ORIGINAL RESEARCH

An Empirical Investigation of the Relationships Among Self-Esteem, Depression and Self-Serving Bias in People with Internet Gaming Disorder

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Introduction: People are generally characterized by a self-serving bias which describes the tendency to ascribe positive outcomes or success to internal or personal causes (self-enhancement motivation) and ascribe negative outcomes or failure to external or situational causes (self-protection motivation). It has been found that the individuals with internet gaming disorder (IGD) who have low self-esteem and high depression exhibit an attenuated self-serving bias. However, the relationships among self-esteem, depression and self-serving bias are not clearly identified.

Methods: A sample of 138 IGD participants completed self-esteem and depression scales and a causal attribution task (Study 1) to examine the relationships among self-esteem, depression and self-serving bias (both self-enhancement and self-protection). In follow-up Study 2, 28 IGD participants were recruited to undertake self-affirmation intervention which can affirm one's sense of global self-view and bolster self-esteem to explore whether self-affirmation would trigger a reduction of depression and a raise of self-serving bias.

Results: The results of path analysis in Study 1 showed that the self-serving bias was predicted by self-esteem and depression, and the depression played a mediating role between self-esteem and self-serving bias. The results of Study 2 showed that the IGD participants reported higher self-esteem, lower depression and engaged in more self-protection motivation after affirming-self manipulation as compared with affirming-other manipulation.

Conclusion: These findings suggest that self-esteem predicts self-serving bias through depression and self-affirmation could trigger an increase of self-esteem, further decrease depression and improve self-serving bias for the individuals with IGD. The present article clearly identified the relationships among these factors and provided a new approach to promote positive self-concept in individuals with IGD. Future research is warranted to explore the lasting benefits of self-affirmation on domains of education, relationships and gaming withdrawal for the individuals with IGD among different populations.

Keywords: internet gaming disorder, self-serving bias, self-esteem, depression

Introduction

Internet gaming disorder (IGD) is defined as recurrent and persistent engagement with online games resulting in significant impairments or distress in a person's life.[1] This manner of excessive or indulgent use of games can lead to various adverse consequences, such as disturbed interpersonal relationships, sleep insufficiency, decreased work/academic achievements, and social adjustment problems.[2,3] Individuals with IGD almost experience symptoms of withdrawal, heightened impulsivity and craving, which were similar to those who developed problematic gambling and substance dependence.[4,5] Accumulating evidence has converged to illustrate that the IGD is associated with decision-making deficits, emotional dysregulation, executive function impairments and hypersensitivity to rewards.[6–8] As a maladaptive mental disorder, IGD has been successively included in 5th

Edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-V) and 11th Revision of the International Classification of Diseases (ICD-11).[9,10] Recent surveys have reported the prevalence rate of IGD ranges from 1.8% to 17.67% across different population ages and countries and is remarkably increased during the COVID-19 pandemic.[5,11–15] Given the significant prevalence and potential negative impacts on daily life and social function, further research is warranted to extend our understanding of psychosocial correlates of IGD and to develop effective intervention strategies.

Despite a considerable amount of research in this area, there is a lack of clarity in the domain of self about IGD. Generally, to maintain a positive view of self, people tend to make more internal, stable and global attributions for positive situations than for negative situations. This kind of phenomenon is defined as self-serving bias, which is assumed to serve a psychologically adaptive strategy for keeping psychological health and defending against threats.[16,17] The self-serving bias is supposed to be engaged by two aspects of motivations, namely self-enhancement and self-protection.[18] Previous literatures have clarified that self-enhancement and self-protection are involved in different psychological processes and manifested differently across cultures.[19–22] Self-enhancement motivation describes the tendency of attributing causation of positive events internally, which serves to regulate superordinate needs to have in advancing one, as clearly manifested in Western cultures; while self-protection motivation describes the tendency of attributing causation of negative events externally, which serves to avoid the environmental feedback threatens reducing an interest below the tolerance point, as clearly manifested in Eastern cultures. Particularly, our previous research has demonstrated that the IGD participants showed an attenuated self-serving bias, with weakened self-enhancement and self-protection.[23] However, it is currently unclear about the psychosocial correlates and factors of the abnormal pattern of self-serving bias in individuals with IGD.

There is general agreement in the literatures that a multitude of factors potentially impact the degree to which an individual displays self-serving bias, such as self-esteem and depression.[24,25] For example, low self-esteem people are more likely to attribute success externally and failure internally than high self-esteem individuals, exhibiting a lack of self-serving bias.[26] Depressed people assign excessively or equally external attribution of positive events and internal attribution of negative events as compare with nondepressed people, also suggesting a diminished or a non self-serving bias.[27,28] Research has found that the self-esteem and depression is related to self-serving bias among different kinds of populations.[25,29] Specifically, the self-esteem is positively correlated with self-serving bias in healthy populations and depression severity is negatively correlated with self-serving bias in depressed populations. It is also verified that the self-esteem and depression could account for significant percentages of the variance in attribution style, proving to be powerful predictors of self-serving bias.[25,30] Notably, low self-esteem and more depressive symptoms have been consistently observed in individuals with IGD across multiple surveys.[31–33] Hence, the self-esteem and depression might be two most critical factors which are associated with the self-serving bias in IGD. However, there is a lack of research exploring the relationships of self-esteem, depression and self-serving bias among the individuals with IGD, which hinders the understanding of potential psychological mechanism underlying the attenuated self-serving bias and the development of effective intervention strategies to promote positive self-concept in these individuals.

In the present article, we collected data on self-esteem, depression and self-serving bias by means of self-reporting questionnaires and laboratory experiment, and investigated the extent to which self-esteem and depression can be applied to explain the self-serving bias among individuals with IGD. For decades, it is well documented that self-esteem and depression are negatively related.[30,34,35] Moreover, empirical research has revealed the causal link between self-esteem and depression.[36,37] That is, self-esteem is supposed to be a predisposing causal factor for depression, low self-esteem contributes significantly to depression, while depression does not contribute to low self-esteem. Considering that both self-esteem and depression are related to self-serving bias and the causal relation between self-esteem and depression, we hypothesized that self-esteem would be a fore predictor of depression and self-serving bias including self-enhancement and self-protection among the individuals with IGD and the depression was hypothesized to be a mediator of the link between self-esteem and self-enhancement/self-protection.

On the basis of aforementioned hypothetical path that the self-esteem was linked to self-serving bias via the depression, raising low self-esteem might be conducive to reduce depression and improve self-serving bias. Steel et al[38] proposed that the individuals with low self-esteem experience more dissonance due to their fewer positive cognitions about the self and less secure resources with which to resilience to self-adequacy threats. Nonetheless, such dissonance or threats can be countered by self-affirmation, a key psychological process which brings about a more extensive view of

self and its resources.[39,40] A cross-lagged research has found that the greater spontaneous self-affirmation predicted increased self-esteem four months later, supporting the conceptualization that self-affirmation bolsters self-esteem over time.[41] Therefore, a self-affirmation intervention could be conducted to help the individuals with IGD elevate self-esteem and promote positive self-view. To this end, we developed a self-affirmation procedure to elicit the individuals with IGD affirm the self and also identified the extent to which the level of depression and the self-serving bias could be changed.

Overall, the present article contained two studies: first examined the associations among self-esteem, depression, self-serving bias (both self-enhancement and self-protection) and second investigated whether self-affirmation intervention would trigger an increase of self-esteem, a decrease of depression and a raise of self-serving bias in IGD samples. Based on prior literatures summarized above, we proposed two hypotheses. **Hypothesis 1**: depression would mediate the relationships between self-esteem and self-enhancement and between self-esteem and self-protection. **Hypothesis 2**: self-affirmation would enhance the level of self-esteem, reduce the level of depression and contribute to the improvements of self-enhancement or self-protection or both.

Overview

The present research consisted of two separate studies. In Study 1, data on self-esteem, depression and self-serving bias were obtained from 138 IGD participants by using Rosenberg Self-Esteem Scale (RSES), Beck depression inventory-Second Edition (BDI-II) and a causal attribution task. Two models (Model 1: self-esteem → depression → self-enhancement and Model 2: self-esteem → depression → self-protection) were built to explore the pathways from self-esteem to self-enhancement/self-protection. In Study 2, 28 IGD participants were received an experimental self-affirmation intervention and afterwards finished the same causal attribution task and scales, further probing into whether raising self-esteem would trigger changes of depression and self-serving bias.

Study 1
Methods
Participants

In study 1, a sample of 139 IGD Participants (71 males and 68 females) between the ages of 18 and 29 years ($M \pm SD$: 20.07 ± 2.02) were recruited from local universities. All participants were college students due to the widespread popularity of online games as a leisure activity among the group of college students. They were all right-handed and absence of historical or current substance abuse (eg, cocaine, alcohol), psychiatry disorders (eg, anxiety), behavioral addictions (eg, problematic gambling) or neurological disorders, thereby excluding confounding effects of other types of addictions and neurological abnormalities. One male participant was excluded due to the deviation from the average value of behavioral results by more than 3 standard deviations. Consequently, a total of 138 participants (70 males and 68 females) were included into final data analysis. The sample size was estimated using the G*Power software package (Version 3.1).[42] According to previous research conducted by Stankovic & Nesic,[43] the power of $(1-\beta) = 0.95$, α error probability = 0.05, medium effect size $\rho = 0.30$ of the expected variable correlations and a two-tailed test were used, a prior power analysis showed the recommend sample size was at least 138.

The selection criteria of participants included Young's Internet Addiction Test (IAT),[44] the nine-item IGD diagnostic criteria proposed in the DSM-V[3,10] and amount of time spending on playing online games. The Young's IAT is a five-point 20-item Likert scale for responses ranging from "1 = Rarely" to "5 = Always". The total score of IAT varies from 20 to 100 with a higher score indicating greater severity of addiction. The nine-item DSM-V criteria were used to assess the addictive symptoms (eg, tolerance and withdrawal) on a dichotomous response scale (0 = no and 1 = yes). Both the IAT and nine DSM-V criteria were accurately translated into Chinese for the convenience of participants and have been commonly used to diagnosed IGD in Chinese research.[5,32] According to prior research,[45,46] the participants were classified as IGD if they satisfied all four of the following criteria: (1) scored 50 or above on Young's IAT; (2) met at least five of the nine DSM-V criteria; (3) played online games for at least two hours per day; (4) had at least two years of game experience. The mean scores of IAT and DSM-V were 68.73 ($SD = 10.37$) and 6.42 ($SD = 1.27$), separately. All participants signed a written informed consent before taking part of the study and were paid 15 Yuan after completing the task.

Task and Materials

In study 1, a causal attribution task was adopted to detect the self-serving bias of IGD participants.[47] The participants were presented with a series of sentences depicting self-related or other-related interpersonal events. For self-related events (happening between the self and another person), the "self" was the target of attribution and the participants were involved in the situation. For other-related events (happening between two other persons), the "other" was the target of attribution and the participants were bystanders (the other persons were strangers to them). The participants were required to imagine the event happening to themselves or between the other two persons, and then indicate via a button press "How likely is it that self/other is that kind of person?" on a four-point Likert scale (1 = "Very unlikely", 2 = "Moderate unlikely", 3 = "Moderate likely", 4 = "Very likely").

According to the construction of experimental materials in previous study,[47] each sentence consisted of a subject, a verb and an object. Forty Chinese two-character verbs (20 positively valenced and 20 negatively valenced) were used four times to construct 160 one-sentence interpersonal events. There were 40 positive self-related events (eg, I support Mei Guo, Yong Wang supports me), 40 negative self-related events (eg, I warn Ke Liang, Hui Li warns me), 40 positive other-related events (eg, Yan Ding supports Mei Guo, Yong Wang supports Lei Su) and 40 negative other-related events (eg, Xin Zhou warns Ke Liang, Hui Li warns Bo Zhao), with the underlined text denoting the target of attribution (no underlines in the formal experiment). The verbs were screened through three steps which were described detailedly in our previous study and have been proven to be suitable for investigating the self-serving bias in IGD.[23] Put simply, these verbs were selected based on the consensus of all ten game players (not participating in the experiment), who considered that the verbs were closely related to games. The two categories of positive and negative verbs were differed in valence ($t = 26.17$, $p < 0.001$) but not in familiarity or arousal ($ps > 0.05$). In these sentences, the word "I" indicated the "self" and all the other names (appearing only once in the experiment) were generated by random combination of Chinese common first names and last names. The positions (subject or object) of attribution targets were counterbalanced across trials.

Measures

Self-Esteem

Self-esteem refers to a global sense of self-worth, or a generally positive self-evaluation.[26] Self-esteem was assessed using the RSES.[48] The RSES contains 10 items rating on a 4 Likert-point scale from 1 = "strongly disagree" to 4 = "strongly agree". The scores range from 10 to 40 and higher scores indicate higher levels of self-esteem. The RSES, as a most widely used measure of self-esteem, has good psychometric properties and good levels of reliability and validity for measuring self-esteem among Chinese college students.[49,50] The Cronbach's alpha of the RSES was 0.88 in the present study.

Depression

Depression is characterized by causeless sadness, a loss of motivation and negatively biased information processing.[51] The levels of depression was assessed using the BDI-II, which has been shown to has good psychometric properties and good sensitivity for detecting depression by a large amount of research.[52,53] The BDI-II consists of 21 self-reported items and evaluates characteristic attitudes and symptoms of depression experienced in the past two weeks. Items are rated on a four-point Guttman scale from 0 = "least" to 3 = "most", with a total score range of 0 to 63. Higher scores suggest more severe depressive symptoms. The Chinese version of this measure has demonstrated good reliability and validity in adults samples.[54] The Cronbach's alpha of the BDI-II was 0.92 in the present study. Because BDI-II is a unidimensional scale, item parcels were created for more suitable indicators to build latent variables by parceling the items with similar loadings into an indicator. The original 21 items in the BDI-II were parceled into 3 indicators. Fit indices values of the BDI-II model after parceling were found as follows: $\chi^2 = 5.963$, df = 5, χ^2/df = 1.193, $p = 0.310$, comparative fit index (CFI) = 0.996, Tucker-Lewis index (TLI) = 0.992, standard root mean square residual (SRMR) = 0.027, root mean square error of approximation (RMSEA) = 0.037.

Procedure

The whole time of the experiment was approximately 20 minutes. First, upon arriving at the lab, participants filled out the basic demographic information, IAT, nine DSM-V criteria of IGD, RSES and BDI-II. Second, the research assistant explained the task instruction to participants performed a shortened version of the task (ten trials) to facilitate better
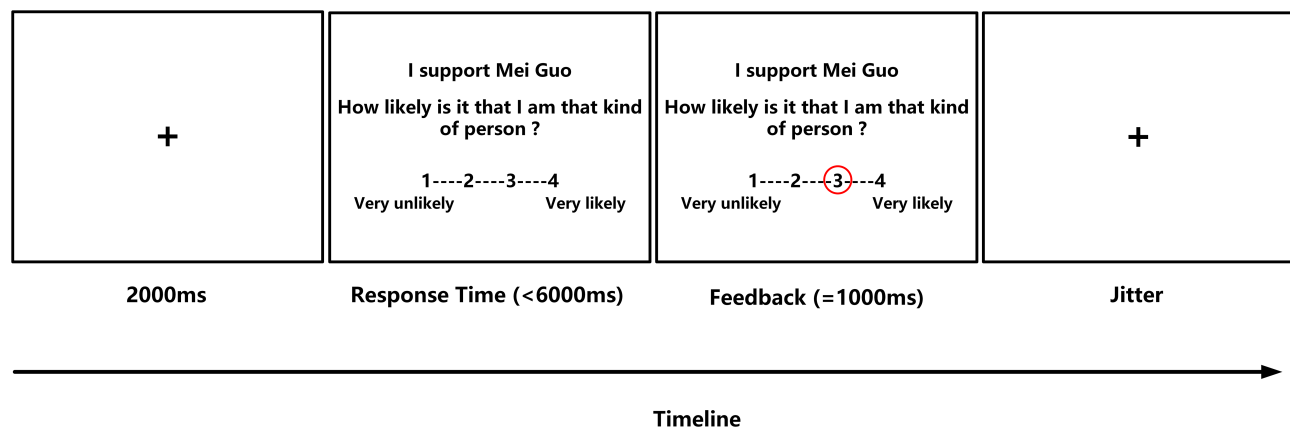
Figure 1 The timeline of one trial in the self-serving bias task. Each stimulus included a description of positive or negative interpersonal event, a question and a 4-point scale. Participants were required to attribute the cause of an event to himself or herself from 1= "Very unlikely" to 4= "Very likely" in 6-s.

understanding. Finally, the participants were instructed to complete the formal task of attributing the causes of 160 interpersonal events. As illustrated in Figure 1, a black fixation cross would present on a white screen immediately followed the stimulus interface displaying one-sentence interpersonal event and a four-point scale. For each trial, the participants were required to press the response button within 6000 ms and correspondingly a red circle would appear around the selected option which lasted for 1000 ms. Between trials, a fixation cross was shown on the screen for a jittered duration of 500–1000 ms.

Data Analysis

First, the behavioral data collected from the causal attribution task was processed. Given that each person may have different levels of self-other bias in causal attribution situation, the other condition was taken as the baseline.[47] According to our previous research,[23] the attribution rating difference scores between self and other in the positive and negative conditions were respectively calculated (self *minus* other) for each participant. In the positive condition, the attribution rating difference scores represented the intensity of "self-enhancement", and higher score indicated a stronger self-enhancement motivation. In the negative condition, the attribution rating difference scores represented the intensity of "self-protection", and higher score inversely indicated a weaker self-protection motivation.

Second, Pearson's correlation analyses were conducted using Statistical Package for the Social Sciences (SPSS, 22.0 Version, SPSS Inc., Chicago, IL, USA) to identify the associations among self-enhancement, self-protection, self-esteem and depression. The scores of these variables were transformed into standardized z-score and then subjected to bivariate correlation analyses. The correlation results were reported as significant after the application of Sequential Bonferroni correction.[55]

Third, based on the correlation matrix, the Model 1 and Model 2 were initially built and mediation path analyses were run to assess the mediating effect of depression between the pathways from self-esteem to self-enhancement and self-esteem to self-protection. Consistent with prior studies,[56,57] participants' age and gender were included as control variables in the path analyses, since that studies have indicated that these demographics might have an effect on self-serving bias.[24,58] The two models were tested via maximum likelihood estimation through IBM-SPSS Amos 24.0, which is a commonly used program to assess path analysis of mediating variables that can simultaneously estimate relationships between latent and observable variables. The following five indices were employed to ensure a good model fit: (1) a non-significant Chi-square statistic; (2) CFI of above 0.95; (3) TLI of above 0.95; (4) SRMR of below 0.05; (5) RMSEA of below 0.05. The significance of the mediation effect of depression was examined using bootstrapping method (5000 samples) and 95% confidence intervals (CI). In mediation analysis conducted with bootstrapping estimation Procedure, the range of the values produced at the 95% CI should not contain zero, reflecting a significant indirect effect.[59]

Results and Discussion

Correlation Analyses

The mean scores, standard deviations and Pearson's correlation analyses for primary variables were shown in Table 1. The results indicated that the self-esteem was negatively correlated with depression ($r = -0.405$, $p < 0.001$) and positively correlated with self-enhancement ($r = -0.223$, $p = 0.009$). Depression was negatively correlated with self-enhancement ($r = -0.315$, $p < 0.001$) and positively correlated with self-protection ($r = 0.208$, $p = 0.014$), suggesting that higher levels of depression predicted weaker self-enhancement and self-protection motivation. According to previous research,[60] there need not be a significant effect of X on Y (r_{xy}) in a mediation analysis but a requirement of significant indirect effect a × b. Based on this point, even though there was no significant relation between self-esteem and self-protection, the mediation analysis was still conducted to further explore whether there existed a mediation effect.

Mediation Analyses

For Model 1, the results of model fit showed that $\chi^2 = 12.172$, df = 12, χ^2/df = 1.014, $p = 0.432$, CFI = 0.999, TLI = 0.999, SRMR = 0.037, RMSEA = 0.010. For Model 2, the results showed that $\chi^2 = 12.316$, df = 12, χ^2/df = 1.026, $p = 0.421$, CFI = 0.999, TLI = 0.998, SRMR = 0.037, RMSEA = 0.014. All five indices of these two models were in the acceptable ranges, demonstrating a good model fit.

Furthermore, the standardized total, direct and indirect effects obtained by bootstrapping estimation procedure for the two mediation models were displayed in Table 2 and Figure 2. In Model 1, the results showed that the self-esteem was significantly related to depression ($\beta = -0.279$, $p = 0.003$) and the depression was significantly related to self-enhancement ($\beta = -0.245$, $p = 0.004$). The self-esteem exerted significant indirect effect on self-enhancement through depression ($\beta = 0.068$, $p = 0.003$). But after controlling for the mediating variable of depression, the self-esteem exerted no significant direct effect on self-enhancement ($\beta = 0.144$, $p = 0.056$). In Model 2, the results showed that the self-esteem was significantly related to depression ($\beta = -0.279$, $p = 0.003$) and the depression was significantly related to self-protection ($\beta = 0.185$, $p = 0.049$). The self-esteem exerted significant indirect effect on self-protection through depression ($\beta = -0.052$, $p = 0.025$). After controlling for the mediating variable of depression, the self-esteem also exerted no significant direct effect on self-protection ($\beta = 0.011$, $p = 0.905$). These results suggested that the self-esteem predicted self-serving bias including self-enhancement and self-protection through depression, which was consistent with our hypotheses. The depression played a mediating role in the relationship between self-esteem and self-serving bias.

Study 2

Methods

Participants

In study 2, twenty-eight IGD Participants (12 male and 16 female) between the ages of 18 and 25 years ($M \pm SD$: 20.43 ± 1.85) were recruited from local universities. All participants were right-handed students and free of any historical or current substance abuse, psychiatry disorders, behavioral addictions or neurological disorders to exclude confounding effects of other types of addictions and neurological abnormalities. The selection criteria for IGD participants included four criteria, which

Table 1 Means, Standard Deviation (SD) and Correlations of the Primary Variables

Variables	M	SD	1	2	3	4	5
1. Age	21.130	2.071	1				
2. Self-esteem	27.587	4.592	0.109	1			
3. Depression	13.376	9.343	−0.087	−0.405***	1		
4. Self-enhancement	0.003	0.235	0.145	0.223**	−0.315***	1	
5. Self-protection	−0.358	0.356	0.060	−0.033	0.208*	0.019	1

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

Table 2 Standardized Total, Direct and Indirect Effects of Model 1 and Model 2

Path Analysis	β	SE	Bootstrapping		
			Bias-corrected Percentile 95% CI		Two-Tailed Significance
			Lower	Upper	
Model 1					
Standardized total effects					
Self-esteem —> Self-enhancement	0.212[a]	0.078	0.054	0.359	0.009**
Standardized direct effects					
Self-esteem —> Depression	−0.279[a]	0.088	−0.438	−0.100	0.003**
Depression —> Self-enhancement	−0.245[a]	0.082	−0.404	−0.082	0.004**
Self-esteem —> Self-enhancement	0.144	0.074	−0.004	0.287	0.056
Standardized indirect effects					
Self-esteem —> Self-enhancement	0.068[a]	0.031	0.022	0.149	0.003**
Model 2					
Standardized total effects					
Self-esteem —> Self-protection	−0.040	0.076	0.054	0.359	0.580
Standardized direct effects					
Self-esteem —> Depression	−0.279[a]	0.088	−0.439	−0.102	0.003**
Depression —> Self-protection	0.185[a]	0.088	0.001	0.345	0.049*
Self-esteem —> Self-protection	0.011	0.076	−0.139	0.160	0.905
Standardized indirect effects					
Self-esteem —> Self-protection	−0.052[a]	0.031	−0.129	−0.006	0.025*

Notes: *p < 0.05, **p < 0.01; [a]Represents that the 95% CI does not overlap with zero.

were consistent with the Study 1. The mean scores of IAT and DSM-V were 66.73 (SD = 10.44) and 6.27 (SD = 1.35), separately. The sample size was also calculated using the G*Power software package (Version 3.1). Given the commonly used values of power of (1–β) = 0.95, α error probability = 0.05, and effect size f = 0.308 (η^2 = 0.19 provided by Kang et al),[61] a prior power analysis showed the recommend sample size was at least 24.
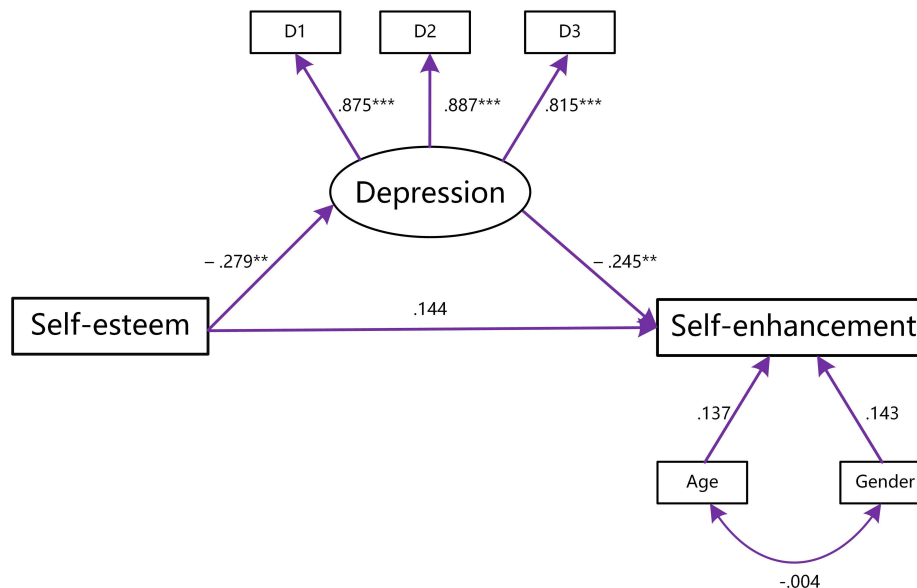
Self-Affirmation Intervention

According to previous experimental studies,[62,63] the self-affirmation intervention was implemented by providing positive feedback via priming procedure which was a widely used experimental affirmation manipulation. In this study, we developed a cooperative balance ball game designed to promote self-affirmation by providing positive social feedbacks.

The program of ball game was written using the Python package (Version 3.0, https://www.python.org/). Figure 3 showed an Overview of the ball game, which comprised of a ball, a horizontal beam and a green box. Participants were instructed to cooperate with three 'real partners' to transport the ball into the green box above. They controlled the left side of the beam by clicking left direction button of computer and "partners" controlled the right side of the beam by clicking right direction button. If the ball was successfully transported into the green box, a word "WIN" would be presented in the interface screen; a word "LOSE" would be presented if the ball fell off the beam and was not transported into the green box. Participants were told that the "partners" played the ball game together on another computer in other laboratory through Internet. Actually, the movement on the right side of the beam was achieved by writing code; it was not real persons playing ball game with participants. This ball game had a simple operation and was easy to get started, thereby the percentage of "WIN" was relatively high at above of 80%. Besides, participants could experience real interpersonal interaction and achieve positive feedback reasonably through the ball game.

The self-affirmation intervention included two manipulations, an affirming-self manipulation and an affirming-other manipulation (control condition). During each manipulation, participants would play ball game with three "partners" to cooperatively transport the ball into designated place in turn. Following eight times of ball games with each "partner", participants would receive an evaluation about themselves or other person from each "partner", which was presented with "I feel about you during the
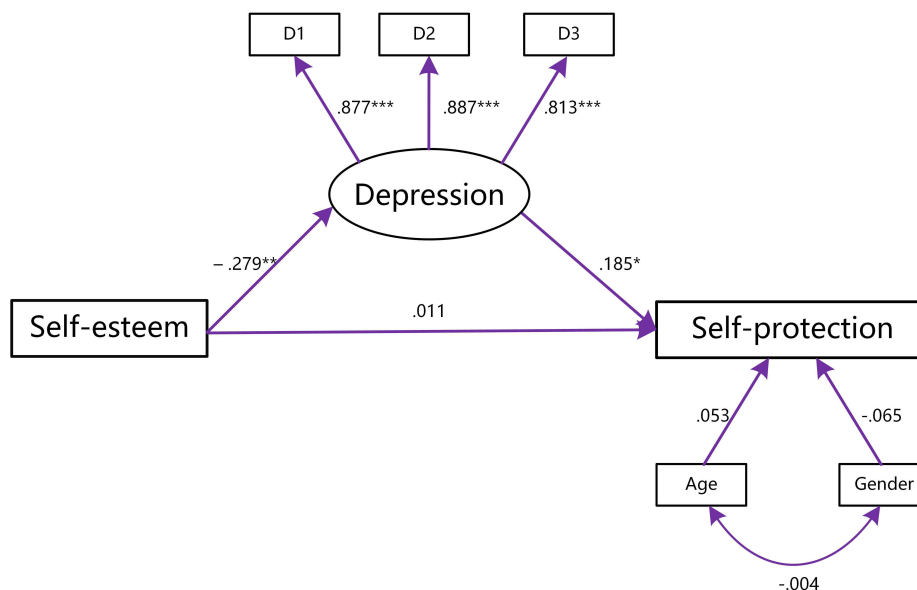
Model 1

Model 2

Figure 2 Path analyses depicting self-esteem to self-enhancement (Model 1) and to self-protection (Model 2) via depression. Standard parameter estimates are presented.
Notes: D1: parcel 1 of depression, D2: parcel 2 of depression, D3: parcel 3 of depression; *p < 0.05, **p < 0.01, ***p < 0.001.

cooperation" or "I feel about other during the cooperation" on a scale from excellent, good, average, fair to poor. In affirming-self manipulation, the feedback was consistently "I feel excellent about you during the cooperation"; in affirming-other manipulation, the feedback was consistently "I feel excellent about other during the cooperation". Therefore, participants would receive three affirming-self feedbacks in affirming-self manipulation or three affirming-other feedbacks in affirming-other manipulation.

Task and Procedure
Participants were instructed to attend two task sessions which were separated by more than 10 days and each lasted approximately 30 minutes. In each session, they first performed the self-affirmation intervention procedure, then completed the causal attribution task (the same task as in Study 1) and finally filled out the RSES and BDI-II.
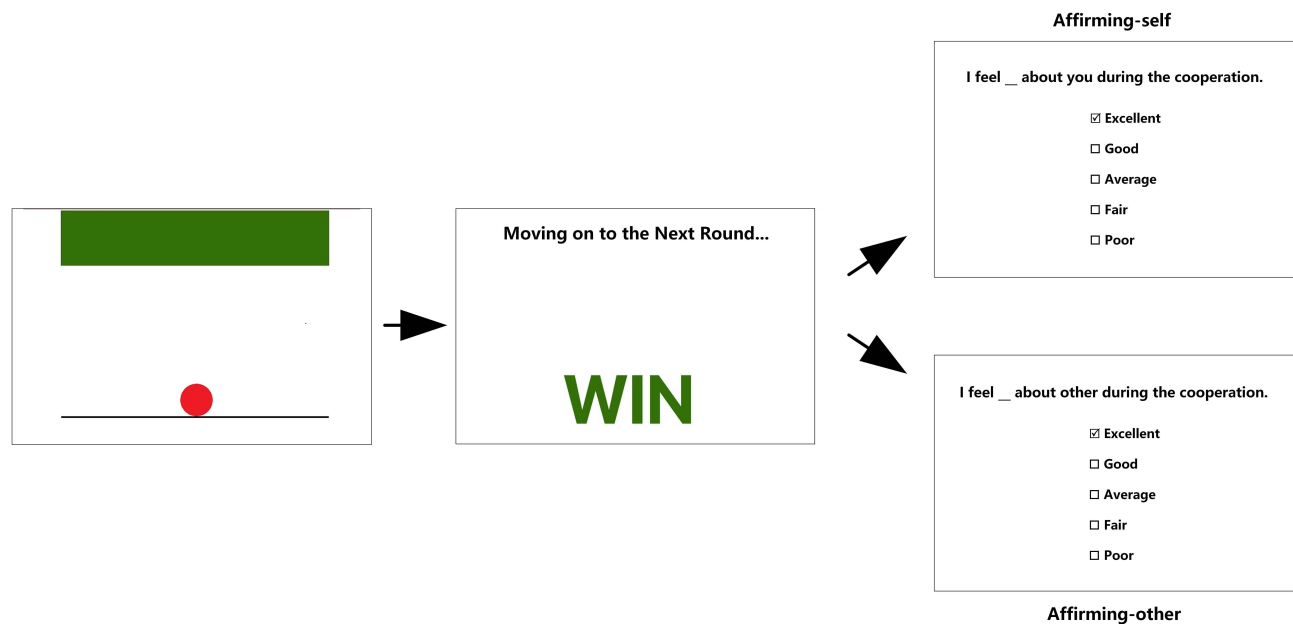
Figure 3 An overview of the cooperative balance ball game for self-affirmation intervention.

At the phase of self-affirmation intervention, participants initially were allowed to practice three times of cooperative balance ball game to familiarize themselves with the movement and velocity of the ball by clicking button. Then they were subjected to affirming-self manipulation or affirming-other manipulation. These two manipulations were in a counterbalanced order across participants. Half of the participants were randomly assigned to the affirming-self manipulation at the first visit and the affirming-other manipulation at the second visit; the remaining half were in the opposite order. At the phase of causal attribution task, following ten exercise trials, participants were asked to finish the formal task procedure. All participants signed a written informed consent before entering the study and were paid 60 Yuan after completing both two task sessions.

Data Analysis

All behavioral data were analyzed with SPSS (Version 22.0, SPSS Inc., Chicago, IL, USA). A paired t-test was used to compare the scores of RSES after the two different manipulations in IGD participants. Similarly, another paired t-test was used to compare the scores of BDI-II after the two different manipulations. Besides, the attribution rating difference scores between self and other (self *minus* other) were computed for each participant. Then, a Manipulation (2; affirming-self, affirming-other) × Valence (2; Negative, Positive) repeated-Measures ANOVA was performed, with Manipulation and Valence as within subject variables; the attribution rating difference score was defined as dependent variable. Simple effect analysis was conducted with Bonferroni correction for significant interaction effects.

Results and Discussion

The results of Paired t-tests showed significant increase in self-esteem after affirming-self manipulation relative to affirming-other manipulation in IGD participants [affirming-self ($M \pm SE$): 30.107 ± 0.772, affirming-other ($M \pm SE$): 28.892 ± 0.827, t (27) = 2.126, p = 0.043, Cohen's d = 0.402]. Significant decrease in depression was observed after affirming-self manipulation relative to affirming-other manipulation [affirming-self ($M \pm SE$): 8.214 ± 0.792, affirming-other ($M \pm SE$): 9.714 ± 0.941, t (27) = −2.075, p = 0.048, Cohen's d = 0.392]. These indicated that the self-affirmation intervention was an effective way to promote an increase of self-esteem for IGD participants, which was in line with previous studies that self-affirmation could produce positive effects to self-esteem.[41,64] Furthermore, a decrease of depression level was also observed. The change of self-esteem was accompanied by a change in depression level.
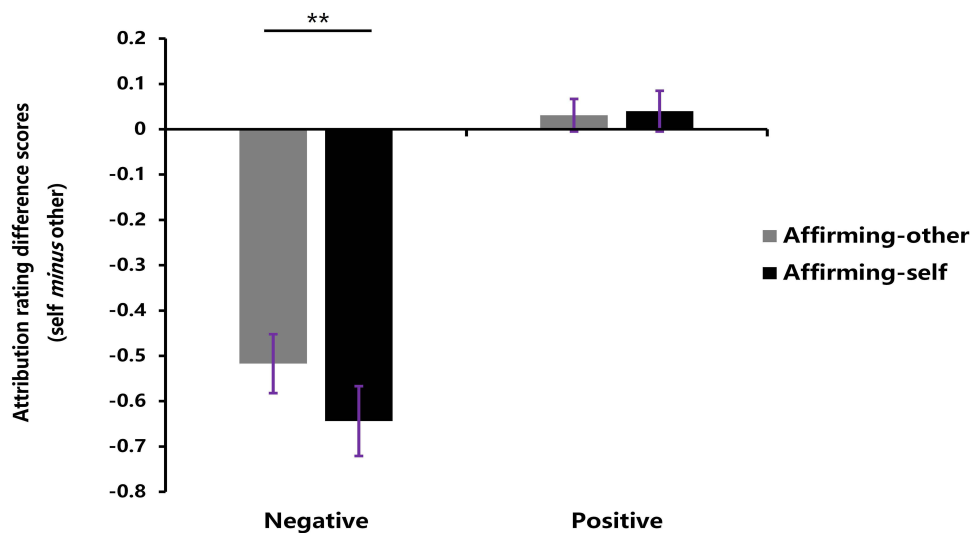
Figure 4 Behavioral results of Study 2. The IGD participants rated lower in the negative condition after affirming-self manipulation as compared with affirming-other manipulation, but there was no significant difference in positive condition (error bars represent standard error of the mean, **$p < 0.01$).

Repeated-measures ANOVA found significant main effect of both manipulation [$F(1, 27) = 4.236$, $p = 0.049$, partial $\eta^2 = 0.136$] and valence [$F(1, 27) = 84.897$, $p < 0.001$, partial $\eta^2 = 0.759$], and significant interaction between manipulation and valence [$F(1, 27) = 7.173$, $p = 0.012$, partial $\eta^2 = 0.210$]. Simple effect analysis for manipulation showed that in the positive condition, IGD participants rated equally after affirming-self manipulation ($M = 0.040$, $SE = 0.036$) and affirming-other manipulation ($M = 0.031$, $SE = 0.045$), $F(1, 27) = 0.052$, $p = 0.821$; but in the negative condition, IGD participants rated lower after affirming-self manipulation ($M = -0.644$, $SE = 0.065$) relative to after affirming-other manipulation ($M = -0.517$, $SE = 0.077$), $F(1, 27) = 11.575$, $p = 0.002$, partial $\eta^2 = 0.300$, as shown in Figure 4. This suggested that compared with affirming-other manipulation, affirming-self manipulation increased the self-protection motivation in IGD participants, but with no effect on self-enhancement motivation. On the whole, the Study 2 showed that the self-affirmation could raise self-esteem, decrease depression level and promote the individuals with IGD to adopt more self-protection motivation when encountering negative interpersonal events.

General Discussion

The self-serving bias has been demonstrated to be correlated with self-esteem and depression in prior research.[25,48] Importantly, the present article adds to the empirical literature by supporting that the self-esteem was linked to self-serving bias via depression and by proving that the self-affirmation intervention could bolster attenuated self-serving bias in IGD samples. Aligns with our hypotheses, the Study 1 showed a mediating pathway by which self-esteem was associated with self-enhancement and self-protection through depression. Moreover, the Study 2 showed that the individuals with IGD exhibited relatively enhanced self-esteem, reduced depression and increased self-protection motivation after self-affirmation intervention.

The Relationships Among Self-Esteem, Depression, and Self-Serving Bias

First and foremost, the current article shed light on the relationships among self-esteem, depression and self-serving bias in individuals with IGD. There is a body of research available in the field of self with respect to IGD. Specifically, an early study found a distorted self-concept in individuals with IGD, who made negative biased evaluations towards both the actual self and ideal self.[65] Besides, our previous study indicated that the individuals with IGD exhibited a low level of self-esteem, a high level of depression and an attenuated self-serving bias with decreases in both self-protection and self-enhancement.[23] Although these studies have detected the abnormal pattern in terms of self in IGD population, the underlying mechanisms are not fully understood and up to now no research has identified the predict paths among self-esteem, depression and self-serving bias. The current article extended these previous works by discovering significant

paths from self-esteem to depression, depression to self-enhancement and depression to self-protection among the individuals with IGD.

The results of path analyses showed that the low self-esteem was related strongly to high depression, which is consistent with previous findings.[36] Subsequently, the depression predicted the lack of self-enhancement and self-protection. In other words, the self-esteem was mainly and indirectly linked to self-enhancement/self-protection through its relation with increased depression among IGD samples. The low self-esteem might be depicted as an antecedent trigger for diminished motivations of self-enhancement and self-protection. It may extrapolate that the individuals with IGD who had low self-esteem tended to exhibit more depressed symptoms and had relatively high risk for the attenuation of self-serving bias. In support of this view, existing evidence has indicated that people with low self-esteem, who tend to overestimate their faults or disadvantages and underestimate their abilities or efforts, are more susceptible to experiencing depression and an absence of self-serving bias.[26,35] So, it could be proposed that raising the level of self-esteem in individuals with IGD is an effective way to develop positive self-concept.

The Effectiveness of Self-Affirmation Intervention

At present, there is substantial evidence that self-affirmation plays a critical role in bolstering a person's self-esteem.[39,40,64] For example, one study conducted by Zhong et al[64] has found that affirming one's positive qualities could temporarily increase self-esteem and alleviate the sense of threat caused by upward social comparison. Accordingly, an experimental self-affirmation intervention was employed in this article to help the individuals with IGD improve self-serving bias and buffer against negative interpersonal events. Precisely, the individuals with IGD exhibited relatively enhanced self-esteem, reduced depression and increased self-protection motivation after self-affirmation intervention. Consistent with our hypotheses, self-affirmation could raise self-esteem and further trigger the changes of depression and self-serving bias. Interestingly, we did not find a significant increase in terms of self-enhancement motivation. This may be due to the prevailing modesty norms in Chinese collectivist culture, especially during interpersonal interactions. The self-system in such culture is oriented towards maintaining social harmony rather than attaining positive self-evaluations. Previous research has found that Chinese participants has a lower level of self-esteem than Westerners and are less likely to behaviorally manifest self-enhancement motivation that is explicit and may violate modesty norms.[21,66] Both self-protection and self-enhancement motivations might be observed in the Western samples after self-affirmation intervention. But in general, the self-affirmation intervention could enhance low self-esteem and improve attenuated self-serving bias for the individuals with IGD.

In addition, self-affirmation has been shown to produce far-reaching benefits in education and relationships.[39,67,68] Specifically, a timely brief affirmation intervention of writing about important values could facilitate minority middle students attend more selective colleges and access to positive structural channels.[68] Self-affirmation also reduced the defensive distancing strategies that low self-esteem people in long-lasting relationships use to regulate the risk of losing their partners' affection.[69] It is also clearly evidenced that self-affirmation interventions significantly decrease alcohol consumption and stimulate strong intentions to cut down cigarette consumption.[70,71] Accumulated research indicates that self-affirmation intervention is effective because it breaks vicious cycles of negative coping responses to psychological threats and/or initiates virtuous cycles of positive coping responses.[39,72] Self-affirmation may result in a relatively smaller positive change in thinking about self for individuals with IGD. A positive experience appears to give a powerful head-start, further creating a motivating effect on self-esteem, reducing depression and improving self-serving bias with time. To some extent, there is speculation that self-affirmation may induce the individuals with IGD to increase the openness to realize negative consequences of persistent gaming and elevate the motivation to curb their game behaviors. Future studies are encouraged to focus on the sustained effects of self-affirmation over time and explore the lasting benefits of self-affirmation on domains of education, relationships and gaming withdrawal for the individuals with IGD.

Limitations and Future Research Directions

There are some limitations that should be noted. First, the participants in our studies were all college students, the sample may not be representative of the entire IGD population. Hence, additional research efforts are recommended to establish the replicability and generalizability of the current findings across different age periods, educational backgrounds, and cultural

contexts. Second, self-esteem and depression were the mainly factors that we focused on related to self-serving bias of IGD samples. Several potential factors such as perceived stress, personality and coping strategies should be further considered to influence the manifestation of self-serving bias for individuals with IGD. Third, the present study employed a cross-sectional design, which limited the ability to make causal Conclusions about the effects of self-affirmation on self-esteem, depression, and self-serving bias. A longitudinal study design, with multiple measurement points over time, would allow for a more robust examination of the temporal relationships between these variables and the effectiveness of self-affirmation interventions.

Despite these limitations, the present article still provides potential practical implications, indicating that the attenuated self-serving bias of IGD could be prevented or enhanced by improving self-esteem. Psychological interventions such as self-affirmation is capable of helping the individuals with IGD increase self-esteem and boost positive self-concept. Not only manipulating positive feedback but also writing important personal values exercise and writing down one's great achievements have been confirmed to be specific effective self-affirmation techniques.[62,73] These brief, economical, and applicable techniques need to be further validated whether self-affirmation could help the individuals with IGD control game time and game cravings. Moreover, future research should address well-timed, well-situated and appropriate implementations of self-affirmation and adopt a longitudinal follow-up design to explore its effectiveness on Internet gaming withdrawal and craving, which would be constructive to foster good relationship and enhance academic performance for the individuals with IGD.

Conclusions

In summary, the present article revealed that among the individuals with IGD, the self-serving bias was linked to self-esteem and depression, and depression played a mediating role between self-esteem and self-serving bias. Then a self-affirmation intervention was implemented to raise the level of self-esteem, subsequently decrease the level of depression and increase self-serving bias. These findings provide evidence for supporting that self-esteem predicts self-serving bias via depression and self-affirmation intervention can improve attenuated self-serving bias and foster positive self-concept for the individuals with IGD.

Data Sharing Statement

The data will be available from the first author Yifan Wang (yifanwang121@163.com) upon reasonable requests.

Ethics Statement

All studies were approved by the Ethics Committee of East China Normal University and were conducted in accordance with the Declaration of Helsinki.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

Disclosure

Yifan Wang and Lei Zhang are co-first authors for this study. The authors declare that they have no conflict of interests with regard to this article.

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