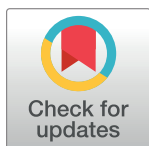


## RESEARCH ARTICLE

# The impact of video game playing on Chinese adolescents' academic achievement: Evidence from a moderated multi-mediation model

Xiaoxia Gu<sup>1</sup>, Norlizah Che Hassan<sup>1\*</sup>, Tajularipin Sulaiman<sup>1</sup>, Zhixia Wei<sup>1,2</sup>, Jingyi Dong<sup>1</sup>

**1** Department of Foundations of Education, Faculty of Educational Studies, Universiti Putra Malaysia, Serdang, Selangor, Malaysia, **2** Hebei Key Laboratory of Children's Cognition and Digital Education, School of Educational Studies, Langfang Normal University, Langfang, Hebei, China

\* [norlizah@upm.edu.my](mailto:norlizah@upm.edu.my)

## Abstract

Internet access for adolescents is becoming more prevalent around the world. Although video game playing has been verified to be negatively related to adolescent academic achievement, the mechanisms underlying this relationship are also unknown. Using a nationally representative sample of adolescents from the China Education Panel Survey (2014–2015), this study aims to explore the parallel mediation roles of self-educational expectation and learning attitude in the link between video game playing and academic achievement, and whether the direct and indirect effects are moderated by parent-child relationship. The results indicate that video game playing in adolescents is both directly and indirectly related to their academic achievement, and self-educational expectation and learning attitude partially mediate this association. Moreover, the results reveal that parent-child relationship moderates the direct association between video game playing and academic achievement as well as the indirect association of video game playing on academic achievement via self-educational expectation, respectively. By showing empirical evidence for the usefulness of social cognitive theory to adolescents' academics in the Internet Age, our research provides a supplement to existing literature.

## OPEN ACCESS

**Citation:** Gu X, Hassan NC, Sulaiman T, Wei Z, Dong J (2024) The impact of video game playing on Chinese adolescents' academic achievement: Evidence from a moderated multi-mediation model. PLoS ONE 19(11): e0313405. <https://doi.org/10.1371/journal.pone.0313405>

**Editor:** Lakshit Jain, University of Connecticut Health Center: UConn Health, UNITED STATES OF AMERICA

**Received:** May 30, 2024

**Accepted:** October 22, 2024

**Published:** November 19, 2024

**Copyright:** © 2024 Gu et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

**Data Availability Statement:** The data underlying the results presented in the study are publicly accessible and available at <http://ceps.ruc.edu.cn/>.

**Funding:** The author(s) received no specific funding for this work.

**Competing interests:** The authors have declared that no competing interests exist.

## 1. Introduction

The rapid development of internet technology has brought about changes worldwide, and computers have become an important part of the daily life of adolescents. They are in a hyper-connected world where constant digital multitasking results in a unique social environment [1]. Thus, video gaming has become a widespread and popular activity among young people across various countries [2–6]. In recent years, the online game industry has been developing particularly rapidly in China, and the number of users continues to climb, with a marked increase in adolescents. As of June 2023, the total number of internet users in China amounted to 1.079 billion, with an internet penetration rate of 76.4%. Within this group, the number of online game users reached 550 million, accounting for 51.0%. Meanwhile, teenagers aged 10 to 19 accounted for 13.9% of the total Netizen population [7]. In particular, it should be noted

that minors are the most loyal users of online games. In China, the number of underage internet users was 193 million in 2022, and the internet penetration rate reached 97.2%. Among them, the proportion of internet users who regularly play games online reached 67.8%, up 5.5 percentage points from 2021 (62.3%), showing an upward trend [8]. In a word, online gaming has seamlessly integrated into our daily lives and internet use and video game playing have become common activities for adolescents.

Furthermore, the influence of video games on youth development, particularly in academics and behaviors, has attracted considerable attention around the world. One of the risk factors is that some adolescents devote a lot of time and energy to online games leading to internet addiction. There is a rich body of evidence suggesting that adolescent gaming addiction is relatively pronounced, with rates reported to be around 8% in U.S. [9], 10% in Hong Kong [10], 15% in Italy [11], and 16% in Saudi Arabia [12]. In particular, some longitudinal studies indicated that once adolescents become addicted to internet use and video game playing, the symptoms tend to persist over time [13, 14]. Stevens et al. pointed out that gaming disorder has emerged as a significant global prevalence, affecting adolescents and young adults across various cultures and societies [15]. Other studies have verified the harmful consequences of video game addiction, such as endangering physical and mental health [16–18], increasing aggressive behavior [19, 20], affecting academic performance [21, 22]. Hence, people are becoming more aware of the problems of excessive video games.

Regarding the impact of video games on adolescents' academic achievement, some studies have confirmed their positive effects, such as enhancing cognitive skills and relieving stress [23, 24], but the drawbacks are more obvious, as frequent video games tend to be negatively correlated with academic performance [21, 22, 25–28]. Adolescence is considered a critical and tumultuous period during which teenagers are establishing their identities and personalities and searching for meaning in their lives. As the famous psychologist Erikson stated, adolescents are exposed to the conflict between self-identity and role confusion [29]. The internet and video games are prone to have a distorting and alienating influence on adolescents whose personalities have not yet matured. Other studies also identified that students are considered to be the group most susceptible to encountering issues with internet usage [30, 31]. Adolescents, navigating unclear role identities and an evolving self-concept, may increasingly turn to internet activities for engagement, which can be accompanied by a declining interest in school life. When facing difficulties with self-control, they tend to overuse of the internet and social media and become addicted to the internet [32, 33]. These are important aspects that reduce students' concentration and affect their academic success. Therefore, the negative impact of the internet and video games on adolescents' academic achievement cannot be ignored.

Individuals, as the principal part, play an important role in the effect of video game playing on academic achievement among adolescents. A few studies have explored the pathways in which video games affect academic achievement, such as academic engagement [34, 35], and self-efficacy [36]. Drummond et al. pointed out that playing video games itself does not appear to affect academic performance, and research is more often needed to clarify the hypothesized theoretical frameworks that support potential mechanisms [37]. By taking a more detailed approach to understanding the effects of specific types of media and different engagement on more stratified groups, it is easier to ensure possible ways to influence learning. However, there is limited research on the intrinsic factors that shape the relationship between video games and academic achievement, particularly from the perspective of combining individuals and families. Thus, the focus of this study is how video game playing relates to adolescents' academic achievement. What are the roles of self-educational expectation and learning attitude at the individual level and parent-child relationship at the family level in this influence pathway? To address this research gap, this study focuses on a group of Chinese junior high school

students who play video games, examines the relationship between adolescents' video game playing, educational expectation, learning attitude, and academic achievement, and explores the role that parent-child relationship plays in these mechanisms.

## 2. Literature review and hypotheses development

### 2.1 Game playing and academic achievement

There have been two opposing views on the value judgment of video games. One side affirms video games, insisting that they have positive effects on people's lives, studies, and work. For example, Gee argued that video games allow individuals to discover social roles, understand social rules, recreate themselves, explore deeper learning styles, and improve comprehension and cognitive abilities [38, 39]. However, the other side takes the opposite stance, believing that video games are driven by commercial interests and adversely affect people's lives and work, such as making young people addicted to games, neglecting their studies, alienating interpersonal relationships, confusing values and even committing crimes. According to Herz, video games eat up our time, win our hearts, and change our minds, leaving the players in a state of "control" [40]. In other words, while video games give us pleasure, they also make us more controlled by the game, even for adolescents.

The findings on the association between video game playing and academic achievement are also divided, with the relationship depending on different ways in which adolescents access the internet. On the one hand, some evidence suggests that good puzzle video games help promote students' thinking skills and facilitates academic development [38, 39, 41, 42]. According to Willoughby, moderate internet use was related to a more positive academic orientation compared with both non use and high levels of use [43]. Nevertheless, on the other hand, the negative link between these two is well-recognized. Studies have shown that commercial electronic casual games cause unfavourable effects on adolescents' academic achievement [25, 44, 45]. Particularly, Adelantado-Renau et al. revealed that the negative effects of screen activities such as watching television and playing video games on adolescents appear to be more significant than those on children [26]. Moreover, other studies proved that longer video game time [27], and more severe problematic internet use, such as gaming addiction [21, 22, 46], were significantly associated with lower academic achievement. Thereby, frequent video game playing among adolescents is a risk factor for unfavorable academic achievement. Therefore, we proposed the following hypothesis:

Hypothesis 1: Video game playing is negatively related to adolescents' academic achievement.

### 2.2 Parallel mediation model

An increasing number of psychological theories are being used to explain human behavior, in which the role of self-processes is continually being emphasized since most external influences work through intermediary self-processing rather than directly affecting human functioning [47]. Currently, the social cognitive theory (SCT), developed by Bandura, stands as one of the most widely used theories for understanding changes in human behavior. Specifically, SCT argues that human behavior is shaped by the interplay of personal factors (e.g., cognitions, beliefs, and self-efficacy), environmental influences (e.g., others' behaviors and feedback), and behavioral change (e.g., past behavior, efforts, and persistence) [48]. This theory reveals that individual behavior is influenced not only by external environmental factors but also regulated by internal cognitive processes. Based on this, SCT proposes that human behavior is

purposefully goal-driven and regulated through a balance of control over internal cognitions and external influences [49].

As with other human behaviors, video game behavior is affected by a complex interaction of cognitive, environmental, and behavioral factors. It can be believed that Bandura's social cognitive theory provides a fruitful and broad framework for understanding adolescents' psychological and behavioral engagement in video games. Van Rooij et al. conducted a comprehensive review of existing popular theories based on children's multidimensional motives for starting, continuing, and stopping video game playing, noting that social cognitive theory is one of the theoretical approaches [50]. Prior research has illustrated that individual-level cognitive structures (e.g., expectancy and self-regulation) are widely recognized as being closely related to internet and gaming behaviors in studies of adolescent development in the digital age [51, 52]. For example, studies found that problematic video gaming and internet use has significant effects on self-esteem [53, 54], self-efficacy [55], and self-concept [56]. Furthermore, other evidence has confirmed that video gaming can influence a range of outcomes by acting on internal personal factors, such as well-being [57, 58], procrastination [59], and academic achievement [36].

A recent study suggested that the concept of self is becoming increasingly important for understanding the psychological mechanisms underlying problematic online games [60]. Buckley and Anderson believed that individuals can acquire a range of complex behaviors, attitudes, expectations, beliefs, and perceptual schemas through their observation and participation in video games [61]. This experience in virtual world probably has a significant impact on adolescents' cognitive development. Following the above mentioned social cognitive theory, personality systems typically cover elements such as values, expectations, beliefs, attitudes, and orientations of one's own and others. These dispositions are often viewed as factors that regulate an individual's behavior rather than as descriptions of habitual behavior [47]. What's more, researchers have noted that the major factors influencing an individual's behavior within a given domain are self-efficacy, outcome expectations, utility beliefs, and interests in the same and related domains [62, 63]. In this sense, self-educational expectation and learning attitude are important components of social cognition, and they can be reflected as a degree of engagement in learning. Given that both self-educational expectation and learning attitude are key predictors of adolescents' academic success, this study examines the simultaneous mediating roles of these two variables within the framework of social cognitive theory. This approach not only provides a more comprehensive picture of the factors that may influence adolescents' academic achievement but also allows for a deeper exploration of the internal mechanisms that shape the relationship between video game playing and academic achievement.

According to social cognitive theory, self-educational expectation, which refers to the realistic goals set by people based on their cognition and understanding of social functioning, is considered to be the most effective predictor of educational attainment [64, 65]. Prior studies have indicated that individuals' educational aspirations in the early academic years have a significant impact on both their future academic achievement and educational attainment, and it serves as a form of psychological energy that can drive young people to actively pursue academic success [66, 67]. The difference between the highly exciting gaming sessions and the real world with heavy academic pressure can easily cause a psychological gap in adolescents, and excessive internet use may bring about risks such as academic burnout and even school dropout [68, 69]. Furthermore, online games lead players to follow specific paths and to be "controlled" [40], which can easily erode their aspirational beliefs. In such circumstances, the most easily lost beliefs among middle school students are giving up diligent studying and lowering self-expectations.

In addition, attitudes are usually interpreted as positive or negative emotions and thoughts associated with specific social objects, which are the result of emotions, thoughts, and

behavioral tendencies due to previous experiences [70]. Attitudes, as a state of mental readiness and relatively enduring organization, are both a prerequisite and a consequence of behavior. Reacting positively to a situation with a positive attitude has a different impact on events and phenomena, as does reacting negatively to a situation with a negative attitude [71]. Previous empirical studies have shown that the extent of effort demonstrated by students in achieving learning goals, as a positive or negative learning attitude, is considered a predictive factor for their academic success [72–74]. In this context, we argue that adolescents, with different behavioral tendencies (e.g., playing video games), with different learning attitudes should differ in academic achievement. Therefore, we proposed the following hypotheses:

Hypothesis 2: Adolescents' self-educational expectation mediates the relationship between video game playing and academic achievement.

Hypothesis 3: Adolescents' learning attitude mediates the relationship between video game playing and academic achievement.

### 2.3 Parent-child relationship as a moderator

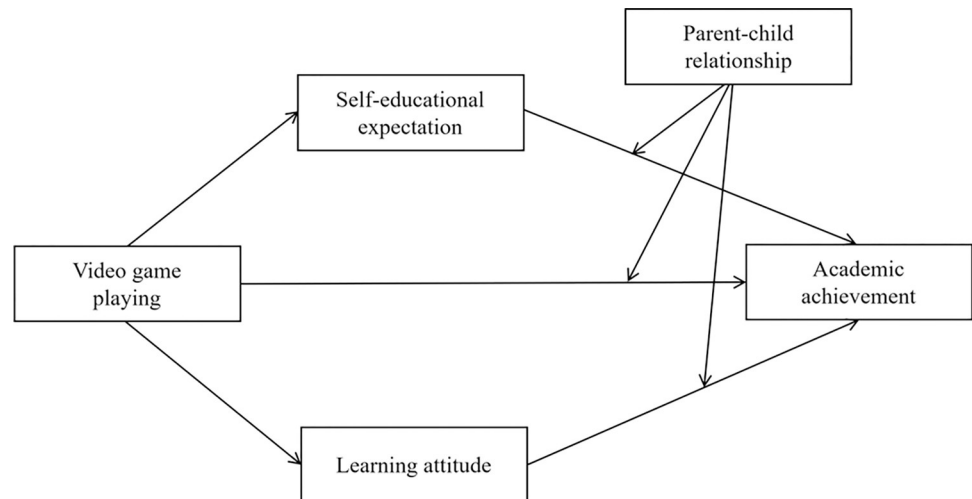
The family system, as a microsystem, plays an essential role in the growth of individuals. Aguilar-Yamuza et al. stated that the family serves as a key factor in preventing most internalizing problems during early childhood and adolescence [75]. Among the many factors of the family system, the parent-child relationship is an important one. It is the first interpersonal relationship that an individual perceives after birth, and the link between parent-child relationship and adolescent problem behavior is an important research topic in the field of developmental psychology [76, 77]. The parent-child relationship is usually defined as the relationship between a parent (primary caregivers, who can be a non-biological parent) and a child [78]. Moreover, the parent-child relationship is recognized as a foundational context for the formation of cyber literacy, which has a strong link to questionable internet use. Empirical research has supported the idea that adolescents who lack social relationships (e.g., parent-child relationships) are at a greater risk for problematic internet usage [79] and even internet addiction [80]. Hence, this study incorporated the parent-child relationship as a key factor.

Differences in the role of the parent-child relationship are also related to adolescents' intrinsic motivation to learn. Previous studies revealed that a high level of parent-child interaction increases the expectations of both parents and children and that the higher shared family expectations, in turn, increase children's achievement, while greater disparities in family expectations act as a disincentive [81]. That is, establishing a good parent-child relationship enables adolescents to feel love and respect from their parents and develop optimistic perceptions and expectations, which positively affects their physical and mental development and growth. Wang et al. also showed that family health is essential to a child's mental health [82]. Nevertheless, a negative parent-child relationship often results in adolescents developing adverse perceptions and experiences towards their surroundings, such as depression [83]. In this view, we can assume that the parent-child relationship plays a moderating role in the effects of video games on adolescents' academic achievement. Therefore, we proposed the following hypotheses:

Hypothesis 4: Parent-child relationship moderates the relationship between adolescent video game playing and academic achievement.

Hypothesis 5: Parent-child relationship moderates the mediating relationship of self-educational expectation between adolescent video game playing and academic achievement.

Hypothesis 6: Parent-child relationship moderates the mediating relationship of learning attitude between adolescent video game playing and academic achievement.



**Fig 1. Proposed hypothesized model.**

<https://doi.org/10.1371/journal.pone.0313405.g001>

According to the above hypotheses, the current study proposes the following research model (See Fig 1).

### 3. Research methods

#### 3.1 Participants

This study used follow-up data for 2014–2015 from the China Education Panel Survey (CEPS), conducted by the National Survey Research Center at Renmin University of China (NSRC). CEPS is the first nationwide and sustained large-scale tracking survey project that targets junior high school students in China. This project carried out the first round of baseline survey in 2013–2014, covering students in the first year of junior high school (Grade 7) and the third year of junior high school (Grade 9) at that time. This survey utilized a multi-stage probability-proportional-to-size sampling (PPS) method. With four stages of sampling, it selected 112 schools, 438 classes, and a total of 19,487 students across China for study, of which 10,279 were in Grade 7. Subsequently, students who were in Grade 7 in the 2013–2014 school year participated in a follow-up survey for the second round of data collection carried out in 2014–2015 (Grade 8 in this school year). The final sample of students successfully followed up was 9,449.

We then adjusted the sample according to the research goal of the present study. First of all, we obtained student demographic information, academic achievement for the 2013–2014 school year, and school information from the baseline survey results to supplement the data for the 2014–2015 school year. Next, considering that this study focuses on the influence of video game playing on adolescents' academic achievement, we excluded students who never go to net bars or video arcades where they play online games (In China, this is a place designed for engaging in online and video gaming, drawing players from both adolescents and adults.), remaining a sample of 1,184. After data matching and removing missing samples for key variables, our study finally included 824 participants.

#### 3.2 Measures

**3.2.1 Video game playing.** The adolescents' video game playing was measured by the question in the student-reported questionnaire of CEPS, namely "How often did you do the

following things in the past year? Going to net bars or video arcades". The original answers were categorized on a 5-point scale from 1 (never) to 5 (always). Since the present study did not include students who did not go to net bars or video arcades to play video games, we recorded the response to a 4-point scale where 1 = seldom, 2 = sometimes, 3 = often, and 4 = always.

**3.2.2 Self-educational expectation.** The adolescents' self-educational expectation was assessed using the question "What is the highest level of education you expect yourself to receive?" in the student-reported questionnaire of CEPS. To facilitate the subsequent analysis, we recorded the response as a 5-point scale where 1 = Junior high school, 2 = High school, 3 = Junior college, 4 = bachelor's degree, and 5 = Master's degree. A higher score means that the adolescent has a higher self-education expectation.

**3.2.3 Learning attitude.** The learning attitude was measured by three questions of the CEPS that described the level of adolescents' engagement and persistence in their studies. Adolescents were asked about the extent to which they agreed with the statements below: "I would try my best to go to school even if I was not feeling very well or I had other reasons to stay at home", "I would try my best to finish even the homework I dislike", and "I would try my best to finish my homework, even if it would take me quite a long time". Each item was measured with a 4-point scale ranging from "1 = strongly disagree" to "4 = strongly agree". Following Eisinga et al. [84], we calculated Spearman-Brown reliability estimates, which are more applicable to the two-to three-item scales. The Spearman-Brown reliability coefficient for learning attitude was 0.800, showing good reliability. The average score of these three items was calculated to reflect the adolescents' learning attitude. A higher score indicates a higher level of learning attitude.

**3.2.4 Parent-child relationship.** The parent-child relationship was assessed by two questions in the student-reported questionnaire of CEPS to reflect the relationship between adolescents and their father and mother, respectively. Adolescents were asked regarding their agreement with the following statements: "How is the general relationship between you and your father?" and "How is the general relationship between you and your mother?" Each answer was followed by a 3-point scale ranging from "1 = Not close" to "3 = Very close". This scale had a relatively high reliability with a Spearman-Brown reliability coefficient = 0.666. An average score was calculated for these two items, with the higher score suggesting a better parent-child relationship.

**3.2.5 Academic achievement.** The adolescents' academic achievement was their performance during the 2014–2015 school year, which is measured by the 2015 midterm exam scores in Chinese, Math, and English provided in CEPS. The Spearman-Brown reliability coefficient for this scale was 0.837, showing satisfactory internal reliability. We added up the scores of these three items as a specific measure of adolescents' academic achievement, with a higher score representing a high level of academic achievement.

**3.2.6 Control variables.** Since adolescents' academic achievement is influenced by factors at multiple levels, this study included individual, family, and school characteristics as control variables. Individual characteristics controlled the adolescent gender, only-child, score in Grade 7. Family characteristics controlled the family's economic status, father's educational level, and mother's educational level. School characteristics controlled the region, ranking, type, and location of the school.

### 3.3 Statistical analyses

This study processed the collected data using SPSS 26.0. Altogether, data was analyzed in three steps. The first step was to perform descriptive statistics (including mean and standard

deviation of the main variables) and correlation analysis. To examine the mediators of self-expectation and learning attitude and the moderator of parent-child relationship, the second step was to conduct parallel mediation analysis and moderated mediation analysis using the PROCESS macro v4.1 for SPSS. This not only tested whether the mediator variables could link the predictor variable (video game playing) to the outcome (academic achievement), but also assessed whether the direct and indirect effects varied by the moderator variable [85]. Finally, all mediated and moderated effects were tested using the Bootstrap method, with a setting of 5,000 bootstrap samples and 95% bias-corrected confidence intervals. If zero is not in the 95% CI, it means statistical significance [86]. In addition, simple slope plots were employed to draw the functions of different parent-child relationships [87].

## 4. Results

### 4.1 Preliminary analyses

Table 1 provides the descriptive statistics and Pearson correlation matrix for the variables of video game playing, self-educational expectation, learning attitude, parent-child relationship, and academic achievement. The results showed that the correlation coefficients between all the key variables were significant, except between parent-child relationship and academic achievement. Specifically, adolescent video game playing was negatively correlated with self-educational expectation ( $r = -0.119$ ,  $p < 0.01$ ), learning attitude ( $r = -0.205$ ,  $p < 0.001$ ), parent-child relationship ( $r = -0.116$ ,  $p < 0.01$ ), and academic achievement ( $r = -0.152$ ,  $p < 0.001$ ). Self-educational expectation was positively associated with learning attitude ( $r = 0.275$ ,  $p < 0.001$ ), parent-child relationship ( $r = 0.078$ ,  $p < 0.05$ ), and academic achievement ( $r = 0.484$ ,  $p < 0.001$ ). In addition, learning attitude was positively correlated with both parent-child relationship ( $r = 0.157$ ,  $p < 0.001$ ) and academic achievement ( $r = 0.254$ ,  $p < 0.001$ ). However, parent-child relationship was not significantly correlated with academic achievement ( $r = 0.033$ ,  $p > 0.05$ ).

### 4.2 Test for the parallel mediation effect

Table 2 presents the results of the mediating and moderating effects. First, Model 1 tested the total effect of adolescents' video game playing on academic achievement. Second, Model 2 and Model 3 examined the effects of adolescents' video game playing on self-educational expectation and learning attitude respectively. Third, Model 4 in the PROCESS macro was used to develop Model 4 (in Table 2) to examine whether there was a direct effect of the two mediating

**Table 1. Descriptive statistics and correlation matrix of key variables.**

Variables	M	SD	Video game playing	Self-educational expectation	Learning attitude	Parent-child relationship	Academic achievement
Video game playing	1.561	0.881	1				
Self-educational expectation	3.075	1.228	-0.119**	1			
Learning attitude	2.767	0.768	-0.205***	0.275***	1		
Parent-child relationship	2.511	0.495	-0.116**	0.078*	0.157***	1	
Academic achievement	187.992	71.465	-0.152***	0.484***	0.254***	0.033	1

Note

\* p-value < 0.05

\*\* p-value < 0.01

\*\*\* p-value < 0.001.

<https://doi.org/10.1371/journal.pone.0313405.t001>



Table 2. Conditional process analyses.

Variables	Model 1 AA		Model 2 SEE		Model 3 LA		Model 4 AA		Model 5 AA	
	$\beta$	t	$\beta$	t	$\beta$	t	$\beta$	t	$\beta$	t
Grade 7 score	0.645	25.055***	0.363	11.470***	0.179	5.221***	0.553	20.794***	0.547	20.466***
Gender	0.004	0.148	0.054	1.893	0.037	1.081	-0.011	-0.435	-0.012	-0.474
Only-child	0.100	3.684***	0.036	1.022	0.046	1.261	0.089	3.426***	0.091	3.492**
Economic status	0.009	0.353	-0.073	-2.229*	-0.052	-1.484	0.029	1.146	0.029	1.128
Father's education	0.046	1.404	0.159	3.951***	0.071	1.624	0.006	0.192	0.009	0.291
Mother's education	0.032	0.940	0.015	0.724	-0.069	-1.521	0.034	1.044	0.035	1.090
School region	-0.179	-6.823***	-0.068	-2.105*	-0.056	-1.592	-0.160	-6.376***	-0.165	-6.578***
School ranking	0.133	5.080***	0.174	5.389***	-0.017	0.477	0.097	3.792***	0.090	3.508**
School type	-0.062	-2.333*	-0.034	-1.036	0.066	1.853	-0.060	-2.342*	-0.052	-2.011*
School Location	0.029	1.055	0.065	1.902	-0.005	-0.122	0.016	0.585	0.012	0.457
VGP	-0.096	-3.609***	-0.094	-2.992**	-0.201	-4.000***	-0.061	-2.440*	-0.065	-2.604**
SEE							0.217	7.799***	0.219	7.833***
LA							0.075	2.914**	0.082	3.171**
PCR									-0.024	-0.964
VGP*PCR									-0.050	-2.051*
SEE*PCR									0.055	2.118*
LA*PCR									-0.026	-0.999
R <sup>2</sup>	0.489		0.227		0.093		0.537		0.542	
F	64.666***		19.825***		6.896***		66.881***		52.919***	

## Note

\* p-value &lt; 0.05

\*\* p-value &lt; 0.01

\*\*\* p-value &lt; 0.001.

**Abbreviations:** AA = Academic achievement, VGP = Video game playing, SEE = Self-educational expectation, LA = Learning attitude, PCR = Parent-child relationship.<https://doi.org/10.1371/journal.pone.0313405.t002>

variables (self-educational expectation and learning attitude) on academic achievement as well as to confirm whether there was a direct effect of video game playing on academic achievement. At this point, the mediating effect test was completed. Finally, Model 15 in PROCESS macro was used to develop Model 5 to determine whether the moderating effect of the parent-child relationship was significant.

In Hypothesis 1, we assumed that video game playing would negatively affect the academic achievement of adolescents. According to Model 1 (Table 2), academic achievement was significantly predicted by video game playing ( $\beta = -0.096$ ,  $p < 0.001$ ). Meanwhile, the results of Model 4 with mediating variables reconfirmed this negative relationship. Therefore, Hypothesis 1 was supported.

Hypothesis 2 predicted that self-educational expectation would mediate the effect of video game playing on academic achievement. According to Models 2 and 4 (Table 2), video game playing negatively related to self-educational expectation ( $\beta = -0.094$ ,  $p < 0.01$ ), and self-educational expectation positively predicted academic achievement ( $\beta = 0.217$ ,  $p < 0.001$ ). The results of bootstrap in Table 3 indicate that through self-educational expectation, the indirect effect of video game playing on academic achievement was significant and negative ( $\beta = -0.020$ ,  $p < 0.01$ , 95%CI = [-0.037, -0.006]). Therefore, Hypothesis 2 was supported.

Hypothesis 3 predicted that learning attitude would mediate the effect of video game playing on academic achievement. As can be seen in Models 3 and 4 (Table 2), video game playing negatively correlated with learning attitude ( $\beta = -0.201$ ,  $p < 0.001$ ), and learning attitude

Table 3. Testing the pathways of the parallel mediation model.

Path	Effect value	Relative effect quantity	Bootstrap (95%CI)
Video game playing → Self-educational expectation → Academic achievement	$-0.094 \times 0.217 = -0.020$	20.83%	[-0.037, -0.006]
Video game playing → Learning attitude → Academic achievement	$-0.201 \times 0.075 = -0.015$	15.63%	[-0.027, -0.005]
Total mediation effect	-0.035	36.46%	[-0.056, -0.017]
Direct effect	-0.061	63.54%	-

<https://doi.org/10.1371/journal.pone.0313405.t003>

positively predicted academic achievement ( $\beta = 0.075, p < 0.01$ ). Combined with the bootstrap results in Table 3, it can be seen that through learning attitude, the indirect effect of video game playing on academic achievement was significant and negative ( $\beta = -0.015, p < 0.01, 95\%CI = [-0.027, -0.005]$ ). Therefore, Hypothesis 3 was supported. In addition, the total mediation effect (-0.035) accounted for 36.46% of the total effect (-0.096).

### 4.3 Test for the moderated mediation effect

Hypothesis 4, Hypothesis 5, and Hypothesis 6 predicted that parent-child relationship would moderate the direct and indirect effect of video game playing on adolescent academic achievement. In Hypothesis 4, we assumed that the parent-child relationship would moderate the direct association between video game playing and academic achievement. As is demonstrated in Model 5 (Table 2), the interaction term between video game playing and parent-child relationship had a significant impact on academic achievement ( $\beta = -0.050, p < 0.05$ ). It means that the parent-child relationship enhanced the negative relationship between video game playing and academic achievement. Therefore, Hypothesis 4 was supported. To further describe the nature of the supported moderation, we plotted predicted academic achievement against video game playing separately for different levels of parent-child relationship. The results are shown in Fig 2. It is evident that among adolescents with high parent-child relationship, there was a somewhat strong correlation between video game playing and academic achievement ( $b = -9.227, p < 0.01$ ), but not for adolescents with low parent-child relationship ( $b = -1.735, p = 0.502 > 0.05$ ).

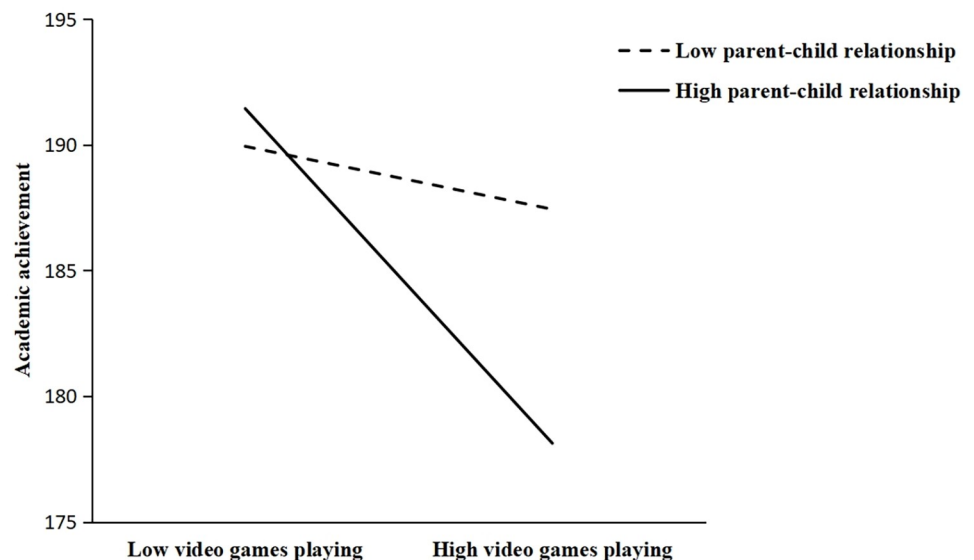


Fig 2. Parent-child relationship as a moderator between video game playing and academic achievement.

<https://doi.org/10.1371/journal.pone.0313405.g002>



**Fig 3. Parent-child relationship as a moderator between self-educational expectation and academic achievement.**

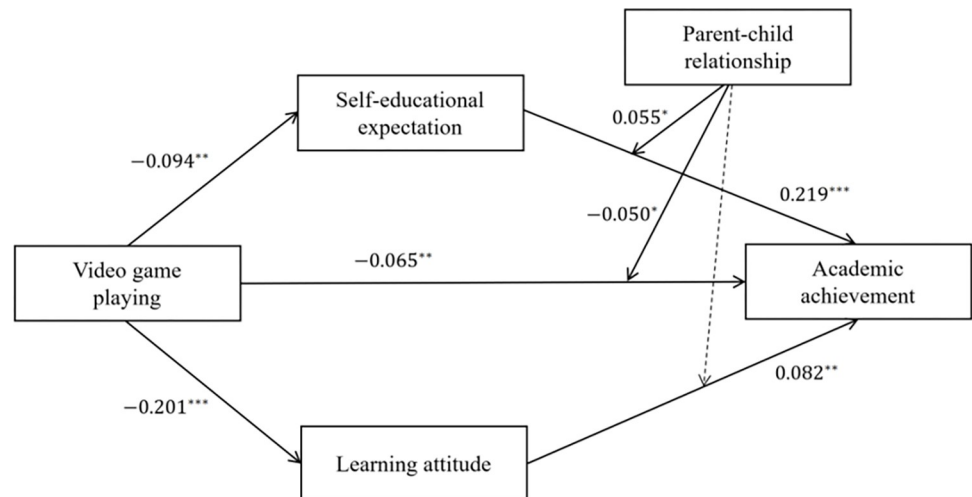
<https://doi.org/10.1371/journal.pone.0313405.g003>

In Hypothesis 5, the current study expected that the indirect relation between video game playing and academic achievement via self-educational expectation was moderated by the parent-child relationship. The results of Model 5 (Table 2) show that there was a significant interaction between parent-child relationship and self-educational expectation in predicting academic achievement ( $\beta = 0.055$ ,  $p < 0.05$ ), which means that parent-child relationship played a positive moderating role in the impact of self-educational expectation on academic achievement. The bootstrap results further indicated that there was a stronger indirect relation between video game playing and academic achievement for adolescents with high-quality parent-child relationship ( $b = -2.091$ , 95%CI = [-3.802, -0.570]), and this indirect relation became weaker for those with low-level parent-child relationship ( $b = -1.283$ , 95%CI = [-2.506, -0.312]). Therefore, Hypothesis 5 was supported. For descriptive purposes, we graphed a simple slope plot, see Fig 3.

In Hypothesis 6, we expected that the indirect relation between video game playing and academic achievement via learning attitude was moderated by parent-child relationship. As is depicted in Model 5 (Table 2), the interaction term of learning attitude and parent-child relationship had a non-significant impact on academic achievement ( $\beta = -0.026$ ,  $p = 0.318 > 0.05$ ). Therefore, Hypothesis 6 was not supported. The overall model accounted for 54.20% of the variance in adolescent academic achievement. Furthermore, the moderated mediation model among the main variables is shown in Fig 4.

## 5. Discussion

Based on the social cognitive theory, this study explored the direct and indirect impacts of video game playing on academic achievement using a representative dataset from CEPS. The findings showed that video game playing is a significant but modest predictor of academic achievement among Chinese adolescents. To evaluate the poorly defined mechanisms by which video game playing predicts academic achievement, two mediators of self-educational expectation and learning attitude were considered and the moderating role of parent-child relationship was also explored. By showing parallel mediation impacts of learning attitude and



**Fig 4. Moderated-mediation model.** Note: \*p-value<0.05, \*\*p-value< 0.01, \*\*\* p-value<0.001.

<https://doi.org/10.1371/journal.pone.0313405.g004>

self-educational expectation, together with the moderating influence of parent-child relationship, our findings generally supported research hypotheses.

### 5.1 Relationship between video game playing and academic achievement

Our study first revealed that video game playing is a factor worth considering when predicting academic achievement among Chinese adolescents, although its effect size is not very strong. Specifically, the higher the degree of Chinese adolescents' video game playing, the less likely they are to achieve good academic achievement. This is consistent with the previous empirical studies in different countries [25–27, 44]. The impact of video games on academic achievement is not absolute, and moderate recreation has certain positive effects on young people. However, if adolescents frequently visit internet cafes to play video games, they could end up spending more time there than is appropriate, which would interfere with their ability to balance study and relaxation. Due to the heavy academic load of adolescents, if they devote a lot of time to video games [27], or even suffer from game addiction [22, 28], it could lead to lower academic achievement. Moreover, with the rapid development of internet technology and smart devices, it has become more and more convenient for adolescents to play video games, and it is even common for families to have good access to the internet. Therefore, the negative impact of excessive video games on adolescents' academic achievement deserves more attention in various countries, including China.

### 5.2 Parallel mediating role of self-educational expectation and learning attitude

Our results revealed that the parallel mediation of self-educational expectation and learning attitude in the association between video game playing and academic achievement was statistically significant. Numerous studies have been conducted to explore the impact of the internet and video games on students' academic achievement, but the mechanism underlying this effect has received less attention. As the social cognitive theory mentioned above emphasizes that external factors influence individual behavior by acting on self-processes [63], the findings of this study respond to this view and supplement a new perspective. Both self-educational expectation and learning attitude are a reflection of an individual self-perception process.

Adolescents who are immersed in video games may experience a gradual decline in their enthusiasm for learning, which can undermine their academic expectations and motivation, ultimately negatively impacting their academic achievement. This is in line with Zhang et al.'s study that internet addiction reduces student engagement in learning, increases dissatisfaction with learning activities, and thus lowers academic achievement [35]. Specifically, several factors related to video games may contribute to the sustained damaging consequences on academic achievement. For instance, adolescents who are addicted to video games gradually lose control over their internet use, thereby reducing the time and energy they devote to their studies [27, 88]. Teenagers with high levels of internet addiction can easily experience negative emotions, such as moodiness, anger, anxiety, and sadness, which make them feel bored and withdrawn from the world outside the internet [89]. Moreover, the immersive environment of online games may sometimes lead adolescents to passively engaging with the virtual world, potentially impacting their autonomy and decision-making skills [19, 40]. All of these ultimately make it difficult for adolescents to focus on study, which in turn may cause a decline in their academic achievement. To address these challenges, parents work with teachers to help adolescents find a balance between video games and academics, and encourage them to actively participate in academic and real-life activities, which will be conducive to fostering their self-awareness and promoting their all-round development [90].

Furthermore, the results showed that the mediating effect of self-educational expectation accounted for a greater proportion than learning attitude. This implies that adolescents' video game playing in particular affects academic achievement by influencing their educational expectations. It can be explained by a psychological difference. Lim and Reeves pointed out that online game worlds typically contain elements such as quests, rankings, incentives, and upgrades [91]. Each action is accompanied by immediate feedback like rewards or punishments, which results in a straightforward but effective psychological control mechanism that makes it possible for the players to enjoy themselves. In contrast, adolescents may put in months of intense learning before they can gain a sense of accomplishment on an exam. The instant gratification provided by such games contrasts sharply with the relatively long payback period of the learning process. As this psychological discrepancy grows, adolescents develop a sense of aversion to learning and lower expectations for education. In addition, adolescents' self-educational expectation, as the main motivation for self-worth realization and thinking ability innovation, is a more permanent and long-term goal setting, and its influence on academic development is more persistent. However, learning attitude, on the other hand, is more inclined to current and short-term tasks, and it is more susceptible to changes in the external environment and tasks, thus its impact on academic achievement is likely to be relatively short-lived. Therefore, we introduced two mediating variables from individual perspectives, especially self-educational expectation, to make the findings more thought-provoking.

### 5.3 Moderating role of parent-child relationship

The present study indicated that parent-child relationship plays a slightly moderating role in the influence of video games on adolescents' academic achievement, whether directly or indirectly. In particular, the parent-child relationship moderated the direct association between video game playing and academic achievement, as well as the indirect association between video game playing and academic achievement via the mediator of self-educational expectation. However, the relationship of video games affecting academic achievement through learning attitude did not differ across parent-child relationship levels. The results highlight that the relationships and interactions between parents and children are important emotional regulators in children's development [92, 93]. Overall, compared with a low parent-child

relationship, the video game playing of adolescents with a high parent-child relationship has a greater impact on academic achievement.

First of all, our findings revealed that the association between video game playing and academic achievement was significant for adolescents with a high level of parent-child relationship, while it was not significant among the low-level parent-child relationship group. This study yielded a different finding that adolescents with high levels of parent-child relationships performed the worst academically when playing video games frequently. A possible explanation is that positive parent-child relationships may lead parents to adopting a more relaxed parenting style, viewing gaming as a shared activity and giving adolescents greater freedom to play video games, rather than strictly limiting their gaming time [94]. Previous literature has confirmed that parents' positive attitudes toward media use is positively correlated with adolescents' internet use and gaming playing [78, 95]. In a close parent-child relationship, the relaxed regulation of gaming by parents may provide adolescents with greater freedom, potentially resulting in excessive gaming that negatively affects their academic achievement. In contrast, parental interference with adolescent autonomy and excessive control is often linked to poor parent-child relationships (e.g., parent-child conflict) [96]. In accord with this, parents may impose stricter rules on video game use to manage their children's behavior, which could weaken the relationship between video games and adolescents' academic achievement. This inspires us to include parenting styles and parental supervision in future studies when exploring the impact of video games on academic achievement.

Moreover, the results further confirmed that parent-child relationship modestly moderated the association between video game playing and academic achievement through self-educational expectation. For adolescents with a better parent-child relationship, this indirect link was greater than for the low parent-child relationship group. That is, the positive effect of adolescents' self-educational expectation on academic achievement is strengthened by the improvement of the parent-child relationship. Adolescence is a crucial period for a person to create identity and develop values [29]. Aligning with the attachment theory, a positive parent-child relationship can fulfill the needs of adolescents and thus facilitate the formation of positive representations of themselves and the environment [97]. In families characterized by low-quality parent-child relationships, children may suffer more negative emotions (e.g., depression) and exhibit adverse social adaptation. These factors are harmful to the development of children's educational expectations. Meanwhile, parental educational aspirations have been identified as a key factor influencing children's educational aspirations [98]. With poorer parent-child relationships, parents are likely to exhibit low expectations of the value and importance of education, thereby lowering children's expectations. On the contrary, good parent-child relationships can minimize the detrimental effects of video games on academic achievement by giving teenagers a safe space where their basic psychological needs can be satisfied. This helps them build positive goals and expectations. Therefore, the role of the parent-child relationship should be taken into account. Nevertheless, the current study indicated that no support was shown for the moderation of parent-child relationship in the association between video game playing and academic achievement through learning attitude. One explanation may be that the physiological and psychological changes that occur during adolescence, together with the intricate social environment, continuously enhance adolescents' autonomy [29]. Hence, the influence of families in shaping learning attitudes becomes more complex. Previous research suggested that family, school, peers, and even neighbors are all significant factors in influencing adolescents' internet use [99]. It implies that adolescents' attitudes toward academics are also susceptible to such multiple external factors, and thus the parent-child relationship may show relatively limited effects in enhancing children's learning attitude. This inspires us to think more about the important role of parent-child relationship in the

deep cognitive level of adolescent self-educational expectation in future research on adolescent video games and even internet use.

## 6. Limitations and implications

To summarize, the current study has the following limitations. First, this study was a cross-sectional design using the data from the survey conducted by CEPS in 2014–2015, thereby constraining our ability to make causal inferences about the findings. A longitudinal study should be adopted in future research to delve deeper into causal relationships and provide a more comprehensive assessment of the impact of video games on adolescents' academic achievement, as well as to elucidate the underlying mechanisms. Second, the data of this study is secondhand data, some of the variables were measured through relatively limited items. Thus, future measures of video game playing could be more quantified in a measurable way like how many times a week or how many hours a week to avoid subjective bias. Future research could improve measurement accuracy by employing more comprehensive scales, such as the parent-child relationship inventory (PCRI) [100]. Moreover, with the rapid development of internet technology, video games are no longer limited to traditional internet cafes and are now easily accessible on various mobile devices that can be used conveniently at home. Therefore, future studies should use the most up-to-date data to measure video game playing among adolescents, and may even go further to differentiate the specific effects of video games and other internet use, such as smartphones [101, 102], on academic achievement. Third, CEPS used a self-report questionnaire to measure students' video game playing, learning attitude, self-educational expectations, and parent-child relationship, which may cause response biases. Thus, future studies should use more objective data collection methods to enhance the validity and reliability of the findings. Additionally, it is important to gather information from adolescents, parents, and teachers for a more thorough evaluation of these variables. Fourth, the sample of this study was limited to junior high school students in the teenage group, but adolescents from different age and grade groups exhibit distinct developmental stages and are exposed to extremely different peer groups and educational contexts. Therefore, future research should include adolescents from different sub-groups to further test the reliability and applicability of the findings of this study. Finally, although this study explored the mechanisms of video game influence on adolescents' academic achievement from the perspective of students' self-perception and parent-child relationship, there are still some unmeasured potential confounding variables that may affect the interpretation of the results. For example, parenting style and parent-child communication quality at the family level [103–105], peer relationships and school climate at the social support level [106–108], and individual characteristics like gender difference, self-control [109–111], have been proven to be significantly associated with children's video game use and academic achievement. Therefore, future studies need to further explore and identify additional potential factors, including family environment, social support, individual psychological characteristics. By integrating these factors to reveal more comprehensively the mechanisms affecting adolescents' academic achievement, the understanding in this area can be enriched and deepened.

Despite these limitations, the findings of the present study provide several theoretical and practical implications for future studies to explore the relationship between adolescent video game playing (even internet use) and academic success. Theoretically, the moderated mediation model proposed by this study, based on social cognitive theory, provides a possible theoretical framework for future research to explore the direct and indirect relationships between video game playing and adolescents' academic achievement. Although previous studies have also explored individual and family factors in the relationship between video games and

academic achievement in the West [4, 37, 44, 112], the current study extended the literature by indicating the mediating role of individual factors (e.g., self-educational expectation and learning attitude) and the moderating role of family factors (e.g., parent-child relationship) in one model based on research in China. In Western countries, child-rearing may place greater emphasis on independence and personal choice, while in East Asian cultures, family expectations and social pressures can have a more significant impact on children's educational pursuits [113, 114]. From this perspective, this study enriches current knowledge by providing robust evidence from a national sample of Chinese adolescents. Moreover, it suggests a theoretical perspective for exploration of the interaction between family, individual, and social factors, as well as valuable insights for future comparative research in different contexts.

In terms of practical implications, a major implication of this study is that key stakeholders (e.g., parents, teachers, and policymakers) should provide balanced guidance on video game use, while fostering positive family relationships to support adolescents' educational expectation and learning attitude, ultimately mitigating the negative impact of excessive gaming on academic achievement. Specifically, our findings revealed that adolescent self-educational expectation and learning attitude were mediating factors of video game playing to reduce academic achievement. Adolescence is a crucial developmental stage during which individuals begin to establish their values and worldviews. This period is characterized by heightened vulnerability due to potential disconnections among the developing brain, behavioral patterns, and cognitive systems [115]. As a result, adolescents become particularly sensitive to external influences, which can significantly impact their development and overall well-being. Thus, the effects of excessive video games on adolescents' academic achievement and even personal development are not only immediate, but also subconsciously eliminate their correct perceptions of academic pursuits. It reminds parents and teachers to attach importance to the potential long-term effects of video games on the cognition of adolescents. Educators could offer courses on time management and self-regulation training to help students cultivate a positive learning attitude and self-educational expectations, effectively guiding them in balancing their study and recreation. In addition, this study found that the parent-child relationship moderated the influence of adolescents' video game playing on academic achievement to some extent, including both the direct effect and the indirect effect through self-educational expectation. Previous studies have demonstrated the effectiveness of a good parent-child relationship in preventing internet addiction [116], but parents may face the challenge of encouraging their children to utilize online resources fully while protecting them from harmful content [117]. Our findings further suggest that educators and parents should focus on fostering a supportive parent-child relationship, combined with reasonable supervision. A positive self-educational expectation of adolescents can be fostered by providing family guidance and assisting children to strike a good balance between recreational activities and academics.

## 7. Conclusions

Considering the significance of individual traits, this study aimed to clarify the possible mechanisms by which video game playing influences adolescents' academic achievement from the perspective of social cognitive theory. By analyzing data from a comprehensive survey in China, the study took an important step in exploring the roles of self-educational expectation, learning attitude, and parent-child relationship and provided valuable insights regarding preventing the adverse effects of excessive gaming on adolescents' academics. The results revealed that self-educational expectation and learning attitude play a parallel mediating role in the association between video game playing and academic achievement. Moreover, parent-child relationship moderated the direct effect of video game playing on academic achievement and



the indirect effect of video game playing on academic achievement via self-educational expectation. While the moderating role of parent-child relationship in the association between learning attitude and academic achievement was not significant. This study highlights the importance of fostering accurate academic perceptions and positive attitudes in adolescents to enhance their academic achievement. Further, guidance provided by various stakeholders to strengthen parent-child relationships is also needed to benefit the academics of adolescents.

## Author Contributions

**Conceptualization:** Xiaoxia Gu, Norlizabeth Che Hassan.

**Data curation:** Xiaoxia Gu.

**Formal analysis:** Xiaoxia Gu.

**Investigation:** Xiaoxia Gu.

**Methodology:** Xiaoxia Gu, Norlizabeth Che Hassan.

**Software:** Xiaoxia Gu.

**Supervision:** Xiaoxia Gu, Norlizabeth Che Hassan, Tajularipin Sulaiman.

**Writing – original draft:** Xiaoxia Gu.

**Writing – review & editing:** Xiaoxia Gu, Norlizabeth Che Hassan, Tajularipin Sulaiman, Zhixia Wei, Jingyi Dong.

## References

1. Anderson J, Rainie L. Millennials will benefit and suffer due to their hyperconnected lives. Pew Research Center; 2012 Feb. Available from: <http://www.pewinternet.org/2012/02/29/millennials-will-benefit-and-suffer-due-to-their-hyperconnected-lives/>
2. Liao Z, Huang Q, Huang S, Tan L, Shao T, Fang T, et al. Prevalence of internet gaming disorder and its association with personality traits and gaming characteristics among Chinese adolescent gamers. *Front Psychiatry*. 2020; 11:598585. <https://doi.org/10.3389/fpsy.2020.598585> PMID: 33312143
3. Wittek CT, Finseràs TR, Pallesen S, Mentzoni RA, Hanss D, Griffiths MD, et al. Prevalence and Predictors of Video Game Addiction: A Study Based on a National Representative Sample of Gamers. *Int J Ment Health Addict*. 2016; 14(5):672–686. <https://doi.org/10.1007/s11469-015-9592-8> PMID: 27688739
4. Rehbein F, Psych G, Kleimann M, Mediasci G, Mößle T. Prevalence and Risk Factors of Video Game Dependency in Adolescence: Results of a German Nationwide Survey. *Cyberpsychol Behav Soc Netw*. 2010; 13(3):269–277. <https://doi.org/10.1089/cyber.2009.0227> PMID: 20557246
5. Griffiths MD, Hunt N. Computer game playing in adolescence: Prevalence and demographic indicators. *J Community Appl Soc Psychol*. 1995; 5(3):189–193. <https://doi.org/10.1002/casp.2450050307>
6. Colder Carras M, Van Rooij AJ, Van de Mheen D, Musci R, Xue QL, Mendelson T. Video gaming in a hyperconnected world: A cross-sectional study of heavy gaming, problematic gaming symptoms, and online socializing in adolescents. *Comput Human Behav*. 2017; 68:472–479. <https://doi.org/10.1016/j.chb.2016.11.060> PMID: 28260834
7. China Internet Network Information Center. diwushierci zhongguo hulian wangluo fazhan zhuangkuang tongji baogao [The 52nd Statistical Report on the Development of the Internet in China]. <https://www.cnnic.net.cn/n4/2023/0828/c88-10829.html>. 2023.
8. Central Committee of the Communist Youth League, China Internet Network Information Center. diwuci quanguo weichengnainren hulianwang shiyong qingkuang diaocha baogao [Report on the 5th National Survey on Internet Usage by Minors]. <https://www.cnnic.net.cn/n4/2023/1225/c116-10908.html>. 2023.
9. Gentile D. Pathological video-game use among youth ages 8 to 18: A national study. *Psychol Sci*. 2009; 20(5):594–602. <https://doi.org/10.1111/j.1467-9280.2009.02340.x> PMID: 19476590

10. Wang CW, Chan CL, Mak KK, Ho SY, Wong PW, Ho RT. Prevalence and correlates of video and internet gaming addiction among Hong Kong adolescents: A pilot study. *The Scientific World Journal*. 2014; 2014:1–9. <https://doi.org/10.1155/2014/874648> PMID: 25032242
11. Milani L, La Torre G, Fiore M, Grumi S, Gentile DA, Ferrante M, et al. Internet gaming addiction in adolescence: Risk factors and maladjustment correlates. *Int J Ment Health Addict*. 2018; 16(4):888–904. <https://doi.org/10.1007/s11469-017-9750-2>
12. Saquib N, Saquib J, Wahid A, Ahmed AA, Dhuhayr HE, Zaghoul MS, et al. Video game addiction and psychological distress among expatriate adolescents in Saudi Arabia. *Addictive Behaviors Reports*. 2017; 6:112–117. <https://doi.org/10.1016/j.abrep.2017.09.003> PMID: 29450245
13. Strittmatter E, Parzer P, Brunner R, Fischer G, Durkee T, Carli V, et al. A 2-year longitudinal study of prospective predictors of pathological Internet use in adolescents. *Eur Child Adolesc Psychiatry*. 2016; 25(7):725–734. <https://doi.org/10.1007/s00787-015-0779-0> PMID: 26526444
14. Liu Y, Gong R, Yu Y, Xu C, Yu X, Chang R, et al. Longitudinal predictors for incidence of internet gaming disorder among adolescents: The roles of time spent on gaming and depressive symptoms. *J Adolesc*. 2021; 92(1):1–9. <https://doi.org/10.1016/j.adolescence.2021.06.008> PMID: 34246122
15. Stevens MW, Dorstyn D, Delfabbro PH, King DL. Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian & New Zealand Journal of Psychiatry*. 2021; 55(6):553–568. <https://doi.org/10.1177/0004867420962851> PMID: 33028074
16. Lam LT, Peng ZW. Effect of pathological use of the internet on adolescent mental health: A prospective study. *Arch Pediatr Adolesc Med*. 2010; 164(10):901–906. <https://doi.org/10.1001/archpediatrics.2010.159> PMID: 20679157
17. Veisani Y, Jalilian Z, Mohamadian F. Relationship between internet addiction and mental health in adolescents. *J Educ Health Promot*. 2020; 9:303. [https://doi.org/10.4103/jehp.jehp\\_362\\_20](https://doi.org/10.4103/jehp.jehp_362_20) PMID: 33426107
18. Lobel A, Engels RC, Stone LL, Burk WJ, Granic I. Video gaming and children's psychosocial wellbeing: A longitudinal study. *J Youth Adolesc*. 2017; 46(4):884–897. <https://doi.org/10.1007/s10964-017-0646-z> PMID: 28224404
19. Ko CH, Yen JY, Liu SC, Huang CF, Yen CF. The associations between aggressive behaviors and Internet addiction and online activities in adolescents. *Journal of Adolescent Health*. 2009; 44(6):598–605. <https://doi.org/10.1016/j.jadohealth.2008.11.011> PMID: 19465325
20. Sun Y, Sun M. How peer influence mediates the effects of video games playing on adolescents' aggressive behavior. *Child Youth Serv Rev*. 2021; 130:106225. <https://doi.org/10.1016/j.childyouth.2021.106225>
21. Jiang Q. Internet addiction among young people in China: Internet connectedness, online gaming, and academic performance decrement. *Internet Research*. 2014; 24(1):2–20. <https://doi.org/10.1108/IntR-01-2013-0004>
22. Islam MI, Biswas RK, Khanam R. Effect of internet use and electronic game-play on academic performance of Australian children. *Sci Rep*. 2020; 10(1):21727. <https://doi.org/10.1038/s41598-020-78916-9> PMID: 33303948
23. Blumberg FC, Altschuler EA, Almonte DE, Mileaf MI. The impact of recreational video game play on children's and adolescents' cognition. *New Dir Child Adolesc Dev*. 2013; 2013(139):41–50. <https://doi.org/10.1002/cad.20030> PMID: 23483692
24. Granic I, Lobel A, Engels RC. The benefits of playing video games. *American Psychologist*. 2014; 69(1):66–78. <https://doi.org/10.1037/a0034857> PMID: 24295515
25. Boxer P, Groves CL, Docherty M. Video games do indeed influence children and adolescents' aggression, prosocial behavior, and academic performance: A clearer reading of Ferguson (2015). *Perspectives on Psychological Science*. 2015; 10(5):671–673. <https://doi.org/10.1177/1745691615592239> PMID: 26386004
26. Adelantado-Renau M, Moliner-Urdiales D, Cavero-Redondo I, Beltran-Valls MR, Martínez-Vizcaíno V, Álvarez-Bueno C. Association between screen media use and academic performance among children and adolescents: a systematic review and meta-analysis. *JAMA Pediatr*. 2019; 173(11):1058–1067. <https://doi.org/10.1001/jamapediatrics.2019.3176> PMID: 31545344
27. Gnambis T, Stasielowicz L, Wolter I, Appel M. Do computer games jeopardize educational outcomes? A prospective study on gaming times and academic achievement. *Psychology of Popular Media*. 2020; 9(1):69–82. <https://doi.org/10.1037/ppm0000204>
28. Sahin M, Gumus YY, Dincel S. Game addiction and academic achievement. *Educ Psychol (Lond)*. 2016; 36(9):1533–1543. <https://doi.org/10.1080/01443410.2014.972342>
29. Erikson EH. *Identity: Youth and Crisis*. W. W. Norton & Company; 1968.

30. Lam LT, Peng ZW, Mai JC, Jing J. Factors associated with Internet addiction among adolescents. *Cyberpsychology & behavior*. 2009; 12(5):551–555. <https://doi.org/10.1089/cpb.2009.0036> PMID: 19619039
31. Milani L, Osualdella D, Di Blasio P. Quality of interpersonal relationships and problematic Internet use in adolescence. *CyberPsychology & Behavior*. 2009; 12(6):681–684. <https://doi.org/10.1089/cpb.2009.0071> PMID: 19788382
32. Mei S, Yau YH, Chai J, Guo J, Potenza MN. Problematic Internet use, well-being, self-esteem and self-control: Data from a high-school survey in China. *Addictive Behaviors*. 2016; 61:74–79. <https://doi.org/10.1016/j.addbeh.2016.05.009> PMID: 27249805
33. Kim J, Hong H, Lee J, Hyun MH. Effects of time perspective and self-control on procrastination and Internet addiction. *J Behav Addict*. 2017; 6(2):229–236. <https://doi.org/10.1556/2006.6.2017.017> PMID: 28494615
34. Sun RQ, Sun GF, Ye JH. The effects of online game addiction on reduced academic achievement motivation among Chinese college students: the mediating role of learning engagement. *Front Psychol*. 2023; 14:1185353. <https://doi.org/10.3389/fpsyg.2023.1185353> PMID: 37519374
35. Zhang Y, Qin X, Ren P. Adolescents' academic engagement mediates the association between Internet addiction and academic achievement: The moderating effect of classroom achievement norm. *Comput Human Behav*. 2018; 89:299–307. <https://doi.org/10.1016/j.chb.2018.08.018>
36. Zhou D, Liu J, Liu J. The effect of problematic Internet use on mathematics achievement: The mediating role of self-efficacy and the moderating role of teacher-student relationships. *Child Youth Serv Rev*. 2020; 118:105372. <https://doi.org/10.1016/j.childyouth.2020.105372>
37. Drummond A, Sauer JD. Timesplitters: Playing video games before (but not after) school on weekdays is associated with poorer adolescent academic performance. A test of competing theoretical accounts. *Comput Educ*. 2020; 144:103704. <https://doi.org/10.1016/j.compedu.2019.103704>
38. Gee JP. Learning by design: Good video games as learning machines. *E-learning and Digital Media*. 2005; 2(1):5–16. <https://doi.org/10.2304/elea.2005.2.1.5>
39. Gee JP. Video games and embodiment. *Games Cult*. 2008; 3(3–4):253–263. <https://doi.org/10.1177/1555412008317309>
40. Herz JC. *Joystick nation: How videogames ate our quarters, won our hearts, and rewired our minds*. Atlantic/Little, Brown; 1997.
41. Adžić S, Al-Mansour J, Naqvi H, Stambolić S. The impact of video games on Students' educational outcomes. *Entertain Comput*. 2021; 38:100412. <https://doi.org/10.1016/j.entcom.2021.100412>
42. Adachi PJ, Willoughby T. More than just fun and games: the longitudinal relationships between strategic video games, self-reported problem solving skills, and academic grades. *J Youth Adolesc*. 2013; 42(7):1041–1052. <https://doi.org/10.1007/s10964-013-9913-9> PMID: 23344653
43. Willoughby T. A short-term longitudinal study of Internet and computer game use by adolescent boys and girls: prevalence, frequency of use, and psychosocial predictors. *Dev Psychol*. 2008; 44(1):195–204. <https://doi.org/10.1037/0012-1649.44.1.195> PMID: 18194017
44. Jackson LA, Von Eye A, Witt EA, Zhao Y, Fitzgerald HE. A longitudinal study of the effects of Internet use and videogame playing on academic performance and the roles of gender, race and income in these relationships. *Comput Human Behav*. 2011; 27(1):228–239. <https://doi.org/10.1016/j.chb.2010.08.001>
45. Anthony WL, Zhu Y, Nower L. The relationship of interactive technology use for entertainment and school performance and engagement: Evidence from a longitudinal study in a nationally representative sample of middle school students in China. *Comput Human Behav*. 2021; 122:106846. <https://doi.org/10.1016/j.chb.2021.106846>
46. Moreno MA, Jelenchick L, Cox E, Young H, Christakis DA. Problematic internet use among US youth: A systematic review. *Arch Pediatr Adolesc Med*. 2011; 165(9):797–805. <https://doi.org/10.1001/archpediatrics.2011.58> PMID: 21536950
47. Bandura A. Social cognitive theory of personality. In: Pervin L. A., John O. P., editors. *Handbook of personality*. 2nd ed. New York: Guilford Publications; 1999. p. 154–196.
48. Bandura A. *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall, Inc; 1986.
49. Bandura A. Social cognitive theory of self-regulation. *Organ Behav Hum Decis Process*. 1991; 50(2):248–287.
50. Van Rooij AJ, Daneels R, Liu S, Anrijs S, Van Looy J. Children's motives to start, continue, and stop playing video games: Confronting popular theories with real-world observations. *Curr Addict Rep*. 2017; 4(3):323–332. <https://doi.org/10.1007/s40429-017-0163-x>
51. Durkin K, Barber B. Not so doomed: computer game play and positive adolescent development. *J Appl Dev Psychol*. 2002; 23(4):373–392. [https://doi.org/10.1016/S0193-3973\(02\)00124-7](https://doi.org/10.1016/S0193-3973(02)00124-7)

52. Lee D, LaRose R. A socio-cognitive model of video game usage. *J Broadcast Electron Media*. 2007; 51(4):632–650. <https://doi.org/10.1080/08838150701626511>
53. Hygen BW, Belsky J, Stenseng F, Steinsbekk S, Wichstrøm L, Skalicka V. Longitudinal relations between gaming, physical activity, and athletic self-esteem. *Comput Human Behav*. 2022; 132:107252. <https://doi.org/10.1016/j.chb.2022.107252>
54. Baturay MH, Toker S. Internet addiction among college students: Some causes and effects. *Educ Inf Technol (Dordr)*. 2019; 24(5):2863–2885. <https://doi.org/10.1007/s10639-019-09894-3>
55. Berte DZ, Mahamid FA, Affouneh S. Internet addiction and perceived self-efficacy among university students. *Int J Ment Health Addict*. 2021; 19(1):162–176. <https://doi.org/10.1007/s11469-019-00160-8>
56. Lemenager T, Neissner M, Sabo T, Mann K, Kiefer F. “Who am i” and “how should i be”: A systematic review on self-concept and avatar identification in gaming disorder. *Curr Addict Rep*. 2020; 7(2):166–193. <https://doi.org/10.1007/s40429-020-00307-x>
57. Sun X, Li X. Video Game Time and Psychosocial Well-being in Chinese Children: the Mediating Role of Self-Esteem. *J Child Fam Stud*. 2024;1–12. <https://doi.org/10.1007/s10826-024-02834-x>
58. Calandri E, Cattelino E, Graziano F. Is playing video games during COVID-19 lockdown related to adolescent well-being? The role of emotional self-efficacy and positive coping. *European Journal of Developmental Psychology*. 2023; 20(3):533–549. <https://doi.org/10.1080/17405629.2022.2148651>
59. Geng J, Han L, Gao F, Jou M, Huang CC. Internet addiction and procrastination among Chinese young adults: A moderated mediation model. *Comput Human Behav*. 2018; 84:320–333. <https://doi.org/10.1016/j.chb.2018.03.013>
60. Green R, Delfabbro PH, King DL. Avatar-and self-related processes and problematic gaming: A systematic review. *Addictive Behaviors*. 2020; 108:106461. <https://doi.org/10.1016/j.addbeh.2020.106461> PMID: 32480244
61. Buckley KE, Anderson CA. A theoretical model of the effects and consequences of playing video games. In: *Playing video games*. Routledge; 2012. p. 427–446.
62. Eccles JS, Wigfield A. Motivational beliefs, values, and goals. *Annu Rev Psychol*. 2002; 53(1):109–132. <https://doi.org/10.1146/annurev.psych.53.100901.135153> PMID: 11752481
63. Bandura A. *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall; 1986.
64. Spenner KI, Featherman DL. Achievement ambitions. *Annu Rev Sociol*. 1978; 4(1):373–420. <https://doi.org/10.1146/annurev.so.04.080178.002105>
65. Koo A. Is there any chance to get ahead? Education aspirations and expectations of migrant families in China. *Br J Sociol Educ*. 2012; 33(4):547–564. <https://doi.org/10.1080/01425692.2012.678755>
66. Strand S, Winston J. Educational aspirations in inner city schools. *Educ Stud*. 2008; 34(4):249–267. <https://doi.org/10.1080/03055690802034021>
67. Domina T, Conley A, Farkas G. The link between educational expectations and effort in the college-for-all era. *Sociol Educ*. 2011; 84(2):93–112. <https://doi.org/10.1177/1941406411401808>
68. Salmela-Aro K, Upadaya K, Hakkarainen K, Lonka K, Alho K. The dark side of internet use: Two longitudinal studies of excessive internet use, depressive symptoms, school burnout and engagement among Finnish early and late adolescents. *J Youth Adolesc*. 2017; 46(2):343–357. <https://doi.org/10.1007/s10964-016-0494-2> PMID: 27138172
69. Bask M, Salmela-Aro K. Burned out to drop out: Exploring the relationship between school burnout and school dropout. *European Journal of Psychology of Education*. 2013; 28(2):511–528. <https://doi.org/10.1007/s10212-012-0126-5>
70. Fishbein M. A consideration of beliefs, and their role in attitude measurement. In: Fishbein M., editor. *Readings in attitude theory and measurement*. New York: John Wiley & Sons; 1967. p. 257–266.
71. Ajzen I, Fishbein M. The influence of attitudes on behavior. In: Albarracín D., Johnson B. T., Zanna M. P., editors. *The handbook of attitudes*. Lawrence Erlbaum Associates Publishers; 2005. p. 173–211.
72. Lipnevich AA, Preckel F, Krumm S. Mathematics attitudes and their unique contribution to achievement: Going over and above cognitive ability and personality. *Learn Individ Differ*. 2016; 47:70–79. <https://doi.org/10.1016/j.lindif.2015.12.027>
73. Niepel C, Burrus J, Greiff S, Lipnevich AA, Brennenman MW, Roberts RD. Students' beliefs and attitudes toward mathematics across time: A longitudinal examination of the theory of planned behavior. *Learn Individ Differ*. 2018; 63:24–33. <https://doi.org/10.1016/j.lindif.2018.02.010>
74. Zimmerman BJ, Bandura A, Martinez-Pons M. Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *Am Educ Res J*. 1992; 29(3):663–676. <https://doi.org/10.3102/00028312029003663>

75. Aguilar-Yamuza B, Herruzo-Pino C, Lucena-Jurado V, Raya-Trenas AF, Pino-Osuna MJ. Internalizing problems in childhood and adolescence: the role of the family. *Alpha Psychiatry*. 2023; 24(3):87–92. <https://doi.org/10.5152/alphapsychiatry.2023.221086> PMID: 37440900
76. Zhen R, Liu R De, Hong W, Zhou X. How do interpersonal relationships relieve adolescents' problematic mobile phone use? The roles of loneliness and motivation to use mobile phones. *Int J Environ Res Public Health*. 2019; 16(13):2286. <https://doi.org/10.3390/ijerph16132286> PMID: 31261619
77. Van Wel F, Linssen H, Abma R. The parental bond and the well-being of adolescents and young adults. *J Youth Adolesc*. 2000; 29(3):307–318. <https://doi.org/10.1023/A:1005195624757>
78. Schneider LA, King DL, Delfabbro PH. Family factors in adolescent problematic Internet gaming: A systematic review. *J Behav Addict*. 2017; 6(3):321–333. <https://doi.org/10.1556/2006.6.2017.035> PMID: 28762279
79. Zhu Y, Deng L, Wan K. The association between parent-child relationship and problematic internet use among English-and Chinese-language studies: A meta-analysis. *Front Psychol*. 2022; 13:885819. <https://doi.org/10.3389/fpsyg.2022.885819> PMID: 36110283
80. Huang S, Hu Y, Ni Q, Qin Y, Lü W. Parent-children relationship and internet addiction of adolescents: The mediating role of self-concept. *Current Psychology*. 2021; 40:2510–2517. <https://doi.org/10.1007/s12144-019-00199-9>
81. Hao L, Bonstead-Bruns M. Parent-child differences in educational expectations and the academic achievement of immigrant and native students. *Sociol Educ*. 1998; 71(3):175–198. <https://doi.org/10.2307/2673201>
82. Wang D, Sun X, He F, Liu C, Wu Y. The mediating effect of family health on the relationship between health literacy and mental health: A national cross-sectional survey in China. *International Journal of Social Psychiatry*. 2023; 69(6):1490–1500. <https://doi.org/10.1177/00207640231166628> PMID: 37095729
83. Hu J, Ai H. Self-esteem mediates the effect of the parent-adolescent relationship on depression. *J Health Psychol*. 2016; 21(6):897–904. <https://doi.org/10.1177/1359105314541315> PMID: 25030796
84. Eisinga R, Grotenhuis M te, Pelzer B. The reliability of a two-item scale: Pearson, Cronbach, or Spearman-Brown? *Int J Public Health*. 2013; 58(4):637–642. <https://doi.org/10.1007/s00038-012-0416-3> PMID: 23089674
85. Hayes AF. *An introduction to mediation, moderation, and conditional process analysis. A regression-based approach*. New York, NY: Guilford Press; 2013.
86. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods*. 2008; 40(3):879–891. <https://doi.org/10.3758/brm.40.3.879> PMID: 18697684
87. Aiken LS, West SG. *Multiple regression: Testing and interpreting interactions*. SAGE Publications, Inc; 1991.
88. Young KS, Rogers RC. The relationship between depression and Internet addiction. *CyberPsychology & Behavior*. 1998; 1(1):25–28. <https://doi.org/10.1089/cpb.1998.1.25>
89. Chang MK, Law SPM. Factor structure for Young's Internet Addiction Test: A confirmatory study. *Comput Human Behav*. 2008; 24(6):2597–2619. <https://doi.org/10.1016/j.chb.2008.03.001>
90. Hu S, Mu Z. Some time is better spent than other time: Chinese adolescents' time use and developmental outcomes. *Child Indic Res*. 2020; 13(5):1739–1765. <https://doi.org/10.1007/s12187-020-09718-8>
91. Lim S, Reeves B. Being in the game: Effects of avatar choice and point of view on psychophysiological responses during play. *Media Psychol*. 2009; 12(4):348–370. <https://doi.org/10.1080/15213260903287242>
92. Morris AS, Silk JS, Steinberg L, Myers SS, Robinson LR. The role of the family context in the development of emotion regulation. *Social Development*. 2007; 16(2):361–388. <https://doi.org/10.1111/j.1467-9507.2007.00389.x> PMID: 19756175
93. Vanassche S, Sodermans AK, Matthijs K, Swicegood G. The effects of family type, family relationships and parental role models on delinquency and alcohol use among Flemish adolescents. *J Child Fam Stud*. 2014; 23(1):128–143. <https://doi.org/10.1007/s10826-012-9699-5>
94. Coyne SM, Padilla-Walker LM, Stockdale L, Day RD. Game on... girls: Associations between co-playing video games and adolescent behavioral and family outcomes. *Journal of Adolescent Health*. 2011; 49(2):160–165. <https://doi.org/10.1016/j.jadohealth.2010.11.249> PMID: 21783048
95. Lee HE, Kim JY, Kim C. The influence of parent media use, parent attitude on media, and parenting style on children's media use. *Children*. 2022; 9(1):37. <https://doi.org/10.3390/children9010037> PMID: 35053662

96. Hadiwijaya H, Klimstra TA, Vermunt JK, Branje SJ, Meeus WH. On the development of harmony, turbulence, and independence in parent–adolescent relationships: A five-wave longitudinal study. *J Youth Adolesc.* 2017; 46(8):1772–1788. <https://doi.org/10.1007/s10964-016-0627-7> PMID: 28044242
97. Bowlby J. Attachment and loss: retrospect and prospect. *American journal of Orthopsychiatry.* 1982; 52(4):664–678. <https://doi.org/10.1111/j.1939-0025.1982.tb01456.x> PMID: 7148988
98. Wu N, Hou Y, Wang Q, Yu C. Intergenerational transmission of educational aspirations in Chinese families: Identifying mediators and moderators. *J Youth Adolesc.* 2018; 47(6):1238–1251. <https://doi.org/10.1007/s10964-018-0820-y> PMID: 29470762
99. Blinka L, Šablatúrová N, Ševčíková A, Husarova D. Social constraints associated with excessive internet use in adolescents: the role of family, school, peers, and neighbourhood. *Int J Public Health.* 2020; 65(8):1279–1287. <https://doi.org/10.1007/s00038-020-01462-8> PMID: 32844251
100. Gerard AB. Parent-child relationship inventory (PCRI) manual. Los Angeles, LA: Western Psychological Services; 1994.
101. Sunday OJ, Adesope OO, Maarhuis PL. The effects of smartphone addiction on learning: A meta-analysis. *Computers in Human Behavior Reports.* 2021; 4:100114. <https://doi.org/10.1016/j.chbr.2021.100114>
102. Hong W, Liu RD, Ding Y, Sheng X, Zhen R. Mobile phone addiction and cognitive failures in daily life: The mediating roles of sleep duration and quality and the moderating role of trait self-regulation. *Addictive Behaviors.* 2020; 107:106383. <https://doi.org/10.1016/j.addbeh.2020.106383> PMID: 32200196
103. Bonnaire C, Phan O. Relationships between parental attitudes, family functioning and Internet gaming disorder in adolescents attending school. *Psychiatry Res.* 2017; 255:104–110. <https://doi.org/10.1016/j.psychres.2017.05.030> PMID: 28535475
104. Chen IH, Lee ZH, Dong XY, Gamble JH, Feng HW. The influence of parenting style and time management tendency on internet gaming disorder among adolescents. *Int J Environ Res Public Health.* 2020; 17(23):9120. <https://doi.org/10.3390/ijerph17239120> PMID: 33291336
105. Wallenius M, Rimpelä A, Punamäki RL, Lintonen T. Digital game playing motives among adolescents: Relations to parent–child communication, school performance, sleeping habits, and perceived health. *J Appl Dev Psychol.* 2009; 30(4):463–474. <https://doi.org/10.1016/j.appdev.2008.12.021>
106. Sun X, Zhang X, Duan C, Yao L, Niu G, Tian Y. Parental active internet mediation and children's academic adaptation: The mediating role of video gaming and moderating role of deviant peer affiliation. *Current Psychology.* 2023; 42(11):9184–9194. <https://doi.org/10.1007/s12144-021-02217-1>
107. Chang E, Kim B. School and individual factors on game addiction: A multilevel analysis. *International Journal of Psychology.* 2020; 55(5):822–831. <https://doi.org/10.1002/ijop.12645> PMID: 31875984
108. Zou H, Deng Y, Wang H, Yu C, Zhang W. Perceptions of school climate and internet gaming addiction among Chinese adolescents: the mediating effect of deviant peer affiliation. *Int J Environ Res Public Health.* 2022; 19(6):3604. <https://doi.org/10.3390/ijerph19063604> PMID: 35329291
109. Cudo A, Kopaš-Posiej N, Griffiths MD. The role of self-control dimensions, game motivation, game genre, and game platforms in gaming disorder: Cross-sectional and longitudinal findings. *Psychol Res Behav Manag.* 2023; 16:4749–4777. <https://doi.org/10.2147/PRBM.S435125> PMID: 38024654
110. Mills DJ, Allen JJ. Self-determination theory, internet gaming disorder, and the mediating role of self-control. *Comput Human Behav.* 2020; 105:106209. <https://doi.org/10.1016/j.chb.2019.106209>
111. Dindar M. An empirical study on gender, video game play, academic success and complex problem solving skills. *Comput Educ.* 2018; 125:39–52. <https://doi.org/10.1016/j.compedu.2018.05.018>
112. Savić Tot T, Adžić S, Tot V, Aleksić M, Zakić N. The impact of time devoted to video games on student achievement. *Educ Inf Technol (Dordr).* 2023; 28(5):5921–5944. <https://doi.org/10.1007/s10639-022-11418-5>
113. Chao R, Tseng V. Parenting of asians. In: Bornstein MH, editor. *Handbook of parenting.* Lawrence Erlbaum Associates; 2002. p. 59–93.
114. Chao RK. Chinese and European American cultural models of the self reflected in mothers' childrearing beliefs. *Ethos.* 1995; 23(3):328–354. <https://doi.org/10.1525/eth.1995.23.3.02a00030>
115. Steinberg L. Cognitive and affective development in adolescence. *Trends Cogn Sci.* 2005; 9(2):69–74. <https://doi.org/10.1016/j.tics.2004.12.005> PMID: 15668099
116. D'Arienzo MC, Boursier V, Griffiths MD. Addiction to social media and attachment styles: a systematic literature review. *Int J Ment Health Addict.* 2019; 17(4):1094–1118. <https://doi.org/10.1007/s11469-019-00082-5>
117. Wang R, Bianchi SM, Raley SB. Teenagers' Internet use and family rules: A research note. *Journal of Marriage and Family.* 2005; 67(5):1249–1258. <https://doi.org/10.1111/j.1741-3737.2005.00214.x>