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Source	<i>Asia-Pacific Journal of Public Health</i> , 27(2), NP2188-NP2196. <a href="http://dx.doi.org/10.1177/1010539511429369">http://dx.doi.org/10.1177/1010539511429369</a>
Published by	SAGE Publications

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This is the author's accepted manuscript (post-print) of a work that was accepted for publication in the following source:

Liao, A. K., Neo, E. C., Gentile, D., Choo, H., Sim, T., Li, D., & Khoo, A. (2015). Impulsivity, self-regulation, and pathological video gaming among youth: Testing a mediation model. *Asia-Pacific Journal of Public Health*, 27(2), NP2188 - NP2196. <http://dx.doi.org/10.1177/1010539511429369>

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# Impulsivity, Self-Regulation, and Pathological Video Gaming Among Youth: Testing a Mediation Model

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and Angeline Khoo<sup>1</sup>

## Abstract

Given the potential negative mental health consequences of pathological video gaming, understanding its etiology may lead to useful treatment developments. The purpose of the study was to examine the influence of impulsive and regulatory processes on pathological video gaming. Study 1 involved 2154 students from 6 primary and 4 secondary schools in Singapore. Study 2 involved 191 students from 2 secondary schools. The results of study 1 and study 2 supported the hypothesis that self-regulation is a mediator between impulsivity and pathological video gaming. Specifically, higher levels of impulsivity was related to lower levels of self-regulation, which in turn was related to higher levels of pathological video gaming. The use of impulsivity and self-regulation in predicting pathological video gaming supports the dual-system model of incorporating both impulsive and reflective systems in the prediction of self-control outcomes. The study highlights the development of self-regulatory resources as a possible avenue for future prevention and treatment research.

## Keywords

adolescent health, child health, psychological/behavioral medicine, smoking/tobacco/drug abuse, population health

Video gaming has become a pervasive part of the lives of children and teenagers today. US, South Korean, and Singaporean teenagers spend about 13.2,<sup>1</sup> 23,<sup>2</sup> and 23.1 h/wk<sup>3</sup> playing video games, respectively. Although the positive effects of video games and Internet use have been documented,<sup>4,5</sup> psychologists, educators, parents, and researchers have become concerned about

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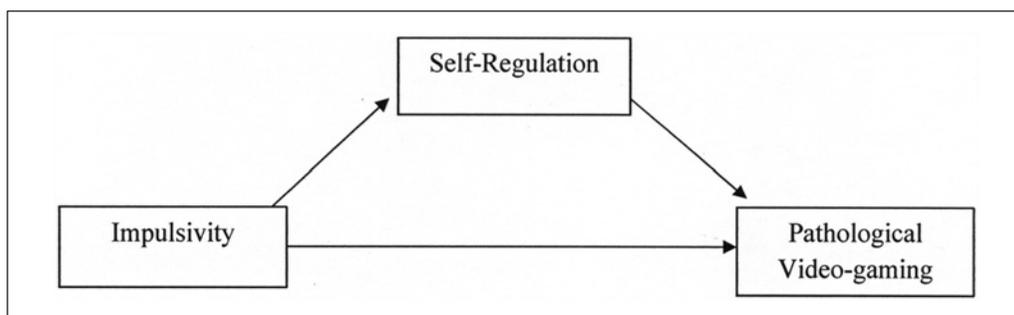
the possible negative effects of extensive video gaming among children and teenagers. In particular, there has been concern about pathological patterns of behavior with video games and other computer- and Internet-related technologies. Longitudinal research has shown that pathological video gaming can lead to negative mental health consequences such as depression, anxiety, and social phobia;<sup>6</sup> pathological Internet use has been linked to later depression.<sup>7</sup>

Although pathological video gaming has received research interest, there is not yet a medical definition of the phenomenon.<sup>8</sup> Most researchers define pathological video game use similar to the *Diagnostic and Statistical Manual of Mental Disorders (DSM)* criteria for pathological gambling as both are considered behavioral addictions.<sup>9</sup> Hence, pathological video game use has been defined by modifying *DSM-IV-TR*<sup>10</sup> criteria for pathological gambling, as indicated by at least 5 out of a list of 10 symptoms of damage to family, social, school, and psychological functioning.<sup>3</sup> This definition includes Brown's core facets of addiction<sup>11</sup>: *saliency* (activity dominates the person's life), *euphoria/relief* (activity provides a "high"), *tolerance* (greater activity is needed to achieve the same "high"), *withdrawal symptoms* (experience of unpleasant effects when unable to engage in the activity), *conflict* (activity leads to conflict with others, work, obligations, or self), and *relapse and reinstatement* (activity is continued despite attempts to abstain from it), and it has shown reasonable reliability, construct validity, as well as convergent and divergent validity.<sup>1,3</sup>

In the *DSM-IV-TR*, pathological gambling is classified as an impulse-control disorder (ICD). Similarly, researchers have argued that pathological video game use, or the more general pathological Internet use, should be classified as an ICD.<sup>9</sup> The essential feature of ICDs is the "failure to resist an impulse, drive, or temptation to perform an act that is harmful to the person or to others."<sup>10(p663)</sup> Recent research has uncovered neurobiological and genetic predispositions that emphasize the role of impulsivity in ICDs and other addictions.<sup>12</sup> Although impulsivity has been linked to substance use disorders and other disorders,<sup>13</sup> researchers have just started exploring the link between impulsivity with pathological video gaming and Internet use. For instance, impulsivity has been identified as a correlate of pathological video gaming,<sup>1,3</sup> as well as a predictor of frequent chat room use<sup>14</sup> and problematic Internet use.<sup>15</sup>

In trying to understand the influence of impulsivity on a problematic behavior such as pathological video gaming, Hofmann et al<sup>16</sup> have argued that it is necessary to adopt a dual-system perspective where researchers examine both the impulsive system and the reflective system to predict behaviors. The reflective system "serves regulatory goals that complement the functions of the impulsive system."<sup>16(p165)</sup> This dual-system perspective is consistent with neurocognitive research suggesting that different brain areas underlie these 2 systems<sup>17</sup> and social-cognitive theories,<sup>18</sup> which portray individuals as proactive, self-organizing, and self-reflecting agents. The notion of agency is predicated on the idea that people have the capacity to make assessments about when and whether they are in control. Central to this "agentic self" is the concept of self-regulation, the ability of an individual to manage his or her own behavior through processes such as observation, evaluation, and reflection.<sup>18</sup> Seay and Kraut<sup>19</sup> found that individuals high in self-regulation reported significantly lower levels of problematic video game use compared with their counterparts. In addition, self-regulation was the largest and most robust of all the predictors of problematic video game use in their study.

Given the potential negative mental health consequences of pathological video gaming, understanding its etiology may lead to useful treatment developments. Hence, the objective of the present study was to take a preliminary step in understanding the etiology of pathological video gaming by examining the intricate role of impulsive and regulatory processes in predicting pathological video gaming. We hypothesized a mediation model in linking these 3 concepts (see Figure 1). It is hypothesized that self-regulation would mediate the relationship between impulsivity and pathological video gaming. Specifically, higher levels of impulsivity would be related



**Figure 1.** The mediation model linking impulsivity and self-regulation to pathological video gaming

to lower levels of self-regulation, which in turn would be related to higher levels of pathological video gaming. Impulsivity is considered the more distal predictor of pathological video gaming compared with self-regulation, as impulsivity is often considered a personality trait.<sup>20</sup> On the other hand, although self-regulation involves a trait-like dispositional capacity, it can also be conceptualized as an adaptive resource that resembles a muscle.<sup>21</sup> It becomes tired after exertion, resulting in diminished capacity. However, regular exercise can produce improvements in self-regulation, similar to the strengthening of muscles.<sup>21</sup>

## Study 1

### Method

**Participants.** The participants were 2712 students (1950 males and 762 females) from 6 primary and 4 secondary schools, 4 of which were boys' schools. Of these participants, 2155 (1510 males and 645 females) completed all scales entering the final analysis. The overall average age of the participants was 10.93 years ( $SD = 2.04$ ; primary students  $N = 1182$ ,  $M = 9.21$ ,  $SD = 0.7$ ; secondary students  $N = 973$ ,  $M = 13.02$ ,  $SD = 0.82$ ). For primary schools, 588 students were from grade 3, and 594 students were from grade 4. For secondary schools, 560 students were from grade 7, and 413 were from grade 8. The racial makeup was 72.5% Chinese, 14.8% Malay, 8.5% Indian, 4.2% other races. This racial composition is representative of the general population of that age-group in Singapore. All levels of socioeconomic status were represented, as assessed by housing type, with 19.1% living in 3-room or smaller public housing, 27.6% living in 4-room public housing, 27.2% living in 5-room public housing or government-built executive flats, and 25.9% living in private housing. Housing type, which is classified by the size of residence (eg, 1-2 room public housing, 3 room public housing, etc), is a major demographic characteristic in studies on Singaporean youth<sup>22</sup> as a proxy indicator of socioeconomic status in the Singaporean context.

**Procedures.** About 20 primary and secondary schools were short-listed based on the principals' attendance at a cyber issues workshop. The principals were duly informed about the scope of the study and were then invited to participate in the study. After considering school zones, type of school (public or private), and students' background to ensure the representativeness of the diversity of Singaporean primary and secondary students, we selected 12 short-listed schools that were most keen on understanding video gaming behavior of their students. To have at least 500 students at each level, 4 classes from each level of third, fourth, seventh, and eighth grades were requested from each of the participating schools. Schools were requested to select classes of different academic abilities, but the final choice was left to them. Ten of the 12 schools were part of study 1, and the other 2 schools were part of study 2. Informed consents were sought from

the parents through the schools. A liaison teacher from each school collated the information and excluded students from the study whose parents refused consent. Participation rate was 99%. Assent was obtained from the students through informing them that participation in the survey was voluntary and they could withdraw at any time. Privacy of the students' responses was ensured by requiring the teachers to seal collected questionnaires in the envelopes provided in the presence of the students. It was highlighted on the questionnaires that the students' responses would be read only by the researchers.

## Measures

*Demographics and video gaming habits.* Besides the usual demographic questions such as gender, age, socioeconomic status measured by housing type, and academic performance, the survey included several items assessing children's video game habits adapted from the General Media Habits Questionnaire (GMHQ) and the Adult Involvement in Media Scale.<sup>3</sup> All the scales in study 1 have been validated for Singaporean youth.<sup>3</sup>

*Impulsivity.* The students' level of impulsivity (IMP) was measured using 10 items adapted from the Barratt Impulsiveness Scale used by Patton et al.<sup>23</sup> Students rated each item on a 4-point scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). A higher score indicated a higher level of impulsivity. This scale yielded a Cronbach's  $\alpha$  of .69.

*Emotional regulation.* In this study, we focused on emotional regulation (ER) as a measure of self-regulation. ER represents the use of self-regulatory strategies as a means of coping amid distressing emotions. ER was measured using a 4-item scale, which is part of the Personal Strengths Inventory–2.<sup>24</sup> Participants rated each item on a 4-point scale, where 1 = *strongly disagree*, 2 = *disagree*, 3 = *agree*, and 4 = *strongly agree*. Cronbach's  $\alpha$  for ER was .70.

*Pathological video gaming.* Pathological video gaming (PVG) was measured with a 10-item instrument derived from the pathological gambling items of the *DSM-IV*. This scale had been used previously in a national study of American youth<sup>1</sup> and has been validated with Singaporean youth.<sup>3</sup> Participants could respond “no,” “sometimes,” or “yes” to each of the 10 symptoms, and each item was scored 0, 0.5, or 1, respectively. A total score for the scale was used, and higher score indicated higher levels of pathological video gaming. Cronbach's  $\alpha$  for PVG was .78.

*Data Analyses.* The SPSS Macro INDIRECT<sup>25</sup> was used to test the mediation model illustrated in Figure 1. INDIRECT uses a product-of-coefficients strategy to test the significance of indirect effects. The indirect effect was estimated by first regressing self-regulation (mediator) on impulsivity (independent variable; IV) and then regressing pathological video gaming (dependent variable; DV) on self-regulation (mediator) and impulsivity (IV). The indirect effect was the product of the sample estimates of the regression coefficients (“Mediator on IV”  $\times$  “DV on mediator controlling for IV”). This strategy is considered a more powerful approach compared with the Baron and Kenny multiple regression approach and the Sobel test.<sup>25</sup> Bootstrapped confidence intervals were estimated to avoid power problems introduced by asymmetric and other nonnormal sampling distributions of an indirect effect. Bias-corrected bootstrapping was used, as it produces more accurate confidence intervals; 5000 bootstrapped samples were used as recommended.<sup>25</sup>

## Results

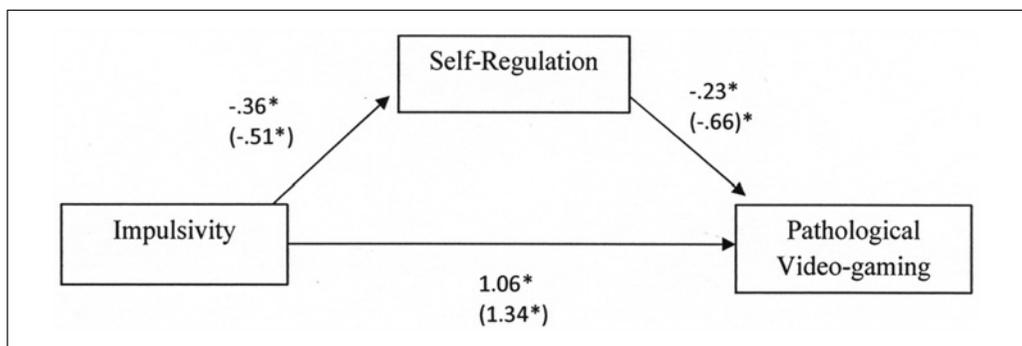
*Descriptive Statistics, Correlational Analyses, and Gender Differences.* The descriptive statistics and correlations among the main variables in the study can be found in Table 1. All 3 main variables, IMP, ER, and PVG, were significantly related to each other. Males ( $M = 2.45$ )

**Table 1.** Descriptive Statistics and Correlations Among the Main Variables of Study 1 and Study 2

	Study 1 (N = 2155)			Study 2 (N = 191)		
	IMP	ER	PVG	IMP	VGSR	PVG
Mean	2.26	2.84	2.23	2.39	2.61	2.57
SD	0.44	0.59	1.74	0.41	0.74	2.12
IMP		-.27 <sup>a</sup>	.29 <sup>a</sup>		-.28 <sup>a</sup>	.33 <sup>a</sup>
ER			-.15 <sup>a</sup>			-.31 <sup>a</sup>

Abbreviations: IMP, impulsivity; ER = emotional regulation; PVG, pathological video gaming; VGSR, video game self-regulation.

<sup>a</sup> $P < .001$ .



**Figure 2.** Results of direct effects of the mediation model for study 1 and study 2 (in parentheses), controlling for gender ( $*P < .001$ )

scored significantly higher than females ( $M = 1.73$ ) on PVG,  $t(2153) = 8.85$ ,  $P < .001$ . There were no gender differences for IMP and ER.

**Mediation Analyses.** In the mediation analysis, PVG was specified as the DV, ER was specified as the mediator, and IMP was specified as the IV. ER and IMP were centered at the mean. Gender was specified as a covariate.

The results of the direct effects in the mediation analysis can be found in Figure 2. Controlling for gender, there was a significant direct effect between IMP and PVG ( $B = 1.06$ ,  $P < .001$ ). There was also a significant indirect effect between IMP and PVG with ER as a mediator (bootstrap mean = 0.08, 95% confidence interval [CI] = 0.04-.13). Hence, as hypothesized, ER mediated the association between IMP and PVG. Specifically, higher levels of impulsivity would be related to lower levels of emotional regulation, which in turn would be related to higher levels of pathological video gaming.

## Study 2

In Study 1, self-regulation was measured in terms of emotional regulation. The objective of study 2 was to supplement study 1 by using a measure of self-regulation that was more specific

to video gaming. Hence, in study 2, self-regulation was measured in terms of video game self-regulation in a different sample of youth.

## Method

**Participants.** Participants were 301 students (229 males, 55 females, and 17 not reported) recruited from 2 secondary schools in Singapore, 1 of which was a boys' school. Of them, 191 (140 males and 51 females) completed all scales entering the final analysis. The overall average age of the participants was 12.88 (SD = 0.80). A total of 132 students were from seventh grade, and 58 students were from eighth grade (1 student did not report grade). The racial makeup was 86.7% Chinese, 5.3% Malay, 4.8% ethnic Indian, and 3.2% other ethnicities.

**Procedures.** The procedures were the same as study 1. However, the 2 schools in study 2 received an additional survey on video game self-regulation.

## Measures

**Video game self-regulation.** A 10-item video game self-regulation (VGSR) scale was developed for the purpose of this study.<sup>26</sup> The construction of items in the scale was based on key constructs of self-regulation such as metacognition, personal agency, and self-efficacy. A sample item was as follows: "I believe I can stop playing videogames." The responses were measured on a 4-point Likert-type scale (1 = *being not true of me*; 2 = *being somewhat true of me*; 3 = *being quite true of me*; and 4 = *being very true of me*). Cronbach's  $\alpha$  for VGSR was .92.

**Impulsivity and pathological video gaming.** The same measures of IMP and PVG were used as in study 1. Cronbach's  $\alpha$ s for the IMP and PVG scales were .70, and .93, respectively.

## Results

**Descriptive Statistics, Correlational Analyses, and Gender Differences.** The descriptive statistics and correlations among the main variables in the study can be found in Table 1. All 3 main variables, IMP, VGSR, and PVG, were significantly related to each other. As in study 1, males ( $M = 2.86$ ) scored significantly higher than females ( $M = 1.75$ ) on PVG,  $t(189) = 3.29$ ,  $P < .01$ , and there were no gender differences for IMP and VGSR.

**Mediation Analyses.** In the mediation analyses, PVG was specified as the DV, VGSR was specified as the mediator, and IMP was specified as the IV. IMP and VGSR were centered at the mean. Gender was specified as a covariate.

The results of the direct effects in the mediation analysis can be found in Figure 2. Controlling for gender, there was a significant direct effect between IMP and PVG ( $B = 1.34$ ,  $P < .001$ ). There was also a significant indirect effect between IMP and PVG with VGSR as a mediator (bootstrap mean = 0.34, 95% CI = 0.10-0.71). Hence, as hypothesized, VGSR mediated the association between IMP and PVG. Specifically, higher levels of impulsivity would be related to lower levels of video game self-regulation, which in turn would be related to higher levels of pathological video gaming.

## Comment

Both study 1 and study 2 supported the hypothesis that self-regulation is a mediator between impulsivity and pathological video gaming. The study highlighted the role of 2 kinds of self-regulation—emotional regulation and a more specific type of regulation related to video gaming. The role of self-regulation had been highlighted by Seay and Kraut<sup>19</sup> who found that

self-regulation was more important than motivational factors in predicting problematic use of online gaming. The authors stated that self-regulatory processes are essential in allowing video gaming to be a harmless and enjoyable pastime rather than being a destructive preoccupation.

One debate in the field of media or technology addiction is whether pathological use can be explained by an addictive personality,<sup>27</sup> a learning model where operant conditioning leads to escalating behaviors, or a social-cognitive model, a theory that extends classical learning theory to include complex human cognitions.<sup>28</sup> The findings of our study are consistent with the argument of LaRose et al<sup>28</sup> that deficient self-regulation is a critical risk factor for media or technology addictions. Hence, the findings support the utility of a social-cognitive model for understanding the etiology of pathological video game use and developing treatments for it.<sup>28</sup>

The investigation of the role of self-regulation and impulsivity helps shift the focus on the harmful or “addictive” characteristics of video games to the study of the internal processes taking place within the individual. This mediating role of self-regulation provides at least 2 important implications. First, the use of both impulsivity and self-regulation in predicting pathological video gaming supports the call by various researchers for the need to examine both impulsive and reflective systems in enabling a more precise prediction of self-control outcomes.<sup>16</sup> Recent evidence suggests that different brain areas may underlie these 2 systems.<sup>17</sup> Second, the findings have implications for mental health providers who are working with pathological video gamers. In particular, the results suggest that developing self-regulatory skills could be a useful strategy in working with pathological gamers. Baumeister et al<sup>21</sup> have argued that it is possible to improve self-regulation through exercise. As an individual performs exercises to improve self-regulation in one sphere, he or she becomes better at self-regulating in other spheres. In fact, the development of self-regulation is one component of cognitive-behavioral treatment that has been found to be useful in helping adolescents with pathological Internet use.<sup>29</sup>

Even though mediation models imply causality, the findings in the study are limited by the cross-sectional nature of the data. It is possible that the relations examined in this study are reciprocal in nature. Hence, longitudinal or experimental studies are needed to establish the temporal order of a causal process. Although most of the instruments used in the study have been validated in the Singaporean context, the exception is the VGSR scale. Hence, more work needs to be done to provide evidence for the validity of this scale.

Future research can move beyond just examining the impulsive and reflective systems in predicting pathological video gaming, as there are still many factors that were not taken into account in the model. Other research has suggested that there are various situational and dispositional moderators that can influence reflective and impulsive processes.<sup>16</sup> For instance, future studies can examine how the influence of peers may impact on these impulsive and reflective processes. The influence of peers has been found to be an important risk factor for various other problem behaviors.<sup>30</sup> Although much is still unknown about the etiology of pathological video gaming, the present study has made an important preliminary step in understanding the internal processes that lead to such behaviors. Consistent with neurocognitive and social-cognitive models, the present study has helped establish the important role of self-regulation in mediating the relations between impulsivity and pathological video gaming and highlight the development of self-regulatory resources as a possible avenue for future prevention and treatment research with pathological video gamers.

### **Authors' Note**

Study 2 of this article was based on the second author's master's dissertation submitted to Nanyang Technological University, Singapore. A version of this article was presented at the ASEAN Regional Union of Psychological Societies Third Congress at Kuala Lumpur, Malaysia in October 2010.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interests with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article:

The authors would like to thank the Ministry of Education, Singapore, and the Media Development Authority for jointly funding the research project (Project #EPI/06AK).

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