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The relationship between psychobiological dimensions of personality and internet gaming disorder: the role of positive and negative affects

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Abstract
Internet gaming disorder (IGD) is an important issue that was included as a tentative disorder in the DSM-5. The aim of the present study was to contribute to the increasing understanding of IGD by examining the indirect relationships between psychobiological components of personality, positive and negative affect, and IGD among a sample of Iranian university students. In a cross-sectional study, 481 Iranian university students (50.3% female; M_{age} = 22.41 years [SD = 4.62]) were recruited from four universities and completed self-report psychometric scales, including the Internet Gaming Disorder Scale (IGDS), Temperament and Character Inventory (TCI), and Positive and Negative Affect Schedule (PANAS). Structural equation modeling was used to empirically explore the relationships. The model of positive affect and negative affect being a mediator between psychobiological components of personality and IGD fit the data. Individuals with higher levels of negative affect had higher levels of IGD (r = 0.60, $p < 0.001$). Furthermore, bootstrapping results showed that psychobiological components of personality affected IGD via negative affect. Findings demonstrated that negative affect mediated the relationships between temperament dimensions of harm avoidance (β = .126), reward dependence (β = .054), persistence (β = −.127), as well as character dimensions of cooperativeness (β = −.047), and self-directedness (β = −.042) with IGD (all p-values <0.001). Findings contribute to the knowledge in the field, and support the proposed models showing that negative affect appears to have an important role in IGD. Clinical implications and study limitations are discussed.

Keywords: Internet gaming disorder, personality, temperament and character, positive and negative affect

Introduction

The internet has been an integral part of modern life and it can be used in many different ways. One online activity that has received growing attention is online game playing (Kuss et al., 2013). Although gaming is a popular form of entertainment and most individuals play games for fun, some individuals play online games in excessive and uncontrolled ways that may lead to a condition termed ‘internet gaming disorder’ (IGD; (King & Delfabbro, 2014; Müller et al., 2015; Weinstein et al., 2017). IGD has been conceptualized as an addictive disorder that clinically disrupts the lives of such individuals including their education and/or occupation, personal relationships, and social activities, and leading to adverse financial, psychological, social or interpersonal impairments (Archana et al., 2019; Lee et al., 2017;

Männikkö et al., 2015). The global prevalence of IGD is estimated to range between 0.5% and 6% (Rehbein et al., 2015). The prevalence rate appears to be higher in Asian countries than in Europe and North America (American Psychiatric Association, 2013). In Iran (where the present study was carried out), the prevalence rate among Iranian youth was reported to be at 17% (Zamani et al., 2010). Therefore, further studies are needed in Iran to investigate predisposing factors that lead to this condition.

Both the American Psychiatric Association (APA) in the fifth *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) and the World Health Organization (WHO) in the eleventh revision of the *International Classification of Diseases* (ICD-11) have recognized problems related to gaming disorder as a potentially diagnosable mental disorder (Zajac et al., 2020). In the DSM-5 (APA, 2013), IGD is included in Section III as a tentative disorder requiring further research. Scholars in the field have also suggested that there is a need to delineate a comprehensive etiopathological model integrating different findings to better understanding the clinical features and potential biopsychosocial risk factors involved in the etiology, development, and maintenance of this condition (Müller et al., 2014; Petry & O'Brien, 2013; Şalvarlı & Griffiths, 2019). Therefore, there is still a dearth of research in the area and further research is needed. It is hoped that such research will allow the field to better understand this condition and will inform decisions about possible placement in forthcoming editions of DSM.

Gamers' personality profiles (Floros & Siomos, 2014; Kim et al., 2016; Kircaburun & Griffiths, 2018; Şalvarlı & Griffiths, 2019), as well as gamers' motivations such as coping with negative emotions (Aydın et al., 2020; Kuss, 2013; Vidyachathoth et al., 2014; Wolniewicz et al., 2018) have suggested two basic factors in the etiology and maintenance of IGD that appear to be important determinants in the enduring disposition of this condition. Personality and individual characteristics have been studied extensively in the context of addictive behaviors.

There are strong evidence concerning the personality determinants of an individual's behavior with addictive behaviors (Andreassen et al., 2013; Floros & Siomos, 2014; MacLaren et al., 2011). More specifically, in explanations concerning the contributory factors to IGD, personality traits have been increasingly studied in contemporary studies (Şalvarlı & Griffiths, 2019). Therefore, further studies are warranted to investigate IGD based on explanatory models of personality.

One of the most well–researched and empirically robust personality models is Cloninger et al.'s psychobiological model of personality (Cloninger et al., 1993; Garcia et al., 2017). However, this has been little studied in the context of IGD. Cloninger et al. (1993) developed a seven-factor dimensional model of personality comprising four temperaments (i.e., harm avoidance, novelty seeking, reward dependence, persistence), and three character dimensions (i.e., self-directedness, cooperativeness, and self-transcendence). While temperament dimensions are highly heritable and manifest in early childhood, character dimensions mature in adulthood (Cloninger et al., 1993; Cloninger & Zohar, 2011; Garcia et al., 2017).

Although the Cloninger's psychobiological model is a well-researched and theory-driven multidimensional model in the field of personality psychopathology (Ando et al., 2004; De Fruyt et al., 2000; Sadock & Ruiz, 2015), it may also provide a better understanding of gamers' personality profiles (Huang et al., 2017; Lee et al., 2017; Mallorqui-Bague et al., 2017). To date, only a few studies have provided support for the relationship between IGD and this particular model of personality. For instance, Lee et al. (2017) in a South Korean study on the temperament and character profiles among university students with IGD found that novelty seeking and harm avoidance traits were positively associated with IGD. In another study, Mallorqui-Bague et al. (2017) compared IGD and gambling disorder based on the temperament and character traits among Spanish patients and found that individuals with IGD scored lower on novelty seeking than those who had gambling disorder. Despite these findings, Cloninger

et al.'s psychobiological model of personality has received relatively little research attention in the context of IGD. Therefore, there is still a paucity of research in this area and further research are needed to identify the potential personality dimensions involved in this condition.

The relationship between personality dimensions and behavioral addictions may be mediated by various factors (Andreassen et al., 2013; Laier et al., 2018; Throuvala et al., 2019). Individual characteristics such as negative and positive affect have been strongly associated with behavioral addictions (Li et al., 2020; Li et al., 2017; Vidyachathoth et al., 2014; Wolniewicz et al., 2018), and have been noted as potential mediating factors in the relationship between personality dimensions and behavioral addiction (Suhr & Tsanadis, 2007). Generally, associations between temperamental traits, maladaptive emotion regulation strategies, affectivity, and negative outcomes (e.g., behavioral addictions, suicidal behavior), have been documented among those with psychological disorders (Pompili et al, 2012). Negative affect refers to the extent to which an individual experiences subjective distress and negative emotions (e.g., anxiety, depression, guilt/shame, hopelessness, worry, anger, disgust, contempt) whereas positive affect refers to the extent to which an individual experiences positive emotions (e.g., enthusiasm, happiness, cheerfulness [Mroczek & Kolarz, 1998; Watson et al., 1988; Zemestani et al, 2021]). The role of negative affect is well-documented among those with IGD (Li et al., 2017; Vidyachathoth et al., 2014; Wolniewicz et al., 2018), and different psychological conditions (Serafini et al, 2017). More specifically, individuals with IGD have higher levels of negative affect and report experiencing more frequent and intense negative emotions (Li et al., 2020; Wolniewicz et al., 2018). This relationship may be explained by the fact that some individuals use the medium of internet-based communication to escape from negative affect (Laier et al., 2018).

According to the DSM-5, IGD may occur due to an individual using gaming as a coping strategy to alleviate negative mood states (APA, 2013). Investigating possible mediating

factors would assist scholars and therapists in a better understanding of potential predisposing effects of psychopathological conditions and may help clinicians to implement more effective interventions and selecting the optimal treatment options for psychological disorders (Kraemer et al., 2001). Some researchers have suggested that research examining emotional and affective states is significant for planning treatment protocols for IGD (Liu et al., 2018). Despite the established relationships between personality traits and behavioral addictions more generally, there is a dearth of research on the relationship between psychobiological dimensions of personality and IGD, as well as factors that may explain this relationship. Therefore, the aim of the present study was to contribute to the increasing understanding of IGD by examining the indirect relationships between psychobiological components of personality, positive and negative affect, and IGD among a sample of Iranian university students. To the best of the authors' knowledge, the present study is the first to examine the extent to which positive and negative affect mediate the relationship between psychobiological dimensions of personality and IGD. Based on prior literature it was hypothesized that: (i) there would a significant association between psychobiological dimensions of personality and IGD; (ii) individuals with higher levels of negative affect would have higher levels of IGD; and (iii) negative affect would mediate the relationship between psychobiological dimensions of personality and IGD.

Methods

Participants and procedure

Participants in the present study included a total of 481 Iranian university students [50.3% female; Mage= 22.41 years (SD=4.62); range =18-45 years] recruited from four universities in the cities of Sanandaj and Kamyaran (Kurdistan, Iran) from May to June 2019. Participants were selected by a convenience sampling method and were approached to take part in the study in common university campus areas such as libraries and cafeterias. All university students were invited to participate and complete paper-and-pencil questionnaires in university

setting. For all participants, the inclusion criteria were being a university student and being aged between 18 to 45 years. The exclusion criteria were any condition affecting the ability to take the assessment and not providing informed consent to participate in the study. No course credits or remunerative rewards were given. After agreeing to take part in the study, the participants provided basic socio-demographic information (i.e., age, gender, education) and other information related to the study including type of social media applications they uses (Instagram, Telegram, Facebook, YouTube, Twitter, and WhatsApp), type of internet use (academic use, online gaming, downloading videos or songs, and engaging in forms of entertainment), and devices used for accessing the internet (i.e., smartphone, laptop, tablet, and/or PC). Following this, the remaining questions comprised psychometric scales (see 'Measures' below).

Measures

Internet Gaming Disorder Scale (IGDS)

The IGDS assesses the DSM-5 nine criteria for IGD outlined in the DSM-5 (APA, 2013). There are two variants of the IGDS (a 27-item version and a nine-item version), and both have dichotomous (0=*no* and 1=*yes*) and polytomous (from 0=*never* to 5=*every day*) scales that only differ in the response options (Lemmens et al., 2015). An example item is: *"During the last year have you felt the need to play more often?"* For the present study, the 27-item dichotomous IGD scale (IGDS-27) was translated into Persian by accredited translators in accordance with gold standard back translation techniques (Brislin, 1970). For the dichotomous scale, all individual scores are summed. Total scores range from 0 to 27, with higher scores indicating greater problems related to IGD. The criterion-related validity of the 27-item dichotomous IGD scale is higher than the polytomous scale. In the original study, the instrument developers report excellent internal consistency for the 27-item dichotomous IGDS (Cronbach's a=0.93;

(Lemmens et al., 2015). The 27-item dichotomous IGDS demonstrated good internal consistency in the present study (α=.81).

Temperament and Character Inventory (TCI)

The TCI is a self-report dichotomous (true/false) personality questionnaire that assesses temperament and character dimensions of personality (Cloninger et al., 1994; Cloninger et al., 1993). The TCI has 226 items comprising four dimensions of temperament: (i) harm avoidance (HA, 35 items), (ii) novelty seeking (NS, 40 items), (iii) reward dependence (RD, 24 items), and (iv) persistence (PS, 8 items); and three dimensions of character: (i) cooperativeness (CO, 42 items), (ii) self-directedness (SD, 44 items), and (iii) self-transcendence (ST, 33 items) dimensions (Cloninger et al., 1993). Items are scored 0 (*false*) or 1 (*true*) and summed into a total score for each dimension. An example item is: "My attitudes are determined largely by influences outside my control". The TCI has demonstrated good psychometric properties in different studies (Garcia et al., 2017). The Persian version of TCI (TCI-125) was used in the present study, which has good psychometric properties among Iranians (Kaviani & Haghshenas, 2000). The TCI-125 demonstrated satisfactory internal consistency in the present study (α=.79).

Positive and Negative Affect Schedule (PANAS)

The 20-item PANAS (Watson et al., 1988) was used to assess positive and negative affect (PA [10 items; e.g., *"interested"*] and NA [10 items; e.g., *"distressed"*]). Items are rated on a five-point response scale from 1 (*very slightly or not at all*) to 5 (*very much or always*). The sum of scores of the ten PA items indicates the final score of the PA scale and, similarly, the sum of scores of the ten NA items indicates the final score of the NA scale. Total scores range from 10 to 50, with higher scores indicating greater affectivity. Internal reliability of the scale is between 0.83 and 0.90 for positive and negative affect. Converging validity correlations are between 0.89 and 0.95 for positive and negative affect (Watson et al., 1988). The Persian

version of the PANAS was used in the present study with Cronbach's alphas for the positive and negative affect scales .81 and .80, respectively (Joshanloo & Bakhshi, 2015). In the present study, Cronbach alphas for positive affect (α=.83) and negative affect (α=.89) were both very good.

Ethics

All study procedures complied with the Declaration of Helsinki regarding research on human participants. The ethical conditions of participation including voluntary participation, privacy, anonymity and confidentiality were explained to the participants. Participants were informed that participation was voluntary and they had the right not to participate and withdraw from the study. The study was approved by the research team's university ethics committee.

Data analysis

Statistical analyses were conducted using IBM SPSS-22 Statistics for Windows (IBM Crop., Armonk, NY, USA; (Allen et al., 2014), and Amos-26 software. Survey data were initially checked for missing item responses. Overall, .008% of items were missing from the survey data. A single imputation using the expectation maximization algorithm was therefore utilized to replace missing data. Descriptive statistics were used to calculate demographic and other selected characteristics of the participants. Zero-order correlation analysis carried out to assess the relationships between study variables. Structural equation modeling (SEM) was utilized to examine how temperament and character dimensions of personality related to IGD via positive and negative affect. Bootstrapping methods were used to testing the mediating role of negative and positive affect in the relationship between temperament and character dimensions of personality and IGD. Prior to conducting the SEM, the data were examined for potential violations of assumptions of normality. The results of univariate and multivariate

coefficients of skewness (sk) and kurtosis (ku) showed that all variables had normal distributions (i.e., skewness < |3| and kurtosis < |8|) (Kline, 2011).

Model fit was tested by inspecting several fit indices, including chi-square (χ^2) test of exact fit, goodness of fit index (GFI), comparative fit index (CFI), incremental fit index (IFI), normed fit index (NFI), and squared root mean residual (SRMR). A non-significant chi-square test of exact fit is indicative of a well-fitting model. The GFI, CFI, IFI, and NFI result in values ranging from 0 to 1, with values greater than 0.90 indicating adequate model fit, and greater than 0.95 indicating good model fit. The SRMR are a measure of poor model fit, with values greater than 0.10 indicating poor model fit, 0.08 to 0.05 indicating mediocre model fit, and below 0.05 indicating close model fit (Hu & Bentler, 1999).

Results

Descriptive statistics

The results of the descriptive findings are reported in Table 1. As shown in Table 1, half of the sample was female (50.5%), and the majority of them were bachelor's students (87.3%). The results also showed that 92.7% used Instagram, 96.2% Telegram, 51.4% WhatsApp, 23.3% Facebook, 28.5% YouTube, and 17.5% Twitter. Also, 51.4% of the participants used the internet for educational purposes, 34.9% for gaming, and 75.7% for music/video downloading. Finally, 99.4% of participants used smartphones, 50.7% used laptops, 13.5% used tablets, and 21% used PCs.

Table 1 here

Correlations among the study variables

A correlation matrix is presented in Table 2. Zero-order correlations showed that harm avoidance, novelty seeking, and reward dependence were positively and significantly correlated with IGD (r=0.45, 0.48, 0.54, respectively, all p-value*s* <0.001). A significant but

negative relationship was found between persistence, cooperativeness, and self-directedness with IGD (r=-0.30, -0.42, -0.35, respectively, all p-value*s* <0.001). In addition, correlations showed that individuals with higher levels of negative affect had higher levels of IGD (r=0.60, p<0.001).

Table 2 here

Model fit indices

As shown in Table 3, the model of positive affect and negative affect as a mediator between temperament and character components of personality and IGD fitted the data. Indicators of model fit with data had appropriate values (χ^2 = 62.48, df = 22, χ^2 /df = 2.82, GFI = 0.92, the CFI = 0.91, IFI = 0.92, NFI = 0.96, and the SRMR = 0.025).

Table 3 here

Standardized direct effects of study variables

According to the standard regression coefficients reported in Table 4, results showed that harm avoidance had a significant effect on IGD (β = .139; p<0.05), negative affect (β = .367; p<0.001), and positive affect (β = -.475; p<0.001). On the other hand, novelty seeking had a significant effect on IGD (β = .230; p<0.001) but no significant effect on positive affect (β = .062; p=0.081) and negative affect (β = .036; p=0.335). Reward dependence had a significant positive effect on IGD (β = .352; p<0.001), and negative affect (β = .157; p<0.001). Furthermore, the standard regression coefficient of persistence had a significant effect on negative affect (β = -.372; p<0.001) and positive affect (β = .126; p<0.001) but had no significant effect on IGD (β = .069; p=0.066). Cooperativeness had a significant effect on IGD (β = -.191; *p<0.001*), negative affect (β = -.139; p<0.001), and positive affect (β = .261; p<0.05). Self-directedness had a negative and significant effect only on negative affect (β = -.122; p<0.001). Finally, Self-transcendence had a positive and significant effect only on positive affect (β = .241; p<0.001).

Table 4 here

Bootstrapping for testing the mediating role of positive and negative affect on study variables

To investigate the mediating role of positive and negative affect in the relationship between the temperament and character dimensions with IGD, the bootstrapping method was performed (see Table 5). It is demonstrated that negative affect mediated the relationships between temperament dimensions of harm avoidance (β = .126), reward dependence (β = .054), and persistence (β = -.127), as well as character dimensions of self-directedness (β = -.042), and cooperativeness (β = -.047), with IGD (all *p*-values <0.001). However, positive affect did not mediate the relationship between any of the temperament and character dimensions with IGD (see Table 5). All standardized effects of temperament and character dimensions of personality on IGD via positive and negative affect are presented in Figure 1.

Table 5 here and Figure 1 here

Discussion

Consistent with the first hypothesis, significant associations were found between IGD and harm avoidance, novelty seeking, reward dependence, persistence, cooperativeness, and self-directedness dimensions. Furthermore, consistent with the second hypothesis, correlations showed that individuals with higher levels of negative affect had higher levels of IGD. In addition, negative affect mediated the relationship between three temperament dimensions (harm avoidance, reward dependence, and persistence) and two character dimensions (self-directedness and cooperativeness) with IGD.

As aforementioned, harm avoidance was highly correlated with IGD which concurs with the studies of Seong et al. (2019) and Choi et al. (2014) but contradicts the study by Teng (2008). According to Cloninger et al.'s (1993) psychobiological model of personality, individuals with higher harm avoidance tend to experience more anxiety, depression, and

loneliness. As a possible consequence, an individual with higher harm avoidance may engage in gaming in a problematic way and this behavior facilitates more inhibition among individuals instead of facing their problems or challenges. In addition, positive affect did not reduce the predisposition profile of harm avoidance on IGD. This suggests a significant predictive role of high harm avoidance in problematic gaming behavior.

In relation to the other temperamental dimension of personality, IGD was positively correlated with novelty seeking in the present study. Likewise, dysfunctional inhibitory control and impulsivity and higher novelty seeking has been found among individuals addicted to the internet more generally. However, the finding here contradicts a study by Mallorqui-Bague et al. (2017) in which low novelty seeking was associated with IGD. Also, in a study by Cho et al. (2008), novelty seeking was lower among individuals with internet addiction. It is important to note that novelty seeking is related to impulsivity (Sadock, Sadock & Ruiz, 2015) and this association may account for uncontrolled gaming behavior among individuals with higher novelty seeking. Also, individuals with high novelty seeking may engage in gaming behavior to avoid boredom. However, something that was unexpected in the present study was that positive affect did not correlate with novelty seeking and therefore, did not mediate the main relationship. Additionally, novelty seeking (which is a disinhibited personality trait) is associated with positive affective states in all individuals (Castellanos-Ryan & Conrod, 2013). This finding warrants further investigation.

It is also noteworthy that individuals who have high harm avoidance and novelty seeking simultaneously, may experience inhibition–disinhibition conflicts (Sadock, Sadock & Ruiz, 2015) which may be important in psychotherapeutic programs when treating IGD. The results of the present study regarding reward dependence is consistent with previous studies by Del and MenchónJosé (2017) and Montag et al. (2011) in which high reward dependence was associated with IGD. One explanation for the paradoxical results here concerning the positive

association of both harm avoidance and reward dependence might be that individuals with high reward dependence are attracted to massively multiplayer online games that allow gamers to play and interact with each other at gaming cafes or in their homes via gaming forums. Additionally, they also get indications of reward in games with tasks, scores, or challenges (Huang et al., 2017).

Moreover, and not surprisingly, positive affect was significantly correlated with high reward dependence. However, positive affect mediated the correlation of reward dependence with IGD in a way that when positive affect was present, less correlation between reward dependence and IGD was observed. One possible explanation might be that positive affect facilitates more effective and creative problem-solving strategies. It has been suggested that individuals in this positive situation are more likely to avoid tasks that interfere with their positive mood state (Isen et al., 1991). Furthermore, the other temperament dimension (i.e., persistence), was negatively correlated with IGD. Individuals with high persistence tend to be more assiduous and they view difficult situations as a personal challenge. Consequently, when they experience boredom or failure, they insist on accomplishing their tasks rather than avoiding them.

Regarding the character dimensions, in accordance with previous research (Dalbudak et al., 2013; Ha et al., 2007) persistence, cooperativeness, and self-directedness had a significant but negative association with IGD. However, results of the present study contradict the findings of Cho et al. (2008) in which high cooperativeness was associated with IGD. According to Cloninger and Zohar (2011), individuals with high cooperativeness tend to communicate effectively with other individuals and experience more social support than others that leads to higher wellness and fewer negative emotions. On the other hand, individuals with low cooperativeness or uncooperative individuals are disinterested in other individuals and tend to lead a solitary life. It should also be noted that one possible consequence of this finding is that

social attachment (high reward dependence) and social detachment (low cooperativeness) does not predict the presence of IGD which may be helpful for clinicians in searching for relevant etiologies of IGD.

Limitations, implications, and conclusions

The results of the present study should be interpreted with some caution because of various limitations. First, the cause-effect relationship between variables cannot be established because of the cross-sectional nature of the data. Therefore, future studies should use a longitudinal design to overcome this limitation. Second, a self-report method was used to collect the data which is prone to several biases (e.g., socio-cultural bias, recall bias, social desirability bias, etc.). Additionally, the length of questionnaire may have affected the quality of responses due to factors such as survey fatigue. Future studies could use different methods such as clinical interviews and third-party corroboration to provide more accurate and/or different data sources. Finally, data were collected from university students utilizing convenience sampling which is a non-randomized sampling strategy. Therefore, the generalization of the results is limited to university students. Future studies could utilize a randomized sampling strategy from different populations other than students and use more nationally representative samples. Future research could also be conducted concerning gaming preferences and genres to find out whether these preferences explain the predisposing factors of personality in IGD or not.

Despite these limitations, the present study contributed to the understanding of psychobiological dimensions of personality and affectivity that could facilitate IGD. The study also adds to the growing literature in the field and contributes to the dearth of studies in this specific area. The findings contribute to the knowledge in the field and support the proposed models showing negative affect (e.g., anxiety, depression, guilt/shame, hopelessness, worry, anger, disgust, contempt) have an important role in behavioral addictions such as IGD. The

findings from the present study have the potential to enrich extant theoretical models and could have important implications for the nosology, prevention, and treatment of the condition. Given the high correlation between psychobiological dimensions of personality and IGD via affectivity, an enhanced understanding of how negative affect could be implemented has implications for the prevention and treatment of comorbid emotional disorders. This suggests that mental health clinicians working with individuals with behavioral addiction could focus on negative affect in the treatment of individuals with IGD. The clinical implications of negative affect particularly depression, hopelessness, anxiety, and worry have received considerable attention in the treatment literature in recent years, especially in the context of emotional disorders.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Ethical Approval All study procedures complied with the Declaration of Helsinki regarding research on human participants. The ethical conditions of participation including voluntary participation, privacy, anonymity and confidentiality were explained to the participants. Participants were informed that participation was voluntary and they had the right not to participate and withdraw from the study. The study was approved by the research team's university ethics committee.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Data Availability Statement The data that support the findings of this study are available on request from the corresponding author upon reasonable request.

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Table 1

Demographics and descriptive statistics (*N*= 481).

Variable	n (%)
Gender	
Female	243 (50.5)
Male	238 (49.9)
Marital status	
Single	354 (73.5)
Married	127 (26.5)
Education Level	
B.A.	420 (83.7)
M.Sc.	31 (6.4)
Ph.D.	30 (6.2)
Social media applications	
Instagram	446 (92.7)
Telegram	466 (96.9)
Facebook	112 (23.3)
WhatsApp	247 (51.4)
YouTube	137 (28.5)
Twitter	84 (17.5)
Type of usage	
Academic use	310 (64.4)
Music/video use	364 (75.7)
Gaming	168 (34.9)
Other entertainment use	171 (35.6)
Usage device	
Mobile	478 (99.4)
Laptop	244 (50.7)
Tablet	65 (13.5)
PC	101 (21.5)

Table 2

Means, standard deviations, and correlations among the study variables ($N = 481$).

	M (SD)	Range	1	2	3	4	5	6	7	8	9	10
1. Harm avoidance	10.46 (4.32)	1-20	–									
2. Novelty seeking	11.20 (3.72)	2-19	.264**	–								
3. Reward dependence	7.91 (2.85)	1-15	.314**	.337**	–							
4. Persistence	2.70 (1.43)	0-5	-.298**	-.361**	-.191**	–						
5. Cooperativeness	13.75 (4.50)	4-24	-.302**	-.467**	-.173**	.255**	–					
6. Self-directedness	12.76 (4.51)	2-24	-.335**	-.568**	-.235**	.356**	.442**	–				
7. Self-transcendence	8.17 (2.87)	1-14	.039	-.003	-.014	.113*	.000	-.046	–			
8. Positive affect	30.11 (7.70)	12-48	-.201**	-.612**	-.238**	.315**	.481**	.443**	-.205**	–		
9. Negative affect	25.39 (8.58)	12-48	.321**	.596**	.354**	-.531**	-.424**	-.490**	-.020	-.551**	–	
10. IGD	11.43 (7.41)	1-27	.457**	.486**	.540**	-.301**	-.426**	-.351**	.035	-.373**	.608**	–

Note: IGD = internet gaming disorder

** $p<0.001$

Table 3

Fit indices of the model

χ^2	df	χ^2/df	GFI	CFI	IFI	NFI	SRMR
62.48	22	2.82	0.92	0.91	0.92	0.96	0.025

Note: χ^2= Chi-Square; GFI= Goodness of Fit Index; CFI= Comparative Fit Index; IFI= Incremental Fit Index; NFI= Normed Fit Index; SRMR= Standardized Root-Mean Square Residual.

Table 4

Standardized direct effects of study variables

			Coefficient	S.E	*β*	*t*	*p*
Harm avoidance	-->	IGD	.213	.065	.139	3.271	.001
Harm avoidance	-->	PA	-.773	.059	-.475	-13.194	.001
Harm avoidance	-->	NA	.622	.063	.367	9.844	.001
Novelty seeking	-->	IGD	.411	.061	.230	6.771	.001
Novelty seeking	-->	PA	.119	.068	.062	1.746	.081
Novelty seeking	-->	NA	.071	.073	.036	.965	.335
Reward dependence	-->	IGD	.817	.080	.352	10.175	.001
Reward dependence	-->	PA	-.104	.089	-.042	-1.169	.241
Reward dependence	-->	NA	.402	.096	.157	4.204	.001
Persistence	-->	IGD	.320	.174	.069	1.836	.066
Persistence	-->	PA	.613	.177	.126	3.467	.001
Persistence	-->	NA	-1.901	.191	-.372	-9.965	.001
Cooperativeness	-->	IGD	-.282	.053	-.191	-5.286	.001
Cooperativeness	-->	PA	.408	.056	.261	7.241	.001
Cooperativeness	-->	NA	-.226	.061	-.139	-3.717	.001
Self-directedness	-->	IGD	.130	.051	.088	2.575	.010
Self-directedness	-->	PA	.086	.056	.055	1.534	.125
Self-directedness	-->	NA	-.198	.061	-.122	-3.275	.001
Self-transcendence	-->	IGD	.136	.082	.059	1.658	.097
Self-transcendence	-->	PA	-.591	.088	-.241	-6.700	.001
Self-transcendence	-->	NA	.040	.095	.016	.417	.677
Positive affect	-->	IGD	.075	.041	.079	1.846	.065
Negative affect	-->	IGD	.349	.038	.385	9.285	.001

Note: IGD = internet gaming disorder; PA= positive affect; NA= negative affect.

** $p < 0.001$.

Table 5

Bootstrapping to examine the mediating role of negative and positive affect

		Mediator			*β*	S.D	*t*	*p*
Harm avoidance	-->	NA	-->	IGD	.126	.022	5.717	.001
Novelty seeking	-->	NA	-->	IGD	.012	.016	0.786	.432
Reward dependence	-->	NA	-->	IGD	.054	.017	3.192	.002
Persistence	-->	NA	-->	IGD	-.127	.022	5.802	.001
Cooperativeness	-->	NA	-->	IGD	-.047	.017	2.785	.006
Self-directedness	-->	NA	-->	IGD	-.042	./018	2.369	.018
Self-transcendence	-->	NA	-->	IGD	.005	.012	0.434	.665
Harm avoidance	-->	PA	-->	IGD	-.033	.020	1.650	.100
Novelty seeking	-->	PA	-->	IGD	.004	.004	1.017	.310
Reward dependence	-->	PA	-->	IGD	-.003	.004	0.726	.468
Persistence	-->	PA	-->	IGD	.009	.006	1.474	.141
Cooperativeness	-->	PA	-->	IGD	.018	.011	1.604	.109
Self-directedness	-->	PA	-->	IGD	.004	.004	0.980	.328
Self-transcendence	-->	PA	-->	IGD	-.017	.010	1.634	.103

Note: IGD = internet gaming disorder; PA= positive affect; NA= negative affect.

** $p < 0.001$.

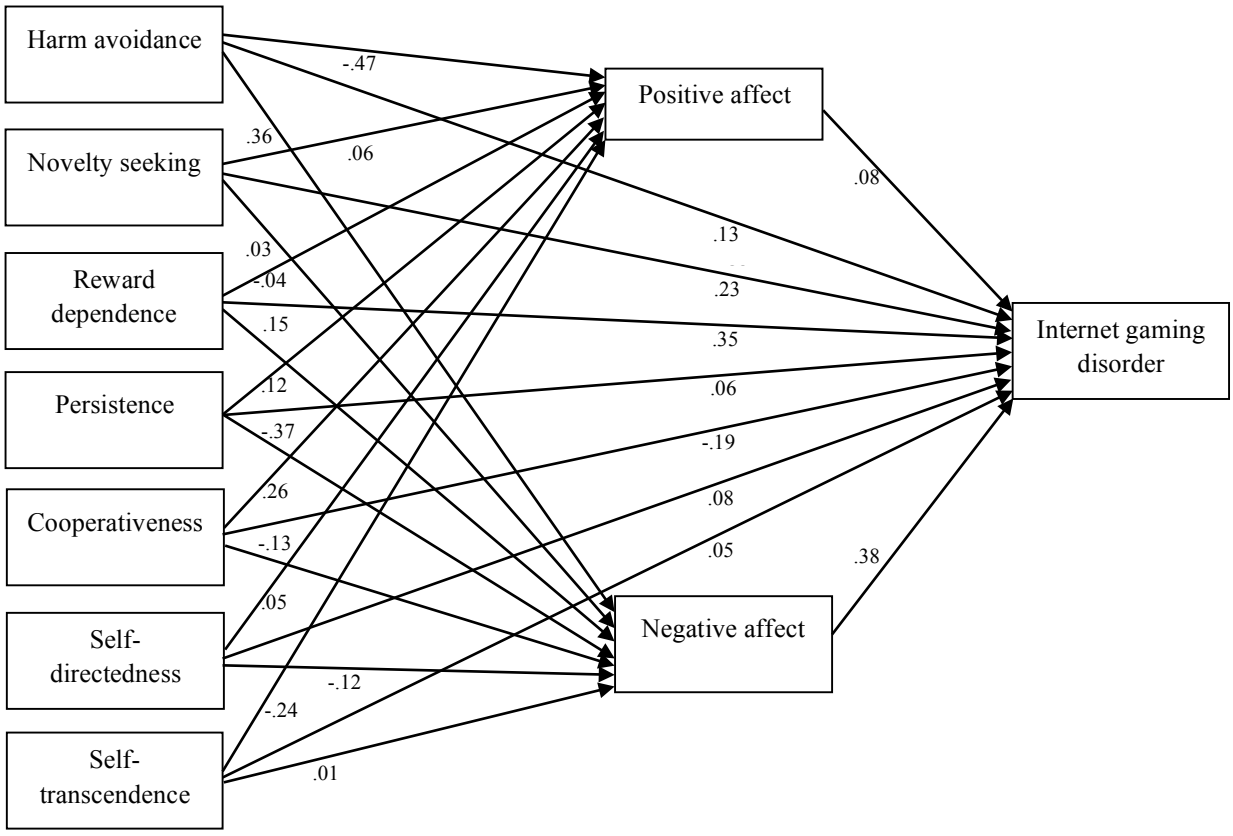

Figure 1. Standardized effects of psychobiological dimensions of personality on internet gaming disorder via positive and negative affect.