



## The Mediation Effects of Behavioral Motivations between Age of Gaming Onset and Internet Gaming Disorder

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### Abstract

**Background and aims:** Internet Gaming Disorder (IGD) exhibits neurobiological similarities with other addictive disorders. Similar to other behavioral addictions, age of onset of game-play impacts the development of IGD. The present study utilized the \ Video Game Functional Assessment–Revised (VGFA-R) to explore the relationship between components of the motivations (mediating variable) contributing to IGD, symptomatic severity of IGD or risk for having IGD and the impact of age of gaming onset.

**Methods:** Participants were recruited via Mass Media Recruitment at a US Midwestern University (304 remained after exclusion criteria applied). The study used a mediation analysis to evaluate the effects of gaming onset on the clinical diagnosis of IGD and the maintaining behavioral function of videogame play.

**Results:** Age of onset (independent variable) was not directly related to IGD. Each level of the VGFA-R was significantly related to the IGD. None of the levels of the VGFA-R significantly mediated the relationship between age of gaming onset and IGD.

**Discussion and conclusions:** Results demonstrated two important findings: (i) a significant relationship between IGD and the VGFA-R (i.e., attention and sensory function), and (ii) age of onset was significantly related to the VGFA-R (attention, escape, tangible and sensory).

*Keywords:* Age of gaming onset, Internet Gaming Disorder, Gaming Motivation, Mediation Analysis, Videogame Addiction

## Introduction

Internet Gaming Disorder (IGD) exhibits neurobiological similarities with other addictive disorders (Pontes & Griffiths, 2014). Similar to other behavioral addictions, age of onset of game-play impacts IGD development (Tsitsika et al., 2014; Weinstein, Livny, & Weizman, 2017). This is similar to substance use disorder, where there is a known association between early substance use onset with the development of a substance use disorder (Rossow & Kuntsche, 2013). Moreover, Maimaris and McCambridge (2014) found that there was no strong evidence that drinking earlier (age of drinking onset) leads to adult alcohol problems but rather has an indirect effect. In relation to video gaming, one study showed that a lower age of game-play initiation was associated with a higher risk of developing IGD (Beard, Haas, Wickham, & Stavropoulos, 2017). In addition to increased IGD prevalence, internet addiction among adolescents is associated with other emotional/behavioral problems (Tsitsika et al., 2014). In a study including adults, participants who were at-risk for or displayed internet addiction reported higher incidences of mood disorders and concurrent behavioral addictions compared to those who did not (Bakken, Wenzel, Götestam, Johansson, & Øren, 2009). The similarities between substance use disorder and IGD with regard to interplay of onset of behavior initiation and diagnosis, as well as neurobiological similarities, demonstrate the need to further investigate the root causes of IGD (Kuss, Pontes & Griffiths, 2018).

While some investigations into motivations influencing IGD have been conducted (Demetrovics, Urban, Nagygyorgy et al, 2011; Ryan, Rigby, & Przybylski, 2006), understanding remains limited and the primary focus has been on diagnostic criteria. Additionally, although many psychometric instruments have been developed to evaluate IGD, few have been empirically and clinically validated, thus failing to offer an accurate understanding of the disorder (Kircaburun,

Pontes, Stavropoulos & Griffiths, 2020; Pontes & Griffiths, 2014). The majority of previously validated instruments address IGD assessment in a clinical setting (Pontes & Griffiths, 2014). Other studies have focused on gaming motivations (e.g., Buono, Upton, Griffiths, Sprong, & Bordieri, 2016; Demetrovics et al., 2011; López-Fernández, Mezquita, Griffiths, Ortet & Ibáñez, 2020; Ryan, Rigby, & Przybylski, 2006; Yee, 2007). While useful, diagnostic tools fail to identify the motivations needed for successful treatment of disordered gaming. One instrument developed to accommodate the DSM-5 criteria is the 20-item Internet Gaming Disorder Test (IGDT-20; Pontes, Király, Demetrovics, & Griffiths, 2014). The IGDT-20 is useful for assessing IGD (Sprong, Griffiths, Lloyd, Paul, & Buono, 2019). However, it does not investigate underlying gaming disorder motivations. Parallel to the treatment of substance use disorders, it is imperative to identify motivations for maladaptive behavior to successfully identify motivations for recovery.

The revised Video Game Functional Assessment (VGFA-R) identifies the functions of gaming that lead to maladaptive game play (Buono et al., 2016) as well as an instrument that evaluates functional analysis of behaviors that contribute to IGD (Buono et al., 2017). The instrument evaluates four primary components (social attention, escape, tangible and intangible rewards, and sensory functions) (Buono et al., 2016). Social attention refers to the impact of responses evoked from others during game play; escape or avoidance refers to providing relief from daily stressors; tangible and intangible rewards refers to rewards available in games for completing tasks, and providing reinforcement for in-game behaviors; and, sensory functions refers to the stimulation that gamers find pleasing (Buono et al., 2017). In a previous study, the VGFA-R was compared with the IGDT-20, and a significant correlation was found between the two instruments (Sprong et al., 2019).

As a relatively newer clinical diagnosis, the identification of viable interventions and treatment modalities for IGD is critical (González-Bueso et al., 2018). While tools assessing the risk of IGD are available, there are few psychometric instruments that identify behavioral contributors to IGD. An accurate understanding of behavioral reinforcements impacting any addictive disorder is vital to the development of effective treatment interventions (Hendrickson & Rasmussen, 2013). Despite the known association between gameplay age of onset and clinical diagnosis of IGD, little research has investigated the interplay between IGD, motivation, and age of behavior initiation. Previous studies have found that escape and social attention-maintained behaviors significantly predicted duration of videogame play (Buono et al., 2017). As aforementioned, the VGFA-R and IGDT-20 were found to be significantly related in a recent study (Sprong et al., 2019), and gender and time spent gaming mediated the relationship between the VGFA-R and IGDT-20 (Buono et al., 2020). However, these studies did not evaluate behavioral motivation (defined by the reinforcing behavioral function) as a mediator between age of gaming onset and IGD. Previous studies, such as Beard, Haas, Wickham, and Stavropoulos (2017), found that earlier age of gaming onset predicted overall IGD symptom severity, controlling for self-esteem factors. Given the direct relationship between age of gaming onset and IGD, and the VGFA-R and IGDT-20, the present study sought to further explore the utilization of the VGFA-R and demonstrate the relationship between components of gaming motivations, IGD, and the impact of gameplay onset. More specifically, the study sought to explore behavioral motivations mediates the direct relationship between age of gaming onset and IGD. The specific research question was used to guide the study was ‘Is the direct relationship between age of gaming onset and IGD mediated by behavioral motivation?’

## **Methods**

### ***Participants***

Participants were recruited via a mass email to students enrolled in a US Midwestern University (N=320 gamers). After eliminating incomplete data, 304 participants remained. Participant's average age was 29.8 years (SD= 9.8), with most participants being Caucasian (n=190, 63%), and female (n=178, 56%). Most gamers played between 0-5 hours per week (n= 88, 29%) and 6-11 hours per week (n=83, 27%). Other demographic/supplemental information is presented in Table 1. Participants were included in the study if they met the following criteria: (i) were aged 18 years or older, and (ii) engaged in at least one hour of video gaming per week. Participants were excluded if they: (i) were not fluent in English language and (ii) did not complete all of the survey assessments.

TABLE 1 HERE

### ***Materials***

The Video Game Functional Assessment–Revised is a 24-item scale that assesses four functions (six questions per function) that maintain video gaming: (i) social attention, (ii) tangible/intangible rewards, (iii) escape/avoidance of demands or pain, and (iv) sensory stimulation (Buono et al., 2016). Study participants are presented with an item and can choose one of seven responses indicating level of agreement/disagreement with the statement (1=*Never*, 2=*Almost never*, 3=*Seldom*, 4=*Half of the time*, 5=*Usually*, 6=*Almost always*, 7=*Always*). The VGFA-R has excellent reliability ( $\alpha = .927$ ) and individual reliabilities for each function were good to excellent: social attention ( $\alpha=.91$ ), escape/avoidance ( $\alpha=.80$ ), tangible/intangible rewards ( $\alpha=.84$ ), and sensory stimulation ( $\alpha=.76$ ).

The 20-item Internet Gaming Disorder Test (IGDT-20) assesses the risk of IGD and items were developed using the DSM-5 IGD criteria (Pontes et al., 2014). There are three to five

questions pertaining to each of six components of addictive behavior including salience (n=3), mood modification (n=3), tolerance (n=3), withdrawal symptoms (n=3), conflict (n=5), and relapse (n=3). Study participants are presented with an item and can choose one of five responses indicating their level of agreement/disagreement with the statement (1=*strongly agree*, 2=*agree*, 3=*neither agree nor disagree*, 4=*disagree*, 5=*strongly disagree*). The overall internal consistency was excellent in the present study ( $\alpha=.93$ ).

### ***Procedure***

Study materials were created in *Qualtrics* online software program, which is an online password-protected software program used to deliver the surveys to participants. A recruitment script providing the IRB approval information, the purpose of the study, approximate time to complete, and inclusion information (e.g., above the age of 18 years) were provided in a recruitment email to all students enrolled at a US Midwestern University. The Assistant Director of Information Technology of the university used the mass email list serve to distribute our recruitment message twice to enrolled college students in academic year of 2017-2018. Participants that agreed to participate in the study were directed to click the link and were asked to answer demographic and participant characteristic information, which was followed by the study materials. Once all materials were completed, a debriefing statement was provided and the *Qualtrics* feature was used that paid study participants directly for their participation.

### ***Data analysis***

In the present study, a mediation analysis was performed to determine how the covariate of gaming onset influenced the relationship between the predictor and outcome variables. The mediation effect (ACME) is the total effect minus the direct effect, which equals to a product of a coefficient of predictor in the second step and a coefficient of mediation variable in the last step.

The positive value represents the statistically significant. The direct effect (ADE) is a direct effect of the predictor on outcome after considering a mediation (indirect) effect of the mediation variable. Therefore, the ACME and ADE were combined to obtain the mediation (indirect) effect and a direct effect of the levels of the VGFA-R and problematic gaming while examining the direct effect of age of gaming onset and the IGDT-20. After a direct relationship between an independent (predictor) and dependent (outcome) variable was established, a mediation analysis was performed to determine if another variable explained a proportion of the relationship rather than presuming the entirety of the relationship is explained by one variable. Several regression analyses were performed to determine if a direct relationship existed with the dependent variable. Age of gaming onset served as the predictor variable, and each VGFA-R level was used as the mediating variable, and the total score of the IGDT-20 was used as the outcome variable, whereas age of gaming onset was used as a mediating variable. All analyses were conducted with SAS statistical software.

### **Ethics**

Approval from the second author's institutional review board (IRB) was requested and obtained prior to recruiting participants for the study (protocol approval code HS17-0060). The study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board at the second author's university approved the study. All participants were informed about the study and all provided informed consent.

### **Results**

Overall findings for this study showed that the mediating variable(s) of the VGFA-R did not indirectly explain the relationship between age of gaming onset (predictor variable) and IGD (outcome variable), because a direct relationship between the predictor variable and outcome variable was non-existent (see Table 2 & 3).

[enter table 2 & 3 here]

### **VGFA-R Attention**

Findings showed a significant effect ( $\beta$  [95% CI] = -0.15 [-0.21; -0.02];  $p=.024$ ) of the independent variable age of gaming onset on the mediator of VGFA-R attention (i.e., VGFA-R attention score was correlated with age of gaming onset). VGFA-R attention had a significant effect ( $\beta$  [95% CI] = 0.62 [0.43; 0.80];  $p<.01$ ) but age of gaming onset was not significant ( $\beta$  [95% CI] = -0.15 [-0.36; 0.07];  $p=.190$ ). VGFA-R attention did not significantly mediate the relationship between age of gaming onset and IGDT-20 total score because a direct relationship did not exist between the predictor and outcome variables, and a relationship between the predictor variable and VGFA-R attention did not exist. However, an effect of total IGDT-20 with VGFA-R attention was significant ( $R^2=0.13$ ,  $F(2,301)=23.3$ ,  $p<.01$ ).

### **VGFA-R Escape**

Findings showed a non-significant effect ( $\beta$  [95% CI] = -0.09 [-0.21; 0.03];  $p=.125$ ) with the independent variable age of gaming onset on the mediator VGFA-R escape, showing VGFA-R escape score was not correlated with age of gaming onset. The following step in the mediation analysis established VGFA-R escape and age of gaming onset effects on IGDT-20 total score. VGFA-R escape had a significant effect ( $\beta$  [95% CI] = 1.34 [1.18; 1.49];  $p<.01$ ) and age of gaming onset was not significant ( $\beta$  [95% CI] = -0.11 [-0.28; 0.05];  $p=0.183$ ). VGFA-R escape did not significantly mediate the relationship between age of gaming onset and IGDT-20 because a direct relationship did not exist between the predictor and outcome variables, and a relationship between the predictor variable and VGFA-R escape did not exist. However, an effect of total IGDT-20 with VGFA-R escape was significant ( $R^2=.50$ ,  $F(2,301)=149.9$ ,  $p<.01$ ).



### **VGFA-R Sensory**

Findings showed a significant effect ( $\beta$  [95% CI] = -0.11 [-0.23; -0.001];  $p=0.047$ ) of the independent variable age of gaming onset and mediator VGFA-R sensory (i.e., VGFA-R sensory score was correlated with age of gaming onset). The following step in the mediation analysis established the VGFA-R sensory and age of gaming onset effects on IGDT-20 total score. VGFA-R sensory had a significant effect ( $\beta$  [95% CI] = 0.98 [0.77; 1.18];  $p < 0.01$ ) and age was not significant ( $\beta$  [95% CI] = -0.13 [-0.33; 0.08];  $p=0.223$ ). VGFA-R Sensory did not significantly mediate the relationship between age of gaming onset and IGDT-20 because a direct relationship did not exist between the predictor and outcome variables, and a relationship between the predictor variable and VGFA-R sensory did not exist. However, an effect of total IGDT-20 with VGFA-R sensory was significant ( $R^2=.24$ ,  $F(2,301)=47.94$ ,  $p < .01$ ).

### **VGFA-R Tangible**

Findings showed a non-significant effect ( $\beta$  [95% CI] = -0.05 [-0.16; 0.06];  $p=0.359$ ) of the independent variable age of gaming onset and mediator VGFA-R tangible (i.e., VGFA-R tangible score was not correlated with age of gaming onset). The following step in the mediation analysis established the VGFA-R tangible and age of gaming onset effects on IGDT-20 total score. VGFA-R tangible had a significant effect ( $\beta$  [95% CI] = 0.91 [0.69; 1.14];  $p < .01$ ) and age of gaming onset was not significant ( $\beta$  [95% CI] = -0.19 [-0.40; 0.02];  $p=0.071$ ). VGFA-R tangible did not significantly mediate the relationship between age of gaming onset and IGDT-20 total score because a direct relationship did not exist between the predictor and outcome variables, and a relationship between the predictor variable and VGFA-R tangible did not exist. However, an effect of total IGDT-20 with VGFA-R tangible was significant ( $R^2=.19$ ,  $F(2,301)=35.49$ ,  $p < .0001$ ).

## Discussion

The present study used mediation analysis to evaluate the effects of gaming onset on internet gaming disorder (IGD), and the maintaining behavioral function of videogame play. While the findings did not conclusively demonstrate full mediation models, it did demonstrate that a relationship exists between each level of the VGFA-R and the dependent variable of IGDT-20 as demonstrated in previous studies (Buono et al., 2020; Sprong et al., 2019). Findings also showed a significant effect between age of gaming onset and the attention/sensory levels of the VGFA-R. This suggests that early gaming onset can lead to IGD and provides therapeutic and clinical prognosticators. As in other disorders such as alcoholism (Strat, Grant, Ramoz, & Gorwood, 2010) and substance use, (Rossow & Kuntsche, 2013), age of onset has been a determining factor in understanding pathology, ideology, and treatment of the disorder (Sprong & Davis, 2018). In extending Beard et al.'s (2017) study which demonstrated the impact of self-esteem on IGD symptomology, there were clear onset of play indicators. Ultimately, the nonsignificant direct effect of age of gaming onset and IGD in the present study did not allow for a full mediation model to help explain relationships between all of the variables. Given that a large portion of our participants played under 11 hours per week, future studies should investigate this further with gamers who play over 24 hours per week. However, given the relationship between each level of the VGFA-R and age of gaming onset, findings confirm previous research by Buono et al. (2019) and Sprong et al. (2018) indicating similarities between the assessment and understanding of gaming motivation.

Since reports of pathological gaming occurred in the early 1980s, and the beginning of systematic research in the mid-1990s, there has been an increase in gaming prevalence (Entertainment Software Association, 2019), rapid gaming industry growth (Siwek, 2017), and the

recognition of IGD by professional and public health organizations (American Psychiatric Association, 2013; Jo et al., 2019). Although much of the research has focused on clinical diagnoses of IGD, much research is still needed to explore how to modify gaming behavior to reduce the impact of problematic gaming and those that would meet criteria as outlined in the IGDT-20. Furthermore, in understanding the impact of IGD progression, future research needs to understand the behavioral and psychometric underpinnings of the disorder, alongside the direct impact of other competing variables that could impinge on IGD treatment.

While the present findings provided further explanation of the behavioral motivations of gaming, the study is not without limitations. First, the results may not have the external validity or ability to generalize beyond the current pooled sample recruited from the first author's university at the time of the study. A second limitation of the study was utilizing a cross-sectional research design. In order to establish causality, the study design and findings must meet three criteria (Sprong, Dallas, Upton, & Bordieri, 2015), including (i) the independent variable must come before the dependent variable, (ii) the variables must covary, and (iii) there must be no other confounding variables. By using cross-sectional research methodology, the relationship between the variables are correlational, and therefore limiting the current findings. Future studies should consider representative methodologies to enhance true sampling across the US. Second, the data were collected via convenience sampling. However, the mean age of gamers (i.e., 29 years), and the proportion of females matched the videogame industry's most recent findings (Entertainment Software Association, 2019).

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Table 1. Demographic information of gamers (N=304)

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	N	% of Population
<b>Gender</b>		
Male	126	41%
Female	178	59%
<b>Ethnicity</b>		
White	190	63%
African American	37	12%
Asian	23	8%
Hispanic/Latino	30	10%
Mixed/Other	24	8%
<b>Hours played/week</b>		
0 to 5	88	29%
6 to 11	83	27%
12 to 17	57	19%
18 to 23	32	11%
24+	44	14%
<b>Reported Type of Games Played*</b>		
Role-playing	191	34%
First-person shooter	194	34%
Real-time strategy	131	22%
Turn-base	99	24%
Simulation	187	24%
Sports	117	15%
Facebook	154	15%
	<b>Mean</b>	<b>Standard Deviation</b>
Age	11.27	7.65
VGFA-R Attention	24.10	8.90
VGFA-R Escape	21.36	8.17
VGFA-R Tangible	27.04	7.21
VGFA-R Sensory	22.05	7.70
IGD-20 Salience	7.86	3.05
IGD-20 Mood	9.45	2.89
IGD-20 Tolerance	8.03	2.94



IGD-20 Withdrawal	7.19	3.08
IGD-20 Conflict	10.70	4.12
IGD-20 Relapse	7.19	2.92
VGFA-R Total	94.55	26.20
IGD-20 Total	50.42	15.65

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\*Multiple individuals self-reported using more than one type of video gaming genre.

Table 2.

*Correlation matrix with P values of overall variables with N = 304*

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Variables	1	2	3	4	5	6
Age	1.00	— <sup>a</sup>	—	—	—	—
VGFA-R Attention	-0.13*	1.00	—	—	—	—
VGFA-R Tangible	-0.05	0.48*	1.00	—	—	—
VGFA-R Sensory	-0.11*	0.60*	0.66*	1.00	—	—
VGFA-R Escape	-0.09	0.46*	0.57*	0.66*	1.00	—
IGDT-20	-0.12*	0.36*	0.43*	0.49*	0.70*	1.00

<sup>a</sup>The correlation coefficient was not shown as it was shown in the asymmetrically diagonal position of the table.

\*Significant coefficients with p-value less than 0.05 marked with asterisk.

Table 3.

*Characteristics of Mediation Analysis*

Variables	$\beta$	SE	<i>t</i> -value	p-value
VGFA-R Attention				
IGDT-20				
Standardized Regression Coefficient				
Intercept	0.00	1.259	11.1	
Age	-0.129	.049	-2.26	.024
IGDT-20				
Standardized Regression Coefficient				
Intercept	0.00	2.872	13.0	
VGFA-R Attention	0.350	.095	6.48	
Age	-0.071	.111	-1.31	0.19
VGFA-R Tangible				
IGDT-20				
Standardized Regression Coefficient				
Intercept	0.00	.738	37.4	
Age	-0.050	.054	-0.92	0.36
IGDT-20				
Standardized Regression Coefficient				
Intercept	0.00	3.428	8.13	
VGFA-R Tangible	.422	.113	8.12	
Age	-0.094	.106	-1.81	0.07
VGFA-R Sensory				
IGDT-20				
Standardized Regression Coefficient				
Intercept	0.00	.784	29.78	
Age	-0.11	.058	-1.99	0.05
IGDT-20				
Standardized Regression Coefficient				
Intercept	0.00	2.77	10.93	
VGFA-R Sensory	0.481	.103	9.51	
Age	-0.062	.103	-1.22	0.22
VGFA-R Escape				
IGDT-20				
Standardized Regression Coefficient				
Intercept	0.00	.834	26.89	
Age	-0.09	.061	-1.54	0.125
IGDT-20				
Standardized Regression Coefficient				
Intercept	0.00	2.09	11.03	
VGFA-R Escape	0.700	.078	17.08	
Age	-0.055	.084	-1.33	0.183