



Passion or addiction? Correlates of healthy versus problematic use of videogames in a sample of French-speaking regular players

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HIGHLIGHTS

- The study confirmed the distinction between engagement and addiction in video games.
- Addiction is linked to impulsive traits and depressive symptoms, but engagement is not.
- Both addiction and engagement correlate with the DSM-5 Internet gaming disorder (IGD).
- IGD criteria do not necessarily reflect problematic use and can pathologize gamers.
- The study calls for refinement of current diagnosis criteria of gaming disorder.

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ABSTRACT

A criticism of current diagnostic approaches to gaming disorder is that they fail to take into account that high and repeated engagement is not problematic per se, nor is it necessarily associated with adverse consequences. To tackle this controversy, we used Confirmatory Factor Analysis (CFA) to test, in regular gamers (N = 268), whether high (but healthy) engagement can be distinguished from problematic engagement by using the Addiction-Engagement Questionnaire (Charlton & Danforth, 2007). We then tested whether differential relationships exist between the engagement and addiction constructs, DSM-5 criteria for Internet gaming disorder (IGD), and psychological factors linked to gaming use and misuse (self-reported impulsivity, motives to play, and depression). Results indicated that a model holding engagement and addiction as two distinct, but related, constructs fits the data well. Second, we showed that although both constructs are linked to the number of IGD criteria endorsed, the relationship is more pronounced for the addiction construct. Third, a differential pattern of correlations was observed with the other study variables, further supporting the need to distinguish the two constructs. Our study emphasizes that research is needed to refine the diagnostic approach to gaming disorder to avoid conflating healthy passion with pathological behavior.

1. Introduction

A growing number of studies focused on excessive use of videogames and its associations with psychiatric, health, and interpersonal problems (e.g., Achab et al., 2011; Longman, O'Connor, & Obst, 2009; Pawlikowski & Brand, 2011; Stetina, Kothgassner, Lehenbauer, & Kryspin-Exner, 2011). Studies also included treatment-seeking cases (Müller et al., 2017; Sakuma et al., 2017; Thorens et al., 2014), indicating that problematic engagement in videogames has become a

clinical reality.

Section 3 of the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) integrated Internet gaming disorder (IGD) as a condition for further study, and the beta draft of the 11th revision of the International Classification of Diseases (ICD-11; World Health Organization, 2017) included gaming disorder in the section “Disorders due to substance use or addictive behaviours.” Following the release of the DSM-5, numerous epidemiological and case-control studies were conducted and

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accumulating data about IGD were gathered, although the validity of the proposed IGD criteria remains debated (Deleuze et al., 2017; Griffiths et al., 2016).

Still, most studies fail to take into account that high engagement is not necessarily problematic (Colder Carras & Kardefelt-Winther, 2018; Király, Tóth, Urbán, Demetrovics, & Maraz, 2017) and that not all highly engaged gamers experience adverse consequences (Billieux et al., 2017; Charlton & Danforth, 2007; Kardefelt-Winther et al., 2017). In this regard, the seminal works of Charlton (2002) and Charlton and Danforth (2007) questioned the approach that consists of applying recycled substance use disorder criteria to the screening of computer-related addictive behaviors. Using Browns's (1993) criteria for behavioral addictions as a rationale, Charlton and Danforth (2007) highlighted that when applied to gaming, these criteria constitute either “core” criteria that potentially reflect addiction (i.e., conflicts, withdrawal, relapse and reinstatement, and behavioral salience), or, in contrast, “peripheral” criteria that reflect elevated yet non-problematic engagement (i.e., cognitive salience, tolerance, and euphoria). Crucially, the IGD criteria included in the DSM-5 comprise both core and peripheral criteria, which is a concern when defining a potentially new disorder. Along the same lines, Deleuze et al. (2017) suggested that IGD criteria conflate high and problematic engagements. Other studies supported the notion that high engagement must be distinguished from harmful engagement. Thus, Billieux et al. (2013) showed in a longitudinal study that fast in-game progression is not associated with symptoms of disordered gaming, implying that high engagement is not necessarily problematic. More recently, Przybylski, Weinstein, and Murayama (2017) used IGD criteria in a large sample from the general population and reported that only a small proportion of the sample could be qualified as having clinically relevant problematic use of online gaming (between 0.3% and 1%). Furthermore, most participants endorsing the IGD diagnosis are highly engaged players who face minimal consequences in relation to gaming. Failing to distinguish between a dysfunctional from a high but healthy engagement might have important repercussions, such as generating unreliable epidemiological studies or pathologizing normal behavior (Aarseth et al., 2017; Bean, Nielsen, van Rooij, & Ferguson, 2017; Billieux, Schimmenti, Khazaal, Maurage, & Heeren, 2015; Markey & Ferguson, 2017).

Accordingly, further disentangling the characteristics and correlates of high versus maladaptive engagement in videogames is urgent. To this end, we tested in a sample of regular gamers whether the two constructs developed by Charlton and Danforth, “engagement” versus “addiction,” are identified by using confirmatory factor analysis (CFA), as their initial works relied only on exploratory factor analyses (Charlton, 2002; Charlton & Danforth, 2007). If successful, this first objective will provide a psychometrically sound French version of the Addiction-Engagement Questionnaire developed by Charlton and Danforth (2007). Our second objective was to explore whether differential relationships exist between Charlton and Danforth's engagement and addiction constructs and specific factors that have been linked to gaming use and misuse, including impulsivity (Billieux, Thorens, et al., 2015; Choi et al., 2014; Ko et al., 2015), depression (Bargeron & Hormes, 2017; Gentile et al., 2011), and motivations to play online (Billieux, Thorens, et al., 2015; Kirby, Jones, & Copello, 2014; Yee, 2006). We expected to find differential associations, so that the addiction construct only would correlate with factors having been related to problematic videogame use in previous studies. Finally, we explored the relationships between the tentative DSM-5 IGD criteria and the engagement and addiction constructs. Because IGD criteria are supposed to measure pathological behavior, we expected them to correlate specifically with the addiction construct.

2. Method

2.1. Participants and procedure

Participants were recruited through an online contact survey sent to the entire student community of the Université catholique de Louvain (Belgium) by using an online platform (Qualtrics, Provo, UT), reaching a total of 1637 potential participants. Inclusion criteria were being 18 years or older, native or fluent French speaker, and playing online videogames at least once per week. Of the 645 eligible participants, 291 gamers completed the entire survey, of which 23 were removed because of incomplete data.

The final sample consisted of 268 participants (48 females) between 18 and 34 years ($M = 21.52$, $SD = 3.00$). Completing the survey guaranteed their participation in a random draw in which five respondents of the total sample received 20 euros in cash. The ethical committee of the Psychological Science Research Institute of the Université catholique de Louvain approved the study protocol.

The participants started the online survey by providing their informed consent. They filled out demographic (age, gender, language, educational level) and online gaming-related information (favorite genre, number of hours spent playing per week). They filled out questionnaires in the following order: the Addiction-Engagement Questionnaire (Charlton, 2002; Charlton & Danforth, 2007), IGD criteria (Petry et al., 2014), the short UPPS-P Impulsive Behavior Scale (s-UPPS-P; Billieux et al., 2012), the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977), and the Motivation to Play in Online Games Questionnaire (MPOGQ; Yee, 2006). All alpha values reported below were obtained in the current sample.

2.2. Instruments

2.2.1. Addiction-Engagement Questionnaire

The Addiction-Engagement Questionnaire (Charlton & Danforth, 2007, 2010) is a 24-item scale measuring two types of online videogame engagement. The participants first indicate which specific game they currently play the most, the name of this game then being implemented in each of the questionnaire's items. In developing the French Addiction-Engagement Questionnaire, the 24 items were first translated into French before being back-translated into English by a bilingual English-French speaker. The back translation resulted in a solution that was acceptable for all items. The first 12 items measure dysfunctional engagement in videogames (Addiction subscale), while the last 12 items are assumed to measure healthy engagement in videogames (Engagement subscale). The French questionnaire, along with the corresponding English items, are reported in the Appendix 1.

2.2.2. Internet gaming disorder (IGD)

The nine IGD criteria were assessed with a nine-item questionnaire provided by Petry et al. (2014). The respondents have to provide a binary answer regarding whether they endorse each item as having occurred over the past 12 months. The IGD items measure preoccupation, withdrawal, tolerance, loss of control, loss of interest, excessive gaming despite problems, deception, negative mood regulation, and jeopardizing. Five or more positive answers are required to indicate IGD (American Psychiatric Association, 2013; Petry & O'Brien, 2013).

2.2.3. Short UPPS Impulsive Behavior Scale (s-UPPS-P)

Impulsivity was measured with the s-UPPS-P (Billieux et al., 2012). This 20-item questionnaire measures five distinct impulsivity facets on a 4-point Likert scale: negative and positive urgency (i.e., acting rashly under the influence of strong negative and/or positive emotions; Cronbach's alphas of 0.81 and 0.75), lack of premeditation (i.e., difficulties taking into account the consequences of an action; Cronbach's $\alpha = 0.84$), lack of perseverance (i.e., difficulties remaining focused on a difficult or boring task; Cronbach's $\alpha = 0.90$), and sensation seeking

(i.e., searching for new and thrilling experiences; Cronbach's $\alpha = 0.81$).

2.2.4. Center for Epidemiologic Studies Depression Scale (CES-D)

The 20-item French version of the CES-D was used (Fuhrer & Rouillon, 1989; Morin et al., 2011) to measure depression. Items are scored on a 4-point Likert scale (Cronbach's $\alpha = 0.90$). The CES-D was used in the current study as a dimensional measure of depression.

2.2.5. Motivation to Play in Online Games Questionnaire (MPOGQ)

The MPOGQ (Yee, 2006) is a 39-item questionnaire that measures the motivations to play online videogames on a 5-point Likert scale. Ten motivations to play are assessed under three main categories: (1) Achievement, including Advancement (i.e., progression in the game; Cronbach's $\alpha = 0.79$), Mechanics (i.e., knowing how the game system works; Cronbach's $\alpha = 0.79$), and Competition (i.e., challenging other players; Cronbach's $\alpha = 0.73$); (2) Social, including Socializing (i.e., helping and chatting with others; Cronbach's $\alpha = 0.80$), Relationship (i.e., forming long-term relationships; Cronbach's $\alpha = 0.77$), and Teamwork (i.e., being part of the group effort; Cronbach's $\alpha = 0.76$); and (3) Immersion, including Discovery (i.e., discovering as many things as possible within the game; Cronbach's $\alpha = 0.85$), Role-Playing (i.e., creating a background for the avatar, interacting with others as if you were the character; Cronbach's $\alpha = 0.84$), Customization (i.e., liking to customize the appearance of the avatar; Cronbach's $\alpha = 0.82$), and Escapism (i.e., escaping from real-life problems through the game; Cronbach's $\alpha = 0.67$). The French version (Billieux et al., 2013) was used in the present study.

2.3. Data analysis

To determine the factorial structure of the Addiction-Engagement Questionnaire, we undertook CFA with maximum likelihood estimation. We compared three models that consider the relationships among the two components of problematic playing of online videogames. The first model holds that there is a single unitary construct of gaming engagement. The second model identifies two independent constructs of addiction and engagement, while the third model recognizes those two factors as being interrelated.

Regarding model evaluation, we chose to compute relative chi-square values (χ^2/df) to test the goodness of fit for each model, because χ^2 is known to increase with sample size, and it is unusual to obtain nonsignificant χ^2 values when performing CFAs on self-reported questionnaires (Byrne, 1994). A relative χ^2 of between 1 and 2 indicates a reasonable fit (Byrne, 2012; Marsh & Hocevar, 1985). Moreover, in addition to χ^2 , two other indices that depended on conventional cutoffs were computed, namely, the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR) (Hu & Bentler, 1999). Their combination was adopted because the RMSEA is sensitive to misspecification of the factor loadings and the SRMR is sensitive to the misspecification of the factor covariances. An RMSEA of between 0 and 0.05 indicates a good fit and that between 0.05 and 0.08 represents an acceptable fit. An SRMR of between 0 and 0.05 indicates a good fit and that between 0.05 and 0.10 represents an acceptable fit (Schermelleh-Engel, Moosbrugger, & Müller, 2003). We also reported the comparative fit index (CFI). A CFI higher than 0.90 indicates an acceptable fit (Hooper, Coughlan, & Mullen, 2008). Internal reliability of the Addiction-Engagement Questionnaire and its two postulated subscales was measured with Cronbach's α coefficient.

Two-tailed Pearson correlations were used to explore the relationships between the Addiction-Engagement subscales and the other constructs included in the study. When both scales of the Addiction-Engagement Questionnaire significantly correlated with a specific construct, Fisher z-to-r transformations were performed to compare these correlations.

Table 1
Descriptive statistics, internal consistency, and Pearson correlations for the Addiction-Engagement Questionnaire.

Scale	Mean	SD	α	1	2
1. Total score (24 items)	87.97	17.81	0.80	–	
2. Addiction subscale (12 items)	32.98	12.44	0.75	0.84*	–
3. Engagement subscale (12 items)	54.99	9.96	0.79	0.74*	0.26*

* $p < 0.001$.

3. Results

3.1. Structural validity of the addiction and engagement constructs

To confirm the bi-factorial nature of high engagement in gaming (engagement versus addiction), we computed a series of CFAs on the 24 items of the Addiction-Engagement Questionnaire.

Means, standard deviations, internal consistency coefficients (Cronbach's α), and correlations for the Addiction-Engagement Questionnaire are reported in Table 1. Cronbach's α ranged from 0.75 to 0.80, suggesting good internal consistency for the 24-item scale and its two subscales.

Absolute fit indices of the three computed models are summarized in Table 2. First, the results showed that the single-factor model in which all items loaded on a unique latent factor poorly fits the data (see Table 2, Model 1).

Second, the two-factor models both had a better fit than the first model did (see Table 2, Model 2), and the two-factor model that assumes an interrelation between the engagement and addiction constructs offers the best fit to the data (see Table 2, Model 3a).

From the modification indices provided for Model 3 and a subsequent content and semantic analysis of the items (see Appendix 2 for details), 11 residual pairs of errors were allowed to covary (see Fig. 1). The CFA computed for the modified third model suggested that the modifications improved the global model fit (see Table 2, Model 3b).

3.2. Correlation analyses

Table 3 reports the Pearson's correlations measured between the two subscales of the Addiction-Engagement Questionnaire, socio-demographics, and other variables included in the study.

First, the number of IGD criteria endorsed were positively correlated with both subscales, with a significant stronger relation for the Addiction subscale ($r = 0.56$ for Addiction and $r = 0.30$ for Engagement). In contrast, the magnitude of the relationship between both subscales and self-reported time spent playing was equivalent. Regarding socio-demographic variables, no significant relationship was observed. Concerning factors that have been linked to videogame overuse, specific significant relationships were identified for the Addiction subscale (with all s-UPPS-P variables, except for lack of premeditation and with depressive symptoms). Numerous relationships were observed between the two facets of the Addiction-Engagement Questionnaire and the various motives to play online. First, all

Table 2
Fit indices of the CFAs for the Addiction-Engagement Questionnaire based on the various hypothesized models.

Model	df	χ^2	χ^2/df	RMSEA	SRMR	CFI
1	252	847.67*	3.36	0.094	0.1040	0.544
2	252	590.12*	2.34	0.071	0.0952	0.741
3a	251	572.90*	2.28	0.069	0.0788	0.754
3b	240	363.35*	1.514	0.044	0.0665	0.906

CFA = confirmatory factor analysis; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; CFI = comparative fit index.

* $p < 0.001$.

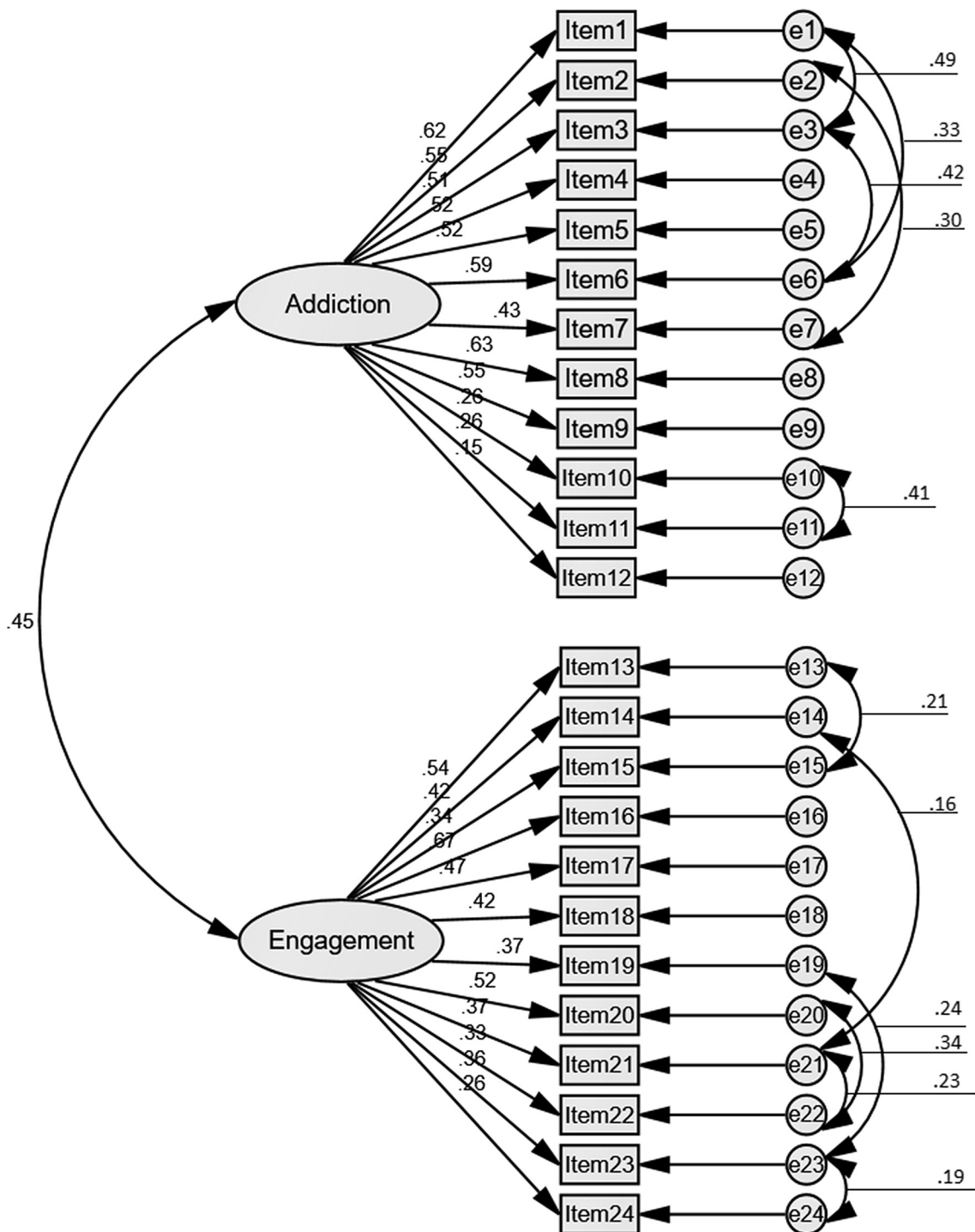


Fig. 1. The standardized estimates of the modified, inter-related, two-factor model. Latent variables are represented by ovals and manifest variables are represented by rectangles. Single-headed arrows represent error variance and factor loading; double-headed arrows represent the correlation between the latent variables.

achievement motives were correlated with both Engagement and Addiction subscales. The only quasi-significant difference in correlations' size concerned the mechanics component, which tended to be more important for players with a high engagement score. Second, the only social motive linked to both engagement and addiction was the relationship motive. However, the latter did not have a significantly more pronounced relationship with any of the videogame engagement subscales. Third, a differential pattern of correlations appeared for immersion motives. Indeed, whereas the escapism motive was similarly linked to both engagement and addiction, the other immersion-related motives were significantly related only to the Engagement subscale.

4. Discussion

The purpose of this study was to further test the relevance of distinguishing between high engagement and problematic engagement in videogames. Indeed, current conceptualizations of problematic use tend to overlook this distinction, engendering conflation between healthy and pathological gaming patterns. The current study thus tested the structural validity of the Addiction-Engagement Questionnaire (using confirmatory analyses) and explored its relationships with DSM-5 IGD criteria, depressive symptoms, and factors that have been related to videogame use and misuse. The main findings of the study are as

Table 3
Pearson correlation between Addiction-Engagement subscales and self-report measures.

Variable	Engagement	Addiction	z	p
Age	.115	-.081	-	-
Gender	.047	.114	-	-
IGD	.303**	.558**	-3.65	.0003
Hours/all games	.255**	.195**	.073	.4654
s-UPPS-P – urgency	.047	.159**	-	-
s-UPPS-P – positive urgency	.112	.199**	-	-
s-UPPS-P – lack of premeditation	-.034	.075	-	-
s-UPPS-P – lack of perseverance	.023	.171**	-	-
s-UPPS-P – sensation seeking	.092	.123*	-	-
CES-D	.061	.272**	-	-
MPOGQ – advancement	.338**	.322**	.21	.8337
MPOGQ – mechanics	.345**	.192**	1.9	.0574
MPOGQ – competition	.223**	.291**	-0.84	.4009
MPOGQ – socializing	.092	-.037	-	-
MPOGQ – relationship	.212**	.141*	.84	.4009
MPOGQ – teamwork	-.049	-.057	-	-
MPOGQ – discovery	.201**	.013	-	-
MPOGQ – role-play	.230**	.051	-	-
MPOGQ – customization	.184**	.076	-	-
MPOGQ – escapism	.287**	.303**	-0.2	.8415

Note. The z and p columns refer to the Fisher z-to-r transformation.
IGD = Internet Gaming Disorder; s-UPPS-P = Short UPPS Impulsive Behavior Scale; CES-D = Center for Epidemiologic Studies Depression Scale; MPOGQ = Motivation to Play in Online Games Questionnaire.
* p < .05.
** p < .005.

follows. First, CFA analyses emphasized that a model holding engagement and addiction as two distinct but related constructs fits the data, further supporting the need to distinguish high from problematic engagement. Second, both constructs are linked to the endorsement of IGD criteria, yet this relationship is more pronounced for the addiction construct. Third, a differential pattern of correlations was observed in which the addiction construct is specifically related to heightened impulsivity and more elevated depression. The engagement construct is specifically related to several immersion motives (role-playing, exploring, customization).

The present study corroborates previous findings by Charlton (2002) and Charlton and Danforth (2007), indicating that recycled substance abuse criteria (e.g., preoccupation, tolerance, euphoria) might not be valid in defining pathological engagement in a behavior such as gaming (Karddefelt-Winther et al., 2017). They constitute peripheral criteria that are not indicative of a genuine disorder. In support of this statement, our study shows that factors that are typically linked to problematic behaviors such as impulsivity or depressive symptoms are not related to the engagement construct, which comprises items that assess peripheral criteria. In contrast, the addiction construct comprises core criteria that are potentially indicative of a disorder (e.g., conflicts, withdrawal symptoms) when co-occurring, and are associated with increased impulsivity and depressive symptoms. These results call for a refinement of the criteria generally used to measure behavioral addictions, as well as for caution when, for example, applying Brown's components model of addiction (1993, modified by Griffiths, 2005) to excessive behaviors. Indeed, such an approach gained popularity in the behavioral addiction field (e.g., “Facebook addiction”, Andreassen, Torsheim, Brunborg, & Pallesen, 2012; “TV series addiction”, Orosz, Bóthe, & Tóth-Király, 2016), insidiously resulting in potential pathologization of normal behavior.

Along the same lines, an important finding was that both Addiction and Engagement subscales positively correlate with the number of DSM-5 IGD criteria endorsed, although the size of this relation is more pronounced for Addiction. This correlation results from the reliance of IGD criteria on polythetic scoring, which mixes core and peripheral criteria. From this observation, the use of IGD criteria to screen for pathological gaming in epidemiological studies (e.g., Rehbein, Kliem,

Baier, Mößle, & Petry, 2015; Subramaniam et al., 2016) is likely to result in an inflated prevalence rate because of the conflation between pathological and highly engaged individuals. The diagnosis must instead focus on the functionally impairing nature of gaming engagement (Billieux, King, et al., 2017; Ferguson, Coulson, & Barnett, 2011). The latter approach is aligned with the conceptualization of gaming disorder included in the beta draft of the ICD-11 (World Health Organization, 2017) and with a recent broader definition of behavioral addictions (Billieux, van Rooij, et al., 2017; Karddefelt-Winther et al., 2017). Along the same lines, time spent playing weekly was also positively correlated with both subscales, which is not surprising, given that it is systematically associated with pathological gaming, while highly engaged gamers can also play a lot without experiencing negative outcomes (Ferguson et al., 2011; Király et al., 2017; Kirby et al., 2014; Lemmens, Valkenburg, & Peter, 2009).

Our findings also fit well with the dualistic model of passion (Vallerand et al., 2003), which posits that any activity in which people invest time and energy can be conceptualized as either “harmonious” or “obsessive” passion. Harmonious passions are adaptive and characterized by autonomous internalization (i.e., the activity becomes part of the self in an integrated and positive way; see Deci & Ryan, 2000) and free will (i.e., the activity is performed on a voluntary basis), and it is practiced in harmony with other aspects of life. In contrast, obsessive passions are maladaptive and globally imply a strong urge to engage in the activity that is beyond one's control. The activity is internalized to such an extent that self-worth depends on the compelled commitment to the activity. Obsessive passions are the result of compensatory behaviors for unfulfilled needs and tend to enter into conflict with other aspects of the person's life, engendering negative consequences (Lalande et al., 2017). We hypothesize that the engagement construct is underlain by a harmonious passion for videogames (e.g., linked to achievement and immersion motives, but not to depressive symptoms), whereas the addiction construct is instead the consequence of an obsessive passion (e.g., mainly linked to achievement motives and escapism, and associated with impulsivity and depressive symptoms). This assumption is consistent with previous researches showing that the harmonious use of videogames predicts life satisfaction, improved psychological adjustment, and a sense of self-realization (Lafrenière, Vallerand, Donahue, & Lavigne, 2009), whereas obsessive use of videogames was linked with dissatisfaction, game use to fulfill basic needs, lower game enjoyment, and more negative consequences (Lafrenière et al., 2009; Przybylski, Weinstein, Ryan, & Rigby, 2009).

On the whole, our study emphasizes the crucial need to distinguish repeated healthy versus repeated maladaptive engagement in videogames to avoid conflating passion with disorder, ultimately pathologizing healthy gamers (Aarseth et al., 2017; Billieux, King, et al., 2017). Notably, our results support a critical approach to diagnostic criteria for gaming disorder, in particular those included in Section 3 of the DSM-5 that adopt a polythetic approach mixing core and peripheral criteria to establish the diagnosis. In this vein, gaming disorder, as defined in the ICD-11 approach (World Health Organization, 2017), is interesting in the sense that it considers functional impairment as a mandatory criterion, and includes core criteria as diagnostic guidelines (e.g., loss of control, continued use despite negative consequences). In contrast, the DSM-5 criteria define the condition as a pattern of persistent or recurrent gaming associated to clinically significant impairment or distress, even though functional impairment per se is not listed in the nine potential inclusionary criteria. As a consequence, most of previous studies having used the DSM-5 criteria have not considered functional impairment as a mandatory diagnosis criterion, which might have inflated the prevalence rates reported (Billieux, King, et al., 2017).

An additional benefit of our study is that it provides a French and psychometrically sound version of the Addiction-Engagement Questionnaire. The limitations of the study must be acknowledged, however, in particular its correlational nature, the convenience sample used, the absence of clinical participants, and the use of self-reports.

Further studies should also consider the impact of psychosocial well-being and several background variables (e.g., socio-economic status, parenting or school support, family and school environments) which have been found to importantly contribute in identifying individuals with problem video gaming (Colder Carras & Kardefelt-Winther, 2018). Despite these limitations, the present study offers important avenues for improving the conceptualization and diagnosis of gaming disorder.

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writing of the report; or in the decision to submit the paper for publication.

Contributors

Jory Deleuze and Joël Billieux designed the study. Jory Deleuze elaborated the online survey and collected the data. Jory Deleuze and Jiang Long did the statistical analyses. Jory Deleuze and Joël Billieux interpreted the results and wrote the article. Jory Deleuze, Jiang Long, Tie-Qiao Liu, Pierre Maurage, and Joël Billieux reviewed the manuscript. All authors approved the final version of the manuscript.

Conflict of interest

All authors have no conflicts of interests to declare.

Appendix 1. Items of the Addiction-Engagement Questionnaire in English and French versions. Examples are provided using the game “League of Legends”

English	French
1. I sometimes neglect important things because of an interest in League of Legends	Je néglige parfois des tâches importantes à cause de mon intérêt pour League of Legends
2. My social life has sometimes suffered because of me playing League of Legends	Ma vie sociale a parfois souffert du fait que jouais à League of Legends
3. Playing League of Legends has sometimes interfered with my work	Jouer à League of Legends a parfois interféré avec mon travail ou mes études
4. When I am not playing League of Legends I often feel agitated	Quand je ne joue pas à League of Legends, je me sens souvent agité
5. I have made unsuccessful attempts to reduce the time I spend playing League of Legends	J’ai tenté de réduire, sans y arriver, le temps passé à jouer à League of Legends
6. I am sometimes late for engagements because I am playing League of Legends	J’ai parfois du retard dans mes obligations/engagement parce que je joue à League of Legends
7. Arguments have sometimes arisen at home because of the time I spend on League of Legends	Des disputes ont parfois eu lieu à la maison à cause du temps que je passe sur League of Legends
8. I think that I am addicted to League of Legends	Je pense que je suis accro/addicte à League of Legends
9. I often fail to get enough sleep because of playing League of Legends	J’ai souvent manqué de sommeil parce que je jouais à League of Legends
10. I never miss meals because of playing League of Legends	Je n’ai jamais raté de repas parce que je jouais à League of Legends
11. I have never used League of Legends as an escape from socializing	Je n’ai jamais utilisé League of Legends pour échapper aux relations sociales
12. I often feel that I spend more money than I can afford on League of Legends	J’ai souvent l’impression que je dépense plus d’argent que ce que je peux me permettre dans League of Legends
13. It would not matter to me if I never played League of Legends again	Ça ne me dérangerait pas si je ne jouais plus jamais à League of Legends
14. I feel happy at the thought of playing League of Legends	Je me sens heureux quand je pense au fait de jouer à League of Legends
15. The less I have to do with League of Legends the better	Au moins je joue à League of Legends, au mieux c’est
16. League of Legends is unimportant in my life	League of Legends n’est pas important dans ma vie
17. I would hate to go without playing League of Legends for more than a few days	Je détesterais ne pas jouer à League of Legends pendant plusieurs jours
18. I rarely think about playing League of Legends when I am not using a computer	Je pense rarement au fait de jouer à League of Legends quand je n’utilise pas un ordinateur (ou autre support me permettant d’y jouer)
19. I pay little attention when people talk about League of Legends	Je ne fais pas beaucoup attention quand les gens parlent de League of Legends
20. It is important to me to be good at League of Legends	C’est important pour moi d’être bon à League of Legends
21. I often experience a buzz of excitement while playing League of Legends	Je ressens souvent un frisson d’excitation quand je joue à League of Legends
22. I like the challenge that learning to play League of Legends presents	J’aime le défi que représente le fait d’apprendre à jouer et de progresser dans League of Legends
23. League of Legends jargon sounds stupid to me	Le vocabulaire/jargon utilisé dans League of Legends me paraît stupide
24. I can’t understand why people like League of Legends	Je ne peux pas comprendre pourquoi les gens aiment League of Legends

Appendix 2. Items for which error pairs were allowed to covary. Examples are provided using the game “League of Legends”

Items of residual correlations implemented for modification	
1	1. I sometimes neglect important things because of an interest in League of Legends
2	1. I sometimes neglect important things because of an interest in League of Legends
3	2. My social life has sometimes suffered because of me playing League of Legends
4	3. Playing League of Legends has sometimes interfered with my work
5	10. I never miss meals because of playing League of Legends
6	13. It would not matter to me if I never played League of Legends again
7	14. I feel happy at the thought of playing League of Legends
8	19. I pay little attention when people talk about League of Legends
9	20. It is important to me to be good at League of Legends
10	21. I often experience a buzz of excitement while playing League of Legends
11	23. League of Legends jargon sounds stupid to me
	3. Playing League of Legends has sometimes interfered with my work
	7. Arguments have sometimes arisen at home because of the time I spend on League of Legends
	7. Arguments have sometimes arisen at home because of the time I spend on League of Legends
	6. I am sometimes late for engagements because I am playing League of Legends.
	11. I have never used League of Legends as an escape from socializing
	15. The less I have to do with League of Legends the better
	21. I often experience a buzz of excitement while playing League of Legends
	23. League of Legends jargon sounds stupid to me
	22. I like the challenge that learning to play League of Legends presents
	22. I like the challenge that learning to play League of Legends presents
	24. I can't understand why people like League of Legends

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