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Pathological video game use among young Swiss men: The use of monothetic and polythetic formats to distinguish between pathological, excessive and normal gaming

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Abstract

There is no agreement about the distinction between pathological, excessive and normal gaming. The present study compared two classifications for defining pathological gaming among young male gamers: the polythetic format (gamers who met at least half of the criteria) and monothetic format (gamers who met all criteria). Associations with mental, health and social issues were examined to assess differences between subgroups of young male gamers. A representative sample of 5,663 young Swiss men filled in a questionnaire as part of the ongoing Cohort Study on Substance Use Risk Factors (C-SURF). Game use was assessed with the Game Addiction Scale. Mental, social and physical factors (depression, anxiety, aggressiveness, physical and mental health, social and health consequences), gambling and substance use (illicit drug use, alcohol dependence and problematic cannabis use) were also assessed. The results indicated that monothetic young male gamers shared problems with polythetic young male gamers, but were even more inclined to mental health issues (depression, anxiety, and aggressiveness) and were more vulnerable to other dependencies like substance use, alcohol dependence or gambling. A second analysis using Latent Class Analysis confirmed the distinction between monothetic and polythetic young male gamers and provided statistical support for this cut-off. These findings support the use of a monothetic format to diagnose pathological gaming and to differentiate it from excessive gaming.

Key words: Monothetic; Online and offline gaming; Pathological use; Polythetic.

Introduction

Gaming is a widespread leisure activity among youths. There are several forms of gaming, such as computer gaming, console gaming, and more recently games played on mobile phones and tablets. Games can be played online (on the Internet, with other gamers) and offline (without Internet). Over the last few decades, access to computer use has exploded. Although these advances connect people wherever they live and provide lots of recreational activities, gaming also has negative effects on physical and mental health [5]. Recently, many studies have focused on assessing the pathological features of gaming [1-4]. However, pathological gaming is not yet considered an officially diagnosable disease and little guidance is available on how to distinguish between excessive and pathological gaming [6]. Indeed, the "internet gaming disorder" does not belong in the DSM-5 mental disorders, and no threshold for classification has been provided [7]. This study investigated this topic.

Definition and related problems

Pathological gaming can be defined as being in poor control of one's computer or game console use, ending up in distress and impairment [8] and can be understood as uncontrollable and destructive uses or activities [9]. The main problem is that there is no agreement on how to distinguish between pathological gaming and excessive gaming. Different cut-offs have been suggested [6,10,11]. Most studies using screening or assessment instruments defined pathological gaming by classifying them in two formats, namely the monothetic and the polythetic. This distinction was suggested for qualifying a diagnosis since the DSM-IV was issued [12,13]. The monothetic format requires that all criteria be met, whereas the polythetic format requires that at least half of them be endorsed [12]. That is to say, the polythetic format is less strict and the underlying pathology may clinically manifest itself in diverse ways.

Gamers belonging in the monothetic class constitute a small group, with a prevalence estimated between 0.4% and 4% by Arnesen [5], at around 2% by other researchers [6,12,14], or even 0.2% in a recent German study [4]. The DSM-IV focused more on the polythetic format to diagnose pathological and addictive disorders, but this cut-off was described as too liberal for non-substance-related use (see for example First et al., 2004 [15]). Thus, using the polythetic format may result in overestimating the prevalence of pathological gaming, from 16% [16] to 39% [6] or 44.3% [13]. Thereby, several authors recommend using the monothetic format to diagnose pathological gaming [1,6,12,13,17]. Unfortunately, the DMS-5 provides no cut-off for gaming, and more investigation is needed to identify pathological gaming [18,19].

Correlates of pathological gaming

Correlates of pathological gaming are important , as some authors distinguish excessive and pathological gaming based on the associated negative consequences in daily life [14]. Thereby, this information may be useful to distinguish pathological gamers from the others. Pathological gaming has a number of well-known detrimental psychological, social and professional correlates. It is associated with an increased risk of developing patterns of problematic gambling [20] and with comorbidity factors such as anxiety, depression, social phobia, panic disorders, loneliness [17], social skill deficits [21], sadness and suicidal ideation [3], introversion, neuroticism and impulsivity [5,14,22-25]. Pathological gaming is also associated with family and social problems [25-29] or substance abuse disorders [30-33].

This study assessed the empirical relevance of the distinction of pathological gaming in two classes (polythetic *vs.* monothetic) among young Swiss men, using a databased approach. Associations with mental health and social issues known to be problematic among

pathological young male gamers were examined to compare monothetic with polythetic formats.

Methods

Participants and procedure

The data used in this study were obtained from the Cohort Study on Substance Use Risk Factors (C-SURF). C-SURF is a longitudinal study designed to assess substance use patterns and related consequences among young Swiss men. Enrolment took place between August 23, 2010 and November 15, 2011 in three out of six army recruitment centers located in Lausanne (French-speaking), and Windisch and Mels (German-speaking). These three centers cover 21 of 26 cantons in Switzerland, including all French-speaking cantons. In Switzerland, army recruitment is mandatory, so all young men around 20 years old were eligible for study inclusion and the sample was highly representative of the Swiss young men and did not focus only on army recruits. A total of 5,990 participants completed the baseline questionnaire. Missing values among participants were deleted listwise, so the study finally included a total of 5,663 participants (94.5% of the sample, with only 0.6% missing for the Game Addiction Scale). More information on sampling and non-response can be found in Studer et al. [34]. Briefly, non-respondents used more alcohol, tobacco and cannabis than respondents, but the magnitude of the differences was small, indicating small non-response bias. The study protocol (Protocol No. 15/07) was approved by the Ethics Committee for Clinical Research of Lausanne University Medical School.

Measures

Game Addiction Scale. The 7-item short version of the Game Addiction Scale [12] was used to assess the use of games during the previous six months. The criteria included salience,

tolerance, mood management, relapse, withdrawal, conflicts and problems. The questions clearly deal about gaming, including games played on all kinds of mediums (i.e. computers, game consoles and hand held game consoles, but also mobile phones or tablets), and focused on both online (i.e. cybergames) and offline gaming. We also added to the original questions of Lemmens et al. a particular hint to Internet gaming. For the seven items, 5-point scale answers were used (α = .86), ranging from "never" (coded=1), through "sometimes" (coded=3)," to "very often" (coded=5). Following Lemmens et al., those who scored "sometimes" or more on all seven items were defined as "monothetic gamers" and those who scored "sometimes" or more on at least half of the items (four-six of seven items) as "polythetic gamers". The other users were also taken into account: "rare or non- gamers" never answered "sometimes" or more (zero of seven items) and "non-problematic gamers" scored "sometimes" or more on a few items (one-three of seven items).

Mental, social and physical factors and consequences were also assessed.

Depression. The Major Depressive Inventory (ICD-10) – WHO-MDI was used to determine the level of depression in the last 2 weeks [35,36]. A six-point scale from "never" (0) to "all the time" (5) was used, and a total score of the 10 criteria was computed (α = .91).

Physical and mental health. The physical and mental health for the past 4 weeks was assessed with the Short Form Health Survey (SF-12) [37], with two subscales: mental and social health, and physical health. The subscales were computed according to the standard scoring, giving 2 composite scores ranging from 0 (health problem) to 100 (no health problem).

Consequences. Seventeen consequences were selected from standard instruments [38-40]. They dealt with social/personal and health consequences (α = .73). Each consequence was coded 0 if it did not occur in the past 12 months and 1 if it occurs at least one time during the past 12 months. Two mean score of consequences were computed, one for social consequences (physical fight, problems with family, problems with friends, performed poorly at school or

work, theft, trouble with police, regretted sexual intercourse, sexual intercourse without condom, damaged properties) and one for health consequences (accident/injury, admitted to an emergency room, attempted suicide, required medical treatment, spent a night in hospital, outpatient surgery, treated in an emergency room because of an accident/injury, went to an emergency department because of problems with substance use). Scores ranged from 0 to 1.

Finally, substance use, problematic substance use and gambling were assessed.

Gambling. Seven questions focused on gambling behavior (from the largest survey in Switzerland, the Swiss Health Survey): these concerned lottery and bets, electronic lottery, gambling machines, gambling tables in casinos, chance/money games on the Internet, money games and card games with money, and other money and chance games. Each gambling question was coded "1" when it had occurred during the previous 12 months and "0" if it had not occurred. A total gambling score was computed, according to the number of gambling behaviors exhibited (from 0 to 7, $\alpha = .66$).

Illicit drug use and problematic substance use. Eighteen questions measured the use of licit drugs (alcohol, tobacco) and illicit drugs (cannabis and 15 others illicit drugs) during the past 12 months. They were coded as "used" or "non-used" and we computed a total score of used drugs ranging from 0 to 18 ($\alpha = .84$). Alcohol dependence (DSM-IV criteria for alcohol dependence, with a total score between 0 "no dependence" to 7 "severe dependence") and problematic cannabis use (Cannabis Use Disorder Identification Test, CUDIT [41], total score between 0 "no problematic use " and 40 "severe problematic use") were also assessed.

Statistical analyses

Two kinds of analyses were conducted to test 1) the difference between polythetic and monothetic young male gamers, 2) to access the existence of different groups of young male gamers and especially the subgroup of monothetic young male gamers.

1) The difference between the four groups of gamers on the comorbidity factors presented above (physical and mental health, consequences, substance use and dependence) was accessed with one-way ANOVA with pairwise contrasts between adjacent groups.

2) Latent class analysis (LCA) [42,43] was performed to discover subgroups. LCA was used to see whether the seven items actually were responded in a similar way, or whether different groups of gamers exist that are not simply along a scale such as polythetic and monothetic where the assessment assumes that all items contribute in the same way to responses. LCA is a popular technique [44] which allows identifying subgroups of participants from their item responses patterns. The categorical classes are a latent variable, and posterior probabilities are used to assign each participant to the most likely latent class. The number of latent classes is unknown, and fit indices for various models are used to assess the optimal number of classes. Bayesian Information Criterion (BIC), sample-size adjusted BIC (ABIC) and Akaike Information Criterion (AIC) were used, for which lower values indicate better fit [45]. The Lo-Mendel-Rubin likelihood ratio test (LMR LRT) indicates if the model with k-class is better than a model with k-1-class [46]. A low p-value indicates that the model with k-1-class is rejected in favor of the model with k-class. The analysis was performed with Mplus 6 [47]. Descriptive statistics compared class assignment to the groups defined by Lemmens et al. recommendations.

Results

Sample characteristics

Preliminary results are presented in Table 1. A total of 2.3% of participants were monothetically-classified young male gamers, and 9.5% were polythetically-classified young male gamers. The participants showed low levels of problem for health or social factors and substance use. Polythetic and monothetic young male gamers appeared to have different

results for some variables, including depression, anxiety, aggressiveness, physical health and substance use, with monothetic young male gamers having higher scores on these variables than polythetic young male gamers.

Please insert Table 1 about here

Comparison between rare or non-users, non-problematic, excessive and pathological young male *gamers*

Significant differences between the groups of young male gamers on the health, social, physical factors and consequences are presented in Table 2. Polythetic and monothetic young male gamers showed the same level of comorbidity factors for some variables, including mental health, social and health consequences and problematic cannabis use. On the opposite side, monothetic young male gamers had significantly more extreme scores than polythetic young male gamers for the other variables: depression, anxiety, aggressiveness, physical health, total of drug used, alcohol dependence and total score of gambling. In general, there was almost for all variables a monotonic relationship from rare or non-gamers to monothetic gamers. No alpha-error correction was performed, as the aim of the study was an exploratory one. However, the rate of significance (66.67%) was largely higher than the nominal 5% of type I error rate, so they cannot all be due to type I error and multiple tests [48].

Please insert Table 2 about here

Latent Class Analysis

Six models were performed to estimate the optimal number of classes. The fit indices are presented in Table 3. The 4-class model was the best one. Even if BIC, ABIC and AIC

decreased for the five-class model, the LMR LRT showed non-significant p-values for the five- and six-class models.

Please insert Table 3 about here

Table 4 presented the latent class profiles. Class 4 (37.24% of the participants) seemed to correspond to the **non-users or rare young male users**. Their most likely answer on the seven items was "never". Class 3 (41.39% of the participants) was a subgroup constituted by **non-problematic young male users**: they endorsed more the answer "never" and "rarely" on the items, except for "longer use than intended" which had a probability of .410 to be endorsed. The two other classes referred to frequent users. Class 2 (5.16% of the participants) aggregated participants who reported the most "sometimes", "often" and "very often" answers (Q1: 90.8% of the answers were "sometimes" or more, Q2: 92.7%, Q3: 81.5%, Q4: 70.3%, Q5: 53.4%, Q6: 57.8%, Q7: 62.3%), whereas class 1 (16.21% of the participants) endorsed most of the time "sometimes" answers, excepted for "upset when unable to play" (.333 answered "never" and .427 "rarely"). Descriptive statistics which compared class assignment to the groups defined by Lemmens et al. recommendations showed that class 2 met the higher number of criteria (5.11) and the higher percentage of **monothetically-classified young male gamers** (50.4%). Class 1 met in average fewer criterions (3.418) and was constituted with most **polythetically-classified young male gamers** (64.8%). Generally, the findings from LCA confirm that a dimensional scale can be constructed from the 7 items.

Please insert Table 4 about here

Discussion

The aim of this study was to explore the differences between subgroups of gamers among young Swiss men and particularly to test whether the distinction between polythetically and monothetically-defined gamers was relevant. To our knowledge, no previous study has focused on data-based approach to differentiate these two subgroups, and on the differences between the two on health and social issues, even if some researchers are beginning to agree on the use of the monothetic format to diagnose pathological gaming [4,6,17].

With 2.3% of participants revealed to be monothetically-classified young male gamers and an additional 9.5% found to be polythetically-classified young male gamers, the prevalence rates in this study were comparable with those found by the researchers who developed the scale [12], but also with the results of other studies conducted in Switzerland [49], Norway [50] and Finland [51], even if the study focused only on male gamers. It is also important to note that, despite not using the same scale to measure game overuse, these studies reported similar proportions of pathological gamers, who corresponded here to the monothetically-classified young male gamers. The prevalence rate was lower in Germany (0.2%, [4]), but these authors did not focus only on young adults and prevalence rates are known to be higher among this population.

Not surprisingly, the different levels of game use had a strong impact on comorbidity factors, but relevant differences were detected between polythetic and monothetic young male gamers. Overall, rare or non young male gamers had fewer problems than non-problematic young male gamers, and non-problematic young male gamers fewer problems than polythetic and monothetic young male gamers. This was true for all variables except health consequences, total of drug used, physical health (no difference between rare or non young male gamers and non-problematic young male gamers), alcohol dependence and problematic cannabis use (no difference between non-problematic young male gamers and polythetic young male gamers). Thereby, polythetic young male gamers already had negative consequences and comorbidity factors associated with their game overuse and can be

distinguished from non-problematic gamers. In addition to this result, polythetic young male gamers differed from monothetic young male gamers regarding 7 of the 11 health-, social- and physical factors. These two groups differed on depression, anxiety, aggressiveness, physical health, number of drug used, alcohol dependence and gambling behavior. Thus, the number of comorbidity factors was higher for monothetic young male gamers in comparison with polythetic young male gamers. No significant difference was found between polythetic and monothetic young male gamers regarding consequences (both social and health consequences), mental health or problematic cannabis use. Monothetic gaming was associated to a higher level of neuroticism (depression, anxiety, aggressiveness) and others addictions like substance use and gambling patterns. Previous studies have shown that game overuse is a predictor for substance use [17]. Problematic gamers drink more, smoke more (cigarettes and cannabis), and have more issues with substance use [32] than non-problematic gamers. We did not find a difference for problematic cannabis use, but alcohol dependence use and number of drug used were more pronounced for monothetic young male gamers than for any other group. Gambling patterns were also more prevalent among monothetic young male gamers. These results concerning substance use and problematic behavior may indicate that monothetic young male gamers are especially vulnerable to other dependencies, but further studies including longitudinal associations are needed to test this hypothesis.

To summarize, monothetic young male gamers were clearly distinct from polythetic young male gamers when considering the associated comorbidity factors. Thus, the subdivision between polythetic and monothetic defined-gamers appeared as a relevant one. However, polythetic young male gamers also showed detrimental issues; even if the severity of mental health issues and dependencies was lower for this subgroup rather than for monothetic young male gamers. The fact that polythetic young male gamers also have game-related issues may

have lead to classify them in the pathologic gamers in previous studies. However, the current study showed that there were different levels in game-related issues among young men.

The LCA conducted to separate four subgroups, which was congruent with the four subgroups defined earlier. 5.16% of the participants were part of the group who mainly endorsed all of the 7 items (i.e. answered "sometimes" or more often more for more than half the participants, class 2). 16.21% of the young male gamers answered "sometimes" and "rarely" for most of the item and a majority of participants (class 1). Even if the prevalence of the criterions was lower than the one of Lemmens et al. recommendations (i.e. class 2 endorsed on average a total of 5.11 criterions instead of 7 for the group of monothetic young male gamers), the LCA showed that the groups defined previously were not only an artifact but could be differentiate in the results of the Game Addiction Scale, and that there was a significant difference between polythetic and monothetic young male gamers.

Overall, these results strengthened the choice of the monothetic format to assess pathological gaming. Indeed, the LCA showed that there was a qualitative difference between monothetic and polythetic young male gamers, and that the cut-off between these two formats appeared as an empirical one, and not only a theoretical one. To our knowledge, it was the first study to test whether this distinction referred to "real" subgroups of gamers. Moreover, monothetic young male gamers were more likely to share additional problems. Pathological use is generally associated with detrimental effects on life outcomes. It is for example a criterion for substance use disorder (e.g. consequence of alcohol use on daily and social life is used to assess alcohol use disorder). Therefore, the fact that monothetic young male gamers shared more issues than their counterparts should be considered as an indicator of pathological gaming [14].

On the other side, the use of polythetic format replicated previous findings about the high percentage of pathological gaming when using the polythetic format [6,13,16], and thus resulted in a high number of pathological young male gamers. Polythetically-defined gamers should not been considered as pathological gamers along with monothetically-defined gamers for two reasons. First, with the choice of the polythetic format, there was no class of "excessive gamers". Indeed, the LCA showed four latent classes, and apart polythetic and monothetic young male gamers, there were only a subgroup of rare and non young male gamers, and a subgroup of non-problematic young male gamers. Second, including polythetic gamers in the definition of pathological gaming may result in an overestimation of pathological gaming [1,6,12,13,17]. Thus, such a definition would result in a high number of false positives, i.e. gamers classified as pathological gamers even if they are not in fact pathological gamers. This phenomenon should be an issue because it gives a false alarm, and because it may be difficult to propose treatment to a huge number of pathological-classified gamers. Real pathological gamers also may miss the treatment they need because they are mingled with false positives.

The main limitation of this study is that it was based on correlations, and we were thus not able to identify causal links between pathological gaming and associated comorbidity factors. Is pathological gaming a cause or a consequence? Or is it a symptom [52], a way of expressing depression or another personality disorder [8]? In all cases, pathological gamers constitute an at-risk population and need to be helped and treated [8]. We can also mention the exploratory character of this study and the fact that we did not do alpha correction for multiple testing corrected p-values. Further studies may confirm that these results are substantial ones.

Another important limitation was that the study design excluded women and referred only to young male gamers. Gaming behavior, its association with comorbidity factors, and the relevance of the distinction between monothetic and polythetic gamers must be studied within

a sample of women. It would also allow assessing the potential differences between men and women.

A last limitation was the assessment of anxiety and aggressiveness with a personality scale. Such a scale may be use as a proxy for the level of anxiety or aggressiveness in a given time period (i.e. the anxiety sensitivity is a risk factor for the development of anxiety disorders [53]), but further investigations with psychological health or distress questionnaires are needed.

To conclude, in this study focusing on young Swiss men, we can observe that a clear distinction existed between monothetic and polythetic gamers, strengthening the choice of the monothetic format for diagnosis of pathological gamers and their differentiation from excessive gamers. Monothetic young male gamers endorsed more comorbidity factors associated with mental, health and substance use issues than polythetic young male gamers. However, excessive gaming (i.e. not yet pathological gaming) was also associated to detrimental effects, as polythetic young male gamers shared a number of social and mental problems. Indeed, polythetic young male gamers may be more likely to shift to the monothetic classification [17]. Therefore, the polythetic screening is valuable for identifying "at risk" gamers [54]. The results of this study also strengthened that young men are a particularly vulnerable group concerning destructive and at-risk behaviors.

References

1. van Rooij AJ, Schoenmakers TM, van de Eijnden RJJM, van de Mheen D (2010) Compulsive Internet use: the role of online gaming and other internet applications. Journal of Adolescent Health. 47: 51-57.
2. King DL, Delfabbro PH, Griffiths MD. Clinical interventions for technology-based problems: Excessive Internet and video game use (2012° Journal of Cognitive Psychotherapy. 26: 43-56.
3. Messias E, Castro J, Saini A, Usman M, Peeples D (2011) Sadness, suicide, and their association with video game and internet overuse among teens: results from the youth risk behavior survey 2007 and 2009. Suicide & Life-Threatening Behavior. 41: 307-315.
4. Festl R, Scharkow M, Quandt T (2013) Problematic computer game use among adolescents, younger and older adults. Addiction. 108: 592-599.
5. Arnesen AA (2010) Video Game Addiction among Young Adults in Norway: Prevalence and Health. Norway: University of Bergen.
6. Charlton J, Danforth I (2007) Distinguishing addiction and high engagement in the context of online game playing. Computers in Human Behavior. 23: 1531-1548.
7. Petry NM, O'Brien CP (2013) Internet gaming disorder and the DSM-5. Addiction. 108: 1186-1187.
8. Pies R (2009) Should DSM-V Designate “Internet Addiction” a Mental Disorder? Psychiatry. 6: 31-37.
9. Mendelson J, Mello N (1986) The addictive personality. Chelsea House, New York.
10. Griffiths MD, Dancaster I (1995) The effect of type A personality on physiological arousal while playing computer games. Addictive Behaviors. 20: 543-548.

11. Wan C-S, Chiou W-B (2006) Why are adolescents addicted to online gaming? An interview study in Taiwan. Cyberpsychology & Behavior. 9: 762-766.

12. Lemmens JS, Valkenburg PM, Peter J (2009) Development and validation of a game addiction scale for adolescents. Media Psychology. 12: 77-95.

13. Griffiths MD (2010) The use of online methodologies in data collection for gambling and gaming addictions. International Journal of Mental Health and Addiction. 8: 8-20.

14. Kuss DJ, Griffiths MD (2012) La dépendance aux jeux vidéo sur internet : une revue systématique des recherches empiriques disponibles dans la littérature. Adolescence. 79: 17.

15. First MB, Frances A, Pincus HA (2004) DSM-IV-TR Guidebook. American Psychiatric Pub.

16. Griffiths MD (1995) Technological addictions. Clinical Psychology Forum. 76: 14-19.

17. Hussain Z, Griffiths MD, Baguley T (2012) Online gaming addiction: classification, prediction and associated risk factors. Addiction Research and Theory. 20: 359-371.

18. Vakili S (2011) Video game addiction. Alberta Helth Service.

19. Petry NM (2013) Commentary on Festl et al. (2013): Gaming addiction – how far have we come, and how much further do we need to go? Addiction. 108: 600-601.

20. Haagsma MC, Pieterse ME, Peters O (2012) The prevalence of problematic video gamers in the Netherlands. Cyberpsychology, Behavior and Social Networking. 15: 162-168.

21. Caplan SE (2005) A Social Skill Account of Problematic Internet Use. Journal of Communication. 55: 721-736.

22. Caplan SE, Williams D, Yee N (2009) Problematic Internet use and psychosocial well-being among MMO players. Computer and Human Behavior. 25: 1312-1319.

23. Ebeling-Witte S, Frank ML, Lester D (2007) Shyness, Internet use, and personality. Cyberpsychology & behavior: the impact of the Internet, multimedia and virtual reality on behavior and society. 10: 713-716.

24. Mehroof M, Griffiths MD (2010) Online gaming addiction: the role of sensation seeking, self-control, neuroticism, aggression, state anxiety, and trait anxiety. Cyberpsychology, Behavior and Social Networking. 13: 313-316.

25. Peters CS, Malesky LA (2008) Problematic usage among highly-engaged players of massively multiplayer online role playing games. Cyberpsychology & Behavior. 11: 481-484.

26. King D, Delfabbro PH (2009) Understanding and Assisting Excessive Players of video games: A community psychology perspective. The Australian Psychological Society Ltd. 21: 62-74.

27. Liu M, Peng W (2009) Cognitive and psychological predictors of the negative outcomes associated with playing MMOGs (massively multiplayer online games). Computer and Humain Behavior. 25: 1306-1311.

28. Peng W, Liu M (2010) Online gaming dependency: a preliminary study in China. Cyberpsychology, Behavior and Social Networking. 13: 329-333.

29. Rehbein F, Kleimann M, Mössle T (2010) Prevalence and risk factors of video game dependency in adolescence: results of a German nationwide survey. Cyberpsychology, Behavior and Social Networking. 13: 269-277.

30. Anderson KJ (2001) Internet use among college students: an exploratory study. Journal of American College Health. 50: 21-26.

31. Bai YM (2001) Internet Addiction Disorder Among Clients of a Virtual Clinic. Psychiatric Services. 52: 1397-1397.

32. Ko C-H, Yen J-Y, Chen C-C, Chen S-H, Wu K, Yen C-F (2006) Tridimensional personality of adolescents with internet addiction and substance use experience. Canadian journal of psychiatry. 51: 887-894.

33. Yellowlees PM, Marks S (2007) Problematic Internet use or Internet addiction? Computer and Human Behavior. 23: 1447-1453.

34. Studer J, Baggio S, Mohler-Kuo M, Dermota P, Gaume J, Bertholet N, Daeppen J-B, Gmel G (2013) Examining non-response bias in substance use research—Are late respondents proxies for non-respondents? Drug and Alcohol Dependence. 132: 316-323.

35. Bech P, Rasmussen NA, Olsen LR, Noerholm V, Abildgaard W (2001) The sensitivity and specificity of the Major Depression Inventory, using the Present State Examination as the index of diagnostic validity. Journal of Affective Disorders. 66: 159-164.

36. Olsen LR, Jensen DV, Noerholm V, Martiny K, Bech P (2003) The internal and external validity of the Major Depression Inventory in measuring severity of depressive states. Psychological Medicine. 33: 351-356.

37. Ware J, Jr., Kosinski M, Keller SD (1996) A 12-Item Short-Form Health Survey: Construction of scales and preliminary tests of reliability and validity. Medical Care. 34: 220-233.

38. Wechsler H, Davenport A, Dowdall G, Moeykens B, Castillo S (1994) Health and Behavioral Consequences of Binge Drinking in CollegeA National Survey of Students at 140 Campuses. The Journal of the American Medical Association. 272: 1672-1677.

39. Bucholz KK, Cadoret R, Cloninger CR, Dinwiddie SH, Hesselbrock VM, Nurnberger JI, Jr., Reich T, Schmidt I, Schuckit MA (1994) A new, semi-structured psychiatric

interview for use in genetic linkage studies: A report on the reliability of the SSAGA. Journal of Studies on Alcohol. 55: 149-158.

40. Hesselbrock M, Easton C, Bucholz KK, Schuckit M, Hesselbrock V (1999) A validity study of the SSAGA--a comparison with the SCAN. Addiction. 94: 1361-1370.

41. Adamson SJ, Sellman JD (2003) A prototype screening instrument for cannabis use disorder: the Cannabis Use Disorders Identification Test (CUDIT) in an alcohol-dependent clinical sample. Drug and Alcohol Review. 22: 309-315.

42. Goodman LA (1974) Exploratory latent structure analysis using both identifiable and unidentifiable models. Biometrika. 61: 215-231.

43. Lazarsfeld PF, Henry NW (1968) Latent structure analysis. Houghton, Mifflin.

44. Feingold A, Tibeiro SS, Capaldi DM (2013) New Approaches for Examining Associations with Latent Categorical Variables: Applications to Substance Abuse and Aggression. Psychology of Addictive Behaviors. 28: 257-267.

45. Raftery AE (1995) Bayesian model selection in social research. Sociological Methodology. 25: 111-163.

46. Lo Y, Mendell NR, Rubin DB (2001) Testing the number of components in a normal mixture. Biometrika. 88: 767-778.

47. Muthén LK, Muthén BO (2010) Mplus user's guide. Sixth edition. Los Angeles, CA: Muthén & Muthén.

48. Iglesias K (2011) L'utilisation des modèles à effets mixtes avec effets aléatoires croisés pour l'analyse de données de type questionnaire dans le champ de la satisfaction au travail. Geneva: University of Geneva.

49. Eidenbenz F (2011) Ambulante Versorgung und Behandlung von medien- und computersüchtigen Kindern und Jugendlichen und ihrer Eltern. In: Möller, editor. Praxishandbuch für Therapeuten, Pädagogen und Eltern. Stuttgart.

50. Johansson A, Götestam KG (2004) Problems with computer games without monetary reward: similarity to pathological gambling. Psychological Reports. 95: 641-650.

51. Kaltiala-Heino R, Lintonenm T, Rimpela A (2004) Internet addiction? Potentially problematic use of the Internet in a population of 12-18 year-old adolescents. Addiction Research and Theory. 12: 89-96.

52. Ha JH, Kim SY, Bae SC, Bae S, Kim H, Sim M, Lyoo IK, Cho SC (2007) Depression and Internet addiction in adolescents. Psychopathology. 40: 424-430.

53. McLaughlin EN, Stewart SH, Taylor S (2007) Childhood anxiety sensitivity index factors predict unique variance in DSM-IV anxiety disorder symptoms. Cognitive Behaviour Therapy. 36: 210-219.

54. Brus A (2012) A young people's perspective on computer game addiction. Addiction Research & Theory. 21: 365-375.

	Game use				
	Total	Rare or non-gamers	Non-problematic gamers	Polythetic gamers	Monothetic gamers
Total	-	44.9%	43.2%	9.6%	2.3%
Mental, social, physical factors					
Depression (0-50)	7.02 (7.16)	5.79 (6.82)	7.23 (6.38)	10.51 (8.68)	12.33 (11.77)
Mental health (0-100)	47.38 (9.07)	48.86 (8.55)	46.97 (8.93)	43.33 (9.98)	43.83 (10.36)
Physical health (0-100)	53.07 (6.30)	53.35 (6.08)	53.23 (6.23)	51.75 (7.09)	50.05 (6.87)
Social consequences, sum-score (0-1)	0.23 (0.20)	0.21 (0.19)	0.24 (0.20)	0.29 (0.21)	0.31 (0.26)
Health consequences, sum-score (0-1)	0.19 (0.22)	0.18 (0.25)	0.19 (0.22)	0.21 (0.22)	0.22 (0.25)
Substance use and dependence					
Drug used, sum-score (0-18)	1.97 (1.61)	1.95 (1.61)	1.97 (1.54)	1.93 (1.53)	2.35 (2.95)
Alcohol dependence (0-7)	0.11 (0.17)	0.10 (0.16)	0.12 (0.17)	0.13 (0.18)	0.18 (0.28)
Problematic cannabis use (0-40)	1.91 (4.67)	1.69 (4.33)	2.06 (4.77)	2.04 (4.74)	2.71 (7.63)
Gambling, sum score (0-7)	0.29 (0.80)	0.24 (0.71)	0.30 (0.75)	0.39 (0.92)	0.82 (1.93)

Table 1. Descriptive statistics for the classification of the young male gamers and other variables

Remark: items range, means and standard deviation are given for each variable.

	Paired comparisons (t-test)		
	Rare or non-gamers v.s. non-problematic gamers	Non-problematic gamers v.s. polythetic gamers	Polythetic gamers v.s. monothetic gamers
Mental, social, physical factors			
Depression	7.29***	9.89***	2.66**
Mental health	-7.52***	-8.61***	-0.57
Physical health	-0.67	-4.98***	-2.77**
Social consequences, sum-score	6.14***	5.36***	0.92
Health consequences, sum-score	1.56	1.60	0.44
Substance use and dependence			
Drug used, sum-score	0.48	-0.46	2.63**
Alcohol dependence	4.63***	1.27	2.66***
Problematic cannabis use	2.83**	-0.07	1.45
Gambling, sum score	2.85**	2.39*	5.45***

Table 2. Differences between classes of young male gamers on health, social, physical factors and consequences

Remark: the following contrasts were used: contrast 1: rare or non-gamers = non-problematic gamers; contrast 2: non-problematic gamers = excessive gamers; contrast 3: excessive gamers = pathological gamers. T-test values are given.

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

Model	BIC	ABIC	AIC	LMR p-value
One-class	8237.19	82472.18	82375.19	-
Two-class	73023.00	72841.87	72644.42	.000
Three-class	71173.49	70900.21	70602.31	.000
Four-class	70419.71	70054.28	69655.92	.000
Five-class	70209.25	69751.66	69252.84	.282
Six-class	70080.74	69531.00	69931.72	.766

Table 3. Comparisons of different LCA models

	Class 1 N = 918; 16.2%	Class 2 N = 292; 5.2%	Class 3 N = 2,344; 41.4%	Class 4 N = 2,109; 37.2%
Thought all day long about gaming				
Never	0.11	0.02	0.34	0.88
Rarely	0.33	0.07	0.368	0.10
Sometimes	0.35	0.10	0.203	0.01
Often	0.18	0.29	0.063	0.00
Very often	0.04	0.52	0.025	0.00
Longer game use than intended				
Never	0.05	0.05	0.144	0.77
Rarely	0.16	0.02	0.283	0.19
Sometimes	0.39	0.08	0.41	0.04
Often	0.35	0.26	0.142	0.00
Very often	0.05	0.60	0.021	0.00
Use to forget about real life				
Never	0.18	0.12	0.546	0.94
Rarely	0.34	0.07	0.283	0.05
Sometimes	0.33	0.15	0.14	0.01
Often	0.14	0.26	0.026	0.00
Very often	0.01	0.40	0.004	0.00
Others unsuccessfully tried to reduce your game use				
Never	0.10	0.17	0.743	0.99
Rarely	0.40	0.13	0.203	0.01
Sometimes	0.41	0.21	0.045	0.00
Often	0.09	0.26	0.009	0.00
Very often	0.00	0.23	0	0.00
Upset when you were unable to play				
Never	0.33	0.26	0.853	0.99
Rarely	0.43	0.21	0.124	0.01
Sometimes	0.21	0.24	0.021	0.00
Often	0.03	0.19	0.003	0.00
Very often	0.00	0.11	0	0.00
Arguments with others about your game use				
Never	0.19	0.24	0.845	0.99
Rarely	0.45	0.18	0.134	0.01
Sometimes	0.33	0.20	0.018	0.00
Often	0.03	0.23	0.002	0.00
Very often	0.00	0.15	0.001	0.00
Neglected important activities				
Never	0.23	0.25	0.699	0.97
Rarely	0.37	0.13	0.233	0.02
Sometimes	0.32	0.23	0.061	0.00
Often	0.08	0.18	0.006	0.00
Very often	0.01	0.21	0.001	0.00
Descriptive statistics with defined groups of gamers				
Number of criteria met (sd)	3.42 (1.73)	5.11 (1.45)	1.20 (0.93)	0.10 (0.30)
% of rare or non-gamers	2.2	0.0	22.8	75.0
% of non-problematic gamers	18.2	2.1	71.3	8.3
% of polythetic gamers	64.8	32.2	2.9	0.0
% of monothetic gamers	49.6	50.4	0.0	0.0

Table 4. Latent class analysis profiles

Remarks: Results are presented in probability scale.