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Abstract

Internet usage has grown exponentially over the last decade. Research indicates that excessive Internet use can lead to symptoms associated with addiction. To date, assessment of potential Internet addiction has varied regarding populations studied and instruments used, making reliable prevalence estimations difficult. To overcome the present problems a preliminary study was conducted testing a parsimonious Internet addiction components model based on Griffiths' addiction components (2005), including salience, mood modification, tolerance, withdrawal, conflict, and relapse. Two validated measures of Internet addiction were used (Compulsive Internet Use Scale [CIUS], Meerkerk et al., 2009, and Assessment for Internet and Computer Game Addiction Scale [AICA-S], Beutel et al., 2010) in two independent samples (*n*s = 3,105 and 2,257). The fit of the model was analysed using Confirmatory Factor Analysis. Results indicate that the Internet addiction components model fits the data in both samples well. The two sample/two instrument approach provides converging evidence concerning the degree to which the components model can organize the self-reported behavioural components of Internet addiction. Recommendations for future research include a more detailed assessment of tolerance as addiction component.

Keywords

Internet addiction, behavioural addiction, addiction components, classification, diagnosis

INTRODUCTION

Over the last decade, the pervasiveness of the Internet has increased radically. Usage has grown by 239% in the developed world (e.g., International Telecommunication Union, 2012). This technology-driven interconnectivity is paralleled by an increase in research indicating that excessive Internet use can lead to symptoms that are associated with problems and/or addiction (Ko, Yen, Chen, Yeh, & Yen, 2009; Leung & Lee, 2012; Young, 2010). Internet addiction has been described as a 21st century epidemic (Christakis, 2010) with prevalence estimates ranging from 0.3% in the USA (Aboujaoude, Koran, Gamel, Large, & Serpe, 2006) to 18.3% in Great Britain (Niemz, Griffiths, & Banyard, 2005). The discrepancy in prevalence estimates is a consequence of the population studied (for example Niemz et al., [2005] studied a restricted student sample), and the fact that the measurement instruments that were used to identify people as being addicted to using the Internet vary in terms of classification and cut-off points for psychopathology. Research on Internet addiction is still in its relative infancy, as indicated by the American Psychiatric Association's (2013) decision to include *Internet Gaming Disorder* as condition that requires further research in the updated fifth edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM). For research to progress further, more specific and sensitive criteria need to be established in order to aid in accurate clinical diagnosis. Furthermore, researchers call for clarity and precision with regards to the conceptualisation of the actual behaviour. For instance, Starcevic (2013) and King and Delfabbro (2013) suggest that Internet use disorder and video game disorder should be treated as separate entities as Internet use disorder is overinclusive (i.e., it can denote a variety of potential online behaviours) and video games can be played both online as well as offline. For the purpose of simplicity and inclusiveness, in the present paper, the term *Internet addiction* will refer to the excessive engagement in online behaviours, including gaming, but not restricted to it, accompanied by the presence of traditional addiction symptoms (American Psychiatric Association, 2013).

To date, the official diagnostic criteria for pathological gambling (Kaltiala-Heino, Lintonen, & Rimpela, 2004; Young, 1999) and substance dependence (Armstrong, Phillips, & Saling, 2000; Nichols & Nicki, 2004; Yuen & Lavin, 2004) are most commonly applied to diagnose potential Internet addiction both in survey research and in clinical settings. Some researchers however question the extent to which there is really such a thing as Internet/ gaming addiction (Blaszczynski, 2006; Shaffer, Hall, & Vander Bilt, 2000). If Internet addiction was to be understood as disease, its (i) hereditary patterns, (ii) etiology, pathophysiology, and (iii) course, prognosis stability over time as well as treatment response should be understood (Pies, 2009). To date, research on neurobiological (Kuss & Griffiths, 2012a) and pathophysiological (Kuss & Griffiths, 2012b) mechanisms in Internet and gaming addiction is growing, but it is still in its infancy, suggesting that the phenomenon needs to be studied in more depth and breadth before Internet addiction can be officially recognised as mental disorder.

The revision of the *DSM (DSM-5)* makes pathological gambling the first behavioural addiction to be recognised alongside substance-related addictions and it theoretically paves the way for other excessive behaviours to be classified as actual addictions (i.e., if one behaviour can be classed as an addiction without the ingestion of a psychoactive substance, there is no reason why other non-chemical behaviours could not be potentially classed as addictions in future revisions). Among those, Internet gaming addiction stands out as the APA has included it in the appendix of the DSM-5 (American Psychiatric Association, 2013). In accordance with substituting the category of Substance Related Disorders with Addiction and Related Disorders (American Psychiatric Association, 2012), the components model of addiction (Griffiths, 2005) postulates substance-related and behavioural addictions (such as Internet addiction) develop via similar biopsychosocial processes and share a number of characteristics, most notably the addiction criteria of salience, mood modification, tolerance, withdrawal, relapse, and conflict. Salience indicates the person is preoccupied with their

behaviour on a number of levels, namely cognitively (their thinking revolves around their behaviour), emotionally (they crave for their substance/behaviour), and behaviourally (other behaviours, i.e., social interactions, are neglected). Someone addicted to the Internet may constantly think about the next time they are going to use the Internet, crave for logging on to their favourite sites, and sacrifice social interactions for being online. Mood modification occurs when the person uses their substance/behaviour in order to elevate depressed moods and escape their real life. The use of the Internet makes them feel better and lets them forget about everyday problems (Young, 2004). Tolerance denotes the requirement to increase the amount of engagement in the addictive behaviour to produce an experience similar to initial behaviour engagement. Over time, the individual may need to increase their time or the intensity of being online to feel the same pleasurable effects (Tsai & Lin, 2003). Withdrawal can occur when the individual decreases or discontinues their behaviour, resulting in negative physiological and psychological symptoms.

For individuals with potentially addictive Internet use, physiological symptoms can include psychosomatic problems, weakened immunity and physiological dysfunction (Cao, Sun, Wan, Hao, & Tao, 2011), whereas psychological symptoms most notably include depression and anxiety (Yen, Ko, Yen, Wu, & Yang, 2007). Conflict denotes both the interpersonal and intrapsychic problems that arise as a consequence of the behaviour. Individuals with potentially addictive Internet use jeopardise their relationships with others for the sake of Internet use (Liu & Kuo, 2007), and may lose control over their usage (Treuer, Fabian, & Furedi, 2001), which can lead to internal conflict. Finally, relapse denotes the unsuccessful efforts to quit the engagement in the behaviour if the person is trying to cease (Griffiths, 2005). Individuals with Internet use problems may be unable to remain abstinent or to moderate their addictive behaviour (Murali & George, 2007).

Taken together, the component model of addiction contributes to a robust account of substance-related and behavioural addictions as it explains their acquisition, development and maintenance. Support for the components model comes from a number of studies assessing behavioural addictions, such as exercise (Griffiths, Szabo, & Terry, 2005), shopping (Clark & Calleja, 2008), gaming (Lemmens, Valkenburg, & Peter, 2009), work (Andreassen, Griffiths, Hetland, & Pallesen, 2012), and social networking addiction (Andreassen, Torsheim, Brunborg, & Pallesen, 2012).

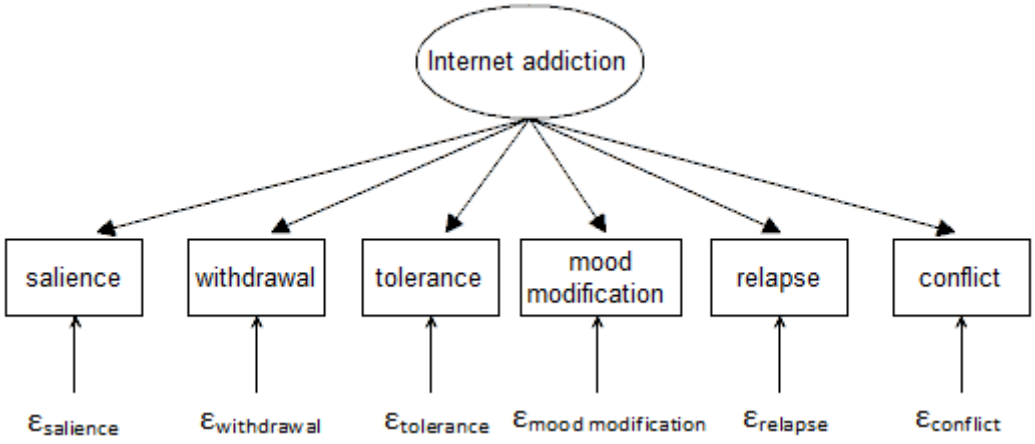
Relatedly, the syndrome model of addiction postulates that all addictions develop via similar distal antecedents that increase vulnerability, including neurobiology and psychosocial context (Shaffer et al., 2004). Proximal antecedents such as specific negative events and/or the continued use of the psychoactive substance and/or engagement in the behaviour may lead to a change in the individual. Addictions can develop that differ in their expression (e.g., drug addiction, or Internet addiction), but share some essential domains, such as symptoms, addiction history, psychology, sociology and treatment approaches. Moreover, addictions as such may not be specific to a particular object or behaviour and one substance or behaviour can be easily substituted by another one (Shaffer et al., 2004). Research supports the likelihood of people switching between substance use or behaviour engagement, such as the use of nicotine following drug treatment (Conner, Stein, Longshore, & Stacy, 1999). Additionally, the use of substances and the engagement in behaviours can co-occur (Smith, Farrell, Bunting, Houston, & Shevlin, 2001). For instance, pathological gambling, substance dependence and alcohol use are commonly experienced together (El-Guebaly et al., 2006).

Further evidence for the syndrome model of addiction has accrued given different forms of addictions share neurobiological similarities. The role of the neurotransmitter dopamine in behavioural as well as in substance-related addictions has been stressed repeatedly (Lopez-Moreno, Gonzalez-Cuevas, Moreno, & Navarro, 2008; Volkow, Fowler,

Wang, Swanson, & Telang, 2007). Similarly, it appears substance-related addictions and excessive Internet and gaming use share a variety of neurobiological mechanisms (Kuss & Griffiths, 2012a), such as reward deficiency (Blum, Cull, Braverman, & Comings, 1996) as a consequence of lack of dopaminergic activity (Liu et al., 2010), the resulting modifications in brain structure (Lin et al., 2012; Volkow, Fowler, & Wang, 2003), and the impairment of cognitive functioning as a consequence of the addiction (Dong, Zhou, & Zhao, 2011; Littel et al., 2012). Taken together, the components and syndrome model of addiction contend that behavioural addictions do not rank behind substance-related addictions in terms of pathogenesis and phenomenological expression. Accordingly, in this paper it is argued that Internet addiction is comparable to other addictions that have been shown to fit the addiction components model. This research aims to lend further support for behavioural addictions and a unitary addiction model which corroborates the APA's decision to replace the restrictive Substance-Use Disorder category with Addiction and Related Disorders and to include Internet Gaming Disorder in the DSM-5 (American Psychiatric Association, 2013). In this preliminary study, it is hypothesised that self-reported Internet addiction predicts the endorsement of the Internet addiction components salience, mood modification, tolerance, withdrawal, conflict and relapse, as represented in Figure 1.

Figure 1

Internet Addiction Components Model



In order to investigate this conjecture, two prominent Internet addiction measures are scrutinised as to their explanatory power of the components model view of possible Internet addiction across age using two independent samples of adolescents and young adults, respectively. The aim is to provide converging evidence concerning the degree to which Griffiths' addiction components model (Griffiths, 2005) can organize the self-reported behavioural components of possible Internet addiction using the Compulsive Internet Use Scale (CIUS) (Meerkerk, Van Den Eijnden, Vermulst, & Garretsen, 2009) and the Assessment for Internet and Computer Game Addiction Scale (AICA-S) (Wölfling, Müller, & Beutel, 2010). The ultimate aim is to provide and validate a model that is economical and assessing potential Internet addiction and may be used in applied psychology contexts, such as pre-screening in clinical settings. The rationale for this study is that using different samples and different measures provides a more stringent test of the proposed model.

METHODS

This preliminary study used a cross-sectional design and integrated two independent data sets collected by the authors, which are described in turn. This study has received ethical

approval by the relevant bodies at the respective institutes and informed consent was obtained from all participants. The first sample (S1) consisted of the 2011 subsample of the annual Monitor Study "Internet and Youth". A total of 3,105 valid responses from students in 13 secondary schools in the Netherlands stratified with regards to region, urbanisation and school level were received. The regions included the East, West and South of the Netherlands, with the West generally more urbanized. School levels included were the first to fourth year of secondary education. The adolescents' mean age was 14.23 years (*SD* = 1.07 years) and 51.70% were female. Of the participants, 54.2% had a higher education qualification (i.e., they participated in HAVO ["Hoger Algemeen Voortgezet Onderwijs"] or VWO ["Voorbereidend Wetenschappelijk Onderwijs"] schooling, the completion of which would allow them to enter higher education). Detailed information of the respective sample characteristics can be found in Table 1. Following the agreement to participate, pen-and-paper questionnaires were distributed to 3,756 students in participating schools. The total response rate was 84%.

Table 1

Sociodemographic Information of Included Samples

	S1 (*N* = 3,105)	S2 (*N* = 2,257)
Age (years)		
M (SD)	14.23 (1.07)	22.67 (6.34)
Range	11 - 19	18 – 64
Sex		
Male	48.3%	35.6%
Female	51.7%	64.4%
Country	The Netherlands	England
Level of study[1]		
Higher education qualification	54.2%	100%
Undergraduate	-	82.8%
Postgraduate	-	17.2%

Note1. In the level of study section, Dutch adolescents were classed as having higher education qualification when their schooling was in HAVO/ VWO.

The second sample (S2) was an opportunity sample of 2,257 students from an English university in the East Midlands (England). The mean age was 22.67 years (SD = 6.34 years), and 64.4% were female. Of these students, 82.8% were undergraduates. Detailed information of the respective sample characteristics can also be found in Table 1. Emails were sent to 28,000 students on a campus at a university in the East Midlands including relevant information about the study as well as the link to the online questionnaire. Participation was incentivised through a lottery for vouchers. The total response rate was 8.1%.

Materials

Internet addiction assessment in Sample 1

In order to assess Internet addiction in Sample 1 (S1), the Compulsive Internet Use Scale (CIUS) (Meerkerk et al., 2009) was used. The CIUS is a self-report instrument that assesses Internet addiction with 14 questions scored on a 5-point Likert scale ranging from 0 ("never") to 4 ("very often") and conceptualises Internet addiction as the addiction to certain online activities (i.e., not the Internet per sé), leading to compulsive Internet use (Meerkerk et al., 2009). It examines a number of addiction symptoms based on official substance dependence and pathological gambling criteria (American Psychiatric Association, 2000) as well as Griffiths' addiction components (2005), including loss of control, salience, withdrawal, mood modification, and conflict. However, it does not assess tolerance. To date, no clinically validated cut-off point for Internet addiction as measured via the CIUS has been proposed. However, it has been shown that when the CIUS scoring is divided into clusters, the average of the highest scoring cluster is 2.8/2.9 (van Rooij, Schoenmakers, Vermulst, van den Eijnden, & van de Mheen, 2011), which translates to a score of 28 following the adopted scoring in the present study. Based on van Rooij et al.'s study (van Rooij et al., 2011), Rumpf

and colleagues adopted a minimum score of 28 out of a possible total of 56 that may be indicative of psychopathology (Rumpf, Meyer, Kreuzer, & John, 2011).

As a psychometric tool, the 14-item version of the CIUS assessing the unidimensional construct of Internet addiction has been validated, and is reliable as it demonstrated sound construct and concurrent validity, factorial stability and internal consistency in an adolescent sample (Meerkerk et al., 2009). Its internal consistency was good with Cronbach's alpha = .88. Moreover, its usage in the current sample has been validated in a previous study (Kuss, van Rooij, Shorter, Griffiths, & van de Mheen, 2013). The wording of the CIUS was slightly adjusted by the authors in order to be appropriate for the Dutch adolescent sample.

Internet addiction assessment in Sample 2

Internet addiction in the English university student sample was measured using Wölfling, Müller and Beutel's Assessment for Internet and Computer Game Addiction Scale (AICA-S) (2010). Initially devised as diagnostic tool in a clinical setting, the AICA-S is a 16-item self-report instrument that assesses both Internet usage (i.e., structural requirements for Internet use, age of onset, frequency of and specific Internet application use, such as gaming) and Internet addiction. Internet addiction is modelled and based on the official diagnostic criteria for substance dependence as outlined in the *Diagnostic and Statistical Manual for Mental Disorders* (*DSM IV-TR*) (American Psychiatric Association, 2000) and the Classification of Mental and Behavioural Disorders (World Health Organization, 1992). In addition to substance dependence criteria, mood modification is also examined (i.e., item 11: "How often do you avoid negative feelings by being online?"). Items are scored on a 5-point Likert scale ranging from 0 ("not at all" or "never") to 4 ("very strongly" or "very often"). The diagnosis of Internet addiction is applied when an individual scores higher than 13 from a possible total score of 24 (Wölfling et al., 2010). In a clinical setting, 11.3% of adolescent psychiatric inpatients were found to fulfil the diagnostic criteria (Müller, Ammerschläger,

Freisleder, Beutel, & Wölfling, 2012). In terms of its psychometric qualities, the AICA-S measures Internet addiction reliably, accurately and exclusively. Its internal consistency is acceptable with Cronbach's alpha = .71, and its utility in assessing Internet addiction in the present sample has been demonstrated in a previous study (Kuss, Griffiths, & Binder, 2013).

Behavioural addiction assessment

In order to assess the extent to which each of the measurement instruments assesses potential Internet addiction as behavioural addiction, each instrument's items were compared against Griffiths' (2005) addiction components. The items that matched the respective components' description best were used and best-fit of these items with the respective addiction components was furthermore cross-checked with the author of the addiction components model. For each component, the single item most representative of the behavioural addiction components as established by Griffiths (2005) per questionnaire was used. A confirmatory approach regarding the literal content of the respective addiction components was chosen over an exclusively exploratory statistical "specification search" (MacCallum, 1986) as it has been noted that it is "an art to find a fragile balance between dutiful theoretical considerations and statistical interpretations" (Boomsma, 2000:474). The aim was to represent Griffiths' addiction components items as closely as possible from a contentual point of view using each of the two included scales. The standardised factor loadings of the behavioural addiction items and their equivalents in the respective Internet addiction measurement instruments are provided in Table 2, including the R square values.

Table 2

Internet Addiction Components

Component	**AICA-S**	**β(SE)**	**R^2**	**CIUS**	**β(SE)**	**R^2**

Salience	How strongly are you mentally preoccupied with the Internet during a day? (item 5)	.59 (.02)	.35	Do you think about the Internet, even when not online? (item 6)	.65 (.02)	.42
Withdrawal	Do you feel moody if you cannot be online? (item 7)	.78 (.01)	.61	Do you feel restless, frustrated, or irritated when you cannot use the Internet? (item 14)	.71 (.02)	.51
Tolerance	Did you recognise having to be online more often or for a longer time to feel good or relaxed again? (item 8)	.87 (.01)	.75	-		
Mood modification	How frequently do you avoid negative temper or feelings by surfing the Internet? (item 11)	.65 (.02)	.42	Do you use the Internet to escape from your sorrows or get relief from negative feelings? (item 13)	.60 (.02)	.36
Relapse	How often have you tried to quit or restrict surfing the Internet? (item 12)	.49 (.02)	.24	Have you unsuccessfully tried to spend less time on the Internet? (item 9)	.61 (.02)	.37
Conflict	Did you face problems or negative consequences because of your Internet usage? (item 15)	.55 (.02)	.30	Do you neglect your daily obligations (school, or family life) because you prefer to go on the Internet? (item 11)	.60 (.02)	.36

Statistical analyses

Statistical analyses were performed using *Mplus* (Muthén & Muthén, 2011). Initially, both samples were compared regarding the participants' Internet addiction scores, Internet addiction prevalence, and endorsement of behavioural addiction criteria. Relationships between the Internet addiction components were assessed using polychoric correlations as the former were treated as ordered categorical rather than continuous (Muthén & Asparouhov, 2002). Next, two independent confirmatory factor analyses (CFA) were conducted for each of the assessment instruments. CFA was used in order to validate the construct of the Internet addiction components model. CFA was the method of choice as it accounts for measurement error, unlike typically used ordinary least square techniques such as multiple regression and correlation (Brown, 2006). The exogenous latent variable was Internet addiction, whereas the observed variables were the addiction components from each scale as specified by Griffiths (2005). The observed variables were treated as ordinal rather than continuous (Jöreskog, 2005) using robust weighted least squares (WLSMV) (Brown, 2006). In comparison to ordinary weighted least squares analyses (WLS), WLSMV is more robust with regards to non-normality of data and less restrictive with regards to sample size, and it corrects means

and variances (Flora & Curran, 2004). Missing data were excluded only if cases were missing on all variables (i.e., in S1, 26 cases were excluded, and in S2, 4 cases were excluded). Other than that, missing data were treated as missing at random (MAR) as there were no missing data patterns apparent from the analyses. These missing data were handled as pairwise present (i.e., they were replaced by estimates using information available from pairs of variables and the entire data set to account for relationships in the data as suggested by Little and Rubin (Little & Rubin, 2002)).

RESULTS

The results indicate that on average, Dutch adolescents scored 9.72 of a possible 56 on the CIUS, whereas English students scored 5.04 out of 24. Based on the respective cut-off criteria, 3.67% of Dutch adolescent sample and 3.18% of the English university students were classified as being addicted to using the Internet. Detailed information on Internet addiction prevalence and Internet addiction components can be found in Table 3.

Table 3

Internet Addiction Prevalence and Internet Addiction Components Across Samples

	S1	S2
Internet addiction		
M (*SD*) on CIUS/AICA-S [max. score]	9.72 (8.07) [56]	5.04 (3.26) [24]
Prevalence	3.67%	3.18%
Internet addiction components[1]		
Salience	2.1%	11.8%
Withdrawal	5.3%	10.8%
Tolerance	-	7.8%
Mood modification	4.9%	17.1%
Relapse	3.5%	8.5%
Conflict	4.6%	16.7%[2]

Note 1. Components were endorsed often and very often by the respective samples.

Note 2. For the English students, conflict was endorsed when they experienced problems in a minimum of three areas of their life out of a possible of six.

The endorsement of the respective Internet addiction components was assessed across samples. Participants who indicated they experienced the respective symptoms either often or very often (and thus falling in the category for frequent experience of symptoms) were taken into account to provide frequencies. Overall, the English university students endorsed all components more frequently, with mood modification and conflict standing out at 17.1% and 16.7%, respectively, compared to 4.9% and 4.6% in the Dutch adolescent sample. The associations between the Internet addiction components pairs in the respective samples were moderate to large. In the Dutch adolescent sample, the correlations varied between the lowest (r = .33) for mood modification and conflict, and the highest (r = .46) for withdrawal and salience, each representing a medium effect (Cohen, 1992), substantiating their conceptual relatedness. A correlation matrix is presented in Table 4 rather than a variance-covariance matrix as the former includes less rounding error and may still be used to create the latter directly (Brown, 2006).

Table 4

Correlation Matrix for CIUS Internet Addiction Components

	Salience	Withdrawal	Mood modification	Relapse
Withdrawal	.46			
Mood modification	.39	.44		
Relapse	.40	.41	.38	
Conflict	.38	.44	.33	.37

In the English university student sample, the correlations between the Internet addiction components varied between being weak (r = .25) for relapse and salience, moderate, and strong (r = .69) for withdrawal and tolerance, demonstrating their association. The correlations between the AICA-S Internet addiction components are presented in Table 5.

Table 5

Correlation Matrix for AICA-S Internet Addiction Components

	Salience	Withdrawal	Tolerance	Mood modification	Relapse
Withdrawal	.49				
Tolerance	.53	.69			
Mood modification	.35	.48	.55		
Relapse	.25	.34	.40	.37	
Conflict	.30	.39	.42	.42	.37

Overall, for both Internet addiction measures, the Internet addiction components model was a good fit to the data, where CFI and TLI ≥ .95, RMSEA < .07, and WRMR ≥ 1 indicate excellent fit (Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999; Steiger, 2007; Yu, 2002). In S1, model fit was excellent (X^2 (5) = 6.33, *ns*; CFI = .999, TLI = .999, RMSEA = .009, WRMR = .347). In S2, model fit was acceptable (X^2 (9) = 121.37, $p < .01$; CFI = .984, TLI = .973, RMSEA = .074, WRMR = 1.281). The RMSEA value was marginally higher than a previously suggested optimal score (Hooper et al., 2008; Hu & Bentler, 1999). A number of researchers have indicated that numerical cut-off points for model fit indices are arbitrary and should be viewed more flexibly in light of the respective models and data (Hayduk & Glaser, 2000; Steiger, 2000). The value for the weighted root-mean-square residual (WRMR) deviates marginally from the estimated excellent fit, ≥ 1 (Yu, 2002). As the fit statistic WRMR is experimental and research on it is still in its infancy, its developers contend that if all other fit indices are good, WRMR does not need to be used (Muthén, 2012).

DISCUSSION

The Internet addiction components model as based on the addiction components model of Griffiths (2005) presented in this paper showed good fit to the data of two

independent samples using two validated assessment instruments. Salience, withdrawal, mood modification, relapse and conflict loaded highly on the Internet addiction components factor using the Compulsive Internet Use Scale (Meerkerk et al., 2009) in a large sample of Dutch adolescents. However, the CIUS does not include an item assessing tolerance to using the Internet. In their original article, Meerkerk and colleagues (2009) stated that in a previous qualitative study, they had found that this component did not appear to be an integral characteristic of compulsive Internet use. From the present data, it is unclear whether the addition of tolerance as addiction component would have changed the model in any way. In this regard, conclusions about disregarding tolerance as key addiction component appear premature as research indicates that tolerance can demarcate individuals who regularly engage in addictive behaviours from individuals who do not. Results from a psychophysiological study measuring gamblers' heart rates (Griffiths, 1993) indicated that tolerance was present among regular gamblers compared to non-regular gamblers. Griffiths demonstrated that arousal levels among regular gamblers (as measured by heart rates) decreased immediately upon cessation of gambling compared to non-regular gamblers whose arousal levels remained elevated. This finding can explain why regular gamblers need to gamble more frequently and faster compared to non-regular gamblers in order to maintain the initial level of excitement and psychophysiological rush. This evidence suggests that tolerance is a component of pathological gambling and may thus be similarly relevant as Internet addiction symptom. Internet users may become habituated to Internet use over time, and may need increased exposure to experience the same pleasurable effects.

A recent review of online game addiction surveys concluded that tolerance (when operationalized as spending more time gaming to affect one's feelings (as does the AICA-S) in contrast to spending more time without a reason), seemed indeed to be a component of online gaming addiction (Hellman, Schoenmakers, Nordstrom, & Van Holst, 2012). On the other hand, spending more time online might be something different than physiological

habituation reactions, which could be indicators of loss of control. Nevertheless, in the present study, the evidence in favour of including tolerance as key Internet addiction component is limited as tolerance has only been assessed in one of the two studies. Given the parallels between different types of addiction, future research should aim to further investigate the role of tolerance in Internet addiction.

In terms of model fit, the predictive power of salience, withdrawal, tolerance, mood modification, relapse and conflict was acceptable in explaining the Internet addiction components model using the Assessment for Internet and Computer Gaming Addiction Scale (Wölfling et al., 2010) in a large sample of English university students. All of Griffiths' items contributed significantly to explaining the Internet addiction components factor. Once the model is validated in clinical samples and tested for sensitivity and specificity, it may be similarly useful in highlighting individuals at risk for developing Internet addiction or addictive Internet behaviours. Moreover, the results of the correlation analyses indicate that both measurement instruments assess the Internet addiction components that constitute a valid construct with acceptable reliability.

The results of this study show that the addiction components model is useful for assessing potential Internet addiction using two distinct scales applied to two separate samples, making a strong claim in favour of the parsimonious model for psychometric (pre-) diagnostic evaluation of potential Internet addiction. The usefulness of the addiction components model for possible Internet addiction has implications for the assessment of problematic Internet use in different populations, notably adults and adolescents, as well as residents in different European countries. Ultimately, the applicability of the addiction components model to yet another behavioural addiction suggests that the syndrome model of addictions as proposed by Shaffer et al. (2004) is viable. It has to be noted however that Shaffer et al. (2000) concede that researchers and treatment providers need to be cautious and

rigorous when studying and treating excessive Internet and computer use particularly as Internet addiction used to be poorly defined and thus suffered from problems regarding construct validity. In light of this, using Griffiths' (2005) components model to discern the integral elements of possible Internet addiction and testing how they apply across currently used measurement instruments appears as a step forward in research on problematic Internet behaviours.

In this study, the English university students were more likely to endorse the Internet addiction components frequently relative to the Dutch adolescents. This could indicate that (i) symptoms were present more frequently, (ii) university students subjectively experienced their symptoms to be present more frequently than adolescents, or that (iii) adolescents do not recognise their behaviours as being problematic. With regards to (i) and (ii), the subjective experience of symptoms appears to be an important indicator of psychopathology because individuals are the best judge of the extent to which their addiction impacts upon their life (Larkin & Griffiths, 2002). Also, as both studies used convenience samples, differences may be caused by random factors instead of real differences in the respective populations. Concerning (iii), adolescents' cognitive control capabilities related to impulse control, foresight, and resistance to peer pressure may not have fully developed (Andrews-Hanna et al., 2011), indicating that the adolescents may lack introspective ability to comprehend potentially problematic Internet usage.

A number of limitations require mentioning. Self-report instruments were used in order to assess potential Internet addiction, which may decrease the validity of achieved classifications (i.e., in some cases, self-reports may be prone to deception and self-serving biases). A self-report can never suffice for diagnosing Internet psychopathology (Beard, 2005). Nevertheless, the choice of self-report measures has a number of advantages, which pay tribute to their widespread usage and scientific acceptability. These include practicality

(ease of administration and cost-effectiveness), interpretability, and information richness. Typically it is assumed that the individual is the best person to be a judge of him- or herself (Paulhus & Vazire, 2009).

Moreover, it has to be conceded that only one item per component has been included in the present study. The respective items were chosen as they fit Griffiths' (2005) initial description of the respective components most appropriately. However, future research has to assess the extent to which the used items reflect broader psychological problems, maladaptive coping styles and boredom. Unless there is strong evidence of a pathological loss of control over behaviour or strong /uncontrollable urges, the utilised items have to be understood as indicators of potential addiction, not clear-cut psychopathology. Otherwise, soft and liberal interpretations could lead to many behaviours being classified as addictions and this is highly questionable and underscores present concerns about the validity and possibly over-pathologising nature of the new DSM-5 classifications.

In addition to this, the procedures in the two studies differed. In S1, pen-and-paper questionnaires were distributed, whereas in S2, participants were asked to fill in online questionnaires. It has been argued that online, participants tend to be more honest and therefore their answers appear to have higher validity relative to offline (Griffiths, 2010). If this were the case, the higher endorsements of each one of the Internet addiction components in the university students who filled in the survey online may indicate that the endorsement in the adolescent group may have been underestimated due to contextual factors, such as social desirability and relative lack of anonymity. In order to verify this conjecture, the study requires replication assessing the different groups with online versus offline surveys which will allow for comparisons to be made.

Moreover, there appeared differences in measurement and sampling between the two studies. Specifically, the different modes of data collection have a potential for selection and

response bias, including the provision of a lottery reward motive for participation in the one sample. This is a potential limitation and should be addressed in future studies.

Also, it is possible that an alternative model would have an even better fit to the data. This preliminary study used two data sets and two measurements. A replication study is needed with a community based sample, using the same sample structure (i.e., items) to see whether or not the data shows a good model fit and whether or not a more (theoretically driven, maybe more parsimonious) model could explain the data even better. Moreover, the samples utilised in this study are different with regards to both age group as well as national residence. This may have decreased the comparability of results. Nevertheless, the analyses showed that both measures utilised in order to assess Internet addiction were comparable as the data from both samples provided a good fit to the Internet addiction components model. In addition to this, prevalence rates were comparable with 3.2% and 3.7% between samples. Ultimately, viewing Internet addiction from the perspective of the Internet addiction components model as based on Griffiths' (2005) initial framework appears valid as two questionnaires using two independent samples provide empirical evidence for it.

The present research has implications for research and clinical practice in the field of addictive disorders. This research suggests that problematic Internet use may be comparable to behavioural addictions as it fulfils traditional addiction criteria, including salience, mood modification, tolerance, withdrawal, conflict and relapse. It has also shown that two independent scales for the assessment of Internet addiction can be significantly reduced and still retain a stable one-factor solution, which evidences the applicability of Griffiths' addiction components model (2005) to popular Internet addiction measures. Over the last decade, the addiction components model has formed the basis for instruments measuring exercise addiction (Griffiths et al., 2005), shopping addiction (Clark & Calleja, 2008), gaming addiction (Lemmens et al., 2009), work addiction (Andreassen, Griffiths, et al., 2012), and

social networking addiction (Andreassen, Torsheim, et al., 2012). The results of the present analysis confirm that the model has utility in assessing the theoretical Internet addiction components factor, without making claims about the fundamental addictive mechanisms underlying the behaviour or symptomatology as this was not the aim of the present paper.

In terms of clinical practice, treating addiction as a syndrome implies that therapy approaches focusing on behavioural disorders such as problematic Internet use may profit from the wide array of knowledge that exists in the domain of evidence based treatment for substance related addictions (Glasner-Edwards & Rawson, 2010). However, at present, treatment facilities and organisational health care structures appear to offer insufficient professional support for adolescents and adults suffering from addictions (McLellan & Meyers, 2004). The reported presence of potentially addictive Internet use in the samples presented here throws light on a ubiquitous problem and indicates that prevention efforts should commence from an early age and it calls for a system supportive of those in need. This is particularly important for activities which theoretically do not have an age limit (i.e., the Internet or computers are being used by children in schools from an early age (Gray, Thomas, & Lewis, 2010)), possibly even from when they commence formal schooling.

Regarding recommendations for future research, it appears useful to study the Internet addiction components model using the CIUS including an item assessing tolerance. Tolerance is an integral criterion for both, substance dependence as well as pathological gambling in the current version of the *DSM* (American Psychiatric Association, 2000) and has been implicated in a number of prominent addiction models, such as the opponent process theory (Solomon, 1980), hedonic homeostatic dysregulation, and reward allostasis (Koob & Le Moal, 1997, 2001), as well as in experimental studies (i.e., Griffiths, 1993). It remains to be seen in how far the exclusion of tolerance in the CIUS is conducive to a potential review of criteria.

CONCLUSION

In this study, excessive Internet use was found to be a problem for a minority of adolescents and young adult university students. The AICA-S and the CIUS measured Internet addiction following the employed Internet addiction components framework well. Both instruments are grounded in substance dependence and pathological gambling criteria as set forth by the American Psychiatric Association (2000) and thus follow the same framework. The APA's reclassification of *Substance Use Disorders* into *Addiction and Related Disorders* (American Psychiatric Association, 2013) calls for a unitary addiction framework which can explain initiation and maintenance of both substance related and behavioural addictions and which views both from a disease framework (Kuss, 2012). Based on this preliminary study, it appears that Griffiths' (2005) addiction components explains possible Internet addiction as operationalized by the questionnaires comprehensively, precisely and parsimoniously, and therefore emphasise that Internet use-related problems can be assessed using a parsimonious framework. In sum, the two sample/two instrument approach provides converging evidence concerning the degree to which the components model can organize the self-reported behavioural components of Internet addiction.

Declaration of Interest

The authors report no conflicts of interest.

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