Exploring the pull and push underlying problem video game use A Self Determination Theory approach

Abstract

Research has revealed that the push to engage in video games is in part the perception that they satisfy three basic psychological needs (competence, autonomy, relatedness). However, the pull toward a problematic style of video game engagement based on Internet Gaming Disorder symptomatology has been found to be explained in part by the daily frustration of these same needs. Currently, these two areas of gaming research have been conducted within separate studies. Therefore, the objective of the present study was to bridge these two theoretically compatible areas of research in exploring the interaction between gaming need satisfaction and daily need frustration in explaining problem video game use and gaming frequency. An online sample of 922 adults (59.1% males; M_{age} = 23.53 years; SD = 6.84) were recruited. Results revealed both gaming need satisfaction and daily need frustration positively contributed to gaming frequency and problem video game use accounting for 19.7% and 23.5% of their respective variances. Furthermore, gaming frequency and problem video game use were highest when both gaming need satisfaction and daily need frustration were high. The implications of these results are discussed within the context of current research and strengths-based clinical approaches.

1. Introduction

Video games are popular recreational activities that are enjoyed by millions every year (Entertainment Software Association, 2018). Although the vast majority of video game users demonstrate a healthy style of engagement, others exhibit symptoms similar to substance abuse

indicative of what can best be described as a gaming disorder (Griffiths, Kuss, Lopez-Fernandez, & Pontes, 2017). Research has often explored factors that facilitate the appeal of video games and those that promote the risk of engaging problematically in video games within separate studies. This may be largely due to the absence of a theoretical framework that offers an explanation of the mechanisms that facilitate both the appeal (or Pull) of video games as well as the risk (or Push) of developing a problematic style of video game engagement. Applications of Self-Determination Theory (SDT; Ryan & Deci, 2000, 2017) suggest satisfying basic psychological needs during video game engagement explains the appeal of video games (Peng, Lin, Pfeiffer, & Winn, 2012; Ryan, Rigby, & Przybylski, 2006). On the other hand, the extent to which these same needs are frustrated or thwarted in daily life has been found to explain an increasingly problematic style of video game en- gagement (Mills, Milyavskaya, Heath, & Derevensky, 2018; Mills, Milyavskaya, Mettler, Heath, & Derevensky, 2018). The present study bridges these two areas of research within SDT in exploring whether an interaction between gaming need satisfaction and daily need frustration explains both gaming frequency as well as problem video game use beyond what these two constructs explain separately.

1.1 Internet Gaming Disorder

Internet Gaming Disorder (IGD) is a persistent pattern of gaming that directly or indirectly contributes to maladaptive functioning (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013). Problem video game use is a secondary term used to describe a pattern of gaming engagement that ranges from minimal to high risk for IGD. Although past research suggests males tend to report greater problem video game use than females (Colder Carras et al., 2017; Lemmens, Valkenburg, & Gentile, 2015), more recent data has failed to provide sufficient evidence of a gender difference for problem video game use (Przybylski, Weinstein, &

Murayama, 2017). Not surprisingly, those reporting greater time gaming also report higher problem video game use (Jeromin, Rief, & Barke, 2016; Sim, Gentile, Bricolo, Serpelloni, & Gulamoydeen, 2012), though this is likely due to high enthusiasm toward video games rather than evidence of a disorder itself (Charlton, 2002; Charlton & Danforth, 2007; Griffiths, 2009). Finally, problem video game use has been found to be associated with greater loneliness, depression, aggression, and anxiety within adult populations (e.g., Andreassen et al., 2016; Bargeron & Hormes, 2017; Lemmens et al., 2015; Mentzoni et al., 2011).

Given the numerous studies demonstrating similar associations be- tween problem video game use and indicators of ill-being, the World Health Organization (WHO) has recently announced they are officially including IGD in the upcoming revision of the International Classification of Diseases (WHO, 2018). At this time, the American Psychiatric Association (APA) continues to consider a 2013 proposal of IGD as a condition for further study in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013). The DSM-5 proposal includes a set of nine symptoms. Endorsing five or more symptoms is a suggested threshold for IGD diagnosis. However, there remains a great deal of debate by scholars on the merits of IGD as a diagnostic category as well as its corresponding symptoms (Aarseth et al., 2016; Griffiths et al., 2016; Kardefelt-Winther, 2015; Przybylski et al., 2017). The larger issue of whether IGD is a diagnostic category will not be addressed in the present study. Rather, the focus will be on whether greater problem video game use (PVGU) can be explained by key assumptions embedded within Self-Determination Theory; a theoretical framework that is guided by social psychological principles.

1.2 Self-Determination Theory

Self-Determination Theory (SDT) proposes that the satisfaction of three basic psychological needs during activity engagement will result in greater intrinsic motivation and overall enjoyment in the activity (Ryan & Deci, 2000, 2017). The three basic psychological needs include competence (possessing adequate knowledge or skill), relatedness (feeling a sense of belonging), and autonomy (perceiving ownership of one's decisions). Studies have shown that video games have the potential to satisfy these three needs, which in turn contributes to users spending more time gaming and reporting greater enjoyment in these video games (Johnson, Gardner, & Sweetser, 2016; Peng et al., 2012; Ryan et al., 2006; Tamborini, Bowman, Eden, Grizzard, & Organ, 2010). Moreover, the principles of SDT were used in designing the highly praised Middle-earth: Shadow of Mordor video game to maximize the satisfaction of competence, relatedness, and autonomy needs through gameplay (Graft, 2015). Thus, like many other activities, need satisfaction plays an essential role in facilitating the appeal of video games. However, it is likely that the extent to which basic needs are perceived to be satisfied through video games only explains one side of PVGU, the pull into playing video games, but not the push to play video games.

Recent advances in SDT suggest experiencing daily obstructions to need satisfaction is a better predictor of problematic behaviors such as PVGU. Vansteenkiste and Ryan (2013) refer to daily obstructions to need satisfaction as need frustration. This includes perceiving external pressures that make one feel untalented or unknowledgeable (competence frustration), feeling forced to do something or behave in certain way (autonomy frustration), or experiencing rejection from peers or colleagues (relatedness frustration). In theory, the emphasis on external pressures distinguishes need frustration from low need satisfaction in that the environment must, in some way, obstruct experiences of need satisfaction (Costa, Ntoumanis, & Bartholomew,

2015). For instance, someone engaging in an activity he or she is not skilled in may ex- perience low satisfaction of competence needs during engagement, but would not necessarily experience a frustration of these same needs. As a result, low need satisfaction might occur without feeling obstructed by the environment, thus implying a lack of need frustration. Nonetheless, an expected negative association between need frustration and need satisfaction does exist.

Further, several recent studies have shown that need frustration and need satisfaction are largely associated with contrasting outcomes. Need satisfaction is positively associated with greater adaptive out- comes such as positive affect and subjective vitality, whereas need frustration is positively associated with maladaptive outcomes such as depressive symptoms and negative affect (Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011; Chen et al., 2015; Gunnell, Crocker, Wilson, Mack, & Zumbo, 2013). Vansteenkiste and Ryan (2013) speculate that the negative consequences emerging from the continued experience of need frustration largely stems from endorsing secondary coping mechanisms to deal with the decline in overall well- being brought about by need frustration.

Pertinent to the present investigation of PVGU is exhibiting an overreliance upon an activity to satisfy basic needs, which is included as one of Vansteenkiste and Ryan's (2013) secondary coping mechan- isms to continued experience of need frustration. Therefore, PVGU could be argued to be a manifestation of individuals' overreliance to- ward video games to satisfy basic psychological needs that have been thwarted within one's immediate environment. Recent findings by Mills, Milyavskaya, Heath, et al. (2018) revealed a positive correlation between daily need frustration and problem video game use. However, the perception that gaming engagement satisfies basic needs is an essential component underlying the assumption that PVGU is an over- reliance toward gaming for need satisfaction, which has not yet been empirically investigated.

1.3 Present study

The present study compares the contributions of gaming need satisfaction and daily need frustration to both time spent gaming and PVGU. As shown in Fig. 1, it is hypothesized that gaming need satisfaction would positively predict both time spent gaming and PVGU, whereas daily need frustration would only positively predict PVGU. Additionally, it is hypothesized that daily need frustration will be more strongly associated with PVGU than gaming need satisfaction. Finally, it is hypothesized that an interaction between gaming need satisfaction and daily need frustration will contribute to both gaming frequency and PVGU such that the greatest frequency gaming and the most severe PVGU would be reported by those indicting high levels of both gaming need satisfaction and daily need frustration.

2. Methods

2.1 Participants

The study was done in compliance with the University's Research Ethics Board, and obtained REB approval prior to any contact or data collection. Following an overview of the study and its purpose, participants provided their informed consent for participation and completed a series of online questionnaires. In total, valid responses were collected from 1026 participants through online social networks (e.g., Facebook, Reddit), online research forums (e.g., Psychological Research on the Net), email invitations, and flyers posted throughout a large university campus. IP addresses were reviewed with duplicate participants removed (n = 5). Although the consent form clearly stated that participants must be at least 18 years of age to participate, 61 participants reported being less than 18 years of age and were, therefore, excluded from the study. Thirty-eight participants were excluded for failing to respond correctly to a

simple attention item. The final sample included 922 participants (59.1% males; M_{age} = 23.53 years; *SD* = 6.84).

Participants in the final sample were recruited from social media

(31.9%), email invitations (23.5%), word of mouth (15.8%), flyers posted around a university campus (11.2%), online research forums (e.g., Psychological Research on the Net; 9.5%), gaming forums (6.5%), and a link from another study (1.6%). Aside from a small difference in age across the various recruitment methods, there were no significant ($p < .01$) differences for the other variables. The majority of participants were from Canada (42%) and the United States (39.4%), however, some were additionally from European (7.8%), Asian and Pacific (9%), and Latin American and Caribbean (1.8%) countries. In the pre- sent study, time spent gaming was not distinguished between playing video games online versus offline. On average, participants reported 12.96 h of video game use per week (*SD* = 13.43 h; Range: 0 to 100 h). Forty-four participants (4.8%) reported an average of zero hours per week gaming. However, many of these participants still reported some level of basic need satisfaction when gaming and PVGU. As such, their data was included to provide a more complete representation of the present participants.

2.2 Instruments

2.2.1 Problem video game use

PVGU was assessed using nine items recommended by Petry and colleagues (2014). Each item was slightly adapted in order to match a revised five-point scale ranging from not at all agree (1) to very strongly agree (5). A sample item is “I spend a lot of time thinking about games even when I am not playing, or planning when I can play next”. Although Jeromin et al.

(2016) recently validated a measure using these nine items with a dichotomous (Yes/No) scale, the five-point scale provides greater information on the severity of PVGU (Lemmens et al., 2015). The 9-item scale was found to have good internal consistency within the present sample ($\alpha = 0.86$). As this scale does not provide a clear IGD classification based on the number of DSM-5 symptoms that are endorsed, an average composite score of three and above was used to classify participants as either "Minimal Risk" or "High Risk" for IGD. This is in line with past research using a measure of video game de- pendency (Rehbein, Kleimann, & Mössle, 2010). Sixty-eight participants (7.4%) met the "High Risk" threshold and significantly differed from their "Minimal Risk" counterparts.1 Average composite scores were used in the primary analyses as a measure of PVGU.

2.2.2 Player Experience of Need Satisfaction (PENS)

The 9-item PENS assesses the experience of need satisfaction while gaming (Ryan et al., 2006). Each need is assessed by three items rated on a 7-point scale ranging from Not at all agree to Very strongly agree. The prompt was slightly adapted so that participants rated their experience of need satisfaction during engagement in what they would consider to be their most preferred game currently. An example item from the competence subscale is "I feel competent at the game". The internal consistencies were found to be adequate (Competence: $\alpha = 0.84$; Autonomy: $\alpha = 0.87$; Relatedness: $\alpha = 0.77$).

2.2.3 Need frustration

The daily experience of need frustration was assessed using an adapted version of the Psychological Need Thwarting Scale (PNTS; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). The original version consists of 12 items assessing the experience of need

frustration in an athletic activity; however, these items were adapted to assess need frustration in daily life. For example, one item from the autonomy subscale was changed from "I feel prevented from making choices with regard to the way I train" to "I feel prevented from making choices". The scale includes four items to assess the frustration of each basic need. Participants rated how frequently they experience each item in their life using a 6-point scale ranging from *almost never* (1) *to almost always* (6). Cronbach alphas were acceptable for the competence ($\alpha = 0.85$), autonomy ($\alpha = 0.84$), and relatedness ($\alpha = 0.74$) frustration subscales.

3. Analytical plan

Statistical analyses were conducted using MPlus version 7.4 with missing values predicted by full information maximum likelihood (Muthén & Muthén, 2015). Based on existing literature (e.g., Chen et al., 2015; Ryan et al., 2006), the items of both the gaming need satisfaction and daily need frustration scales are assumed to load onto three first-order factors (i.e., competence, autonomy, and relatedness), which further load onto a second-order factor. Exploratory and confirmatory factor analyses were conducted prior to the primary analyses to confirm the existence of these second-order factors. The overall fit of the present data to the hypothesized model was assessed using path analysis with average composite scores for gaming need satisfaction, daily need frustration, and PVGU. Time spent gaming was entered as reported. Coefficient estimates were calculated controlling for the effects of gender and age. In line with recommendations from Aiken and West (1991), averages of gaming need satisfaction and daily need frustration were centered by subtracting the overall sample mean from each of the participants' average composite scores. These mean centered values were then multiplied to create an interaction term. Given that issues with normality were expected for at least two of the included variables (e.g., PVGU, time spent gaming), robust maximum likelihood was used to estimate coefficients (Muthén & Muthén,

2015). Acceptable model fit was indicated by values of 0.08 or lower for root mean square error of approximation (RMSEA), near or above 0.95 for both comparative fit index (CFI) and Tucker-Lewis Index (TLI), and less than 0.06 for standardized root mean squared residual (SRMR) (Byrne, 2013; Hu & Bentler, 1999; Kline, 2016).

4. Results

4.1 Preliminary analyses

Exploratory (EFAs) and confirmatory factor analyses (CFAs) were conducted in reviewing the factor structures of the PVGU measure, PENS, and PNTS. The EFA suggested a one-factor solution for the 9-item PVGU measure, which was further confirmed by a CFA ($\chi^2(27) = 71.980$, $p < .001$; RMSEA = 0.056, 90CI [0.041, 0.072]; CFI = 0.961; TLI = 0.948; SRMR = 0.037). Results from an EFA revealed only two eigenvalues were above 1 for the PENS. However, this could indicate a second-order factor. Therefore, the three-factor solution was chosen with each first-order factor loading onto a second-order factor, gaming need satisfaction. The present data provided strong support of this three-factor structure of the PENS in the subsequent CFA ($\chi^2(24) = 43.231$, $p = .009$; RMSEA = 0.039, 90CI [0.019, 0.058]; CFI = 0.988; TLI = 0.982; SRMR = 0.027). Similar to the PENS, an EFA revealed only two eigenvalues were above 1 for the PNTS. As with the PENS, this may indicate a second-order factor, daily need frustration. A further issue for the PNTS was that after reviewing the three-factor loadings of the EFA, an item from the competence frustration subscale, I feel inadequate because I am not given opportunities to fulfill my potential, and an item from the relatedness frustration subscale, I feel that other people are envious when I achieve success, did not load highly onto their respective factors and meaningfully cross-loaded onto a second factor. These items were therefore removed from the scale resulting in both the competence and relatedness

frustration subscales being made up of only three items, whereas the autonomy subscale retained all four items. A CFA of the three first-order factors each loading onto a second-order factor revealed satisfactory fit ($\chi^2(32) = 97.533$, $p < .001$; RMSEA = 0.062, 90CI [0.048, 0.077]; CFI = 0.97; TLI = 0.957; SRMR = 0.037). The Cronbach alphas also improved for both competence and relatedness frustration (Competence: $\alpha = 0.87$; Relatedness: $\alpha = 0.85$). Means, standard deviations, and bivariate correlations are provided in Table 1.

4.2 Primary analyses

The primary objective was to assess the fit of the present data to a proposed model (see Fig. 1). Results from a path analysis revealed a good fit of the data to the proposed model ($\chi^2(3) = 5.389$, $p = .145$; RMSEA = 0.030, 90CI [0.000, 0.069]; CFI = 0.994; TLI = 0.962; SRMR = 0.022). Coefficient estimates for this model are presented in Fig. 2. As expected, gaming need satisfaction positively contributed to both time spent gaming and PVGU (Time Spent Gaming: $\beta = 0.350$, $p < .001$, 95CI[0.291, 0.408]; PVGU: $\beta = 0.257$, $p < .001$, 95CI [0.201, 0.314]). Further, in line with our hypotheses, daily need frustration positively contributed to PVGU ($\beta = 0.332$, $p < .001$, 95CI [0.272, 0.393]). However, contrary to our hypothesis, the difference in coefficient estimates for gaming need satisfaction and daily need frustration on PVGU was not significant based on the proportion of overlap of the confidence intervals (Cumming, 2009). Further, time spent gaming was also postively predicted by daily need frustration ($\beta = 0.102$, $p = .004$, 95CI[0.032, 0.171]), which was not expected. However, a review of the proportion of overlap between the confidence intervals provided support that gaming need satisfaction is a stronger predictor of time spent gaming than daily need frustration. Finally, the interaction of gaming need satisfaction and daily need frustration was found to significantly predict both time spent gaming and PVGU (Time Spent Gaming: $\beta = 0.087$, $p = .027$, 95CI[0.010, 0.163];

PVGU: β = 0.075, p = .016, 95CI[0.014, 0.136]. The moderation effects were graphed (see Fig. 3). Evaluation of the interaction effects were done using procedures described by Preacher, Curran, and Bauer (2006). As expected, for participants reporting higher daily need frustration (+1SD), gaming need satisfaction was more strongly associated with both time spent gaming and PVGU (Time Spent Gaming: β = 0.361, p < .001, 95CI[0.278, 0.445]; PVGU: β = 0.370, p < .001, 95CI [0.292, 0.447]). Although the association was weaker for participants reporting lower daily need frustration (-1SD), gaming need satisfaction was still significantly positively related to time spent gaming and PVGU (Time Spent Gaming: β = 0.230, p < .001, 95CI[0.144, 0.315]; PVGU: β = 0.254, p < .001, 95CI[0.170, 0.340]). The overall model accounted for 19.7% of the variance of time spent gaming and 23.5% of the variance of PVGU.

5.Discussion

The present study contributes to understanding problem video game use (PVGU), and by extension, Internet Gaming Disorder (IGD), from a widely employed framework of social psychology: Self-Determination Theory (Ryan & Deci, 2000, 2017). In line with this theoretical framework, the factors that facilitate the appeal of video games (gaming need satisfaction) were found to contribute to both time spent gaming as well as PVGU. Furthermore, increased experiences of impediments to satisfying these same basic psychological needs in daily life (daily need frustration) were found to positively contribute to PVGU. However, of particular interest to theory is that the interaction between gaming need satisfaction and daily need frustration further contributed to time spent gaming and PVGU. This suggests that both high gaming need satisfaction and high daily need frustration are required aspects of PVGU. These findings are discussed in terms of their implications for theory.

Gaming need satisfaction was found to be a strong, positive predictor of time spent gaming, which is consistent with previous studies (e.g., Johnson et al., 2016; Ryan et al., 2006). In line with expectations, gaming need satisfaction also positively predicted PVGU. This relation may in fact represent the underlying effect of gaming need satisfaction upon individuals' enthusiasm toward gaming, which research has shown to be associated with greater PVGU (Charlton, 2002). Theoretically, need satisfaction facilitates the internalization of an activity into the self, which Vallerand's research (2010, 2015) has shown to be a necessary component in the possible, but not inevitable, development of a behavioral addiction. Indeed, for many the internalization of an activity within the self will bring about positive outcomes due to the experience of need satisfaction through engagement. Further research is needed to understand the role of gaming need satisfaction in contributing to PVGU longitudinally.

The present findings build on two previous studies that separately demonstrated that lower satisfaction (Weinstein, Przybylski, & Murayama, 2017) and higher frustration (Mills, Milyavskaya, Mettler et al., 2018; Mills, Milyavskaya, Heath et al., 2018) of basic psychological needs in daily life contributes to greater PVGU. Consistent with these previous findings, the present data revealed that higher daily need frustration corresponded to greater PVGU. However, the present study goes beyond previous research in contrasting the effect of daily need frustration and gaming need satisfaction onto PVGU. Contrary to hypotheses, the observed differences in the effects of gaming need satisfaction and daily need frustration onto PVGU were not significant suggesting both contribute to PVGU, but in different ways. As such, these associations suggest that gaming need satisfaction and daily need frustration may be required facets of PVGU explaining different sides of the same coin. That is, the “pull” or enthusiasm toward video games is explained by gaming need satisfaction, but the “push” to engage problematically in gaming is

explained by daily need frustration. Further research is needed to investigate whether this is indeed a coping mechanism that is brought about by continued experience of need frustration, as argued by Vansteenkiste and Ryan (2013). However, this research does appear to support the contention made by Lalande et al. (2017) that a problematic style of engagement in an activity that one finds to be significant and important may be indicative of a compensatory response to deficits to daily need satisfaction brought about by continued experiences of need frustration.

Finally, based on the observed moderation effect, the present study provides initial evidence that PVGU is in part a manifestation of an overreliance toward video games to satisfy basic needs. That is, PVGU was highest for those reporting greater gaming need satisfaction and higher daily need frustration. Furthermore, these individuals also re- ported the greatest time spent gaming, possibly as a means of coping with the experience of need frustration (Vansteenkiste & Ryan, 2013). As a result, individuals struggling with PVGU may find themselves unable to meet their basic needs elsewhere suggesting interventions may require a strengths-based approach in which the clinician assists the client in searching for alternative activities that are aligned with personal values, goals, and strengths (c.f., Padesky & Mooney, 2012). Future research should build on these findings by exploring the inter- play between gaming need satisfaction and daily need frustration through multi-wave studies and multi-level modeling that can account for individual variation.

Findings from the present study are not without limitations. First, self-report data assumes that items were responded to honestly and accurately. Within the present study, data was thoroughly reviewed before continuing to the primary analyses with all steps indicating strong support that the items were responded to as intended. Second, although some causal language was used, this language is consistent with language used to describe the results of the

statistical analyses that were employed. Given the cross-sectional design of the present study, causality cannot be inferred, which is why several recommendations were given to explore these associations longitudinally. Third, the data used for the EFA and CFA were from the same sample, which could imply that the measurement issues that were observed are limited to the present sample. Finally, the results are based on a general population sample versus a clinical sample. Therefore, the relevance of Self- Determination Theory to PVGU should be revisited within a clinical sample once the criteria of IGD have been firmly established.

5.Conclusion

In summary, the present findings provide a first look into the differential effects of gaming need satisfaction and daily need frustration onto PVGU. As research on PVGU and other behavioral addictions continues to progress, it is important that researchers and clinicians account for the broader environment that may promote maladaptive behaviors like PVGU as part of an adaptive response to an unsupportive environment. That is, although engaging problematically in a chosen activity such as video games is inherently maladaptive by definition, the pursuit to satisfy basic psychological needs is adaptive. As such, working with these individuals in gradually altering their style of engagement in video games is advised versus simply “cutting the cord.” It is hoped that these findings drive further research on the application of SDT to the area of behavioral addictions in an effort to assess both the appeal of the activity as well as individuals' general perception of their environment as either need satisfying or need frustrating.

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Tables and Figures

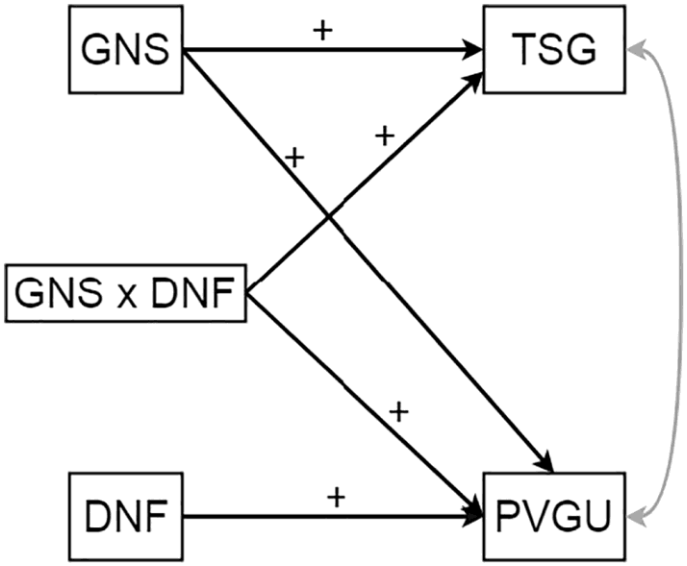

Fig. 1. Hypothesized model depicting the differential contribution of gaming need satisfaction (GNS) and daily need frustration (DNF) onto time spent gaming (TSG) and Internet Problematic Video Game Use (PVGU), and effect of the interaction between GNS and DNF onto TSG and PVGU.

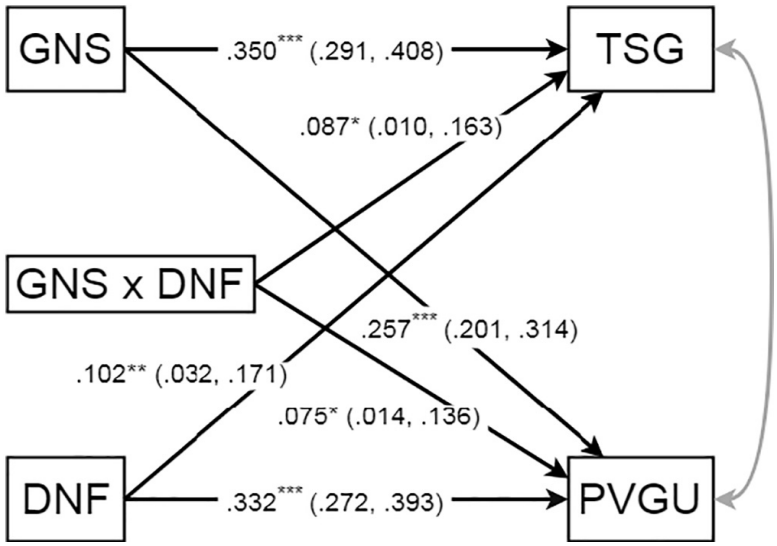

Fig. 2. Coefficient estimates for a model depicting the differential roles of gaming need satisfaction (GNS) and daily need frustration (DNF) in predicting time spent gaming (TSG) and Problematic Video Game Use (PVGU) as well as a hypothesized interaction between GNS and DNF. Note that this interaction was created using mean-centered variables as recommended by Aiken and West (1991), and is included as an observed variable within the model. All paths are standardized with 95% confidence intervals in parentheses. The light grey line represents a correlation between time spent gaming and PVGU. $*p < .05$

$**p < .01$ $***p < .001$.

Table 1

Means, standard deviations, and bivariate correlations.

	M	*SD*	1	2	3	4	5	6	7
1. Age	23.53	6.84	1.000						
2. Gender[a]	59.1% male		−0.031	1.000					
3. TSG	12.96	13.43	−0.025	−0.276***	1.000				
4. PVGU	1.74	0.71	−0.072	−0.248***	0.327***	1.000			
5. GNS	4.36	1.24	−0.153***	−0.296***	0.395***	0.321***	1.000		
6. DNF	2.87	1.01	−0.177***	0.090	0.109	0.322***	0.013	1.000	
7. GNS × DNF[b]	n/a	n/a	0.066	0.052	0.109	0.098	0.028	0.101	1.000

Notes: Time Spent Gaming (TSG), Problematic Video Game Use (PVGU), Gaming Need Satisfaction (GNS), Daily Need Frustration (DNF).

[a] Gender (Males = 1, females = 2).

[b] Interaction between GNS and DNF.

*** $p < .001$ (Bonferroni adjusted, rounded).

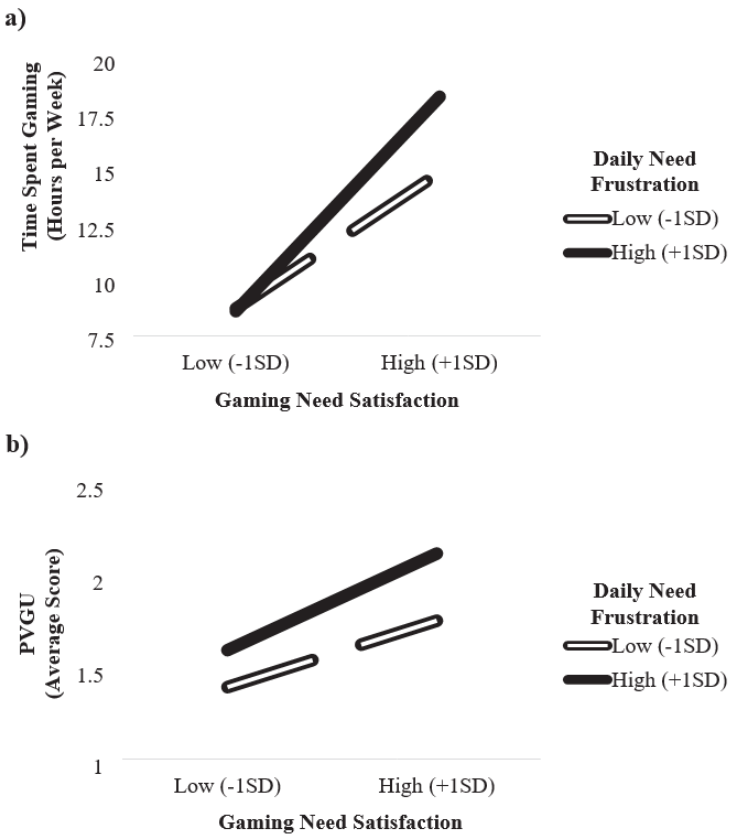

Fig. 3. Moderation effect of daily need frustration (DNF) on the association between gaming need satisfaction (GNS) with time spent gaming (upper graph, a) and gaming need satisfaction with Problematic Video Game Use (PVGU; lower graph, b).