

# Development of the game addiction inventory for adults (GAIA)

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This study describes the development of the Game Addiction Inventory for Adults (GAIA). First, a pool of 147 video game addiction-related items was generated from interviews with 25 people who have had experience with video game addiction and a literature review. Next, an online survey of 456 adult-aged video game players drawn from university students and participants of online video game web sites provided data for reduction of the item pool and examination of the factor structure of the pool using common factor analysis. Finally, a correlational analysis was conducted between the factor solution and associated variables. The GAIA consists of five addiction-related subscales: loss of control and consequences, agitated withdrawal, coping, mournful withdrawal, and shame; and a 26-item overall addiction subscale was produced by summing these five factors. In addition, an engagement subscale was also developed from the factor analytic process and was found to be quantitatively and qualitatively different from the addiction related subscales. The subscales of the GAIA demonstrated good internal consistency, good convergent validity, and concurrent validity with other measures of video game addiction. The GAIA demonstrated mixed discriminant validity with pathological gambling and substance addictions. Future research should continue to investigate the psychometric properties of the GAIA and the utility of its subscales in research and clinical settings.

**Keywords:** Addiction, inventory, measurement, problem video game play, scale, video game

## INTRODUCTION

Our understanding of video game addiction is still in its infancy but anecdotal evidence and early research suggests that some individuals play video games in an addictive and harmful manner. The media has regularly highlighted sensational cases of injury or death that have allegedly resulted from video game addiction (ABC News, 2011; Macleans, 2008; Mail Online, 2011).

In response to the increasing reports of video game addiction, the American Medical Association proposed the addition of a diagnosis for video game addiction to the next revision of the *Diagnostic and Statistical Manual of Mental Disorders*, the fifth edition (DSM-V). The American Psychiatric Association responded with a cautionary statement against prematurely classifying video game addiction as a mental disorder and suggested that more research is needed before it can be considered for inclusion as a formal diagnosis (APA, 2007). However, “Internet Use Gaming Disorder” will be included in an appendix of the DSM-V to encourage further study (APA, 2012a).

While the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition, text revision (DSM-IV-TR; APA, 2000) avoided use of the word “addiction”, recent research increasingly supports the validity of a broad conceptualization of addiction that encompasses both behavioral and substance addictions (el-Guebaly, Mudry, Zohar, Tavares, & Potenza, 2012; Grant, Potenza, Weinstein, & Gorelick, 2010). For example, individuals with behavioral addictions and individuals with substance addictions both present with the shared core feature of a failure to resist an impulse, drive or temptation to perform an act that is harmful to the person or others. Individuals in both substance and behavioral addictions describe feeling urges or cravings prior to engaging in addictive acts and a decrease in anxiety or positive mood state after

the addictive acts. Also, behavioral addictions resemble substance addictions in natural history and response to treatment. Both types of addictions lead to the development of tolerance and show similar patterns of comorbidity with other mental health disorders. Research supports an overlapping genetic contribution to and similar neurobiological mechanisms in both behavioral and substance addictions. Overall, evidence is being accumulated that behavioral addictions and substance addictions are etiologically and conceptually more similar than distinct, though much of the data on behavioral addictions are overrepresented by pathological gambling research. In recognition of the fact that behavioral and substance use addictions are phenomenologically similar, the DSM-V will include substance use disorders and pathological gambling in a new “Substance Use and Addictive Disorders” category (APA, 2012b).

Early research proposed a number of conceptualizations of video game addiction. Griffiths and Meredith (2009) have suggested that video game playing can be thought of as a non-financial form of gambling, where players play for points rather than money. Although this comparison was based on similarities between slot machines and early arcade-style video game machines, one could argue that the concept can be extended to view the increasingly varied virtual reward systems in modern video games as a variation of this proposed risk-for-reward “gambling” system. The apparent similarity between video game playing and gambling has led to many early screening instruments for video game addiction being adapted from instruments for pathological gambling. Young (2009) conceived of addictive online video game play as a subtype of Internet addiction that is related to online pathological gambling. Online games have been suggested to provide adolescents with a method for compensating for unsatisfied needs and motivations in their real life outside of gaming, or may act as substitutes for these needs and motivations in their real lives (Wan & Chiou, 2006a, 2006b).

Some researchers and clinicians have criticized the validity of the concept of video game addiction. Wood (2008) argues that the clinical consequences commonly seen in video game addiction such as loss of time and loss of control are normative human experiences and therefore not sufficient for a diagnosis of addiction. Wood (2008) also argues that the perceived prevalence of video game addiction is overestimated due to sensationalist media reports.

Additionally, research by Charlton (2002) and Danforth (Charlton & Danforth, 2007; Charlton & Danforth, 2010) has identified the possibility that confusion between pathological video game addiction and non-pathological video game engagement has contributed to the overestimation of the prevalence of video game addiction. These researchers based their investigation of video game addiction on Brown’s criteria (1993) for behavioral addictions: salience,

conflict, loss of control, relief [labeled “mood modification” in Griffith’s (2005) reiteration of the model], tolerance, withdrawals, and relapse and reinstatement. However, Charlton and Danforth (2007) demonstrated that items adapted to assess Brown’s criteria for video game play load on to an addiction factor and an engagement factor that are moderately independent. Specifically, the addiction factor (Charlton & Danforth, 2007) is associated with pathology and is indicated by the core criteria of: behavioral salience (domination of a person’s life by a need to perform an activity), withdrawal symptoms (where cessation of an activity leads to the occurrence of unpleasant emotions or physical effects), conflict (where an activity leads to conflict with others or self-conflict), and relapse and reinstatement (resumption of an activity with the same vigor despite subsequent attempts to abstain). In contrast, the engagement factor (Charlton & Danforth, 2007) is not necessarily associated with pathology and is indicated by the milder peripheral criteria of: cognitive salience (the tendency to think about an activity to an increasingly greater extent), tolerance (spending an increasing amount of time performing an activity), and euphoria (gaining a buzz of excitement or a high from an activity). The researchers found that video game players who endorsed all the core addiction criteria spent a significantly greater amount of time playing per week than those who only endorsed peripheral engagement criteria (Charlton & Danforth, 2007). Charlton (2002) suggested a developmental model where video game players progress through a stage of engagement before reaching addiction.

### Development of assessment measures

Early scale development efforts have created a number of assessment measures including the: DSM-IV-JV (Fisher, 1994), Excessive Game Playing Scale (Griffiths & Hunt, 1998), Problem Videogame Playing Scale (Salguero & Moran, 2002), Asheron’s Call Addiction and Engagement Scales (Charlton & Danforth, 2007). Griffiths and Meredith (2009) suggested that measures for video game addiction criteria have been problematic because they typically have no indication of severity, have no temporal dimension, have a tendency to overestimate the prevalence of problems, and fail to account for the context of video game use. The validity of early video game measures may also be questionable due to other factors: (a) Many existing measures are standardized against juvenile populations despite business research, suggesting that the mean age of video game players is now 37 years of age [Entertainment Software Association (ESA), 2011]. (b) Measures have tended to use the amount of time playing video games as the main indicator of addiction. A survey of 18,872 American consumers found that 4% of the population, dubbed extreme gamers, spent 48.5 h each week or nearly 7 h each day on average. Extreme gamers spent significantly more

than the 13 h per week spent by the average gamer (Gamespy, 2010). Amount of time is likely correlated with addiction but it does not necessarily imply addictive involvement. For example, an owner of a self-sustaining Internet business might comfortably play video games for 8 h a day without this behavior impacting their work or social life. (c) Many existing measures include unvalidated cut scores for identifying addiction. Cut scores should only be determined after we sufficiently understand the disorder, and the population afflicted by the disorder, to properly grasp the impact of setting the cut score at a certain level (Dwyer, 1996). Therefore measures might be more useful if they reported dimensional profiles to help define the construct of video game addiction until such time that the availability of additional epidemiological information makes the implementation of cut scores valid. (d) Many of the measures that have been created so far have incomplete reliability and validity data. (e) Directly adapting the diagnostic criteria for gambling and substance addictions for use in the diagnosis of video game addiction may lack validity because of inherent differences in the target addictive behavior. Diagnostic items that attempt to identify illegal behavior, excessive financial cost or physiological effects may not be applicable to video game addiction because video games are not legally controlled, may not necessarily impose a high financial burden, and do not involve the introduction of exogenous substances into the body. (f) Adapting diagnostic criteria for gambling or substance addictions for the diagnosis of video game addiction might cause diagnostic reification, such that assumptions about similarities between the constructs might be prematurely imposed on the still developing construct of video game addiction. Hyman (2010) discussed how reification can create epistemic blinders that can stifle the development of a valid diagnosis. In the absence of any validated theory, video game addiction scales would be developed most successfully using an unbiased data-driven approach rather than relying on adaptation of diagnostic criteria from gambling or substance addictions.

### CORRELATES OF VIDEO GAME ADDICTION

Despite the lack of a formal diagnosis for video game addiction, researchers have used findings of relationships between physical and psychosocial variables and nascent video game assessment scores to suggest various correlates that help define the theoretical construct of video game addiction. A review of research and case studies conducted by Griffiths and Meredith (2009) outlined a number of potential correlates of video game addiction. Research suggests that psychological correlates include: well-being or euphoria while playing, inability to stop, craving more and more time, neglect of family and friends, feeling empty, depressed or irritable when not playing, lying to

employers and family about activities, and problems with school or job. Physical correlates include: carpal tunnel syndrome, dry eyes, headaches, back aches, eating irregularities, neglecting personal hygiene, and sleep disturbances. Case studies of video game addicts suggest that excessive video game play is associated with underlying problems such as relationships, lack of friends, physical appearance, disability, and coping (Griffiths & Meredith, 2009).

A review of research by Young (2009) examined excessive gaming as a subtype of Internet addiction and found that extreme players may show a tendency toward neuroticism and suffer from emotional problems or low self-esteem. In children, attempts to limit game play may cause the child to become angry, irrational, or violent. Addicted video game players who lose access to their game may experience loss, stop thinking rationally, and act out.

A study by Hussain and Griffiths (2009) found that many massively multiplayer online role-playing game (MMORPG) players play for the purpose of escape. MMORPGs are video game where players, through use of a game avatar, explore a persistent online game world populated by hundreds or thousands of other players with the goals of socializing and completing in game tasks, missions and battles to accumulate new abilities and equipment for their avatar. The MMORPG genre is represented by specific video game titles like World of Warcraft, Guildwars, or Star Wars: Knights of the Old Republic. The researchers suggested that dependent online video game players may place a higher than normal importance on online gaming in their lives than non-dependent gamers and are more likely to use games to change their mood and to cope with problems in their everyday lives. In their sample, the amount of online gaming for the dependent players increased over time and they had difficulty cutting down play time. Another study (Ng & Wiemer-Hastings, 2005) found that players of MMORPGs spend more time playing than players of other types of games. The researchers suggested that dependent gamers may find online socializing more pleasant and satisfying than offline socialization.

Published scale development research efforts have supported the existence of a relationship between a lack of psychological well-being and video game addiction. Lemmens, Valkenburg, and Peter (2009) found that high scores on their video game addiction scale were correlated with greater video game usage, loneliness, lack of life satisfaction, lack of social competence, and aggression. King, Delfabbro, and Zajac (2011) found that high scores on their video game addiction scale were weakly associated with depression, anxiety, and stress. Starcevic, Berle, Porter, and Fenech (2011) found that problem gamers they identified using their Video Game Use Questionnaire had significantly elevated scores on all the subscales of the Symptom Checklist 90 assessment of psychopathology when compared to non-problem gamers.

## The present study

Converging evidence from a number of different studies suggests some correlates or symptoms of video game addiction as well as some methods of conceptualizing it. However, the construct of video game addiction is still far from clear and early measures of the construct have a number of weaknesses. Still, according to Strauss and Smith (2009), efforts to develop valid and reliable video game addiction measures can provide data to help drive understanding of the video game addiction construct. Reciprocally, refinements to the construct help with the creation of measures with greater validity and reliability. Newer video game addiction assessments such as the Problem Video Game Playing Test (PVGGT; King et al., 2011), Game Addiction Scale [GAS; Lemmens, Valkenburg, & Peter, 2009], and revisions to the Asheron's Call scales (Charlton & Danforth, 2010) have attempted to address some of the previously mentioned problems. This study describes a systematic effort to develop a video game addiction assessment, the Gaming Addiction Inventory for Adults (GAIA), with strong reliability and validity, using an inductive method that is intended help drive future increases to our understanding of the video game addiction construct in a manner free of diagnostic reification.

## METHOD

### Procedure and participants

This study was approved by the University of Calgary Conjoint Faculties Ethics Review Board. Data for this study were gathered by administering items on a web-based questionnaire to two separate samples of adult participants (age 18 years and older). One sample of 351 psychology students at the University of Calgary was recruited through the University of Calgary Research Participation System, whereby students receive bonus credit toward any psychology course in exchange for their research participation. The second sample of 298 participants was recruited through video gaming-related websites, whereby participants were entered into a draw for a \$100 monetary prize. The two samples were combined into a single sample of 649 participants to provide increased statistical power. The full sample of 649 ranged in age from 18 to 54 years ( $M = 21.13$ ,  $SD = 4.47$ ) and was predominantly male (64.6%).

A subset of the total sample of participants who reported playing two or more hours of video games per week were used for development of the scale to increase the likelihood that the resulting scale would be pertinent to video game addiction. The scale development phase involved a series of factor analyses to identify a set of factors from a large item pool. The 456 participants ranged in age from 18 to 54 years ( $M = 21.2$ ,  $SD = 4.8$ ) and were predominantly male (79.2%).

The full sample of 649 participants was used to assess the external validity of the newly developed scale by examining score distributions of the summed scores for each factor and the correlations between the summed scores and other variables associated with video game addiction. The full sample of participants was used to evaluate external validity so that the performance of the new scale could be assessed across a more diverse group of participants including casual video game players and non-players.

## MATERIALS

### Development of the item pool and questionnaire

The item pool consisted of 147 items related to addictive video game play, generated from interview data and a review of the literature. The majority of the items were generated from interviews with 16 self-described video game addicts, 4 significant others of addicts, and 5 mental health care professionals who had treated video game addicts in their work that were recruited using Twitter, Facebook, word-of-mouth, and telephone calls. The interviews with each participant were approximately 1 h in duration. Interview participants were asked questions from a semi-structured form about their video game addiction experiences, video game play patterns, conceptualizations of video game addiction, and their experiences with the effects of video game addiction. Notes taken during the interviews were examined for major themes which were translated into items for the preliminary pool. This preliminary pool was also augmented with items generated from a review of video game addiction research literature, the 24 items from Charlton and Danforth's (2010) addiction and engagement scales (modified for video games in general), and a selection of items from both the PVGTT (King et al., 2011) and the GAS (Lemmens et al., 2009) to provide coverage for areas not addressed by the items generated through interviews. Each item was rated on a 1 (Strongly Disagree) to 5 (Strongly Agree) scale. One-third (33.33%; 49 items) of the items in the pool were reverse-keyed.

### External validity measures

#### *Well-being*

A number of measures of psychosocial well-being were used as a means of assessing the construct validity of the GAIA. The measures were selected to assess the association of participants' video game play with: interference in their social relationships, lowered life satisfaction, and psychiatric distress as found in previous research (Griffiths & Meredith, 2009; King et al., 2011; Lemmens et al., 2009).

Relationship need satisfaction, for the 280 participants who reported being in intimate relationships, was measured using the nine-item Basic Need Satisfaction in Relationship subscale of the Self Determination Scale (La Guardia, Ryan, Couchman, & Deci, 2000).

The scale assesses the degree to which a participant feels support for their autonomy, competence, and relatedness needs from a target figure. The scale has demonstrated strong test–retest reliability ( $r=0.92$ ) when the target figure is a romantic partner.

Social Connectedness was measured using the 20-item Social Connectedness Scale – Revised (Lee, Draper, & Lee, 2001). Participants rate items such as “I feel understood by the people I know” on a scale of 1 (Strongly Disagree) to 7 (Strongly Agree). All items in the measure are averaged together, after reverse-scoring items where appropriate, to achieve a total social connectedness score. The scale has demonstrated high test–retest reliability ( $r > 0.96$ ) and positive correlation with global self-esteem measures in past research.

Life satisfaction was measured using the six-item Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985). Participants expressed their agreement with items such as “In most ways my life is close to my ideal” on a scale of 1 (Strongly Disagree) to 7 (Strongly Agree). The SWLS has been shown to correlate with measures of mental health and to be predictive of suicide attempts (Pavot & Diener, 2008). The scale has demonstrated good test-reliability ( $r > 0.80$ ) and internal consistency ( $\alpha = 0.79$ ).

Self-esteem was measured using the Rosenberg Self-Esteem Scale (Rosenberg, 1989), a 10-item Likert scale with items answered on a four-point scale (Strongly Agree to Strongly Disagree). The scale has demonstrated reasonable internal consistency ( $\alpha = 0.88$ ) and good test–retest reliability ( $r = 0.85$ ) after a two-week interval (Blascovich & Tomaka, 1991).

The presence of psychological symptoms was measured using the Brief Symptom Inventory 18 – Short Form (BSI-18; Derogatis, 2000), an abbreviated version of the 53-item Brief Symptom Inventory (BSI; Derogatis, 1993). The BSI-18 includes 18 items that measure psychological symptoms. The overall Global Severity Index, which has good internal consistency ( $\alpha = 0.89$ ), was used in this study.

### ***Gambling and substance addictions***

Addiction to gambling was assessed using the Problem Gambling Severity Index (PGSI) which is composed of nine four-point Likert scale items that were designed to measure a single, problem gambling construct (Holtgraves, 2009). The measure has demonstrated small to moderate correlations with measures of gambling frequency and faulty gambling-related cognitions. The Alcohol, Smoking, and Substance Involvement Screening Test (WHO ASSIST Working Group, 2002) was used to assess the presence of substance addiction. Scores of 27 or higher suggest high risk of dependence and likelihood of health, social, financial, legal and relationship problems as a result of their substance use. The ASSIST has excellent psychometric properties (Humeniuk et al., 2008).

### ***Video game addiction***

Three published video game addiction measures were used to assess the concurrent validity and to provide a benchmark for psychometric quality of the newly developed video game addiction scale. The Asheron’s Call addiction and engagement scales (Charlton & Danforth, 2010) assess the pathological core criteria of addiction to the MMORPG game Asheron’s Call: behavioral salience, withdrawal, conflict, and relapse (12 items) and the non-pathological peripheral engagement criteria: cognitive salience, tolerance, and euphoria (12 items). Convergent validity with Brown’s (1991, 1993) criteria for behavioral addiction has been demonstrated in previous research (Charlton & Danforth, 2007). For the purposes of this study, the items in the measure were adapted to assess video game play in general (e.g. “I sometimes neglect important things because of an interest in video games”) rather than specific play of the “Asheron’s Call” video game. In this study, the addiction ( $\alpha = 0.90$ ) and engagement ( $\alpha = 0.84$ ) scales demonstrated reasonable internal consistency. The adapted addiction scale demonstrated a large and medium convergence with addiction scales designed to be used with any video game titles, specifically the Problem Video Game Playing Test ( $r_s = 0.84$ ) and the Game Addiction Scale ( $r_s = 0.77$ ). The adapted engagement scale demonstrated a small convergence with the Problem Video Game Playing Test ( $r_s \geq 0.47$ ) and Game Addiction Scale ( $r_s \geq 0.46$ ). These data seem to suggest that it was reasonable to adapt the original Asheron’s Call addiction and engagement scale items to assess addictive video game play in general and to include the items in the factor analysis for the present scale development project.

King, Delfabbro, and Zajac (2011) developed a 20-item Likert scaled (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always) Problem Video Game Playing Test (PVGTT) based on Young’s (1998) Internet addiction questionnaire. This single factor scale measures the core aspects of behavioral addiction including salience, mood modification, tolerance, withdrawal, conflict, and relapse. The PVGTT demonstrated high internal consistency ( $\alpha = 0.92$ ). Significant relationships were seen between PVGTT scores with average play session duration times, worry about video game playing, and adapted DSM-IV-TR criteria. Overall PVGTT scores were significantly but weakly correlated with measures of depression, anxiety, and stress.

Lemmens, Valkenburg, and Peter (2009) developed a 21-item Likert scaled (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Very Often) Game Addiction Scale based on a single factor model of addiction. The scale taps second-order factors of game addiction including: salience, tolerance, mood modification, relapse, withdrawal, conflict, and problems did indeed fit a single game addiction super-factor model,  $\chi^2(364) = 1083.29$ ,  $p < 0.001$ ;  $\chi^2/df$  ratio = 2.98. The

21-item scale had good reliability in two separate samples,  $\alpha = 0.94$  and  $\alpha = 0.92$ . The scale showed strong correlation with time spent on games. The scale showed moderate correlations with loneliness life satisfaction, social competence, and aggression in the expected directions.

### Data analysis

Data analysis in this study was performed using IBM SPSS version 19 (IBM Corp., Armonk, NY). Data gathered from the preliminary item pool were analyzed using a series of exploratory common factor analyses to explore the factor structure of the pool and to eliminate items from the pool. Factors were extracted using the maximum likelihood method. The sample size of the study exceeded the minimum 300 participants recommended by Tabachnick and Fidell (2007) for an adequate factor analysis. Sampling adequacy for the factor analysis was assessed using two measures: Bartlett's test of sphericity and the Kaiser–Meyer–Olkin measure of sampling adequacy. Two quantitative methods, Horn's (1965) parallel analysis and Velicer's (1976) minimum average partials (MAP) test, were used to determine the number of factors to extract from the data. These methods were implemented using published SPSS macros (O'Connor, 2000).

The goal of this study was to produce a strong and stable factor solution. Factors with fewer than three items are considered weak and unstable. Strongly loading items (0.50 or better) are desirable and indicate a solid factor (Costello & Osborne, 2005). The strength of the factor solutions was assessed using the ratio between the  $\chi^2$  test statistic generated by the maximum likelihood extraction and the degrees of freedom in the solution, and the amount of item response variance explained by the solution.

An iterative process was used to reduce the initial pool of 147 items down to the final 6-factor solution of 31 items. The process included: removing items with poor loadings values ( $<0.30$ ), removing items with low communality ( $<0.32$ ), removing factors with less than three items loaded on to them, removing factors with poor interpretability, and removing redundant items. Poor normality was not used as a criterion for removing items from the pool because video game addiction may be an extreme activity with low prevalence.

Once an adequate factor solution was found, items in each factor were rescaled to a 0 to 4 scale and then summed to produce individual scale scores for each factor. The extracted factors were analyzed to assess the scale's internal consistency using Cronbach's alpha. Groth-Marnat (2009) recommends internal consistency alpha values of at least 0.70 for research purposes, and at least 0.90 for clinical decision making.

Finally, the external validity of the scale was evaluated by examining the correlations between each summed scale score and variables associated with video game addiction. Values of Spearman's rank correlation coefficient ( $r_s$ ) may be interpreted as an

indication of large ( $r_s \geq 0.80$ ), medium ( $r_s \geq 0.50$ ), and small ( $r_s \geq 0.20$ ) effect size (Ferguson, 2009).

## RESULTS

### Common factor analysis ( $n = 456$ )

After completion of the iterative series of factor analyses, a final pool of 31 items was analyzed. Measures of sampling adequacy including Bartlett's test of sphericity,  $\chi^2(465) = 7983.25$ ,  $p < 0.001$ , and the Kaiser–Meyer–Olkin measure of sampling adequacy, 0.93, suggested the pool of item data was suitable for factor analysis.

A final maximum likelihood extraction was computed to determine the optimal number of factors. Parallel analysis suggested that it would be appropriate to extract a 7-factor solution. MAP test results suggested that it would be appropriate to extract a 6-factor solution. The 6-factor solution was interpretable and accounted for 65.42% of the overall variance. The goodness-of-fit test was significant,  $\chi^2(294) = 669.7$ ,  $p < 0.001$ ;  $\chi^2/\text{df}$  ratio = 2.28. The item factor loadings were above 0.50 and item communalities were above 0.32 (Table I).

Five of the factors were moderately correlated with each other ( $>0.32$ ) but Factor 3, engagement, did not correlate with the other five ( $<0.09$ ). Because of this pattern of correlations and because the items of the five correlated factors all loaded strongly on the first unrotated factor, a 26-item total addiction score was calculated, excluding the factor 3 items. Table II displays the factor labels and internal reliability estimates for the summed subscales and total addiction score.

### External validity ( $n = 649$ )

#### Score distributions

The distribution of subscale scores (Figure 1) on factors 1, 2, 4, 5, 6 and the total addiction score were similarly shaped with multiple peaks that may suggest the presence of non-player, casual player, and extreme player discrete subgroups in the sample. The engagement subscale only featured a single peak and seemed to be continuous normally distributed.

#### Correlations with self-reported video game play and video game addiction scales

All seven scores were significantly correlated with self-reports of video game play and other video game addiction measures in the expected directions (Table III). As expected, due to overlapping items, the correlation between the addiction subscale with the Asheron's Call addiction scale had a large effect size,  $r_s(649) = 0.96$ , as did the correlation between the engagement subscale and the Asheron's Call engagement scale,  $r_s(649) = 0.87$ . Large effect sizes were seen in the correlation between the addiction and total scores and the PVGT,  $r_s(649) > 0.80$ . The correlations between the addiction total score and Asheron's

Table I. Common factor analysis direct oblimin-rotated loadings and communalities.

Item	Factor						Communality
	1	2	3	4	5	6	
Arguments have sometimes arisen at home because of the time I spend on video games	0.77						0.65
I think that I am addicted to video games	0.76						0.60
I am sometimes late for engagements because I am playing video games	0.73						0.60
My social life has sometimes suffered because of me playing video games	0.72						0.56
Playing video games has sometimes interfered with my work	0.70						0.58
When I am not playing video games I often feel agitated	0.69						0.73
I often fail to get enough sleep because of playing video games	0.66						0.52
I often feel that I spend more money than I can afford on video games	0.64						0.46
I have made unsuccessful attempts to reduce the time I spend playing video games	0.62						0.54
I sometimes neglect important things because of an interest in video games	0.58						0.46
I feel angry when I am unable to play video games		-0.86					0.80
I feel irritable when I am unable to play video games		-0.84					0.77
I feel anxious when I am unable to play video games		-0.77					0.70
I have had increased conflict with other people when I am unable to play video games		-0.51					0.57
Video games are unimportant in my life			0.73				0.54
It would not matter to me if I never played video games again			0.67				0.47
The less I have to do with video games, the better			0.62				0.47
I rarely think about playing video games when I am not using a computer or gaming console			0.60				0.42
I pay little attention when people talk about video games			0.60				0.38
I often play video games to feel better				0.82			0.68
I often play video games to release stress				0.80			0.59
I often play video games to change my mood, relax tension or feel more excited				0.68			0.54
I often play video games to forget about my life outside of gaming				0.52			0.48
I feel lonely when I am not able to play video games					0.83		0.71
I miss my game character when I am unable to play video games					0.77		0.60
I have nothing else to do besides play video games					0.68		0.51
I feel sad when I am unable to play video games					0.63		0.62
I feel like something is wrong or off when I am unable to play video games					0.54		0.59
I have tried to hide the negative effects of my video game play (e.g. claiming to play less than you do, lying, faking illness, forging school transcripts)						0.71	0.61
I feel a sense of shame about negative effects in my life resulting from my video game play						0.63	0.49
I often regret neglecting other tasks due to my video game play						0.62	0.49

Note: Loadings <0.30 suppressed.

Table II. Common factor analysis direct oblimin-rotated factor internal consistency scores.

Factor	# of items	Label	$\alpha$
1	10	Loss of control and consequences	0.92
2	4	Agitated withdrawal (negative loaded)	0.90
3	5	Engagement <sup>a</sup>	0.78
4	4	Coping	0.82
5	5	Mournful withdrawal	0.88
6	3	Shame	0.77
Overall	26	Overall addiction score (sum of factors 1, 2, 4, 5, 6)	0.94

Note: <sup>a</sup>Factor items were reverse scored.

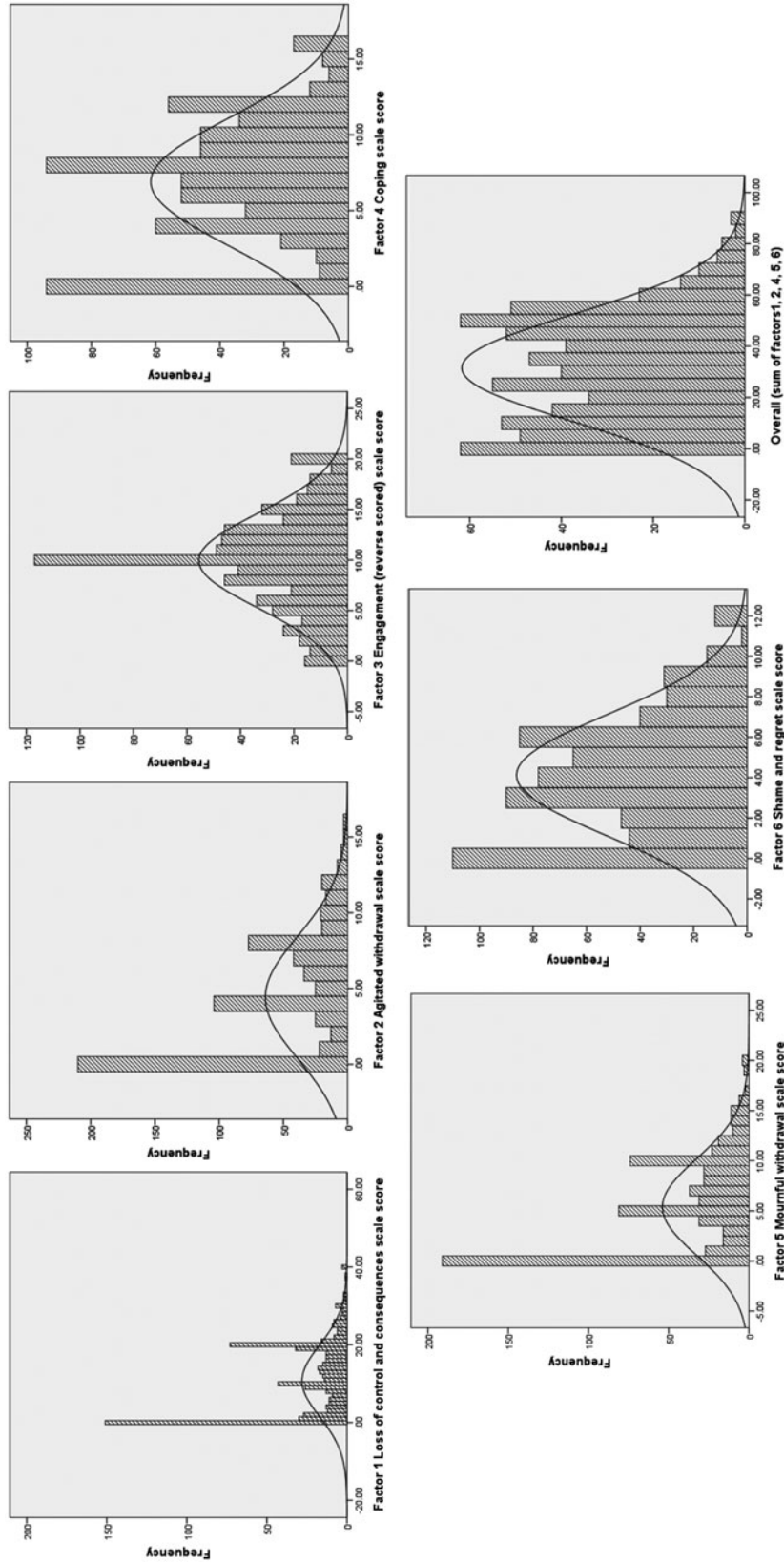


Figure 1. Factor and overall addiction summed score distributions.



Table III. Spearman rank order correlations between scale factors, overall score, and self-reported play frequency, duration, video game addiction self-diagnosis, and other video game addiction scales.

Variable	Factor 1 Loss of control and consequences	Factor 2 Agitated withdrawal	Factor 3 Engagement (reverse scored)	Factor 4 Coping play	Factor 5 Mournful withdrawal	Factor 6 Shame	Overall addiction score	M	SD
I do not play video games regularly	-0.26**	-0.21**	-0.50**	-0.35**	-0.21**	-0.16**	-0.29**	2.59	1.46
I am not addicted to video games	-0.41**	-0.39**	-0.36**	-0.25**	-0.42**	-0.36**	-0.45**	3.68	1.24
How many days per week do you play video games?	0.49**	0.38**	0.50**	0.46**	0.40**	0.29**	0.51**	3.90	2.51
How many hours per day do you play video games?	0.44**	0.38**	0.49**	0.38**	0.40**	0.29**	0.47**	3.58	4.04
Hours played per week	0.50**	0.41**	0.52**	0.44**	0.43**	0.31**	0.52**	18.97	26.26
Asheron's Call addiction	0.96**	0.71**	0.33**	0.54**	0.72**	0.61**	0.91**	26.32	9.71
Asheron's Call engagement	0.36**	0.25**	0.87**	0.47**	0.29**	0.23**	0.39**	35.66	8.46
PVGT	0.85**	0.69**	0.36**	0.64**	0.69**	0.59**	0.87**	42.35	17.47
Game Addiction Scale	0.78**	0.62**	0.37**	0.60**	0.64**	0.53**	0.81**	43.80	18.41

Notes: N = 649. PVGT = Problem Video Game Playing Test. PVGT items were Likert scaled (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always). Game Addiction Scale items were Likert scaled (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Very Often). Remaining variables were Likert scaled (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

\*\*Correlation is significant at the 0.01 level (2-tailed).

addiction scale, the PVGT, and the Game Addiction Scale,  $r_s(649) > 0.80$ , had a large effect size.

***Correlations with well-being, demographic variables, pathological gambling, and substance addictions***

All seven scores were significantly negatively correlated with social connectedness, self-esteem, and life satisfaction (Table IV) as expected. In general, five of the six subscales and the total addiction score were significantly correlated with psychological problems as measured by the BSI-18. Notably, engagement was not correlated with psychological problems,  $r_s(649) = -0.01$ . For the 279 participants who reported being in romantic relationships, all seven scores were negatively correlated with relationship satisfaction. Age was not significantly correlated with any of the seven scores. Gender (males = 1, females = 2) had a small negative correlation with each, meaning that male participants typically scored higher.

All seven scores were significantly correlated with problem gambling, as measured by the PGSI (see Table IV). The correlations between the PGSI and the coping and engagement subscales had small effect sizes. In terms of substance abuse, very few participants endorsed problems with use of stimulants, cocaine, inhalants, sedatives, hallucinogens, and opioids on the ASSIST. With the exception of the engagement subscale, scores were negatively correlated with tobacco, alcohol, and cannabis ASSIST scores. Engagement was negatively correlated with alcohol but not any other substances.

## DISCUSSION

This study described the development of a new video game addiction measure for adults, the Gaming Addiction Inventory for Adults (GAIA). Overall, the new measure demonstrated strong factor loadings and communalities, good internal consistency, and had evidence to support the convergent and concurrent validity of the scale. The development of items for the measure was based on interview data and a review of research and previously developed assessments, rather than a direct adaptation of existing DSM criteria for substance dependence and pathological gambling diagnoses. The development process yielded a 6-factor, 31-item video game addiction scale. The factors in the scale assess: (1) loss of control and consequences (loss of control of video game play and negative consequences), (2) agitated withdrawal (anger, anxiety, and conflict when unable to play video games), (3) engagement (interest in video games), (4) coping (use of video games to modify mood or escape), (5) mournful withdrawal (feeling a sense of grief or loss when unable to play video games), and (6) shame (regret over the negative effects resulting from a lack of control over playing video games). However, the distribution and item loading for the engagement factor appear categorically different from the rest of the scale

factors, suggesting it was not directly related to video game addiction. Therefore, the engagement items were omitted from the overall addiction summed score. Items adapted from Charlton and Danforth's (2010) Asheron's Call addiction and engagement scales were strongly represented in the final factor solution. Factor 1 (loss of control and consequences) was composed of 10 items adapted from the Asheron's Call addiction scale. Factor 3 (engagement) was composed of five items adapted from the Asheron's Call engagement scale. One item adapted from the PVGT (King, Delfabbro, & Zajac, 2011), "I often play video games to change my mood, relax tension or feel more excited," and two of the items adapted from the GAS (Lemmens, Valkenburg, & Peter, 2009), "I often play video games to release stress" and "I often play video games to feel better," were included on factor 4 (coping).

### **Engagement versus addiction**

The items on the engagement factor, when reversed scored, assessed whether participants thought video games were important in their lives, think about games even when away from their gaming device, or care about being involved with video games. This engagement factor had the strongest relationship with the number of hours of video games played per week. However, this engagement factor was not correlated with psychological problems. Furthermore, items in the factor did not load on the first unrotated factor of the factor solution, lending support to Charlton and Danforth's (2007) argument that engagement is intertwined with, but ultimately should not be confused with, addiction. Participant summed Engagement scores were normally distributed suggesting that engagement is on a continuum with non-players and video game players. In contrast, the multiple peaks on the other addiction-related factor summed score distributions suggest that addictive play of video games may be categorically different from non-play and non-pathological play. Engagement demonstrated a level of internal consistency appropriate for use in research settings.

In terms of the distinction between engagement and addiction, Charlton and Danforth (2007) argued that a polythetic system of video game addiction classification, like that used in the DSM-IV-TR for pathological gambling and substance dependence diagnoses, could result in artificially inflated prevalence rates due to confusion between core addiction-based criteria and peripheral engagement-based criteria. The researchers found that using a monothetic classification system, where endorsement of both core addiction and peripheral engagement criteria were necessary for a video game addiction diagnosis, resulted in a video game addiction prevalence rate of 1.8%. In contrast, a DSM-like polythetic system, where endorsement of 5 out of 10 mixed core and peripheral criteria were necessary for a video game addiction diagnosis, resulted in a

Table IV. Spearman rank order correlations between scale factors, overall score and measures of well-being, demographics, measures of gambling (PGSI) and substance addictions (ASSIST).

Variable	Factor 1 Loss of control and consequences	Factor 2 Agitated withdrawal	Factor 3 Engagement (reverse scored)	Factor 4 Coping play	Factor 5 Mournful withdrawal	Factor 6 Shame	Overall addiction score	M	SD
Relationship need satisfaction	-0.51**	-0.51**	-0.31**	-0.23**	-0.53**	-0.39**	-0.54**	35.84	7.23
Social connectedness	-0.54**	-0.53**	-0.25**	-0.38**	-0.56**	-0.41**	-0.61**	82.89	17.03
Self-esteem	-0.42**	-0.39**	-0.17**	-0.30**	-0.43**	-0.39**	-0.48**	24.56	5.56
Satisfaction with life	-0.31**	-0.30**	-0.22**	-0.23**	-0.30**	-0.33**	-0.36**	19.21	4.33
BSI-18	0.38**	0.30**	-0.01	0.22**	0.34**	0.25**	0.39**	14.24	14.45
Age	-0.05	-0.06	0.06	-0.01	-0.01	-0.06	-0.05	21.13	4.47
Gender	-0.42**	-0.35**	-0.42**	-0.29**	-0.33**	-0.26**	-0.42**	1.35	.48
Problem gambling	0.48**	0.47**	0.14**	0.16**	0.46**	0.35**	0.50**	3.37	5.36
Tobacco	-0.09*	-0.08*	0.01	-0.09*	-0.09*	-0.13**	-0.11**	3.03	6.55
Alcohol	-0.19**	-0.20**	-0.13**	-0.14**	-0.25**	-0.20**	-0.24**	5.54	7.41
Cannabis	-0.13**	-0.14**	0.00	-0.09*	-0.17**	-0.14**	-0.16**	1.89	5.49

Notes: N = 649 except for relationship need satisfaction where N = 270. Relationship need satisfaction items were Likert scaled (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree). Social connectedness items were Likert scaled (1 = Strongly Disagree, 2 = Disagree, 3 = Mildly Agree, 4 = Mildly Agree, 5 = Agree, 6 = Strongly Agree). Some items were reverse scored. Higher scores indicate greater social connectedness. Self-esteem items were Likert scaled (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree). Some items were reverse scored. Higher scores indicate greater self-esteem. Satisfaction with life items were Likert scaled (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree). BSI-18 items were Likert scaled (1 = Not at All, 2 = A little bit, 3 = Moderately, 4 = Quite a bit, 5 = Extremely). Problem gambling items were Likert scaled (1 = Never, 2 = Sometimes, 3 = Most of the time, 4 = Always). Substance addiction items were coded in ordinal fashion. Greater scores indicate greater substance addiction.

\*Correlation is significant at the 0.05 level (2-tailed).

\*\*Correlation is significant at the 0.01 level (2-tailed).

much higher video game addiction prevalence rate of 38.7%. Similar findings have been reported by Hussain, Griffiths, and Baguley (2012) in a large online sample of gamers. Together, the present research and previous research findings support the exclusion of engagement, from the overall summed addiction score when it is used to assess video game addiction. The overall addiction scale score, created by summing the items from factors 1, 2, 4, 5, and 6, assesses many aspects of video game play that seem to be related to the video game addiction construct. The strong internal consistency of the summed scale score makes it appropriate for clinical use.

### Evidence of validity

The addiction subscales and total addiction score were related to other measures of video game addiction and engagement. The PVGT and GAS correlated with all seven scores, more strongly with the total score, and less strongly with the engagement score. The modified Asheron's Call addiction scale correlated more strongly with the addiction subscales and the engagement scales with the engagement subscale. Overall, good concurrent validity for the scale was suggested by the findings in this study.

Males were more likely to score higher on the new video game addiction scales and overall addiction score than females. Scales were not related to the age of participants, suggesting that video game addiction should not be assessed differently between older and younger adults. However, further research across a sample that includes both adults and adolescents is needed because there may be a change in video game-related behaviors that takes place before the age of 18 that could not be detected using an adult development sample. On the contrary, a recent video game addiction study detected a significant effect of age across a sample of adolescents and adult participants (Hussain et al., 2012).

Surprisingly, all of the video game addiction subscales and total score were related to pathological gambling, suggesting a degree of overlap between the constructs, behaviors, or scales. This relationship requires further investigation. Equally surprising was the negative relation between substance abuse and the gaming addiction scales. The size of the effect was small but suggests that video game addiction may be a substitute for substance addiction or a protective factor against such behaviors, or vice versa.

### Comparison to addiction in the DSM-IV-TR

Comparison to the DSM-IV-TR criteria for pathological gambling (APA, 2000, p. 674) suggests that all of the factors identified in this new video game addiction measure correspond to criteria for pathological gambling except for factor 5 (mournful withdrawal). On the other hand, the pathological gambling criteria for financial distress were only represented by a single item in the factor solution for video game

addiction despite the presence of three items in the initial item pool. This confirms that financial distress may not be as strong a component of the video game addiction construct, or that the financial distress items in the initial item pool may not have been of sufficient quality for a financial distress factor to be extracted.

Comparison with the DSM-IV-TR criteria for substance dependence (APA, 2000, p. 197) suggests that all of the factors identified in this new video game addiction measure correspond to criteria for substance dependence except for the factor for intervention by family and friends. The DSM-IV-TR criteria for substance dependence make no mention of a mournful withdrawal criterion corresponding to the factor found in the present video game addiction measure. However, the criteria for substance dependence make an allowance for different types of withdrawal based on different substances. On the other hand, the substance dependence criteria for tolerance and taking an addictive substance in larger amounts over a longer period of time were only represented by a single item in the factor solution for video game addiction. However, there was an insufficient number of tolerance items in the initial item pool for a tolerance factor to have been extracted (<3).

Similarities between video game addiction, gambling addiction, and substance addiction observed in the analysis of the GAIA suggest that the three addictions all share the same core failure to resist an impulse, drive, or temptation to perform an act, despite harm to the person or others described in emerging research on a unified addiction construct (el-Guebaly et al., 2012; Grant et al., 2010). These similarities support the notion that shared underlying neural pathways and environmental conditions underlie all addictions. However, potential differences between video game addiction, gambling addiction, and substance addictions were noted in the absence of support for factors related to financial distress and tolerance and the presence of two distinct withdrawal factors in the GAIA's factor structure. Furthermore, video game addiction and substance addiction appeared to be mutually exclusive conditions in the participants used to assess the external validity of the GAIA. These differences suggest that there may be uniqueness in the outward expression of addiction due to an individual's chosen addictive activity, despite shared underlying features related to a general addiction construct. An individual's choice of addictive activity might be based on compatibility of an activity with life roles, comfort with legal constraints on the activity and mediating factors such as access to computers or finances.

With regard to video game addiction assessment, these similarities and difference suggest that development of video game addiction scales using substance dependence criteria is not recommended. However, a subset of pathological gambling criteria may in fact form a reasonable basis for the assessment of video game addiction. Overall, development of both

assessments and treatments for video addiction might benefit from accounting for its unique features to maximize clinical effectiveness.

### Cut scores

The multiple peaks seen in the distributions of many of the scores on the new scale suggest that cut scores could be successfully assigned using the contrasting groups method to delineate non-players, casual gamers, and high-risk or addicted gamers using a discriminant function (Mills, 1983). However, Dwyer (1996) highlighted the need to adequately understand the construct being measured, and the population that would be affected, before setting a cut score. When enough data are established to implement cut scores, research suggests that a monothetic approach is less prone to over-estimation of prevalence rates (Charlton & Danforth, 2007; Hussain et al., 2012).

### Limitations and strengths

One of the limitations of this study was that the participants used to develop this scale were video game players but were not necessarily video game addicts. Measuring features of addiction in members of the general community in this study required the assumption that video game addiction is on the same continuum as normal non-pathological video game play. There is no way to validate whether this assumption was true in this study. In fact, the multiple peaks in the distributions of most of the factor summed scores and the overall addiction score suggested a categorical difference between non-players, casual video game players, and extreme video game players. However, without a clinical definition for video game addiction, there was no easy way to ensure recruitment of large numbers of certified video game addicts for this study. Another limitation is that some of the latent factors of the video game addiction construct may have been underdeveloped (e.g. interference, intervention) or may not have been detected (e.g. tolerance, financial distress) in the factor analysis due to an insufficient number or quality of the items in the initial pool. Finally, predictive validity of the new measure was not assessed due to a lack of resources for follow up analyses of the participants.

One of the strengths of this project is that this scale was created with a very broad examination of the variables that could be associated with video game addiction and few preconceptions about the diagnostic characteristics of video game addiction. This scale contains multiple factors which may be useful for clinicians and researchers to report profiles of what video game players and video game addicts look like. The new scale also has a more complete base of psychometric data than many existing scales currently have typically reported. The new measure was also developed using a sample of adults rather than

adolescent populations upon which much of the previous research has focused.

## CONCLUSIONS

It will be important to the video game addiction research field that the resulting scale is adopted for use in other research projects to help provide further scale validity and reliability data. Further development of the scale could be accomplished by adding items to increase the reliability of the dropped interference factor, improve the chance for a tolerance and financial distress factor to be extracted, and bolster the number of items on each factor to a minimum of five items. On the treatment front, it would be important that clinicians use the scale to help understand patients who come to them for video game addiction treatment. When base rates of video game addiction are better understood, cut scores should be implemented as a means of identifying test takers who have are playing video games in an addictive manner.

Theoretically sound, valid, and reliable scales are needed to help to elucidate the many questions about video game addiction. Reciprocally, advances in our understanding of the video game addiction construct will continue to drive further scale development. In the United States alone, consumers spent \$15.9 billion on video games (ESA, 2011) in 2010. It is in the interest of game developers to continue to develop video games that offer consumers a compelling entertainment experience. It behoves researchers and clinicians to understand the nature of the harm that has been coming to people who play video games in an addictive manner.

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