



# Parent-child relationship and problematic smartphone use among chinese adolescents: a moderated mediation model

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## Abstract

To explore the influence and mechanism of parent-child relationship on adolescents' problematic smartphone use, a sample of 3355 Chinese adolescents ( $M_{age}=16.93$ ,  $SD=0.49$ , range: 14–19 years old; 48% boys) is recruited to measure parent-child relationship, problematic smartphone use, personal growth initiative, and school belonging. The results are as follows. (1) After controlling for gender, age and time spent online per day, parent-child relationship is negatively correlated with problematic smartphone use, and the negative association between parent-child relationship and problematic smartphone use is mediated by the personal growth initiative. (2) The association between parent-child relationship and problematic smartphone use, the association between parent-child relationship and personal growth initiative, and the association between personal growth initiative and problematic smartphone use are all moderated by school belonging and are stronger in adolescents with a high level of school belonging. The present study highlights the mediating role of personal growth initiative and the moderating role of school belonging in the association between parent-child relationship and problematic smartphone use. This study also contributes to a better understanding of the effects, paths, and conditions of parent-child relationship on the problematic smartphone use of adolescents and provides constructive suggestions for preventing adolescents' problematic smartphone use in the mobile Internet era.

**Keywords** Parent-child relationship · Problematic smartphone use · Personal growth initiative · School belonging · Adolescents

## Introduction

In China, the use of smartphones is becoming more

and more common among adolescents. According to the research report on the Internet use of minors in 2019 released by China Internet Network Information Center, the number of underage Netizens in China reached 175 million, and smartphones became the main tool for adolescents to access the Internet, accounting for 93.1% (China Internet Network Information Center, 2020). Young people readily develop attachment toward smartphones, seeking the proximity of smartphones and experiencing distress on separation (Konok et al., 2016). Many individuals even get addicted to smartphones, especially adolescents (Yen et al., 2009). For children and adolescents, problematic smartphone use is related to a series of psychological problems such as depression, loneliness, and social anxiety (Çağan et al., 2014; Chen et al., 2016; Wang et al., 2014). Several studies have shown that the incidence of problematic smartphone use among Chinese adolescents is more than 10% (Bian et al., 2016; Tang et al., 2016). In addition, affected by the COVID-19 pandemic, many students cannot return to school (The Lancet, 2020), and must study online at home,

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the use of electronic devices has risen accordingly (Dong et al., 2020). Therefore, with the immersion of smartphones in daily life and the increasing problem of problematic smartphone use, it is of great practical significance to explore the influencing mechanism of adolescents' problematic smartphone use.

Although there is no unified definition, problematic smartphone use usually refers to excessive, addictive and/or inappropriate use of smartphones, which may cause adverse consequences (Billieux, 2012). Some researchers think the concept of addiction overstates the severity of problematic use and some everyday cyber behaviors, such as smartphone use, are over-pathologized (Ellis et al., 2019; Orben & Przybylski, 2019). Problematic smartphone use is not officially recognized as a mental disorder. It focuses on some problematic but non-pathological uses. And it consists of four dimensions: dangerous use, prohibited use, dependence and financial problems (Billieux et al., 2008; Billieux, 2012). Therefore, problematic smartphone use includes not only dependent behaviors, but also problematic use patterns in normal life, weakening the concept of addiction (or dependence). In our study, we focus on students' problem behavior. Therefore, we use the term "problematic smartphone use".

Among the many factors that affect problematic smartphone use, family factors are particularly important. Among them, family relationship, especially parent-child relationship, is one of the most important factors affecting problematic smartphone use (Ahmadi & Saghafi, 2013; Huang et al., 2021; Jia et al., 2018). Numerous studies have confirmed the link between parent-child relationship and adolescents' problematic smartphone use (Gao et al., 2020; Zhen et al., 2019). For example, positive parent-children relationship is associated with decreased adolescents' problematic smartphone use (Liu et al., 2013; Zhu et al., 2015). However, little research exists that comprehensively examines the influence of family, individual, and school factors on adolescents' problematic smartphone use. Home-school cooperation plays an important role in adolescents' development (Epstein & Salinas, 2004; Li et al., 2019; Liu et al., 2007). And for adolescents' development, individual initiative factor is very critical. Therefore, This study comprehensively investigates how parent-child relationship as a family factor, school belonging as a school factor and personal growth initiative as an individual factor conjunctively affect adolescents' problematic smartphone use.

### Parent-child relationship and problematic smartphone use

According to problem behavior theory, dysfunctional family relationship, particularly parent-child relationship plays

an important role in the onset and intensification of adolescents' problematic smartphone use (De Leo & Wulfert, 2013; Yen et al., 2008). The problematic mobile phone use mechanism pathway model proposed by Billieux's team also emphasizes that interpersonal relationship is the most critical predictor of problematic smartphone use (Billieux, 2012; Billieux et al., 2015). Theoretically, a good parent-child relationship has two core functions: emotional warmth and social control, both of them are negatively linked to adolescents' problematic smartphone use. A positive relationship with parents provides adolescents with warmth and security, which may satisfy their offline psychological needs and, in turn, alleviate their problematic smartphone use (Jia et al., 2017). Social control theory suggests that adherence to conventional institutions, such as those established by parents, serves as a form of social control. Adolescents under social control might more readily accept supervision and constraints from parents, and the risk of problematic smartphone use would also decrease (Jia et al., 2017, 2018). Many studies have shown that poor parent-child relationship is closely related to problematic smartphone use (Liu & Kuo, 2007; Park et al., 2008; Shin et al., 2011). In addition, the parent-child relationship is the core of family therapy. Therefore, we believe that by improving the parent-child relationship, adolescents' problematic smartphone use can be managed.

Although many prior studies have provided ample evidence of the association between poor parent-child relationship and adolescents' problematic smartphone use (Gao et al., 2020; Zhen et al., 2019), little research exists that comprehensively examines the influence of family, individual, and school factors on adolescents' problematic smartphone use. Recently, Huang et al., (2021) employed a network analysis approach to comprehensively analyze the impact of individual, family and school factors on problematic smartphone use, the study found that the core factors in the network were peer attitudes towards smartphone use, self-control ability, and the parent-child relationship. The study revealed the importance of comprehensively considering various influencing factors, but didn't explain the comprehensive mechanism of individual, family and school factors on problematic smartphone use. According to problem-behavior theory, individual behavior needs to be studied from the perspective of development and the interaction between individuals, the environment, and behavior (Jessor, 1987). The environment has different influences on behavior because of individual differences, and individuals show different behaviors because of different environments. Therefore, the present study constructed a moderated mediation model to test the mediating role of individual factors (e.g., personal growth initiative) and the moderating role of school factors (e.g., school belonging) in the association between

parent-child relationship and problematic smartphone use among Chinese adolescents. The findings advance our understanding of how and when parent-child relationship is related to problematic smartphone use and how to protect adolescents from problematic smartphone use.

### Personal growth initiative as mediator

Throughout life, individuals are likely to experience challenging, adverse situations that require changes in the way they interact with others and handle various quotidian situations. Personal growth initiative is defined as the active and intentional involvement of the individual in his or her personal growth process (Robitschek, 1998). Personal growth initiative is associated with the person's ability to evaluate adverse and stressful situations as challenges and opportunities for personal growth, allowing them to experience less stress when coping with these situations (Weigold & Robitschek, 2011; Yakunina et al., 2013b). Theorists and prior empirical research have long argued the importance of parent-child relationship in the development of adolescents, and poor parent-child relationship creates environmental stress for adolescents. According to problem-behavior theory, environmental stress may affect individual behavior through individual factors (Jessor, 1987). Therefore, personal growth initiative may play a mediating role between parent-child relationship and problematic smartphone use. First, parent-child relationship may be related to personal growth initiative, and several reasons exist for supporting the aforementioned hypothesis. The first reason is that the characteristics of the family system of individuals may be related to personal growth initiative indices (Robitschek & Kashubeck, 1999; Whittaker & Robitschek, 2001). Regarding the family system, family cohesion and communication were demonstrated to be positively related to personal growth initiative, whereas family conflict was negatively related to personal growth initiative (Robitschek & Kashubeck, 1999). Families with good parent-child relationship usually have high family cohesion and less family conflict (Sun et al., 2020b). Thus, good parent-child relationship may be linked to personal growth initiative through family cohesion. The second reason is that research has revealed that authoritative parenting styles are positively related to personal growth initiative, whereas authoritarian and indulgent parenting styles are negatively related to personal growth initiative (Hirata & Kamakura, 2017), and authoritative parenting is positively linked to good parent-child relationship (Trost et al., 2020). Thus, good parent-child relationship may be positively related to personal growth initiative through authoritative parenting. Overall, it is reasonable to assume that parent-child relationship is significantly associated with personal growth initiative.

Moreover, personal growth initiative might be a susceptibility factor for problematic smartphone use. Weak personal growth initiative is related to difficulties with adapting to new contexts. Therefore, people with low personal growth initiative experience higher stress and anxiety and lower life satisfaction (Stevic & Ward 2008; Weigold & Robitschek, 2011; Yakunina et al., 2013a; Yakunina et al., 2013b). Many empirical studies have shown that negative emotions, such as stress and anxiety, are positively related to problematic smartphone use (Bianchi & Phillips, 2005; Demirci et al., 2015; Hong et al., 2012; Matar Boumosleh & Jaalouk, 2017). According to the compensatory Internet use model (Kardefelt-Winther, 2014), problematic smartphone use functions to avoid anxiety. Thus, problematic smartphone use may be associated with low personal growth initiative through negative emotions. In addition, Weigold et al., (2014) confirmed that personal growth initiative was positively correlated with self-control, indicating that people with strong personal growth initiative have control over the consequences of their actions. A significant negative association was found between self-control and problematic smartphone use (Kim et al., 2018; Liu et al., 2018; Sok et al., 2019). In addition, personal growth initiative is negatively correlated with problematic behaviors, such as gambling and negative risk taking (Loo et al., 2014; Yin & Zheng, 2019). Although the existing studies have not directly discussed the association between personal growth initiative and problematic smartphone use, the previous analyses show that personal growth initiative is negatively related to problematic smartphone use is reasonable.

Considering that parent-child relationship may be related to personal growth initiative, and there is an association between personal growth initiative and problematic smartphone use, we propose the following hypothesis.

**Hypothesis 1** Personal growth initiative mediates the association between parent-child relationship and adolescents' problematic smartphone use.

### School belonging as a moderator

School belonging reflects how accepted, respected, and supported students feel in their social context at school (Goode now & Grady, 1993), which has an important impact on adolescents' health and behavioral performance (Bao & Xu, 2006). The need to belong is a powerful, fundamental, and extremely pervasive human motivation that has multiple influences on people's emotions, cognitions, and behaviors (Baumeister & Leary, 1995). Adolescents use smartphones to gain more support and a sense of belonging (Walsh et al., 2009). Thus, adolescents who lack a sense of belonging may

use smartphones more than adolescents with a strong sense of belonging, putting them at greater risk of problematic smartphone use (Wang et al., 2017). That is, belonging is negatively related to adolescents' problematic smartphone use. In line with this notion, prior empirical studies have indicated that adolescents who lack of school belonging usually have problematic smartphone use behavior (Anderman, 2003; McWhirter et al., 2018).

Moreover, school belonging may moderate the direct and indirect association between parent-child relationship and problematic smartphone use. According to problem-behavior theory (Jessor, 1987), individuals show different behaviors because of different environments, and school belonging is an environmental factor that can alleviate the adverse effects of negative factors on problematic behaviors.

In line with problem-behavior theory, previous studies have suggested that school belonging serves as a protective function against risk behaviors (Brooks et al., 2012). For example, Hatchel et al., (2019) suggested that school belonging acted as a protective factor that alleviated the negative effects of peer victimization on suicidality. Meanwhile, belonging may moderate the association between environmental factors and adolescents' problematic smartphone use. In support of this notion, Zhou et al., (2017) found that adolescents' preference for social connections moderates the association between the quality of interpersonal relationship and adolescents' Internet addiction. Thus, school belonging may moderate the association between parent-child relationship and adolescents' problematic smartphone use. Another study indicated that belonging regulates the association between individual factors (e.g., self-esteem) and problematic smartphone use (Wang et al., 2017). Therefore, the study hypothesizes that school belonging may moderate the association between personal growth initiative and adolescents' problematic smartphone use. Moreover, according to relational developmental systems, the combined effect of different development environments (e.g., family and school) will contribute to individual development (Overton, 2013). That is, school belonging may exacerbate the association between parent-child relationship and adolescents' personal growth initiative. To sum up, school belonging as a positive environmental factor may buffer the direct and indirect correlations between parent-child relationship and adolescents' problematic smartphone use.

To date, there is no research to examine whether school belonging has a moderating effect on the direct and/or indirect association between parent-child relationships and problematic smartphone use. Based on problem-behavior theory (Jessor, 1987) and empirical grounds, we propose the following hypothesis.

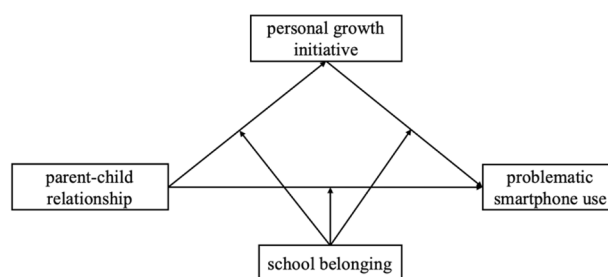


Fig. 1 Conceptual model

**Hypothesis 2** The direct and indirect associations between parent-child relationships and adolescents' problematic smartphone use vary as a function of school belonging, and these associations are stronger for adolescents with higher school belonging.

## The present study

This study tested the mechanisms underlying the association between parent-child relationship and problematic smartphone use in adolescents. Specifically, we examined a moderated mediation model to answer two questions: (a) whether personal growth initiative mediated the association between parent-child relationship and problematic smartphone use and (b) whether school belonging moderated the direct and indirect associations between parent-child relationship and adolescents' problematic smartphone use. Testing mediator and moderator variables in a single model could generate more comprehensive information than assessing two separate models (Fairchild & MacKinnon, 2009). The moderated mediation model in the present study (see Fig. 1) can indicate both how and when parent-child relationship influences problematic smartphone use.

## Methods

### Participants

A total of 3453 students in the eleventh grade were recruited from 65 high schools in the cities of Qingdao, they completed a battery of self-report questionnaires measuring their parent-child relationship, problematic smartphone use, personal growth initiative and school belonging. 98 students were excluded for missing data on the main variables. Finally, 3355 valid samples were obtained. Of this group, 48% of the participants were males. The mean age of the participants was 16.93 ( $SD_{age} = 0.49$ , range = 14–19).

## Procedure

We adopted convenience sampling to select the target school. In the 65 target schools (ordinary senior high schools), we used the cluster random sampling method to choose several 11th-grade classes. All schools received a letter of information that detailed the study's purposes and procedures, and all the participants' parents agreed that they could participate in this program. Students in the target classes were invited to participate anonymously in the survey in classrooms. The authenticity, independence, and integral nature of all answers and the confidentiality of the information collected were emphasized to all participants by well-trained psychology graduate students. It took the participants approximately 20 min to complete the questionnaire. Each participant completed the measures independently in a self-administered format to safeguard confidentiality. All participations were voluntary, and the data was kept completely confidential.

## Measurements

### Parent-child relationship

The adapted Network of Relationships Inventory (NRI, Furman & Buhrmester 1985) was used in this study. For example, NRI includes "How much do you and this person play around and have fun". It was adapted in this study (e.g., "How much do you and your parents play around and have fun"). Participants rated 8 items on a five-point scale (1 = never, 5 = always). Responses across the 8 items can be added and averaged to generate a final NRI score, with higher scores indicating better parent-child relationship. In this study, Cronbach's  $\alpha$  for the NRI was 0.87.

### Problematic smartphone use

Problematic smartphone use was assessed using the Mobile Phone Problem Use Scale-10 (MPPUS-10, Foerster et al., 2015). Participants rated 10 items (e.g., "When I'm in a bad mood, I use my phone to make me feel better") on a five-point scale (1 = completely not true, 5 = completely true). Responses across the 10 items can be added and averaged to generate a final MPPUS score, with higher scores representing greater problematic smartphone use. Cronbach's  $\alpha$  for the MPPUS was 0.91.

### Personal growth initiative

The Personal Growth Initiative Scale (PGIS, Robitschek, 1998) was used in this study. Participants rated 9 items (e.g., "I know how to change specific things that I want to

change in my life") on a six-point scale (1 = strongly disagree, 6 = strongly agree). Responses across the 9 items can be added and averaged to generate a final PGIS score, with higher scores representing a higher level of personal growth initiative. Cronbach's  $\alpha$  for the PGIS was 0.93.

### School belonging

The School Belonging Scale (SBS) from the Programmer for International Student Assessment (PISA, OECD, 2018) was used in this study. Participants rated 5 items (e.g., "I like my school") on a four-point scale (1 = strongly disagree, 4 = strongly agree). Responses across the 5 items can be added and averaged to generate a final SBS score, with higher scores representing a higher level of school belonging. Cronbach's  $\alpha$  for the SBS was 0.88.

## Statistical analysis

In this study, we first used a factor analysis to conduct a common variance analysis for detecting common method biases. Secondly, we conducted analyses of variance and calculated descriptive statistics and correlations using SPSS 26.0. We used model 4 of the PROCESS macro (Hayes, 2013) to test mediation. Then, we tested the moderated mediation model using model 59 of the PROCESS macro. This SPSS macro PROCESS is specifically developed for testing complex models, including both mediator and moderator variables. This macro has been used by many scholars to test moderated mediation or mediated moderation models (e.g., Cero & Sifers 2013; Chardon et al., 2016).

## Results

### Common Method Bias

All the data in this study were obtained through the self-report of the participants, so there may be common method deviation. This study has carried out corresponding control in the research procedure (anonymous answers and reverse scoring of some questions). However, in order to ensure the rigor and scientificity of research results, we further adopted Harman's single-factor test to test common method deviation (Podsakoff et al., 2012). The results showed that the variance explained by the first factor was 33.14% (less than the 40% standard), indicating that there was no serious common method bias in the data in this study.



**Table 1** Descriptive statistics and intercorrelations between variables

Variables	<i>M</i>	<i>SD</i>	1	2	3	4
1 parent-child relationship	3.78	0.79	1			
2 personal growth initiative	4.63	0.88	0.37***	1		
3 school belonging	3.24	0.63	0.39***	0.49***	1	
4 problematic smartphone use	2.52	0.94	-0.38***	-0.35***	-0.38***	1

Note. *N* = 3355. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$

## Preliminary analyses

In this study, 71.4% of adolescents use smartphones to surf the Internet every day, and 11.1% spend more than 2 h surfing the Internet on average every day. The descriptive statistics and correlation matrix are presented in Table 1. As expected, after controlling for gender, age and time spent online per day, adolescents with better parent-child relationship were less likely to have problematic smartphone use, which is also true for adolescents with higher personal growth initiative. In addition, adolescents with better parent-child relationship were more likely to have higher personal growth initiative. Moreover, adolescents with higher levels of school belonging are less likely to have problematic smartphone use; they may have higher levels of personal growth initiative and better parent-child relationship as well.

## Testing for mediation

As shown in Table 2, after controlling for gender, age and time spent online per day, parent-child relationship was negatively associated with problematic smartphone use ( $\beta = -0.37$ ,  $p < .001$ ). In addition, parent-child relationship was positively associated with personal growth initiative ( $\beta = 0.38$ ,  $p < .001$ ), which in turn was negatively associated with problematic smartphone use ( $\beta = -0.23$ ,  $p < .001$ ).

The direct association between parent-child relationship and problematic smartphone use was also significant ( $\beta = -0.28$ ,  $p < .001$ ), which suggested that personal growth initiative partially mediated the link between parent-child relationship and problematic smartphone use (indirect effect =  $-0.09$ ,  $SE = 0.01$ , 95%  $CI = -0.10 - -0.07$ ). This indirect effect accounted for 24.32% of the variance in participants' problematic smartphone use. Thus, Hypothesis 1 was supported.

## Testing for moderated mediation

Hypothesis 2 predicted that school belonging buffers the direct and/or indirect association between parent-child relationship and problematic smartphone use. As shown in Table 3, after controlling for gender, age and time spent online per day, a significant association between parent-child relationship and problematic smartphone use was observed ( $\beta = -0.23$ ,  $p < .001$ ), and this association was also moderated by school belonging ( $p < .01$ ). Figure 2 shows the plot of the association between parent-child relationship and problematic smartphone use separately for low and high levels of school belonging (1 *SD* below the mean and 1 *SD* above the mean, respectively; see Fig. 2). Simple slope tests showed that the association between parent-child relationship and problematic smartphone use was stronger at a high level of school belonging ( $\beta_{\text{simple}} = -0.28$ ,  $p < .001$ ) than at

**Table 2** Testing the mediation effect of parent-child relationship on problematic smartphone use

Outcome	Predictors	<i>R</i> <sup>2</sup>	<i>F</i>	$\beta$	LLCI	ULCI	<i>t</i> value
PSU	Gender	0.21	216.47***	-0.11	-0.17	-0.05	-3.63***
	Age			0.02	-0.05	0.08	0.53
	Time spent online per day			0.11	0.09	0.12	12.33***
	PCR			-0.37	-0.40	-0.34	-23.57***
PGI	Gender	0.15	144.78***	-0.13	-0.20	-0.07	-4.17***
	Age			0.007	-0.06	0.07	0.20
	Time spent online per day			-0.02	-0.04	-0.004	-2.37*
	PCR			0.38	0.35	0.41	23.30***
PSU	Gender	0.25	223.44***	-0.14	-0.20	-0.08	-4.74***
	Age			0.02	-0.04	0.08	0.60
	Time spent online per day			0.10	0.09	0.12	12.10***
	PCR			-0.28	-0.32	-0.25	-17.23***
	PGI			-0.23	-0.26	-0.20	-14.14***

Note: *N* = 3355, PSU = problematic smartphone use, PGI = personal growth initiative, PCR = parent-child relationship. Bootstrap sample size = 5000, LL = low limit, CI = confidence interval, and UL = upper limit. The research variables (excluding gender, age and time spent online per day) in the regression models were standardized. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

a low level of school belonging ( $\beta_{\text{simple}} = -0.18, p < .001$ ). That is, the negative direct association between parent-child relationship and problematic smartphone use, the positive association between parent-child relationship and personal growth initiative and the negative association between personal growth initiative and problematic smartphone use were stronger when school belonging was high.

The association between parent-child relationship and personal growth initiative was significant ( $\beta = 0.22, p < .001$ ) and was moderated by school belonging ( $p < .05$ ). Figure 3 depicts the results of the effect analysis. The plot shows the association between parent-child relationship and personal growth initiative, separately for low and high levels of school belonging (1 SD below the mean and 1 SD above the mean, respectively; see Fig. 3). Simple slope tests showed that the association between parent-child relationship and personal growth initiative was stronger at a high level of

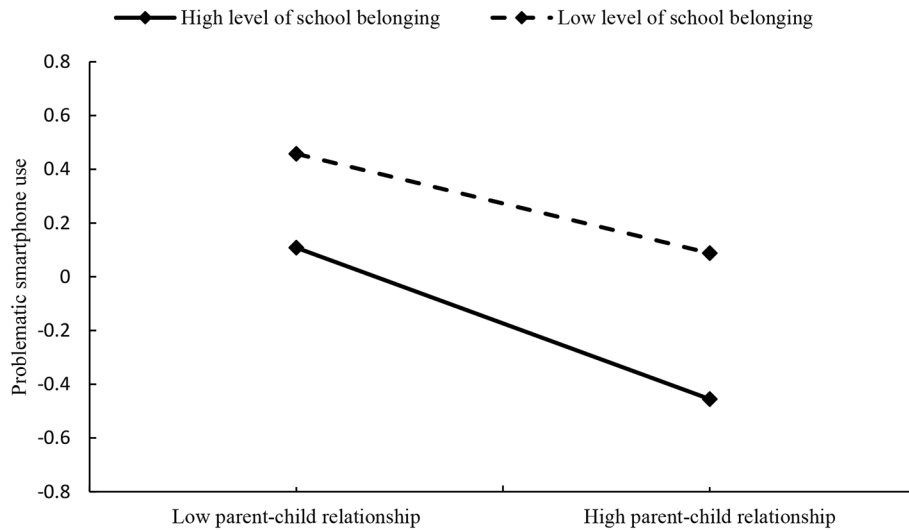
school belonging ( $\beta_{\text{simple}} = 0.25, p < .001$ ) than at a low level of school belonging ( $\beta_{\text{simple}} = 0.19, p < .001$ ).

In addition, the association between personal growth initiative and problematic smartphone use was significant ( $\beta = -0.15, p < .001$ ), and this association was also moderated by school belonging ( $p < .001$ ). Figure 4 shows the plot of the association between personal growth initiative and problematic smartphone use separately for low and high levels of school belonging (1 SD below the mean and 1 SD above the mean, respectively; see Fig. 4). Simple slope tests showed that the association between personal growth initiative and problematic smartphone use was stronger at a high level of school belonging ( $\beta_{\text{simple}} = -0.21, p < .001$ ) than at a low level of school belonging ( $\beta_{\text{simple}} = -0.09, p < .001$ ). Therefore, Hypothesis 2 was supported.

**Table 3** Testing the moderated mediation effect of parent-child relationship on problematic smartphone use.

Outcome	Predictors	R <sup>2</sup>	F	$\beta$	LLCI	ULCI	t value			
PGI	Gender	0.29	228.00***	-0.16	-0.22	-0.10	-5.32***			
	Age			0.05	-0.01	0.11	1.60			
	Time spent online per day			0.0003	-0.02	0.02	0.04			
	PCR			0.22	0.19	0.25	13.55***			
	SB			0.42	0.39	0.45	25.94***			
	PCR×SB			0.03	0.01	0.06	2.47*			
PSU	Gender	0.29	172.76***	-0.13	-0.19	-0.08	-4.48***			
	Age			-0.003	-0.06	0.06	-0.09			
	Time spent online per day			0.09	0.07	0.10	10.78***			
	PCR			-0.23	-0.27	-0.20	-14.09***			
	PGI			-0.15	-0.19	-0.12	-8.67***			
	SB			-0.22	-0.26	-0.19	-12.60***			
	PCR×SB			-0.05	-0.08	-0.02	-3.17**			
	PGI×SB			-0.06	-0.09	-0.03	-4.21***			
	The effects of PCR on PSU at moderator values = $M \pm SD$				$\beta$	Boot SE	Boot LLCI	Boot ULCI		
	$M - 1 SD (2.61)$				-0.18	0.02	-0.23	-0.14		
$M (3.24)$				-0.23	0.02	-0.27	-0.20			
$M + SD (3.87)$				-0.28	0.02	-0.33	-0.24			
The effects of PCR on PGI at moderator values = $M \pm SD$				$\beta$	Boot SE	Boot LLCI	Boot ULCI			
$M - 1 SD (2.61)$				0.19	0.02	0.14	0.23			
$M (3.24)$				0.22	0.02	0.19	0.25			
$M + SD (3.87)$				0.25	0.02	0.21	0.29			
The effects of PGI on PSU at moderator values = $M \pm SD$				$\beta$	Boot SE	Boot LLCI	Boot ULCI			
$M - 1 SD (2.61)$				-0.09	0.02	-0.13	-0.05			
$M (3.24)$				-0.15	0.02	-0.19	-0.12			
$M + SD (3.87)$				-0.21	0.02	-0.26	-0.16			

Note: N = 3355, PSU = problematic smartphone use, PGI = personal growth initiative, PCR = parent-child relationship, SB = school belonging. Bootstrap sample size = 5000, LL = low limit, CI = confidence interval, UL = upper limit. The research variables (excluding gender, age and time spent online per day) in the regression models were standardized. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$



**Fig. 2** School belonging moderates the association between parent-child relationship and problematic smartphone use

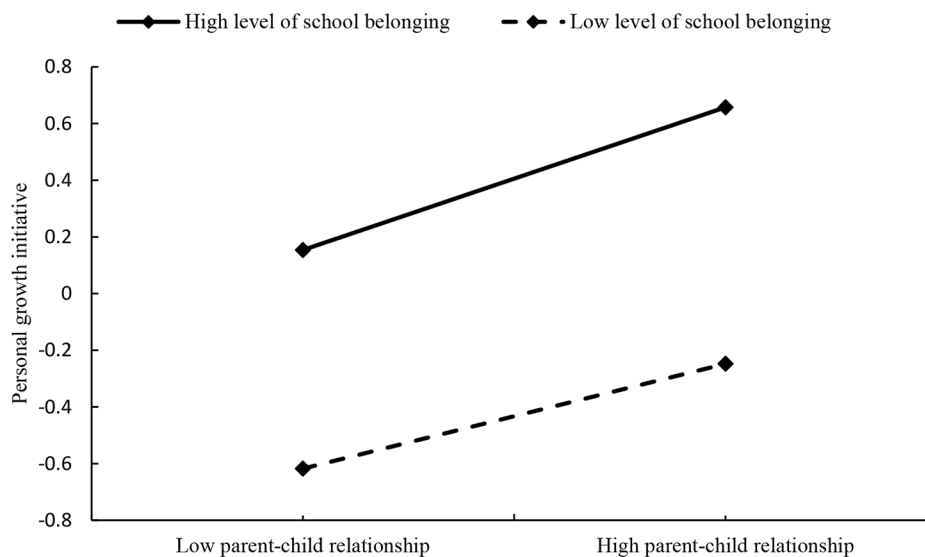
## Discussion

This study constructed a moderated mediation model to analyze the mechanisms underlying the association between parent-child relationship and problematic smartphone use in adolescents. The results indicated that parent-child relationship was negatively related to adolescents' problematic smartphone use, personal growth initiative played a mediating role, and school belonging played a moderating role in the association between parent-child relationship and problematic smartphone use. In addition, the association between parent-child relationship and personal growth

initiative, and the association between personal growth initiative and problematic smartphone use were also moderated by school belonging.

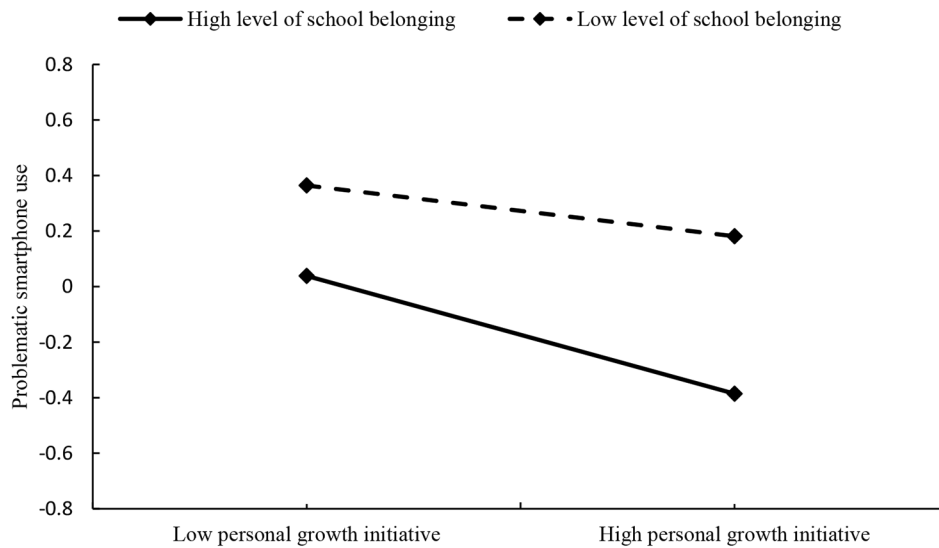
### Parent-child relationship was negatively related to problematic smartphone use

Our study found that parent-child relationship was negatively correlated with problematic smartphone use in adolescents. This result was consistent with problem behavior theory (De Leo & Wulfert, 2013) and previous cross-sectional and longitudinal empirical studies (Gao et al., 2020;



**Fig. 3** School belonging moderates the association between parent-child relationship and personal growth initiative





**Fig. 4** School belonging moderates the association between personal growth initiative and problematic smartphone use

Huang et al., 2021; Kong & Lim, 2012; Zhen et al., 2019). Good parent-child relationship not only provides adolescents with a warm environment and positive communication to satisfy their need for relatedness (Guo et al., 2014), but also helps in the supervision of adolescents' daily behaviors. All of these factors serve to protect adolescents from problematic smartphone use. In fact, adolescents who receive more support from their parents tend to participate in fewer negative and anti-social behaviors (Reitz et al., 2006), whereas adolescents with insufficient parental attention and support are more likely to be psychologically unstable and escape from reality through excessive use of smartphone (Davis, 2001). Therefore, when adolescents cannot get support from their parents, they may turn to the virtual world to seek support. These findings emphasize the importance of establishing high-quality parent-child relationship to reduce adolescents' problematic smartphone use risk.

### The mediating role of personal growth initiative

This study found that personal growth initiative mediated the association between parent-child relationship and adolescents' problematic smartphone use. This result was consistent with problem behavior theory, environmental factors can be related to individual behavior through individual factors (Jessor, 1987). For the first stage of the mediation process (i.e., parent-child relationship → personal growth initiative), our findings support the notion that good parent-child relationship is related to increased personal growth initiative. This finding is consistent with attachment theory (Ainsworth, 1989; Bowlby, 1969), which indicates that good interpersonal relationship plays a vital role in people's

well-being. Positive parent-child relationship provides secure attachment to adolescents to form good psychological diatheses such as personal growth initiative.

For the second stage of the mediation model (i.e., personal growth initiative → problematic smartphone use), this study revealed that personal growth initiative was negatively associated with adolescents' problematic smartphone use. Personal growth initiative played a protective role in the treatment of psychopathology (Robitschek et al., 2019). And personal growth initiative could reduce the likelihood of problem behaviors (Yakunina et al., 2013a). In addition, Weigold & Robitschek (2011) pointed out that a low level of personal growth initiative was associated with the adoption of ineffective coping strategies, such as the prevalent use of emotion-focused coping strategies rather than the use of problem-focused strategies. Using smartphones is an emotion-focused coping strategy (Sun et al., 2019). Thus, personal growth initiative is negatively related to adolescents' problematic smartphone use.

Mostly importantly, this study found that personal growth initiative mediated the association between parent-child relationship and adolescents' problematic smartphone use. Personal growth initiative as an internal mechanism determined how parent-child relationship influenced adolescents' problematic smartphone use. The formation and evolution of personal growth initiative are related to positive relations with others (Robitschek & Keyes, 2009) and the relationship between parents and children runs through the development of adolescents. Therefore, Parent-child relationship directly affects adolescents' personal growth initiative and then their behavior. In line with attachment theory (Ainsworth, 1989; Bowlby, 1969), the present study

findings suggest that positive relationship between parents and adolescents provide secure attachment to adolescents to form a high level of personal growth initiative to resist problematic potential.

### The moderating role of school belonging

Our study found that the association between parent-child relationship and problematic smartphone use, the association between parent-child relationship and personal growth initiative, and the association between personal growth initiative and problematic smartphone use were moderated by school belonging. These three associations were more potent for individuals with a high level of school belonging. Consistent with problem-behavior theory (Jessor, 1987), individual development will be affected by environmental factors. The results highlight the importance of school belonging to adolescents' development. According to the theory of school membership (Wehlage, 1989), adolescents with a high level of school belonging have better relationships with their peers and teachers, are more willing to participate in school activities, have a more positive evaluation and feeling toward the school, are more willing to abide by school rules, and are less likely to have problematic smartphone use.

First, the association between parent-child relationship and problematic smartphone use was moderated by school belonging, and this association was stronger for adolescents with a high level of school belonging. Consistent with prior study, individuals who lack of belonging would engage in activities that may satisfy their need for social connections (Newman & Smith, 2016; Sicilia et al., 2016; Wang et al., 2017). Giving that smartphone is a portable device, people can use it anytime and anywhere, which makes it easier for those who lack of belonging to overuse it (Wang et al., 2017; Allen et al., 2018) pointed out that interpersonal attachment is an important connotation of school belonging. Therefore, the interaction model of school belonging and parent-child relationship follows the interaction model of different interpersonal relationship. According to the interaction model of parent-child relationship and peer relationship on problematic behavior (Tian & Tian, 2014), two modes can explain the results of this study. The first is an additive model, which indicates that when parent-child relationship and friend relationship are both good, they are associated with less problematic behavior; alternatively, when both relationships are poor, they are associated with more problematic behavior (Sun et al., 2020a). In other words, in the current study, adolescents with good parent-child relationship and a high level of school belonging are associated with lower likelihood of problematic smartphone use. However, if adolescents have poor parent-child relationship and a low level of school

belonging, their problematic smartphone use may also be more serious. The second is the compensation model, which indicates that one of the good relationships can buffer the influence of another poor relationship on problematic behavior. Parents and friends are the main objects of communication and dependence of adolescents, and there are similarities in providing emotional support and instrumental help for adolescents (He et al., 2018). Therefore, when one relationship is poor, the good relationship of another can buffer the effect of the poor relationship on individual problematic behavior. That is, school belonging could moderate the association between poor parent-child relationship and adolescents' problematic smartphone use. In summary, school belonging could exacerbate the link between parent-child relationship and adolescents' problematic smartphone use.

Second, the results revealed that school belonging moderated the association between parent-child relationship and personal growth initiative, and the association between parent-child relationship and personal growth initiative was stronger for adolescents with a high level of school belonging than for adolescents with a low level of school belonging. According to self-determination theory, students with school belonging have more social support (Gini et al., 2018). Social support could buffer the negative effects of stress events on physical and mental status (Ren & Li, 2020). That is, students with a high level of school belonging could obtain more support from peers and teachers and then form positive perceptions and evaluations of themselves, which protects them from the impact of a negative environment (e.g., poor parent-child relationship) (Bandura, 1997). In other words, school belonging could alleviate the negative impact of poor parent-child relationship on personal growth initiative. In addition, school belonging was associated with psychological functioning (Allen et al., 2018, 2021). Empirical research had also revealed that positive recognition from surrounding people could improve individuals' personal growth initiative (Stevic & Ward, 2008). Therefore, school belonging may be a protective factor of personal growth initiative. Adolescents with a high level of school belonging may have positive interaction with others and attachment to school. Thus, on the one hand, they may be more willing to spend time on school activities and offline interaction with others rather than using smartphones to meet basic psychological needs. On the other hand, they do not want to disappoint others because of their overuse of smartphones. Therefore, school belonging moderated the association between parent-child relationship and personal growth initiative, and the effect was stronger for adolescents with a high level of school belonging.

Moreover, we found that the association between personal growth initiative and adolescents' problematic smartphone

use was moderated by school belonging, and this association was stronger for adolescents with a high level of school belonging. Students with school belonging have more social support (Gini et al., 2018). According to the main-effect model of social support (Gong, 1994), social support can enhance the positive effect. That is, school belonging can exacerbate the link between personal growth initiative and problematic smartphone use. People with high levels of personal growth initiative adapt better to different situations, overcome stressful situations, seek appropriate solutions to the situations faced (Loo et al., 2014; Robitschek et al., 2012), and experience more fulfilling relationships, a greater sense of autonomy, mastery, and purpose in life compared with those who are lower in personal growth initiative (Robitschek & Keyes, 2009). A high level of school belonging means a safe and supportive environment. Therefore, compared with students with a low level of school belonging, students with high personal growth initiative are in a safe and supportive environment, which can encourage them to take positive measures to deal with various problems, reducing the incidence of problematic smartphone use.

## Limitations and implications

Several limitations of the present study must be considered. First, this study only uses self-report method to collect data, the validity of the data may be influenced by social desirability and other biases. Therefore, future research can collect data from third-party observation (e.g., parents, teachers, and peers). Second, this study is a cross-sectional survey study and cannot interpret causality. Longitudinal or experimental researches are needed to confirm the causal assumptions among these variables in the further studies. Third, because all of the participants in this study were sophomores in high school, the representativeness of the samples is limited. Thus, These results should be carefully generalized in other sample. Future research may consider participants of different grades (e.g., junior school students).

Despite these limitations, this study theoretically contributed to problem behavior theory, and it is the first attempt to test the mediating role of personal growth initiative and the moderating role of school belonging in the association between parent-child relationship and problematic smartphone use in adolescents. This study comprehensively investigated the influence of family, school, and individual factors on individual behavior and deepened prior studies by examining the mechanisms underlying this relationship. In another way, this study also helps us better predict the factors and variables that should be considered in the prevention and intervention of students' problematic smartphone use in future online learning environments.

Specifically, adolescents are expected to switch freely between family life and digital environments. Our study explains how and when parent-child relationship influences adolescents' problematic smartphone use. In addition, this study has significant practical implications. First, parent-child relationship is negatively related to adolescents' problematic smartphone use and positively related to adolescents' personal growth initiative; therefore, parents should pay attention to their relationship with adolescents. For example, when communicating with adolescents, parents should put down their smartphones, listen to them carefully and have some benign interaction with them. Second, for this generation of special adolescents during the COVID-19 pandemic, exploring the influence of personal growth initiative on individual behavior is of great significance. Studies have found that interventions were effective in promoting personal growth initiative (Robitschek, 1997; Thoen & Robitschek, 2013; Wang & Tien, 2011) and that psychoeducation regarding personal growth initiative and activities for personal growth was proven effective (Thoen & Robitschek, 2013); therefore, parents can adopt the psychoeducation method to promote adolescents' personal growth initiative. Finally, from the perspective of home-school cooperation, this study provides new methods to prevent problematic smartphone use. School belonging not only enhances the direct negative association between parent-child relationship and problematic smartphone use but also enhances the indirect association between parent-child relationship and problematic smartphone use through the mediation of personal growth initiative. Therefore, improving school belonging may also be an effective way to buffer adolescents' problematic smartphone use. Schools can hold various class activities to enhance students' school belonging and can remind adolescents of the importance of social support and multiparty cooperation for their development.

## Conclusions

Extensive studies have shown that poor parent-child relationship is linked to adolescents' problematic smartphone use. Extending the literature, the present study reveals the influence and mechanism of parent-child relationship on adolescents' problematic smartphone use. Specifically, personal growth initiative mediates the relationship between parent-child relationships and problematic smartphone use. This study also explores how school belonging moderates this mediation model. We hope that our efforts can set a platform for future research to study the influence of parent-child relationship and the contributing factors of problematic smartphone use.

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**Data Availability** Some or all data, models, or code generated or used during the study are available from the corresponding author by request.

## Declarations

**Ethical approval** The research procedures performed in studies involving human participants were approved by the Institutional Review Board at the Collaborative Innovation Center of Assessment toward Basic Education Quality at Beijing Normal University.

**Informed consent** Informed consent was obtained from all research participants included in the study. They were informed that participation was voluntary.

**Conflict of interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

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