What lead gaming problematically addictive for certain people instead of others? Correlates of personality, protective factors and biaxial structure of Internet Gaming Disorder

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ABSTRACT

Due to great heterogeneity in gaming behavior patterns, the non-hierarchical polythetic criteria of Internet Gaming Disorder (IGD) has been criticized for its lack of specificity. Although the biaxial structure (i.e., symptoms and problems) could be more sensitive for different gaming patterns, the reasonable basis underlying which remain insufficient. This study aimed to investigate the mechanism of the biaxial IGD model based on DSM-V from the perspective of individual characteristics. The behavioral inhibition system (BIS)/activation system (BAS), protective factors including perceived social support and self-related factors, negative affect state and IGD-20 Test were assessed in a sample of 311 young males with excessive video gaming. Structural equation model analysis was used to test the hypothetical interactions between the protective factors and the biaxial IGD model. According to the results, independent predictive paths to the biaxial structure were observed that self-related factors negatively predicted the problems domain directly. Further analysis validated the specific problem-protective role of self-regulation and -efficacy, indicating how positive gaming pattern generated. The study provided reasonable support for the biaxial structure of IGD and deepened our insight of predisposing characteristics for different gaming patterns, bringing potentials for development of more effective diagnosis and interventions for excessive gaming or IGD.

KEYWORDS

IGD, self-related support, support system, biaxial model, gaming behavior patterns.

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1. Introduction

Internet Gaming Disorder (IGD) refers to a specific type of behavioral addictions characterized by excessive and compulsive preoccupation in video games, along with difficulties in cognitive control (Brand, Young, & Laier, 2014; Dong & Potenza, 2014). With the popularization of the smart devices and internet, gaming addiction has gradually become a global health concern especially in male youths. According to Lau et al. (2018), beyond 90% of adolescents reported their video games use. A recent investigation in China indicates that the prevalence rate of IGD in China ranges from 3.5% to 17% (Long et al., 2018), slightly higher than the data from other countries (Gentile et al., 2017). Since being included in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) (APA, 2013), IGD has been attracting increasing attention. However, the diagnostic criteria and pathological mechanisms of IGD still remain ambiguous and need further research.

1.1. Heterogeneity in gaming patterns

The non-hierarchical diagnostic criteria of IGD has been criticized for its lack of specificity, making the concept of IGD unacceptably heterogeneous (Kuss, Griffiths & Pontes, 2017). For example, population scales for IGD diagnosis often use polythetic cut-off as diagnostic criteria (e.g., meeting five out of nine distinct criteria in DSM-V for positive diagnosis), which actually reveals that the video gamers could be treated as homogeneous and comparable from the perspective of severity diagnosis (Caspi & Moffitt, 2018; Colder Carras & Kardefelt-Winther, 2018). Unfortunately, the polythetic construct overlooks the qualitative specificity among gamers. For more than one decade, there has been an ongoing consideration about individual differences in gaming patterns (Charlton & Danforth, 2007; Charlton & Danforth, 2010; Griffiths, 2010; Kwak et al, 2020). Case study reported by Griffiths (2010) illustrates that similar excessive gaming could lead to contrary consequences (i.e., beneficial and adverse gaming pattern) for individuals in different life contexts. Consistently, Deleuze et al., (2018) have distinguished the engagement from problematic addiction in regular gamers. Other research has also demonstrated the heterogeneity in terms of both behavioral and neural patterns among video gamers who were faced with excessive gaming behaviors. Compared with pro-gamers, the ordinary gamers who play video games with a similar frequency and duration show more problematic behaviors and higher orbitofrontal cortex (OFC) activation in resting-state (Kwak et al, 2020). Given the important role of OFC in rewarding process and widely enhanced resting-state functional connectivity between OFC and fronto-parietal network in gamers with IGD (Yan et al., 2021), gamers with different gaming patterns may possess key differences in not only behavioral presentations but also neural activities. Therefore, the polythetic criteria of IGD is insufficient for an exact diagnosis, which would lead to misunderstandings or confusions among different patterns (e.g., individuals who are too preoccupied with video game would be evaluated as the same states as individuals who are confronted with disproportionately more

conflicts in daily lives for their gameplay by an IGD scale), thereby misleading the further interventions (Charlton & Danforth, 2007; Colder Carras & Kardefelt-Winther, 2018).

1.2. The biaxial model, personality and protective factors

The researchers have sought to extract distinct potential factors to represent the heterogeneity in gaming patterns, for example, the 'core' and 'peripheral' criteria (Charlton & Danforth, 2007). Wakefield (2015) has proposed a 'biaxial' conception, which argues that both impaired control and consequent harm components should be considered to define a diagnostic "gate" of substance use disorder. Based on this, Carras et al. (2018) has further confirmed the rationality of biaxial format in IGD diagnosis, by which the heterogeneity among gamers could be recognized. Specifically, the researchers selected and distinguished the symptom criteria (e.g., salience, tolerance, withdrawal and mood modification) and the problem criteria (i.e., conflicts in life) from the traditional IGD criteria, then performed a latent class analysis based on the constructs. According to the corresponding behavioral patterns in different classes (e.g., Engagement, moderate symptoms with relatively low problems; Concerned, low symptoms with high problems; and At-risk, moderate symptoms with high problems), the results show a comparatively independent relationship between the IGD symptoms and the consequent negative consequences, which matches in only two subgroups (i.e., IGD class and Normative class). Thus, taking both symptoms and problems into consideration is proved to be an effective approach to understand and describe different gaming patterns, reducing the heterogeneity of IGD and tightening it conceptually. However, with respect to the practical value of the biaxial model in diagnosis or even intervention of IGD, some crucial questions about the basic mechanism have yet been clarified: how different behavioral patterns generate? namely what factors contribute to the relative independence between the symptoms and problems?

Charlton et al., (2010) have identified that personality is a reasonable support for the disjunction between different gaming patterns. Personality traits are considered as the core predisposing variable in the development of behavioral addiction including IGD (Brand et al., 2016; Dieris-Hirche et al., 2020), among which the Behavioral Inhibition System/Behavioral Activation System (BIS/BAS) are used in this study to define the personality factor. The BIS/BAS are two basic brain systems, developed to assess personality dimensions concerning sensitivity to punishment and rewards based on Gray's reinforcement sensitivity theory (Carver & White, 1994) which are potentially associated with human's addictive behaviors (Yen et al., 2012). Yen et al., (2009) revealed that young adults with Internet addiction show high scores in both BIS and BAS. Given the important role of reward processing in video gaming addiction (Kuhn et al., 2011) and distinctive behavioral patterns (Kwak et al., 2020; Yan et al., 2021), the BIS/BAS may underlie the heterogeneity in gaming patterns, which need to be verified.

Kwak et al., (2020) underlines the importance of a well-organized support system for gamers to possess a positive gaming pattern in their excessive game playing, while a specific definition of the support system is unclear so far. Generally, support, in the context of addictive

behaviors, refers to the characteristics of individuals which protect the gamers from problematic addiction and be associated with psychosocial well-being (ElSalhy et al., 2019; Kwak et al., 2020; Stockdale & Coyne, 2018). According to the sources and attributes, the protective factors of IGD in recent research could be regarded into two categories: social support including families, friends and others (Baysak, Yertutanol, Dalgat, & Candansayar, 2018), and self-related supportive factors including self-efficacy (Bakioğlu, 2020; Cheng, Cheung, & Wang, 2018; Fumero, Marrero, Voltes, & Peñate, 2018), self-regulation (Mascia, Agus, & Penna, 2020; van Deursen, Bolle, Hegner, & Kommers, 2015) and self-esteem (Beard, Haas, Wickham, & Stavropoulos, 2017), which might be associated with self-determination (Hui & Tsang, 2012).

Perceived social support has been considered as a key protective factor of IGD in previous research (Dancoine & Gentina, 2018; Gunuc & Dogan, 2013; Longman, O'Connor, & Obst, 2009; Peng, Zhou, Wang, Zhang, & Hu, 2020; L. Wartberg, Kriston, & Kammerl, 2017; Zhou et al., 2017). Mazzoni et al., (2016) have suggested that the Internet use would be problematically addictive when purpose of which is to compensate the lack of offline social support. Consistently, several studies have demonstrated that offline instead of online social support is negatively associated with Internet addiction (Brailovskaia, Rohmann, Bierhoff, Schillack, & Margraf, 2019; Mazzoni et al., 2016). Specifically, given that gaming is in term of the very intense emotional rewards, the negative affect states (e.g., anxiety, depression and stress), as crucial motivational factors of specific addictive behaviors (Detrovics et al., 2011; Fumero, Marrero, Bethencourt, & Peñate, 2020; Jeong et al., 2020), have been confirmed as the mediate variables between the social support and IGD (Ma, Quan, & Liu, 2014; Tham, Ellithorpe, & Meshi, 2020; Yeh, Ko, Wu, & Cheng, 2008; Zhang et al., 2018), which means social support in real life could reduce the risk of IGD through diluting the motive for gaming. Hence, the lack of offline social support may be a predisposing factor for negative affect, which may induce gaming behaviors for compensation and further develop into IGD.

Self-related IGD protective factors (e.g., self-efficacy, self-regulation and self-esteem) essentially refers to the one's general attitude or behavioral preference towards oneself, which are closely associated with psycho-social well-being based on the self-determination theory (Black & Deci, 2000; Deci & Ryan, 2000; Eisenman, 2007; Field et al., 1998; Reeve, 2002). Self-determination is defined as a psychological construct that is characterized by volitional action or self-determined behaviors based on intentional and conscious decision (Nota, Soresi, Ferari, & Wehmeyer, 2011). Previous research has confirmed the importance of self-efficacy in keeping Internet users from problematic addiction such as IGD (Bakioğlu, 2020; Cheng, Cheung, & Wang, 2018; Fumero, Marrero, Voltes, & Peñate, 2018; İskender & Akin, 2010; Sakuma et al., 2017). Similarly, self-esteem has also been considered as a protective factor of IGD (Cheng et al., 2018; Fumero et al., 2018). Beard et al., (2017) argued that excessive gameplay does not always lead to IGD due to the mediating effect of self-esteem. Van et al., (2015) found that self-regulation is significantly associated with addictive smartphone behavior instead of habitual smartphone use, which reveals that even through experiencing the same

smartphone use, individuals with low self-regulation might be more inclined to present problematic behaviors compared to high self-regulation ones. The speculation is further validated by Mascia et al., (2020), indicating that self-regulation could generate a direct and independent effect on negative consequences of addictive symptoms. Considering the important effect of self-determination on behaviors and cognitions control (Deci & Ryan, 2000), self-related support may play a part in controlling gaming motivation as well as preventing the excessive gaming from causing problems based on gamers' own will.

Taken together, both social and self-related supportive factors show protective effects on IGD, however, different mechanisms may exist, which may serve as a reasonable support for the biaxial IGD model as well as distinguished gaming patterns. Despite abundant research on IGD and gaming patterns, for our best knowledge, there is a lack of evidence for the disjunction between IGD problems and symptoms constructs based on the DSM-V criteria, meanwhile there is no such studies constructing the supportive factors and investigating the relationship between the different supportive components and the biaxial IGD model up to now. Thus, the present study was conducted.

1.3. The present study

The present study is the first to provide empirical evidence for the DSM-V-based biaxial IGD model within video gamers in terms of individual supportive characteristics. Using structural equation model (SEM), the hypotheses that the personality traits (BIS/BAS) and supportive factors constructed (i.e., social and self-related support) asymmetrically affect the DSM-V-based biaxial IGD model (i.e., symptoms and problems) were tested (H1-H8). As suggested by Charlton et al., (2010), the relationship between the two axes was set as causality (H9). The affect domain (negative states) mentioned above was hypothesized as a core mediating factor based on the previous studies (H10-H14). The initial paths are shown in Fig. 1. Based on the model, we aimed at clarifying the mechanism underlying different gaming patterns as well as the independence between IGD symptoms and problems from the perspective of individual characteristics.

Figure 1. Research model and hypotheses. PF: personality factors; Self-related Support: self-efficacy, self-regulation and self-esteem; Affect Domain: negative affect states including anxiety, depression and stress; Symptoms and Problems: biaxial model of IGD criteria.

2. Methods

2.1. Participants

A total of 311 Chinese youths aged from 18 to 28 were recruited through advertising on the Internet, most of which were students in local colleges. The inclusion criteria were as follows: (1) only males, due to the disproportional distribution of IGD in term of gender (Long et al., 2018); (2) with a gameplay history more than 1 year before the study; (3) engagement in Internet gaming for over 10 hours per week for a minimum of 1 year; and (4) reporting of Internet gaming as their primary online activity. Participants who reported current or history of use of illegal substances or current use of psychotropic medications were excluded. Out of the 311 participants, 307 completed the questionnaires seriously according to the lie-detection questions ($M_{age}=22.6$, $SD=2.7$).

2.2. Measures and Materials

2.2.1. Behavioral Inhibition System/Behavioral Activation System Scales (BIS/BAS)

The personality factors (PF) associated with gaming disorder were defined using Behavioral Inhibition System/Behavioral Activation System (BIS/BAS). The Chinese 18-item version of BIS/BAS Scales developed and adapted by Li et al., (2008) were utilized, with the reliabilities of two subscales validated. Cronbach's alpha of BIS and BAS subscale were 0.77 and 0.72 respectively in the current sample.

2.2.2. The General Self-Efficacy Scale (GSES)

The level of Self-Efficacy was measured by the GSES developed by Schwarzer et al., (1995), which consists of 10 items on a 4-point Likert scale with a single dimension. The reliability of the Chinese version has been confirmed by Wang et al., (2001) (the Cronbach's alpha was 0.87). Cronbach's alpha was 0.89 in the current sample.

2.2.3. The Self-Esteem Scale (SES)

The Self-Esteem Scale (SES) contains 10 items on a 4-point Likert scale, with a higher score indicating a higher level of self-esteem. Good reliability of the SES has been reported with a Cronbach's alpha of 0.88 (Hollinger & Fleming, 1984). Cronbach's alpha in the current sample was 0.81.

2.2.4. Character Strength Inventory (CSI) Scale

The level of Self-Regulation was measured through the Chinese version of self-regulation subscale in the CSI Scale. The subscale consists of 8 items on a 7-point Likert scale with a satisfactory reliability (the Cronbach's alpha was 0.83) (Wright et al., 2017). Cronbach's alpha in the current sample was 0.77.

2.2.5. The Multidimensional Scale of Perceived Social Support (MSPSS)

The Chinese version of MSPSS was implemented to measure perceived social support. The scale contains three 7-point Likert subscales with 4 items in each subscale including family support, friend support and other support. The good reliabilities of the three subscales have been reported, the Cronbach's alpha of which was 0.87, 0.85 and 0.91 (Zimet, Dahlem, Zimet, & Farley, 1988). In this study, Cronbach's alpha coefficients were 0.78, 0.84 and 0.81 for three subscales respectively, with a total Cronbach's alpha of 0.88.

2.2.6. Depression Anxiety Stress Scales (DASS)

The Depression Anxiety Stress Scales (DASS) developed by Lovibond et al., (1995), also called DASS-21, consists of 3 subscales (i.e., Depression, Anxiety and Stress) with totally 21 items. The Chinese version of the scale shows a good reliability (the Cronbach's alpha was 0.77, 0.79 and 0.76) (Gong et al., 2010). Cronbach's alpha of three subscales in the present study ranged from 0.79 to 0.91, with a total Cronbach's alpha of 0.90.

2.2.7. Internet Gaming Disorder-20 (IGD-20) Test

The 20-item IGD-20 Test was developed based on the nine DSM-5 IGD criteria, which can assess severity of Internet gaming addiction (Pontes, Kiraly, Demetrovics, & Griffiths, 2014). Each item is answered in a 5-point Likert response scale. The factor analysis in Chinese youths suggested a 5-dimensional construction of the test (i.e., Salience-Tolerance, Mood modification, Withdrawal, Relapse and Conflict). According to Pontes et al., (2014) and Carras et al., (2018), the Conflict factor, presenting a comparatively independent relationship with other factors, was extracted to represent the problems dimension of IGD in this study (e.g., I think my gaming has

jeopardized the relationship with my partner), and the rest factors were aggregated to represent the symptoms dimension (e.g., Salience-tolerance: I usually think about my next gaming session when I am not playing). The Chinese version of the IGD-20 Test has been validated in China, with a Cronbach's alpha of 0.92 (Shu, Ivan Jacob, Meng Xuan, & Anise, 2019). The total Cronbach's alpha coefficient was 0.93 and those for the subscales ranged from 0.69 to 0.91 in the present study.

2.3. Statistical Analysis

The data was analyzed using R software, version 3.6.1. We first examined the general characteristics of the participants using descriptive statistics. Then, correlation tests were performed to overview the associations among the observed variables in this study. To validate the hypothesis and investigate the way how the supportive factors influence the biaxial model of IGD, confirmed factors analysis (CFA) and SEM were implemented using the R package LAVAAN (Rosseel, 2012). The hypothesized measurement model was: Problems and symptoms of IGD were constructed by the subscales of IGD-20 Test (see Table 1); Affect Domain was constructed by the subscales of DASS-21; as we hypothesized, social support subscales and self-related scales were combined into two support factors respectively; and Personality Factors were constructed by BAS and BIS. Besides, fitness of the model was examined using the χ^2 test. Due to its sensitivity to the sample size (Hooper, Coughlan, & Mullen, 2008), other fit indices were calculated included the following: Root mean square error of approximation (RMSEA) ≤ 0.08 , Comparative Fit Index (CFI) > 0.90 , and Tucker–Lewis index (TLI) > 0.90 indicate a good fit (Hu & Bentler, 1999). As the Shapiro–Wilks test showed not all of the data followed a normal distribution, robust standard errors and test statistics were employed, and the fit indices were modified based on the scaled test statistics (Rosseel, 2012).

2.4. Ethics

The study was approved by the Ethics Committee of the Institute of Psychology, Chinese Academy of Sciences. All participants were informed about the study and provided informed consent.

3. Results

Table 1. Descriptive statistics of the observed variables across three groups

	Regular gamers (n=81)		Risk gamers (n=214)		Disordered gamers (n=12)		F	p value
	Mean	SD	Mean	SD	Mean	SD		
Age	22.6	1.8	23.1	1.4	22.1	2.1	1.45	0.273
IGD	34.4	5.0	52.2	7.8	76.6	3.8	211.3*	<0.001
Salience-Tolerance	1.6	0.4	2.6	0.6	4.0	0.5	112.9*	<0.001
Mood modification	2.6	0.8	3.2	0.7	3.9	0.6	18.9*	<0.001
Withdrawal	1.4	0.4	2.2	0.7	3.3	0.5	61.6*	<0.001
Relapse	1.6	0.5	2.7	0.8	4.3	0.6	78.9*	<0.001
Conflict	1.5	0.5	2.5	0.6	3.6	0.7	80.8*	<0.001
Personality Factors								
BIS	12.4	3.6	14.1	3.1	15.1	2.2	7.4*	0.001
BAS	37.9	6.3	38.9	5.3	37.8	6.3	0.71	0.494
Social Support								
Family support	22.0	4.6	19.9	4.7	20.4	5.9	4.4*	0.013
Friend support	22.4	5.5	20.5	3.5	23.7	4.1	6.6*	0.002
Other support	22.1	4.2	20.9	4.4	23.6	2.6	6.4*	0.002
Self-related Support								
Self-regulation	41.4	5.7	35.4	7.5	37.3	11.6	14.7*	<0.001
Self-esteem	29.7	3.6	27.1	4.5	26.7	4.0	8.4*	<0.001
Self-efficacy	27.6	5.4	25.3	5.7	27.2	6.5	3.7*	0.027
DASS								
Depression	8.0	1.6	10.0	2.9	11.7	5.4	13.4*	<0.001
Anxiety	8.5	1.5	10.5	2.6	12.4	5.3	17.2*	<0.001
Stress	9.4	3.0	12.4	3.9	13.6	5.2	14.3*	<0.001

Note: IGD = Internet Gaming Disorder; BIS = Behavioral Inhibition System; BAS = Behavioral Activation System; DASS = Depression Anxiety Stress Scales.

Table 2. Correlations among the study variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Salience-Tolerance	1	0.20**	0.67**	0.68**	0.54**	0.27**	-0.01	-0.15*	-0.15*	-0.11	-0.21*	-0.28**	-0.09	0.35**	0.34**	0.33**
2. Mood modification		1	0.29**	0.25**	0.14*	0.16*	0.23**	0.04	0.12	0.14*	-0.11	0.01	-0.02	0.09	0.11	0.11
3. Withdrawal			1	0.58**	0.40**	0.18**	-0.08	-0.08	-0.16**	-0.18**	-0.12	-0.26**	-0.05	0.29**	0.33**	0.27**
4. Relapse				1	0.54**	0.28**	-0.01	-0.17**	-0.12	0.06	-0.24**	-0.26**	-0.12	0.28**	0.33**	0.27**
5. Conflict					1	0.23**	-0.12	-0.22**	-0.22*	-0.18**	-0.37**	-0.26**	-0.16**	0.36**	0.25**	0.34**
6. BIS						1	0.35**	-0.19**	-0.10	-0.03	-0.13	-0.15*	-0.10	0.38**	0.49**	0.48**
7. BAS							1	0.11	0.24**	0.29**	0.24**	0.38**	0.46**	-0.07	0.01	0.04
8. Family support								1	0.82**	0.55**	0.31**	0.25**	0.28**	-0.23**	-0.16*	-0.18**
9. Friend support									1	0.93**	0.28**	0.29**	0.26**	-0.31**	-0.25**	-0.28**
10. Other support										1	0.28**	0.29**	0.26**	-0.31**	-0.25**	-0.28**
11. Self-regulation											1	0.33**	0.41**	-0.28**	-0.19**	-0.30**
12. Self-esteem												1	0.55*	-0.46**	-0.32**	-0.29**
13. Self-efficacy													1	-0.20**	-0.11	-0.11
14. Depression														1	0.72**	0.74**
15. Anxiety															1	0.75**
16. Stress																1

Note: BIS = Behavioral Inhibition System; BAS = Behavioral Activation System.

* $p < 0.05$, ** $p < 0.01$

3.1. Preliminary analyses

Based on the IGD-20 Test scores and related criteria (Pontes et al., 2014; Yu et al., 2019), all participants were classified into three groups: the regular gamers ($IGD < 40$), the risk gamers ($40 \leq IGD < 71$), and the disordered gamers ($IGD \geq 71$). The descriptive statistics of the observed variables across three groups are shown in Table 1. Significant differences were observed in most of variables among the three groups. To overview the associations among the observed variables, we investigated the correlations among all variables. Table 2 shows the correlations among all measured variables. Obviously, all pairwise correlation coefficients among variables within the same latent factors are positive significantly.

3.2. CFA and SEM

To further confirm the reliability and validity of the constructs in this study, CFA was applied. As shown in Table 3, the Cronbach's alpha values for all latent factors surpassed 0.70, demonstrating the good reliability. Additionally, based on the Fornell-Larcker criterion, the square root of AVE (Average Variance Extracted) of the constructs were compared with pairwise correlation among the latent variables to confirm the discriminant validity. The results show good discriminant validity among the latent variables except a poor discriminant validity between PF and self-related support that the correlation coefficient (0.77) is slightly higher than the square roots of AVE (0.70 and 0.69). The reason might be that individual's inward attitude is particularly similar and relevant to the personality. Table 4 shows the standardized factor loading of the measurement model. All factor loadings were significant.

Table 3. Reliability and the discriminant validity for the measurement model.

	Cronbach's alpha	Correlations/ $\sqrt{AVE}$					
		PF	SS	Self-S	AD	Sym.	Prob.
PF	0.76	0.70					
SS	0.91	0.37	0.96				
Self-S	0.70	0.77	0.44	0.69			
AD	0.89	-0.10	-0.34	-0.43	0.86		
Sym.	0.76	-0.10	-0.16	-0.33	0.45	0.81	
Prob.	-	-0.17	-0.21	-0.36	0.36	0.62	1

Note: AVE = Average Variance Extracted; PF = personality factors; SS = Social Support; Self-S = Self-related Support; AD = Affect Domain; Sym. = Symptoms; Prob. = Problems. The diagonals of the correlation table are square roots of AVE. The latent variable Problems is constructed by a single dimension, so the Cronbach's alpha is not provided.

Table 4. Factor loading estimates of the measurement model after standardization.

		Standard	
Constructs	Factor loadings	Error	p value
PF			
BAS	0.498	0.056	<0.001
BIS	0.505	0.056	<0.001
Self-S			
Self-regulation	0.605	0.049	<0.001
Self-esteem	0.650	0.046	<0.001
Self-efficacy	0.739	0.041	<0.001
SS			
Family support	0.939	0.025	<0.001
Friend support	0.969	0.024	<0.001
Other support	0.960	0.024	<0.001
AD			
Depression	0.837	0.025	<0.001
Anxiety	0.843	0.022	<0.001
Stress	0.882	0.025	<0.001
Sym.			
Salience-Tolerance	0.875	0.026	<0.001
Withdrawal	0.744	0.022	<0.001
Mood modification	0.547	0.039	<0.001
Relapse	0.786	0.035	<0.001
Prob.			
Conflict	1	-	-

Note: PF = personality factors; SS = Social Support; Self-S = Self-related Support; AD = Affect Domain; Sym. = Symptoms; Prob. = Problems. The latent variable Problems is constructed by a single dimension, so the statistic is not provided.

Figure 2. Final Structural Equation Model with the standardized coefficients. PF: personality factors;

Self-related Support: self-efficacy, self-regulation and self-esteem; Affect Domain: negative affect states including anxiety, depression and stress; Symptoms and Problems: biaxial model of IGD criteria.

*p < 0.05, **p < 0.01, ***p < 0.001.

Table 5. Standardized paths of structural model and 95% CI calculated by bootstrapping.

Endogenous latent factors	Predictors (latent factors)	Estimates	SE	95% CI (bootstrapping)
Prob.	Sym.	0.577***	0.055	0.58 ~ 0.90
	AD	0.040	0.081	-0.19 ~ 0.27
	Self-S	-0.191**	0.068	-0.56 ~ -0.09
	SS	-0.041	0.076	-0.19 ~ 0.13
	PF	0.091	0.132	-0.44 ~ 0.98
Sym.	AD	0.447***	0.066	0.30 ~ 0.58
	Self-S	-0.134	0.092	-0.98 ~ 0.05
	SS	0.047	0.071	-0.09 ~ 0.16
	PF	0.122	0.127	-0.22 ~ 0.81
AD	Self-S	-0.531**	0.196	-1.41 ~ -0.26
	SS	-0.228**	0.086	-0.33 ~ -0.01
	PF	0.328*	0.166	0.13 ~ 1.25
Self-S	PF	0.740***	0.061	0.70 ~ 1.25
SS	PF	0.348***	0.072	0.36 ~ 0.98

Note: SE = Standard Error; CI = Confidence Interval; PF = personality factors; SS = Social Support; Self-S = Self-related Support; AD = Affect Domain; Sym. = Symptoms; Prob. = Problems. *p < 0.05, **p < 0.01, ***p < 0.001.

The hypothesized SEM model shown in Fig. 1 was tested. As presented in Fig. 2, significant paths were illustrated by solid line. The direct paths from PF to biaxial IGD model were not significant (symptoms: -0.125, p=0.168; problems: 0.150, p=0.254). The final model suggested that the symptoms of IGD was indirectly predicted by both support factors, both fully mediated by affect domain. The significant predictive paths to the problems of IGD consisted of two parts: one was predicted by the symptoms domain (0.577, p<0.001) as previous research suggested, and another, as we assumed and expected, was from self-related support directly (-0.191, p=0.008). To further confirm the reliability of the path coefficients, we reran the model with bootstrap sampling for 1000 times to calculate the 95% CI of the coefficients. As shown in Table 5, all paths estimated were solid according to whether zero was contained in the 95% CI. Table 6 presents the fit indices of the model. Although the model yielded a comparatively large χ^2 of 180 (p<0.001), other indices suggested a good fit.

Table 6. Fit indices of the SEM model

χ^2	RMSEA	CFI	TLI
180***	0.067	0.953	0.936

Note: RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index. ***p < 0.001.

3.3. Post-hoc analysis

To identify the details of the direct interaction between the self-related support and the IGD problems domain, we further conducted a partial correlation analysis between each self-related protective factor (i.e., self-efficacy, self-regulation and self-esteem) and IGD factors including Salience-Tolerance, Mood modification, Withdrawal, Relapse and Conflict, by controlling the affect domain. Table 7 shows that after eliminating the indirect effect mediated by negative affect, self-regulation ($\rho = 0.31, p < 0.001$) and -efficacy ($\rho = 0.17, p = 0.008$) presented significantly negative correlations with Conflict rather than other factors. And self-esteem showed significant interactions with all IGD factors excluding Mood modification.

Table 7. Partial correlations between the self-related protective factors and IGD factors.

control variable	Self-related factors	Conflict	Salience-Tolerance	Withdrawal	Mood modification	Relapse
DASS	Self-regulation	-0.31***	-0.11	-0.03	-0.08	-0.11
	Self-efficacy	-0.17**	-0.05	-0.002	0.001	-0.08
	Self-esteem	-0.15*	-0.16*	-0.15*	0.06	-0.16*

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4. Discussion

The present study investigated the relationships among the biaxial IGD model, personality and the supportive factors of IGD. The results indicated that both social support and self-related support (measured by self-efficacy, self-regulation and self-esteem) negatively predicted the symptoms of IGD, mediated by the negative affect states (i.e., affect domain including depression, anxiety and stress). The symptoms further led to the problems of IGD. What's more, the problems domain of the biaxial model presented a direct negative association with self-related support, and post-hoc analysis further indicated the all three observed self-related protective factors could negatively predict problems when indirect effect mediated by affect state was controlled. Given the asymmetric interactions that the symptoms domain had no significant direct association with both support factors, the result reflected the mechanism of disjunction between the IGD problems and symptoms. Although having no significant direct association with IGD, personality was confirmed as the basis of these clinical features.

Consistent with previous research, the present study confirmed that the negative affect was a strong predictor of excessive gaming behavior (Demetrovics et al., 2011; Fumero et al., 2020; Jeong et al., 2020), which mediated the effect from personality traits and the support factors to IGD symptoms. Among individual's predisposing characteristics in development of IGD, emotional competence plays a critical role (Che et al., 2017; Seo, Kang, & Chae, 2012). Longitude studies have also indicated that emotional regulation deficits could predict future

IGD symptoms (Estevez, Jauregui, Sanchez-Marcos, Lopez-Gonzalez, & Griffiths, 2017; Wichstrom, Stenseng, Belsky, von Soest, & Hygen, 2019). As a common comorbid psychiatric condition in IGD, depression is related to maladaptive emotional regulation (Yen et al., 2017), which plays a mediating role on the predictive relationship between trait emotional intelligence and IGD tendency (Dang, Zhang, Leong, & Wu, 2019). Depressive individuals are reported to be more prone to play game for escaping from negative feelings (Kim et al., 2017). As a result, sufficient support system in real life, either social or self-related support, could relieve and compensate the negative feelings, then leading to a dilution effect for motives of gaming to reduce the IGD symptoms. Furthermore, Blasi et al., (2019) have reported that emotion problems could enhance problematic video game use, and this study, from the perspective of biaxial IGD model, deepened the insight that it was through the rise of symptoms that negative affect states induced the gaming problems.

The direct path from self-related support to problems domain not only interprets the relatively independent relationship between symptoms and problems, but reveals how different gaming patterns develop from the perspective of individual characteristics. Charlton et al., (2007) have already proposed different behavioral patterns in video gamers (i.e., engagement and addiction), and further proved that personality plays a crucial role in that (Charlton & Danforth, 2010). However, the diagnosis criteria they used are not identical to current criteria in DSM-V (APA, 2013; Brown, 1991; M. Griffiths & Hunt, 1998). Pontes et al., (2014) provides reasonable support for hierarchical structure of IGD criteria based on DSM-V that conflict factor show a different pattern from other factors across the latent classes. Carras et al. (2018) have proved the heterogeneity in gaming patterns on a descriptive level based on the biaxial IGD model. The present study went further and provided empirical evidence for the relatively independent relationship between problems and symptoms, explaining the development mechanism underlying different behavioral patterns. Specifically, self-related support could directly reduce the IGD problems caused by symptoms, which means that even though individual is highly engaged in gaming with high symptoms, this usage is not necessarily pathological, especially for individual who has a high degree of self-support. And in contrast, insufficient self-related support would increase the risk of problems, making it disproportionately exceed the corresponding symptoms. Thereby, different gaming patterns appear.

After eliminating the indirect effect mediated by negative affect, self-regulation and -efficacy specifically protected the IGD problems (i.e., Conflict) rather than symptoms factors. While self-esteem served as a general protective factor mitigating all IGD factors excluding Mood modification. The result validated the direct effect of self-related protective factors on the IGD problems, indicating that self-regulation and -efficacy were two specific protective factors for problems, as well as two predisposing variables for distinct gaming patterns. Based on the self-determination theory, the direct effect may reflect autonomous control on the negative outcomes (Deci & Ryan, 2000), which is closely associated with self-regulation and -

efficacy. The I-PACE (Interaction of Person-Affect-Cognition-Execution) model proposed by Brand et al., (2016) has pointed out that negative consequences of specific behavioral addiction are caused by diminished control for behaviors, emphasizing the association between self-control and problems. Previous research has also highlighted the role of self-related support and executive functions in self-control (Baumeister, Schmeichel, & Vohs, 2007). Consequently, the cognitive mechanism of the "problem-protecting" effect might be explained by enhanced executive control, which need to be further validated. Anyway, this study brought an inspiration for future diagnosis and intervention of IGD that self-related characteristics were linked to different gaming patterns, which would be used to predict or even alter gamers' behavioral patterns with appropriate approaches.

In conclusion, our research sheds light on the asymmetric relationship between the protective factors (i.e., social and self-related support) and two diagnosis domains of IGD based on DSM-V (i.e., symptoms and problems), validating the specific problem-protective role of self-related protective factors and providing reasonable support for both biaxial structure of IGD criteria and the distinctions among gaming behavioral patterns. These findings have potentials for development of more effective diagnosis and therapeutic interventions for IGD in the future, however, there are several limitations in the current study that should be noticed. First, causality among the variables is assumption-based due to the cross-sectional design. Future longitudinal studies should be conducted to validate the relationship between the support system and IGD. Second, the sample was collected in one area with a relatively small sample size, which may limit the generalizability. Third, the study did not take genders and game genres into consideration. Although there is report that addiction is nothing to do with game genres (Entwistle, Blaszczynski, & Gainsbury, 2020), contradictory result also exists (Kokonyei et al., 2019). Therefore, future research comparing the results among different genders and game genres is needed.

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