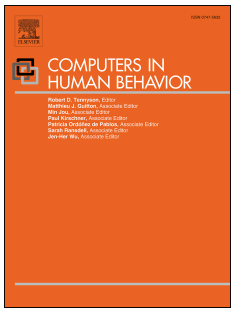

Self-determination theory, internet gaming disorder, and the mediating role of self-control

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SELF-DETERMINATION THEORY, INTERNET GAMING DISORDER, AND THE MEDIATING ROLE OF SELF-CONTROL

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Abstract

Internet Gaming Disorder (IGD) suggests a sustained, problematic pattern of video gaming contributing to both physical and psychological harms. Applications of self-determination theory have revealed two correlates of IGD: (1) daily frustration of basic needs (i.e., competence, autonomy, and relatedness), and (2) stronger extrinsic gaming motivations. Theory and recent research suggests that poorer self-control (i.e., deficits in the ability to regulate emotions, behaviors, and impulses) may be one mechanism by which daily need frustration is associated with IGD and less adaptive gaming motivations. Thus, the present study explores whether self-control explains the relation between daily need frustration and IGD. A total of 487 university students (50.3% female; M_{age} = 19.50 years, SD = 1.90) completed the IGD Scale, the Basic Need Satisfaction and Frustration Scale, the Self-Control Scale, and the Gaming Motivations Scale. Correlations showed that poorer self-control was associated with higher IGD and less adaptive video gaming motivations. Structural equation modelling further revealed that poorer self-control partially explained the relation between daily need frustration and IGD suggesting that daily need frustration undermines individuals' self-control, which in turn contributes to greater IGD. Collectively, these findings inform theory on the development of IGD from the perspective of self-determination theory.

SELF-DETERMINATION THEORY, INTERNET GAMING DISORDER, AND THE MEDIATING ROLE OF SELF-CONTROL

1. Introduction

The vast majority of individuals in the U.S. play video games. According to the Entertainment Software Association (ESA), 65% of U.S. adults play video games regularly (ESA, 2019) with the majority being between 18 to 34 years of age. Many individuals use video games as means of competing and/or socializing with friends and family, exploring virtual worlds, or relaxing from daily stress (Demetrovics et al., 2011; Fuster et al., 2012; Yee, 2006). The popularity of video games has grown in recent years. According to the ESA (2019b), the video gaming industry reported a record $43.4 billion in revenue in 2018, which is an 18% increase from the previous year. However, the growth in popularity of video games has been met with some growing concerns about how individuals are engaging with these games.

Recent evidence suggests that a subset of video game players experience substantial psychological consequences (e.g., depression, anxiety, suicidal ideation) and physical harms (e.g., substance use, self-injury, sleep deprivation) stemming from sustained and problematic patterns of video game engagement (Bargeron & Hormes, 2017; Bonnaire & Baptista, 2019; Cheng, Cheung, & Wang, 2018; Griffiths, Kuss, Lopez-Fernandez, & Pontes, 2017; King & Delfabbro, 2018; Lam, 2014; Männikkö, Ruotsalainen, Miettunen, Pontes, & Kääriäinen, 2017; Strittmatter et al., 2015; Van Rooij et al., 2014). This evidence has led the American Psychiatric Association (APA) and the World Health Organization (WHO) to recognize problem video gaming (or Internet Gaming Disorder [IGD]) as a burgeoning mental health condition requiring further study (APA, 2013; WHO, 2017). The APA's proposed criteria for IGD within the *Diagnostic and Statistical Manual for Mental Disorders – 5* (DSM-5; APA, 2013) largely

parallels those of substance use and gambling disorders, and are described at length elsewhere (see Griffiths et al., 2016; Petry et al., 2014). Present estimates place the prevalence rate of IGD between 1% and 3% of the population (Ferguson, Coulson, & Barnett, 2011; Petry, Zajac, & Ginley, 2018; Przybylski, Weinstein, & Murayama, 2017). Although there continues to be a debate about IGD (see Aarseth et al., 2017; Kuss, Griffiths, & Pontes, 2016; van Rooij et al., 2018; Van Rooij & Kardefelt-Winther, 2017), the growing popularity of video gaming and the adverse consequences that are associated with IGD necessitate further study into the mechanisms that explain its development.

Drawing on past research, the present study explores for the first time the relation between two mechanisms that are embedded in self-determination theory (SDT; Ryan & Deci, 2017) and video game players' self-control. The interplay among these constructs may collectively inform a developmental model of IGD. Specifically, research has found that the frustration (or thwarting) of the needs for competence, autonomy, and relatedness in daily life is associated with more severe IGD symptoms (Allen & Anderson, 2018; Mills, Milyavskaya, Mettler, & Heath, 2018). Vansteenkiste and Ryan (2013) argue that changes in self-control might explain the negative consequences of daily need frustration, which would include increased severity of IGD symptoms. Additionally, past findings have shown that endorsing strong extrinsic motivations to play video games is associated with greater IGD (Mills, Milyavskaya, Heath, & Derevensky, 2018). Research has found evidence that poorer self-control is associated with extrinsic motivations (Briki, 2016; Converse, Juarez, & Hennecke, 2019; Holding, Hope, Verner-Filion, & Koestner, 2019; Jordalen, Lemyre, Solstad, & Ivarsson, 2018). As such, poorer self-control might facilitate increased IGD severity through an endorsement of stronger extrinsic motivations toward video gaming. The present study is the

first to address these unexplored relations within the context of video game engagement and IGD severity.

2. Theoretical Framework

2.1. Basic Psychological Need Theory

Basic psychological need theory is one of six mini-theories of SDT (Ryan & Deci, 2017). It postulates that the satisfaction of three basic psychological needs fosters psychological well-being. As a result, humans are inherently drawn toward activities that satisfy these needs, which include needs for competence (i.e., feeling effective and skilled), autonomy (i.e., acting under one's own volition and in agreement with values and goals), and relatedness (i.e., sensing connection to peers). Need satisfaction has been implicated in explanations of greater student and worker engagement (Sulea, van Beek, Sarbescu, Virga, & Schaufeli, 2015; Van den Broeck, Vansteenkiste, De Witte, & Lens, 2008), overall enjoyment of physical and leisure activities (Leversen, Danielsen, Birkeland, & Samdal, 2012; Teixeira, Carraça, Markland, Silva, & Ryan, 2012), and even adaptive sleep patterns (Campbell et al., 2015; Howell & Sweeny, 2019).

However, basic psychological needs may also be frustrated such that individuals experience active impediments to the satisfaction of one or more of the needs in their daily lives (Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013). Research has found that while need satisfaction predicts psychological well-being (e.g., positive affect, life satisfaction, subjective vitality), need frustration predicts mental ill-being (e.g., depressive symptoms, negative affect; Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011; Chen et al., 2015; Gunnell, Crocker, Wilson, Mack, & Zumbo, 2013; Rodríguez-Meirinhos, Antolín-Suárez, Brenning, Vansteenkiste, & Oliva, 2019; Vanhove-Meriaux, Martinent, & Ferrand, 2019). Need frustration includes being made to feel inferior in terms of effectiveness (competence

frustration), feeling forced to act in a way that is uncomfortable or uncharacteristic (autonomy frustration), and sensing rejection or isolation from family and/or peers (relatedness frustration). As illustrated in these definitions and in past findings, need frustration is not synonymous with a lack of need satisfaction, as the former requires the environment to actively thwart or obstruct the satisfaction of basic needs. Nonetheless, the two are negatively related such that increased need frustration is associated with less need satisfaction. But, as demonstrated in a recent study by Tóth-Király, Bőthe, Orosz, and Rigó (2018), the relationship between need satisfaction and need frustration is more nuanced with the majority of individuals experiencing a bit of both need satisfaction and need frustration in their daily lives.

Research has found that need satisfaction during video game engagement is associated with increased video gaming frequency, greater intentions to play specific games in the future, and higher video game enjoyment (Johnson, Gardner, & Sweetser, 2016; Peng, Lin, Pfeiffer, & Winn, 2012; Przybylski, Rigby, & Ryan, 2010; Ryan, Rigby, & Przybylski, 2006). However, when need satisfaction during video game engagement outweighs need satisfaction experienced in daily activities, video game players are expected to exhibit a more problematic pattern of engagement in video games. In line with Vansteenkiste and Ryan (2013), it is argued that higher IGD severity is in part a reflection of video game players' reliance on their video gaming as a means of satisfying these basic psychological needs. This has been called the need-density hypothesis (Rigby & Ryan, 2011), and research has generally supported this hypothesis in the literature (Allen & Anderson, 2018; Bender & Gentile, 2019; Mills, Milyavskaya, Mettler, et al., 2018). In short, basic psychological needs appear to explain both the draw to play video games enthusiastically and the push to play video games problematically.

2.2. Organismic Integration Theory

A second mini-theory of SDT is the organismic integration theory; a widely employed framework for understanding intrinsic motivation, extrinsic motivation, and amotivation (Ryan & Deci, 2000, 2017). Intrinsic motivation implies that one is engaging in an activity for the pleasure and enjoyment in the activity itself, whereas extrinsic motivation implies that something unrelated to the activity is facilitating engagement. Although intrinsic motivation is in a category of its own, four subtypes of extrinsic motivation have been identified in the literature. The first, external regulation, is the prototypical extrinsic motivation in which activity engagement is driven primarily by rewards and/or approval by an authority figure. The second, introjected regulation, consists of unsanctioned internal pressures (e.g., guilt, shame, obligation) to engage in an activity. The third, identified regulation, occurs when activity engagement aligns with specific values and/or goals held by the individual. The fourth, integrated regulation, happens when the individual believes that their sense of self is expressed through engagement in the activity. A recent meta-analysis has cautioned against measuring integrated regulation due to its strong overlap with both identified regulation and intrinsic motivation, however (Howard, Gagné, & Bureau, 2017). Finally, expressing strong amotivation toward activity engagement indicates that one perceives that they lack volition and choice in engaging in the activity, but engages in it, nonetheless.

Intrinsic motivation and integrated and identified regulation are often found to be associated with adaptive outcomes such as increased vitality and enjoyment, whereas introjected and external regulation, and amotivation are associated with maladaptive outcomes including emotional exhaustion and increased problematic patterns of activity engagement (Clarke, 2004; Gagné et al., 2015; González-Cutre & Sicilia, 2012; Litalien, Guay, & Morin, 2015; Mouratidis, Vansteenkiste, Sideridis, & Lens, 2011; I. Tóth-Király, Vallerand, Bőthe, Rigó, & Orosz, 2019).

Research using Lafrenière, Verner-Filion, and Vallerand's (2012) Gaming Motivation Scale (GAMS) has found similar results. Specifically, intrinsic motivation for video gaming was associated with less severe anxiety symptoms among adolescent gamers, but amotivation towards video games was associated with more severe symptoms of depression and anxiety (Peracchia, Presaghi, & Curcio, 2019). Further, Mills, Milyavskaya, Heath and colleagues (2018) found that extrinsic motivations for video gaming and amotivation towards video gaming were associated with higher IGD with introjected regulation for and amotivation towards video gaming being stronger predictors of IGD relative to the other extrinsic motivations. It should be noted, however, that their study did not include the intrinsic motivation subscale due to measurement problems. Nonetheless, these findings collectively support the view that video gaming motivations play an important role in understanding the presence or absence of IGD.

2.3. Self-Control

Self-control refers to the ability to effectively manage behaviors, thoughts, and emotions typically from the perspective that one must inhibit innate urges and impulsive behaviors (Diamond, 2013; Nigg, 2016). Indeed, individuals differ in terms of the strength of their self-control with lower self-control being associated with a variety of psychopathological traits such as emotional instability as well as obsessive-compulsive and perfectionistic qualities (Tangney, Baumeister, & Boone, 2004). Other studies have unsurprisingly revealed that lower self-control predicts various addictive behaviors ranging from substance use to gambling to binge eating (Bergen, Newby-Clark, & Brown, 2012; de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Vainik, García-García, & Dagher, 2019).

Questions regarding predictors of self-control remain largely unanswered. Some of the limited research in this area has found more adaptive parental and peer relationships to be

associated with elevated self-control among adolescents (Burt, Simons, & Simons, 2006; Hay & Forrest, 2006; Kim, Siennick, & Hay, 2018). These findings are consistent with the associations between self-control and reports of secure and insecure attachment observed by Tangney and colleagues (2004), whereby less insecure attachment and greater secure attachment were associated with greater self-control. As such, experiencing unsupportive environments and controlling or punitive relationships in daily life appears to undermine individuals' self-control, thus contributing to increased problem behaviors.

3. Research Model and Hypotheses of the Present Study

Consistent with past findings (Allen & Anderson, 2018; Mills, Milyavskaya, Mettler, et al., 2018), daily need frustration is expected to be associated with higher IGD severity. Drawing on research on addictive behaviors more broadly (see review by de Ridder et al., 2012), lower self-control is expected be associated with elevated IGD severity. Additionally, it is hypothesized that self-control will mediate the relation between daily need frustration and levels of IGD severity. This specific hypothesis stems from propositions set forth by Vansteenkiste and Ryan (2013) that one outcome of continued experiences of need frustration would be the undermining of individuals' self-control in their daily life. Indeed, this SDT-derived proposition appears to be in line with the strength model of self-control such that the strain individuals experience from daily need frustration would tax resources required to enact self-control, and thus lead to a depletion in the ability to regulate the self (Baumeister, Vohs, & Tice, 2007; Hagger, Wood, Stiff, & Chatzisarantis, 2010).

In addition to the above expectations, Tangney and colleagues' (2004) findings suggest that video game users with higher self-control would act with more volition in their selection of activities. As such higher self-control is expected to be positively associated with more adaptive

video gaming motivations (i.e., intrinsic motivation and integrated and identified regulation), which largely reflect that a person's engagement in activities is out of personal interest in the activity itself. Conversely, higher self-control is anticipated to be negatively associated with maladaptive video gaming motivations (i.e., introjected and external regulation and amotivation), as these motives suggest that engagement is not under the control of the individual. These hypotheses are generally supported by recent findings (Converse et al., 2019; Holding et al., 2019).

Finally, the anticipated relations between self-control and video gaming motivations may aid in further explaining the effect of daily need frustration on IGD severity. Specifically, it is proposed that the anticipated negative effects of daily need frustration on self-control will result in endorsing maladaptive motivations for video gaming, which in turn will predict higher IGD severity. As such, a combination of both poorer self-control and stronger extrinsic motivations for and amotivation towards video gaming are expected to partially explain the effect of daily need frustration on the severity of IGD.

4. Methods

4.1. Participants and Procedure

Undergraduates from a large Midwestern University were recruited for a cross-sectional, online, survey study titled "Motivation, Academics, Gaming, and Well-Being." The study advertisement and the informed consent explained that being 18 years or older and playing video games were requirements for participation. All participants received partial course credit as compensation. All procedures were approved by the University's Institutional Review Board prior to data collection.

In total, 668 began the survey, but only 662 finished. Twelve people skipped more than 25% of the items and were removed. Of those remaining, 115 reported that they never play video games and were removed. Finally, participants who failed two (N = 30) or three (N = 18) of the three attention checks were removed. These attention checks were randomly embedded within questionnaires and asked participants to select a specific response as the answer. Of the remaining participants, 398 passed all attention checks and 89 failed one. We chose to allow for one failed attention check because IGD is associated with attention problems (see review by Weinstein & Weizman, 2012), and we did not want to exclude those who may be suffering from IGD but remained attentive for most of the survey. Those who failed one attention check did in fact have significantly higher IGD scores (M = 1.07, SD = 1.12) than those who failed none (M = 0.56, SD = 0.63), $t(100.56) = -4.13$ (equal variances not assumed), $p < .001$, $d = 0.69$.

Thus, the final sample consisted of 487 people (50.3% female) aged 18 to 40 years (M = 19.50, SD = 1.90). Most of the sample self-identified as White (81.1%), followed by Asian / Pacific Islander (10.7%), Latino / Hispanic (3.5%), African American (2.3%), Multi-Racial (1.8%), Other (0.4%), and Native American (0.2%). Almost all the participants (92.8%) reported that English was their native language. According to frequency reports 20.7% played video games almost every day, 12.3% played about four or five times a week, 18.7% played about two or three times a week, 12.3% played about once a week, 14.8% played a couple of times a month, 7.4% played about once a month, and 13.8% played less than once a month. On average, participants had played video games for 9.81 years (SD = 3.95), with typical gaming sessions lasting for 82.62 minutes (SD = 58.00). The average weekly playtime was 15.29 hours (SD = 12.09).

4.2. Measures

Participants completed measures in the order described below. Other measures not central to this study were also completed. Unless otherwise noted, all scale scores were calculated by averaging the relevant items (after reverse coding, as necessary). Missingness in the data was negligible and was dealt with by taking the average of all available items when items were missing. The descriptive statistics and reliabilities for the primary variables can be found in Table 1.

4.2.1. Basic Psychological Need Satisfaction and Frustration.

Participants completed the 24-item Basic Psychological Need Satisfaction and Frustration Scale (BPNSF) using a five-point response scale with anchors at 1 = *Not true at all* and 5 = *Completely true* (Chen et al., 2015). This measure includes six four-item subscales assessing the satisfaction and frustration of three basic psychological needs for competence, autonomy, and relatedness. The BPNSF was shown to be reliable (i.e., internally consistent) and valid (i.e., relating to well-being and ill-being in expected ways) in four culturally diverse samples (United States, Peru, Belgium, and China) (Chen et al., 2015). Example items include: "I feel confident that I can do things well" (competence satisfaction) and "I feel excluded from the group I want to belong to" (relatedness frustration). The order of items was randomized for each participant.

4.2.2. Gaming Habits

To assess gaming habits, participants completed part of the General Media Habits Questionnaire (GMHQ) (Gentile, Lynch, Linder, & Walsh, 2004). Participants reported the number of hours they play video games on a typical weekday (Monday-Friday) in four blocks of time: 6 am to Noon, Noon to 6 pm, 6 pm to Midnight, and Midnight to 6 am. This question was repeated for typical weekend days (Saturday & Sunday) with the same time blocks. Average weekly playtime was calculated by: (1) summing the four weekday playtimes and multiplying by

five, (2) summing the four weekend playtimes and multiplying by two, and (3) adding these two new variables. This measurement approach has been reliably used in research on violent media effects and has been shown to be positively related to IGD, as expected (Allen & Anderson, 2018; Bender & Gentile, 2019).

4.2.3. Video Gaming Motivations

Participants completed the 18-item Gaming Motivations Scale, using a seven-point response scale with anchors at 1 = *Do not agree at all* and 7 = *Very strongly agree*. The prompt asked participants why they play video games and each item represents one possible reason with six three-item subscales assessing intrinsic motivation (e.g., "Because it is stimulating to play"), integrated regulation (e.g., "Because it is an extension of me"), identified regulation (e.g., "Because it is a good way to develop important aspects of myself"), introjected regulation (e.g., "Because I feel that I must play regularly"), external regulation (e.g., "For the prestige of being a good player"), and amotivation (e.g., "It is not clear anymore; I sometimes ask myself if it is good for me"). This measure has demonstrated good reliability (i.e., internal consistency) and validity (i.e., relating to need satisfaction and gaming frequency as expected). The order of items was randomized for each participant.

4.2.4. Internet Gaming Disorder

Participants completed the 27-item, polytomous version of the Internet Gaming Disorder Scale (Lemmens, Valkenburg, & Gentile, 2015). This measure assesses how frequently individuals experienced each of the nine proposed IGD symptoms during the last year. Each item began with "During the last year…" and participants rated each item using a six-point response scale with anchors at 0 = Never and 5 = Every day or almost every day. The 27-item version includes nine subscales (each with three items) assessing the nine criteria for IGD proposed in

the DSM-V: preoccupation (e.g., "have there been periods when you were constantly fretting about a game?"), tolerance (e.g., "have you felt the need to play more often?"), withdrawal (e.g., "have you been feeling miserable when you were unable to play a game?"), persistence (e.g., "did you try to play less, but couldn't?"), escape (e.g., "have you played games to escape negative feelings?"), problems (e.g., "have you skipped work or school so that you could play games?"), deception (e.g., "have you played games secretively?"), displacement (e.g., "have you been spending less time with friends, partner, or family in order to play games?"), and conflict (e.g., "have you experienced serious problems at work or school because of gaming?"). This measure has demonstrated good reliability (i.e., internal consistency) and validity (i.e., relating to gaming playtime, loneliness, aggression, and self-esteem as expected). The order of all items was randomized for each participant.

4.2.5. Self-Control

Participants completed the 36-item Self-Control Scale using a five-point response scale with anchors at 1 = *Not at all* and 5 = *Very much* (Tangney, Baumeister, & Boone, 2004). Example items include "I am good at resisting temptation," "I am lazy," and "I do certain things that are bad for me, if they are fun," with the latter two items being reverse scored. This measure has demonstrated good reliability (i.e., internal consistency and test-retest) and validity (i.e., relating to academic performance, psychopathology, adjustment, and interpersonal success as expected). The order of all items was randomized for each participant.

4.3. Data Analysis

The data used for these analyses are available through the Open Science Framework website (https://osf.io/r9nwc/?view_only=7265df1ab17a4f389308aa6ab9db42ab). Data were visually screened for univariate outliers and non-normality at the scale level before conducting

analyses. There were four high outliers for weekly playtime, but these values were reasonable so a 90% winsorization was applied to reduce their statistical influence without excluding them. After this, no outliers remained. Variables were considered approximately normal if their skewness and kurtosis values were less than one in absolute value. Introjected regulation and IGD both had positive skew and kurtosis (> 1), but these variables were not transformed because our structural equation models (SEMs) used maximum likelihood estimation with robust (Huber-White) standard errors, which is robust against non-normality. All other variables were approximately normal.

Analyses were carried out in the following order. First, the measurement models for each measure were tested individually (based on questionnaires) and improved as necessary to attain good model fit before testing the full measurement model (see Supplemental Materials for a full outline of the steps that were carried out). Second, the correlations among latent variables in the measurement model as well as correlations among observed variables (based on item averages) were examined to provide an initial assessment of the relations among variables. Third, a series of SEMs was specified to test hypotheses. All analyses were carried out using R (R Core Team, 2019), with measurement models and SEMs tested using the "lavaan" package (Rosseel, 2012).

The fit of measurement models and SEMs, was assessed with the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR; Hu & Bentler, 1999). CFI and TLI values were considered acceptable if ≥ .90 and good if ≥ .95. RMSEA values were considered acceptable if ≤ .08 and good if ≤ .06. SRMR values were considered acceptable if < .10 and good if < .05.

5. Results

5.1. Measurement Models

The full details for all measurement models can be found in the Supplemental Materials. SEMs were simplified with item parceling based on the factorial algorithm described by Rogers and Schmitt (2004) for self-control and IGD. For both variables, three item parcels, which served as indicators of the latent self-control and IGD variables were used. Latent variables for need satisfaction and need frustration were specified by corresponding subscales. To improve model fit, satisfaction residuals were allowed to correlate with frustration residuals for each of the three needs (e.g., the residual for competence satisfaction correlated with the residual for competence frustration). For the gaming motivations scale, a bi-factor model was employed to avoid problematic multicollinearity among the gaming motivations. Bi-factor modeling has been applied successfully to SDT-based measures of exercise motivation (Gunnell & Gaudreau, 2015) and workplace motivation (Howard, Gagné, Morin, & Forest, 2018) as well as a measure of gaming motivations which was not based on SDT (Wu, Lai, Yu, Lau, & Lei, 2017). The integrated regulation subscale was ultimately dropped for two reasons: (1) doing so avoided factor loadings that were theoretically and empirically inappropriate, and (2) recent meta-analytic evidence suggests that measures of integrated regulation should be removed from measures assessing the continuum of self-determined motivation (Howard, Gagné, & Bureau, 2017). Thus, the final bi-factor modeling of gaming motivations included 15 items as indicators, with all items loading onto both a general motivation factor and a specific motivation factor (intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation), with each specific motivation having three items as indicators. Importantly, the correlations among the general and specific motivation factors were all constrained to zero (as is necessary in bi-factor modeling).

The full measurement model included all the latent variables described above as well as gender and weekly playtime, which were both specified as latent variables based on a single indicator (the observed variables). Specifying these observed variables as latent allowed for the estimation of correlations among all variables in the model and was only necessary in the measurement model. The fit for the measurement model was good according to CFI, TLI, and RMSEA values and acceptable according to the SRMR value (see Table 2). The factor loadings for the latent variables are reported in Table 3. Factor loadings for the general motivation factor ranged from 0.48 to 0.75 for the intrinsic, identified, introjected, and external items and ranged from -0.19 to 0.21 for the amotivation items. Thus, the general factor represents the quantity of motivation across all motivation types. The specific factors (i.e., intrinsic, identified, introjected, external, amotivation) represent the quality of motivation, which remains after accounting for quantity.

5.2. Associations among Variables

Table 4 shows the correlations among the primary variables. Among the latent variables, IGD scores were significantly positively related to need frustration and significantly negatively related to need satisfaction and self-control, as expected. IGD was also significantly positively related to general motivation, introjected regulation, and amotivation. A similar pattern of associations was found between weekly playtime and the same variables, though these were weaker in magnitude and weekly playtime was not significantly related to introjected regulation or amotivation. Also as expected, self-control was negatively related to the maladaptive forms of gaming motivation (introjected regulation, external regulation, and amotivation), although the relation with external regulation was not significant. Contrary to our expectations, self-control was unrelated to adaptive forms of gaming motivation (intrinsic motivation, integrated

regulation, and identified regulation). Finally, as expected, self-control was positively related to need satisfaction and negatively related to need frustration.

The relations among the observed variables were similar, except the gaming motivations were more frequently significantly related to other variables when general levels of motivation were not controlled for. Specifically, IGD scores and need frustration were both significantly positively related to all six types of motivation. Need satisfaction was significantly positively related to intrinsic motivation and significantly negatively related to introjected regulation. Self-control was significantly negatively related to integrated and introjected regulations as well as amotivation.

5.3. Structural Equation Models

The first model specified self-control as a mediator between need satisfaction and frustration and video gaming outcomes (IGD and weekly playtime). The data fit this model well (see Table 2) explaining a substantial proportion of the variance in self-control (37.4%), IGD (23.2%), and weekly playtime (18.6%). The primary results are reported in Table 5 and Figure 1 (all results for all models including factor loadings and variances are available in Supplemental Materials). In line with expectations, need satisfaction positively predicted self-control, whereas need frustration negatively predicted self-control. Moreover, need frustration positively predicted both IGD and weekly playtime. The residuals for IGD and weekly playtime were also positively related. In addition to these effects, males (compared to females) had higher IGD scores and weekly playtimes. The indirect effects of need satisfaction and need frustration on IGD through self-control were both significant (see Table 6). Need satisfaction had a protective effect through self-control, whereas need frustration had a harmful effect, with the latter more than twice as large as the former.

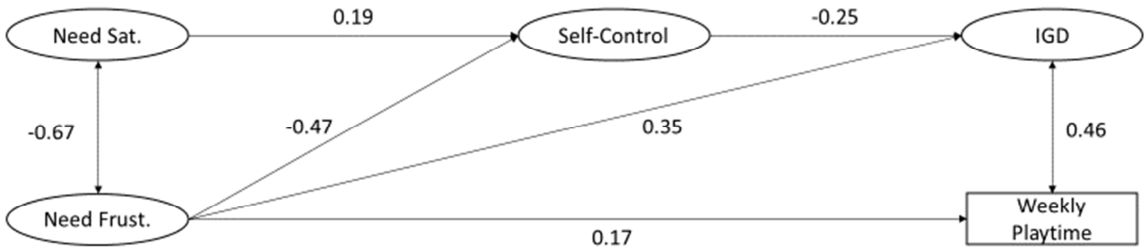

Figure 1. Self-control as a mediator between need satisfaction/frustration and gaming outcomes (Model 1). Sat. = Satisfaction, Frust. = Frustration, IGD = Internet Gaming Disorder. Only paths significant at $p < .05$ are shown. All estimates are fully standardized. This model also controlled for gender, but these paths are not shown.

Next, a second model in which gaming motivations served as mediators between self-control and gaming outcomes was specified. This model also fit the data well (see Table 2) and explained a noticeable proportion of the variance in general motivation (19.7%) identified regulation (12.1%), introjected regulation (13.3%) and amotivation (10.9%), but small proportions of the variance in external regulation (5.1%) and intrinsic motivation (0.1%). It also explained large proportions of the variance in IGD scores (61.3%) and weekly playtime (40.4%). The primary results are reported in Table 7 and Figure 2. Self-control negatively predicted introjected regulation, amotivation, IGD, and weekly playtime. General motivation positively predicted both IGD and weekly playtime. Introjected regulation and amotivation both positively predicted IGD, but intrinsic motivation, identified regulation, and external regulation did not significantly predict IGD or weekly playtime. As in Model 1, the residuals for IGD and weekly playtime were positively correlated, although the correlation was much weaker in this model. In addition to these effects, males (compared to females) had higher levels of general motivation but lower levels of identified and external regulations. The indirect effects of self-control on IGD through introjected regulation and amotivation were both significant, with self-control

demonstrating a protective effect (see Table 6). The indirect effect through introjected regulation was almost three times as large as the indirect effect through amotivation.

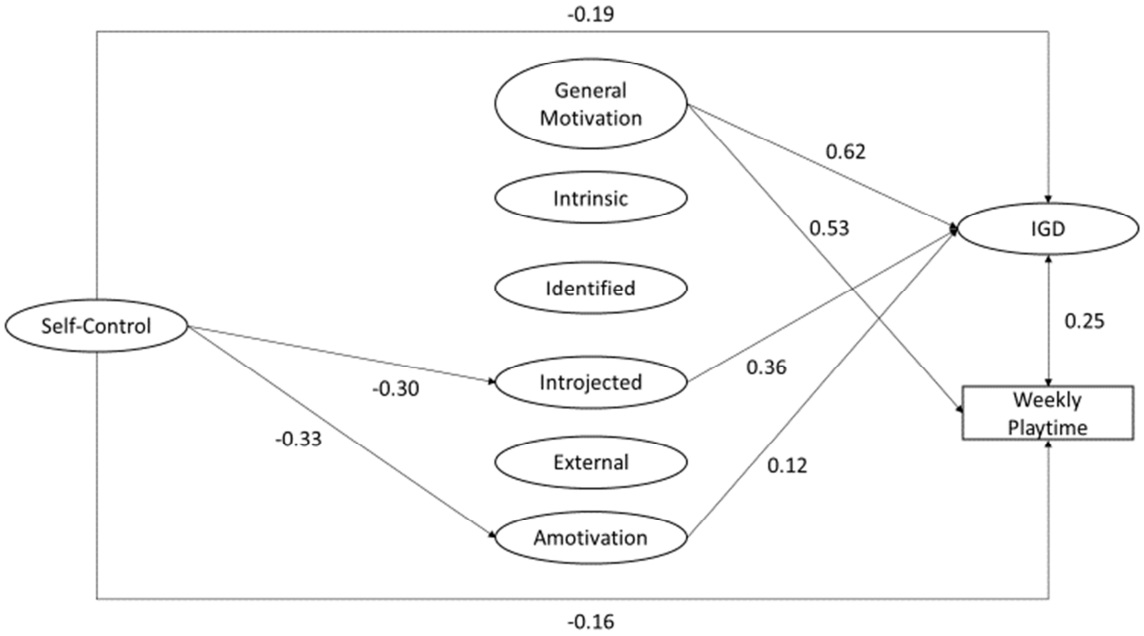

Figure 2. Gaming motivations as mediators between self-control and gaming outcomes (Model 2). IGD = Internet Gaming Disorder. Only paths significant at $p < .05$ are shown. All estimates are fully standardized. This model also controlled for gender, but these paths are not shown.

Finally, Models 1 and 2 were combined to create a serial mediation model in which need satisfaction and frustration predicted self-control, which in turn predicted gaming motivations, which in turn predicted gaming outcomes. This model fit the data well (see Table 2) and explained substantial proportions of the variance in self-control, gaming motivations, and gaming outcomes (see Table 8 for specific proportions). Need satisfaction and need frustration were negatively related once again. Need satisfaction positively predicted self-control, general motivation, intrinsic motivation, and amotivation, with the prediction of intrinsic motivation much stronger than the other variables. Need frustration negatively predicted self-control and positively predicted general motivation, introjected regulation, and amotivation. Self-control

negatively predicted amotivation and IGD. Once again, general motivation was positively related to both IGD and weekly playtime and introjected regulation and amotivation both positively predicted IGD. The effects of gender were also the same as in Model 2.

The indirect effects of need satisfaction on IGD through self-control and general motivation were both significant, with need satisfaction being harmful (linked to higher IGD) through the general motivation path but protective through the self-control path (see Table 6). The indirect effects of need satisfaction on IGD through amotivation and through both self-control and amotivation were not significant, however. The indirect effects of need frustration on IGD through self-control, general motivation, and introjected regulation were all significant, with need frustration linked to higher IGD in all cases. The indirect effect of need frustration on IGD through amotivation alone was not significant, but the path through self-control and then amotivation was significant. As before, need frustration was linked to higher levels of IGD. Finally, the indirect effects of both need satisfaction and need frustration on weekly playtime were significant, with both linked to higher weekly playtimes.

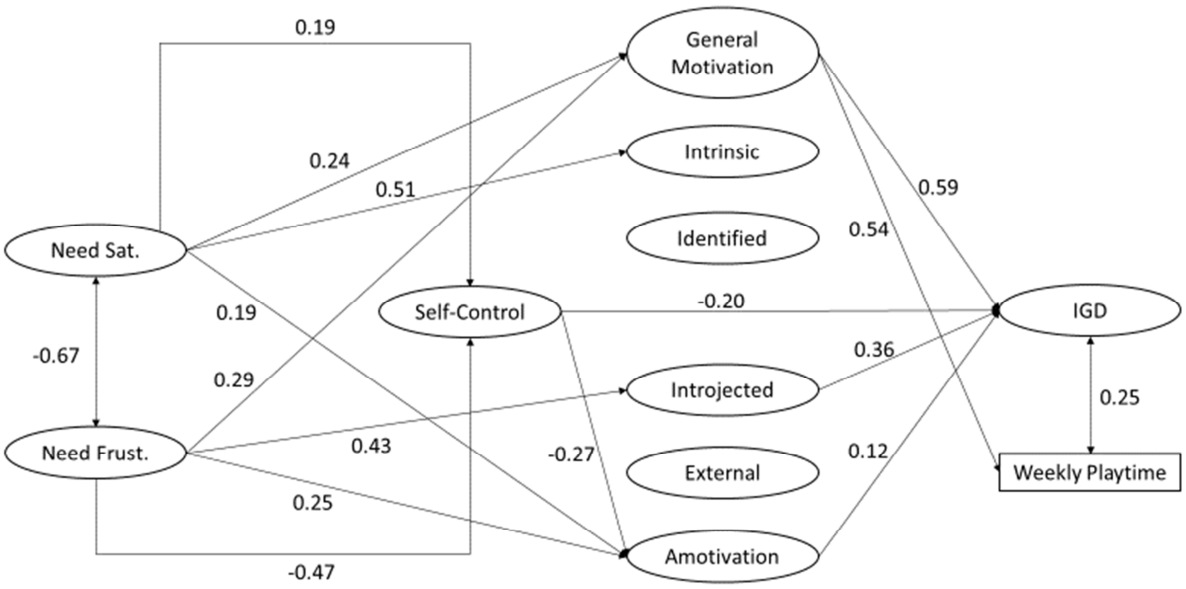

Figure 3. A serial mediation model with self-control and gaming motivations as mediators (Model 3). Sat. = Satisfaction, Frust. = Frustration, IGD = Internet Gaming Disorder. Only paths significant at $p < .05$ are shown. All estimates are fully standardized. This model also controlled for gender, but these paths are not shown.

6. Discussion

Similar to other results (de Ridder et al., 2012; Tangney et al., 2004), the present findings support the association between lower self-control and more severe IGD symptoms among university students. Furthermore, the present findings support those of past studies showing a positive association between the daily frustration of basic needs for competence, autonomy, and relatedness and the severity of IGD symptoms (Allen & Anderson, 2018; Mills, Milyavskaya, Mettler, et al., 2018). Building on past findings, the present study is the first to assess the mediating role of poorer self-control in explaining the association between daily need frustration and IGD. Specifically, findings suggest that greater daily need frustration contributes to higher IGD through poorer self-control. The present results further show that lower self-control among video game players is associated with a stronger amotivation towards video gaming,

which is further positively associated with IGD. Collectively, these results speak to the interplay between self-control and fundamental elements embedded in SDT.

The strength model of self-control proposes that people possess limited psychological resources to enact self-control (Baumeister et al., 2007; Hagger et al., 2010). Daily need frustration is assumed to tax these limited psychological resources (Ryan & Deci, 2017). As such, Vansteenkiste and Ryan (2013) suggest that lower self-control may explain, at in least in part, the presence of negative consequences stemming from daily need frustration. Present findings offer initial support for this hypothesis with self-control accounting for more than 20% of the total effect of daily need frustration on IGD in our simplest and most complex models. On the other hand, daily need satisfaction protected against increased IGD through its positive effect on self-control. Future research in this area should explore how positive and negative affect might further inform the interplay between daily need satisfaction and frustration and self-control. For instance, daily need frustration is predictive of negative affect and depressive symptoms (Chen et al., 2015; Rodríguez-Meirinhos et al., 2019), which require one to enact emotion regulation strategies such as reappraisal or suppression (Gross & John, 2003). Experimental studies have found that when suppression is used, people are less persistent and are unable to conceal their emotional frustrations, implying that suppressing thoughts may itself use up resources required for self-control (Baumeister, Bratslavsky, Muraven, & Tice, 1998). Studies have found maladaptive coping strategies, including suppression, to be associated with greater IGD (Blasi et al., 2019; Loton, Borkoles, Lubman, & Polman, 2016; Schneider, King, & Delfabbro, 2017; Yen et al., 2018). Therefore, considering emotion regulation might enhance interpretations of the present model and may bring to light further questions on the relation

between daily need satisfaction/frustration and self-control, and the collective role these constructs play in explaining IGD and other addictive behaviors.

In addition to the satisfaction and frustration of basic psychological needs, the present study assessed the strength of participants' intrinsic motivation and extrinsic motivation for playing video games as well as their amotivation towards video gaming. This is the first study to apply a bi-factor model to items of the GAMS, which other SDT studies have recently done with similar measures (e.g., Gunnell & Gaudreau, 2015; Howard, Gagné, Morin, & Forest, 2018). The bi-factor model includes a general motivation factor, which accounts for the strength of participants' video gaming motivation separately from the quality of their video gaming motivations. Consistent with a recent meta-analysis (Howard et al., 2017), the measurement model suggested the removal of the integrated regulation subscale. Moreover, differences were observed between the raw and the latent correlations presented in in Table 4. Specifically, IGD was positively associated with each video gaming motivation when correlations were calculated from the raw data. However, the latent correlations, which included the general factor, revealed that IGD was positively associated with introjected regulation and amotivation towards video gaming as well as participants' general motivation for playing video games, but was not related to the other video gaming motivations. This finding conflicts with past studies that have relied on more traditional modeling techniques that do not control for the high intercorrelations among video gaming motivations through a bi-factor model (Mills, Milyavskaya, Heath, et al., 2018). Nonetheless, these findings are more in line with SDT in that introjected regulation and amotivation are expected to be associated with a more problematic pattern of video gaming engagement.

The final model also identified general motivation as a strong predictor of both IGD scores and weekly playtime. This aligns with other recent research that applied a bi-factor model to a measure of gaming motivations not based on SDT (Wu et al., 2017). Interestingly, general motivation was positively predicted by both need satisfaction and need frustration. This is likely because the general motivation factor was based on both autonomous (i.e., intrinsic and identified) and controlled (i.e., introjected and external) forms of motivation. Thus, people with IGD seem to have high levels of motivation across the spectrum of self-determination. Importantly, after controlling for general motivation, introjected regulation and amotivation predicted greater IGD but not weekly playtime. This suggests that the strength of users' general video gaming motivation contributes to frequency of video game playing, whereas the quality of video gaming motivation, specifically those that are more maladaptive, appear to contribute to a more problematic pattern of video game engagement.

In line with expectations, self-control was associated with less introjected regulation and amotivation. These two bivariate associations have two broader implications for SDT. First, by definition, greater self-control implies increased command over internal drives. As such, these findings suggest that greater self-control may reduce the strength of "unsanctioned" internal pressures one places on himself or herself, thus lessening players' introjected regulation over playing video games. It should be noted that in the final model, self-control was not significantly associated with introjected regulation beyond the effect of daily need frustration suggesting that further study on this relation is required. Nonetheless, the implication to theory drawn from the bivariate association as well as the observed path between self-control and introjected regulation in Model 2 deserves attention. Second, greater self-control indicates that the individual acts with volition. Therefore, high self-control implies that the choice to engage or to not engage in video

games is more deliberate, and that individuals are aware of their reasons for doing either. This association was present in both Model 2 and Model 3 suggesting it may be more robust.

Interestingly, self-control was not associated with intrinsic motivation or identified regulation within the context of video gaming. This implies that self-control does not necessarily facilitate the endorsement of adaptive motivations but does protect against a strong endorsement of maladaptive motivations. This finding conflicts with some emerging evidence suggesting a small positive relation between self-control and adaptive motivations (Converse et al., 2019; Holding et al., 2019). Therefore, future work is needed to reassess the relation between self-control and video gaming motivations as well as to assess the relation of self-control to motivations in other domains (e.g., physical activities, academic engagement) in order to better understand how these two constructs are related. Nonetheless, the negative association between self-control and maladaptive motivations is consistent with findings from these past studies (Converse et al., 2019; Holding et al., 2019), which, as shown in Model 2 of the present study, partially explained the effect of self-control on IGD.

Finally, results from the present study reveal evidence for the first time that supports a model whereby both self-control and video gaming motivations explain the effect of daily need frustration on IGD. Specifically, the first model shows that daily need frustration contributes positively to IGD through its negative effect on self-control. As already explained, daily need frustration appears to tax players' resources for enacting effective control over their emotions, behaviors, and impulses, which in turn results in more problematic patterns of video game engagement. Additionally, as shown in the final model, daily need frustration seems to facilitate IGD through increases in players' introjected regulation as well as their general motivation to play video games. This suggests that as daily need frustration rises, individuals may play video

games out of a need to satisfy internal pressures to play due to a natural desire to feel valued, which they may perceive as only possible through video gaming (Liu & Peng, 2009). As such, the positive association between daily need frustration and general motivation for playing video games might be reflective of a strong motivation to be immersed in an environment where one is respected and valued. This differs from the relation between daily need satisfaction and general motivation in that daily need satisfaction appears to contribute to the more adaptive motivations that were subsumed by the general factor (i.e., intrinsic motivation and identified regulation). Therefore, it is likely that higher need satisfaction allows for engagement in video games for the enjoyment in video games themselves and nothing more. Lastly, a serial mediation was found whereby daily need frustration contributes to poorer self-control, which in turn contributes to greater amotivation toward video games, which positively contributes to IGD. As self-control was not significantly associated with introjected regulation in the final model, a similar serial mediation was not found for this type of motivation. This implies that daily frustration contributes to amotivation in part through the taxing of psychological resources associated with self-control, whereas introjected regulation appears to be a direct consequence of daily need frustration. Further research is required to assess whether or not these cross-sectional relations replicate in longitudinal data.

The present findings are not without several limitations. First, the nature of self-report data implies a trust in participants' accurate interpretation of items as well as their honest answers. Second, the cross-sectional design of the study limits the ability to infer causality. As such, future research should now focus on the associations between daily need satisfaction and frustration and self-control over time to more accurately understand how these constructs are

related. Finally, as this study was based on data from a university sample, the generalizability of results may be limited.

7. Conclusion

This is the first study to examine Vansteenkiste and Ryan's (2013) proposition that poorer self-control explains the negative consequences stemming from daily need frustration. Specifically, the present findings suggest that daily need frustration increases IGD by undermining individuals' ability to regulate their behaviors and urges, and by fostering maladaptive motivations for video gaming—especially players' amotivation towards video gaming. Amotivation reflects a feeling of powerlessness to regulate video gaming engagement, even when one doubts the benefits of video gaming. This appears to parallel the compulsive patterns of video gaming that problem video game players display. Assuming that self-control can be enhanced through practice—a fundamental assumption of the Strength Model of Self-Control (Baumeister et al., 2007)—future research should explore the means by which self-control may be strengthened. One possible route to enhancing self-control is through mindfulness (Bishop et al., 2004; Teper, Segal, & Inzlicht, 2013). Indeed, research has already shown that IGD declines after participating in mindfulness-based interventions and is also negatively associated with players' tendency to be more mindful in daily activities (Deplus, Billieux, Scharff, & Philippot, 2016; Li, Garland, & Howard, 2018; Li et al., 2017; Mills, 2019). Cognitive behavioral therapy and future episodic thinking exercises have also been shown to enhance self-control in other areas of study (Bickel, Quisenberry, Moody, & George Wilson, 2015; Lechner, Sidhu, Kittaneh, & Anand, 2019). In short, while more work is necessary to test the directionality of the associations observed in the present study, the present findings form a

foundation for further investigations into the interplay between need satisfaction, need frustration, and self-control within the context of video gaming and other related areas of study.

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Table 1.
Descriptive Statistics and Reliabilities for Primary Variables

Variable	Min.	Max.	Mean	*SD*	*α*
Need Satisfaction	1.33	5.00	3.86	0.58	0.88
Need Frustration	1.08	5.00	2.50	0.74	0.88
Intrinsic Motivation	1.00	7.00	4.25	1.46	0.71
Integrated Regulation	1.00	7.00	2.52	1.56	0.87
Identified Regulation	1.00	7.00	2.75	1.53	0.81
Introjected Regulation	1.00	6.33	1.82	1.13	0.78
External Regulation	1.00	7.00	3.29	1.68	0.79
Amotivation	1.00	7.00	2.69	1.51	0.79
IGD Score	0.00	4.22	0.65	0.77	0.96
Weekly Playtime	0.00	43.70	15.29	12.09	N/A
Self-Control	1.78	4.69	3.31	0.50	0.89

Note. $N = 487$. IGD = Internet Gaming Disorder, N/A = Not Applicable.

Table 2.
Fit Indices for the Measurement Model and Structural Equation Models

Model	χ^2	df	*p*	CFI	TLI	RMSEA	90% CI for RMSEA	SRMR
Full MM	556.80	310	.000	.962	.951	.040	[.035, .045]	.052
Model 1	107.52	61	.000	.986	.979	.040	[.028, .051]	.032
Model 2	381.75	187	.000	.963	.950	.046	[.040, .052]	.047
Model 3	543.97	310	.000	.964	.953	.039	[.034, .044]	.045

Note. MM = Measurement Model, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residual.

Table 3.
Factor Loadings for Latent Variables in the Full Measurement Model

Parameter	Estimate	*SE*	*Z*	*p*	Std. Est.
IGD Score =~					
IGD Parcel 1	1.00	--	--	--	0.93
IGD Parcel 2	1.11	0.04	27.74	< .001	0.97
IGD Parcel 3	1.12	0.04	26.84	< .001	0.92
Self-Control =~					
Self-Control Parcel 1	1.00	--	--	--	0.85
Self-Control Parcel 2	1.02	0.04	23.96	< .001	0.89
Self-Control Parcel 3	1.06	0.05	22.78	< .001	0.88
General Motivation =~					
Intrinsic Item 1	1.00	--	--	--	0.48
Intrinsic Item 2	1.22	0.12	10.20	< .001	0.52
Intrinsic Item 3	1.56	0.15	10.19	< .001	0.67
Identified Item 1	1.55	0.18	8.78	< .001	0.75
Identified Item 2	1.38	0.17	8.22	< .001	0.64
Identified Item 3	1.68	0.19	9.04	< .001	0.71
Introjected Item 1	1.13	0.15	7.37	< .001	0.65
Introjected Item 2	1.04	0.15	6.81	< .001	0.59
Introjected Item 3	0.73	0.13	5.80	< .001	0.49
External Item 1	1.59	0.16	9.72	< .001	0.63
External Item 2	1.60	0.16	9.83	< .001	0.66
External Item 3	1.32	0.15	8.88	< .001	0.54
Amotivation Item 1	0.36	0.14	2.65	.008	0.17
Amotivation Item 2	0.44	0.13	3.33	.001	0.21
Amotivation Item 3	-0.45	0.14	-3.33	.001	-0.19
Intrinsic Motivation =~					
Intrinsic Item 1	1.00	--	--	--	0.68
Intrinsic Item 2	0.57	0.24	2.34	.019	0.35
Intrinsic Item 3	0.32	0.10	3.13	.002	0.19
Identified Regulation =~					
Identified Item 1	1.00	--	--	--	0.47
Identified Item 2	0.96	0.38	2.51	.012	0.43
Identified Item 3	0.37	0.23	1.62	.106	0.15
Introjected Regulation =~					
Introjected Item 1	1.00	--	--	--	0.30
Introjected Item 2	1.67	0.37	4.51	< .001	0.49
Introjected Item 3	1.82	0.43	4.27	< .001	0.64
External Regulation =~					
External Item 1	1.00	--	--	--	0.44
External Item 2	0.41	0.14	2.96	.003	0.19
External Item 3	1.63	0.46	3.54	< .001	0.74
Amotivation =~					
Amotivation Item 1	1.00	--	--	--	0.86
Amotivation Item 2	0.83	0.06	13.03	< .001	0.73

Amotivation Item 3	0.92	0.07	12.75	< .001	0.69
Need Satisfaction =~					
Competence Satisfaction	1.00	--	--	--	0.79
Autonomy Satisfaction	1.02	0.10	10.54	< .001	0.76
Relatedness Satisfaction	0.84	0.10	8.39	< .001	0.60
Need Frustration =~					
Competence Frustration	1.00	--	--	--	0.83
Autonomy Frustration	0.73	0.06	11.59	< .001	0.66
Relatedness Frustration	0.71	0.06	12.40	< .001	0.67
Weekly Playtime (Latent)* =~					
Weekly Playtime (Observed)	1.00	--	--	--	1.00
Male (Latent)* =~					
Male (Observed)	1.00	--	--	--	1.00

Note. *SE* = standard error (of the unstandardized estimate), Std. Est. = fully standardized estimate, IGD = Internet Gaming Disorder. The "=~" symbol indicates that the following variables loaded onto the preceding latent variable. *Weekly playtime and male (gender) were only specified as latent variables to allow them to correlate with other variables in this model. These variables were specified as observed in all future models.

Table 4.
Correlations Among Primary Variables (Observed and Latent)

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. IGD Score	---	**.54**	**-.17**	**.35**	**-.34**	.03	---	.02	**.39**	-.00	**.17**	**.63**	**.22**
2. Weekly Playtime	**.52**	---	**-.14**	**.20**	**-.19**	.09	---	-.00	.07	-.08	-.01	**.59**	**.36**
3. Need Satisfaction	**-.18**	**-.13**	---	**-.67**	**.49**	.18	---	.04	**-.30**	.07	.01	.02	.00
4. Need Frustration	**.33**	**.17**	**-.62**	---	**-.58**	.12	---	.01	**.43**	-.01	**.13**	**.12**	-.08
5. Self-Control	**-.33**	**-.17**	**.42**	**-.50**	---	-.09	---	-.05	**-.21**	-.06	**-.27**	-.07	.04
6. Intrinsic Motivation	**.38**	**.44**	**.11**	**.10**	-.07	---	---	.00	.00	.00	.00	.00	.02
7. Integrated Regulation	**.57**	**.50**	-.07	**.16**	**-.11**	**.53**	---	---	---	---	---	---	---
8. Identified Regulation	**.50**	**.52**	.00	**.12**	-.06	**.59**	**.81**	---	.00	.00	.00	.00	**-.30**
9. Introjected Regulation	**.66**	**.43**	**-.15**	**.31**	**-.19**	**.38**	**.67**	**.60**	---	.00	.00	.00	-.13
10. External Regulation	**.44**	**.40**	.07	**.10**	-.09	**.62**	**.54**	**.54**	**.51**	---	.00	.00	**-.21**
11. Amotivation	**.29**	.01	-.07	**.21**	**-.28**	-.03	.04	-.04	**.28**	.08	---	.00	-.04
12. General Motivation	---	---	---	---	---	---	---	---	---	---	---	---	**.43**
13. Male	**.19**	**.36**	.00	-.07	.06	**.30**	**.31**	**.25**	**.19**	**.23**	-.03	---	---

Note. $N = 487$. Correlations below the diagonal are based on observed variables and correlations above the diagonal are based on latent variables in the measurement model. Note that due to the bi-factor modeling, correlations among latent gaming motivations were constrained to zero. To aid interpretation, correlations significant at $p < .05$ are bolded.

Table 5.
Parameter Estimates for Regressions and Covariances in Model 1

Parameter	Estimate	*SE*	*Z*	*p*	Std. Est.
Regressions					
IGD Score (23.2%) ~					
Self-Control	-0.37	0.10	-3.92	< .001	-0.25
Need Satisfaction	0.22	0.12	1.85	.065	0.17
Need Frustration	0.31	0.10	3.24	.001	0.35
Male	0.34	0.06	5.67	< .001	0.24
Weekly Playtime (18.6%) ~					
Self-Control	-2.92	1.49	-1.96	.050	-0.11
Need Satisfaction	0.65	1.71	0.38	.703	0.03
Need Frustration	2.64	1.29	2.05	.041	0.17
Male	9.22	1.02	9.08	< .001	0.38
Self-Control (37.4%) ~					
Need Satisfaction	0.16	0.06	2.52	.012	0.19
Need Frustration	-0.28	0.05	-5.52	< .001	-0.47
Male	0.01	0.04	0.22	.823	0.01
Covariances Among Residuals					
Competence Satisfaction ~~					
Competence Frustration	-0.07	0.03	-2.67	.008	-0.33
Autonomy Satisfaction ~~					
Autonomy Frustration	0.10	0.03	-3.73	< .001	-0.31
Relatedness Satisfaction ~~					
Relatedness Frustration	-0.23	0.03	-8.16	< .001	-0.59
IGD Score ~~ Weekly Playtime	3.04	0.38	8.05	< .001	0.46
Covariances Among Variables					
Need Satisfaction ~~					
Need Frustration	-0.29	0.04	-6.79	< .001	-0.67
Male	0.00	0.02	0.18	.860	0.01
Need Frustration ~~ Male	-0.04	0.02	-1.78	.074	-0.09

Note. *SE* = standard error (of the unstandardized estimate), Std. Est. = fully standardized estimate, IGD = Internet Gaming Disorder. The "~" symbol indicates that the preceding variable was predicted the following variables. The amount of variance explained for each predicted variable is in parentheses. The "~~" symbol indicates that the preceding variable covaried with the following variable.

Table 6.
Indirect Effects in Models 1-3

Indirect Effect	Estimate	*SE*	*Z*	*p*	Std. Est.
Model 1					
NS → Self-Control → IGD	-0.06	0.03	-2.14	.033	-0.05
NF → Self-Control → IGD	0.10	0.03	3.25	.001	0.12
Model 2					
Self-Control → Introjected → IGD	-0.16	0.06	-2.67	.008	-0.11
Self-Control → Amotivation → IGD	-0.06	0.02	-2.31	.021	-0.04
Model 3: Predicting IGD					
NS → Self-Control → IGD	-0.05	0.02	-2.31	.021	-0.04
NS → General Motivation → IGD	0.18	0.09	2.12	.034	0.14
NS → Amotivation → IGD	0.03	0.02	1.54	.124	0.02
NS → Self-Control → Amotivation → IGD	-0.01	0.01	-1.63	.103	-0.01
NF → Self-Control → IGD	0.08	0.03	3.20	.001	0.09
NF → General Motivation → IGD	0.15	0.06	2.52	.012	0.17
NF → Introjected → IGD	0.14	0.06	2.36	.018	0.15
NF → Amotivation → IGD	0.03	0.02	1.64	.102	0.03
NF → Self-Control → Amotivation → IGD	0.01	0.01	2.01	.044	0.02
Model 3: Predicting Weekly Playtime					
NS → General Motivation → Weekly Playtime	2.85	1.37	2.09	.037	0.13
NF → General Motivation → Weekly Playtime	2.40	0.97	2.46	.014	0.16

Note. *SE* = standard error (of the unstandardized estimate), Std. Est. = fully standardized estimate, NS = Need Satisfaction, NF = Need Frustration IGD = Internet Gaming Disorder. The "→" symbol indicates that the following variable was predicted by the preceding variable.

Table 7.
Parameter Estimates for Regressions and Covariances in Model 2

Parameter	Estimate	*SE*	*Z*	*p*	Std. Est.
Regressions					
IGD Score (61.3%) ~					
General Motivation	0.53	0.09	6.26	< .001	0.62
Intrinsic	0.01	0.03	0.22	.824	0.01
Identified	0.00	0.07	0.00	.998	0.00
Introjected	0.55	0.18	3.14	.002	0.36
External	-0.01	0.04	-0.22	.823	-0.01
Amotivation	0.05	0.02	2.52	.012	0.12
Self-Control	-0.28	0.06	-4.42	< .001	-0.19
Male	0.02	0.09	0.26	.799	0.02
Weekly Playtime (40.4%) ~					
General Motivation	7.92	1.35	6.88	< .001	0.53
Intrinsic	0.58	0.64	0.89	.371	0.06
Identified	0.12	2.13	0.05	.957	0.01
Introjected	1.49	2.17	0.69	.493	0.06
External	-0.63	0.78	-0.80	.422	-0.05
Amotivation	-0.34	0.39	-0.88	.378	-0.04
Self-Control	-4.26	1.40	-3.04	.002	-0.16
Male	3.32	2.19	1.52	.129	0.14
General Motivation (19.7%) ~					
Self-Control	-0.13	0.11	-1.19	.235	-0.07
Male	0.71	0.13	5.35	< .001	0.44
Intrinsic (0.1%) ~					
Self-Control	-0.08	0.22	-0.38	.708	-0.03
Male	-0.03	0.22	0.14	.891	0.01
Identified (12.1%) ~					
Self-Control	-0.08	0.16	-0.49	.623	-0.04
Male	-0.61	0.19	-3.26	.001	-0.34
Introjected (13.3%) ~					
Self-Control	-0.29	0.09	-3.38	.001	-0.30
Male	-0.18	0.09	-1.94	.052	-0.19
External (5.1%) ~					
Self-Control	-0.16	0.13	-1.23	.220	-0.08
Male	-0.38	0.17	-2.17	.030	-0.21
Amotivation (10.9%) ~					
Self-Control	-1.05	0.17	-6.13	< .001	-0.33
Male	-0.13	0.17	-0.74	.459	-0.04
Covariances Among Residuals					
IGD Score ~~ Weekly Playtime	0.99	0.31	3.22	.001	0.25
Covariances Among Variables					
Self-Control ~~ Male	0.01	0.01	1.07	.287	0.05

Note. *SE* = standard error (of the unstandardized estimate), Std. Est. = fully standardized estimate, IGD = Internet Gaming Disorder. The "~" symbol indicates that the preceding variable

was predicted the following variables. The amount of variance explained for each predicted variable is in parentheses. The "~~" symbol indicates that the preceding variable covaried with the following variable.

Table 8.
Parameter Estimates for Regressions and Covariances in Model 3

Parameter	Estimate	*SE*	*Z*	*p*	Std. Est.
Regressions					
IGD Score (61.3%) ~					
General Motivation	0.58	0.11	5.22	< .001	0.59
Intrinsic	0.00	0.03	0.04	.970	0.00
Identified	-0.00	0.07	-0.05	.961	-0.00
Introjected	0.56	0.19	2.89	.004	0.36
External	-0.01	0.04	-0.18	.857	-0.01
Amotivation	0.06	0.02	2.54	.011	0.12
Self-Control	-0.30	0.07	-4.20	< .001	-0.20
Need Satisfaction	0.03	0.10	0.34	.734	0.03
Need Frustration	0.01	0.07	0.07	.943	0.01
Male	0.02	0.10	0.22	.827	0.02
Weekly Playtime (41.4%) ~					
General Motivation	9.16	1.80	5.10	< .001	0.54
Intrinsic	0.98	0.75	1.31	.191	0.10
Identified	0.01	2.14	0.00	.998	0.00
Introjected	0.93	2.42	0.39	.700	0.03
External	-0.50	0.76	-0.65	.517	-0.04
Amotivation	-0.18	0.40	-0.46	.645	-0.02
Self-Control	-2.73	1.58	-1.72	.085	-0.11
Need Satisfaction	-2.99	1.75	-1.71	.087	-0.13
Need Frustration	-0.32	1.29	-0.25	.807	-0.02
Male	2.95	2.11	1.40	.162	0.12
General Motivation (24.2%) ~					
Self-Control	-0.02	0.12	-0.20	.844	-0.02
Need Satisfaction	0.31	0.14	2.23	.026	0.24
Need Frustration	0.26	0.10	2.52	.012	0.29
Male	0.66	0.13	5.01	< .001	0.46
Intrinsic (14.1%) ~					
Self-Control	-0.36	0.27	-1.34	.179	-0.14
Need Satisfaction	1.13	0.29	3.94	< .001	0.51
Need Frustration	0.42	0.21	1.95	.051	0.28
Male	0.17	0.20	0.84	.404	0.07
Identified (12.7%) ~					
Self-Control	-0.03	0.23	-0.13	.900	-0.12
Need Satisfaction	-0.04	0.25	-0.14	.890	-0.02
Need Frustration	0.03	0.18	0.16	.873	0.03
Male	-0.62	0.16	-3.76	< .001	-0.35
Introjected (25.5%) ~					
Self-Control	-0.03	0.10	-0.25	.806	-0.03
Need Satisfaction	-0.03	0.12	-0.29	.770	-0.04
Need Frustration	0.24	0.11	2.21	.027	0.43
Male	-0.13	0.08	-1.54	.124	-0.14

External (7.9%) ~					
Self-Control	-0.33	0.20	-1.64	.100	-0.17
Need Satisfaction	0.41	0.27	1.55	.120	0.24
Need Frustration	0.09	0.16	0.56	.578	0.07
Male	-0.35	0.15	-2.25	.024	-0.19
Amotivation (13.5%) ~					
Self-Control	-0.87	0.23	-3.82	< .001	-0.27
Need Satisfaction	0.53	0.26	1.99	.046	0.19
Need Frustration	0.47	0.21	2.21	.027	0.25
Male	-0.00	0.18	-0.01	.993	-0.00
Self-Control (37.8%) ~					
Need Satisfaction	0.17	0.06	2.57	.010	0.19
Need Frustration	-0.28	0.05	-5.56	< .001	-0.47
Male	0.01	0.04	0.16	.873	0.01
<u>Covariances Among Residuals</u>					
Competence Satisfaction ~~					
Competence Frustration	-0.08	0.03	-2.82	.005	-0.34
Autonomy Satisfaction ~~					
Autonomy Frustration	-0.10	0.03	-4.16	< .001	-0.34
Relatedness Satisfaction ~~					
Relatedness Frustration	-0.22	0.03	-7.90	< .001	-0.58
IGD Score ~~ Weekly Playtime	1.00	0.32	3.12	.002	0.25
<u>Covariances Among Variables</u>					
Need Satisfaction ~~					
Need Frustration	-0.28	0.04	-6.84	< .001	-0.67
Male	0.00	0.01	0.20	.843	0.01
Need Frustration ~~ Male	-0.04	0.02	-1.79	.074	-0.09

Note. *SE* = standard error (of the unstandardized estimate), Std. Est. = fully standardized estimate, IGD = Internet Gaming Disorder. The "~" symbol indicates that the preceding variable was predicted the following variables. The amount of variance explained for each predicted variable is in parentheses. The "~~" symbol indicates that the preceding variable covaried with the following variable(s).

Highlights

- Self-control (SC) and Internet Gaming Disorder (IGD) are explored in the context of self-determination theory
- Poorer SC is associated with IGD and extrinsic gaming motivations
- Basic need frustration contributes to IGD through its negative effect on players' SC