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ORIGINAL PAPER

Deviant peer affiliation, self-control, and aggression during early adolescence: within-person effects and between-person differences

Yuxi Li[1,2] · E. Scott Huebner[3] · Lili Tian[1,2]

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Abstract

Abundant studies have explored the relations among deviant peer affiliation, self-control, and aggression without separating within-person from between-person effects. Moreover, it is unclear whether self-control mediates the associations between deviant peer affiliation and aggression during early adolescence. This longitudinal study used Random Intercept Cross-Lagged Panel Model to examine the dynamic relations among deviant peer affiliation, self-control, and aggression within individuals, including examining whether self-control mediated the relations between deviant peer affiliation and aggression. A total of 4078 early adolescents (54% boys, $M_{age} = 9.91$, $SD = 0.73$) completed questionnaires on four occasions across 2 years. Results indicated: (a) Deviant peer affiliation and aggression positively predicted each other; (b) Self-control and aggression negatively predicted each other but were unstable; (c) Deviant peer affiliation and self-control negatively predicted each other; and (d) Self-control mediated the path from aggression to deviant peer affiliation, but not vice versa. The results more precisely identify the relations among deviant peer affiliation, self-control, and aggression within individuals, providing valuable information for prevention and intervention programs targeted at alleviating early adolescent aggression.

Keywords Deviant peer affiliation · Self-control · Aggression · Early adolescence · Random intercept cross-lagged panel model

Introduction

Early adolescence is a crucial period when adolescents undergo extensive changes in their physiology, cognition, emotions, and social interactions, accompanied by a sharp increase in the incidence of aggression [1]. Aggression in early adolescence is associated with psychological maladjustment throughout adolescence and adulthood [2, 3]. Considering its detrimental consequences, the key determinants of aggression should be identified. Research shows that peers exert a significant impact on the development and behavior of individuals during the transition from childhood to adolescence [4]. For example, deviant peer affiliations provide an environment that encourages oppositional and disruptive behavior, increasing the risk of the development of aggression in early adolescents [5, 6].

However, not all adolescents exposed to peer environmental risks necessarily develop aggression. Therefore, exploring the underlying psychological mechanisms that account for the relation between deviant peer affiliation and aggression should be of great significance for developing effective prevention and intervention strategies. The General Aggression Model (GAM) [7] provides a useful framework to identify factors involved in the development of aggression as it integrates domain-specific theories on learning and priming processes involved in human aggression. GAM proposes that situational-specific factors influence individuals' internal states, which in turn lead to outcomes. Specifically, situational factors (e.g., deviant peer affiliation) can

✉ Lili Tian
paipaishu@163.com

Yuxi Li
liyuxi2933@163.com

E. Scott Huebner
HUEBNER@mailbox.sc.edu

1 Philosophy and Social Science Laboratory of Reading and Development in Children and Adolescents (South China Normal University), Ministry of Education, Guangzhou 510631, People's Republic of China

2 School of Psychology, South China Normal University, Guangzhou 510631, People's Republic of China

3 Department of Psychology, University of South Carolina, Columbia, SC 29208, USA

promote changes in internal states (e.g., self-control), further increasing the possibility of aggression. However, research has not clarified the uniqueness of these relations in early adolescent development. For example, extant studies have ignored the critical distinction between the within-person and between-person effects of these important constructs, which prevents a comprehensive understanding of the development of aggression during early adolescence. Thus, this study investigated the longitudinal associations among deviant peer affiliation, self-control, and aggression in early adolescents, including whether self-control was a mediator, while distinguishing between- and within-person variance through Random Intercept Cross-Lagged Panel Model (RI-CLPM) [8].

Deviant peer affiliation and aggression

Aggression refers to any intentionally harmful behavior, including physical aggression (i.e., kicking or pushing) and relational aggression (i.e., taunting or social isolation) [9]. Aggression peaks during early adolescence, presenting a serious problem for adolescents and society [1]. Research has revealed that about 9.0–24.3% of Chinese children and adolescents exhibit aggression [10, 11]. Previous studies have found that peer factors, such as affiliation with deviant peers, present powerful risks for the development of aggression during early adolescence [5]. Deviant peer affiliation refers to selective relationships with peers who exhibit serious problem behaviors, such as cheating and substance abuse [12]. In early adolescence, as parental supervision decreases and the diversity of peer groups increases, adolescents' likelihood of involvement in deviant peer experiences significantly increases [13]. Adolescents tend to model their peers' behavior. Thus, adolescents who affiliate with deviant peers may view aggression as an acceptable or even desirable way to solve problems, which leads them to continue engaging in aggression [14]. Indeed, a study of 438 adolescents showed that deviant peer affiliations positively predicted aggression 6 months later [15].

Aggression may also, in turn, elicit or aggravate deviant peer affiliation. Aggressive adolescents fail to form close friendships with non-deviant peers [16]. They are more likely to actively connect with similarly rejected peers, increasing their likelihood of deviant peer affiliation [6]. For example, one study employing autoregressive cross-lagged models demonstrated that a higher frequency of physical aggression significantly predicted a higher occurrence of deviant peer affiliations among adolescents [12]. Given the evidence, deviant peer affiliation appears to be an important contextual predictor and consequence of aggression in adolescence. However, previous studies relied primarily on between-person approaches to reveal the associations between deviant peer affiliation and aggression, failing to clarify the connections within adolescents, which diminished their ability to derive reliable inferences. Thus, this study used RI-CLPM to examine the prospective bidirectional relations between deviant peer affiliation and aggression in early adolescents at the within-person level.

Self-control and aggression

Self-control refers to the ability to override or make changes in internal reactions, interrupting undesirable behaviors and refraining from acting on them [17]. GAM [7] asserts that self-control is the most influential factor in inhibiting aggression. Adolescents with sufficient self-control can cognitively reevaluate events and resist temptation before engaging in impulsive behaviors, which reduces the occurrence of aggression [17]. In comparison, adolescents with low self-control may engage in aggression for short-term gain [18]. Previous empirical research has also demonstrated robust support for the association from self-control to aggression. Findings from large longitudinal studies of Western samples implicated positive associations between low self-control and aggression during adolescence and adulthood [19]. A meta-analysis including 58 studies involving 39,116 Chinese students also found that self-control is moderately negatively correlated with aggression [20]. Research has further demonstrated that self-control augmentation can significantly reduce aggression [21].

The GAM [7] suggests that aggression may also impair the self-control that helps adolescents suppress impulses. That is, aggression may prompt cognitive resources to push individual's behavior toward impulsivity [16]. For example, a study of adolescents in Finland and the United States showed that their aggression predicted a subsequent lack of self-control in adulthood, both in males and females [22]. Existing research has also revealed that the experience of aggression within the family, such as exposure to corporal punishment, negatively affects adolescents' self-control [23]. Aggression appears to facilitate the inhibition of self-control; however, more research is needed to understand the possible bidirectional relations between self-control and aggression within individuals. Such knowledge should inform effective prevention strategies. Therefore, the current study was designed to clarify at the within-person level whether early adolescents who have low self-control are a greater risk of developing aggression and vice versa.

Deviant peer affiliation, self-control, and aggression

Although substantial evidence supports a positive association between deviant peer affiliation and aggression, not all adolescents who affiliate with deviant peers directly engage in aggression. Developmental psychologists argue that the interactions between individual development and

their environments increase their risk of engaging in aggression [24]. Early adolescents show increased sensitivity to social influences, making adolescents with deviant peers more susceptible to engaging in aggression [4]. Simultaneously, self-control matures across adolescence, enabling adolescents to inhibit deviant cognition and behavior [25]. GAM [7] suggests that situational factors influence behavior through various internal mechanisms, so self-control may be a potential mediating mechanism underlying the progression from deviant peer affiliation to aggression.

Previous research has investigated the link from deviant peer affiliation to aggression through self-control. For example, adolescents who affiliate with deviant peers initially resist deviant behavior, but over time, they experience more opportunities and reinforcement from deviant peers and exhibit lower self-control, which ultimately leads to more aggression [26]. A cross-sectional study of 438 Chinese adolescents showed that moral disengagement (a structure like self-control) mediated the relation between deviant peer affiliation and aggression [15]. Group Socialization Theory [27] assumes that socialization processes bring individuals closer to the characteristics of the group to which they belong and makes adolescents more similar. Aggressive adolescents are prone to exhibiting a lack of self-control, which makes it more difficult for them to resist temptation and increases the risk of deviant peer affiliations [19, 28]. However, little is known about their transactional relations at the within-person level, which may be critical for determining the directionality of the relations among the variables. Therefore, this study hypothesized that individual differences in self-control would play a mediating role in the bidirectional relations between deviant peer affiliations and adolescents' aggression.

The present study

This longitudinal study used RI-CLPM to examine the dynamic within-person relations among deviant peer affiliation, self-control, and aggression in early adolescents, and to examine the potential mediating role of self-control. Students' sex, age, and family socioeconomic status (SES) were treated as covariates, because these demographic variables are associated with the study variables [29, 30]. This study proposed four hypotheses at the within-person level: (1) Deviant peer affiliation and aggression would bidirectionally and negatively predict each other; (2) Self-control and aggression would bidirectionally and negatively predict each other; (3) Deviant peer affiliation and self-control would be inversely related; (4) Self-control would mediate the reciprocal associations between deviant peer affiliation and aggression. Cross-Lagged Panel Model (CLPM) was also included as an auxiliary analysis to gain insight into the longitudinal relations between deviant peer affiliation, self-control, and aggression in early adolescents.

Method

Participants

Participants included 4078 early adolescents (54% boys, M_{age} = 9.91 at Time 1, SD = 0.73) from public primary schools in a city located in a Southern China province. The reason for choosing these schools was the establishment of long-term cooperative relations between the schools and the researchers' institution. At Time 1 (T1), 49.7% of the participating students were in Grade 4, and 50.3% were in Grade 5. Students completed four assessments across 2 years, with 6-month intervals. The retained percentages of T1 participants at Time 2 (T2) to Time 4 (T4) were 97.3%, 97.9%, and 96.9%, respectively. Thus, a total of 3763 students completed all 4 measurements. Students who transferred to other schools or were absent on the day of the assessment were the main causes of attrition. The missing completely at random (MCAR) test was performed for all variables in the four measurements waves [31]. MCAR tests showed a normed chi-square (χ^2/df) of 2.60 ($p < 0.001$), which mean that the data may be missing at random [32]. Full information maximum likelihood (FIML) analyses were used to estimate the measurement model in Mplus 8.0.

Procedure

The current study was approved by the Human Research Ethics Committee of South China Normal University and the relevant school boards, principals, and teachers. We informed students and their parents about the study, and we obtained student assent and parental consent prior to the data collection. In the middle of each semester, the students completed the self-report questionnaires. Measures were administered by a trained graduate assistant in the regular classroom setting following the same instructions. The students could take as much time as needed to respond to the measures. In addition to being informed of the general nature of the study, participants were assured that their responses would be kept confidential. Students could also withdraw at any time.

Measures

Deviant peer affiliation was assessed by the Peer Affiliation and Social Acceptance Scale (PASA) [33]. The original PASA consisted of six items. For this study, two reverse-keyed items in the original scale were eliminated due to low factor loadings. Thus, the current study used four items

(e.g., "The percentage of your friends who break the rules."). Response options ranged from 1 (less *than* 25%) to 5 (*more than* 75%). The mean score was calculated, and higher scores reflected higher levels of deviant peer affiliation. This four-item version of the PASA has shown good internal consistency reliability and validity with Chinese students [34]. Confirmatory factor analysis (CFA) results with this sample demonstrated a good fit, $\chi^2(2) = 8.345$, CFI = 0.999, TLI = 0.997, SRMR = 0.007, RMSEA = 0.032 (90% CI = 0.012 − 0.056). The Cronbach's coefficients α were 0.77, 0.77, 0.80, and 0.82 for T1 to T4, respectively.

Aggression was assessed using items rephrased from a subscale derived from the Chinese version of the Multidimensional Peer Victimization Scale (MPVS) [35]. Students were asked to answer three questions about physical aggression (e.g., "I deliberately kicked others.") and seven questions about relational aggression (e.g., "I deliberately speak ill of others."). Response options ranged from 0 (*never*) to 3 (*always*). The mean score was calculated, and higher scores showed higher aggression. The Cronbach's coefficients α were 0.90, 0.90, 0.90, and 0.93 for T1 to T4, respectively.

Self-control was measured using the Self-Control Scale [17], which consists of thirteen items. Sample items were as "I am good at resisting temptation." and "Sometimes I cannot stop myself from doing something". Response options ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). The total score was analyzed, and higher scores indicated higher self-control. In this study, the Cronbach's coefficients α were 0.70, 0.75, 0.79, and 0.80 for T1 to T4, respectively.

Covariates Sex, age, and SES at T1 were treated as covariates. Sex (1 = boys, 2 = girls) and age were reported by the students. Parental education levels were reported by the parents (1 = never attended school to 8 = doctoral degree), with higher scores reflecting higher SES. Parental education levels were used as indicators of SES, because they are the most stable and common aspect of SES, and they reflect parental economic (e.g., income and occupation) and social status (e.g., prestige) [29, 30].

Statistical analysis

The data analysis was divided into the following steps. First, SPSS 24.0 was used for calculating descriptive statistics and correlation coefficients. Then, Intra-Class Correlation Coefficients (ICCs) were calculated for all study variables. ICC represents the proportion of between-person variance, and 1-ICC represents the variance explained by within-person fluctuations across the measured waves for each variable. RI-CLPM was performed if each measure differed substantially at the within-person level (i.e., at least 10%) [8]. Second, CFA was used to evaluate longitudinal measurement invariance to determine consistency across the four measurements. A difference in ΔCFI not exceeding a threshold of 0.01 and a change in ΔRMSEA not exceeding a threshold of 0.015 were considered indicative of invariant measurement [36]. Third, the current study used RI-CLPM, which can examine the direction of associations among variables at the within-person level after distinguishing between-person effects from within-person effects. Fourth, traditional CLPM were used and added as auxiliary analyses in the current study. The employment of RI-CLPM and CLPM together provided a more comprehensive understanding for analyzing the development of aggression during early adolescence. This study used 1000 samples for percentile bootstrapping to test whether indirect effects were significant. Indirect effects were considered statistically significant if the 95% confidence interval for the estimate did not include zero. All path analyses were performed in Mplus 8 [37]. The maximum likelihood robust estimator (MLR) was used to account for non-normally distributed data. The model was considered to have sufficient fit when CFI > 0.90, TLI > 0.90, RMSEA < 0.08, and SRMR < 0.10 [38].

Results

Descriptive statistics

Table 1 displays the sample characteristics of key variables. Pearson correlations are reported in Appendix 1 of the supplementary materials. The ICCs reflected that approximately 27% of the variance of deviant peer affiliation could be explained by fluctuations within persons. About 62% of the variance in self-control could be explained by within-person fluctuations. About 38% of the variance of aggression could be explained by within-person fluctuations.

Table 1 Sample characteristics of key variables (N = 4078)

	Time 1		Time 2		Time 3		Time 4	
	M	SD	*M*	SD	*M*	SD	*M*	SD
Deviant Peer Affiliation	0.80	0.84	0.73	0.77	0.73	0.83	0.74	0.86
Self-Control	45.30	7.63	45.68	7.89	46.18	8.22	45.72	8.37
Aggression	0.16	0.34	0.13	0.29	0.11	0.27	0.10	0.27
Age	9.91	0.73	10.42	0.73	10.91	0.73	11.41	0.73

Longitudinal measurement invariance

The study tested configuration, metric, and scalar-invariant models for all study variables, as shown in **Appendix 2** of the supplementary materials.

Within-person effects

As shown in Fig. 1, after controlling the covariates, the RI-CLPM revealed significant associations among deviant peer affiliation, self-control, and aggression, respectively. Standardized path coefficients and covariate effects are reported in **Appendix 3** and **Appendix 4** of the supplementary materials. After the between-person stability was partialled out, in the path from T3 to T4, adolescents reporting higher deviant peer affiliation displayed lower self-control and more aggression. Self-control negatively predicted deviant peer affiliation, beginning at T3 to T4. Moreover, the association between aggression and self-control became less stable with time, and a significant reciprocal association was observed only from T1 to T2. Furthermore, aggression at T2 negatively predicted self-control at T3, and self-control at T3 negatively predicted subsequent aggression.

The mediation analysis revealed that T2 aggression indirectly affected T4 deviant peer affiliation via T3 self-control at the within-person level; however, no significant mediation effect was identified in the remaining paths (see **Appendix 5** of the supplementary material).

Auxiliary analyses: between-person effects

Standard CLPMs were constructed as auxiliary analyses in addition to the primary RI-CLPMs. Covariate effects were minimal, please see **Appendix 4** of the supplementary material. As shown in Fig. 2, after controlling the covariates, the CLPM findings showed that all paths among deviant peer affiliation, self-control, and aggression represented significant reciprocal cross-lagged paths. Moreover, the paths from deviant peer affiliation to aggression via self-control were significant, and vice versa. More information is provided in **Appendix 3** and **Appendix 4** of the supplementary material.

Discussion

Early adolescence is a critical period for studying the relations among deviant peer affiliations, self-control, and aggression given the unique developmental changes and peer influences occurring at that time [1, 28]. After controlling for covariates, we used RI-CLPM to explore longitudinal relations among deviant peer affiliation, self-control, and aggression, including whether self-control was a potential mediator at the within-person level. CLPM was used as a supplementary analysis to investigate the between-person relations among variables. The results provided meaningful implications for intervention and prevention in early adolescents.

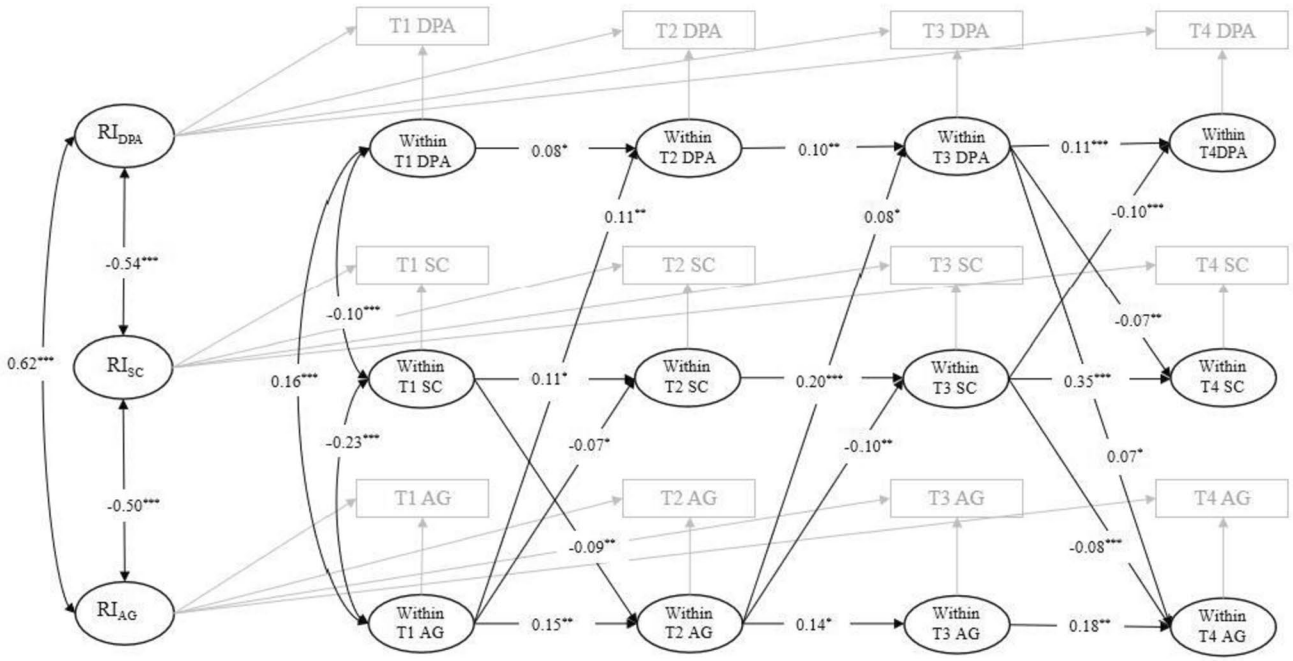

Fig. 1 RI-CLPM for deviant peer affiliation, self-control, and aggression ($N = 4078$). *DPA* deviant peer affiliation, *SC* self-control, *AG* aggression, *T1* time 1, *T2* time 2, *T3* time 3, *T4* time 4. $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

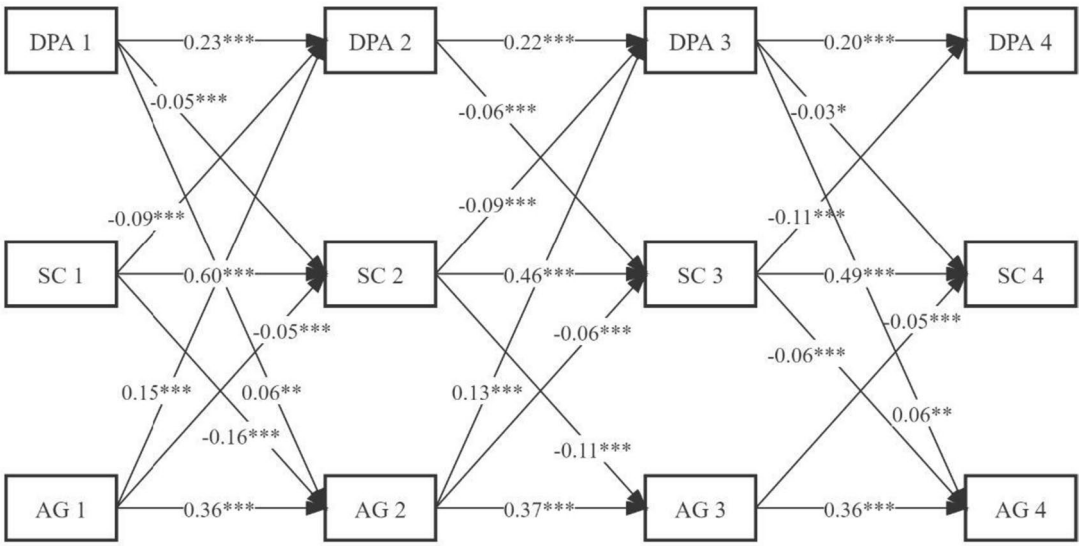

Fig. 2 CLPM for deviant peer affiliation, self-control, and aggression ($N = 4078$). *DPA* deviant peer affiliation, *SC* self-control, *AG* aggression, *T1* time 1, *T2* time 2, *T3* time 3, *T4* time 4. $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Deviant peer affiliation and aggression

The findings supported hypothesis 1. Reciprocal relations between deviant peer affiliation and aggression were observed at the within-person level in early adolescents. The relations suggest that early adolescents who affiliate with deviant peers are more prone to engage in aggression. Adolescents imitate and learn deviant behavior in keeping with the group norms of their deviant peers, which provides opportunities for adolescents to engage in aggression and reinforces adolescents' positive attitudes toward aggression [12, 39]. Moreover, in Chinese cultures that emphasize group harmony and cohesion, aggressive adolescents are more likely to feel excluded from peers, resulting in difficulty forming close relationships with mainstream peers [40]. This isolation encourages them to affiliate with deviant peers through homogeneous selection processes and gain a sense of belonging and relatedness need satisfaction [16]. Although this study observed bidirectional relations between deviant peer affiliation and aggression at the within-person level, the effect of deviant peer affiliation on aggression appeared later in the measurement period. This finding suggested that peers play an increasingly important role as individuals enter adolescence [27]. However, adolescents' associations with deviant peers may not be sufficient to trigger more observable aggressive behaviors; they may also respond to deviant behavior through withdrawal and internalizing behaviors or substance use [2, 3].

The auxiliary CLPM analysis also supported a reciprocal association between affiliation with deviant peers and aggression in early adolescents. This finding could be explained in that CLPM studies confuse within- and between-person effects. However, both RI-CLPM and CLPM results revealed that peers exert an important role in early adolescent development and behavioral socialization, related to aggression. Thus, in an environment characterized by deviant behavior, adolescents' alertness to the intentions of others may help them interrupt default negative thought patterns, which in turn may prevent adolescents from further engaging in aggression [41]. This finding has contributed to the understanding of the development of aggression during early adolescence, providing implications for preventing the escalation of problem behaviors.

Self-control and aggression

Consistent with hypothesis 2, self-control and aggression demonstrated a transactional process at the within-person level during early adolescence, although the bidirectional relations were unstable over time. This finding may reflect that the development of self-control is related to the external environments encountered by the individual, which means that aggressive adolescents develop weakened self-control reserves or are unable to practice self-control in later life [26]. Adolescents with insufficient self-control resources will participate in various problem behaviors and experience adverse outcomes, whereas adolescents with sufficient self-control resources will use them to resist engaging in aggression [21]. The finding of an unstable relation between self-control and aggression was intriguing. This finding suggests that although most aggressive adolescents show deficits in self-control, self-control gradually improves during adolescence as the brain and associated functions continue to develop [42]. The self-control analysis using LGCM did

indeed find that adolescents' levels of self-control increased over time (see **Appendix 6** of the supplementary materials). However, aggression may become less significant to the early development of self-control in teenagers once self-control development has reached a somewhat steady state and there is some resilience to changes in the external environment [43]. Moreover, developmental trajectory of aggression observed in this study revealed aggression declined during early to mid-adolescence (see **Appendix 6** of the supplementary materials), perhaps diminishing the impact of aggression on self-control [44].

The CLPM findings showed that among early adolescents, aggression and self-control displayed a stable, bidirectional negative relation. This discrepancy from the RI-CLPM results suggested that the CLPM findings might not adequately account for changes in aggression and self-control at the within-person level [8]. These results imply that interventions that target low self-control and high aggression in early adolescence may be most beneficial because of their direct effects.

Deviant peer affiliation, self-control, and aggression

Consistent with hypothesis 3, deviant peer affiliation and self-control negatively predicted each other from T3 to T4. This result suggested that adolescents displaying low self-control tend to connect with similar deviant peers, which in turn weakens the development of self-control [27]. However, the associations between deviant peer affiliation and self-control may partly reflect within-individual transactional effects. On one hand, this may reflect the gradual decline in deviant peer affiliations as individuals enter early adolescence, reducing their impact on self-control (see **Appendix 6** of the supplementary materials). On the other hand, it may reflect that adolescents who have frequent and repeated contact with deviant peers do not diminish their self-control, and only adolescents who maintain close friendships with deviant peers are more likely to show decreased self-control [45]. Moreover, the research suggested that self-control was a crucial factor for peer group selection in early adolescents, rather than the only factor [46]. In contrast, the auxiliary CLPM analysis revealed a bidirectional relation between deviant peer affiliation and self-control across all waves. This inconsistency demonstrated that the bidirectional association between deviant peer affiliation and self-control may manifest between-person effects [43].

The findings partially supported hypothesis 4. The RI-CLPM results revealed that the association from T2 aggression to T4 deviant peer affiliation was mediated by T3 self-control. Aggression in early adolescence may eventually hinder the development of self-control over time, which is crucial to understanding deviant behavior, because adolescents with poor self-control are more likely to socialize with deviant peers [26]. This finding was also consistent with the GAM [7], which posits that aggression affects the development of self-control and ultimately results in differences in adolescent engagement in deviant behavior. However, the RI-CLPM results did not identify T2 self-control as a mediator in the bidirectional relation from T1 aggression to T3 deviant peer affiliation. The results may reflect that aggression significantly affected self-control at T1–T3, whereas self-control significantly affected deviant peer affiliation only at T3–T4. Although it is theoretically plausible that adolescents who affiliate with deviant peers are more likely to display subsequent aggression via self-control, the RI-CLPM did not support self-control as a mediator at the within-person level. This finding indicated that although peers play a more salient role as early adolescents become adolescents, parents remain important supervisors. Deviant peer affiliation may draw parents' attention and elicit actions to reduce the chances of other adverse effects occurring [41]. Also, the auxiliary CLPM supported the mediating role of self-control in the relations between aggression and deviant peer affiliation. This finding implied that self-control does not play a mediating role in the relation from deviant peer affiliation to aggression after separating between-person effects from within-person effects, although further longitudinal research is required to clarify this finding.

Strengths, limitations and future direction

This study displayed several strengths. First, because previous studies have focused more on the influence of proximal factors (e.g., genetics) on aggression in adolescents, and less on peer factors, the results highlighted the importance of paying attention to the peer environment and personality factors in the development of behavioral problems and offered implications for prevention and interventions for early adolescent problem behaviors [7]. Second, longitudinal models were used to investigate the reciprocal relations among deviant peer affiliation, self-control, and aggression, respectively. Moreover, the current study considered the mediating role of self-control in the bidirectional association between deviant peer affiliation and aggression. Third, because traditional longitudinal research designs may fail to capture within-person changes, this study used RI-CLPM to more precisely and comprehensively analyze the within-person relations among deviant peer affiliation, self-control, and aggression [8].

Despite these strengths, this study had some limitations. First, although the use of self-reported measures was reasonable, future research should include data from multiple respondents to address possible limitations of self-reports. Second, this study was a longitudinal study of Chinese early adolescents. Therefore, it is uncertain whether the findings can be generalized to middle and late adolescent individuals or individuals from other cultures. Third, some path

relations displayed small effect sizes, although small effects can still reveal the dynamic development of associations at the within-person level. Furthermore, small effects might progressively develop into larger effects over time [47].

Implication

Early adolescence is a critical phase for identifying externalizing problems and a vital opportunity to prevent such problems from escalating during adolescence and later periods. These findings extended the literature and provided implications for prevention and intervention with adolescent aggression by examining longitudinal associations among deviant peer affiliation, self-control, and aggression. First, both deviant peer affiliation and self-control displayed predictive effects on aggression, although the direct effect of self-control was most robust. Nevertheless, given the important role of self-control in plasticity and reduced aggression during early adolescence, parents, teachers, and public policy makers need to pay timely attention to the early development of self-control in children and design effective programs to promote self-control, such as self-control training [48]. Second, although deviant peer affiliation may not be the main direct target of intervention strategies at the within-person level, the importance of the peer environment on aggression should not be ignored. Parents and teachers should encourage and support early adolescents in establishing healthy friendships, which can effectively prevent them from affiliating with deviant peers. Third, aggression predicted lower self-control and more deviant peer interactions. Teachers and other professionals need to identify highly aggressive adolescents as soon as possible and provide empirically supported interventions to promote positive outcomes for these adolescents.

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Author contributions Yuxi Li participated in the study design, collected data, performed the statistical analysis, wrote the main manuscript text and prepared figures. E. Scott Huebner participated in the study design and coordination and helped draft the manuscript. Lili Tian participated in the study design, collected data, and coordination and draft the manuscript. All authors reviewed and approved the manuscript.

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Data availability Our study is not able to share data and relevant materials publicly because our data derive from an ongoing scientific research project supporting by National Natural Science Foundation of China. Because the survey data involve users' privacy and confidentiality issues, we have signed confidentiality agreements with the data providers, that is, relevant elementary school boards.

Declarations

Conflict of interest The authors have no conflict of interest to disclose.

Ethical standards The study procedures performed in were in accordance with the ethical standards of the institutional research committee (School of Psychology Research Ethics Committee, South China Normal University) and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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