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Normative, passionate, or problematic? Identification of adolescent gamer subtypes over time

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Background and aims: For most youngsters, gaming is a fun and innocent leisure activity. However, some adolescents are prone to develop problematic gaming behavior. It is therefore important to have a comprehensive understanding of psychosocial and game-related characteristics that differentiate highly engaged gamers from problematic gamers. To that end, this study evaluated the stability and consistency of Internet gaming criteria (as suggested by the DSM-5) and psychosocial characteristics in a two-wave longitudinal study including 1928 young adolescents (mean age = 13.3 years, *SD* = 0.91, 57% boys). *Methods:* A confirmatory factor analysis revealed good stability of the Internet gaming disorder (IGD) construct over time. Latent class analyses revealed three classes for boys (recreational, engaged, and problematic) and two classes for girls (recreational and engaged). *Results:* Significant differences between classes emerged for problem criteria (conflict and problems in social life), gaming duration, impulsivity, social competence, and attention/hyperactivity. The absence of a problematic gaming class for girls suggests that girls are less likely to develop problematic gaming behavior. *Discussion:* The IGD criteria as proposed by the DSM-5 are a helpful tool to identify problematic gamers, although the results of this study suggest that using a strict cut-off point might result in false positives, particularly for boys. Problem criteria appeared to be the most sensitive and specific in identifying the problematic gamer, whereas escapism criteria were the least specific and sensitive. Careful consideration of the current proposed criteria to identify problematic gaming behavior could benefit the research and clinical field.

Keywords: Internet gaming disorder, adolescence, gamer subtypes, problematic gaming, sensitivity, specificity

INTRODUCTION

Playing games is a popular leisure time activity among young adolescents (Stevens et al., 2017). For many of these youngsters, gaming is an innocent and fun way of spending their time. Adolescence is characterized by a period of increased experimentation with different behaviors such as drinking, smoking, and sexual behavior (Romer, Reyna, & Satterthwaite, 2017). These behaviors have been defined as risky behaviors because they have the tendency to illicit uncontrolled actions and can contribute to an unhealthy behavioral pattern once adolescents get "overinvolved" in these risky behaviors (Steinberg, 2005). This might similarly apply to gaming behavior (van den Brink, 2017). Moderate involvement in risk behaviors, however, is part of normal adolescent development (Crone & Dahl, 2012; Spear, 2013). That is, adolescents experiment with these behaviors and possibly learn how to regulate their behavior by doing so (Romer et al., 2017; Spear, 2013). It is therefore very difficult to decide how much involvement in risky behaviors results in problematic development, since almost all adolescents engage in these behaviors to some degree. Nevertheless, in the substance use, research field advances have been made to get a better understanding of problematic substance use interfering with healthy development versus relatively normative substance use (D'Amico et al., 2016; Richter, Pugh, Peters, Vaughan, & Foster, 2016). This research has led to the development of screening tools such as the Audit (problematic drinking), Cudit (problematic cannabis use), and the CRAFFT (problematic alcohol use) that are used in clinical settings to identify problematic involvement in substance use (Connor, Haber, & Hall, 2016). In the field of gaming research, such criteria have not yet been established in a similar manner. In fact, the definition of gaming disorder based on the nine criteria defined in the appendix of the DSM-5 (American Psychiatric Association [APA], 2013) is criticized by several scholars (cf. Aarseth et al., 2017; Griffiths et al., 2016; Kardefelt-Winther, 2015). It is questioned whether these nine criteria are sensitive and specific enough to disentangle problematic gaming behavior from recreational gaming behavior (Griffiths et al., 2016; van Rooij, Looij, & Billieux, 2017). Moreover, it is questioned whether gaming disorder

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actually exists as a primary diagnosis (Kuss & Lopez-Fernadez, 2016), whether there is stability of gaming disorder symptoms (Baysak, Yertutanol, Dalgar, & Candansayar, 2018), and concerns about pathologizing normative behavior are raised (Aarseth et al., 2017). Despite disagreement in the field, the World Health Organization (WHO) acknowledged the existence of gaming addiction in June 2018. The WHO's definition of gaming addiction reveals overlap with the DSM-5 criteria and includes three important aspects: (a) loss of control over gaming, (b) loss of interest in other activities, and (c) continuation despite negative consequences. According to the WHO, the problems need to be present for at least 12 months and should be sufficiently serious.

Although the ongoing discussion regarding the proper assessment and the existence of gaming addiction is highly relevant, this discussion might obstruct both the screening as well as the provision of appropriate treatment for problematic gaming behavior (van den Brink, 2017). In this study, the nine criteria of the Internet Gaming Disorder Scale developed by Lemmens, Valkenburg, and Gentile (2015), which is based upon the nine criteria in the DSM-5 appendix, will be reviewed for its stability over time and its specificity and sensitivity in identifying differences between normative and problematic adolescent gamers (12–16 years) in a longitudinal design. The approach is twofold; first, it is evaluated how well specific items contribute to an underlying latent factor of problematic gaming and whether this construct is stable over time and stable between sexes. In a second step, latent classes of gamers are evaluated in relation to gaming-specific behaviors and in relation to psychological and social functioning that previously have been related to problematic gaming behavior (Peeters, Koning, & van den Eijnden, 2018; Van Den Eijnden, Koning, Doornwaard, Van Gurp, & Ter Bogt, 2018).

Gaming behavior and healthy adolescent development

Some adolescents have more difficulties regulating their gaming behavior than others. Differences in gaming behavior between adolescents can be expressed not only in terms of variance in duration and frequency of use (van Rooij et al., 2017) but also in terms of perceived social problems and conflict with significant others or problems at school (Billieux et al., 2015; Müller et al., 2015; Peeters et al., 2018; Van Den Eijnden et al., 2018). In-depth knowledge of why some youngsters are more prone to excessive gaming compared to their peers and at what point excessive gaming becomes problematic and remains problematic over time is of crucial importance to understand healthy adolescent development. The adolescent period is characterized as a developmental stage where customs and habits with respect to health risk behaviors emerge and are learned (Chambers, Taylor, & Potenza, 2003; Spear, 2013). Some behavioral tendencies can result in excessive and problematic involvement in risk behavior (Chambers et al., 2003; Müller et al., 2015; Wiers et al., 2007). Unhealthy behavioral patterns with respect to gaming can have a negative impact on adolescent development (Van Den Eijnden et al., 2018), and may lay a foundation for more severe problems later in life (Müller et al., 2015). Therefore, it is important to get a better understanding of who is at risk and which psychosocial characteristics are typical for problematic gamers (Billieux et al., 2015; Müller et al., 2015). To that end, and in addition to distinguish different types of gamers over time, differences in psychological and social functioning will be analyzed. In a recent longitudinal study by Van Den Eijnden et al. (2018), both life satisfactions and social competence were found to be related to problematic gaming behavior. Problematic gamers were less satisfied with their life and reported lower social competence over time. In a different study, Peeters et al. (2018) found that both attention and social competence were important predictors of an increase in Internet gaming disorder (IGD) symptoms over time among adolescent gamers. Both studies further revealed gender differences in problematic gaming behavior, indicating that boys more often report problematic gaming behavior than girls (Peeters et al., 2018; Van Den Eijnden et al., 2018). Therefore, differences in psychological and social functioning, namely, social competence, life satisfaction, and problems with attention will be analyzed in relation to the latent classes. In addition, sex differences will be evaluated.

What do we know so far about latent classes and gaming behavior?

Previous cross-sectional studies using latent class analyses (LCAs) to differentiate between subgroup of gamers reveal some important findings. First, particularly problem criteria, such as conflict with parents, problems with school, and experiencing negative consequences, appear to be relevant criteria for differentiating between recreational and problematic gamers (Carras & Kardefelt-Winther, 2018). Symptom criteria such as preoccupation, tolerance and withdrawal, craving, mood enhancement, and impaired control appeared to be less relevant (Carras & Kardefelt-Winther, 2018). Second, the motives for gaming behavior differ between subgroups of gamers. For instance, Billieux et al. (2015) found that some, but not all problematic gamers, report escapism and achievement motives. It is possible that some problematic gamers play games as a coping strategy and that their problematic gaming behavior is a result of an underlying (mental) problem. However, recent longitudinal findings indicate that problematic gaming behavior has a negative impact on adolescents' psychosocial well-being, indicating that gaming behavior is not only the result of other mental problems, but it also negatively affects psychosocial well-being over time (Van Den Eijnden et al., 2018). Third, problematic gamers more often report problems with psychological well-being than engaged gamers. Depression, social anxiety, substance use, and problems at school are higher among problematic gamers compared to adolescents who play games on a recreational level (van Rooij et al., 2017). Although these studies shed more light on different subtypes of possible problematic gamers in adolescence, comparison between these studies is difficult because latent classes are based upon different assessments of problematic gaming behavior. Moreover, some results are based upon cross-sectional assessments (cf. Billieux et al., 2015; Carras & Kardefelt-Winther, 2018; Van Rooij et al., 2017), which provide no

information about stability of symptoms over time. Particularly in a young group of adolescents whose behavior and competencies rapidly change (Crone & Dahl, 2012), the question of stability and consistency of problematic gaming behavior over time will be highly relevant (Baysak et al., 2018). A decline in symptoms of problematic gaming behavior, a phenomenon also known as "maturing out" (Ashenhurst, Harden, Corbin, & Fromme, 2015), could be particularly prevalent in a group of young adolescents among who engaged gaming might be part of a transient youth culture. Therefore, evaluating stability of symptoms over time seems to be an important first step, before differences in psychosocial well-being are considered.

In this study, we would like to move beyond the discussion whether gaming should or should not be regarded a behavioral addiction, in favor of searching for behavioral profiles that differentiate between normative and problematic gaming in adolescence without using strict cut-off criteria for gaming disorder. The cut-off criteria will only be used to map the differences that would have been found in the identification of problematic gamers based on the DSM-5 criteria (i.e., sensitivity and specificity analyses). To that end, the aim of this study is threefold. First, we will evaluate the stability of gaming problems over time in a group of young adolescents [12–16 years; i.e., confirmatory factor analysis (CFA)]. Second, we will identify different groups of users (LCA) and see which of the nine criteria of IGD is essential for problematic gaming (i.e., sensitivity/specificity analyses). Finally, the different groups of gamers are compared on gaming specific behaviors (i.e. frequency and duration), psychological well-being (i.e., attention/impulsivity problems and life satisfaction), and social functioning (i.e., social competence).

METHODS

Participants

This study was part of an ongoing (since 2015) longitudinal study, the Digital Youth Project, that monitors trends in online and gaming behavior of young adolescents. For this study, wave 2 (2016) and wave 3 (2017) were included (now referred to as T1 and T2) because the first wave (T0) included a smaller and more selective sample than in 2016 and 2017. Adolescents completed an online survey during school hours under the guidance of a research assistant. Parents were informed about the content and aim of the study, and could refuse participation of their child by withholding informed consent. Adolescents were informed about the anonymous and voluntary nature of the study and were allowed to quit participation at any moment. The faculty ethics committee approved this study (FETC 16-076 Eijnden). In total 1,928 adolescents participated at T1 (education: 50% lower, 25% middle, and 25% high), and 1,420 at T2 (74%; education: 54% lower, 31% middle, and 15% high). The mean age was 13.3 ($SD = 0.91$), and 57% were boys at T1. Attrition analyses of missing data between T1 and T2 revealed that the 508 adolescents who dropped out scored significantly higher on duration of gaming [$t(1637) = -3.007$, $p < .01$] scored significantly higher on the sum of IGD criteria [$t(1629) = -3.832$, $p < .01$], scored significantly lower on social competence [$t(1901) = -2.674$, $p < .01$], and higher on impulsivity [$t(1912) = -2.154$, $p = .03$].

The sample included in all three (i.e., CFA, LCA, and ANOVA) analyses (T1: $N = 1,629$; T2: $N = 1,120$) differed from the study sample (T1: $N = 1,928$; T2: $N = 1,420$) due to missings on the IGD symptoms scale (i.e., those who did not play games in the past 3 months did not respond to this question). Adolescents who indicated that they did not play games in the past 3 months had missing data on the IGD symptoms [T1 = 32 (3% of male sample) boys and 209 (25% of female sample) girls]; [T2 = 52 (7% of male sample) boys and 205 (32% of female sample) girls]. Some other participants did not complete the IGD symptoms scale (T1: $N = 58$; T2: $N = 43$).

Measures

Internet gaming disorder criteria. The Internet Gaming Disorder Scale (Lemmens et al., 2015) was used to assess IGD symptoms. This scale is based on the nine criteria described in the DSM-5 appendix (APA, 2013). Respondents were asked to indicate whether they experienced each of the nine symptoms in the past 6 months ("yes" or "no"). An example item is "have you experienced serious conflicts with parents, brother(s) or sister(s), or friends because of gaming?" Cronbach's α was .78 at T1 and .77 at T2. Adolescents were also asked to indicate how much they perceived themselves to be addicted to gaming (i.e., not at all, almost not, a bit, quite a bit, and a lot).

Gaming behavior. Several questions regarding gaming behavior were assessed. First, adolescents were asked whether they had played any game in the past 3 months. When they answered this question with "yes," adolescents were asked about the number of days per week that they played games (i.e., less than once a week, 1–7 days). In addition, adolescents were asked to report about the hours spend on gaming during a particular gaming day (i.e., less than 1 hr, 1 hr, and 9 or more hours a day). These items were only used as outcome and were not part of the LCAs.

Social competence. Social competence was assessed using a Dutch version (Competentiebelevingsschaal voor Adolescenten; Treffers, Goedhardt, Veerman, van den Bergh, & Ackeart, 2002) of the Harters' Self Perception Profile of Adolescents (Harter, 1988). The subscale "Close Friendships" was used, which assesses the ability to establish and retain close friendships. This subscale included five items, which could be answered on a 5-point scale (ranging from "*totally agree*" to "*totally disagree*"). Examples of items are "I find it hard to get friends on whom I can count" and "I have no close friend to do things together." Mean scores on the five items were calculated and used as a measure of social competence. Cronbach's α for T1 was .62 and .64 for T2. Higher scores indicated more problems with establishing and retaining close friendships and thus poorer social competence. Mean scores for the total group at T1 were $M = 1.67$, $SD = 0.071$ and for T2 were $M = 1.65$, $SD = 0.69$.

Life satisfaction. Respondents' life satisfaction was measured using the 5-item Satisfaction with Life Scale developed by Diener, Emmons, Larsen, and Griffin (1985).

Examples of items are "I am satisfied with my life" and "In most ways, my life is close to my ideal." Response categories ranged from "*totally agree*" to "*totally disagree*." Cronbach's α for this scale was .83 for both waves. Lower scores indicate less satisfaction with life. Mean scores for the total group for T1 were $M = 4.13$, $SD = 0.56$ and for T2 were $M = 4.06$, $SD = 0.65$.

Attention-deficit hyperactivity disorder (ADHD). ADHD problems were assessed using the ADHD questionnaire (Scholte & van den Ploeg, 2005). The scale includes three subscales that provide information about perceived ADHD problems: attention problems, impulsivity, and hyperactivity. The three subscales included nine items for attention (e.g., "I have little attention for details and tend to make unnecessary mistakes"), six items for impulsivity (e.g., "I find it difficult to wait for my turn"), and six items for hyperactivity (e.g., I feel restless") on a 5-point scale ranging from 1 (*never*) to 5 (*very often*). Mean scores of each subscale were calculated and used as measure of attention problems (T1: $M = 2.24$, $SD = 0.76$; T2: $M = 2.33$, $SD = 0.83$), hyperactivity (T1: $M = 2.24$, $SD = 0.92$; T2: $M = 2.20$, $SD = .88$), or impulsivity (T1: $M = 1.95$, $SD = 0.75$; T2: $M = 1.97$, $SD = 0.71$). Higher scores indicate more attention problems, more impulsivity, or more hyperactivity. Cronbach's α for attention was .87 and .88, for hyperactivity was .86 and .86, and for impulsivity was .83 and 82 for T1 and T2, respectively.

Data analyzing strategy

Similarly, as in the study of Lemmens et al. (2015), a CFA was performed to check whether the nine criteria equally well loaded on a single latent factor. In contrast to the study by Lemmens et al. (2015), in which the factor loadings were evaluated cross-sectionally, we were interested in the stability of the construct over time. Measurement invariance (MI) of the latent IGD construct, as defined by the nine DSM-5 IGD criteria, is a prerequisite to study differences between latent classes and over time (van de Schoot et al., 2013). Only when MI is guaranteed, it can be assumed that the same underlying latent construct is assessed at both waves. The factor loadings were therefore evaluated for each wave separately. Then, we tested for MI to assess stability of the IGD construct over time, by constraining the factor loading and intercepts between waves. In the second step, we performed LCAs. We compared models for boys and girls together and separately to determine whether assuming gender differences would be appropriate or not. Model fit for the number of classes was determined by looking at (a) Akaike information criteria (AIC), (b) Bayesian Information Criteria (BIC), (c) entropy value, (d) acceptable class size (>2%), and content of classes also in consideration of previous literature. These criteria were similar as approaches defined in the studies of Meeus, Van De Schoot, Keijsers, Schwartz, and Branje (2010) and Peeters et al. (2014) and reflect a good balance between model fit consideration and theoretical interpretation of classes. Participants were assigned to the class with the highest probability and stability of class membership was investigated between T1 and T2. For the last step in our approach, we transported class membership to SPSS [if the entropy is high enough (i.e., >.80), transporting patterns to other statistical programs is allowed, Clark & Muthén, 2009] and compared IGD symptom scores between classes, evaluated difference with respect to gaming-specific characteristics (e.g., frequency and duration) as well as psychosocial characteristics (e.g., impulsivity and social competence) between the different latent classes of gamers. A simple ANOVA with post-hoc test (Tukey) was used to observe class differences. In addition, a χ^2 test was performed to observe possible differences in classification between the LCA and using the five or more cut-off criteria as prescribed by the DSM-5 appendix for diagnosing IGD. For the CFA an LCA, we used Mplus version 8; for the ANOVA, we used SPSS IBM version 24. Missing data were handled by full information likelihood while performing combined analyses between waves (i.e., MI testing). For the LCA, and consequently also for the ANOVA comparing classes on outcomes, only the study sample was included (T1: $N = 1{,}928$; T2: $N = 1{,}420$).

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board of the Faculty of Social Science, Utrecht University approved the study (FETC16-076 Eijnden). All subjects were informed about the study and all provided informed consent. Parental consent was sought for those younger than 18 years of age.

RESULTS

Confirmatory factor analyses (CFAs)

Only adolescents who indicated that they played games in the past 3 months reported about gaming behavior and symptoms; non-gamers [T1: males = 32 (2%), females = 209 (11)%; T2: males = 52 (5%), females = 205 (25%)] were therefore excluded for the CFA. The CFAs showed that the factor loadings for T1 and T2 are acceptable to good indicators of the latent construct (Table 1). A relatively low factor loading was observed for the "escapism" symptom, possibly suggesting poorer contribution to the latent construct. The relatively lower factor loading for the escapism symptom appears to be more evident at T1 than T2.

To assess whether the IGD construct was stable over time (avoiding to compare apples and oranges over time), MI was determined by first constraining the factor loadings (metric invariance) between wave 1 and wave 2, and in addition constraining the intercepts (scalar invariance) between wave 1 and wave 2. Model fit for metric invariance (AIC = 13,948; BIC = 14,106) was slightly better than for scalar invariance (baseline model; AIC = 13,950; BIC = 14,152). Model fit for scalar invariance improved only on the BIC compared to previous models (AIC = 13,960; BIC = 14,069). Since we have a relatively large sample size ($N = 1{,}724$), including too many parameters (overfitting) is a serious concern. The BIC is less biased with respect to overfitting when compared to the AIC (Dziak, Coffman, Lanza, & Li, 2017). Therefore, the BIC was leading our

Table 1. Confirmatory factor analyses loadings for wave 1 and wave 2

	Wave 1	Wave 2
Symptom 1 ("give up other activities")	0.71	0.74
Symptom 2 ("preoccupation")	0.81	0.80
Symptom 3 ("withdrawal")	0.85	0.81
Symptom 4 ("tolerance")	0.80	0.81
Symptom 5 ("loss of control")	0.77	0.82
Symptom 6 ("escapism")	0.57	0.68
Symptom 7 ("problems")	0.68	0.80
Symptom 8 ("deceive/lie")	0.79	0.67
Symptom 9 ("conflict in relationships")	0.77	0.82

choice for the best fitting model. In sum, The CFA and the MI analyses revealed that the nine symptoms reflect a similar construct over time, and comparison of the latent construct between waves is acceptable.

Latent class analyses (LCAs)

LCAs with the nine IGD criteria were performed by comparing a model for boys and girls together and separately, as differences in perceived IGD symptoms between boys and girls were observed in previous studies (Peeters et al., 2018; Van Den Eijnden et al., 2018). The results for both waves are presented in Table 2. Although a good model was identified while considering no gender differences and including three classes, a much better model for girls was identified when considering two classes. For boys, a three-class solution was the best fit considering both waves (see Table 2 for an overview). It was therefore decided to continue with separate analyses for boys and girls. Descriptive statistics with respect to gaming behavior for boys and girls are presented in Tables 3 and 4.

For males, the first group reported almost no gaming disorder symptoms, with the exception that a relatively substantial group reported escapism symptoms (T1 = 15% and T2 = 8%). With respect to gaming behavior, this group scored relatively low on duration and frequency of gaming behavior. Therefore, this class was labeled as the recreational gamers (T1 = 67% and T2 = 67%). A second group, labeled as engaged gamers (T1 = 30% and T2 = 31%), reported on average more symptom criteria (e.g., tolerance and loss of control) and less problem criteria (e.g., conflict and problems; Carras & Kardefelt-Winther, 2018). With respect to gaming behavior, this group plays almost every day, although the hours spend on gaming are lower compared to the last group of gamers, labeled the problematic gamers (T1 = 3% and T2 = 2%). The problematic gamers reported problem as well as symptom criteria.

For females, only two classes emerged. The largest group of female gamers (T1 = 90% and T2 = 95%) reported no gaming disorder symptoms, with the exception of escapism symptoms (around 8% at T1 and T2). In this group, gamers spend on average a few days per week, a few hours on gaming behavior. This group is labeled as the recreational gamers. A much smaller group reported overall more symptoms, but in particular more problem symptoms and loss of control. This engaged group (T1 = 10% and T2 = 5%) spends more time and more hours on gaming behavior. In addition, they identify themselves as more addicted compared to the other group of gamers. However, in their gaming behavior, they are more similar to the male engaged gamers than to the male problematic gamers. Therefore, this class is labeled as engaged gamers.

Based on the outcomes of the LCA, we analyzed the stability of the latent IGD construct between males and females separately. For males, a latent factor correlation of .56 was found between T1 and T2. For females, this latent factor correlation was .91. It should be noted that for females only two groups were identified, possibly explaining this high stability of group membership over time. For boys, the group membership over time was lower. Further inspection of the problematic gaming group revealed that only 3 of the 26 problematic gamers at T1 (11.5%) were problem gamers at T2 as well. Another group of adolescents ($n = 6$) moved from problem gamer at T1 to engaged gamer at T2 (23%); another group problematic gamers at T1 ($n = 7$) became recreational gamer at T2 (27%). The biggest group of problematic gamers at T1 ($n = 10$, 38.5%) dropped out of the study. These findings suggest that stability of latent class membership as expressed in the correlation does not reflect

Table 2. Latent class model fit measures for each wave and each class separately

	AIC		BIC		Entropy	
	T1	T2	T1	T2	T1	T2
Class 1 all	10,705	6,308	10,739	6,394		
Class 2 all	9,083	5,297	9,785	5,393	0.84	0.84
Class 3 all	8,934	5,212	9,048	5,318	0.86	0.87
Class 4 all	8,914	5,204	9,038	4,154	0.75	0.76
Class 1 male	8,190	4,892	8,274	4,696		
Class 2 male	7,117	4,248	7,211	4,334	0.81	0.79
Class 3 male	6,992	4,159	7,095	4,255	0.83	0.82
Class 4 male	6,978	4,154	7,091	4,259	0.70	0.74
Class 1 female	1,961	1,105	2,035	1,173		
Class 2 female	1,730	931	1,813	1,008	0.85	0.94
Class 3 female	1,726	NA	1,819	NA	0.67	NA
Class 4 female	1,730	937	1,831	1,030	0.72	0.37

Note. AIC: Akaike information criteria; BIC: Bayesian information criteria.

Table 3. Descriptive statistics for male latent classes for T1 and T2

	Recreational ($N = 692$)		Engaged ($N = 309$)		Problematic ($N = 26$)	
T1	Mean	*SD*	Mean	*SD*	Mean	*SD*
Frequency gaming (days) T1	5.44[a]	2.22	6.96[b]	1.54	6.88[b]	1.67
Duration gaming (hr) T1	3.66[a]	1.60	4.70[b]	2.15	5.25[b]	2.79
Self-declared IGD T1	2.28[a]	1.02	3.24[b]	1.04	3.63[b]	1.31
Frequency gaming (days) T2	5.09[a]	2.33	6.26[b]	1.96	6.56[b]	1.75
Duration gaming (hr) T2	3.83[a]	1.85	4.53[b]	1.85	5.00[b]	2.56
Self-declared IGD T2	2.10[a]	1.14	2.84[b]	1.10	3.00[b]	1.55
	Recreational ($N = 468$)		Engaged ($N = 216$)		Problematic ($N = 15$)	
T2	Mean	*SD*	Mean	*SD*	Mean	*SD*
Frequency gaming (days) T1	5.71[a]	2.20	6.52[b]	1.77	7.13[b]	1.30
Duration gaming (hr) T1	3.88[a]	1.85	4.21[b]	1.81	5.53[c]	2.13
Self-declared IGD T1	2.43[a]	1.12	3.02[b]	0.95	3.53[b]	1.30
Frequency gaming (days) T2	4.95[a]	2.32	6.41[b]	1.79	6.60[b]	2.38
Duration gaming (hr) T2	3.60[a]	1.62	4.74[b]	1.94	7.33[c]	2.26
Self-declared IGD T2	2.01[a]	1.03	3.14[b]	0.99	3.93[c]	1.28

Note. Different subscripts mean significant differences between classes. *SD*: standard deviation; IGD: Internet gaming disorder.

Table 4. Descriptive statistics for the female latent classes for T1 and T2

	Recreational ($N = 544$)		Engaged ($N = 58$)	
T1	Mean	*SD*	Mean	*SD*
Frequency gaming (days) T1	2.95[a]	2.45	5.28[b]	2.10
Duration gaming (hr) T1	2.32[a]	1.91	3.95[b]	0.96
Self-declared IGD T1	1.36[a]	1.00	2.74[b]	0.66
Frequency gaming (days) T2	2.89[a]	2.59	3.80[b]	2.06
Duration gaming (hr) T2	2.32[a]	1.78	3.87[b]	0.91
Self-declared IGD T2	1.31[a]	1.24	2.10[b]	0.61
	Recreational ($N = 398$)		Engaged ($N = 23$)	
T2	Mean	*SD*	Mean	*SD*
Frequency gaming (days) T1	3.33[a]	2.27	5.37[b]	2.03
Duration gaming T1	2.50[a]	1.16	4.00[b]	2.21
Self-declared IGD T1	1.50[a]	0.77	2.44[b]	1.04
Frequency gaming (days) T2	2.81[a]	2.03	5.65[b]	2.35
Duration gaming (hr) T2	2.35[a]	1.02	4.30[b]	1.92
Self-declared IGD T2	1.28[a]	0.59	2.83[b]	1.11

Note. Different subscripts mean significant differences between classes. *SD*: standard deviation; IGD: Internet gaming disorder.

stability in the problematic classes. Membership for the problematic class for males appears variable between waves. It should be noted however that the attrition analyses revealed that the more problematic gamers dropped out of the study. It is therefore possible that among the problematic gamers at T1, some would have been identified as problematic at T2, if they would still have been part of the study (compare also 38.5% dropout among problematic gamers to 26% in the total sample).

The results of the χ^2 distribution combining the LCA results and the IGD cut-off score for gaming disorder (cut-off = 5 or more) revealed the following results with respect to Internet gaming disorder. For males, 55 (5.6% of the male sample) adolescents would have been identified as having an IGD at waves 1 and 23 (3.3% of the male sample) adolescents at wave 2. For females, 2 (0.3% of the female sample) adolescents would have been identified as having an IGD at wave 1, and 1 (0.2% of the female sample) adolescent at wave 2. Within the group of engaged gamers, classified based on the LCA, 29 male (3% of the total male sample) adolescents at T1 and 8 male adolescents at T2 (1.2% of the total male sample) would have been identified as having a gaming addiction according to DSM-5 criteria (while receiving an "engaged gamer" label based on the LCA). For the female group, only two at T1 and one adolescent at T2 would have been identified as having an Internet gaming disorder.

Table 5 (males) and Table 6 (females) include information about how often IGD symptoms are scored with a "yes" or "no" for each class and wave separately. For males and

Table 5. Sensitivity and specificity analyses for IGD symptoms for boys

	Recreational		Engaged		Problem	
	T1 (%)	T2 (%)	T1 (%)	T2 (%)	T1 (%)	T2 (%)
Symptom 1 ("give up other activities")	3.0	2.0	28.2	20.4	88.5	80.0
Symptom 2 ("preoccupation")	6.5	7.4	54.7	39.4	92.3	100
Symptom 3 ("withdrawal")	2.3	0.0	54.7	41.7	100	93.3
Symptom 4 ("tolerance")	2.4	2.6	52.8	34.7	100	93.3
Symptom 5 ("loss of control")	3.6	0.0	38.5	35.6	96.2	100
Symptom 6 ("escapism")	15.5	7.7	47.6	52.3	88.5	86.7
Symptom 7 ("conflict and problems")	5.4	2.4	32.7	39.8	88.5	100
Symptom 8 ("deceive/lie")	0.3	1.5	19.1	13.4	84.6	66.7
Symptom 9 ("problems in relationships")	0.6	0.4	19.1	17.6	92.3	80.0

Note. Percentages represent adolescents that responded with "yes" on the IGD symptom. IGD: Internet gaming disorder.

Table 6. Sensitivity and specificity analyses for IGD symptoms for girls

	Recreational		Engaged	
	T1 (%)	T2 (%)	T1 (%)	T2 (%)
Symptom 1 ("give up other activities")	1.3	1.0	34.5	52.2
Symptom 2 ("preoccupation")	1.9	1.0	44.8	39.1
Symptom 3 ("withdrawal")	0.6	0.5	27.6	39.1
Symptom 4 ("tolerance")	1.3	0.3	31.1	47.8
Symptom 5 ("loss of control")	0.9	0.8	42.0	47.8
Symptom 6 ("escapism")	7.4	7.6	58.6	65.2
Symptom 7 ("conflict and problems")	0.8	0.5	22.4	30.4
Symptom 8 ("deceive/lie")	0.6	1.8	27.8	13.1
Symptom 9 ("problems in relationships")	0.2	0.0	10.4	17.4

Note. Percentages represent adolescents that responded with "yes" on the IGD symptom. IGD: Internet gaming disorder.

females, particularly symptom "escapism" is revealing relatively poor specificity and sensitivity between classes. Recreational gamers, both males and females, relatively often experience escapism symptoms.

Psychosocial characteristics

In Table 7, differences in psychosocial factors are presented between different types of gamers. Male problematic gamers scored significantly higher on impulsivity and hyperactivity, and lower on social competence compared to both recreational gamers and engaged gamers at T1. At T2, impulsivity and social competence were significantly different between all three types of gamers, with higher scores for impulsivity and lower scores for social competence as gaming became more problematic.

For girls (Table 8), the recreational and engaged gamers significantly differed on impulsivity, attention problems, and social competence at both waves, with the latter group reporting higher levels of impulsivity and lower levels of social competence. Hyperactivity was only significantly different at wave 1 for girls.

DISCUSSION

The aim of this study was threefold. First, it was evaluated whether there was a stable construct of problematic gaming behavior using the nine IGD criteria assessed using the IGD scale (Lemmens et al., 2015). Second, a sensitivity and specificity analyses with respect to the individual IGD symptoms were performed. Third, possible differences in gaming characteristics and psychosocial factors were observed between the latent classes.

Stability, sensitivity, and specificity of the IGD symptoms

With respect to our first aim, we found that all IGD symptoms contributed relatively well to the latent factor of problematic gaming behavior. This latent factor was invariant over time suggesting that the construct can be assessed consistently over time among adolescents. Within this group of young adolescents (mean age = 13.3 years), adolescents report fairly stable and consistent on the gaming disorder symptoms over a period of 1 year. This stability, however, includes all adolescents, also those who do not report any gaming disorder symptoms. In contrast, within the group of problematic gaming, only a relatively small group (20%) of adolescents revealed stability of problematic gaming between waves (i.e., being identified as problematic gamer on both waves). Some of the problematic gamers at T1 dropped out, but also new problematic gamers emerged. This suggests that problematic gaming in young adolescents can be transient in nature for some adolescents.

With respect to gender differences, the results of the LCA suggested different subtypes of gamers for males and

Table 7. Psychosocial differences between different types of male gamers at T1 and T2

	T1			T2		
	Recreational ($N = 692$)	Engaged ($N = 309$)	Problematic ($N = 26$)	Recreational ($N = 468$)	Engaged ($N = 216$)	Problematic ($N = 15$)
Life satisfaction 1	4.15 (0.58)	4.09 (0.59)	3.95 (1.02)	4.15 (0.56)	4.11 (0.59)	4.26 (0.66)
Impulsivity 1	**1.92 (0.74)^{a}**	**2.28 (0.76)^{b}**	**2.76 (1.10)^{c}**	1.96 (0.77)^{a}	2.19 (76)^{b}	2.40 (0.73)^{b}
Hyperactivity 1	**2.14 (0.88)^{a}**	**2.53 (0.94)^{b}**	**3.07 (1.14)^{c}**	2.18 (0.88)^{a}	2.47 (0.91)^{b}	2.86 (0.79)^{b}
Attention 1	2.16 (0.73)^{a}	2.58 (0.74)^{b}	2.78 (1.07)^{b}	2.17 (0.72)^{a}	2.48 (0.75)^{b}	2.76 (0.84)^{b}
Social competence 1	**1.69 (0.70)^{a}**	**1.84 (0.71)^{b}**	**2.32 (0.92)^{c}**	1.66 (0.69)^{a}	1.85 (0.67)^{b}	2.08 (0.81)^{b}
Life satisfaction 2	4.06 (0.78)	4.09 (0.62)	3.96 (1.07)	4.08 (0.75)	4.09 (0.60)	4.07 (0.85)
Impulsivity 2	1.99 (0.74)^{a}	2.22 (0.71)^{b}	2.56 (1.02)^{b}	**1.95 (0.74)^{a}**	**2.27 (0.72)^{b}**	**2.79 (1.16)^{c}**
Hyperactivity 2	2.17 (0.94)^{a}	2.40 (0.89)^{b}	2.70 (1.24)^{b}	2.12 (0.92)^{a}	2.49 (0.88)^{b}	2.91 (1.19)^{b}
Attention 2	2.29 (0.80)^{a}	2.61 (0.74)^{b}	2.38 (0.87)^{a}	2.24 (0.79)^{a}	2.66 (0.74)^{b}	2.74 (0.68)^{b}
Social competence 2	**1.72 (0.72)^{a}**	**1.75 (0.74)^{a}**	**2.50 (0.82)^{b}**	**1.63 (0.69)^{a}**	**1.91 (0.73)^{b}**	**2.58 (0.87)^{c}**

Note. Different subscripts mean significant differences between classes. Differences between all three classes are represented in bold.

Table 8. Psychosocial differences between different types of female gamers T1 and T2

	Wave 1		Wave 2	
	Recreational ($N = 544$)	Engaged ($N = 58$)	Recreational ($N = 398$)	Engaged ($N = 23$)
Life satisfaction 1	4.15 (0.48)	4.13 (0.61)	4.14 (0.46)	4.20 (0.48)
Impulsivity 1	**1.77 (0.67)^{a}**	**2.08 (0.70)^{b}**	1.77 (0.65)	1.80 (0.53)
Hyperactivity 1	**2.16 (0.90)^{a}**	**2.49 (0.85)^{b}**	2.13 (0.89)	2.30 (0.93)
Attention 1	**2.14 (0.70)^{a}**	**2.60 (0.80)^{b}**	2.17 (0.72)	2.43 (0.81)
Social competence 1	**1.80 (0.74)^{a}**	**2.39 (0.60)^{b}**	1.52 (0.61)	1.55 (0.52)
Life satisfaction 2	**4.03 (0.52)^{a}**	**3.82 (0.51)^{b}**	4.02 (0.48)	3.86 (0.75)
Impulsivity 2	**1.82 (0.64)^{a}**	**2.07 (0.70)^{b}**	**1.83 (0.62)^{a}**	**2.18 (0.74)^{b}**
Hyperactivity 2	2.15 (0.81)	2.25 (0.91)	2.15 (0.82)	2.43 (0.97)
Attention 2	**2.31 (0.70)^{a}**	**2.72 (0.83)^{b}**	**2.33 (0.70)^{a}**	**2.70 (0.84)^{b}**
Social competence 2	**1.69 (0.57)^{a}**	**2.17 (0.52)^{b}**	**1.52 (0.59)^{a}**	**1.79 (0.61)^{b}**

Note. Different subscripts mean significant differences between classes. Differences between two classes are represented in bold.

females. Three groups of male gamers were distinguished: (a) recreational gamers, (b) engaged gamers, and (c) problematic gamers. For females, a two-group solution fitted the data best with (a) recreational gamers and (b) engaged gamers. Using a cut-off point for the IGD symptoms, as suggested for an IGD diagnosis congruent with the DSM-5 (Petry, Rehbein, Ko, & O'Brien, 2015), appeared to be particularly problematic for the male engaged gamers. A total of 29 boys at T1 and 8 boys at T2 would have been identified as having an IGD on basis of the DSM-5 cut-off point while the LCAs identified these boys as engaged gamers. To get a better understanding of this observed difference in the identification of problematic gamers, responses on the IGD symptoms were further analyzed and revealed two important things: First, the most important finding with respect to reported symptoms between types of gamers was found for "problem symptoms" such as conflict, deceive a lie, and giving up other activities. This was found for females and males but particularly prevalent and characteristic for the male problematic gamer. A similar finding was found by Carras and Kardefelt-Winther (2018), who found that the problem criteria most strongly differentiated between recreational and problematic gamers. In addition, the symptoms that seem to identify the problematic gamer in this study, closely matche the WHO definition of gaming disorder focusing on (a) loss of control over gaming, (b) loss of interest in other activities, and (c) continuation despite negative consequences.

Second, further evaluation of the responses on the specific symptoms revealed that the "escapism" symptom was less discriminative between classes for both males and females. This finding was supported by the lower factor loadings for this symptom at both waves. This finding is in line with Billieux et al. (2015) who found two problematic clusters of gamers. However, for one of these clusters, escapism motives appear to underlie their game play and it was suggested that the gaming behavior of this particular group might be a coping strategy for another (mental) problem. Escapism symptoms might therefore not identify adolescents at risk of problematic gaming but may rather be a reflection of another underlying problem. Future research could benefit from studying this assumption in more detail; based on the result of this study, we can at least conclude that the sensitivity of the symptom is low and does not contribute to identification of the problematic gamer, also non-problematic gamers score high on this symptom. It is further noticeable that the criteria "problems in relationships" and "deceiving/lying" are less often perceived as

symptoms in the engaged male gamers group, suggesting that these symptoms might be typical for the problematic gamer. Lying about gaming behavior might be indicative for perceived problems with gaming. This symptom might be closely related to perceived problems with family and friends. When gaming behavior is resulting in perceived (by the adolescent themselves) conflict in relationships, it might be better to lie about gaming (to avoid conflict), as suggested by Carras and Kardefelt-Winther (2018) who found that particular problem symptoms such as conflict with parents or problems with school or friends are important for problematic gaming behavior. These findings are particular relevant with respect to the ongoing debate (e.g., Griffiths et al., 2016; Kardefelt-Winther, 2015) about the discriminative ability of the IGD criteria. It is essential for future research to include clinical samples to gain more comprehensive knowledge of the symptoms that discriminate between engaged and problematic male gamers and between problematic gaming as primary and secondary disorders (Billieux et al., 2015; Griffiths et al., 2016). Moreover, the findings of this study indicate that future research focusing on the development of screening tools as well as treatment for problematic gaming behavior could benefit from incorporating elements of gaming symptoms that are defined by the WHO.

Gaming characteristic and psychosocial differences between adolescent gamers

With respect to gaming behavior, the classes for males mainly differed with regard to hours spend on gaming per week (highest among the problematic gamers) and self-declared game addiction (problematic gamers perceived their behavior more often as addicted compared to the engaged gamers). However, it should be noted that the group problematic gamers was relatively small (2.4%) and only observed among the male gamers. This suggests that particularly boys are at risk of the development of problematic gaming, a finding consistent with previous literature (Andreassen et al., 2016; Carras & Kardefelt-Winther, 2018). For girls, only a recreational and engaged class of gamers was found. Again, self-declared addiction and duration were important gaming characteristic that differentiated between the two groups. Moreover, for girls, frequency of gaming also differentiated between recreational and engaged gamers.

With respect to psychosocial differences between types of gamers, for males, it was found that problematic gamers were less socially competent and more impulsive compared to the engaged and recreational gamers. For females, compared to the recreational gamers, the engaged gamers were less socially competent and more impulsive. Taken together, these results suggest that lack of control is an important characteristic for males as well as for females that might underlie the development of problematic gaming behavior. These findings are in line with a study by Billeux et al. (2015) who found that problematic gaming behavior was characterized by lower behavioral control. Moreover, these findings are in agreement with studies that found strong overlap between ADHD and problematic gaming behavior (Andreassen et al., 2016; Müller et al., 2015). Adolescents who have problems with impulsivity/attention are perhaps more likely to be attracted toward games and are less able to stop with gaming. As a result, adolescents with ADHD might be at in increased risk of developing problematic gaming behavior (Peeters et al., 2018).

Both difficulties on a personal level, and difficulties on an intrapersonal level, such as experiencing problems with friendship (formation) and social interaction, appear to be important risk factors for problematic gaming. Weaker social competence was more common among the (more) problematic gamers (i.e., engaged gamers for females). This finding is partly in contrast with a study by Carras et al. (2017) who found that friendship quality was higher among a group of heavy adolescent gamers. It was suggested that this group used gaming for online social interaction and therefore scored relatively high on friendship quality. In this study, both the engaged gamers and the male problematic gamers scored significantly lower on social competence (e.g., friendship quality), suggesting that more (problematic) gaming was associated with a lower perceived social competence. The similarities between problematic and engaged male gamers on several psychosocial characteristics could, at least for some adolescents, reflect a weak line between the engaged and problematic classes. Analyses reflecting on transitions between classes and waves indeed reveal that more than 50% of the problematic gamers at T2 were engaged gamers at T1.

It should further be noted, however, that a small group of adolescents indicated that they did not play games at all in the past 3 months. These adolescents were excluded from the analysis. It is therefore possible that the recreational gamers score relatively better on social competence compared to the non-gamers. Research by Van Den Eijnden et al. (2018) indeed also reveals positive effects of frequency of gaming on social competence. Nevertheless, it remains a fact that the problematic gamer reports more problems with social competence.

Taken together, these findings indicate that both relatively weak behavioral control and relatively weak social competence are important differentiating characteristics of the more problematic gaming adolescents. These youngsters might have more difficulties to control their behavior and could more easily lose grip of their game play. In addition, when youngsters experience problems in social interaction, gaming might be a satisfying and rewarding activity in which the need for belonging, which is not met in real life, can be found online (Peeters et al., 2018). Therefore, adolescents who experience difficulties in social interaction and behavioral control are at an increased risk of developing problematic gaming behavior.

Limitations

The findings of this study should be considered in light of some limitations. First of all, for data-driven statistical methods like LCA, it is crucial to select a representative sample to ensure that generalization to other similar populations is possible. In this particular study, however, we are fairly convinced that the study sample is a good reflection of the general population. The Digital Youth Project, of which this study is part, reveals similar prevalence rates of IGD (according to the DSM-5 definition) as a national representative study. In this study at T1, 5.6% of

the boys would have been identified as problematic gamer, compared to 5.2% of the boys in a national representative study (HBSC; Stevens et al., 2017). For girls, the prevalence of IGD was a bit lower, namely, 0.3% compared to 0.9% in the national representative study. However, it should be noted that adolescents from the lower levels of education were slightly overrepresented in the Digital Youth Project (HBSC; Stevens et al., 2017).

Second, a substantial amount of adolescents (26%) participated only at the first wave and not at the second wave. Attrition analyses revealed that the more problematic gamers (scored significantly higher on duration and total of IGD symptoms) were more likely to drop out at follow-up. Consistent with the findings of this study, this dropout group scored significantly lower on socially competence and behavioral control, compared to adolescents who completed both waves. This implies that if we would have included this group in this study at wave 2, the number of problematic gamers would probably have been higher. It is possible that these problematic gamers drop out of the study due to negative consequences of their gaming behavior. Perhaps, these adolescents skipped school because of their gaming behavior and as a result were not included in follow-up.

Finally, this study is conducted relatively early in adolescence, which makes it less likely that a disorder has already developed. This is also represented by the low percentage of problematic male gamers (i.e., 2.4%). Longitudinal studies throughout adolescence and early adulthood are needed to gain better insight into the development of gaming behavior. Studies comprising a larger timespan could increase our understanding of the (in)stability of problematic gaming throughout adolescence and young adulthood.

CONCLUSIONS

The IGD scale (Lemmens et al., 2015), based on the nine IGD criteria of the DSM-5, seems to differentiate well between recreational, engaged, and problematic gamers. In addition, it reveals to be a consistent measure of IGD criteria over time in young adolescents. Clear sex differences emerged between the latent classes observed, with boys being more likely to be classified as problematic gamers than girls. The WHO definition of gaming disorder closely matches the symptoms that appeared to be characteristic for the problematic gamer in this study; losing interest in other activities, losing control, and continuing gaming despite negative consequence such as problems and conflict. This also indicates that some caution with the cut-off criteria for an IGD disorder (DSM-5) is required since not all criteria differentiate equally efficient between engaged and problematic gamers. Future research should further disentangle the poor differentiating criteria from the properly differentiating criteria by comparing clinical and non-clinical gamers. Diagnostic evaluation of IGD could be optimized by the inclusion of certain criteria that must be at least present (for adolescents), such as experiencing problems in social relations.

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