



Internet addiction in adolescents: Prevalence and risk factors



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ABSTRACT

As new media are becoming daily fare, Internet addiction appears as a potential problem in adolescents. From the reported negative consequences, it appears that Internet addiction can have a variety of detrimental outcomes for young people that may require professional intervention. Researchers have now identified a number of activities and personality traits associated with Internet addiction. This study aimed to synthesise previous findings by (i) assessing the prevalence of potential Internet addiction in a large sample of adolescents, and (ii) investigating the interactions between personality traits and the usage of particular Internet applications as risk factors for Internet addiction. A total of 3105 adolescents in the Netherlands filled out a self-report questionnaire including the Compulsive Internet Use Scale and the Quick Big Five Scale. Results indicate that 3.7% of the sample were classified as potentially being addicted to the Internet. The use of online gaming and social applications (online social networking sites and Twitter) increased the risk for Internet addiction, whereas extraversion and conscientiousness appeared as protective factors in high frequency online gamers. The findings support the inclusion of 'Internet addiction' in the DSM-V. Vulnerability and resilience appear as significant aspects that require consideration in further studies.

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1. Introduction

With the availability and mobility of new media, Internet addiction has emerged as a potential problem in young people. Based on a growing research base (Young, 2010), the American Psychiatric Association aims to include *Internet Use Disorder* in the appendix of the upcoming fifth edition of the Diagnostic and Statistical Manual for Mental Disorders (2012) for the first time, acknowledging the problems arising from this type of addictive disorder. Adolescents appear to be a population at risk for developing Internet addiction (Leung, 2007) due to variability in developing their cognitive control (Casey, Tottenham, Liston, & Durston, 2005) and boundary setting skills (Liu & Potenza, 2007).

With regards to prevalence of Internet addiction in adolescents, estimates vary widely across countries. Using Young's Internet Addiction Test (1999), 1.5% of Greek (Kormas, Critselis, Janikian, Kafetzis, & Tsitsika, 2011) and 1.6% of Finnish adolescents (Kaltiala-Heino, Lintonen, & Rimpela, 2004) were found to be addicted to using the Internet. Using a modified version of the Minnesota Impulsive Disorders Inventory, 4% of US high school were identified as addicted to using the Internet (Liu, Desai, Krishnan-Sarin,

Cavallo, & Potenza, 2011). Higher prevalence rates have been reported in South East Asian countries (e.g., Taiwan, Singapore, South Korea and China). For example, using Young's Internet Addiction Test (1998a) 8% of adolescents in China (Cao, Sun, Wan, Hao, & Tao, 2011) and 10.7% of adolescents in South Korea (Park, Kim, & Cho, 2008) were found to be addicted to using the Internet. In comparison and unsurprisingly, prevalence estimates in youth psychiatric settings are reported to be considerably higher. For instance, the prevalence of Internet addiction among minors using the Assessment of Internet and Computer Game Addiction Scale (Wölfling, Müller, & Beutel, 2010) was found to be 11.3% in Germany (Müller, Ammerschläger, Freisleder, Beutel, & Wölfling, 2012), and assessed via the Internet Addiction Test (Young, 1998b), 11.6% of adolescent outpatients in Latin America were classed as being Internet addicts (Liberatore, Rosario, Colon-De Marti, & Martinez, 2011). A detailed outline of the reported studies can be found in Table 1.

Overall, in the reported studies to date, a variety of measurement instruments have been used that do not allow for a clear-cut and comparable estimation of Internet addiction prevalence in both adolescent and adult populations. Therefore, there is a need for utilising actual clinical criteria in order to demarcate potentially pathological (i.e., addictive) behaviours from high-engagement behaviours that appear to be linked to a number of

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Table 1

Overview of prevalence studies of internet addiction in adolescents.

Study	Aim	Sample and country	Design	Internet addiction measures	Prevalence
Kormas et al. (2011)	To assess the determinants and psychosocial implications associated with potential problematic Internet use (PIU) and PIU among adolescents	N = 866 randomly selected adolescents in Greece (mean age = 14.7 years)	Cross-sectional pen-and-paper questionnaire study	Young's Internet Addiction Test (Young, 1999), scoring >50/100 indicates addiction	1.5% with problematic Internet use
Kaltiala-Heino et al. (2004)	To assess the prevalence of features suggesting a harmful Internet use among 12–18 year-olds in Finland	N = 7292 representative of adolescents in Finland (4 age groups, mean ages = 12.6, 14.6, 16.6 and 18.6 years)	Cross-sectional postal survey	Pathological gambling criteria (addicted when 4/7 criteria met)	1.6% addicted
Liu et al. (2011)	To explore the prevalence and health correlates of problematic Internet use among high school students in the United States	N = 3,560 high school students in USA (age range = 14–18 years)	Cross-sectional pen-and-paper survey	Modified Minnesota Impulsive Disorder Inventory (Grant et al., 2005), endorsing craving, withdrawal, and abstinence attempts simultaneously indicates problematic Internet use	4% With problematic Internet use
Cao et al. (2011)	To investigate the prevalence of problematic Internet use (PIU) and its relationships with psychosomatic symptoms and life satisfaction among adolescents in mainland China	N = 17,599 adolescents in China sampled via stratified cluster sampling in schools (mean age = 16.1 years)	School-based cross-sectional survey	Young's Internet Addiction Test (Young, 1999), scoring >50/100 indicates addiction	8.1% With problematic Internet use
Park et al. (2008)	To explore relations between risk and protective factors and Internet addiction adolescents in South Korea	N = 903 middle and high school students in South Korea (60.5% middle school seniors, 39.5% high school students (12.4% freshmen, 27.1% juniors)) randomly selected from schools in Seoul	Cross-sectional pen-and-paper survey	Modified Young's Internet Addiction Scale (IAS) (1998a), scoring ≥70 indicates addiction	10.7% Addicted
Müller et al. (2012)	To explore Internet addiction prevalence in a clinical context in Germany	N = 81 child and adolescent psychiatric patients in Germany (mean age = 13.6 years)	Cross-sectional pen-and-paper questionnaire	Assessment of Internet and computer game addiction scale (Wölfling et al., 2010), scoring >7/15.5 indicates addiction	11.3% Addicted
Liberatore et al. (2011)	To study the prevalence of Internet addiction in adolescents receiving treatment for a diagnosed psychiatric illness	N = 71 adolescent outpatients in Puerto Rico, Latin America (age range = 13–17 years)	Cross-sectional pen-and-paper questionnaire	Internet Addiction Test (Young, 1998a), scores ≥80/100 indicate addiction	11.6% Addicted

personality traits in addicted Internet users (Charlton & Danforth, 2010). In this study, clinical criteria for Internet addiction will be adopted, which will provide an indication of potential Internet addiction assessed via self-report (Meerkerk, Van Den Eijnden, Vermulst, & Garretsen, 2009). The criteria are based on the official diagnoses of substance dependence and pathological gambling (American Psychiatric Association, 2000) and are planned to be integrated in the proposed addition to the updated DSM, *Internet Use Disorder* (American Psychiatric Association., 2012). Accordingly, *Internet addiction* as adopted in this paper does not refer to a clinical diagnosis, but to a potentially pathological behavioural pattern. It is denoted by the presence of the following symptoms: (i) a loss of control over the behaviour, (ii) conflict (internal and interpersonal), (iii) preoccupation with the Internet, (iv) using the Internet to modify mood, and (v) withdrawal symptoms (Meerkerk et al., 2009).

From the perspective of the engagement in specific online activities, rather than focusing on Internet addiction per se, researchers have now identified a number of activities that can be engaged in excessively online that may lead to symptoms similar to substance-related addictions (Yellowlees & Marks, 2007). Among these, excessive online gaming (Kuss & Griffiths, 2012a), excessive online gambling (Griffiths & Parke, 2010), and the use of social media (van den Eijnden, Meerkerk, Vermulst, Spijkerman, & Engels, 2008), such as online social networks (SNSs) (Kuss & Griffiths, 2011) appear to stand out. Their increasing diversity and usage growth among young populations (Entertainment Software Association., 2012; Lenhart, Purcell, Smith, & Zickuhr, 2012) is mirrored by the rising number of treatment studies (King, Delfabbro, Griffiths, & Gradisar, 2011; Liu, Liao, & Smith, 2012).

Research and clinical practice suggest that the concept of Internet addiction is not to be taken lightly as a number of negative

consequences of excessive Internet use in adolescents have been identified in the literature. For instance, a recent review of the neuroscientific evidence (Kuss & Griffiths, 2012c) indicates that Internet addiction in adolescence can have a negative impact on identity formation (Kim et al., 2012) and change the structure of the developing brain (Lin et al., 2012; Yuan et al., 2011). In addition to this, it may negatively affect cognitive functioning (Park et al., 2011), lead to poor academic performance and engagement in risky activities (Tsitsika et al., 2011), poor dietary habits (Kim et al., 2010), low quality of interpersonal relations (Milani, Osualdella, & Di Blasio, 2009), and self-injurious behaviour (Lam, Peng, Mai, & Jing, 2009) in adolescents. From the reported negative consequences, it appears that Internet addiction can have a variety of detrimental psychosocial and physical outcomes for adolescents that may require professional intervention (King, Delfabbro, & Griffiths, 2012).

In addition to this, Internet addiction appears to be comorbid with clinical disorders and premorbid symptoms. In adolescents, Internet addiction has been reported to be comorbid with depression and insomnia (Cheung & Wong, 2011), suicidal ideation (Fu, Chan, Wong, & Yip, 2010), attention-deficit hyperactivity disorder, social phobia, and hostility (Ko, Yen, Chen, Yeh, & Yen, 2009), schizophrenia, obsessive-compulsive disorder (Ha et al., 2006), aggression (Ko, Yen, Liu, Huang, & Yen, 2009), drug use (Gong et al., 2009), and problematic alcohol use (Ko et al., 2008a). These comorbidities may be suggestive of a bidirectional causality relationship and similar etiology (Ko, Yen, Chen, Chen, & Yen, 2008b; Mueser, Drake, & Wallach, 1998), and increased severity of psychopathology relative to a single presenting mental health problem (de Graaf, Bijl, Spijker, Beekman, & Vollebergh, 2003). In light of this, Internet addiction in adolescents cannot be dismissed as a transitory phenomenon that will take care of itself.

Instead, it appears important to establish and explore a diagnosis that may prove beneficial for young populations who experience similar and related problems (King, Delfabbro, Griffiths, & Gradisar, 2012).

The personality traits that distinguish addicted gamers from high engagement gamers are reported to be negative extraversion (i.e., introversion), emotional stability, agreeableness, negative valence (indicated by being demanding, needy, and eager to impress), and attractiveness (characterised by care about appearance, being well groomed, neat and efficient, and highly motivated) (Charlton & Danforth, 2010). Other research has indicated that online gaming addiction may be related to neuroticism, anxiety, and sensation seeking (Mehroof & Griffiths, 2010). Apart from online gaming, research indicates that adolescent Internet addicts score significantly lower on extraversion compared to non-addicted adolescents (Huang et al., 2010), have low emotional stability, low extraversion, and low agreeableness (van der Aa et al., 2009). In summary, low emotional stability, low agreeableness, and low extraversion seem convincing candidates for increasing the risk of Internet addiction as these associations are found in multiple studies. However, to date, no study has investigated the interactions between personality and different types of potentially problematic Internet usage in increasing the risk for being addicted to using the Internet. Assessing the interactions between these variables may allow discerning both risk as well as protective factors for Internet addiction in adolescents who use the Internet frequently. Specifically, the identification of characteristics that demarcate frequent users who develop addiction symptoms from frequent users who do not may prove beneficial with regards to prevention and treatment. Behaviours and cognitions associated with the preventive character traits in the risk groups (i.e., high frequency users of specific Internet applications) can be established and maintained.

With this study, it is aimed to fill the gap in knowledge in current research by (i) assessing the prevalence of Internet addiction in a large sample of adolescents, and (ii) for the first time exploring the interactions between personality traits and the usage of particular Internet applications as risk factors for Internet addiction. Based on previous research, the hypotheses are that (i) using online applications that enable social functions (i.e., SNSs, chatting, instant messaging, and *Twitter*) and online gaming, and (ii) specific personality traits (i.e., low emotional stability, low agreeableness, and low extraversion) increase the risk for being addicted to the Internet, and (iii) there exist interaction effects between the usage of specific Internet applications and personality traits in elevating or decreasing the chances of Internet addiction, the precise nature of which still needs to be determined.

2. Materials and methods

2.1. Design

In this study, the 2011 subsample of the annual Monitor study “Internet and Youth” (Eijnden, Spijkerman, Vermulst, van Rooij, & Engels, 2010) which specifically assesses Internet usage behaviours among adolescents was utilised, including 3173 adolescents from 13 schools in the Netherlands. The Monitor study uses school sampling stratified according to region of the school, urbanisation, and education level. A total of 3756 questionnaires were distributed in participating classes with an overall response rate of 84%. Response rate varied mainly due to logistics, such as entire classes dropping out due to teacher absence or delay within school logistics. Of the questionnaires distributed, 3105 were valid (i.e., students provided answers for most questions) and were used in the present study.

2.2. Sample

The data of a total of 3105 Dutch adolescents (aged 11–19 years, $M = 14.2$, $SD = 1.1$ years) were used in this study. The sample characteristics are presented in Table 2.

In terms of gender distribution, 51.7% of the adolescents were females and an overwhelming majority of the participants were born in the Netherlands (96.5%). In terms of school level, 45.8% of adolescents participated in VMBO (“voorbereidend middelbaar beroepsonderwijs”, i.e., pre-professional education that incorporates ages 12–16), and 54.2% were in HAVO/VWO (“hoger algemeen voortgezet onderwijs”/ “voorbereidend wetenschappelijk onderwijs”, i.e., higher general and pre-university education including ages 12–18).

2.3. Materials

A paper-and-pencil survey was used that included sections on (i) sociodemographic information, (ii), Internet use, (iii) Internet addiction, and (iv) personality traits.

2.3.1. Sociodemographics

In this section, general sociodemographic information was inquired about, including questions about gender, date and country of birth, weight and height, and level of schooling.

2.3.2. Internet use

In the section on Internet use, adolescents were asked to state how frequently and where they used the Internet and whether they are supervised when using it. In addition to this, the following Internet application uses were inquired about in terms of days per week and hours per day: instant messenger (e.g., MSN), e-mail, surfing, *Twitter*, chat, social networking sites, forums, *Habbo Hotel*, weblogs, *YouTube*, online poker, downloading, television and radio live streaming, as well as online, offline, and browser games. For these variables, usage hours per week were calculated in order to provide a more detailed and elaborated picture of overall usage.

2.3.3. Internet addiction

In order to assess Internet addiction, the Compulsive Internet Use Scale (CIUS) (Meerkerk et al., 2009) was employed. It is a 14-item unidimensional self-report questionnaire rated on a 5-point ordinal scale (ranging from 0 = ‘never’ to 4 = ‘very often’) that enquires into the following addiction symptoms: loss of control, pre-occupation (cognitive and behavioural), withdrawal symptoms, coping/mood modification, and conflict (inter- and intrapersonal). Total scores were calculated by summing up scores for each question. These criteria are based on the DSM-IV TR diagnoses for substance dependence and pathological gambling (American Psychiatric Association, 2000). The CIUS was marginally adjusted for the usage in the present Dutch adolescent population, as previously used in other studies (van Rooij, Schoenmakers, van de Eijnden, & van de Mheen, 2010).

At present, no definitive cut-off value for the CIUS has been established. However, using the CIUS in two adolescent samples, van Rooij, Schoenmakers, Vermulst, van den Eijnden, and van de Mheen (2011) located a group addicted to playing online games. A latent class analysis of CIUS scoring patterns found a mean score on each indicator in the highest group of 2.8 in one sample and 2.9 in the second sample (van Rooij et al., 2011). This translated to a total score of around 28, given these item scores. Based on van Rooij et al.’s study, Rumpf and colleagues adopted a minimum score of 28 out of a possible total of 56 that may be indicative of psychopathology and thus demarcates potential addiction from high engagement, and this cut off point will be used here (Rumpf, Meyer, Kreuzer, & John, 2011). In terms of the psychometric

Table 2

Sociodemographics of total sample and subsamples of not addicted and addicted adolescents.

Adolescents (N = 3,105)	N	Percent of total	Not addicted (n)	Percent of total	Addicted (n)	Percent of total	Overall test
<i>Age (years)</i>							
Mean (SD)	14.23 (1.07)		14.24 (1.08)		14.02 (1.00)		
11 years	2	0.1	2	0.1	0	0	
12 years	40	1.4	37	1.3	3	0.1	
13 years	725	25.2	696	24.2	29	1.0	
14 years	1061	36.9	1011	35.2	50	1.7	
15 years	721	25.1	700	24.4	21	0.7	
16 years	244	8.5	241	8.4	3	0.1	
17 years	65	2.3	63	2.2	2	0.1	
18 years	14	0.5	13	0.5	1	0	
19 years	2	0.1	2	0.1	0	0	FET = 13.76
<i>Sex</i>							
Male	1501	48.3	1431	46.5	51	1.7	
Female	1604	51.7	1534	49.8	62	2.0	$\chi^2 = 0.43$
<i>School level^a</i>							
VMBO	1410	45.8	1340	43.5	70	2.3	
HAVO/VWO	1668	54.2	1625	52.8	43	1.4	$\chi^2 = 12.31^*$
<i>Country of birth</i>							
Netherlands	2951	96.5	2843	93.0	108	3.5	
Suriname	5	0.2	5	0.2	0	0	
Netherlands Antilles	6	0.2	6	0.2	0	0	
Aruba	1	0	1	0	0	0	
Turkey	3	0.1	3	0.1	0	0	
Marokko	5	0.2	5	0.2	0	0	
Indonesia	2	0.1	2	0.1	0	0	
Other	85	2.8	80	2.6	5	0.2	FET = 16.22

Note 1: Abbreviations. FET = Fisher's exact test.

Note 2: A respondent is classified as "addicted user" when they scored >27 on the CIUS.

Note 3: Due to missing values, the sum total of participants may not equal 2257 for each variable analysed.

* $p < .01$.^a VMBO and HAVO/VWO refer to pre-professional education (ages 12–16), higher general and pre-university education (ages 12–18), respectively.

qualities of the CIUS, its construct and concurrent validity, temporal and factorial stability/invariance, and internal consistency have been proven to be good (Meerkerk et al., 2009). In the present analysis, the internal consistency of the CIUS was found to be excellent with Cronbach's $\alpha = .88$ (Cronbach, 1951).

2.3.3.1. Risk. In this context, the definition for Internet addiction risk was defined as the probability of addiction for a person possessing a particular personality trait and/or using a specific application of the Internet relative to a person who does not have the trait and/or does not use the specific application. In contrast to that, a risk ratio refers to the event of addiction relative to the risk of addiction, and can therefore reach a maximum of 1 (Sistrom and Garvan, 2004).

2.3.4. Personality measure

Personality was assessed using the short self-report measure Quick Big Five (QBF) (Vermulst & Gerris, 2009) that was based on Goldberg's personality markers (1992). It measures the big five personality traits extraversion, agreeableness, conscientiousness, emotional stability, and resourcefulness via 30 questions (six per trait) scored on a 7-point ordinal scale (ranging from 1 = 'is not completely correct' to 7 = 'is exactly correct'). Total scores were calculated by summing up the relevant response scores per personality trait. Overall, the internal consistency of the respective subscales was good, with a Cronbach's α of .86 for extraversion, .84 for conscientiousness, .81 for agreeableness, .82 for emotional stability, and .75 for resourcefulness.

2.4. Statistical analyses

For the analyses, adolescents classed as addicted to using the Internet and those who were not were compared with regards to

(i) the frequency of their Internet usage, (ii) the location of usage, and (iii) their CIUS scores using independent samples *t*-tests, assuming unequal variances when group sizes were unequal as indicated by significant Levene's tests, and chi-squared (χ^2) tests in the case of categorical outcomes. For the main analyses, the assumptions of linearity, independence of errors, and multicollinearity of the relevant variables were checked. Response patterns for the CIUS were checked in order to ensure adequate variability of responses were found. In addition to this, continuous predictors were centred at their mean by subtracting mean scores from the observed values to eliminate potential collinearity problems (Aiken & West, 1991). Next, a logistic regression analysis using the backward LR method was used including all personality traits and the following Internet applications: MSN, Twitter, chat, SNS, and online games, with Internet addiction status as binary outcome variable (i.e., the dependent variable was addicted versus non-addicted). The significant predictors were then entered into a model containing interaction effects. The final model presents all significant interactions and relevant main effects. In order to follow-up the interactions in more detail, linear regression analyses per group (addicted and non-addicted) and simple effects analyses were performed. For all analyses, only significant results are reported.

3. Results

Response pattern analysis revealed a total of 2457 different response patterns in the data for the CIUS, indicating a good variability in CIUS scores. When analysing the response pattern in more detail, 191 participants answered "never" to all items, and "seldom", "sometimes", "often" and "very often" were endorsed on all items by one participant each. In terms of Internet use, results indicated that nearly all adolescents (99.8%) used the Internet at

home or in school. In 44.9% of cases, Internet activities were not generally supervised at home, compared to a 10.2% lack of Internet supervision at school. Furthermore, 3.7% (95% CI [3.0, 4.4]) of the adolescents in this sample were classified as potentially addicted to using the Internet. In terms of sociodemographic variables, Internet addicts differed significantly from non-addicts with regards to their school level, with adolescents at VMBO being significantly more likely to be in the addicted group relative to the HAVO/VWO students ($X^2(1) = 12.31, p < .01$). More specifically, 5% of VMBO students were identified as potentially addicted to using the Internet, in comparison to only 2.6% of the HAVO/VWO students.

As presented in Table 3, compared to non-addicted adolescents, addicted adolescents used the Internet for significantly more days per week ($M = 6.67, SD = 0.74$ vs. $M = 5.83, SD = 1.55$; $t(149.97) = -10.95, p < .01$), and significantly more hours per day ($M = 4.33, SD = 1.34$ vs. $M = 2.96, SD = 1.38$; $t(2782) = -8.86, p < .01$). In addition to this, the groups differed significantly with regards to where they used the Internet, with addicted adolescents using it more often in the kitchen ($X^2(1) = 4.47, p < .05, 25.7\%$ vs. 17.9%), via WiFi ($X^2(1) = 6.20, p < .01, 65.5\%$ vs. 53.6%) and via their mobile phones ($X^2(1) = 16.50, p < .01, 44.2\%$ vs. 26.9%). Finally, the addicted adolescents scored significantly higher on the CIUS ($M = 33.37, SD = 5.66$) than non-addicted adolescents ($M = 8.82, SD = 6.65$; $t(124.10) = 44.97, p < .01$).

The final model including the significant interactions and relevant main effects of Internet application usage and personality traits as presented in Table 4 predicted Internet addiction status significantly ($X^2(10) = 148.16, p < .001$) and explained 23% of the variance in Internet addiction (Nagelkerke's $R^2 = .23$). In terms of personality traits, agreeableness was the strongest predictor of Internet addiction ($b = -.109, \text{Wald } X^2(1) = 13.00, p < .001$). Moreover, every unit increase in agreeableness decreased the odds of being addicted to using the Internet by 10.3%. Addicted adolescents scored significantly lower on agreeableness ($M = 30.53, SD = 4.80$) than non-addicted adolescents ($M = 33.12, SD = 4.85$; $t(2823) = 5.45, p < .001$).

The next personality trait predictive of Internet addiction was emotional stability ($b = -.089, \text{Wald } X^2(1) = 17.12, p < .001$). Every unit increase in emotional stability decreased the odds of being addicted to the Internet by 8.5%. Addicted adolescents scored significantly lower on emotional stability ($M = 24.48, SD = 7.23$) than non-addicted adolescents ($M = 29.49, SD = 6.58$; $t(2876) = 7.66, p < .001$). The third personality trait to predict Internet addiction significantly was resourcefulness ($b = .062, \text{Wald } X^2(1) = 6.34, p < .05$). Every unit increase in resourcefulness score increased the odds of being addicted to the Internet by 6.4%. Finally, consci-

entiousness significantly predicted Internet addiction ($b = -.042, \text{Wald } X^2(1) = 4.45, p < .05$). Every unit increase in conscientiousness score decreased the odds of being addicted to the Internet by 4.1%. Addicted adolescents scored significantly lower on conscientiousness ($M = 23.64, SD = 6.21$) than non-addicted adolescents ($M = 25.91, SD = 7.04$; $t(114.46) = 3.65, p < .001$).

In terms of the respective online applications, the use of the social applications *Twitter* ($b = .026, \text{Wald } X^2(1) = 16.16, p < .001$) and social networking sites ($b = .031, \text{Wald } X^2(1) = 18.06, p < .001$) significantly predicted Internet addiction. Every additional hour of weekly *Twitter* and SNS use increased the odds of being addicted to the Internet by 2.6% and 3.2%, respectively. Compared to non-addicted adolescents, addicted adolescents spent significantly more hours per week on *Twitter* ($M = 15.32, SD = 22.12$ vs. $M = 4.95, SD = 12.67$; $t(111.71) = -4.89, p < .01$), and SNS ($M = 22.10, SD = 20.34$ vs. $M = 9.12, SD = 11.65$; $t(111.70) = -6.65, p < .01$).

Furthermore, the use of online games significantly predicted Internet addiction ($b = .022, \text{Wald } X^2(1) = 6.47, p < .05$). Every additional weekly hour playing online games increased the odds of being addicted to the Internet by 2.3%. Addicted adolescents played online games for significantly more hours per week ($M = 11.31, SD = 17.72$) than non-addicted adolescents ($M = 3.68, SD = 9.38$; $t(114.43) = -4.55, p < .01$).

In addition to the predictive main effects, two interactions appeared significant. First, the interaction between weekly online gaming hours and extraversion predicted Internet addiction ($b = -.003, \text{Wald } X^2(1) = 6.82, p < .01$), and decreased the odds of being addicted to the Internet by 0.3%. Following up the significant interactions with linear regression analyses in the different groups indicated that in the addicted group, extraversion did predict the extent of online gaming ($b = -.436, F(1) = 5.12, p < .05$), whereas in the non-addicted group it did not ($b = -.003; F(1) = 0.01, ns$).

Secondly, the interaction between weekly online gaming hours and conscientiousness predicted Internet addiction ($b = .003, \text{Wald } X^2(1) = 6.14, p < .05$), and increased the odds of being addicted to the Internet by 0.3%. Following up the significant interactions with linear regression analyses in the different groups indicated that in the addicted group, conscientiousness did not predict the extent of online gaming ($b = .198; F(1) = .51, ns$), whereas in the non-addicted group, it did ($b = -.140; F(1) = 31.76, p < .001$).

4. Discussion

In the present research, the risk for Internet addiction in a large sample of Dutch adolescents was investigated by looking at the interplay between personality traits and the usage of different Internet applications. Using a validated self-report measure (Meerkerk et al., 2009), it was found that 3.7% of the adolescents included were classified as addicted to using the Internet. This appears to be at the more conservative end of estimates that range from 1.5% in Greece (Kormas et al., 2011) to 10.7% in South Korea (Park et al., 2008). Using a conservative threshold with the CIUS, it was possible to establish a cut-off indicative of Internet addiction as based on this validated and frequently used self-report measure. Nevertheless, it needs to be noted that in the reported studies, different measurement tools have been used which makes it difficult to compare prevalence rates across questionnaires.

In this study, the expected relationship between social application and online gaming use as predictors of Internet addiction was established. The use of both *Twitter* and SNSs increased the risk of being addicted to using the Internet by 2.6% and 3.2%, respectively. The primary motivation for using social Internet applications relates to the maintenance of established offline networks (Donath & Boyd, 2004; Ellison, Steinfield, & Lampe, 2007). Previous research

Table 3
Internet use among not addicted and addicted adolescents.

	Not addicted ($n = 2965$)	Addicted ($n = 113$)	
Frequency	$M(SD)$	$M(SD)$	T
Days/week	5.83 (1.55)	6.67 (0.74)	10.95**
Hours per day	2.96 (1.38)	4.33 (1.34)	9.16**
Location	%	%	X^2
Living room	55.4	58.4	0.40
Own room	42.2	50.4	3.02
Kitchen	17.9	25.7	4.47*
Other room	33.8	39.8	1.78
Wi-Fi	53.6	65.5	6.20**
Mobile phone	26.9	44.2	16.50**
No Internet	0.1	0.0	0.12
Internet addiction	$M(SD)$	$M(SD)$	T
CIUS score	8.82 (6.65)	33.37 (5.66)	44.97**

* $p < .05$.

** $p < .01$.

Table 4

Logistic regression of Internet application use and personality traits on Internet addiction risk.

	95% CI for exp b			
	b (SE)	Lower	Exp b	Upper
Constant	−4.029 (0.173)			
Online games* extraversion	−0.003** (0.001)	0.995	0.997	0.999
Online games* conscientiousness	0.003* (0.001)	1.001	1.003	1.006
Twitter	0.026** (0.006)	1.013	1.026	1.039
SNS	0.031** (0.007)	1.017	1.032	1.047
Online games	0.022* (0.009)	1.005	1.023	1.040
Emotional stability	−0.089** (0.021)	0.877	0.915	0.954
Resourcefulness	0.062* (0.025)	1.014	1.064	1.117
Agreeableness	−0.109** (0.030)	0.845	0.897	0.952
Conscientiousness	−0.042* (0.020)	0.922	0.959	0.997
Extraversion	−0.008 (0.22)	0.950	0.992	1.036

Note 1: $R^2 = .06$ (Cox and Snell), .23 (Nagelkerke). Model $X^2(9) = 148.16$, $p < .001$.* $p < .05$.** $p < .01$.

indicates that these motivations differ between age groups, with young adolescents expressing their identities by means of a self-display of personal information and older adolescents expressing it through connections (Lee, Lee, & Kwon, 2010). However, unlike the hypothesised relationship, the use of social applications other than SNSs and Twitter did not contribute to predicting Internet addiction. A variety of studies have indicated that the excessive use of online social networking sites may be problematic (e.g., Kuss & Griffiths, 2011; Leung & Lee, 2012) as it tends to reinforce the establishment and maintenance of online, rather than offline, social networks. In a similar vein, excessive use of Twitter may have detrimental consequences for real life communication and is believed to activate the hedonistic dopamine system (Hofmann, Vohs, & Baumeister, 2012), that offers instantaneous gratification when using applications such as Twitter.

Additionally, playing online games increased the risk of being addicted to the Internet by 2.3%. Overall, previous research indicates that unlike other game forms, such as browser and offline games, online games appear to have a high addictive potential, so that vulnerable people may develop addiction as a consequence of frequent engagement (Kuss & Griffiths, 2012b). In this study, only the frequent use of online games, and neither browser nor offline games, increased the risk of being addicted to the Internet. Online games require a large amount of commitment and time investment on behalf of the player in order for him to be able to achieve game imminent goals which may in turn contribute to the development of maladaptive behaviours and coping strategies that reinforce gaming (Kuss, Louws, & Wiers, 2012). Taken together, and viewed from the frequency of usage and potential problems, the desire to use online media appears to be very strong. In line with this, a recent study indicates that it appears significantly stronger than the desire for tobacco, sex, coffee, alcohol, and eating, it is significantly more difficult to resist and can lead to “pathological abuse” (Hofmann et al., 2012).

In addition to the specific usage of the Internet, a number of personality traits appeared to predict Internet addiction. As hypothesized, low emotional stability increased the risk of Internet addiction. Low emotional stability is congruent with high neuroticism (Matthews, Deary, & Whiteman, 2009) and the latter has been found to be predictive of Internet addiction and Internet gaming addiction in university students (Dong, Wang, Yang, & Zhou, 2012; Mehroof & Griffiths, 2010; Tsai et al., 2009), and therefore the present study extends previous research by utilising an adolescent sample.

Moreover, low agreeableness was found to increase the risk of Internet addiction. Low agreeableness corresponds to aggression-hostility (Zuckerman, 2002). In adolescents, aggression has been

associated with Internet addiction after controlling for television watching (Ko, Yen, Liu, et al., 2009b). Online disinhibition (Joinson, 1998), as a consequence of online anonymity, may lead to deindividuation (Zimbardo, 1969) and can foster aggressive behaviours (Ko, Yen, Liu, et al., 2009b). This process may be particularly problematic for adolescents as their cognitive control capabilities may not be adequately developed (Casey et al., 2005).

In addition to the personality traits hypothesised to be linked to Internet addiction, resourcefulness was found to increase the risk of being addicted to using the Internet. Resourcefulness has been related to openness to experience (Matthews et al., 2009). Previous research indicates that increased novelty seeking, which is part of openness to experience, is linked to Internet addiction in college students (Ko et al., 2010). Similarly, openness to experience has been found to be associated with marijuana use (Terracciano, Löckenhoff, Crum, Bienvenu, & Costa, 2008). From this, it appears that characteristics indicative of resourcefulness and openness to experience, such as creativity, imagination, and innovation may lead adolescents to engage in pleasurable activities, such as using the Internet, excessively. Alternatively, these gamers are highly creative, enthusiastic users who get carried away with their hobbies with the consequence of negative side effects that may be transitory. In order to determine these relationships in more depth, in-depth qualitative studies need to be conducted in the future.

The final personality trait that was found to increase the risk of Internet addiction was negative conscientiousness. This finding is a replication of previous research using the CIUS to assess Internet addiction in a large sample of 16,925 11–80-years olds (Meerkerk, Van den Eijnden, Vermulst, & Garretsen, 2007). It indicates that the less conscientious adolescents are, the more likely they are to experience problems related to Internet addiction. From an explanatory point of view, adolescents who are less conscientious would chose using the Internet over other, less pleasurable activities, such as doing their homework, and may therefore be at increased risk of using the Internet excessively.

In addition to these main effects, it was found that the effect of online gaming frequency interacted with specific personality traits in increasing the risk for Internet addiction. First, the amount of online gaming (i.e., number of hours played) and low scores on extraversion predicted Internet addiction. More specifically, low scores on extraversion predicted the extent of online gaming in the adolescents who were addicted as indicated by their CIUS scores. In this regard, higher extraversion can be viewed as personality trait that fulfils a preventive function. Of the adolescents who frequently engage in online gaming, those who are more extraverted were less likely to become addicted to using the Internet. Introversion has been implicated in Internet and online gaming

addiction time and again (Huang et al., 2010; van der Aa et al., 2009; Young, 2009). Interestingly, in this study low extraversion (or introversion) has been found to increase the risk of Internet addiction only among online gamers. It appears that there might be a mutually reinforcing relationship between online gaming and introversion (Weaver et al., 2009) in such a way that individuals with introverted traits start playing games because they find it easier to interact virtually than in real life, which in turn exacerbates their shyness in real life and makes them turn to the game. The directionality of this relationship needs to be examined in future research.

Second, the amount of online gaming (number of hours) and low scores on conscientiousness increased the risk of being addicted to using the Internet. Viewing this effect in more detail, it appeared that in the participants who did not meet the cut-off point for Internet addiction using the CIUS, conscientiousness appeared as predictor of weekly online gaming hours. Adolescents who engaged in playing online games frequently and who had higher conscientiousness scores were less likely to be addicted to using the Internet. Frequent online gamers who score highly on conscientiousness may feel a strong commitment to their virtual personae, guilds and high-level game content as they are organised, systematic, and thorough (Vermulst & Gerris, 2009). Rather than developing problems indicative of potential Internet addiction, they immerse in the game world in a more healthy way and are able to switch off. Their loyalty to their guild and achievement striving may lead them to engaging in end-game content at higher levels which typically requires an increased investment of time (Ducheneaut, Yee, Nickell, & Moore, 2006). Potentially, frequent online gamers who also score high on conscientiousness may be characterised by high engagement, but not addiction (Charlton & Danforth, 2007) relative to those online gamers who play similarly frequently, but who score low on conscientiousness. In order to explore this topic further, qualitative research is needed. From the perspective of research design, it appears important to pay close attention to the effects of interacting variables on the development of Internet addiction because this may allow us to tackle questions of etiology and risk.

Overall, the reported hours of Internet use appear somewhat different in comparison to other studies. For instance, in a sample of 136,589 13–18 year old South Korean adolescents, Do, Shin, Bautista, and Foo (2013) reported a relatively low mean daily Internet use of 86 min for non-study related purposes, in comparison to the non-pathological group in the present study that spent an average of approximately three hours online per day and the potentially addicted group that spent an average of 4.3 h on the Internet. Online research on 216 Austrian secondary school students revealed that they spent a comparatively relatively high daily average of 4.79 h online (Appel, Holt, Stiglbauer, & Batinic, 2012). This divergence in numbers can be explained by the fact that the South Korean study only inquired into non-study related usage of the Internet, whereas another study found that nearly 90% of children and adolescents use the Internet at school (Johnson, 2010), indicating that a proportion of the online time reported in Appel et al.'s study may have been spent for educational purposes. As an alternative explanation, this study used an online collection method which may have purported technophilic adolescents to participate rather than their not so technologically inclined peers. Self-selection bias has been generally reported as a limitation in online research (Bethlehem, 2008). Consequently, it appears necessary to cross-check online usage times using similar methods while specifying usage purposes in order for comparisons across studies to be possible. Therefore, future researchers are encouraged to be precise with regards to what kinds of Internet usage they assess.

Finally, in terms of sociodemographic variables, adolescents in different schooling types appeared to differ significantly from

one another with regards to the probability of being addicted to using the Internet, with VMBO students being more likely than HAVO/VWO students. Therefore, VMBO students should be targeted as they appear to be a population at risk for developing Internet addiction (van Rooij et al., 2010), and future research is encouraged accordingly. Widespread Internet accessibility appeared to contribute to the likelihood of being addicted to the Internet, as adolescents who used it in the kitchen, on their mobile phones, and via WiFi were more likely to be addicted to the Internet than the adolescents who did not have extensive access. In the current ubiquitous media environment, it appears that adolescents make increasing use of the Internet on the go, anytime and anywhere. The ever increasing numbers of adolescents with access to mobile Internet technology via smartphones, laptops and tablets (Lenhart et al., 2012) appears as potential explanation for the discerned problems related to Internet use. The more adolescents are able to use their favourite applications whenever and wherever they want may increase the likelihood for the development of negative consequences due to excessive use. This contention needs to be examined in future studies.

4.1. Limitations

There are a number of limitations to the present study. First, self-report measures like the ones used here do not suffice for any clinical assessment of diagnosed psychopathology. Specifically, rather than offering a clear-cut diagnosis, the CIUS scores in this sample are an indicator of addictive behaviours. The conservative cut-off point for addiction adopted here may serve as a benchmark based on which populations can be identified that may be particularly at risk for developing and/or experiencing problematic behaviours that may impact their lives in a variety of negative ways, without assuming that the adolescents identified as potentially addicted require professional help. Viewed from the perspective of clinical practice, self-report measures are the most commonly used tools to provide psychiatrists and psychologists with an indication of psychopathology level prior to treatment. They are pragmatic regarding the ease of administration and scoring (Ruben, 1999). In addition to this, using a scale may not only allow for the identification of pathological online behaviours, but it may aid the recognition of adolescents who may be at risk for developing Internet addiction as indicated by the number of symptoms endorsed. Second, the study used data of a cross-sectional nature. Therefore, the results of this study provide an indication of association, not causality. In order to view Internet addiction from an etiological point of view, it is necessary to investigate the present data taking into consideration the longitudinal cohort. Third, in this study, a categorical classification of potential psychopathology has been adopted at the expense of a more extensive dimensional analysis. Participants were classed into groups depending on whether they met a sufficient number of diagnostic criteria or not. This procedure is common in everyday clinical practice as the diagnostic manuals request diagnoses being made based on cut-offs (American Psychiatric Association, 2000). The advantages of this method include ease of communication, clinical decision-making, and agreement with health care and insurance providers (Brown & Barlow, 2005). Therefore, being imminently exploratory in nature, the present study has applied a concise categorical approach. Future researchers are advised to look beyond categories and investigate the matter in a dimensional fashion. Fourth, the number of hours of Internet application use used in the present paper is a very rough estimate given it is a multiplication from days per week and hours per day. Therefore, it might be prone to a number of methodological problems, such as ceiling effects, and dividing weekdays/weekenddays might be more prudent in future studies.

As such, the adopted number of hours of Internet application use provides a rough estimate.

4.2. Implications

The present research has a number of implications for prevention, treatment, and research. In terms of prevention, the identification of specific variables associated with Internet addiction (i.e., the respective personality traits as well as specific usages of the Internet) allows for targeting individuals who appear to be at risk for developing Internet addiction. These adolescents and their parents may be approached by teachers and educated about the problems their Internet usage may cause. With regards to prevention, raising awareness and providing education for both adolescents and their parents appear as key themes. For instance, messages on *Twitter* would be a good place to start targeting both parties, as well as advertisements in the sidebars of social networking sites about where to get help in case of concern and/or need. Messages on *Twitter* could be re-tweeted by relevant organisations which have a readership of adolescents and/or parents, or schools with *Twitter* feeds could re-tweet. In this light, the online space in which problematic behaviours occur can be used as a preventive and educative tool which may prove beneficial in decreasing associated problems and concerns.

For the purpose of treatment, the present research may benefit mental health practitioners in their efforts to develop specific approaches that pay tribute to the respective individuals' personality and associated needs and requirements. Scores on personality scales tend to vary just like personality tends to be changing rather than remaining stable over the course of life (Krueger, 2005). However, the results of the current study may serve as starting point for the development of specialised treatments of Internet addiction taking into consideration the respective personality traits. For instance, an adolescent with low conscientiousness may especially benefit from a meticulously regulated day structure in the course of treatment, whereas an adolescent who is not stable emotionally is likely to be helped by continuous encouragement and positive cognitive restructuring. The same holds true for the utilisation of different Internet applications. The excessive gamer may be aided by supporting the discovery of alternative adventurous activities (such as offline and browser games) that provide the possibility of achievement and rewards. With regards to the gamer with low agreeableness, the cultivation of social contacts may serve as form of exposure therapy whereby antagonistic attitudes towards others can be gradually unlearned. The excessive gamer with low resourcefulness may be helped by exploring creative recreational activities that may open up alternative ways of thinking and being to him. Similarly, the problematic social application user may be helped by encouraging the establishment of a real life social network with peers and maintaining it in the real world, rather than online.

So far, treatment research indicates that cognitive behavioural therapy in combination with family or group therapy appears beneficial for adolescents suffering from Internet addiction (Liu et al., 2012), and may be used in multimodal school-based settings (Du, Jiang, & Vance, 2010). In such a way, the present research encourages practitioners to pay attention to the actual behaviours and Internet usages as well as the individuality of their adolescent patients with the goal of symptom relief and eventual successful therapy completion. In light of research in the area, the current study paves the way for future investigations of the interplay between different factors, such as personality and specific online application use, in increasing the risk for possible Internet addiction. The next step may be to view Internet addiction from an etiological perspective, and consider relationships between these factors in a treatment population diagnosed with Internet

addiction. Recommendations include verification of results using the longitudinal Monitor Study data and further replications, which allow for prospective assessment of causality.

5. Conclusion

In conclusion, Internet addiction appears as a mental health problem for Dutch adolescents. The results support the American Psychiatric Association's efforts to include Internet addiction in the updated version of the DSM as a psychiatric condition that requires further research (2012). Although conservative relative to other estimates, the reported prevalence of addiction-related problems in 3.7% of the present Dutch adolescent sample is somewhat disconcerting. Internet addiction is associated with a variety of psychological and physical health problems and may impact the developing adolescent in a variety of domains. This study paves the way for future research into Internet addiction. It highlights the risk of high frequency usage of specific Internet applications, which, separately and in combination with particular personality traits, may foster the development of psychopathology. Similarly, it specifies personality traits which, in frequent users, may serve as protective factors. Accordingly, vulnerability on the one hand and resilience on the other are important aspects that need to be taken into consideration in further studies. From a mental health perspective, it is of utmost importance to identify the factors that contribute to the risk for Internet addiction and at the same time discern those that have a protective function. Ultimately, this will further a general understanding of why the excessive engagement in a behaviour leads to pathogenesis in one individual, but not in another.

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