



# The wild west of measurement: Exploring problematic technology use cut off scores and their relation to psychosocial and behavioural outcomes in adolescence

Tracey Connolly<sup>a</sup>, Gray Atherton<sup>a</sup>, Liam Cross<sup>a</sup>, Andrea Piovesan<sup>b</sup>, Linda K. Kaye<sup>a,\*</sup>

<sup>a</sup> Edge Hill University, UK

<sup>b</sup> Iuav University of Venice, Austria

## ARTICLE INFO

### Keywords:

Problematic use  
Measurement  
Smartphones  
Social media  
Internet gaming disorder  
Adolescents

## ABSTRACT

A plethora of research explores “problematic use” of technologies, but conceptualising what “problematic” refers to and how it is operationalized remains an ongoing issue. There is a lack of consistency in how cut-offs are used to distinguish “problematic” users and how this is then handled in subsequent analyses. We compared various scoring strategies common to “problematic” use research and how this impacted prevalence rates and impacts on psychosocial and behavioural variables amongst high school students. Adolescents ( $N = 446$ ) completed measures of “problematic” use of smartphones, online gaming and social media, as well as self-esteem and problematic school behaviour. For each “problematic” technology use questionnaire, we divided the sample into high and low “problematic” technology use groups, using both a polythetic and a monothetic scoring method. Prevalence rates varied substantially based on the scoring method used, despite these techniques being rather interchangeable in the literature. Furthermore, logistic regressions indicated that overall, polythetic rather than monothetic methods elicited more observable differences between high and low “problematic” user groups. This suggests that consistency and consensus on scoring methods is paramount to ensure that researchers are adhering to standardised parameters.

Within 21st-century Westernized society, most adolescents have access to an internet-connected mobile device. The Childwise Monitor Report found that 71 % of 15 to 16-year-olds use smartphones to access the internet (Leggett, 2020), mirroring the 74 % adult access recorded in a recent Office of National Statistics (ONS) survey (Prescott, 2015). Of any subgroup, adolescents are the most exposed to the internet (Vigna-Taglianti et al., 2017). These individuals have grown up in a world where the United Nations state that digital interaction and connectivity are a human right, not just a privilege (La Rue, 2011). Access to smart technology has revolutionized young people’s experiences, with exposure to screens for entertainment, education and behaviour modification occurring from ages 0–3 years old (Kim, 2015; Nevski & Siibak, 2016).

Despite the ubiquitous everyday functional use of digital technology and the internet in young people lives, a large proportion of academic research has sought to understand this as a pathological issue (Gentile, 2009; Kuss, van Rooij, Shorter, Griffiths, & van de Mheen, 2013). Indeed, it is not uncommon to see terms such as “excessive use” (Suhail

& Bargees, 2006), “pathological use” (Davis, 2001), “problematic use” (Shapira et al., 2003), “internet addiction” (Block, 2008), and many similar terms in the academic literature. This has been brought on by concerns that time using technology is unhealthy, and may displace time from doing more “healthy” activities (Neuman, 1988; Valkenburg & Peter, 2009). As such, an abundance of research has been dedicated to exploring “problematic” use to understand the correlates and likely effects of so-called unhealthy technology use. Three areas of particular focus in the “problematic” use literature include smartphones, social media and online gaming. The following sections will make reference to each of these.

## 1. Online gaming

Online gaming is a specific online activity that is common to the “problematic” use literature. Within the last decade, this issue has been researched extensively, especially since the recognition of Internet Gaming Disorder (IGD) as an appended item under “condition for

\* Corresponding author. Department of Psychology, Edge Hill University, St Helens Road, Ormskirk, L39 4QP, UK.

E-mail address: [Linda.kaye@edgehill.ac.uk](mailto:Linda.kaye@edgehill.ac.uk) (L.K. Kaye).

<https://doi.org/10.1016/j.chb.2021.106965>

Received 4 March 2021; Received in revised form 11 July 2021; Accepted 23 July 2021

Available online 24 July 2021

0747-5632/© 2021 Elsevier Ltd. All rights reserved.

further study” in the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders (DSM-5) in 2013 (APA, 2013). This is focused on addiction criteria such as: preoccupation; withdrawal symptoms; tolerance; unsuccessful attempts to control; loss of interests in other activities; continued behaviour despite understanding psychosocial problems; deception; use to relieve negative mood, and loss of significant relationship, job, educational or career opportunity (Pontes, Kiraly, Demetrovics, & Griffiths, 2014). Other research exploring smartphone and social media use have taken these addiction principles and designed psychometric instruments to explore “smartphone addiction” and “social media addiction” (Csibi, Griffiths, Cook, Demetrovics, & Szabo, 2018; Van Den Eijnden, Lemmens, & Valkenburg, 2016). Sometimes this includes modifying IGD measures, despite online gaming being a largely distinct phenomenon from smartphone use or social media use.

Research in the field of “problematic” online gaming has found that adolescents with so-called IGD are more likely to have higher rates of impulsivity, maladaptive beliefs, aggression, depression, anxiety and lower self-esteem (Beard, Haas, Wickham, & Stravropoulos, 2017; Kardefelt-Winther, 2014; King & Delfabbro, 2014; Kwak, Hwang, Kim, & Han, 2020). Further, academic performance is compromised as a correlate of pathological gaming (Gentile et al., 2009). Finally, concerning behavioural correlates, evidence suggests that excessive gaming can predict problematic behaviours in adolescence, such as delinquency (Holtz & Appel, 2011; Morris & Johnson, 2014). Correspondingly, other work suggests that “problematic” online gamers are prone to violence (Sincek et al., 2017).

## 2. Smartphones

Unlike online gaming, “problematic” smartphone use is not yet clinically recognised in any diagnostic manual. Although smartphones are typically multi-purpose devices, these are often studied unidimensionally in respect of the device use as a whole, rather than specific functionalities. Indeed, a plethora of research has been dedicated to exploring “smartphone addiction” to ascertain what this comprises, how it can be measured and what the psychological correlates may be (Kwon et al., 2013; see Gutierrez, Rodriguez de Fonseca, & Rubio, 2016 for review). For example, findings suggest that among adolescents, there may be gender differences in smartphone dependence. That is, females may show higher levels than males (Yang, Lin, Huang, & Chang, 2018; Van Deursen, Bolle, Hegner, & Kommers, 2015), and their experiences of dependence is more likely to correlate with experiences of impulsivity and aggression (Lee, Sung, et al., 2018; 2018b). Further physical and psychosocial correlates of smartphone overuse have also been shown, such as the higher likelihood of depressive symptoms, social anxiety, stress, poor sleep, lower life satisfaction and poor self-esteem (Hong et al., 2019; Kim & Koh, 2018; Lee & Kim, 2018; Samaha & Hawi, 2016; Tamura, Nishida, Tsuji, & Sakakibara, 2017; Thomee, Harenstam, & Hagberg, 2011; Yang, Yen, Ko, Cheng, & Yen, 2010). In addition to this, academic impacts have also been noted, with findings suggesting that those at risk of being “addicted” to smartphones typically have lower academic performance and behavioural conduct problems (Lee et al., 2018a, 2018b; Roser, Schoeni, Foerster, & Rööslü, 2016). Academically, this could be explained by frequency of notifications and alerts from smartphones leading to decreased attention (David, Kim, Brickman, Ran, & Curtis, 2015), affecting both academic and social performance among “problematic” users (Seo, Park, Kim, & Park, 2016). Further, smartphone use has been associated with other types of behavioural delinquency such as cyberbullying (Catone et al., 2020).

Smartphone use is largely ubiquitous (Fullwood, Quinn, Kaye, & Redding, 2017), therefore it is not clear which of the many functions of a smartphone are driving the above outcomes - though there are several possibilities. For one, smartphones allow unrestricted access to the internet, where users can fulfil their needs of socialization, information finding, and entertainment. As these needs are essential parts of daily

life, the reliance on smartphones to fulfil these fundamental needs have awoken concerns about their addictive potential (Tanyana & Xavier, 2018). However, some research suggests that the “problematic” use of smartphones may stem less from the technology itself, but instead from the escapism it affords. For instance, Wang, Wang, Gaskin, and Wang (2015) found that perceived stress moderated the relationship between entertainment motivation and “problematic” smartphone use in a large sample of college students, indicating that smartphone “problematic” use was primarily a tool to escape problems in everyday life rather than the problem in and of itself. In this way, some suggest that the immediate gratification smartphones can provide are merely a vehicle for those with a higher need to escape pressures.

## 3. Social media use

While smartphone usage includes a plethora of online activity, one common use that is particularly salient to adolescents is engagement with social media platforms, an activity that accounts for the highest proportion of smartphone usage (Bian & Leung, 2015; Bianchi & Phillips, 2005). As adolescents are typically known to both “create and consume” social media (Nesi & Prinstein, 2018) it is essential to understand how this corresponds to “problematic” use and psychosocial and behavioural experiences. This is relevant given that recent evidence found that adolescents who report intense social media use also score lower on psychological, social and school well-being measures (Boer et al., 2020). Specifically, in respect of self-esteem, this has been studied extensively in relation to social media, particularly for image-based social media (Chua & Chang, 2016; Fardouly & Vartanian, 2015), based on the extent to which social comparisons may be fostered on these platforms which may promote upward comparisons, leading to poorer self-regard (Festinger, 1954; Ryding & Kuss, 2019; Vogel, Rose, Roberts, & Eckles, 2014). However, there may be positive effects of moderate social media use in respect of supporting social cohesion with peers (Lee, 2009). These issues may be particularly important when examining the adolescent population, for whom self-comparison and self-evaluation are pivotal for identity development (Van der Aar, Peters, & Crone, 2018).

Additionally, other work suggests that so-called “problematic” social media use is linked to distraction, procrastination, stress, hostility, interpersonal conflicts and could impact academic achievement (Griffiths, Fernandez, Throuvala, Pontes & Kuss, 2018). Further, “problematic” social media use has been studied in relation to aggression, such as cyberbullying (Craig et al., 2020) and violence (Patton et al., 2014). Correspondingly, other research suggests that “problematic” social media usage can lead to online conflicts that spill over into offline conflicts, often contributing to school fights, both verbal and physical (George & Odgers, 2015).

## 4. Measurement issues

However, despite the aforementioned findings being rather extensive in the current literature, we note some reservations in our scrutiny of the literature. One of the significant ongoing issues with most research in this field is the methodological strategies used to classify what constitutes “problematic” use. Methodological strategies to determine this will, for obvious reasons, impact the observed prevalence rates found across studies. Indeed, different authors use different methodological scoring approaches here. Interestingly, it is not uncommon for “addiction” measures to be used, but authors do not specify what the cut-offs are to determine “pathological” or “problematic” use. Frequently, the total or mean scores are used as a single variable, with no acknowledgement of any sub-sample classifications (Chen et al., 2020a; 2020b; Leung et al., 2020; Soraci, Ferrari, Antonino, & Griffiths, 2020). Other frequent practices include a ‘polythetic’ classifying criteria (e.g., Andreassen, Torsheim, Brunborg, & Pallesen, 2012; Brailovskaia, Margraf, & Köllner, 2019; Gul, YurumezSolmaz, Gul, & Oner, 2018; Hou,

Xiong, Jiang, Song, & Wang, 2019; Sampath, Kalyani, Soohinda, & Dutta, 2017). Pathological level is often determined from this, based on an individual responding ‘neither agree nor disagree’ (usually 3 or more on a 5-point scale) on more than half of the items in a given questionnaire (i.e. on a 10 item questionnaire rated on a 5-point scale, they would need to respond “3” on at least six of the items).

Alternatively, the more conservative approach of “monothetic scoring” would be classifying a person who scored at the mid-point or above (e.g., 3 or above on a 5-point scale) on all items of a scale, and perhaps more representative of someone who could be considered clinically vulnerable. Monothetic versus polythetic scoring distinctions have their roots in psychiatry, and grew to prominence following the DSM-III in which many diagnoses were changed to polythetic classification (Schwartz & Wiggins, 1987). For instance, individuals with borderline personality disorder can be diagnosed so long as they fulfil five of the eight criteria for diagnoses, meaning that no particular criteria must specifically be met, but rather a threshold of criteria, any five of which is indicative of the condition. In contrast to DSM III measures which have monothetic scoring in relation to validated (or at least well-clinically defined) constructs, online “addiction” measures have employed monothetic scoring before medical constructs have been developed. This raises concerns about whether cut-offs for these measures are appropriate.

The literature reveals some variation across studies concerning the elusive concept of technology-related “addictions” and determining their prevalence in adolescence. For IGD, previous research has noted that prevalence rates vary across countries, between 1.6 % and 19.9 % (Pontes, 2018). Studies have used the Internet Gaming Disorder Scale (IGDS; Pontes & Griffiths, 2015), whereby a cut-off is determined for those who answered “yes” on a dichotomous scale to five or more of the nine DSM criteria. For example, Wartberg, Kriston, and Thomasius (2020) found IGD prevalence in adolescents to be 3.5 %. Conversely, Pontes et al. (2014) recommend that rather than a dichotomous yes/no response scale, that a 5-point endorsement scale is less likely to present statistical analysis issues. Based on this response format and using their recommended total score cut-off of 71 out of 100, 5.3 % of participants were found to reach “problematic” (or “disordered”) levels. Using the Internet Gaming Disorder Scale Short Form (IGDS9-SF), more recent evidence suggests that optimal cut-offs for this may be lower than previously suggested. Namely, although the cut-off for the IGDS9-SF originally was proposed as a total score of more than 36 out of 45 (Pontes & Griffiths, 2015), more recent evidence suggests the optimal cut-off as more than 16 (Severo et al., 2020). However, most research tends to use the cut-off from the original validation paper of 36.

Similar discrepancies have been observed in the literature on “problematic” smartphone and social media use. Additionally, these present further issues in that they do not have clinical diagnostic criteria yet articulated in any clinical diagnostic manual. As such, it appears to be quite typical practice for researchers to apply IGD criteria, but modify the wording to apply to smartphones or social media. In relation to smartphone use, commonly used measures include the Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016), Facebook Intrusion Questionnaire (Elphinston & Noller, 2011), Facebook Intensity Scale (Orosz, Tóth-Király, & Bóthe, 2016), the Social Media Craving Scale (Savci & Griffiths, 2019) and the Social Media Disorder Scale (SMD-9; Van Den Eijnden et al., 2016). Findings using the BSMAS scale, recommending a cut-off of 19 out of 30 have found prevalence rates of “social media addiction” to be between 10.2 % and 21.7 % on samples of students (Chen et al., 2020a; 2020b). In relation to the SMD-9 scale, this follows the IGD-20 model of addiction affirmation, so seeks a cut-off point based on participants endorsing at least five out of nine DSM-5 criteria. Using this scoring approach, Van Den Eijnden et al. (2016) found prevalence rates of “social media addiction” in adolescents to fall between 7.3 % and 11.6 %.

In relation to “problematic” smartphone use, this is often measured using the Smartphone Application-Based Addiction Scale (SABAS; Csibi,

Demetrovics, & Szabo, 2016) or Smartphone Addiction Scale (SAS; Kwon et al., 2013). Neither the SAS nor the SABAS appear to specify a recommended cut-off and so researchers have tended to use this only to determine level of “addiction” based on total scores rather than establish diagnostically-vulnerable sub-samples (Chen et al., 2020a; 2020b; Kwon et al., 2013).

In line with the above observations about varied prevalence rates and discrepant scoring approaches, it is not entirely clear or consistent about how “problematic” is being operationalized across this field. Indeed, this has recently been highlighted to be a valid concern in research illustrating that instruments measuring intentionally nonsensical concepts such as “offline friend addiction” can be validated using techniques such as these (Satchell et al., 2021). This not only represents a problem when gauging prevalence rates of so-called “problematic” use, but importantly may be skewing the relationship with the observed correlates. For example, recent evidence suggests that choice of technology use measures impacts on the magnitude of the relationship with psychological variables (Shaw et al., 2020). As such, the current study sought to address a number of research questions (RQs):

RQ1. What proportion of adolescents can be classified as “problematic” users of social media, smartphones and online gaming, based on the different scoring methods?

RQ2. What is the relationship between (“problematic”) use of technologies and psychosocial and behavioural outcomes in adolescents?

RQ3. How does “problematic” use scoring method elicit differences between those who may be classified as “high” versus “low” problematic user?

## 5. Method

### 5.1. Participants

Six hundred and eighty two students from a secondary school in the northwest of the UK were invited to take part. All data was collected over two days in January of 2020 during two from sessions in school. Four hundred and forty eight individuals completed the survey, though two later opted out and were therefore not included in the analysis. This left a final sample of 446 individuals, aged between 11 and 16 years old with a mean age of 13.71 years ( $SD = 1.40$ ), of which 227 identified as females and 218 males.

Table 1 includes a break-down of sub-samples per year group. Some individuals declined to answer specific questions or scales so the number of complete responses varies between subjects/scales. This study received ethical approval from the Department of Psychology Research Ethics Committee at Edge Hill University and was approved by the headteacher of the participating school. Full informed consent was sought from participants and parents and both were fully debriefed after data collection.

### 5.2. Design and procedure

This study employed a survey design where individuals completed a paper-based survey assessing “problematic” online gaming (IGD-20), social media (SMD-9) and smartphone (SABAS) use, alongside self-esteem (ASQ) and a measure developed with individuals working at

**Table 1**  
Sample demographics.

	N (%)	Age M (SD)	Gender M/F n
Year 7	60 (13.5)	11.45 (0.50)	22/38
Year 8	78 (17.5)	12.49 (0.50)	43/35
Year 9	89 (20.0)	13.47 (0.50)	44/45
Year 10	125 (28.0)	14.44 (0.50)	59/65
Year 11	94 (21.0)	15.42 (0.50)	50/44
Total	446 (100)	13.71 (1.40)	218/227

the school which targeted problematic behaviours (referred to as the Problematic Behaviour Scale; PBS). Demographic variables of self-identifying gender, chronological age and year group at school were also collected. The survey took approximately 40 min to complete and contained 60 questions.

## 6. Materials

### 6.1. Online gaming

“Problematic” online gaming was measured using the Internet Gaming Disorder Test (IGD-20; Pontes et al., 2014). This measure was created by Pontes et al. (2014) after recognition of the condition in DSM-5 (APA 2013). The 20-item test measures responses to the nine addiction criteria from DSM-5 (APA 2013): preoccupation; withdrawal symptoms; tolerance; unsuccessful attempts to control; loss of other interests; continued excessive use; deception around amounts used; used in an escapist capacity and jeopardy of career, relationships and opportunities. Validity was established in the original study and validated after translation into Spanish, Arabic and Chinese and Persian (Fuster, Carbonell, Pontes, & Griffiths, 2016; Hawi & Samaha, 2017; Shu, Ivan Jacob, MengXuan, & Anise, 2019; Vahidi, Zamanzadeh, Musavi, Janani, & Namdar, 2019). Examples of items are “When I am not gaming I feel more irritable” and “I often think that a whole day is not enough to do everything I need to do in-game”. Participants responded to each item on a 5-point Likert scale (1 = “never”, 2 = “rarely”, 3 = “sometimes”, 4 = “often” and 5 = “always”), in respect of how much the items related to their online gaming in the last year. Diagnosis of addiction is affirmed if a person meets five or more of the nine criteria within a year, and the original study set a cut off score of 71/100 (Pontes et al., 2014).

### 6.2. Smartphone use

“Problematic” smartphone use was measured using the Smartphone Application Based Addiction Scale (SABAS; Csibi, Demetrovics & Szarbo, 2016; Csibi et al., 2018). The Hungarian Brief Addiction to Smartphone Scale was originally developed by Csibi et al. (2016) using Griffiths’ (2018) components model of addiction: salience; mood modification; tolerance; withdrawal; conflict and relapse. This was translated and modified into the 6-item scale used here, developed by Csibi et al. (2018). Further translation for use in Hong Kong and Taiwan validated the SABAS against other social media and internet “addiction” scales (Leung et al., 2020). Examples of items are “I feel that my smartphone is the most important thing in my life” and “If I try to cut the time I use my smartphone, I manage to do so for a while, but then I end up using it as much or more than before”. Participants responded to each item on a 5-point Likert scale (1 = “never”, 2 = “rarely”, 3 = “sometimes”, 4 = “often” and 5 = “always”). No pre-established cut of criteria exists for this measure.

### 6.3. Social media use

“Problematic” social media use was measured using the Social Media Disorder Scale (SMD-9; Van Den Eijnden et al., 2016). This includes nine items, one for each of the DSM-5 addiction criteria (APA, 2013). Fung (2019) further validated the use of SMD-9 in Chinese populations. Examples of items used are “How often in the last year have you felt bad when you couldn’t use social media?” and “How often in the last year have you lied to parents/carers or friends about the amount of time you spend on social media?”. Participants responded to each item on a 5-point Likert scale (1 = “never”, 2 = “rarely”, 3 = “sometimes”, 4 = “often” and 5 = “always”), the extent to which the items were relevant to their social media use within the last year. No pre-established cut off criteria exists for this measure.

### 6.4. Self-esteem

Self-esteem was measured using the Adolescent Self-esteem Questionnaire (ASQ; Hafekost et al., 2016). This measure was developed by the survey team of the university of Western Australia as part of the Young Minds Matter survey of child and adolescent mental health and well-being. It specifically captures stressors relevant to the lives of adolescents, rather than referencing adult focused measures that may not have fully represented an adolescent’s experiences. It was validated against “the gold standard” self-esteem test used in research, the Rosenberg Self-Esteem Scale, which some felt was outdated (Hafekost, Boterhoven de Haan, Lawrence, Sawyer, & Zubrick, 2017). Examples of items are “I feel good about my abilities compared to others (e.g. at school, playing sports or socially)” and “I feel useless”. Similar to the other measures, this was also reported on a 5-point Likert scale (1 = never, 5 = always).

### 6.5. Problematic School Behaviour

A bespoke questionnaire was created for this study to measure problematic school behaviours (PSB). Specifically, this included escalating behaviours that were related to smartphone use, social media use and online gaming; capturing sanctions imposed by the school taking part. This scale was developed in collaboration with individuals who worked at the target school. These behaviours have been observed multiple times over several years, across all age groups within the school. It contained 13-items assessing problems experienced arising from social media, online gaming or smartphone use, and whether those issues had remained online, bled into offline life, affected interpersonal relations with peers and resulted in adult intervention from staff members at the school. Examples items include “In the last year have problems or issues that began by using your smart phone, social media or gaming resulted in you: Blocking/deleting/unfriending someone? Physically fighting with friends? Being isolated from lessons?” In line with the other measures, this was also reported on a 5-point Likert scale (1 = never, 5 = always). The full scale used can be found in the Supporting Materials.

## 7. Results

Data from questionnaires that had more than one third of the items missing (more than 6 for IGD, 3 for SMD, 2 for SABAS, 4 for ASQ, and 4 for PSB) were excluded from analysis. Therefore, their data from that specific questionnaire were removed but their data from the other questionnaires were kept. The remaining missing responses (i.e., the missing data from questionnaires with one third or less missing items) were replaced with the mean of the completed items, after relevant items were reversed scored. Table 2 indicates how many participants completed at least two thirds of each questionnaire (N column). Finally, total scores were calculated for the five questionnaires by summing the

**Table 2**  
Descriptive statistics for all study variables.

Variable	M (SD)	N	$\alpha$	Skewness	Outliers (%)	KS test
Online gaming use (IGD)	41.14 (14.31)	440	.90	1.01	13 (3.0)	.120*
Smartphone use (SABAS)	15.46 (5.11)	442	.79	0.11	1 (0.2)	.059*
Social media use (SMD)	17.30 (7.55)	440	.87	1.13	14 (3.2)	.136*
Self-esteem (ASQ)	41.65 (9.90)	390	.89	-0.39	0 (0.0)	.067*
Problematic school behaviour (PSB)	20.36 (7.39)	437	.87	1.88	13 (3.0)	.160*

Outliers: number of participants who differed 2.5 times from the mean; KS: Kolmogorov-Smirnov; \* $p < .001$ .

items. Table 2 shows mean, standard deviation, skewness, number of outliers (i.e., number of participants who differed 2.5 times from the mean), test of normality, and Cronbach’s alpha, which showed acceptable scale reliability for all five scales.

Based on scores from each of the “problematic” technology use scales, participants were placed in either a low or high “problematic” technology use group. This split was undertaken following the monothetic and the polythetic cut-off rule. For example, for the polythetic rule, participants who responded 3, 4 or 5 to half or more of the SABAS items were assigned to the high smartphone use group and the remaining participants were assigned to the low smartphone use group. Conversely, following the monothetic rule, participants who responded 3, 4 or 5 to all the SABAS items were assigned to the high smartphone use group and the remaining participants were assigned to the low smartphone use group. The same two splits were conducted using the SMD and IGD questionnaires.

However, using the monothetic rule with the IGD responses resulted in having only 1 participant in the high group, preventing us to run any statistical analysis. We therefore used the official cut-off instead of the monothetic; participants who scored equal or higher than the official cut-off (71) were assigned to the high online gaming group and the remaining participants to the low online gaming group. Table 3 breaks down number of participants, mean and standard deviation of self-esteem and problematic school behaviour in the groups.

The main aim was to test whether the stricter or more lenient cut-offs lead to different results and which cut-off is more reasonable to use. To achieve this aim, a logistic regression with self-esteem and problematic school behaviour scores as predictors was conducted per each cut-off rule.

7.1. Correlations

First, we investigated the relationship between all study variables based on the total scores for each measure (see Table 4). There were significant positive correlations between the three technology use scale scores, which was particularly strong between social media use and smartphone use ( $r_s = 0.645, p < .001$ ). There was also a significant

Table 3

Number of participants, mean and standard deviation of self-esteem and problematic school behaviour of the low and high technology use groups using the monothetic/official and polythetic cut-offs.

Questionnaire	Split Rule	Group	Self-esteem (ASQ)		PSB		
			N (%)	M (SD)	N (%)	M (SD)	
Online gaming (IGD)	Official	Low	370 (95.6)	41.81 (9.89)	412 (95.4)	20.22 (7.40)	
		High	17 (4.4)	38.29 (9.73)	20 (4.6)	23.65 (7.29)	
	Polythetic	Low	296 (74.5)	42.18 (9.93)	328 (75.9)	19.82 (7.24)	
		High	91 (25.5)	39.96 (9.62)	104 (24.1)	22.15 (7.76)	
	Smartphone use (SABAS)	Monothetic	Low	356 (91.8)	41.96 (9.98)	395 (90.8)	19.85 (7.25)
			High	32 (8.2)	38.69 (8.58)	40 (9.20)	25.15 (7.3)
Polythetic		Low	140 (36.1)	43.88 (10.34)	157 (36.1)	17.99 (6.73)	
		High	248 (63.9)	40.46 (9.45)	278 (63.9)	21.67 (7.45)	
Social media use (SMD)	Monothetic	Low	381 (97.9)	41.85 (9.72)	428 (98.2)	20.10 (7.01)	
		High	8 (2.1)	31.50 (13.91)	8 (1.8)	34.38 (13.46)	
	Polythetic	Low	268 (68.9)	43.07 (9.59)	298 (68.4)	18.49 (6.53)	
		High	121 (31.1)	38.46 (9.91)	138 (31.6)	24.39 (7.59)	

NB: PSB = Problematic School Behaviour.

Table 4

Spearman’s correlations between the study variables.

	SABAS	SMD	ASQ	PSB
Online gaming (IGD)	.215**	.115*	-.032	.089
Smartphone use (SABAS)		.645**	-.278**	.403**
Social media use (SMD)			-.272**	.535**
Self-esteem (ASQ)				-.254**
Problematic school behaviour (PSB)				

\*p < .05; \*\*p < .001.

negative relationship between our outcome variables, that is self-esteem and problematic school behaviour ( $r_s = -.254, p < .001$ ). Finally, both smartphone and social media use were positively related to problematic school behaviour (both  $p < .001$ ) and negatively related to self-esteem (both  $p < .001$ ). Meanwhile, online gaming was not related to either of the outcome measures.

We then conducted two linear regression analyses to test whether “problematic” smartphone and social media use could predict self-esteem and problematic school behaviour. Online gaming was excluded because it did not correlate with the outcome measures. Table 5 shows the details of the models conducted. Results indicated that increased social media use predicted higher level of problematic school behaviour ( $\beta = 0.48, p < .001$ ) and lower levels of self-esteem ( $\beta = -0.26, p < .001$ ). In contrast, smartphone use did not predict the outcome measures ( $ps > .15$ ), probably due to the shared variance with social media use ( $r_s = 0.645$ ), which was a better predictor.

7.2. Analysis based on scoring technique

To establish whether scoring technique of “problematic” use scales resulted in differential outcomes, two logistic regressions were conducted for each technology use scale with self-esteem and problematic school behaviour as predictors and the categorisation groups obtained through the monothetic (official for IGD) and polythetic cut-off as outcome. By comparing the AIC of the regression, we could infer whether a more strict (monothetic/official) or a lenient (polythetic) cut-off would show the differences in diagnostics between the methods.

Table 6 shows the results of the logistic regressions.

8. NB: PSB = problematic school behaviour

8.1. Online gaming

Table 6 indicates that the logistic regression with the IGD official cut-off as outcome was not significant, suggesting that participants’ self-esteem and problematic school behaviour did not predict whether they were classified as a low or high “problematic” scorer for online gaming.

In contrast, the logistic regression with the IGD polythetic cut-off as outcome was significant. Problematic school behaviour, but not self-esteem, significantly predicted the categorisation indicated by the IGD polythetic cut-off. The OR suggested that participants with higher problematic school behaviour were 4 % more likely to be part of the

Table 5

Regression models.

Outcome	Model statistics	Predictor	$\beta$	p
Self-esteem	$F(2, 386) = 23.07, p < .001, R^2 \text{ adj} = .10$	Social media use	-.26	<.001
		Smartphone use	-.09	.15
Problematic School Behaviour	$F(2, 433) = 69.84, p < .001, R^2 \text{ adj} = .24$	Social media use	.48	<.001
		Smartphone use	.02	.66

$\beta$ : Standardized coefficient.

**Table 6**  
Logistic regression models.

Outcome	Predictor	X <sup>2</sup>	AIC	B	SE	OR
IGD official	PSB	3.39	132.22	.04	.03	1.04
	Self-esteem			-.03	.03	.98
IGD polythetic	<b>PSB</b>	<b>7.77*</b>	<b>378.60</b>	<b>.04*</b>	<b>.02</b>	<b>1.04</b>
	Self-esteem			-.01	.01	.99
SABAS monothetic	<b>PSB</b>	<b>15.07***</b>	<b>200.61</b>	<b>.08***</b>	<b>.02</b>	<b>1.08</b>
	Self-esteem			-.01	.02	.99
SABAS polythetic	<b>PSB</b>	<b>37.53***</b>	<b>416.23</b>	<b>.10***</b>	<b>.02</b>	<b>1.10</b>
	Self-esteem			-.02*	.01	.98
SMD monothetic	<b>PSB</b>	<b>19.96***</b>	<b>62.59</b>	<b>.12***</b>	<b>.04</b>	<b>1.13</b>
	Self-esteem			-.05	.04	.95
SMD polythetic	<b>PSB</b>	<b>69.57***</b>	<b>373.08</b>	<b>.12***</b>	<b>.02</b>	<b>1.13</b>
	Self-esteem			-.03**	.01	.97

\*p < .05; \*\*p < .01; \*\*\*p < .001.

group of high “problematic” online gaming group following the polythetic rule.

This would suggest that the polythetic rule could be more useful than the official rule to capture differences between low and high online gaming use using the IGD questionnaire. However, this result should be taken with caution given the low OR (4 %), which is probably explained by the fact that IGD scores were not related to self-esteem and PSB scores in the first place (see Table 4).

### 8.2. Smartphones

Table 6 indicates that the logistic regression with the SABAS monothetic cut-off as outcome was significant. Problematic school behaviour, but not self-esteem, significantly predicted the categorisation indicated by the SABAS monothetic cut-off. The OR suggested that participants with higher problematic school behaviour were 8 % more likely to be part of the high “problematic” smartphone use group following the monothetic rule.

The logistic regression with the SABAS polythetic cut-off as outcome was also significant, and both problematic school behaviour and self-esteem significantly predicted the categorisation indicated by the SABAS polythetic cut-off. The OR suggested that participants with higher problematic school behaviour were 10 % and participants with lower self-esteem were 2 % more likely to be part of the high “problematic” smartphone use group following the polythetic rule.

The ORs and the AIC, which was higher in the polythetic than the monothetic cut-off, would suggest that the polythetic rule could be more useful than the monothetic rule to capture differences between low and high smartphone use using the SABAS questionnaire.

### 8.3. Social media

Table 6 indicates that the logistic regression with the SMD monothetic cut-off as outcome was significant. Problematic school behaviour, but not self-esteem, significantly predicted the categorisation indicated by the SMD monothetic cut-off. The OR suggested that participants with higher problematic school behaviour were 3 % more likely to be part of the high “problematic” social media use group following the monothetic rule.

The logistic regression with the SMD polythetic cut-off as outcome was also significant, and both problematic school behaviour and self-esteem significantly predicted the categorisation indicated by the SMD polythetic cut-off. The OR suggested that participants with higher problematic school behaviour were 3 % and participants with lower self-esteem were 3 % more likely to be part of the high “problematic” social media use group following the polythetic rule.

The ORs and the AIC, which was higher in the polythetic than the monothetic cut-off, would suggest that the polythetic rule could be more

useful than the monothetic rule to capture differences between low and high social media use using the SMD questionnaire.

## 9. Discussion

To address our observations about varied prevalence rates and discrepant scoring approaches in the “problematic” use literature, we used a large data set from an adolescent sample to compare how scoring techniques impacted prevalence rates of “problematic” online gaming, social media, and social media use. Further, we sought to understand how the “problematic” use measures related to self-esteem and problematic school behaviour, and whether this varied based on scoring technique. That is, whether the polythetic split or the monothetic split led to different results and which cut-off rule should be preferred. The main findings and implications are discussed in the subsequent sections.

Concerning RQ1, we found substantial differences in prevalence rates between scoring techniques for all three technologies. Specifically, we were interested in the high “problematic” technology use groups following the monothetic and the polythetic cut-off rule given that these are used interchangeably within the literature. Prevalence rates were especially discrepant for smartphone use which varied from ~8 % (monothetic) to ~64 % (polythetic). Social media use varied from ~2 % (monothetic) to ~31 % (polythetic) and online gaming from ~4 % (monothetic) to ~26 % (polythetic). There are some interesting points to note about this. Firstly, the prevalence range for IGD largely corresponds to previously observed prevalence rates, mainly when using the recommended diagnostic cut-off (Pontes, 2018; Wartberg et al., 2020). However, as may be expected when no clinical diagnostic criteria exist for “problematic” social media and social media use, these technologies’ prevalence rates were a little more divergent from previous findings. Namely, for social media, the prevalence rate was a somewhat wider range than previous studies which have used the same measure (Van Den Eijnden et al., 2016).

There are some important implications of these findings. Perhaps the critical note to point is that established diagnostic criteria and at the very least, conceptual clarity must precede scale development for the specific technology of interest. It seems that where established diagnostic cut-offs were available, more similar current findings to previous work were available. However, this is not to say that these are entirely without fault. As is evidenced from the discrepant prevalence rates between scoring techniques even for IGD, the way these are used by researchers in this area required extensive consistency and consensus. This may first be aided by more concerted efforts on conceptual considerations, member checking, stakeholder participation and other dialogic approaches to seeking a firmer conceptual basis on these issues. This may, in turn, assist with scale development, validation and scoring practices which may be more uniform and stable as a result. Investment in consistent scoring practices is not just relevant for addressing questions about prevalence rates, but importantly how these may be impactful on any corresponding psychological variables. Indeed, the current findings illuminate this to be important, as discussed in the following section.

Whilst we would expect there to be differences in prevalence rates based on scoring method, we sought to understand how this may subsequently impact upon commonly correlated variables relating to psychosocial well-being and problematic behaviour. However, first in relation to RQ2, we explored the extent to which “problematic” use scales related to self-esteem and problematic school behaviour when just using scale total scores. Based on total scores from the “problematic” use scales, our results showed that “problematic” social media usage significantly predicted lower self-esteem and higher reported problematic school behaviour. “Problematic” smartphone use followed this trend in relation to the correlational analysis but not the regression analysis, possibly due to the high level of shared variance with social media use which was a better predictor. By contrast, “problematic” online gaming was not related to either of the outcome measures. However, of primary

interest to this study in relation to RQ3, we explored whether self-esteem and problematic school behaviour better predicted the technology use groups identified by the monothetic or the polythetic method, so to recognise the classification method that would be more useful to detect differences between low and high technology use individuals.

In relation to online gaming measured through IGD, the classification groups identified by the official cut-off were not predicted by neither self-esteem nor problematic school behaviour. This is especially intriguing as the official cut-off (71) is cited to be aligned with the DSM behavioural addiction criteria (Pontes, 2018; Pontes & Griffiths, 2015). In contrast, problematic school behaviours predicted the classification groups identified by the polythetic cut-off, with individuals with higher problematic school behaviour being slightly more likely to be part of the high “problematic” online gaming use group.

Taking RQ3 further to explore “problematic” smartphone use measured through SABAS, the groups identified by the monothetic cut-off were predicted by problematic school behaviour but not by self-esteem. Meanwhile, both problematic school behaviour and self-esteem predicted the groups identified by the polythetic method, with individuals with higher problematic school behaviour and lower self-esteem being more likely to be part of the high smartphone use group. Again, there is some suggestion here which delineates between monothetic and polythetic scoring on some of the measured outcomes, highlighting that for the SABAS measure, which is a commonly used measure in the literature, there are some assurances needed on how “problematic” use is being determined given this has differential impacts.

Finally, we found similar results when exploring “problematic” social media use measured through SMD. The groups identified by the monothetic cut-off were predicted by problematic school behaviour but not by self-esteem. In contrast, both problematic school behaviour and self-esteem predicted the groups identified by the polythetic method, with individuals with higher problematic school behaviour and lower self-esteem being more likely to be part of the high social media use group. It seems there is a degree of delineation evident for measured outcomes based on scoring method which highlights that existing research which has interchangeably used polythetic and monothetic scoring for the SMD measure may be overlooking basic measurement rigour when testing effects on psychosocial or behavioural impacts.

The findings reported in the present paper, particularly the AIC comparisons, suggest that the polythetic method may be more accurate, compared to the monothetic method, to detect differences between high and low smartphone use groups when measured via SABAS and between high and low social media use groups when measured via SMD. However, further studies should be conducted to replicate these findings, possibly with variables other than self-esteem and problematic school behaviour, and to validate an official method. We feel particularly cautious to declare the polythetic method as more promising compared to the official method for IGD given that the OR coefficient was small (4 %) and the correlations indicated no relationship between online gaming use and self-esteem and problematic school behaviour.

## 10. Limitations

As with all research, our study is not without limitations. The first is that the data was obtained from one target school. Whilst this allowed for a certain level of control in the data, this does raise the question about the generalisability to other adolescent samples. Secondly, we only measured a select number of outcome variables (self-esteem and problematic school behaviour), but it would be interesting to conduct additional research to explore how these findings applied across a broader range of psychosocial and behavioural outcomes.

## 11. Conclusion

Whilst problematic technology use continues to be in an ongoing concern for the general public and in public health policy agenda, we

observe that the academic literature in this area is subject to a range of discrepancies and inconsistencies. Our findings illuminate these issues in respect of the impacts on observed prevalence rates but also how these correspond to psychosocial and behavioural outcomes. Overall, it seems that at least for SMD and SABAS there is some degree of delineation in the psychosocial and behavioural impacts based on whether these used polythetic or monothetic scoring procedures. Polythetic techniques appear in all cases to be better at detecting group differences relative to monothetic approaches. This suggests that much greater care and consensus is needed by researchers using these (and other) tools especially when establishing how “problematic” technology use corresponds to psychosocial or behavioural variables. More intriguingly, when established cut-offs were used for online gaming (IGD-20), there were no observed delineation for these impacts when the literature may typically suggest otherwise. We urge researchers in this area to be led by established diagnostic criteria, to avoid applying criteria from one type of technology to another, and to reach consensus on a consistent scoring approach when using “problematic” use scales.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.chb.2021.106965>.

## Author contributions

Conceptualization: TC, LC, GA, LK; Methodology TC; Validation: TC, LC; Formal analysis: AP, LC; Investigation: TC; Resources: TC; Data Curation: TC; Writing - Original Draft: TC, LK; Writing - Review & Editing: LC, GA, AP; Supervision: LC; Project administration: TC.

## References

- Andreassen, C. S., Billieux, J., Griffiths, M. D., Kuss, D. J., Demetrovics, Z., Mazzoni, E., et al. (2016). The relationship between addictive use of social media and video games and symptoms of psychiatric disorder: A large-scale cross-sectional study. *Psychology of Addictive Behaviors*, 30(2), 252–262. <https://doi.org/10.1037/adb0000160>
- Andreassen, C. S., Torsheim, T., Brunborg, G. S., & Pallesen, S. (2012). Development of a Facebook addiction scale. *Psychological Reports*, 110(2), 501–517. <https://doi.org/10.2466/02.09.18.pr0.110.2.501-517>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.
- Beard, C. L., Haas, A. L., Wickham, R. E., & Stravopoulos, V. (2017). Age of initiation and internet gaming disorder: The role of self-esteem. *Cyberpsychology, Behavior, and Social Networking*, 20(6), 397–401. <https://doi.org/10.1089/cyber.2017.0011>
- Bian, M., & Leung, L. (2015). Linking loneliness, shyness, social media addiction symptoms, and patterns of social media use to social capital. *Social Science Computer Review*, 33(1), 61–79.
- Bianchi, A., & Phillips, J. G. (2005). Psychological predictors of problem mobile phone use. *CyberPsychology and Behavior*, 8(1), 39–51.
- Block, J. J. (2008). Issues for DSM-V: Internet addiction. *American Journal of Psychiatry*, 165(3), 306–307.
- Boer, M., van den Eijnden, R. J., Boniel-Nissim, M., Wong, S. L., Inchley, J. C., Badura, P., & Stevens, G. W. (2020). Adolescents' intense and problematic social media use and their well-being in 29 countries. *Journal of Adolescent Health*, 66(6), S89–S99.
- Brailovskaia, J., Margraf, J., & Köllner, V. (2019). Addicted to Facebook? Relationship between Facebook addiction disorder, duration of Facebook use and narcissism in an inpatient sample. *Psychiatry Research*, 273, 52–57. [j.psychres.2019.01.016](https://doi.org/10.1016/j.psychres.2019.01.016), 10.1016.
- Catone, G., Senese, V. P., Pisano, S., Siciliano, M., Russo, K., Muratori, P., et al. (2020). The drawbacks of Information and Communication Technologies: Interplay and psychopathological risk of nomophobia and cyber-bullying, results from the bullying and youth mental health Naples study (BYMHNS). *Computers in Human Behavior*, 113, 106496. <https://doi.org/10.1016/j.chb.2020.106496>
- Chen, I.-H., Pakpour, A. H., Leung, H., Potenza, M. N., Su, J.-A., Lin, C.-Y., et al. (2020a). Comparing generalized and specific problematic social media/internet use: Longitudinal relationships between social media application-based addiction and social media addiction and psychological distress. *Journal of Behavioral Addiction*, 9(2), 410–419. <https://doi.org/10.1556/2006.2020.00023>
- Chen, I.-H., Strong, C., Lin, Y.-C., Tsai, M.-C., Leung, H., Lin, C.-Y., et al. (2020b). Time invariance of three ultra-brief internet-related instruments: Social media application-based addiction scale (SABAS), bergen social media addiction scale (BSMAS), and the nine-item internet gaming disorder scale- short form (IGDS-SF9) (study Part B). *Addictive Behaviors*, 101, 105960.

- Csibi, S., Demetrovics, Z., & Szabo, A. (2016). Hungarian adaptation and psychometric characteristics of Brief Addiction to Social media Scale (BASS). *Psychiatria Hungarica*, 31(1), 71–77.
- Csibi, S., Griffiths, M. D., Cook, B., Demetrovics, Z., & Szabo, A. (2018). The psychometric properties of the social media application-based addiction scale (SABAS). *International Journal of Mental Health and Addiction*, 16(2), 393–403. <https://doi.org/10.1007/s11469-017-9787-2>
- Chua, T. H. H., & Chang, L. (2016). Follow me and like my beautiful selfies: Singapore teenage girls' engagement in self-presentation and peer comparison on social media. *Computers in Human Behavior*, 55, 190–197.
- Craig, W., Boniel-Nissim, M., King, N., Walsh, S. D., Boer, M., Donnelly, P. D., et al. (2020). Social media use and cyber-bullying: A cross-national analysis of young people in 42 countries. *Journal of Adolescent Health*, 66(6), 100–108. <https://doi.org/10.1016/j.jadohealth.2020.03.006>
- David, P., Kim, J.-H., Brickman, J. S., Ran, W., & Curtis, C. M. (2015). Mobile phone distraction while studying. *new media & society*, 17(10), 1661–1679.
- Davis, R. A. (2001). A cognitive-behavioral model of pathological Internet use. *Computers in Human Behavior*, 17(2), 187–195. [https://doi.org/10.1016/s0747-5632\(00\)00041-8](https://doi.org/10.1016/s0747-5632(00)00041-8)
- Elphinston, R. A., & Noller, P. (2011). Time to face it! Facebook intrusion and the implications for romantic jealousy and relationship satisfaction. *Cyberpsychology, Behavior, and Social Networking*, 14(11), 631–635. <https://doi.org/10.1089/cyber.2010.0318>
- Fardouly, J., & Vartanian, L. R. (2015). Negative comparisons about one's appearance mediate the relationship between Facebook usage and body image concerns. *Body Image*, 12, 82–88. <https://doi.org/10.1016/j.bodyim.2014.10.004>
- Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, 7(2), 117–140.
- Fullwood, C., Quinn, S., Kaye, L. K., & Redding, C. (2017). My virtual friend: A qualitative analysis of the attitudes and experiences of social media users: Implications for social media attachment. *Computers in Human Behavior*, 75, 347–355. <https://doi.org/10.1016/j.chb.2017.05.029>
- Fung, S. F. (2019). Cross-cultural validation of the social media disorder scale. *Psychology Research and Behavior Management*, 12, 683.
- Fuster, H., Carbonell, X., Pontes, H. M., & Griffiths, M. D. (2016). Spanish validation of the internet gaming disorder-20 (IGD-20) test. *Computers in Human Behavior*, 56, 215–224.
- Gentile, D. (2009). Pathological video-game use among youth ages 8 to 18: A national study. *Psychological Science*, 20(5), 594–602. <https://doi.org/10.1111/j.1467-9280.2009.02340.x>
- George, M. J., & Odgers, C. L. (2015). Seven fears and the science of how mobile technologies may be influencing adolescents in the digital age. *Perspectives on Psychological Science : A Journal of the Association for Psychological Science*, 10(6), 832–851. <https://doi.org/10.1177/1745691615596788>
- Griffiths, M., Lopez-Fernandez, O., Throuvala, M., Pontes, H. M., & Kuss, D. J. (2018). *Excessive and problematic use of social media in adolescence: A brief overview executive summary*. <https://doi.org/10.13140/RG.2.2.11280.71682>
- Gul, H., Yurumez Solmaz, E., Gul, A., & Oner, O. (2018). Facebook overuse and addiction among Turkish adolescents: Are ADHD and ADHD-related problems risk factors? *Psychiatry and Clinical Psychopharmacology*, 28(1), 80–90. <https://doi.org/10.1080/24750573.2017.1383706>
- Gutierrez, J. D.-S., Rodriguez de Fonseca, F., & Rubio, G. (2016). Cell-phone addiction: A review. *Frontiers in Psychiatry*, 7, 175. <https://doi.org/10.3389/fpsy.2016.00175>
- Hafekost, J., Lawrence, D., Boterhoven de Haan, K., Johnson, S. E., Saw, S., Buckingham, W. J., et al. (2016). Methodology of young minds matter: The second Australian child and adolescent survey of mental health and wellbeing. *Australian and New Zealand Journal of Psychiatry*, 50(9), 866–875.
- Hafekost, K., Boterhoven de Haan, K., Lawrence, D., Sawyer, M. G., & Zubrick, S. R. (2017). In *Validation of the adolescent self-esteem questionnaire: Technical report*. Perth, Australia: Telethon Kids Institute and the Graduate School of Education, The University of Western Australia, 15(10), 2018.
- Hawi, N. S., & Samaha, M. (2017). Validation of the Arabic version of the internet gaming disorder-20 test. *Cyberpsychology, Behavior, and Social Networking*, 20(4), 268–272.
- Holtz, P., & Appel, M. (2011). Internet use and video gaming predict problem behavior in early adolescence. *Journal of Adolescence*, 34(1), 49–58. <https://doi.org/10.1016/j.adolescence.2010.02.004>
- Hong, W., Liu, R.-D., Oei, T.-P., Zhen, R., Jiang, S., & Sheng, X. (2019). The mediating and moderating roles of social anxiety and relatedness need satisfaction on the relationship between shyness and problematic mobile phone use among adolescents. *Computers in Human Behavior*, 93, 301–308. <https://doi.org/10.1016/j.chb.2018.12.020>
- Hou, Y., Xiong, D., Jiang, T., Song, L., & Wang, Q. (2019). Social media addiction: Its impact, mediation, and intervention. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, 13(1). <https://doi.org/10.5817/CP2019-1-4>
- Kardefelt-Winther, D. (2014). The moderating role of psychosocial well-being on the relationship between escapism and excessive online gaming. *Computers in Human Behavior*, 38, 68–74. <https://doi.org/10.1016/j.chb.2014.05.020>
- Kim, M. H. (2015). The effects of maternal parenting behavior, smart devices addiction, and children's self regulation on their use of smart devices. *Korean Journal of Chemical Engineering*, 11(6), 133–151.
- Kim, E., & Koh, E. (2018). Avoidant attachment and social media addiction in college students: The mediating effects of anxiety and self-esteem. *Computers in Human Behavior*, 84, 264–271. <https://doi.org/10.1016/j.chb.2018.02.037>
- King, D. L., & Delfabbro, P. H. (2014). The cognitive psychology of internet gaming disorder. *Clinical Psychology Review*, 34(4), 298–308.
- Kuss, D. J., van Rooij, A. J., Shorter, G. W., Griffiths, M. D., & van de Mheen, D. (2013). Internet addiction in adolescents: Prevalence and risk factors. *Computers in Human Behavior*, 29(5), 1987–2996. <https://doi.org/10.1016/j.chb.2013.04.002>
- Kwak, K. H., Hwang, H. C., Kim, S. M., & Han, D. H. (2020). Comparison of behavioral changes and brain activity between adolescents with Internet Gaming Disorder and student pro-gamers. *International Journal of Environmental Research and Public Health*, 17(2), 441.
- Kwon, M., Lee, J., Won, W., Park, J., Min, J., Hahn, C., et al. (2013). Development and validation of a social media addiction scale. *PLoS One*, 8(2), Article e56936. <https://doi.org/10.1371/journal.pone.0056936>
- La Rue, F. (2011). *Report of the Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression*. New York: United Nations. [http://www2.ohchr.org/english/bodies/hrcouncil/docs/17session/A.HRC.17.27\\_en.pdf](http://www2.ohchr.org/english/bodies/hrcouncil/docs/17session/A.HRC.17.27_en.pdf). (Accessed 11 July 2011).
- Lee, S. J. (2009). Online communication and adolescent social ties: Who benefits more from internet use? *Journal of Computer-Mediated Communication*, 14(3), 509–531. <https://doi.org/10.1111/j.1083-6101.2009.01451.x>
- Lee, H., & Kim, J. (2018). A structural equation model on Korean adolescents' excessive use of social media. *Asian Nursing Research*, 12(2), 91–98. <https://doi.org/10.1016/j.anr.2018.03.002>
- Lee, J., Sung, M. J., Song, S. H., Lee, Y. M., Lee, J. J., Cho, S. M., & Shin, Y. M. (2018a). Psychological factors associated with social media addiction in South Korean adolescents. *The Journal of Early Adolescence*, 38(3), 288–302.
- Lee, S. Y., Lee, D., Nam, C. R., Kim, D. Y., Park, S., Kwon, J. G., & Choi, J. S. (2018b). Distinct patterns of internet and social media-related problems among adolescents by gender: Latent class analysis. *Journal of Behavioral Addictions*, 7(2), 454–465.
- Leggett, S. (2020). *Mobile phone ownership and usage is up among kids – but it can be tough parenting this more private and personal technology [Web log message]*. <http://www.childwise.co.uk/bits-blogs/mobile-phone-ownership-and-usage-is-up-among-kids-but-it-can-be-tough-parenting-this-more-private-and-personal-technology>
- Leung, H., Pakpour, A. H., Strong, C., Lin, Y.-C., Tsai, M.-C., Griffiths, M. D., et al. (2020). Measurement invariance across young adults from Hong Kong and taiwan among three internet-related addiction scales: Bergen social media addiction scale (BSMAS), social media application-based addiction scale (SABAS), and internet gaming disorder scale-short form (IGDS-SF9) (study Part A). *Addictive Behaviors*, 101, 105969. <https://doi.org/10.1016/j.addbeh.2019.04.027>
- Morris, R. G., & Johnson, M. C. (2014). Sedentary activities, peer behavior, and delinquency among American youth. *Crime & Delinquency*, 60(6), 939–968. <https://doi.org/10.1177/001128710386205>
- Nesi, J., & Prinstein, M. J. (2018). Using social media for social comparison and feedback-seeking: Gender and popularity moderate associations with depressive symptoms. *Journal of Abnormal Child Psychology*, 43(8), 1427–1438. <https://doi.org/10.1007/s10802-015-0020-0>
- Neuman, S. B. (1988). The displacement effect: Assessing the relation between television viewing and reading performance. *Reading Research Quarterly*, 23, 414–440. <https://doi.org/10.2307/747641>
- Nevski, E., & Siibak, A. (2016). The role of parents and parental mediation on 0–3-year olds' digital play with smart devices: Estonian parents' attitudes and practices. *Early Years*, 36(3), 227–241.
- Orosz, G., Tóth-Király, I., & Bőthe, B. (2016). Four facets of Facebook intensity — the development of the multidimensional Facebook intensity scale. *Personality and Individual Differences*, 100, 95–104. <https://doi.org/10.1016/j.paid.2015.11.038>
- Patton, D. U., Hong, J. S., Ranney, M., Patel, S., Kelley, C., Eschmann, R., et al. (2014). Social media as a vector for youth violence: A review of the literature. *Computers in Human Behavior*, 35, 548–553. <https://doi.org/10.1016/j.chb.2014.02.043>
- Pontes, H. M. (2018). Making the case for video game addiction: Does it exist or not? In C. Ferguson (Ed.), *Video game influences on aggression, cognition, and attention* (pp. 41–57). Springer.
- Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior*, 45, 137–143.
- Pontes, H. M., Kiraly, O., Demetrovics, Z., & Griffiths, M. D. (2014). The conceptualization and measurement of DSM-5 internet gaming disorder: The development of the IGD-20 test. *PLoS One*, 9(10), e110137. <https://doi.org/10.1371/journal.pone.0110137>
- Prescott, C. (2015). *Internet access—households and individuals: 2017*. London: Office for National Statistics.
- Roser, K., Schoeni, A., Foerster, M., & Rössli, M. (2016). Problematic mobile phone use of Swiss adolescents: Is it linked with mental health or behaviour? *International Journal of Public Health*, 61(3), 307–315.
- Ryding, F. C., & Kuss, D. J. (2019). The use of social networking sites, body image dissatisfaction, and body dysmorphic disorder: A systematic review of psychological research. *Psychology of Popular Media Culture*. <https://doi.org/10.1037/ppm0000264>
- Samaha, M., & Hawi, N. S. (2016). Relationships among social media addiction, stress, academic performance, and satisfaction with life. *Computers in Human Behavior*, 57, 321–325.
- Sampath, H., Kalyani, S., Soohinda, G., & Dutta, S. (2017). Patterns, attitudes, and dependence toward WhatsApp among college students. *Journal of Mental Health and Human Behavior*, 22(2), 110.
- Satchell, L., Fido, D., Harper, C., Shaw, H., Davidson, B. I., Ellis, D. A., et al. (2021). Development of an Offline-Friend Addiction Questionnaire (O-FAQ): Are most people really social addicts? *Behavior Research Methods*, 53, 1097–1106. <https://doi.org/10.3758/s13428-020-01462-9>



- Savci, M., & Griffiths, M. D. (2019). The development of the Turkish social media craving scale (SMCS): A validation study. *International journal of mental health and addiction*. <https://doi.org/10.1007/s11469-019-00062-9>
- Schwartz, M. A., & Wiggins, O. P. (1987). Diagnosis and ideal types: A contribution to psychiatric classification. *Comprehensive Psychiatry*, 28(4), 277–291.
- Seo, D. G., Park, Y., Kim, M. K., & Park, J. (2016). Mobile phone dependency and its impacts on adolescents' social and academic behaviors. *Computers in Human Behavior*, 63, 282–292. <https://doi.org/10.1016/j.chb.2016.05.026>
- Severo, R. B., Barbosa, A. P. P. N., Fouchy, D. R. C., da Cunha Coelho, F. M., Pinheiro, R. T., de Figueiredo, V. L. M., et al. (2020). Development and psychometric validation of internet gaming disorder scale-short-form (IGDS9-SF) in a Brazilian sample. *Addictive Behaviors*, 103, Article e106191. <https://doi.org/10.1016/j.addbeh.2019.106191>
- Shapira, N. A., Lessig, M. C., Goldsmith, T. D., Szabo, S. T., Lazoritz, M., Gold, M. S., et al. (2003). Problematic internet use: Proposed classification and diagnostic criteria. *Depression and Anxiety*, 17(4), 207–216.
- Shaw, H., Ellis, D. A., Geyer, K., Davidson, B. I., Ziegler, F. V., & Smith, A. (2020). Quantifying social media 'use': Choice of measurement impacts relationships between 'usage' and health. *Technology, Mind and Society*, 1(2). <https://doi.org/10.1037/tmb0000022>
- Shu, M. Y., Ivan Jacob, A. P., Meng Xuan, Z., & Anise, M. S. W. (2019). Psychometric validation of the Internet Gaming Disorder-20 Test among Chinese medium school and university students. *Journal of Behavioral Addictions*, 8(2), 295–305.
- Sneck, D., Tomasic Humer, J., & Duvnjak, I. (2017). Correlates of problematic gaming—Is there support for proneness to risky behaviour? *Psychiatria Danubina*, 29(3), 302–312.
- Soraci, P., Ferrari, A., Antonino, U., & Griffiths, M. D. (2020). Psychometric properties of the Italian version of the social media application-based addiction scale (SABAS). *International journal of mental health and addiction*. <https://doi.org/10.1007/s11469-020-00222-2>
- Suhail, K., & Bargees, Z. (2006). Effects of excessive internet use on undergraduate students in Pakistan. *CyberPsychology and Behavior*, 9(3), 297–307. <https://doi.org/10.1089/cpb.2006.9.297>
- Tamura, H., Nishida, T., Tsuji, A., & Sakakibara, H. (2017). Association between excessive use of mobile phone and insomnia and depression among Japanese adolescents. *International Journal of Environmental Research and Public Health*, 14(7), 701.
- Tayana, P., & Xavier, C. (2018). Is social media addiction really an addiction? *Journal of Behavioral Addictions J Behav Addict*, 7(2), 252–259. <https://doi.org/10.1556/2006.7.2018.49>
- Thomee, S., Harenstam, 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(66). <https://doi.org/10.1186/1471-2458-11-66>
- Vahidi, M., Zamanzadeh, V., Musavi, S., Janani, R., & Namdar, A. H. (2019). Validation of the Persian version of the internet gaming disorder-20 test among the students of tabriz university of medical sciences. *Journal of Torbat Heydariyeh University of Medical Sciences (Journal of Health Chimes)*, 7, 15–26.
- Valkenburg, P. M., & Peter, J. (2009). Social consequences of the internet for adolescents: A decade of research. *Current Directions in Psychological Science*, 18, 1–5. <https://doi.org/10.1111/j.1467-8721.2009.01595.x>
- Van Den Eijnden, R. J., Lemmens, J. S., & Valkenburg, P. M. (2016). The social media disorder scale. *Computers in Human Behavior*, 61, 478–487.
- Van der Aar, L., Peters, S., & Crone, E. (2018). The development of self-views across adolescence: Investigating self-descriptions with and without social comparison using a novel experimental paradigm. *Cognitive Development*, 48, 256–270.
- Van Deursen, A. J., Bolle, C. L., Hegner, S. M., & Kommers, P. A. (2015). Modeling habitual and addictive social media behavior: The role of social media usage types, emotional intelligence, social stress, self-regulation, age, and gender. *Computers in Human Behavior*, 45, 411–420.
- Vigna-Taglianti, F., Brambilla, R., Priotto, B., Angelino, R., Cuomo, G., & Dicedue, R. (2017). Problematic internet use among high school students: Prevalence, associated factors and gender differences. *Psychiatry Research*, 257, 163–171.
- Wartberg, L., Kriston, L., & Thomasius, R. (2020). Internet gaming disorder and problematic social media use in a representative sample of German adolescents: Prevalence estimates, comorbid depressive symptoms and related psychosocial aspects. *Computers in Human Behavior*, 103, 31–36. <https://doi.org/10.1016/j.chb.2019.09.014>
- Vogel, E. A., Rose, J. P., Roberts, L. R., & Eckles, K. (2014). Social comparison, social media, and self-esteem. *Psychology of Popular Media Culture*, 3(4), 206.
- Wang, J.-L., Wang, H.-Z., Gaskin, J., & Wang, L.-H. (2015). The role of stress and motivation in problematic social media use among college students. *Computers in Human Behavior*, 53, 181–188.
- Yang, S. Y., Lin, C. Y., Huang, Y. C., & Chang, J. H. (2018). Gender differences in the association of social media use with the vitality and mental health of adolescent students. *Journal of American College Health*, 66(7), 693–701.
- Yang, Y.-S., Yen, J.-Y., Ko, C.-H., Cheng, C.-P., & Yen, C.-F. (2010). The association between problematic cellular phone use and risky behaviors and low self-esteem among Taiwanese adolescents. *BMC Public Health*, 10(1), 217. <https://doi.org/10.1186/1471-2458-10-217>