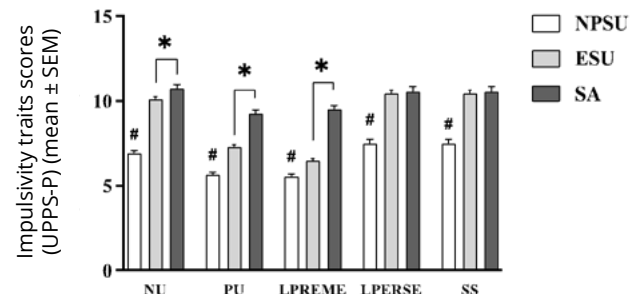


Figure 4. Mean score  $\pm$  standard error of the mean (SEM) obtained by each of the three groups in the five impulsivity personality traits measured through the UPPS-P. NU: negative urgency, PU: positive urgency, LPPRE: lack of premeditation, LPPERSE: lack of perseverance and SS: sensation seeking, NPSU: non-problematic smartphone use, ESU: excessive smartphone use and SA: smartphone addiction.  $*p \leq .05$ .

## Discussion

In the present research we found three different clustering profiles based on the level of smartphone addiction and the impulsivity personality traits. One group showing low PSU and low impulsivity personality traits scores (NPSU group). One group presenting an impulsive profile with an excessive but almost no addictive smartphone use (ESU group), showing only elevated loss of control addictive symptomatology. And finally, one group displaying an impulsive profile, with an excessive and addictive smartphone use (SA group). Compared to the NPSU group, the ESU and the SA groups showed higher levels of impulsivity in all dimensions: NU, PU, LPREME, LPERE and SS. However, compared to the ESU group, the SA group showed even higher levels of impulsivity in NU, PU and LPREME, which are the three impulsivity personality dimensions that characterize this addictive profile. This study shows the impulsivity personality traits that differentiate excessive from addictive smartphone use, pointing towards their importance for the design of intervention programs, that should address their reduction. We also found that age was negatively correlated with the principal measures (smartphone daily usage, smartphone addiction and impulsivity scores). Other studies have found a special vulnerability of young people to PSU and have expressed the need for taking this population into special consideration in the development of this problematic behavior (Pastor, García-Jiménez & López-de-Ayala, 2022; Sohn, Rees, Wildridge, Kalk & Carter, 2019; Wacks & Weinstein, 2021).

Comparing the three groups, the NPSU group showed the lowest daily smartphone usage. In addition, this group displayed the lowest impulsivity scores in all traits. Compared to the SA group, the NPSU group showed lower addiction symptomatology in all measures, and compared to the NPSU group, only lower scores in loss of control. 8.84% of the participants in this group scored as addicted to smartphones, which might describe a little but existent population that makes a smaller use of their smartphones besides showing high levels of addiction. This can be due to specific life circumstances that impede a larger smartphone use, but also and presumably due to the lower impulsivity levels, that describe a self-controlled profile which besides these addictive symptoms, is able to overcome the excessive behaviour. This group represents how low impulsivity might play a protective role in the development of PSU as documented in previous studies (Cudo, Torój, Demczuk & Francuz, 2020; Kim et al., 2016).

The ESU group is characterized by an excessive daily smartphone usage compared to the NPSU group, however, these individuals are not showing great signs of addiction, as almost all smartphone addiction measures are like the NPSU group. Only the loss of control addictive symptomatology showed to be increased in this group. This

addictive property is closely related to this excessive use, as it represents a high tendency to check the smartphone for not missing out conversations, and to neglect work or other previously planned tasks for spending more time than expected on the smartphone (López-Fernández, 2017). 9.94% of the individuals in this group showed SA, but this rate is still similar to the NPSU group. As a result, this group refers to a subpopulation that makes a high use of their smartphone but does not show an addictive pattern. This result might enlighten the open controversy about the limits between ESU and SA, showing that an excessive smartphone use is not always related to addiction, which contributes to the avoidance of over-pathologizing (Panova & Carbonell, 2018) and highlights that PSU studies need to put the attention not only in the “how much”, but also in the “why” (Busch & McCarthy, 2021). Although the reasons for spending much time on the smartphone are diverse, the data replicates that an impulsive personality profile is closely related to an excessive smartphone use (Kim et al., 2016; van Endert & Mohr, 2020). Moreover, this impulsivity driven ESU has been related to risky behaviours such as using the smartphone while walking (Igaki, Romanowich & Yamagishi, 2019) and while driving (Hayashi, Rivera, Modico, Foreman & Wirth, 2017). Hence, although this group is not addiction-based, considering the overuse, the loss of control symptomatology and the impulsive personality profile, individuals with ESU could be taken into consideration as a risky population and as a vulnerable group to potentially develop SA.

Participants from the SA group showed similar daily smartphone usage as the ESU group, that is in both cases higher than in the NPSU group. However, compared to the previous two groups (NPSU and ESU), the SA group is clearly distinguished for containing the highest number of participants with addiction to smartphone and for showing also higher scores in the five symptoms of smartphone addiction. The impulsivity personality traits that characterize this group and distinguishes it from the ESU group are negative urgency, positive urgency, and lack of premeditation. Negative and positive urgency are closely related constructs and the majority of studies find positive correlations between them (Billieux et al., 2021). Negative urgency is the impulsivity personality trait that has been more often associated with risky behaviours and addictions. In fact, it is considered a transdiagnostic endophenotype of addictive disorders (Um, Whitt, Revilla, Hunton & Cyders, 2019), drug abuse, problematic gambling, risky sexual behaviors and binge eating (Cyders, Coskunpinar & VanderVeen, 2016; Fischer, Wonderlich, Breithaypt, Byrne & Engel, 2018). In the same line, negative urgency has been linked to smartphone addiction, as a decisive mediator in the relation between post-traumatic stress disorder, depression, anxiety and stress with PSU (Contractor et al., 2017; Lee & Lee, 2019). As the development of addictions tend to respond to the necessity of

escaping from negative emotions, the smartphone use could be fulfilling the function of avoiding the confrontation with the negative emotions present in the reality (Li et al., 2021). Positive urgency has been considered as triggering factor of problematic behaviours, that are performed to maintain these positive emotions or enhance them (Billieux, Gay, Rochat & Van der Linden, 2010). It has been previously linked to other addictions such as food addiction (VanderBroek-Stice, Stojek, Beach, vanDellen & MacKillop, 2017), pathological gambling and cocaine addiction (Albein-Urios, Martínez-González, Lozano, Clark & Verdejo-García, 2012) and has been stated as a PSU risk factor (Billieux et al., 2010). Individuals with a high positive urgency have shown to be more vulnerable to cognitive interference by the presence of a smartphone device (Canale et al., 2019). The third and last impulsivity trait characterizing the SA group is lack of premeditation, also linked to addictive disorders and risky behaviours (López-Torres, León-Quismondo & Ibáñez, 2021; Minhas et al., 2021) and to PSU (Canale et al., 2021). Not valuing the consequences of the excessive use might be responsible for the damage the development of SA causes on the social, work, or academic-related domains. Lack of perseverance and sensation seeking are both present in the ESU and the SA group. Lack of perseverance could be associated to an excessive smartphone usage stated by its relation with procrastination (Rozgonjuk, Kattago & Täht, 2018) and distraction (Canale et al., 2019); and sensation seeking for the compulsive seeking of the positive and novel rewards these devices are constantly offering (Wang et al., 2019). Hence, the SA group might describe a subpopulation that is at risk of suffering or suffering already smartphone addiction.

One limitation of the present study is that it was performed on a non-probabilistic sample without the intended inclusion of any specific individuals with a PSU diagnose that could have given even more information about SA, which on the other hand is difficult as this problematic behaviour is not yet integrated in the main diagnostic manuals. Still, we found a total of  $n = 99$  individuals presenting SA, which represented 24.03% of the total sample. There was also a gender imbalance, however, no differences were found between both groups. The sample and therefore the conclusions extracted are also more representative of the population with a higher educational level. In addition, research was conducted in a Spanish population, thus future studies could extend it to other countries, as the included assessment tools are validated in different languages. The occupation of the participants was not registered, which could be also a relevant sociodemographic information. Also, the activities the participants were engaging in when using their smartphones were not registered, which should be included in future studies. Finally, the survey was taken online, which could have also biased the results towards people who make more use of technology. However, the assessment was not

excessively long, and it could have been easily completed by individuals without a very regular access to technology. Yet, it would be desirable for future studies to also perform face-to-face and paper-and-pencil data collection to obtain more representative samples.

The present study constituted an examination of PSU considering individual differences based on the impulsivity personality traits. The resulting description of the three existing groups might contribute to better discern ESU from SA through the specific impulsivity dimensions present in SA: negative urgency, positive urgency and lack of premeditation. These profiles can be considered when addressing future vulnerability studies, prevention and intervention programs, that should focus on training inhibitory control but especially these three dimensions of impulsivity aiming to avoid the future development of SA.

## Conflict of interests

The authors declare no conflict of interest.

## References

- Albein-Urios, N., Martínez-González, J. M., Lozano, O., Clark, L. & Verdejo-García, A. (2012). Comparison of impulsivity and working memory in cocaine addiction and pathological gambling: Implications for cocaine-induced neurotoxicity. *Drug and Alcohol Dependence*, 126, 1–6. doi:10.1016/j.drugalcdep.2012.03.008.
- Alhassan, A. A., Alqadhib, E. M., Taha, N. W., Alahmari, R. A., Salam, M. & Almutairi, A. F. (2018). The relationship between addiction to smartphone usage and depression among adults: A cross sectional study. *BMC Psychiatry*, 18, 1–8. doi:10.1186/s12888-018-1745-4.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.
- Amez, S. & Baert, S. (2020). Smartphone use and academic performance: A literature review. *International Journal of Educational Research*, 103, 101618. doi:10.1016/j.ijer.2020.101618.
- Anshari, M., Alas, Y. & Sulaiman, E. (2019). Smartphone addictions and nomophobia among youth. *Vulnerable Children and Youth Studies. An International Interdisciplinary Journal for Research, Policy and Care*, 14, 242–247. doi:10.1080/17450128.2019.1614709.
- Beison, A. & Rademacher, D. J. (2016). Relationship between family history of alcohol addiction, parents' education level, and smartphone problem use scale scores. *Journal of Behavioral Addictions*, 6, 84–91. doi:10.1556/2006.6.2017.016.
- Billieux, J., Gay, P., Rochat, L. & Van der Linden, M. (2010). The role of urgency and its underlying psychological mechanisms in problematic behaviours. *Behaviour*

- Research and Therapy*, 48, 1085–1096. doi:10.1016/j.brat.2010.07.008.
- Billieux, J., Heeren, A., Rochat, L., Maurage, P., Bayard, S., Bet, R.,... Baggio, S. (2021). Positive and negative urgency as a single coherent construct: Evidence from a large-scale network analysis in clinical and non-clinical samples. *Journal of Personality*, 89, 1252–1262. doi:10.1111/jopy.12655.
- Billieux, J., Maurage, P., Lopez-Fernandez, O., Kuss, D. J. & Griffiths, M. D. (2015). Can disordered mobile phone use be considered a behavioral addiction? An update on current evidence and a comprehensive model for future research. *Current Addiction Reports*, 2, 156–162. doi:10.1007/s40429-015-0054-y.
- Busch, P. A. & McCarthy, S. (2021). Antecedents and consequences of problematic smartphone use: A systematic literature review of an emerging research area. *Computers in Human Behavior*, 114, 106414. doi:10.1016/j.chb.2020.106414.
- Canale, N., Moretta, T., Pancani, L., Buodo, G., Vieno, A., Dalmaso, M. & Billieux, J. (2021). A test of the pathway model of problematic smartphone use. *Journal of Behavioral Addictions*, 10, 181–193. doi:10.1556/2006.2020.00103.
- Canale, N., Vieno, A., Doro, M., Rosa Mineo, E., Marino, C. & Billieux, J. (2019). Emotion-related impulsivity moderates the cognitive interference effect of smartphone availability on working memory. *Scientific Reports*, 9, 18519. doi:10.1038/s41598-019-54911-7.
- Cándido, A., Orduña, E., Perales, J. C., Verdejo-García, A. & Billieux, J. (2012). Validation of a short Spanish version of the UPPS-P impulsive behaviour scale. *Trastornos Adictivos*, 14, 73–78. doi:10.1016/S1575-0973(12)70048-X.
- Charrad, M., Ghazzali, N., Boiteau, V. & Niknafs, A. (2014). Nbclust: An R package for determining the relevant number of clusters in a data set. *Journal of Statistical Software*, 61, 1–36. doi:10.18637/jss.v061.i06.
- Cheever, N. A., Rosen, L. D., Carrier, L. M. & Chavez, A. (2014). Out of sight is not out of mind: The impact of restricting wireless mobile device use on anxiety levels among low, moderate and high users. *Computers in Human Behavior*, 37, 290–297. doi:10.1016/j.chb.2014.05.002.
- Claes, L. & Müller, A. (2017). Resisting temptation: Is compulsive buying an expression of personality deficits? *Current Addiction Reports*, 4, 237–245. doi:10.1007/s40429-017-0152-0.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Ed.). London: Routledge. doi:10.4324/9780203771587.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112, 155–159. doi:10.1037//0033-2909.112.1.155.
- Contractor, A. A., Weiss, N. H., Tull, M. T. & Elhai, J. D. (2017). PTSD's relation with problematic smartphone use: Mediating role of impulsivity. *Computers in Human Behavior*, 75, 177–183. doi:10.1016/j.chb.2017.05.018.
- Cudo, A., Toró, M., Demczuk, M. & Francuz, P. (2020). Dysfunction of self-control in facebook addiction: Impulsivity is the key. *Psychiatric Quarterly*, 91, 91–101. doi:10.1007/s11126-019-09683-8/.
- Cyders, M. A., Coskunpinar, A. & VanderVeen, J. D. (2016). Urgency: A common transdiagnostic endophenotype for maladaptive risk taking. *The Dark Side of Personality: Science and Practice in Social, Personality, and Clinical Psychology*, 157–188. doi:10.1037/14854-009.
- Dalley, J. W. & Robbins, T. W. (2017). Fractionating impulsivity: Neuropsychiatric implications. *Nature Reviews Neuroscience*, 18, 158–171. doi:10.1038/nrn.2017.8.
- 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, 85–92. doi:10.1556/2006.4.2015.010.
- Dhamayanti, M., Dwiwina, R. G. & Adawiyah, R. (2019). Influence of adolescents' smartphone addiction on mental and emotional development in West Java, Indonesia. *Bandung Medical Journal*, 51, 46–52. doi:10.15395/mkb.v51n1.1577.
- Duke, É. & Montag, C. (2017). Smartphone addiction, daily interruptions and self-reported productivity. *Addictive Behaviors Reports*, 6, 90–95. doi:10.1016/j.abrep.2017.07.002.
- Eide, T. A., Aarestad, S. H., Andreassen, C. S., Bilder, R. M. & Pallesen, S. (2018). Smartphone restriction and its effect on subjective withdrawal related scores. *Frontiers in Psychology*, 9, 1444. doi:10.3389/fpsyg.2018.01444.
- Elhai, J. D., McKay, D., Yang, H., Minaya, C., Montag, C. & Asmundson, G. J. G. (2021). Health anxiety related to problematic smartphone use and gaming disorder severity during COVID-19: Fear of missing out as a mediator. *Human Behavior and Emerging Technologies*, 3, 137–146. doi:10.1002/hbe2.227.
- Elhai, J. D., Yang, H., McKay, D. & Asmundson, G. J. G. (2020). COVID-19 anxiety symptoms associated with problematic smartphone use severity in Chinese adults. *Journal of Affective Disorders*, 274, 576–582. doi:10.1016/j.jad.2020.05.080.
- Elhai, J. D., Yang, H., Rozgonjuk, D. & Montag, C. (2020). Using machine learning to model problematic smartphone use severity: The significant role of fear of missing out. *Addictive Behaviors*, 103, 106261. doi:10.1016/j.addbeh.2019.106261.
- Fischer, S., Wonderlich, J., Breithaupt, L., Byrne, C. & Engel, S. (2018). Negative urgency and expectancies increase vulnerability to binge eating in bulimia nervosa. *Eating Disorders*, 26, 39–51. doi:10.1080/10640266.2018.1418253.
- Geng, Y., Gu, J., Wang, J. & Zhang, R. (2021). Smartphone addiction and depression, anxiety: The role of bedtime



- procrastination and self-control. *Journal of Affective Disorders*, 293, 415–421. doi:10.1016/j.jad.2021.06.062.
- Grant, J. E., Lust, K. & Chamberlain, S. R. (2019). Problematic smartphone use associated with greater alcohol consumption, mental health issues, poorer academic performance, and impulsivity. *Journal of Behavioral Addictions*, 8, 335–342. doi:10.1556/2006.8.2019.32.
- Hartigan, J. A. & Wong, M. A. (1979). Algorithm AS 136: A k-means clustering algorithm. *Applied Statistics*, 28, 100–108. doi:10.2307/2346830.
- Hayashi, Y., Rivera, E. A., Modico, J. G., Foreman, A. M. & Wirth, O. (2017). Texting while driving, executive function, and impulsivity in college students. *Accident Analysis & Prevention*, 102, 72–80. doi:10.1016/j.aap.2017.02.016.
- Igaki, T., Romanowich, P. & Yamagishi, N. (2019). Using smartphones while walking is associated with delay but not social discounting. *The Psychological Record*, 69, 513–524. doi:10.1007/s40732-019-00348-3.
- Jo, H. S., Euihyeon, N. & Kim, D. J. (2017). The relationship between smartphone addiction predisposition and impulsivity among Korean smartphone users. *Addiction Research & Theory*, 26, 77–84. doi:10.1080/16066359.2017.1312356.
- Kim, Y., Jeong, J. E., Cho, H., Jung, D. J., Kwak, M., Rho, M. J.,... Choi, I. Y. (2016). Personality factors predicting smartphone addiction predisposition: Behavioral inhibition and activation systems, impulsivity, and self-control. *PloS one*, 11, e0159788. doi:10.1371/journal.pone.0159788.
- Kliesener, T., Meigen, C., Kiess, W. & Poulain, T. (2022). Associations between problematic smartphone use and behavioural difficulties, quality of life, and school performance among children and adolescents. *BMC Psychiatry*, 22, 195. doi:10.1186/s12888-022-03815-4.
- Konok, V., Pogány, Á. & Miklósi, Á. (2017). Mobile attachment: Separation from the mobile phone induces physiological and behavioural stress and attentional bias to separation-related stimuli. *Computers in Human Behavior*, 71, 228–239. doi:10.1016/j.chb.2017.02.002.
- Kotbagi, G., Morvan, Y., Romo, L. & Kern, L. (2017). Which dimensions of impulsivity are related to problematic practice of physical exercise? *Journal of Behavioral Addictions*, 6, 221–228. doi:10.1556/2006.6.2017.024.
- Kuru, T. & Çelenk, S. (2021). The relationship among anxiety, depression, and problematic smartphone use in university students: The mediating effect of psychological inflexibility. *Alpha Psychiatry*, 22. doi:10.5455/apd.136695.
- Kwon, M., Kim, D. J., Cho, H. & Yang, S. (2013a). The smartphone addiction scale: Development and validation of a short version for adolescents. *PloS One* 8, e83558. doi:10.1371/journal.pone.0083558.
- Kwon, M., Lee, J. Y., Won, W. Y., Park, J. W., Min, J. A., Hahn, C.,... Kim, D. J. (2013b). Development and validation of a Smartphone Addiction Scale (SAS). *PloS One*, 8, e56936. doi:10.1371/journal.pone.0056936.
- Lee, A. K. & Lee, H. (2019). Negative urgency mediates the relation between negative emotion and smartphone addiction. *Korean Journal of Stress Research*, 27, 396–403. doi:10.17547/kjsr.2019.27.4.396.
- Lee, A. R., Son, S. M. & Kim, K. K. (2016). Information and communication technology overload and social networking service fatigue: A stress perspective. *Computers in Human Behavior*, 55, 51–61. doi:10.1016/j.chb.2015.08.011.
- Li, J., Zhan, D., Zhou, Y. & Gao, X. (2021). Loneliness and problematic mobile phone use among adolescents during the COVID-19 pandemic: The roles of escape motivation and self-control. *Addictive Behaviors*, 118, 106857. doi:10.1016/j.addbeh.2021.106857.
- López-Fernández, O. (2017). Short version of the Smartphone Addiction Scale adapted to Spanish and French: Towards a cross-cultural research in problematic mobile phone use. *Addictive Behaviors*, 64, 275–280. doi:10.1016/j.addbeh.2015.11.013.
- López-Torres, I., León-Quismondo, L. & Ibáñez, A. (2021). Impulsivity, lack of premeditation, and debts in online gambling disorder. *Frontiers in Psychiatry*, 11, 618148. doi:10.3389/fpsyt.2020.618148.
- Minhas, M., Murphy, C. M., Balodis, I. M., Acuff, S. F., Buscemi, J., Murphy, J. G. & MacKillop, J. (2021). Multidimensional elements of impulsivity as shared and unique risk factors for food addiction and alcohol misuse. *Appetite*, 159, 105052. doi:10.1016/j.appet.2020.105052.
- Mitchell, M. R. & Potenza, M. N. (2014). Addictions and personality traits: Impulsivity and related constructs. *Current Behavioral Neuroscience Reports*, 1, 1–12. doi:10.1007/s40473-013-0001-y.
- Moreno, M., Estevez, A. F., Zaldívar, F., Montes, J. M. G., Gutiérrez-Ferre, V. E., Esteban, L.,... Flores, P. (2012). Impulsivity differences in recreational cannabis users and binge drinkers in a university population. *Drug and Alcohol Dependence*, 124, 355–362. doi:10.1016/j.drugalcdep.2012.02.011.
- Murphy, C. M., Stojek, M. K. & MacKillop, J. (2014). Interrelationships among impulsive personality traits, food addiction, and Body Mass Index. *Appetite*, 73, 45–50. doi:10.1016/j.appet.2013.10.008.
- Niedermoser, D. W., Petitjean, S., Schweinfurth, N., Wirz, L., Ankli, V., Schilling, H.,... Walter, M. (2021). Shopping addiction: A brief review. *Practice Innovations*, 6, 199–207. doi:10.1037/pri0000152.
- Olson, J. A., Sandra, D. A., Chmoulevitch, D., Raz, A. & Veissière, S. P. L. (2022a). A nudge-based intervention to reduce problematic smartphone use: Randomised

- controlled trial. *International Journal of Mental Health and Addiction*, 1–23. doi:10.1007/s11469-022-00826-w.
- Olson, J. A., Sandra, D. A., Colucci, É. S., Al Bikaii, A., Chmoulevitch, D., Nahas, J., ... Veissière, S. P. (2022b). Smartphone addiction is increasing across the world: A meta-analysis of 24 countries. *Computers in Human Behavior*, 129, 107138. doi:10.1016/j.chb.2021.107138.
- Panova, T. & Carbonell, X. (2018). Is smartphone addiction really an addiction? *Journal of Behavioral Addictions*, 7, 252–259. doi:10.1556/2006.7.2018.49.
- Pastor, Y., García-Jiménez, A. & López-de-Ayala, M. C. (2022). Regulatory strategies for smartphone use and problematic Internet use in adolescence. *Anales de Psicología*, 38, 269–277. doi:10.6018/analesps.461771.
- Ratan, Z. A., Zaman, S. B., Islam, S. M. S. & Hosseinzadeh, H. (2021). Smartphone overuse: A hidden crisis in COVID-19. *Health Policy and Technology*, 10, 21–22. doi:10.1016/j.hlpt.2021.01.002.
- Rozgonjuk, D., Kattago, M. & Täht, K. (2018). Social media use in lectures mediates the relationship between procrastination and problematic smartphone use. *Computers in Human Behavior*, 89, 191–198. doi:10.1016/j.chb.2018.08.003.
- Samaha, M. & Hawi, N. S. (2016). Relationships among smartphone addiction, stress, academic performance, and satisfaction with life. *Computers in Human Behavior*, 57, 321–325. doi:10.1016/j.chb.2015.12.045.
- Savidou, L. G., Fagundo, A. B., Fernández-Aranda, F., Granero, R., Claes, L., Mallorquí-Baqué, N.,... Jiménez-Murcia, S. (2017). Is gambling disorder associated with impulsivity traits measured by the UPPS-P and is this association moderated by sex and age? *Comprehensive Psychiatry*, 72, 106–113. doi:10.1016/j.comppsy.2016.10.005.
- Sohn, S., Rees, P., Wildridge, B., Kalk, N. J. & Carter, B. (2019). Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young people: A systematic review, meta-analysis and GRADE of the evidence. *BMC Psychiatry*, 19, 1–10. doi:10.1186/s12888-019-2350-x.
- Um, M., Whitt, Z. T., Revilla, R., Hunton, T. & Cyders, M. A. (2019). Shared neural correlates underlying addictive disorders and negative urgency. *Brain Sciences*, 9, 36. doi:10.3390/brainsci9020036.
- van Endert, T. S. & Mohr, P. N. C. (2020). Likes and impulsivity: Investigating the relationship between actual smartphone use and delay discounting. *Plos One*, 15, e0241383. doi:10.1371/journal.pone.0241383.
- VanderBroek-Stice, L., Stojek, M. K., Beach, S. R. H., vanDellen, M. R. & MacKillop, J. (2017). Multidimensional assessment of impulsivity in relation to obesity and food addiction. *Appetite*, 12, 59–68. doi:10.1016/j.appet.2017.01.009.
- Wacks, Y. & Weinstein, A. M. (2021). Excessive smartphone use is associated with health problems in adolescents and young adults. *Frontiers in Psychiatry*, 12, 762. doi:10.3389/fpsy.2021.669042.
- Wang, J., Wang, P., Yang, X., Zhang, G., Wang, X. C., Zhao, F.,... Lei, L. (2019). Fear of missing out and procrastination as mediators between sensation seeking and adolescent smartphone addiction. *International Journal of Mental Health and Addiction*, 17, 1049–1062. doi:10.1007/s11469-019-00106-0.
- Whiteside, S. P. & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, 30, 669–689. doi:10.1016/s0191-8869(00)00064-7.
- Wilcockson, T. D. W., Osborne, A. M. & Ellis, D. A. (2019). Digital detox: The effect of smartphone abstinence on mood, anxiety, and craving. *Addictive Behaviors*, 99, 106013. doi:10.1016/j.addbeh.2019.06.002.
- World Health Organization. (2019). *ICD-11: International classification of diseases* (11th revision). Retrieved at <https://icd.who.int/>.
- World Medical Association. (2013). World Medical Association declaration of Helsinki: Ethical principles for medical research involving human subjects. *The Journal of American Medical Association*, 310, 2191–2194. doi:10.1001/jama.2013.281053.
- Yang, Q. & Gong, X. (2021). The engagement–addiction dilemma: An empirical evaluation of mobile user interface and mobile game affordance. *Internet Research*, 31, 1745–1768. doi:10.1108/INTR-11-2020-0622.



