

Excessive internet use in European adolescents: What determines differences in severity?

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Abstract

Objectives This study investigated the differences between non-excessive, moderately excessive, and highly excessive internet use among adolescents. These differences were explored in terms of personal characteristics, psychological difficulties, environmental factors, and manner of internet use.

Methods A representative sample was investigated, consisting of 18,709 adolescents aged 11–16 and their parents, from 25 European countries. Excessive internet use was measured using a five item scale covering following factors: salience, conflict, tolerance, withdrawal symptoms, and relapse and reinstatement. The main data analysis utilised multinomial and binary logistic regression models.

Results The vast majority of respondents reported no signs of excessive internet use. Moderately excessive users (4.4 %) reported higher emotional and behavioural difficulties, but also more sophisticated digital skills and a broader range of online activities. The highly excessive users (1.4 %) differed from the non-excessive and moderately excessive users in their preference for online games and in having more difficulties with self-control.

Conclusions Adolescents who struggle with attention and self-control and who are inclined toward online gaming may be especially vulnerable to the otherwise uncommon phenomenon of excessive internet use.

Keywords Adolescents · Excessive internet use · Internet addiction

Introduction

The Internet has become an integral aspect of life for contemporary adolescents. This is the first generation to grow up completely in the digital era, and internet penetration among adolescents is nearly 100 % in most developed countries. At the same time, compared to adults, young people are more involved in time-consuming online applications like social networking sites and games. Therefore, public and academic discussions about the potential harmful effects of internet use on child development have produced terminology ranging from “problematic internet use” to “internet addiction” (Beard 2011).

At this time, only a specific Internet Gaming Disorder has been listed as a future research need in the DSM-5 (American Psychiatric Association 2013) while problematic use of social networking sites (SNS) or online pornography has not been included in this category.

Drawing on findings about differences in patterns of internet use, we work with the term “excessive internet use” (EIU), since it represents a continuum of internet misuse. Its extreme end may include users who are at risk of developing symptoms of addictive behaviour. The literature has identified several consequences involving reduced psychological, social, and physical well-being in

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young people due to excessive computer use (c.f. Kalmus et al. 2014), e.g. increased depression (van den Eijnden et al. 2008) and increased irritability and nervousness due to reduced quality of sleep (Nuutinen et al. 2014). While viewing the concept of excessive internet use as a continuum, it is worth noting that not all forms of highly engaged internet use are necessarily problematic. The recently developed “Model of Four” has shown distinct user types that differ in levels of self-regulation, motivation for change, craving for internet use, and offline engagement (Dreier et al. 2014). Many frequent and highly engaged internet users never actually develop the problematic form of internet use (Charlton 2002). The question of what distinguishes them from users who develop such patterns of internet use still remains unanswered.

A review of the existing literature suggests that excessive internet use in children is a result of the interaction of several factors (Beard 2011). It has been shown that children’s personal characteristics, various psychological (emotional) difficulties, environmental factors, and manner of internet use may all be crucial in determining the development and degree of the problem. Boys (Durkee et al. 2012) and older children (Kalmus et al. in press) have been considered at risk of EIU in some studies. Psychological difficulties such as lower self-esteem, lower self-efficacy, increased anxiety, depressive symptoms, and attentional difficulties (Ko et al. 2012) have been identified as important predictors of EIU. Environmental factors, particularly those relating to the family—the most important social mediator of children’s life—may be an important activator or inhibitor of EIU. For instance, children from single-parent families were shown to be more at risk (Ko et al. 2007), while the prevalence of EIU has shown to correlate inversely with parents’ level of education (Kalmus et al. in press). However, it must be noted that EIU was less strongly associated with family situation and parental mediations than with behavioural and emotional difficulties. Finally, the way in which children use the Internet is also predictive—excessive use is often associated with time-consuming online applications like SNS and online games. EIU is also correlated with more time spent online (Holstein et al. 2014).

However, it must be noted that those factors were often not studied together in a setting where it would be possible to control for their effects (cf. for instance Durkee et al. 2012, as a good example). Thus, we aimed to apply a model combining a variety of potential protective and risk factors to explore the key differences between children who are highly engaged online and yet do not develop problematic patterns of internet use, and those who become excessive or problematic internet users (regardless of frequency).

Methods

Participants

The present study analysed data from the international research project EU Kids Online II. Using a random stratified sample method, the project surveyed approximately 1,000 internet users between the ages of 9 and 16 and their parents (one parent per respondent) in 25 European countries ($N = 25,142$). Thanks to the three-stage (sampling points, addresses, and individuals), random probability cluster sampling technique; the sample was representative of the population of children using the Internet Livingstone et al. 2011). However, only children aged 11–16 years were asked about excessive internet use, and thus the final sample included 18,709 participants (9,352 boys and 9,357 girls). Several a priori procedures (van de Vijver and Leung 2011) were used to maximise the quality of the data: the questionnaire was created in English and then translated to 24 national languages and back-translated to English. Cognitive and pilot tests were conducted. Face-to-face interviews were performed by interviewers in respondents’ homes during the spring and summer of 2010. Sensitive questions were self-completed by children in private and without supervision. Further details are described in Livingstone et al. (2011).

Measures

Excessive internet use (EIU)

The EIU scale consisted of five items measured on a four-point scale (ranging from never to very often). The scale was created using the components model of behavioural addictions (Griffiths 2005) to cover 5 out of 6 factors of addictions: salience—I have gone without eating and sleeping because of the internet; withdrawal symptoms—I have felt bothered when I cannot be on the internet; tolerance—I have caught myself surfing when I am not really interested; relapse—I have tried unsuccessfully to spend less time on the internet; and conflict—I have spent less time than I should with either family, friends, or doing schoolwork because of the time I spend on the internet. The EIU scale was created as a mean value of the five items ($M = 1.48$, $SD = 0.54$, skewness = 1.38). We opted to use the mean score instead of the sum to minimise the number of missing values; i.e., at least one of five items had to be answered to be included in the analysis. No imputation of missing values was employed for cases with no valid answer. Scale Cronbach’s alpha was 0.77.

The EIU scale was not validated for discriminatory purposes; therefore, we decided to calculate statistical discrimination based on the standard deviation, identifying

three distinct groups. Due to the lack of a validated cutoff point, we decided to use labels referring to the extent of use, rather than clinical diagnoses. Thus, we refer to non-excessive, moderately excessive, and highly excessive internet users. The non-excessive group ($N = 17,378$, 94.2 % of the sample) included the sample up to two standard deviations towards higher EIU, the moderately excessive group ($N = 820$, 4.4 % of the sample) were those who scored more than two standard deviations above the scale mean, and the highly excessive group ($N = 253$, 1.4 % of the sample) scored over three standard deviations above the scale mean. The proportion of highly excessive internet users obtained was consistent with previous research on internet addiction in European adolescents (for instance 1.98 % reported by Johansson et al. 2004, 1.2 % reported by Tsitsika et al. 2013).

Several scales were used to estimate psychological and behavioural difficulties.

Assessment of emotional problems

The scale was constructed as a mean score of five items measured on a three-point scale ranging from not true (=1) to very true (=3). Sample items included “I am often unhappy, sad, or tearful” or “I worry a lot”. The scale internal consistency was sufficient (Cronbach’s alpha 0.65).

Assessment of problem behaviour

The scale was constructed as the sum the scores from five dichotomous items asking whether any of the following had happened to the respondent in the past 12 months (no = 0; yes = 1): had so much alcohol that they got really drunk; missed school without parents knowing; was in trouble with the police; was in trouble with teachers for bad behaviour; had sexual intercourse. The possible scores ranged from 0 to 5. The scale Cronbach’s alpha was 0.65.

Assessment of self-efficacy

The scale was constructed as a mean score of four items using a three-point response scale ranging from not true (=1) to very true (=3). Items were adapted from the Generalised self-efficacy scale (Schwarzer and Jerusalem 1995). Sample items included “I can generally work out how to handle new situations” or “I am confident that I can deal with unexpected problems”. The scale Cronbach’s alpha was 0.65.

Assessment of self-control

The scale was constructed as a mean score of four items measured on a three-point response scale ranging from not true (=1) to very true (=3). Sample items included “I am

easily distracted and find it difficult to concentrate” or “I get very angry and often lose my temper”. The scale Cronbach’s alpha was acceptable, 0.62.

Assessment of internet use and sociodemographics

Further, the children were asked several questions about how they use the Internet. For number of online activities, children were asked to select from a list of 17 online activities those they had done in the past month. Sample activities included “watched video clips,” “downloaded a movie” or “used a webcam”. The number of online skills was measured by asking children which skills they possessed, choosing from a list of eight. Sample skills included “block unwanted adverts or junk mail/spam” or “bookmark a website”. Time spent online was measured in minutes per week and combined from two different questions asking for estimates of time spent online on an average school day and on an average non-school day. The children were also asked whether they had internet access in private (e.g. in their bedroom), and whether they used either social networking sites or gaming/virtual world sites on a daily or near-daily basis.

Parents answered the following questions: family type (single-parent or two-parent family; participants reporting family type other were excluded from the analysis due to its heterogeneity), parental frequency of internet use [from less than once a month (=1) to daily or almost daily (=4)], and the highest education attained by any of the parents (i.e., ranging from “not completed primary education” to “second stage of tertiary” and calculated as the higher value of mother’s and father’s education).

As for correlations between excessive internet use and independent variables, all the constructs, except gender, family type and parents’ frequency of internet use, were significantly correlated.

Data analysis

Multinomial and binary logistic regression models were used to estimate the odds or predict odds of falling into the categories of “moderately and highly excessive internet users based on the same sets of predictors. “Non-excessive internet users” were used as a reference category in the former model, and “moderately excessive users” were used in the latter model. Two separate models were estimated to examine the determinants of different levels of severity of EIU. Because of the large number of missing cases, the differences between the excluded and included participants were examined. Upon testing continuous variables for normal distribution, the Mann–Whitney test was used to deal with non-normally distributed data. A *t* test was used to compare the groups’ mean scores on the EIU scale. Other binary analyses were carried out using the Spearman correlation coefficient to

examine the relationships between the main study constructs. To guard against multicollinearity, the VIF score (variance inflation factor) for each variable in each model was examined. No VIF statistic for any variable was found above 2.2 (tolerance not below 0.45), suggesting that multicollinearity was not a problem for these regression models (Menard 1995; Myers 1990). Linearity in the logit of continuous variables was assessed as well, using the Box-Tidwell transformation, which adds a term of the form $x \ln(x)$ to the model, where x represents a continuous variable (Geurro and Johnson 1982). If the coefficient for this variable is significant, then there is evidence for non-linearity in the logit. With the exception of minutes spent online per day, number of online activities, and self-control, the analysis showed that none of the interaction terms were significant, which indicated that the assumption of linearity in the logit was also satisfied.

Results

Descriptive statistics

Descriptives of all variables are presented in Table 1.

Out of 18,709 participants, 258 did not answer the questions on excessive internet use (see, Table 1). A number of participants had missing values in one or more predictor variables. Therefore, a total number of 10,887 participants were used when predicting moderately and highly excessive use of the internet ($N_{\text{Excluded}} = 7,822$). The comparisons between participants who were included and excluded from the analyses showed no significant differences in gender, excessive internet use, or in the parent's frequency of internet use. However, significant age differences were found between the included and excluded participants ($Mdn_{\text{excluded}} = 14$, $Mdn_{\text{included}} = 13$, $U = 40450434.50$, $z = -4.23$, $p < 0.001$, $r = -0.03$), as well as differences in minutes spent online per day ($Mdn_{\text{excluded}} = 85.71$, $Mdn_{\text{included}} = 90.00$, $U = 38,696,194.00$, $z = -3.37$, $p < 0.001$, $r = -0.02$). Although significant, the differences in the following variables occurred only on or after the third decimal place and were, therefore, considered negligible: number of online activities, number of digital skills, frequency of visiting of SNS, frequency of playing online games and visiting virtual worlds, parent's level of education, self-efficacy, emotional problems, problem behaviour, and self-

Table 1 Descriptive statistics, EU Kids Online II study collected in Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Turkey, UK in 2010

	<i>N</i>	%	<i>M</i> (<i>SD</i>)	Skewness	Range
Age	18.709		13.50 (1.69)	0.002	11–16
Male	9.352	50.0			0–1
Minutes spent online per day	18.317		103.83 (64.52)	0.88	5–270
Number of online activities	18.708		8.13 (3.47)	0.04	0–17
Number of digital skills	18.594		4.43 (2.58)	−0.25	0–8
Frequency of visiting of SNS	18.207		2.87 (1.25)	−0.57	1–4
Frequency of playing online games ^a	17.600		2.12 (1.21)	0.43	1–4
Family type					0–1
1-parent family	1,604	10.0			
2-parent family	14.359	90.0			
Total	15.963	100.0			
Parent education	18.632		4.14 (1.33)	0.13	1–7
Parent's frequency of internet use (IU)	14.836		3.58 (0.71)	−1.81	1–4
Emotional problems	18.653		1.35 (0.39)	1.23	1–3
Problem behaviour	17.914		0.47 (0.92)	2.35	0–5
Self-efficacy	18.661		2.24 (0.45)	−0.19	1–3
Self-control	18.681		1.47 (0.42)	0.93	1–3
Excessive internet use					1–3
Non-excessive internet use	17.378	94.2			
Moderately excessive internet use	820	4.4			
Highly excessive internet use	253	1.4			
Total	18.451	100.0			

^a The frequency of playing online games includes the frequency of visiting virtual worlds

control. In addition, the groups differed in family type ($\chi^2_{(1)} = 123.83$, $p = 0.001$), with excluded participants living more often in single-parent families than included participants (single-parent family: $N_{\text{excluded}} = 697$, $N_{\text{included}} = 901$; two-parent family: $N_{\text{excluded}} = 4,279$, $N_{\text{included}} = 9,986$). Although the included and excluded participants differed significantly in the majority of the main study constructs, the sizes of the observed differences were negligible. The one difference worth pointing out was in family type: excluded participants were more likely to live in single-parent families.

Associations among main constructs and predicting moderately and highly excessive internet use

Multinomial logistic regression analysis with “non-excessive internet users” as a reference category was employed to predict the odds of moderately and highly excessive use of the Internet (Table 2). A test of the full model versus an intercept-only model was statistically significant (LR $\chi^2_{(28)} = 877.15$, $p < 0.001$) (the full model explained a significant amount of the original variability in moderately and highly excessive internet use). Adjusted odds ratios are presented in Table 2. Psychological factors were found to be the strongest predictors of moderately and highly excessive use of the internet. With the exception of the parent’s frequency of internet use, both excessive groups showed different patterns of internet use. For instance, moderately excessive users were more likely to report a higher number of online activities and digital skills than the reference group, while highly excessive users spent more time in virtual worlds or playing online games than non-excessive users. Regarding children’s demographic characteristics, only girls were more likely to report highly excessive use of the internet.

Binary logistic regression analysis with “moderately excessive users” as a reference category was employed to predict the odds of being a highly excessive user (Table 2). A test of the full model versus an intercept-only model was statistically significant (LR $\chi^2_{(14)} = 43.85$, $p < 0.001$). Adjusted odds ratios, indicating changes in odds resulting from unit changes in the independent variables, are presented in Table 2. The results show that moderately and highly excessive users had similar psychological profiles, but the highly excessive users spent more total time online, including time spent in virtual worlds/playing games, and they showed lower levels of self-control.

Discussion

The distinction between various levels of excessive internet use is rarely made when the research focus is on predictors

and risk factors of internet overuse. Our analysis suggests the importance of differentiating between several levels of excessive use, as each level is defined by specific characteristics. We compared three groups of adolescent internet users classified according to their scores on the Excessive Internet Use Scale, with those up to two SDs as having no problems, those between two and three SDs being moderately excessive, and those with scores above three SDs as highly excessive internet users.

Playing online games is a risk factor specifically associated with highly excessive internet use. Internet gaming was the primary variable that predicted the increase of the odds of highly excessive internet use when compared to moderately excessive users (other, less significant predictive factors included low self-control and overall time spent online). Internet gaming is generally perceived as a risk factor for developing internet addiction, and our findings provide support for the decision of the American Psychiatric Association, which, with its publication of the DSM-5, called specifically for further investigation of Internet Gaming Disorder (American Psychiatric Association 2013; King et al. 2013). Social networking sites, although often associated with disinhibited internet use and potentially with internet addiction (Kuss and Griffiths 2011), had no such impact on excessive internet use in our study. Our findings also support previous studies that indicated low self-control or even attention deficit/hyperactivity disorder as an important factor associated with internet addiction (Bioulac et al. 2008). Ko et al. (2012) argue that such children are easily bored and in need of immediate stimulation and reward; the internet and especially computer games may be excellent medium to fulfil these needs. It is possible that the worst outcomes are the result of a coincidence of both factors (excessive gaming and attentional difficulties). This should be addressed by future research and also considered by practitioners and caregivers.

Where the excessive groups did not differ from each other and what distinguishes them from the non-excessive group are the increased psycho-behavioural difficulties (emotional problems, behavioural problems, low self-efficacy). It is notable that various emotional difficulties have been shown to be the strongest predictors of internet addiction (Weinstein and Lejoyeux 2010; Spada 2014). However, our results suggest that it predicts a wider range of excessive internet use, not only the most extreme cases that could be termed an addiction. Explanation could be the mood management hypothesis (Reinecke and Vorderer 2013)—i.e., to cope with stress and everyday problems, some children turn to the Internet for relief and escape.

Interestingly, the moderately excessive group is characterised by having the widest variety of online activities and the highest number of online skills out of all three groups; there is no difference in these variables between

Table 2 Multinomial and binary logistic regression models predicting moderately and highly excessive internet users, EU Kids Online II study collected in Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Turkey, UK in 2010

	Reference category: not excessive (N = 10,285)				Reference category: moderately excessive (N = 459)			
	Moderately excessive (N = 459)		Highly excessive (N = 143)		Highly excessive (N = 143)		Highly excessive (N = 143)	
	B (SE)	OR 95 % CI	B (SE)	OR 95 % CI	B (SE)	OR 95 % CI	B (SE)	OR 95 % CI
Intercept (constant)	-7.14 (0.66)***		-11.50 (0.126)***		-5. (1.46)***			
Age	0.04 (0.04)	1.05 (0.97-1.12)	0.07 (0.07)	1.07 (0.95-1.23)	0.06 (0.08)	1.06 (0.91-1.23)	0.01	
Gender (boys, ref.)	0.03 (0.11)	1.03 (0.83-1.29)	0.51 (0.20)*	1.66 (1.12-2.47)	0.45 (0.24)	1.57 (0.99-2.49)	1.06	
Minutes spent online per day	0.01 (0.01)***	1.01 (1.01-1.01)	0.08(0.00)	1.01 (1.01-1.01)	0.01 (0.01)*	1.00 (1.00-1.01)	1.57	
Number of online activities	0.05 (0.02)*	1.06 (1.01 - 1.10)	0.05(0.04)	1.06 (0.98-1.14)	0.01 (0.04)	1.01 (0.93-1.10)	1.00	
Number of digital skills	0.06 (0.03)*	1.06 (1.01-1.12)	0.04 (0.05)	1.04 (0.95-1.15)	-0.02 (0.05)	0.98 (0.89-1.09)	1.01	
Visiting of SNS	0.03 (0.06)	1.03 (0.92-1.16)	0.07 (0.12)	1.07 (0.86-1.35)	0.03 (0.13)	1.03 (0.81-1.32)	0.98	
Playing online games	0.06 (0.05)	1.06 (0.96-1.17)	0.34 (0.09)***	1.41 (1.17-1.68)	0.29 (0.10)**	1.33 (1.10-1.61)	1.03	
Family type (2-parent f., ref.)	-0.03 (0.17)	0.97 (0.70 - 1.35)	-0.05 (0.29)	0.95 (0.54-1.69)	0.03 (0.33)	1.03 (0.53-1.98)	1.03	
Parent education	-0.01 (0.04)	0.99 (0.91-1.07)	-0.02 (0.08)	0.98 (0.84-1.14)	0.02 (0.08)	1.02 (0.86-1.20)	1.02	
Parent's frequency of IU	-0.17 (0.07)*	0.85 (0.74-0.97)	-0.24 (0.12)*	0.79 (0.62-1.00)	-0.14 (0.14)	0.87 (0.66-1.15)	0.87	
Emotional problems	0.83 (0.12)***	2.29 (1.82-2.89)	1.11 (0.20)***	3.05 (2.08-4.47)	0.36 (0.23)	1.43 (0.92-2.23)	1.43	
Problem behaviour	0.83 (0.24)***	2.28 (1.44-3.63)	1.33 (0.37)***	3.77 (1.83-7.79)	0.63 (0.42)	1.88 (0.82-4.29)	1.88	
Self-efficacy	-0.42 (0.12)***	0.66 (0.52-0.83)	-0.35 (0.22)	0.71 (0.46-1.08)	0.02 (0.23)	1.02 (0.65-1.62)	1.02	
Self-control	1.22 (0.12)***	3.38 (2.67-4.28)	1.72 (0.21)***	5.59 (3.73-8.37)	0.60 (0.24)*	1.83 (1.15-2.91)	1.83	
Model χ^2 (df)	877.15 (28)***				43.85 (14)***			
H-L χ^2 (df)					7.49 (8)			
R ² (Nagelkerke)	0.20				0.11			
R ² (Cox and Snell)	0.08				0.07			

B Unstandardised regression coefficient, SE standard error, OR odds ratio, CI confidence interval for OR

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

non-excessive and highly excessive users. On one hand, this may indicate that for many highly excessive users, internet gaming is their primary or sole online activity, and it puts them at risk for developing problematic patterns of internet use. On the other hand, frequent but non-pathological use of the Internet leads to better digital competence in adolescents (Sonck et al. 2012). Therefore, time spent online does not itself imply problematic internet use and may have a positive impact on children's digital literacy. The family context, with the exception of parental internet use, had no impact on how adolescents scored on excessive internet use. Parents' frequency of internet use is negatively correlated with EIU in children and points to the fact that informed and experienced parents may be better equipped to regulate their children's internet use (Paus-Hasenbrink et al. 2012). Overall, parental influence on children's excessive internet use is weak and has been discussed previously in the literature (Kalmus et al. in press).

Several methodological caveats should be noted regarding the validity of the instruments and sample sizes. The Excessive Internet Use Scale was not validated for discriminatory purposes and does not match all of the proposed diagnostic criteria for internet addiction (American Psychiatric Association 2013). Therefore, we cannot claim that the highly excessive internet users suffer from internet addiction; we may only assume they are at risk of developing such a problem. Due to study's cross-sectional design, we are unable to say whether the users in the moderately excessive group are in transition toward joining the highly excessive group, or whether they will remain a distinct category of its own. This question should be addressed in future research. Also, the Cronbach's alphas were generally low for all measures of predictors. This may be due in part to the small number of scale items (Cortina 1993). However, coefficients above 0.6 are considered acceptable in non-clinical settings (Clark and Watson 1995). The sample size was reduced considerably due to missing responses to some survey items. We tested for differences between the respondents included in and those excluded from the analysis and found that the excluded group was slightly older, spent less time online, and lived more often in single-parent families. These are all factors that were previously associated with higher risk of excessive internet use, and they could therefore lead to underrepresentation of internet-related problems in the analytical sample. However, that was not the case in our analysis: included and excluded participants did not differ in EIU. The differences might, however, lead to underestimation of the effects of age and family type and overestimation of the effect of time spent online. Nevertheless, these differences should not compromise the main findings of the study: that

internet gaming and low self-control are the strongest predictors of highly excessive internet use in adolescents.

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