

RESEARCH ARTICLE

Open Access



The association between future self-continuity and problematic mobile video gaming among Chinese college students: the serial mediation of consideration of future consequences and state self-control capacity

Junxian Shen^{1,2}, Jiansong Zheng^{1*}  and Tao Zhang¹

Abstract

Background To explore the relationship between future self-continuity and problematic mobile video gaming among Chinese college students and to examine the serial mediation of consideration of future consequences and state self-control capacity on the association between future self-continuity and problematic mobile video gaming, based on Identity-Based Motivation Theory.

Methods The Problematic Mobile Video Gaming Scale, Future Self-continuity Scale, Consideration of Future Consequences Scale, and Short Version of State Self-control Capacity Scale were administered to a sample comprising 800 college students (338 males accounting for 42.3%). Multivariate analysis and latent variables analysis were utilized to explore the separate mediating role consideration of future consequences and state self-control capacity played in the association between future self-continuity and problematic mobile video gaming, and their serial mediation also was investigated. The Bootstrap method was employed to test the significance of these mediation effects.

Results The negative association between future self-continuity and problematic mobile video gaming was moderately found. Students with increased consideration of future consequences from higher levels of future self-continuity have decreased their problematic mobile video gaming. Future self-continuity significantly positively predicted state self-control capacity, which in turn significantly negatively predicted problematic mobile video gaming. The serial mediation was also found.

Conclusion The findings revealed why differences in identification with the current and future selves become influencing factors in problematic mobile video gaming. This study observed the mediating role that consideration of future consequences and state self-control capacity play in the association between future self-continuity and problematic mobile video gaming.

Keywords Problematic mobile video gaming, Future self-continuity, Consideration of future consequences, State self-control capacity

*Correspondence:

Jiansong Zheng
janson6868@163.com

Full list of author information is available at the end of the article



© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

Background

Problematic mobile video gaming (PMVG) refers to the phenomenon in which the users of mobile digital devices are strongly dependent on mobile video games, and play mobile video games repeatedly over a long period of time [1]. Previous research found that problematic online gaming was positively associated with mental health problems such as social anxiety, depression, and dependence [2–4]. China's size of mobile phone online game users has reached about 521 million, accounting for 48.9% of mobile phone netizens in 2022 [5]. With the popularity of mobile phones and tablet computers, mobile video games have become common entertainment for college students [6, 7]. It is necessary to address the potential problematic mobile video gaming among college students.

Existing literature remains lacking on the association between problematic mobile video gaming and future self-continuity and the corresponding potential mediation mechanisms. Future self-continuity refers to the psychological connection between an individual's current self and future self [8]. Future self-continuity affects individuals' intertemporal decision-making, mainly in terms of time discounting [9, 10]. People with lower levels of future self-continuity are more concerned about current benefits and losses than the future [9]. Individuals with higher levels of future self-continuity are more likely to view their future selves as their current selves, and they will place more importance on future gains and losses, by reducing time discounting in intertemporal decision-making [11, 12]. Mobile video games can bring immediate rewards to gamers, and make them procrastinate by increasing their time discounting for achieving long-term goals [11, 13, 14]. Mobile video games can relieve college students' stress and make them relaxed, but excessive uses of mobile video games would increase the uncertainty about their future [15]. Future self-continuity may be able to be negatively associated with problematic mobile video gaming among college students.

This view is supported by Identity-Based Motivation Theory (IBM), which assumes that an individual's self-concept is dynamically constructed, consisting of building the current and future self [16]. When people perceive their current tasks to be beneficial for the construction of their future identities, they will actively work to overcome the current problems in order to complete the tasks [16–18]. College students who aspire to pursue certain professions will strengthen their accessibilities to the occupations by actively participating in the relevant trainings. When college students' perceptions of their future identities conflict with their current task, they may perceive that the current difficulties are not worth overcoming, and the idea "this is not for me" may appear in their minds resulting in refusing potential challenges

from the current task [19]. College students with lower degrees of future self-continuity are more likely to participate in problematic mobile video gaming. Based on this, we developed a hypothesis that

H1: Future self-continuity negatively predicts problematic mobile video gaming among college students.

Consideration of future consequences means that individuals' present decision-making principles are based on current profits or future gains [20]. The General Aggression Model suggests that decision-making criteria are influenced by the interaction between perception and consideration of future consequences [21]. People with higher consideration of future consequences consider more future implications of their current behavior [9, 10]. In this vein, college students with higher levels of consideration of future consequences are more aware of the disadvantages of problematic mobile video gaming, and they may be able to readily demonstrate an immediate cessation of mobile video gaming [22]. College students with lower degrees of consideration of future consequences may indulge in mental satisfaction from mobile video games, likely resulting in their possible problematic mobile video gaming [23, 24]. Previous studies have found that future self-continuity among college students positively correlates with their consideration of future consequences [9, 15, 25]. Undergraduate students who score low on future self-continuity tend to view their future selves as strangers, and manifest less concern for that selves' benefits [15]. In contrast, college students with high levels of future self-continuity value their own development in the future, and may consider more about the future consequences of their current actions [26]. In this context, university students with higher consideration of future consequences from increased levels of future self-continuity may show less problematic behaviors in mobile video gaming. Based on this, we proposed the hypothesis that

H2: Future self-continuity positively predicts consideration of future consequences, which in turn negatively predicts problematic mobile video gaming.

Self-control denotes the process by which individuals change their behavioral tendencies to achieve long-term goals [27]. State self-control capacity refers to a self-control ability that is not disturbed by environments [28, 29]. State self-control capacity is able to reduce many negative behaviors such as juvenile delinquency, deceptive behavior, and aggression [16, 30]. Previous surveys among Chinese college students suggested that state self-control capacity was effective in reducing mobile phone dependence [31, 32]. College students' state self-control capacity may be able to help them overcome their phone

dependence including problematic mobile video gaming [33, 34]. It has been found that college students with higher levels of future self-continuity were more likely to have stronger state self-control capacity [35]. Future self-continuity functions to enhance self-control and shift students' attention from short-term enjoyment from online games in their daily lives to long-term goals such as career pursuits after their graduation [15]. State self-control capacity represents a psychological resource to help students reach their desired future selves [26, 35]. In this context, state self-control capacity may play a mediating role in the association between future self-continuity and problematic mobile video gaming. Based on this, we proposed the hypothesis that

H3: Future self-continuity positively predicts state self-control capacity, which in turn negatively predicts problematic mobile video gaming.

IBM theory suggests that individuals' identity-based motivation drives them to devote limited time and energy to their identity-consistent behaviors [16, 36]. Identifications with certain future identities allow individuals to perceive their reachable future [37]. If people are aware that current tasks are meaningful for future developments, they will strive to complete the tasks and overcome the difficulties during the tasks through their state self-control capacity [38, 39]. RM Adelman, et al. [15] pointed to a positive association between consideration of future consequences and self-control. Students' directing attention away from their present towards their future allows them to effectively exert self-control to regulate their behaviors for the attainment of beneficial outcomes, especially when they consider more future consequences currently [15, 29]. According to IBM theory, college students' clear perceptions of their careers after their graduation may actively mobilize their consideration of future consequences, and then they will strive hard for beneficial future results with their higher levels of state self-control capacity, resulting in lower levels of problematic mobile video gaming [16]. Based on this, we proposed the hypothesis that

H4: Consideration of future consequences and state self-control capacity play a serial mediating role in the relationship between future self-continuity and problematic mobile video gaming.

Gender differences in problematic online gaming have been consistently found by scholars [19, 40, 41]. Specifically, males or boys show higher risks of problematic online gaming, and may exhibit symptoms such as anxiety and depression [42, 43]. However, the gender-specific factor differs regarding time playing,

social motives, and personality [44]. Boys rather than girls spend more time on online games, however, which is positively associated with their pro-social behaviors [45]. While RA Desai, et al. [45] argued that more aggressive girls were attracted to gaming. Boys love action and competitive games such as massively multiplayer online role-playing games while girls prefer casual games mainly for interpersonal motivation [44]. In this context, males' and females' perspectives on their future selves, as a type of personality, may have different impacts in their gaming behaviors, and even problematic mobile video gaming.

Students who are the only child in their families positively correlated with their educational resources and the expectations that they may receive from their parents, which may have a negative impact on their problematic online gaming, future considerations, and self-control capacity [46, 47]. Individuals in early grades have more free time, likely undeveloped specific goals, and are more susceptible to the temptation of problematic video online games [48]. Students from urban rather than rural areas may have more social resources in line with careers after their graduation, and possibly show higher consideration of future consequences [49, 50], higher levels of self-control capacity [32, 34], and lower prevalence of problematic video gaming [51, 52].

The contributions of this study are the exploration of the association between future self-continuity and problematic mobile video gaming, and the serial mediation effect of this relationship. In addition, we investigated the effects of demographic information on gaming disorder, such as gender differences in problematic mobile video gaming. According to the empirical evidence, theoretical contributions and practical guidance were elaborated to overcome the potential problematic mobile video gaming of university students in the [Discussion](#) section.

According to IBM theory, the extent to which identities of college students after their graduation can correlate with their levels of consideration of future consequences and state self-control capacity [16]. Problematic mobile video gaming may be a roadblock in their pursuit of future identities [53, 54]. We developed mediation models with problematic mobile video gaming as the dependent variable, future self-continuity as the independent variable, and consideration of future consequences and state self-control capacity as mediating variables. The serial mediation mechanism of consideration of future consequences and state self-control capacity on the relationship between future self-continuity and problematic mobile video gaming was investigated. The specific research framework is shown in [Fig. 1](#).

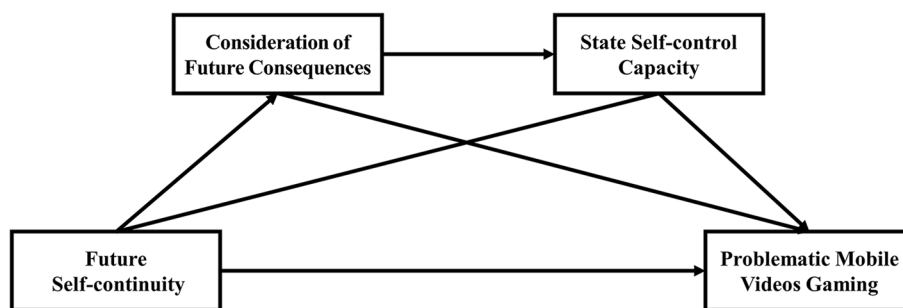


Fig. 1 Research framework

Methods

Sampling and procedure

We utilized a random sampling method for recruiting participants. All participants signed the informed consent form before completing the questionnaire. A questionnaire survey was conducted among freshmen, sophomores, and juniors in four universities in Wuhan, China. A total of 900 college students volunteered to participate in the survey. The validity of these questionnaires was checked by three indicators, including unlimited item scores, missing demographic information, and overfilling time. When a participant ignored any items, or spent either less than 30 s or more than 10 min filling in the questionnaire, the corresponding observation would be deleted. Finally, 800 usable questionnaires were analyzed.

SPSS 21.0 and Process 3.0 were applied [55]. Correlation and regression analyses were performed. Sobel tests with the Bootstrap method were applied to estimate 95% confidence intervals for mediating effects by randomly sampling 5000 Bootstrap samples.

Measures

Future self-continuity (FSC) was measured by a Chinese version of Future Self-Continuity Scale (FSCS) [56]. The scale contains 10 items and each item is rated on a 6-point Likert scale. The scale includes three domains: 4 items on the similarity subscale (e.g. “How similar are you now to what you will be like 10 years from now?”), ranging from 1 (completely different) to 6 (exactly the same); 3 items on the vividness subscale (e.g. “How vividly can you imagine what you will be like in 10 years from now?”), ranging from 1 (not at all) to 6 (perfectly); 3 items on the positivity subscale (e.g. “Do you like what you will be like 10 years from now?”), ranging from 1 (not at all) to 6 (perfectly). Higher scores indicated higher degrees of respondents’ FSC.

Consideration of future consequences (CFC) was assessed by Consideration of Future Consequences Scale (CFC) [20]. The scale contains 12 items, which were

answered using a 5-point Likert scale ranging from 1 (extremely uncharacteristic) to 5 (extremely characteristic). Questions 3, 4, 5, 9, 10, 11, and 12 were reverse scored. Higher scores indicate higher levels of respondents’ CFC. Sample items included: “I consider how things might be in the future, and try to influence those things with my day to day behavior.” and “I am willing to sacrifice my immediate happiness or well-being in order to achieve future outcomes.”

State self-control capacity (SSCC) was measured by a Chinese revision of State Self-Control Capacity Scale (SSCCS) [57]. The scale was simplified to 10 items with questions 3, 6, 9, 10, 11, 12, 13, 15, 16, and 18 in the full scale. The simplified version also had good reliability and validity [34]. Each item is rated on a 7-point Likert scale, ranging from 1 (totally disagree) to 7 (totally agree). All items were reverse scored except the 5th and 8th questions of the simplified version. Higher scores indicate higher degrees of respondents’ SSCC. Sample items included: “I need something pleasant to make me feel better.” and “I feel drained.”

Problematic mobile video gaming (PMVG) was assessed by the Problematic Mobile Video Gaming Scale (PMVGS) [1]. The scale contains 11 items. Each item is rated on a 5-point Likert scale, ranging from 1 (never) to 5 (very often). Higher scores indicate respondents’ worse situation of PMVG. The scale contains three domains: 4 items on the withdrawal symptoms subscale (e.g. “During the last year, have you felt miserable when you were unable to play mobile video games or played less than usual?”); 4 items on the mood modification subscale (e.g. “During the last year, have you played mobile video games to feel better?”); 3 items on conflict subscale (e.g. “During the last year, have you ever jeopardized your school or work performance because of playing mobile video games?”).

Demographic variables *Gender* was coded as “male: 1, female: 0”. *Student’s place of origin* was an ordinal variable revealing place attributes of students before rolling in their universities and was coded as “rural: 1, urban: 2,

city: 3". *Only child* referred to whether the student is the only child in a family and was coded as: "yes: 1, no: 0". *Grade* was coded as "freshman: 1, sophomore: 2, junior: 3".

Results

Reliability test results

Cronbach α values of scales were calculated to ensure the reliability of the data [58]. The results showed that the Cronbach α values of future self-continuity, consideration of future consequences, state self-control capacity, and problematic mobile video gaming in this study were 0.753, 0.773, 0.786, and 0.901, respectively. All Cronbach α values were more than 0.7, showing good reliability [59]. Therefore, the survey data is suitable to investigate the mediating effects of the variables.

Test for common method bias

Because of using questionnaires, it was necessary to test the common method bias [60]. The test for common method biases was conducted by using Harman's single-factor test, in which all items of the scales were included for factor analysis [60, 61]. The results showed that there were 10 factors with their characteristic root greater than 1. The first factor explained only 18.92% of the variance and did not reach the threshold of 40%, indicating that there were no serious common method biases.

Multivariate analysis results

Descriptive statistics and results of correlation analysis were shown in Table 1. Correlation analysis showed that *Gender* was associated with PMVG ($\rho=0.163$,

$p<0.001$), indicating that male college students were more likely to have PMVG than female college students. *Grade* and *Only Child* were not significantly correlated with the other variables in the study. *Student's Place of Origin* showed positive correlations with FSC and CFC ($\rho=0.174, p<0.001$; $\rho=0.164, p<0.001$, respectively), indicating that university students coming from urban areas reported higher degrees of FSC and CFC, respectively.

There was a significant positive correlation between FSC and CFC as well as FSC and SSCC, respectively ($\rho=0.168, p<0.001$; $\rho=0.283, p<0.001$) and a significant negative correlation between FSC and PMVG ($\rho=-0.214, p<0.001$); CFC was significantly positively related to SSCC ($\rho=0.376, p<0.001$) and was significantly negatively correlated to PMVG ($\rho=-0.262, p<0.001$); There was a significantly negative relationship between SSCC and PMVG ($\rho=-0.472, p<0.001$).

Using model 6 in Process 3.0 plugin of SPSS, the serial mediating analysis was tested by controlling for all demographic variables. All variables were normalized. The results were presented in Table 2. It showed that FSC significantly positively predicted CFC ($\beta=0.148, p<0.001$). FSC and CFC significantly positively predicted SSCC, respectively ($\beta=0.233, p<0.001$; $\beta=0.342, p<0.001$). FSC, CFC, and SSCC significantly negatively predicted PMVG, respectively ($\beta=-0.070, p=0.031$; $\beta=-0.098, p=0.003$; $\beta=-0.426, p<0.001$). The direct negative effect of FSC on PMVG was significant ($\beta=-0.204, p<0.001$). Hypothesis 1 was tested.

Table 2 also reported the impacts of demographic variables on the main variables. Gender did not saliently

Table 1 Means, standard deviations and correlation coefficients of the variables

Variables	M \pm SD	1	2	3	4	5	6	7
1. Gender (1 = male)	42.3%							
2. Only Child (1 = Yes)	40.8%	-0.140***						
3. Grade		0.037	-0.012					
Freshmen	52.9%							
Sophomores	31.5%							
Juniors	15.6%							
4. Student's place of origin (1 = urban)	66.5%	-0.090*	0.366***	-0.002				
5. FSC	29.5 \pm 6.0	-0.046	-0.041	-0.070	0.174***			
6. CFC	38.7 \pm 6.5	0.016	-0.043	0.025	0.164***	0.168***		
7. SSCC	41.3 \pm 7.9	0.052	-0.014	-0.020	0.068	0.283***	0.376***	
8. PMVG	28.3 \pm 9.3	0.163***	-0.053	0.061	-0.016	-0.214***	-0.262***	-0.472***

1. ***, $p<0.001$; **, $p<0.01$; *, $p<0.05$

2. $N=800$

3. FSC means Future Self-continuity; CFC means Considerations of Future Consequences; SSCC means State Self-control Capacity; PMVG means Problematic Mobile Videos Gaming

4. Percentages were reported for the categorical variables including Gender, Only Child, Grade, and Student's Place of Origin

Table 2 Results of regression analysis

	CFC		SSCC		PMVG		PMVG	
	β	S.E	β	S.E	β	S.E	β	S.E
FSC	0.148***	0.035	0.233***	0.033	-0.070*	0.032	-0.204***	0.035
CFC			0.342***	0.033	-0.098**	0.033		
SSCC					-0.426***	0.034		
Gender	0.021	0.071	0.126	0.065	0.356***	0.062	0.297***	0.070
Only child	-0.037	0.076	-0.014	0.070	0.074	0.067	0.086	0.075
Grade	0.046	0.047	-0.019	0.043	0.058	0.041	0.055	0.046
Student's place of origin	0.169***	0.044	-0.037	0.041	0.014	0.039	-0.011	0.044
R	0.221		0.442		0.521		0.263	
F	8.121***		48.279***		59.247***		19.777***	

1. ***, $p < 0.001$; **, $p < 0.01$; *, $p < 0.05$

2. $N = 800$

3. FSC means Future Self-continuity, CFC means Considerations of Future Consequences, SSCC means State Self-control Capacity, PMVG means Problematic Mobile Videos Gaming

predict CFC and SSCC ($\beta = 0.021, p = 0.766; \beta = 0.065, p = 0.055$), but significantly positively predicted PMVG ($\beta = 0.356, p < 0.001$ in the model with mediating variables as the input variables; $\beta = 0.297, p < 0.001$ in the model without mediating variables as the independent variables). Males rather than females were highly likely to show PMVG, and there were no significant gender differences in CFC and SSCC. No empirical evidence supported significant predictive relations between students' sibship and main variables including CFC, SSCC, and PMVG ($\beta = -0.037, p = 0.629; \beta = -0.014, p = 0.839; \beta = 0.070, p = 0.270$). There were insignificant predictive associations between students' grades and variables including CFC, SSCC, and PMVG ($\beta = 0.046, p = 0.323; \beta = -0.019, p = 0.653; \beta = 0.043, p = 0.158$). Student's place of origin significantly positively predicted their degrees of CFC ($\beta = 0.169, p < 0.001$), but showed insignificant prediction for their levels of SSCC and PMVG ($\beta = -0.037, p = 0.365; \beta = 0.014, p = 0.721$).

The mediation effects were verified by the Bootstrapping approach. The results were shown in Table 3. The Bootstrap 95% confidence interval without value 0

means that the mediating effect is significant. The total indirect effect was significant and accounted 66.2% of the total effect. The indirect effects of the three pathways were significant. Specifically, the pathway "FSC \rightarrow CFC \rightarrow PMVG" was significant and its indirect effect accounted 6.9% of the total effect. Hypothesis 2 was tested. The pathway "FSC \rightarrow SSCC \rightarrow PMVG" was significant and its indirect effect accounted 48.5% for the total effect. Hypothesis 3 was tested. The serial mediation pathway "FSC \rightarrow CFC \rightarrow SSCC \rightarrow PMVG" was significant and its indirect effect accounted 10.3% of the total effect. Hypothesis 4 was tested.

Results of the structural equation model

In order to verify the net effects between the study variables, latent variables analysis without controls was employed to investigate the mediation pathways of these variables. Covariance based structural equation modeling (CB-SEM) was utilized to solve the model. Modification Indices (MI) were used to correlate terms or them and latent variables to improve the fitness of the model. The

Table 3 Results of the test for mediating effects based on the Bootstrap method

Paths	Effect Sizes	S.E	95% Confidence Intervals		Mediation Proportion
			Bootstrap LLCI	Bootstrap ULCI	
Total indirect effects	-0.135	0.022	-0.181	-0.093	66.2%
Path1: FSC \rightarrow CFC \rightarrow PMVG	-0.014	0.006	-0.029	-0.004	6.9%
Path2: FSC \rightarrow SSCC \rightarrow PMVG	-0.099	0.018	-0.137	-0.065	48.5%
Path3: FSC \rightarrow CFC \rightarrow SSCC \rightarrow PMVG	-0.021	0.006	-0.035	-0.010	10.3%

FSC means Future Self-continuity, CFC means Considerations of Future Consequences, SSCC means State Self-control Capacity, PMVG means Problematic Mobile Videos Gaming

Table 4 Fitness of the structural equation model

Type	Indicator	Abbreviation	Obtained value	Acceptable threshold value
Normed fit index	$\chi^2(714)$	-	1.553	< 3
	Root mean square error of approximation	RMSEA	0.026	< 0.08
	Standardized root mean square residuals	SRMR	0.048	< 0.05
Absolute Fitness Indices	Goodness-of-fit Index	GFI	0.938	> 0.90
	Adjusted Goodness-of-fit Index	AGFI	0.918	> 0.90
Incremental Fit Measures	Tucker-Lewis Index	TLI	0.964	> 0.90
	Normed Fit Index	NFI	0.925	> 0.90
	Non-normed fit index	NNFI	0.964	> 0.90
	Comparative Fit Index	CFI	0.971	> 0.95

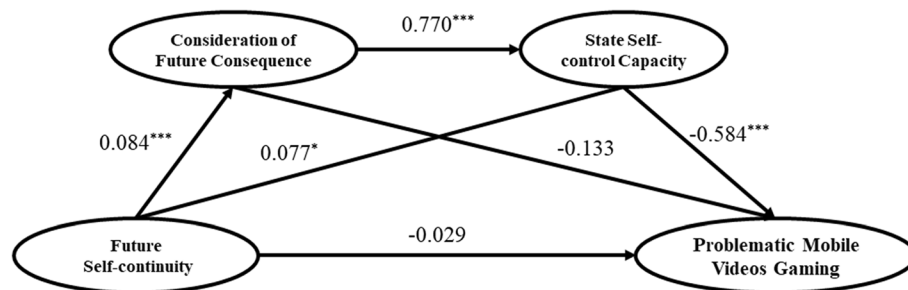


Figure 2. Results of covariance based structural equation modeling

Notes.

1. ***, $p < 0.001$; *, $p < 0.05$.

2. $N = 800$.

Fig. 2 Results of covariance based structural equation modeling. Notes. 1. ***, $p < 0.001$; *, $p < 0.05$. 2. $N = 800$

lavaan package in R language was employed to perform these actions [62].

Table 4 showed the fit of the structural equation model. The model fitted well with its obtained values all met the corresponding criteria [63]. Figure 2 illustrated the results of SEM. The results showed that FSC significantly predicted CFC ($\beta = 0.084, p < 0.001$). FSC and CFC significantly predicted SSCC ($\beta = 0.077, p = 0.013$; $\beta = 0.770, p < 0.001$). FSC and CFC did not have significant effects on PMVG ($\beta = -0.029, p = 0.307$; $\beta = -0.133, p = 0.113$), but SSCC significantly predicted PMVG ($\beta = -0.584, p < 0.001$). Hypothesis 1 was not supported.

With the goal of verification for significant mediation effects, the Bootstrap method was utilized to run 5,000 Bootstrap re-samplings (Table 5). The results of the mediation effect test showed that the mediation pathway “FSC → CFC → PMVG” ($Effect = -0.011, p = 0.120$) was insignificant. Hypothesis 2 was not tested. However, we found two significant mediating paths including “FSC → SSCC → PMVG” ($Effect = -0.045, p = 0.012$) and “FSC → CFC → SSCC → PMVG” ($Effect = -0.038,$

Table 5 Verification of mediation pathways based on the Bootstrap method

Mediation Pathways	Effect Sizes	S.E
Total indirect effects	-0.094***	0.022
Path1: FSC → CFC → PMVG	-0.011	0.007
Path2: FSC → SSCC → PMVG	-0.045*	0.018
Path3: FSC → CFC → SSCC → PMVG	-0.038***	0.010

1. ***, $p < 0.001$; *, $p < 0.05$

2. $N = 800$

3. FSC means Future Self-continuity, CFC means Considerations of Future Consequences, SSCC means State Self-control Capacity, PMVG means Problematic Mobile Videos Gaming

$p < 0.001$). The total indirect effect was also significant ($Effect = -0.094, p < 0.001$). Hypothesis 3 and 4 were supported again.

Discussion

In the internet age, mobile video games have become a common way for young people to release their stresses [1, 52]. However, excessive mobile video gaming has given

rise to several health-related problems including depression, anxiety, and procrastination [51, 64]. University students are the mainstay in the future labor market, and their connection between their present and future selves plays an important role in their careers [65]. University students with higher degrees of future self-continuity reported less bad behaviors such as academic delay and smoking [66, 67]. It is essential to uncover the possible elimination effects of future self-continuity on problematic mobile video gaming, and the relevant mediation mechanisms.

The negative association between future self-continuity and problematic mobile video gaming was found in the multivariable analysis with controls, although the latent variables analysis results did not report this direct effect. This may provide a direction to mitigate problematic mobile video gaming among college students. Future self-continuity emphasizes on the overlap of the current selves and future selves, and its higher level implies a high similarity between current selves and future selves [10]. When college students are able to touch their futures, their mobile video gaming addictions are likely weakened [68]. Future self-continuity may be a predictor of emotional stability, which has been shown to associate with problematic gaming behaviors [44, 69]. College students can improve their future self-continuity by writing letters for their future selves [10, 65]. Universities can also organize events to enhance university students' vivid visual depictions of their future selves [70, 71]. On a larger scale, long-term orientation at the society level may enhance the future self-continuity of students in that society, and reduce their occurrence of problematic mobile video gaming [72].

The mediating role that consideration of future consequences plays in the association between future self-continuity and problematic mobile video gaming was found by the regression results, but insignificant in the structural equation model. University students with higher levels of future self-continuity probably consider more future consequences when they play games using their convenient mobile devices [26, 49]. In this vein, gaming behaviors bring them benefits such as relaxation rather than disadvantages such as gaming disorders [73]. However, students' consideration of future consequences was a behavioral intention, rather than actual behavior, possibly leading to a weak significant predictive effect on problematic mobile video gaming [26, 74].

Empirical evidence supported the mediation effect of state self-control capacity on the relationship between future self-continuity and problematic mobile video gaming. The convenience of mobile devices tests college students' self-control capacity, and university students

with higher levels of future self-continuity tend to show higher degrees of state self-control capacity, and are able to end immediate rewards brought by games, which in turn they can avoid gaming addiction [75, 76]. The chain mediation pathway "future self-continuity → consideration of future consequences → state self-control capacity → problematic mobile video gaming" was tested, and can provide insights to college students, universities, and education sectors. Specifically, strengthening of future self-continuity in line with more consideration of future consequences and higher state self-control capacity, can have a positive impact on non-addiction to mobile video games [26, 49, 74].

In contrast to neuroanatomical features' evidence that females are more likely to be addicted to online games [77], male participants reported more problematic mobile video gaming in our survey. Similarly, most studies have revealed that a greater proportion of men spend more time on games, which in turn likely predicts their problematic gaming behaviors [44, 78, 79]. Gender differences in gaming addiction need to be disaggregated [40]. Specifically, males prefer multiplayer online role-playing games, which can give them senses of satisfaction and vanity, and the potential inconsistency between the virtual and real world may contribute to their problematic gaming behaviors [44, 80]. However, girls prefer casual games for their interpersonal motives, which may predispose them to emotional issues, and the gamers are more likely to exhibit anxiety and depressive symptoms [40, 81, 82]. In conclusion, gender differences in problematic mobile video games differ likely regarding the types of games [44, 78]. Follow-up studies are necessary to consider the males' and females' gaming addiction caused by different forms of games.

The empirical data showed that university students who come from urban rather than rural areas consider more consequences of their future for the possible reason that urban students have greater social capitals, so they can easily consider more consequences of current behavior on themselves or their families in the future [83, 84]. However, there is no empirical evidence supporting that students from urban areas exhibited higher levels of state self-control capacity and fewer behaviors of problematic gaming, conceivably because the prevalence and cheaper price of smart communication tools eliminate possible urban-rural differences in students' self-control capacity and problematic mobile video gaming [85, 86]. University students' grade and attribute of the only child did not significantly affect their consideration of future outcomes, self-control capacity, and problematic mobile video gaming, possibly because China's information development allowed individuals of different grades and

with different numbers of siblings to have equal access to education and information resources, causing potential indifferent situations on problematic mobile video gaming [87, 88].

Although we obtained some beneficial conclusions, there was still a limitation in the study. The cross-sectional data used in the study made it unable to observe causality. Follow-up surveys can be considered to manipulate the factors of future self-continuity, and track the corresponding alternations in problematic mobile video gaming among college students.

Conclusions

Based on the IBM theoretical framework, the association between future self-continuity and problematic mobile video gaming among college students was explored. The separate mediating effects and the serial mediation of consideration of future consequences and state self-control capacity in the aforementioned relation were explored. Results indicated that (i) university students' future self-continuity negatively predicted their problematic mobile video gaming. (ii) University students' future self-continuity positively predicted their consideration of future consequences, which in turn negatively predicted their problematic mobile video gaming. (iii) University students' future self-continuity significantly positively predicted their state self-control capacity, which in turn significantly negatively predicted their problematic mobile video gaming. (iv) University students' future self-continuity significantly positively predicted their consideration of future consequences and state self-control capacity, which in turn significantly negatively predicted their problematic mobile video gaming. The findings encourage college students to develop future self-continuity to curb online gaming addiction, and provide direction for universities and education sectors to prepare college students for better employments by enhancing their future self-continuity.

Abbreviations

PMVG	Problematic Mobile Video Gaming
FSC	Future Self-continuity
CFC	Consideration of Future Consequences
SSCC	State Self-control Capacity
CB-SEM	Covariance based structural equation modeling
MI	Modification Indices

Acknowledgements

The authors would like to thank the college students from four universities for agreeing to participate in the study.

Authors' contributions

JXS was responsible for the conceptualization, methodology, writing of the original draft preparation. JSZ was responsible for data analysis, the revision of the paper. TZ was responsible for the revision of the paper and guidance of application for statistical methods. All authors have read and approved the final manuscript.

Funding

This study is supported by the Research Project of Macao Polytechnic University (RP/ESCHS-04/2020).

Availability of data and materials

The dataset used and analyzed during the current study is available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The ethics review of this study can be waived, according to *Measures for the Ethics Review of Life Sciences and Medical Research Involving Human*, released by China authorities, including the National Health Commission (NHC), Ministry of Education, Ministry of Science and Technology and National Administration of Traditional Chinese Medicine with its website as https://www.gov.cn/zhengce/zhengceku/2023-02/28/content_5743658.htm. As reported by this document, the need for ethics approval can be waived, if the collected data does not cause harm to humans, does not involve sensitive personal information or commercial interests, and is anonymized. Our data collection meets all these criteria, so the ethical review of this paper was waived.

All participants were required to read and signed on a written informed consent by ticking a box in the online survey. The survey questionnaire was disseminated only after obtaining the participants' consent. In addition, this study followed the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

¹Faculty of Humanities and Social Sciences, Macao Polytechnic University, Macao, People's Republic of China. ²Wuhan Sports University, Wuhan, Hubei, People's Republic of China.

Received: 8 August 2022 Accepted: 20 July 2023

Published online: 08 August 2023

References

- Sheng JR, Wang JL. Development and psychometric properties of the problematic mobile video gaming scale. *Curr Psychol*. 2021;40(9):4624–34.
- Chen C, Leung L. Are you addicted to Candy Crush Saga? An exploratory study linking psychological factors to mobile social game addiction. *Telematics Inform*. 2016;33(4):1155–66.
- Gioia F, Colella GM, Boursier V. Evidence on Problematic Online Gaming and Social Anxiety over the Past Ten Years: a Systematic Literature Review. *Curr Addict Rep*. 2022;9:1–16.
- Nazari N, Shabbir MS, Sevbitov AV, Sadeghi M, Griffiths MD. Psychometric evaluation of the Russian version of the Gaming Disorder Scale for Adolescents. *Curr Psychol*. 2023;42:1–15.
- China Internet Network Information Center. The 51st Statistical Report on China's Internet Development. 2023. <https://cnnic.cn/NMediaFile/2023/0322/MAIN16794576367190GBA2HA1KQ.pdf>.
- Lopez-Fernandez O, Männikkö N, Kääriäinen M, Griffiths MD, Kuss DJ. Mobile gaming and problematic smartphone use: a comparative study between Belgium and Finland. *J Behav Addict*. 2018;7(1):88–99.
- Hussain I, Cakir O, Ozdemir B. Studying internet addiction profile of university students with latent class analysis. *Educ Inf Technol*. 2020;25:4937–59.
- Ersner-Hershfield H, Garton MT, Ballard K, Samanez-Larkin GR, Knutson B. Don't stop thinking about tomorrow: Individual differences in future self-continuity account for saving. *Judgm Decis Mak*. 2009;4(4):280–6.
- Ersner-Hershfield H, Wimmer GE, Knutson B. Saving for the future self: Neural measures of future self-continuity predict temporal discounting. *Soc Cogn Affect Neurosci*. 2009;4(1):85–92.

10. Hershfield HE. Future self-continuity: How conceptions of the future self transform intertemporal choice. *Ann N Y Acad Sci*. 2011;1235(1):30–43.
11. Gröpel P, Steel P. A mega-trial investigation of goal setting, interest enhancement, and energy on procrastination. *Personality Individ Differ*. 2008;45(5):406–11.
12. Sokol Y, Serper M. Development and validation of a future self-continuity questionnaire: a preliminary report. *J Pers Assess*. 2019;102(5):677–88.
13. De Groot O, Verboven F. Subsidies and time discounting in new technology adoption: Evidence from solar photovoltaic systems. *American Economic Review*. 2019;109(6):2137–72.
14. Nordby K, Løkken RA, Pfuhl G. Playing a video game is more than mere procrastination. *BMC psychology*. 2019;7(1):1–12.
15. Adelman RM, Herrmann SD, Bodford JE, Barbour JE, Graudejus O, Okun MA, Kwan VS. Feeling closer to the future self and doing better: Temporal psychological mechanisms underlying academic performance. *J Pers*. 2017;85(3):398–408.
16. Oyserman D, Destin M. Identity-based motivation: Implications for inter-vening. *Couns Psychol*. 2010;38(7):1001–43.
17. Nurra C, Oyserman D. From future self to current action: An identity-based motivation perspective. *Self and identity*. 2018;17(3):343–64.
18. Vaid SS, Harari GM. Smartphones in personal informatics: a framework for self-tracking research with mobile sensing. *Digital Phenotyping and Mobile Sensing*. 2019. p. 65–92.
19. Yang X, Wang P, Hu P. Trait procrastination and mobile phone addiction among Chinese college students: a moderated mediation model of stress and gender. *Front Psychol*. 2020;11:3318.
20. Strathman A, Gleicher F, Boninger DS, Edwards CS. The consideration of future consequences: weighing immediate and distant outcomes of behavior. *J Pers Soc Psychol*. 1994;66(4):742–52.
21. Joireman J, Anderson J, Strathman A. The aggression paradox: understanding links among aggression, sensation seeking, and the consideration of future consequences. *J Pers Soc Psychol*. 2003;84(6):1287–302.
22. Lukavská K. The immediate and long-term effects of time perspective on Internet gaming disorder. *J Behav Addict*. 2018;7(1):44–51.
23. Sun C, Sun B, Lin Y, Zhou H. Problematic mobile phone use increases with the fear of missing out among college students: the effects of self-control, perceived social support and future orientation. *Psychol Res Behav Manag*. 2022;15:1–8.
24. Upadhyay D. Consideration of future consequences and decision-making patterns as determinants of conflict management styles. *IIMB Manag Rev*. 2021;33(1):5–14.
25. Kim J, Nan X. Effects of consideration of future consequences and temporal framing on acceptance of the HPV vaccine among young adults. *Health Commun*. 2016;31(9):1089–96.
26. Pozolotina T, Olsen SO. Consideration of immediate and future consequences, perceived change in the future self, and health behavior. *Health Mark Q*. 2019;36(1):35–53.
27. Baumeister RF. Yielding to temptation: Self-control failure, impulsive purchasing, and consumer behavior. *J Consum Res*. 2002;28(4):670–6.
28. Johnson RE, Lanaj K, Barnes CM. The good and bad of being fair: Effects of procedural and interpersonal justice behaviors on regulatory resources. *J Appl Psychol*. 2014;99(4):635–50.
29. Clinton ME, Conway N, Sturges J, Hewett R. Self-control during daily work activities and work-to-nonwork conflict. *J Vocat Behav*. 2020;118:103410.
30. Liu Q, Zhou Z, Niu G, Fan C. Mobile phone addiction and sleep quality in adolescents: mediation and moderation analyses. *Acta Psychol Sin*. 2017;49(12):1524–36.
31. Chen Y, Li R, Liu X. Relatedness frustration and compensatory behaviors in social networking sites among Chinese college students: Role of self-control failure. *Curr Psychol*. 2023;42:307–16.
32. Jiang Z, Zhao X. Self-control and problematic mobile phone use in Chinese college students: the mediating role of mobile phone use patterns. *BMC Psychiatry*. 2016;16(1):1–8.
33. Tian L, Zhou X. An empirical study on the causes of mobile phone dependence of college students. *Int J Wireless Inf Networks*. 2023;30(1):129–36.
34. Zhong W, Wang Y, Zhang G. The impact of physical activity on college students' mobile phone dependence: the mediating role of self-control. *Int J Ment Heal Addict*. 2021;19:2144–59.
35. Fu G, Li S, Guo J. The relationship between future self-continuity and mobile phone dependence of college students: mediating role of self-control. *Int'l J Soc Sci Stud*. 2020;8:17–24.
36. Hershfield HE, Cohen TR, Thompson L. Short horizons and tempting situations: Lack of continuity to our future selves leads to unethical decision making and behavior. *Organ Behav Hum Decis Process*. 2012;117(2):298–310.
37. Di Domenico SI, Fournier MA, Rodrigo AH, Dong M, Ayaz H, Ruocco AC. Need fulfillment and the modulation of medial prefrontal activity when judging remembered past, perceived present, and imagined future identities. *Self Identity*. 2018;17(3):259–75.
38. Dreves PA, Blackhart GC. Thinking into the future: how a future time perspective improves self-control. *Personality Individ Differ*. 2019;149:141–51.
39. Stolarski M, Zajenkowski M, Jankowski KS, Szymaniak K. Deviation from the balanced time perspective: a systematic review of empirical relationships with psychological variables. *Personality Individ Differ*. 2020;156:109772.
40. Baloğlu M, Şahin R, Arpacı I. A review of recent research in problematic internet use: gender and cultural differences. *Curr Opin Psychol*. 2020;36:124–9.
41. Su W, Han X, Jin C, Yan Y, Potenza MN. Are males more likely to be addicted to the internet than females? A meta-analysis involving 34 global jurisdictions. *Comput Hum Behav*. 2019;99:86–100.
42. Wartberg L, Zieglermeier M, Kammerl R. An empirical exploration of longitudinal predictors for problematic internet use and problematic gaming behavior. *Psychol Rep*. 2021;124(2):543–54.
43. Sung Y, Nam T-H, Hwang MH. Attachment style, stressful events, and Internet gaming addiction in Korean university students. *Personality Individ Differ*. 2020;154:109724.
44. Dieris-Hirche J, Pape M, te Wildt BT, Kehyayan A, Esch M, Aicha S, Herpertz S, Böttel L. Problematic gaming behavior and the personality traits of video gamers: a cross-sectional survey. *Comput Hum Behav*. 2020;106:106272.
45. Desai RA, Krishnan-Sarin S, Cavallo D, Potenza MN. Video-gaming among high school students: health correlates, gender differences, and problematic gaming. *Pediatrics*. 2010;126(6):1414–24.
46. Li L, Shi J, Wu D, Li H. Only child, parental educational expectation, self-expectation and science literacy in Zhuang adolescents in China: a serial mediation model. *Child Youth Serv Rev*. 2020;115:105084.
47. Li Y, Hu T, Ge T, Auden E. The relationship between home-based parental involvement, parental educational expectation and academic performance of middle school students in mainland China: a mediation analysis of cognitive ability. *Int J Educ Res*. 2019;97:139–53.
48. André F, Broman N, Håkansson A, Claesdotter-Knutsson E. Gaming addiction, problematic gaming and engaged gaming—Prevalence and associated characteristics. *Addict Behav Rep*. 2020;12:100324.
49. Olivera-Figueroa LA, Unger A, Papastamatelou J, Zimbardo PG. A time to get vaccinated? The role of time perspective, consideration of future consequences, conspiracy beliefs, religious faith, gender, and race on intention to vaccinate for COVID-19 in the United States. *Int J Environ Res Public Health*. 2023;20(4):3625.
50. Liang Y, Zhou N, Dou K, Cao H, Li J-B, Wu Q, Liang Y, Lin Z, Nie Y. Career-related parental behaviors, adolescents' consideration of future consequences, and career adaptability: a three-wave longitudinal study. *J Couns Psychol*. 2020;67(2):208–21.
51. Wang J-L, Sheng J-R, Wang H-Z. The association between mobile game addiction and depression, social anxiety, and loneliness. *Front Public Health*. 2019;7:247.
52. Shi J, Boak A, Mann R, Turner NE. Adolescent problem video gaming in urban and non-urban regions. *Int J Ment Heal Addict*. 2019;17:817–27.
53. Singh L, Rathbone CJ, Moulds ML, Holmes EA. Future self-imagery of young people in Sweden during the COVID-19 pandemic: an exploratory mixed methods analysis. *Curr Psychol*. 2022:1–15.
54. Dingle GA, Cruwys T, Frings D. Social identities as pathways into and out of addiction. *Front Psychol*. 2015;6:1795.
55. Hayes AF. *Statistical methods for communication science*. New York: Routledge; 2020.
56. Shen J, Wang Y, Zhou C. Application of the Chinese version of the Future Self-continuity Questionnaire in college students. *Chin Ment Health J*. 2022;36(1):73–6. In Chinese.
57. Fei A, Yang Q, Yu W, Zijiang H. Validity and reliability of the Chinese version of the S. *Chin Ment Health J*. 2020;34(12):1036–40. In Chinese.

58. Miller MD. Classical Test Theory Reliability. In: Peterson P, Baker E, McGaw B, editors. *International Encyclopedia of Education*. 3rd ed. Oxford: Elsevier; 2010. p. 27–30.
59. Adamson KA, Prion S. Reliability: measuring internal consistency using Cronbach's α . *Clin Simul Nurs*. 2013;9(5):179–80.
60. MacKenzie SB, Podsakoff PM. Common method bias in marketing: Causes, mechanisms, and procedural remedies. *J Retail*. 2012;88(4):542–55.
61. Min H, Park J, Kim HJ. Common method bias in hospitality research: a critical review of literature and an empirical study. *Int J Hosp Manag*. 2016;56:126–35.
62. Rosseel Y. lavaan: An R Package for Structural Equation Modeling. *J Stat Softw*. 2012;48(2):1–36.
63. Dash G, Paul J. CB-SEM vs PLS-SEM methods for research in social sciences and technology forecasting. *Technol Forecast Soc Chang*. 2021;173:121092.
64. Blouin-Hudon EMC, Pychyl TA. A mental imagery intervention to increase future self-continuity and reduce procrastination. *Appl Psychol*. 2017;66(2):326–52.
65. Chishima Y, Wilson AE. Conversation with a future self: a letter-exchange exercise enhances student self-continuity, career planning, and academic thinking. *Self Identity*. 2021;20(5):646–71.
66. Blouin-Hudon EMC, Pychyl TA. Experiencing the temporally extended self: Initial support for the role of affective states, vivid mental imagery, and future self-continuity in the prediction of academic procrastination. *Pers Individ Differ*. 2015;86:50–6.
67. Zhao X, Dichtl FF, Foran HM. Predicting smoking behavior: intention and future self-continuity among Austrians. *Psychol Health Med*. 2022;27(5):1042–51.
68. Qi H, Bi C, Kang Q, Wu Q, Wu D. Far from the Future: Internet Addiction Association with Delay Discounting Among Adolescence. *Int J Ment Health Addict*. 2022:1–20.
69. Hershfield HE, Maglio SJ. When does the present end and the future begin? *J Exp Psychol Gen*. 2020;149(4):701–18.
70. Rutchick AM, Slepian ML, Reyes MO, Pleskus LN, Hershfield HE. Future self-continuity is associated with improved health and increases exercise behavior. *J Exp Psychol Appl*. 2018;24(1):72–80.
71. Van Gelder J-L, Hershfield HE, Nordgren LF. Vividness of the future self predicts delinquency. *Psychol Sci*. 2013;24(6):974–80.
72. Zheng J, Wang TY, Zhang T. The extension of particularized trust to generalized trust: The moderating role of long-term versus short-term orientation. *Soc Indic Res*. 2023;166(2):269–98.
73. Ciccarelli M, Cosenza M, Nigro G, Griffiths M, D'Olimpio F. Gaming and gambling in adolescence: the role of personality, reflective functioning, time perspective and dissociation. *Int Gambl Stud*. 2022;22(1):161–79.
74. Guo M, Lou Y, Zhang N. Consideration of future consequences and self-control mediate the impact of time perspectives on self-rated health and engagement in healthy lifestyles among young adults. *Curr Psychol*. 2022:1–11.
75. Schiebener J, Brand M. Decision-making and related processes in internet gaming disorder and other types of internet-use disorders. *Curr Addict Rep*. 2017;4:262–71.
76. Runions KC. Toward a conceptual model of motive and self-control in cyber-aggression: rage, revenge, reward, and recreation. *J Youth Adolesc*. 2013;42:751–71.
77. Wang Z, Hu Y, Zheng H, Yuan K, Du X, Dong G. Females are more vulnerable to Internet gaming disorder than males: Evidence from cortical thickness abnormalities. *Psychiatry Res Neuroimaging*. 2019;283:145–53.
78. Király O, Urbán R, Griffiths MD, Ágoston C, Nagygyörgy K, Kökönyei G, Demetrovics Z. The mediating effect of gaming motivation between psychiatric symptoms and problematic online gaming: an online survey. *J Med Internet Res*. 2015;17(4):3515.
79. Hoff RA, Howell JC, Wampler J, Krishnan-Sarin S, Potenza MN. Differences in associations between problematic video-gaming, video-gaming duration, and weapon-related and physically violent behaviors in adolescents. *J Psychiatr Res*. 2020;121:47–55.
80. Wongkitrungrueng A, Suprawan L. Metaverse Meets Branding: Examining Consumer Responses to Immersive Brand Experiences. *Int J Hum-Comput Interact*. 2023:1–20.
81. Shen KS. Measuring the sociocultural appeal of SNS games in Taiwan. *Internet Res*. 2013;23(3):372–92.
82. Meng Y, Deng W, Wang H, Guo W, Li T. The prefrontal dysfunction in individuals with Internet gaming disorder: a meta-analysis of functional magnetic resonance imaging studies. *Addict Biol*. 2015;20(4):799–808.
83. Yavuz O. Exploring the impacts of school reforms on underrepresented urban students' college persistence. *Educ Res Eval*. 2016;22(7–8):354–73.
84. Chen J. Hysteresis effects and emotional suffering: Chinese rural students' first encounters with the urban university. *Sociol Res Online*. 2022;27(1):101–17.
85. Zhang H, Zhou ZE, Liu Y, Shi Y, Xiao J. Too depleted to control yourself? Effect of customer mistreatment on after-work maladaptive behaviours through self-control capacity impairment. *Appl Psychol*. 2022;71(1):27–48.
86. Columb D, Griffiths MD, O'Gara C. Online gaming and gaming disorder: More than just a trivial pursuit. *Ir J Psychol Med*. 2022;39(1):1–7.
87. Mathiyazhagan S, Wang Z. N'KaNa-my dream: community action towards the holistic child development in India. *Child Youth Serv Rev*. 2021;122:105924.
88. Mlambo VH, Masuku MM, Ndebele NC. Students' Perceptions on the Availability of Prescribed Study Material under the New NSFAS Book Allowance Funding Model. *Int J Learn High Educ*. 2022;30(1):173–91.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

