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Perceived quality of parental homework assistance and adolescents' grit:

A longitudinal analysis

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Abstract

Background

The longitudinal associations between different dimensions of parental homework assistance and adolescents' grit remain insufficiently understood. Guided by self-determination theory, this study examined basic psychological need satisfaction as a mediator and cognitive reappraisal and expressive suppression as moderators of these associations.

Methods

Data were drawn from a three-wave longitudinal study of 4,212 Chinese adolescents followed from Grade 8 (2020) to Grade 10 (2022). Structural equation modeling examined the direct and indirect associations of perceived parental control, responsiveness, and structure at baseline with consistency of interests and perseverance of effort at the final wave, through basic psychological need satisfaction at the intermediate wave. Cognitive reappraisal and expressive suppression at baseline were examined as moderators of the associations between parental homework assistance and subsequent need satisfaction. Analyses adjusted for gender, parental education, family income, cognitive ability, and baseline levels of need satisfaction and grit. Indirect effects were evaluated using 5,000 bootstrap resamples.

Results

Parental control was negatively associated with subsequent consistency of interests ($b = -0.07$, $p < .01$), whereas responsiveness was positively associated with this dimension ($b = 0.06$, $p < .05$). Structure showed significant positive indirect associations with consistency of interests ($B = 0.006$, 95% CI [0.003, 0.009]) and perseverance of effort ($B = 0.018$, 95% CI [0.011, 0.026]) through need satisfaction. None of the three assistance dimensions showed a significant direct association with perseverance of effort. Expressive suppression moderated the responsiveness–need satisfaction association ($b = -0.06$, $p < .05$). Conditional

indirect associations between responsiveness and both grit dimensions were significant at low, but not high, levels of expressive suppression. No significant moderating effects of cognitive reappraisal were observed.

Conclusions

The findings reveal distinct prospective associations between different dimensions of parental homework assistance and adolescents' grit. Basic psychological need satisfaction may represent a potential pathway linking parental structure to both grit dimensions, while expressive suppression may influence how parental responsiveness relates to subsequent need satisfaction. These findings provide insights into the psychological processes underlying these associations and inform future research on supportive homework assistance practices.

Keywords**:** parental homework assistance; grit; basic psychological needs; emotion regulation; adolescents

Perceived quality of parental homework assistance and adolescents' grit: A longitudinal analysis

Grit refers to how people exhibit continued striving and focused interest over time regardless of setbacks, obstacles, or boredom (Duckworth et al., 2007; Duckworth et al., 2011). Extensive studies have shown that grit could promote the development of youth across various arenas, such as academic performance (Çınar-Tanrıverdi & Karabacak-Çelik, 2023), health (Gorin et al., 2024), life satisfaction (Bae et al., 2024), and even smartphone use (Kim et al., 2023). While grit is widely recognized as a predictor of success, it also represents an educational outcome (Duckworth et al., 2007). However, research detailing the specific educational elements that foster grit is still limited.

The ecological framework of human development (Bronfenbrenner, 2005) conceptualizes the environment as a set of nested systems comprising the microsystem, mesosystem, exosystem, and macrosystem. Within this framework, the mesosystem emphasizes the interconnections between different settings rather than focusing on a single setting. Moreover, homework is considered the setting where home and school intersect most closely within the mesosystem (Warton, 2001). The present study examines the relationship between parental homework assistance and grit development, while also exploring potential underlying mechanisms.

Parental Homework Assistance and Grit

Duckworth (2016) posits that parents play an essential role in cultivating children’s grit. Effective parenting, according to this perspective, requires balancing support and demands during child socialization. Many studies have explored the relationship between different parenting factors and children’s grit development, such as parenting style (Lin et al., 2024), parental harsh discipline (Cui & Lan, 2020), parental autonomy support (Du et al., 2023), parental academic socialization, and psychological control (Wei & Liu, 2022), and parental assistance (Li et al., 2024).

In the Chinese cultural context, parents tend to prioritize academic achievement and test scores due to intense academic competition (Fong, 2004). This leads them to focus extensively on providing homework assistance, which directly impacts school performance and grades. However, among the different types of parental assistance, previous research has consistently showed the mixed results of the relationship between homework assistance and academic achievement (Cooper et al., 2000; Desimone, 1999; Pomerantz et al., 2005; Xu, 2004).

Given these mixed findings, some researchers have suggested that the "quality" of homework assistance is more crucial than the "quantity" (Cooper et al., 2000; Moroni et al., 2015). Within the framework of self-determination theory (Deci & Ryan, 1985, 1987), high-quality homework assistance could effectively satisfy children's three basic psychological needs: competence, autonomy, and social relatedness. Based on theoretical considerations, Dumont et al. (2014) have identified and empirically tested three key dimensions of homework assistance: responsiveness, structure, and control.

The responsiveness dimension reflects the degree to which parents provide emotional support and encouragement during homework assistance. It involves attentiveness to the child's needs and responding to them in a positive and constructive manner (Dumont et al., 2014; Guill et al., 2020; Ryan & Deci, 2017). The structure dimension pertains to the organization and consistency that parents bring to the homework process. This includes setting clear expectations, providing a conducive environment for studying, and establishing routines that promote discipline and focus. Such structure helps children develop good study habits and time management skills (Dumont et al., 2014; Farkas & Grolnick, 2010). The control dimension encompasses the level of authority and supervision parents exert over the homework process. While guidance and monitoring are important, excessive control can undermine autonomy and lead to negative outcomes such as reduced intrinsic motivation and increased stress (Dumont et al., 2014; Guill et al., 2020).

The three dimensions of parental homework assistance (responsiveness, structure, and control), each uniquely and crucially shape adolescents' grit development. Studies by Benckwitz et al. (2023) and Guill et al. (2020) show parental responsiveness significantly and positively affects students' persistence. Responsiveness, via emotional support and encouragement, cultivates perseverance. It creates a safe and motivating environment, boosting self-efficacy and nurturing resilience during academic challenges. The structure dimension strengthens grit by offering a stable learning framework. As indicated by Xu (2024) and Morrissey et al. (2014), structured support is key for developing persistent behaviors. Consistent routines and organized learning environments help adolescents internalize systematic work habits, making them more likely to approach tasks methodically and persistently. The control dimension has a dual nature. Gonida & Cortina (2014) and Karbach et al. (2013) highlight the delicate balance between beneficial guidance and overbearing control. Moreover, Pomerantz et al. (2005) note that overcontrol causes dependency or rebellion, hindering grit development. While moderate supervision, by setting clear boundaries and expectations, helps maintain focus and supports persistence, excessive control undermines intrinsic motivation and autonomy, reducing persistence.

Basic Psychological Needs as Mediators

Many studies focused on homework assistance have been conducted in the framework of SDT (Grolnick et al., 1997; Grolnick & Pomerantz, 2009), which postulates that high-quality parental homework assistance fosters children's basic psychological needs. However, the direct evidence for the relationship between parental homework assistance quality and children’s basic psychological needs is scarce.

According to SDT, fulfillment of the three basic psychological needs will promote intrinsic motivation and facilitate the internalization of extrinsic motivations, guiding individuals toward positive and integrated development. Strengthened intrinsic motivation enhances goal-oriented enthusiasm and perseverance, ultimately boosting grit. Thus, satisfying these needs significantly contributes to grit development. To date,

only two studies have explored the relationship between need fulfilment and grit. Jiang et al. (2019) examined 2963 Chinese adolescents and found that grit predicted psychological needs, which played a mediating role in the grit–subjective well-being relationship. Here, grit was treated as a personality trait and predictor. Santana-Monagas and Núñez (2022) used latent profile analysis to identify four need profiles: thwarted, fulfilled, low-fulfillment, and neutral. Students in the fulfilled profile showed optimal grit and well-being.

Emotion Regulation as Moderator

Emotion regulation（ER) refers to the intrinsic and extrinsic processes that are responsible for managing one's emotions toward goal accomplishment (Thompson, 1994). ER involves not only reducing the intensity or frequency of emotional states but also developing the capacity to generate and sustain emotions (Calkins & Hill, 2007). Previous studies have suggested two kinds of ER that have been operationalized: cognitive reappraisal (CR) and expressive suppression (ES). CR refers to a cognitive change strategy that involves redefining a potentially emotion-eliciting situation in such a way that its emotional impact is changed, and ES refers to a form of response modulation involving the inhibition of ongoing emotion-expressive behavior. CR involves reframing stressful events positively and actively improving mood, leading to more positive and fewer negative emotions (John & Gross, 2004). In contrast, ES can cause psychological costs and less positive emotion. While suppressing negative emotions may not reduce their intensity, suppressing positive emotions can decrease happiness (John & Gross, 2004).

Literature suggests that ER has a stress-reducing effect by buffering the negative consequences of stressful events (Salovey et al., 1999; Wranik et al., 2007). Homework is often a source of distress, and researchers even describe it as "battlefield" for students, teachers and parents (Cooper & Valentine, 2001). Homework may trigger a variety of negative emotions and feelings among students such as tension (Solomon et al., 2002), helplessness (Pomerantz et al., 2006), disengagement (Reeve & Tseng, 2011), and ultimately lead to reduced effort (Trautwein et al., 2009). Thus, the impact of stress in homework completion and

homework assistance is likely to be less profound when individuals possess higher abilities for managing emotions associated with stressful situations (Lazarus, 1999). Likewise, ER may serve as a coping resource to reduce negative reactions when confronted with a stressful event (Salovey et al., 1999).

Parental Homework Assistance in Adolescents

Adolescence is characterized by a fundamental developmental tension: a significantly increased need for autonomy juxtaposed with a continued reliance on parental support for navigating academic challenges (Eccles & Harold, 1993; Wild & Gerber, 2007). This tension is central to the stage-environment fit theory, which posits that optimal development occurs when the social environment aligns with an individual's evolving developmental needs. Parents are challenged to adapt their role from providers of direct solutions to facilitators of autonomous problem-solving (Patall et al., 2008). This period of dynamic renegotiation makes adolescence a uniquely sensitive and informative stage to study how parenting practices, such as homework assistance, interact with a child's psychological needs.

Critically, empirical research confirms that the quality of parental homework assistance remains a stable and significant predictor of adolescents' academic functioning. Longitudinal and cross-sectional studies across secondary school grades (e.g., Grades 5-9) have shown that the associations between the key dimensions of assistance quality (responsiveness, structure, and control) and outcomes such as homework effort, procrastination, and achievement do not weaken substantially across these years (Benckwitz et al., 2024). These findings highlight that how parents are involved becomes more critical than if they are involved. Furthermore, while the level of perceived assistance may decline, its qualitative impact persists. Therefore, adolescence is not a period of fading influence but one where the nature and quality of parental support are paramount and consistently consequential.

Current study

We used the longitudinal data from three time points from Grade 8 to Grade 10 to explore the relationship between the quality of parental homework assistance and grit, and also the mechanism underlying this relationship. We also explored the moderating role of emotion regulation. Specifically, we hypothesize that: 1) Parental responsiveness and structure will positively predict adolescent grit, while parental control will negatively predict adolescent grit; 2) basic psychological needs could mediate this relationship; 3) ER may moderate the relationship between the quality of parental homework assistance and basic psychological need. The relationship between quality of parental homework assistance and grit may be stronger when students have a lower level of ER (see Figure 1).

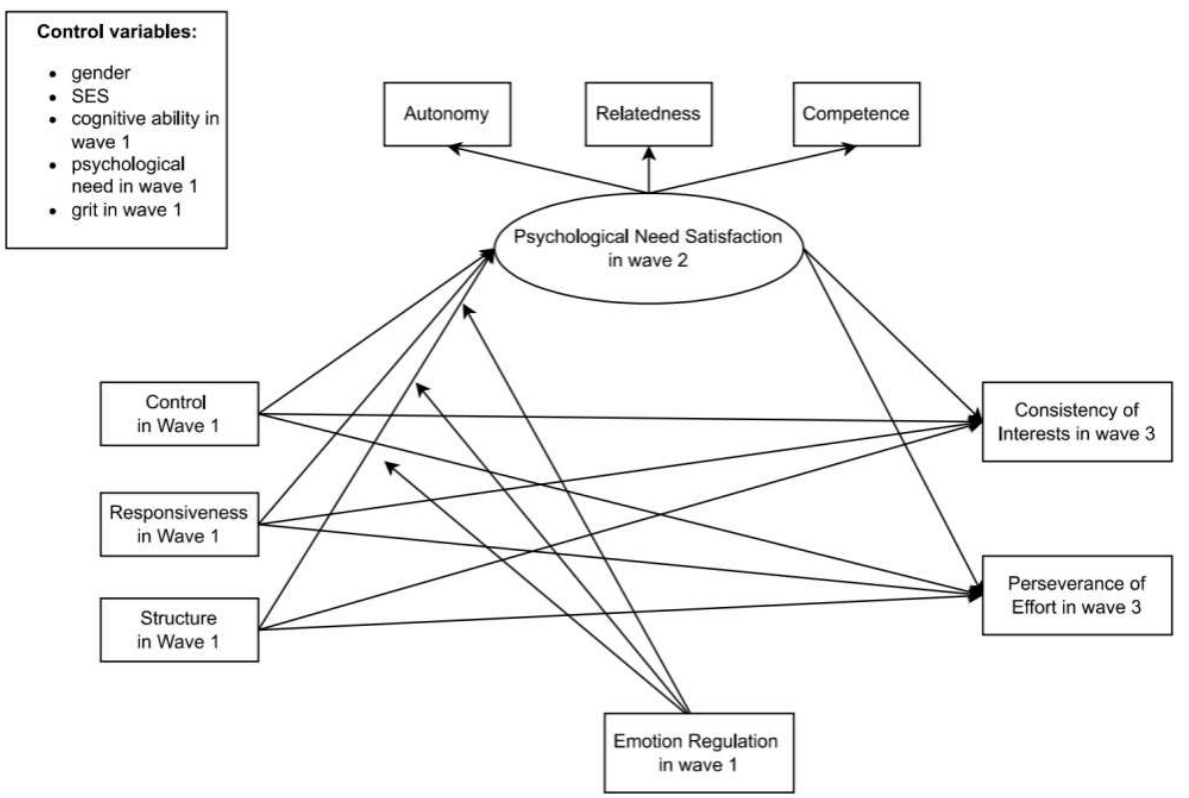

Figure 1. The conceptual model.

Method

Participants

The current study utilized data from 4987 Chinese adolescents. To ensure a valid assessment of PA and grit, the analysis was restricted to public school students living with their parents (n = 4212; 56.8% female; Grades 8–10, approximately 13–16 years). Participants were drawn from families with a median parental education level of lower secondary school or vocational middle school education, and the median annual family income ranged from ¥14,001 to 30,000.

Procedure

The data were drawn from the Child Academic and Psychological Development Study (CAPS), a longitudinal study tracking adolescent development in Hebei Province, located in the North China Region. The protocol received ethical approval from Beijing Normal University's Institutional Review Board. Data were collected using a three-wave longitudinal design with annual assessments, conducted in public secondary schools across Xushui District during the autumn of 8th grade (T1, October 2020), 9th grade (T2, November 2021), and 10th grade (T3, October 2022).

Students completed written questionnaires in classrooms during regular school hours. All questionnaires were administered in Chinese by trained research assistants or school psychologists. For scales without existing Chinese versions, a rigorous translation process was employed: initial translation from English to Chinese was followed by back-translation and reconciliation of inconsistencies by two bilingual scholars, ensuring cultural appropriateness and conceptual equivalence of items. Retention rates remained high at T2 (98.6%, n = 4152; 56.7% female) and T3 (92.3%, n = 3888; 42.5% female). Despite this reduction, no significant differences were found between the T2 and T3 samples, preserving the validity of the longitudinal analysis.

Measures

PA at T1

PA at Time 1 (T1) was assessed using the 14-item scale (Quality of Parental Homework Involvement) developed by Dumont et al. (2014), comprising three subscales: (a) control (4 items; e.g. “My parents tutor me in my homework even when I don't need help.”). (b) responsiveness (4 items; e.g. “My parents guide me through my homework when I ask for it.”), and (c) structure (6 items; e.g., “My parents want me to finish my homework before I go to play with my friends.”). Responses were collected on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The total Cronbach's alpha for the entire sample was 0.90, with subscale alphas of 0.77 for control, 0.90 for responsiveness, and 0.88 for structure.

Grit at T1 and T3

Grit was assessed at T1 and T3 using Duckworth et al.'s (2007) 12-item measure (Grit Scale), which includes two subscales: (a) consistency of interest (CI; 6 reverse-scored items; e.g., "I frequently change long-term goals") and (b) perseverance of effort (PE; 6 standard items; e.g., "I achieve goals through sustained work"). Items were rated on a 4-point Likert scale ranging from 1 (not at all consistent) to 4 (fully consistent). At T1, the total Cronbach's alpha was 0.82, with subscale alphas of 0.87 for CI and 0.86 for PE. At T3, the total Cronbach's alpha was 0.85, with subscale alphas of 0.87 for CI and 0.86 for PE.

Psychological need satisfaction at T1 and T2

Psychological need satisfaction was measured using a 12-item scale (adapted from Basic Psychological Needs Scales, BPNS) (La Guardia et al., 2000), which assesses competence satisfaction (4 items, e.g., ‘‘I have confidence that I can do things well.’’), autonomy satisfaction (4 items, e.g., ‘‘For what I do, I have the feeling that I can choose freely.’’), and relatedness satisfaction (4 items, e.g., ‘‘I think the people I care about also care about me.’’). Items were rated on a 5-point Likert scale, ranging from 1 (Completely Disagree) to 5 (Completely Agree).

At T1, the total Cronbach's alpha was 0.89, with subscale alphas of 0.80 for competence, 0.70 for autonomy, and 0.80 for relatedness. At T2, the total Cronbach's alpha was 0.90, with subscale alphas of 0.82 for autonomy, 0.71 for relatedness, and 0.82 for competence.

ER at T1

To assess T1's ER, we used a 10-item measure (Gullone & Taffe, 2012), which taps into reappraisal (6 items, e.g., "When I want to feel happier, I think about something different.") and suppression (4 items, e.g., "I don't want to show my emotions."). Items were rated on a 4-point Likert scale, ranging from 1 (completely inconsistent) to 4 (completely consistent). The Cronbach's alpha for reappraisal was 0.87, for suppression was 0.73, and for the whole sample was 0.82.

Cognitive ability at T1

Raven's SPM (Chinese version) was utilized to assess the children's cognitive ability at T1 (Zhang & Wang, 1989). Following instructions, the items are presented according to their level of difficulty. According to Raven (1938), a standard SPM is estimated to be completed in 45 min. One point is awarded for each correct choice, and the total scores are calculated out of 60 points. The raw scores are converted to age-standardized scores.

Plan of analysis

This study employed longitudinal data analysis to investigate the impact of PA on adolescents' grit. To ensure data integrity, missing and outlier values were addressed using the Expectation-Maximization (EM) algorithm (Enders, 2010). Control variables included gender, socioeconomic status (SES), cognitive ability, T1 psychological needs, and T1 grit.

Initially, common method bias was assessed. Then, a Confirmatory Factor Analysis (CFA) was conducted to validate the measurement model. PA at T1 (control, responsiveness, and structure) served as the independent variable; psychological needs at T2 (including autonomy, relatedness, and competence) acted as

the mediating variable; ER at T1 (composed of reappraisal and suppression) functioned as the moderating variable; and grit at T3 (measured by CI and PE) was the dependent variable. CFA was performed using R 4.5.2 (Zhang et al., 2021b), with model fit evaluated via χ^2/df, SRMR, RMSEA, and CFI. A model was deemed acceptable if CFI > 0.90 (Little, 1997), RMSEA < 0.08, and SRMR < 0.08 (Hu & Bentler, 1999).

Following validation of the measurement model, Structural Equation Modeling (SEM) was employed to analyze direct, mediating, and moderating effects, using Mplus 8.3. Initial descriptive statistics and Pearson correlations were calculated to explore preliminary relationships among variables (Field, 2013). SEM was then used to examine the direct effects of PA on grit. The mediating role of psychological needs was tested using the bias-corrected bootstrap method with 5000 resamples. Finally, interaction terms were constructed to assess the moderating effect of ER and simple slope analysis was conducted at ±1 SD of ER to interpret the significant interactions.

Results

Preliminary statistics

Common method bias was assessed through Harman's single-factor test using principal component analysis in SPSS 26.0. All measurement items underwent unrotated exploratory factor analysis constrained to extract one latent factor. The results indicated that at T1, the first factor accounted for 25.74% of the total variance; at T2, it explained 28.64%; and at T3, it accounted for 27.67%. These percentages were all substantially below the 40% critical threshold suggested by Podsakoff et al. (2003), indicating the absence of common method bias. Before testing the hypothesized model, we examined the correlations between all variables to obtain a preliminary understanding of the data, and the results showed that the majority of correlations were in the expected directions. The correlation analysis in the present study showed that the three dimensions of parental homework involvement (responsiveness, structure, and control) did not exhibit clear

differential correlations with the three subdomains of basic psychological needs (relatedness, competence, and autonomy). Given the high intercorrelations among these three psychological need subscales and the lack of distinct correlational patterns, the three dimensions of psychological needs were combined into a single latent variable in the subsequent structural model analysis. Table 1 presents the means, standard deviations, and correlations between all variables.

Confirmatory factor analyses

Consistent with previous studies investigating the factor structure of grit (Muenks et al., 2017), three distinct models—including a one-factor model, a two-correlated-factor model, and a bifactor model—were tested for the grit scale at two measurement waves (T1 and T3) in the present study. In the one-factor model, all items of the grit scale were treated as indicators loading on a single latent variable, which was used to represent overall grit. For the two-correlated-factor model, each item was assigned to load on one of two interrelated latent factors, corresponding to the two core dimensions of grit (i.e., perseverance of effort and consistency of interest). Furthermore, to verify whether grit could be regarded as a unified construct with two subcomponents, a bifactor model was employed; in this model, each item loaded simultaneously on a general grit factor and a specific factor corresponding to one of the two grit dimensions (Muenks et al., 2017).

At T1, the one-factor model exhibited poor data fit ($\chi^2_{(54)} = 13926.448$, CFI = 0.481, TLI = 0.366, RMSEA = 0.231, SRMR = 0.214). By comparison, the two-correlated-factor model achieved adequate fit to the data ($\chi^2_{(53)} = 900.071$, CFI = 0.970, TLI = 0.963, RMSEA = 0.058, SRMR = 0.058). This model also yielded significantly superior fit compared to the one-factor model ($\Delta\chi^2_{(1)} = 13026.377$, $p < .001$), and all standardized factor loadings reached statistical significance ($\beta s > 0.30$, $ps < .001$). The bifactor model at T1

Table 1. *Means, standard deviations, and bivariate correlation coefficients among all concepts.*

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
T1																							
1.	**gender**	1.49	0.50	1																			
2.	**FEDU**	2.11	0.81	0.00	1																		
3.	**MEDU**	2.11	0.87	-0.01	0.65**	1																	
4.	**family annual income**	4.39	1.83	-0.03	0.29**	0.30**	1																
5.	**cognitive ability**	46.31	8.52	0.11**	0.09**	0.06**	0.07**	1															
6.	**control**	2.57	0.91	-0.22**	-0.02	-0.03	-0.05**	-0.16**	1														
7.	**responsiveness**	3.31	1.05	-0.01	0.14**	0.14**	0.07**	0.05**	0.48**	1													
8.	**structure**	3.69	0.90	0.03	0.06**	0.05**	0.04*	0.12**	0.37**	0.62**	1												
9.	**CI**	2.51	0.68	0.03	0.07**	0.06**	0.08**	0.07**	-0.16**	0.04*	0.04*	1											
10.	**PE**	2.87	0.63	-0.04**	0.07**	0.05**	0.04**	0.02	0.26**	0.41**	0.45**	0.13**	1										
11.	**competence**	3.60	0.78	-0.07**	0.09**	0.09**	0.10**	0.08**	0.21**	0.39**	0.41**	0.13**	0.59**	1									
12.	**autonomy**	3.66	0.73	0.00	0.07**	0.06**	0.05**	0.08**	0.20**	0.37**	0.42**	0.02	0.49**	0.67**	1								
13.	**relatedness**	3.81	0.81	0.07**	0.09**	0.08**	0.09**	0.13**	0.14**	0.37**	0.42**	0.03*	0.46**	0.62**	0.64**	1							
14.	**reappraisal**	2.93	0.67	-0.02	0.05**	0.03*	0.04**	0.04*	0.25**	0.38**	0.43**	0.03*	0.51**	0.49**	0.47**	0.48**	1						
15.	**suppression**	2.79	0.69	-0.03*	0.01	-0.02	-0.04*	-0.04**	0.16**	0.07**	0.09**	-0.12**	0.13**	0.04**	0.10**	0.00	0.28**	1					
T2																							
16.	**competence**	3.54	0.75	-0.08**	0.09**	0.10**	0.06**	0.06**	0.14**	0.27**	0.29**	0.12**	0.44**	0.50**	0.37**	0.36**	0.34**	0.02	1				
17.	**autonomy**	3.64	0.68	0.01	0.04*	0.04**	0.05**	0.07**	0.13**	0.25**	0.32**	0.05**	0.40**	0.40**	0.45**	0.37**	0.35**	0.05**	0.70**	1			
18.	**relatedness**	3.78	0.77	0.10**	0.06**	0.06**	0.06**	0.10**	0.08**	0.27**	0.32**	0.07**	0.36**	0.38**	0.36**	0.46**	0.32**	-0.02	0.62**	0.66**	1		
T3																							
19.	**CI**	2.48	0.52	-0.06**	0.03*	0.04*	0.05**	0.05**	-0.08**	0.07**	0.05**	0.45**	0.18**	0.13**	0.04**	0.06**	0.06**	-0.06**	0.18**	0.09**	0.09**	1	
20.	**PE**	2.72	0.53	-0.12**	0.04**	0.03	0.00	-0.03	0.20**	0.27**	0.28**	0.18**	0.50**	0.40**	0.33**	0.28**	0.33**	0.07**	0.47**	0.39**	0.34**	0.25**	1

Note. FEDU = father's education level, MEDU = mother's education level, CI = consistency of interest, PE = perseverance of effort; T1 = Time 1; T2 = Time 2; T3 = Time 3. Gender was coded as 1 = male and 2 = female.

*$p < .05$, **$p < .01$, ***$p < .001$.

showed acceptable fit ($\chi^2_{(42)}$ = 1148.675, CFI = 0.959, TLI = 0.935, RMSEA = 0.074, SRMR = 0.030), though its fit was marginally worse than that of the two-correlated-factor model.

The pattern of model fit at T3 was consistent with that observed at T1. The one-factor model again failed to achieve satisfactory fit to the data ($\chi^2_{(54)}$ = 14327.687, CFI = 0.495, TLI = 0.383, RMSEA = 0.239, SRMR = 0.216). In contrast, the two-correlated-factor model provided significantly better fit ($\chi^2_{(53)}$ = 788.340, CFI = 0.975, TLI = 0.969, RMSEA = 0.055, SRMR = 0.057). The difference in fit between this model and the one-factor model was statistically significant ($\Delta\chi^2_{(1)}$ = 13539.347, $p < .001$), and all factor loadings were significant ($\beta s > .30$, $ps < .001$). The bifactor model at T3 also demonstrated acceptable fit ($\chi^2_{(42)}$ = 1297.965, CFI = 0.956, TLI = 0.930, RMSEA = 0.080, SRMR = 0.031), but it still did not outperform the two-correlated-factor model in terms of fit.

Aligning with earlier findings (Credé et al., 2017; Li et al., 2016; Muenks et al., 2017), the two-correlated-factor model of grit proved to be the best-fitting model at both T1 and T3 measurement waves. This result supports the theoretical conceptualization of grit as a two-dimensional construct rather than a unidimensional one (see Table 2).

Table 2. *The CFA model result*

Model 1 (T1)	**χ^2 Value**	**χ^2 DF**	**CFI**	**TLI**	**RMSEA**	**SRMR**
One-factor model	13926.448	54	0.481	0.366	0.231	0.214
Two-correlated-factor model	900.071	53	0.970	0.963	0.058	0.058
Bifactor	1148.675	42	0.959	0.935	0.074	0.030

Model 2 (T2)	**χ^2 Value**	**χ^2 DF**	**CFI**	**TLI**	**RMSEA**	**SRMR**
One-factor model	14327.687	54	0.495	0.383	0.239	0.216
Two-correlated-factor model	788.34	53	0.975	0.969	0.055	0.057
Bifactor	1297.965	42	0.956	0.930	0.080	0.031

The mediation model

To examine the mediating role of psychological need satisfaction at T2 in the relationship between PA at T1 and grit at T3, a mediated model was constructed. The model demonstrated acceptable fit ($\chi^2/df = 22.99$, CFI = 0.93, TLI = 0.87, RMSEA = 0.07).

The results of direct effect are presented in Figure 2. The two dimensions of T1 PA (Control and Responsiveness) were related to T3 CI as follows: Control was negatively associated with T3 CI (b = -0.07, SE = 0.02, $p < .01$), and responsiveness was positively associated with T3 CI (b = 0.06, SE = 0.02, $p < .05$). Results indicated that psychological need satisfaction significantly mediated the relationship between PA dimensions and adolescents' grit. Specifically, T1 Structure positively associated with T2 psychological need satisfaction (b = 0.10, SE = 0.02, $p < .01$). Furthermore, T2 psychological need satisfaction was associated with T3 CI (b = 0.11, SE = 0.02, $p < .01$) and PE (b = 0.33, SE = 0.02, $p < .01$), indicating that psychological need satisfaction enhances grit (Detailed data are shown in Table 3).

As shown in Table 4, the indirect paths structure→need→CI (B = 0.006, SE = 0.002; 95% CI [0.003, 0.009]) and structure→need→PE (B = 0.018, SE = 0.004; 95% CI [0.011, 0.026]) were significant, confirming the mediating role of psychological need satisfaction.

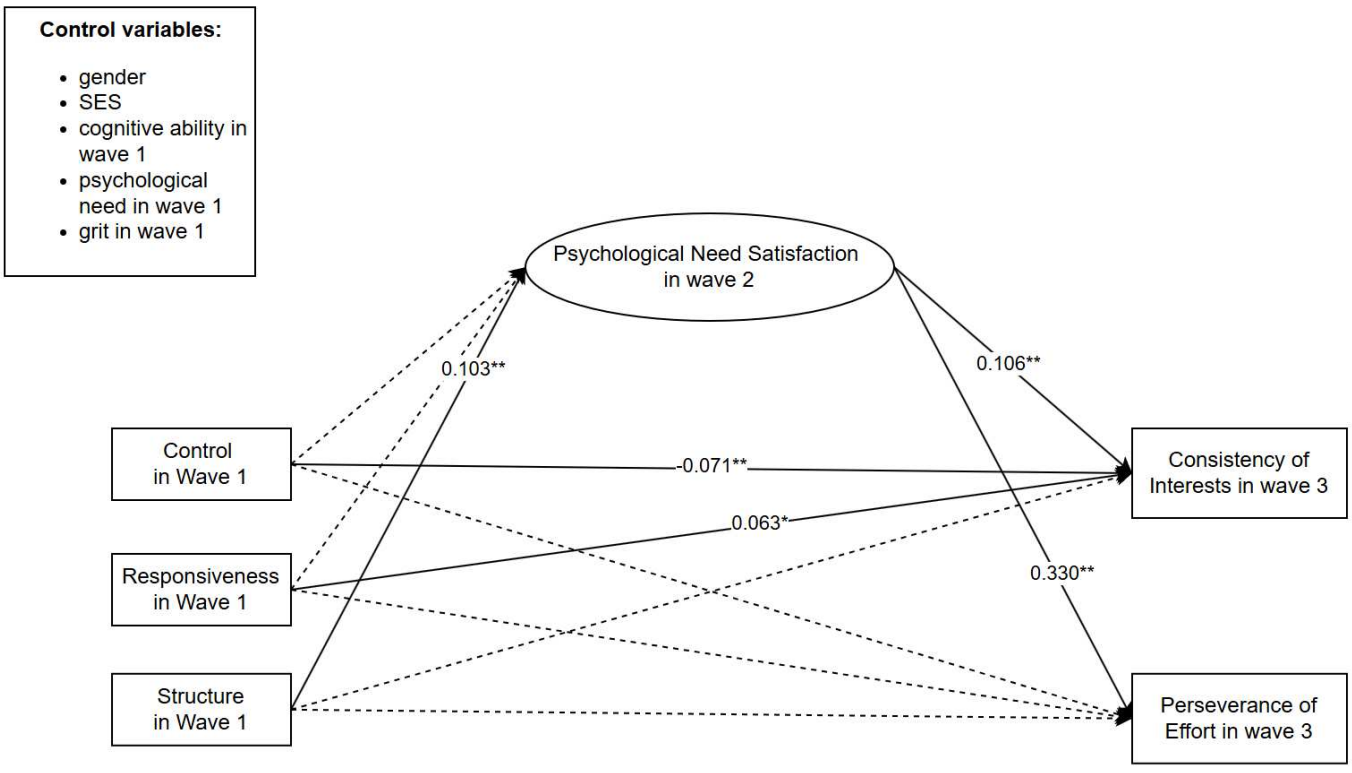

Figure 2. *The final model's path: All estimates are standardized coefficients.*

Table 3. *The results of model coefficients.*

	Model 1 T2 Psychological Need Satisfaction			Model 2 T3 Consistency of interests			Model 3 T3 Perseverance of Effort		
	b	***SE***	***t***	***b***	***SE***	***t***	***b***	***SE***	***t***
gender	-0.01	0.02	-0.39	-0.10	0.01	-7.37**	-0.12	0.01	-9.01**
maternal education level	0.04	0.02	1.92	0.00	0.02	0.13	-0.04	0.02	-2.22*
Father 's education level	-0.01	0.02	-0.62	-0.03	0.02	-1.52	0.03	0.02	1.82
family annual income	0.01	0.02	0.38	0.01	0.02	0.36	-0.06	0.01	-4.31**
T1									
cognitive ability	0.02	0.02	0.91	0.01	0.01	0.93	-0.05	0.01	-4.10**
psychological need satisfaction	0.44	0.02	19.86**						
Consistency of interests				0.41	0.02	25.97**			
Perseverance of Effort							0.31	0.02	15.69**
control	-0.02	0.02	-0.75	-0.07	0.02	-3.86**	0.02	0.02	1.16
responsiveness	0.03	0.02	1.39	0.06	0.02	2.98*	0.04	0.02	1.79
structure	0.10	0.02	4.86**	-0.02	0.02	-1.18	-0.02	0.02	-0.91
reappraisal	0.13	0.02	6.15**	0.01	0.02	0.50	0.04	0.02	1.88
suppression	-0.04	0.02	-2.27*	-0.01	0.02	-0.84	0.00	0.02	-0.18
control × reappraisal	0.00	0.03	-0.17						
control × suppression	0.01	0.02	0.27						
responsiveness × reappraisal	0.03	0.02	1.45						
responsiveness × suppression	-0.06	0.03	-2.43*						
structure × reappraisal	0.01	0.03	0.37						
structure × suppression	-0.02	0.03	-0.75						
T2 psychological need satisfaction				0.11	0.02	5.13**	0.33	0.02	16.60**
R^2	0.36			0.21			0.33		
F	19.42**			15.89**			22.67**		

Moderating Effects of emotion regulation at T1

This study examined the moderating role of ER in the relationship between PA and psychological need satisfaction. ER served as a potential moderator. As shown in Table 3, our analysis revealed that T1 suppression significantly moderated the link between responsiveness and psychological need satisfaction (*b* = -0.06, SE = 0.03, $p < .05$). In Table 4, the responsiveness→need→CI path was stronger under low suppression (B = 0.005, SE = 0.002, 95% CI [0.002, 0.009]), whereas this relationship became non-significant under high suppression (*B* = -0.001, SE = 0.002, 95% CI [-0.005, 0.002]). A similar pattern was observed for responsiveness→need→PE, with the effect being non-significant under high suppression

(*B* = -0.004, SE = 0.006, 95% CI [-0.016, 0.005]) but significant under low suppression (*B* = 0.015, SE = 0.005, 95% CI [0.005, 0.025]) (see Figure 3). These results highlight suppression as a crucial factor influencing the PA–grit relationship.

Table 4. *The conditional indirect effect.*

	B	SE	95% CI
Indirect path			
control→need→CI	-0.001	0.001	-0.003 to 0.001
control→need→PE	-0.009	0.003	-0.009 to 0.004
responsiveness→need→CI	0.002	0.001	-0.001 to 0.004
responsiveness→need→PE	0.005	0.004	-0.002 to 0.012
structure→need→CI	0.006	0.002	0.003 to 0.009
structure→need→PE	0.018	0.004	0.011 to 0.026
Conditional indirect effect			
responsiveness→need→CI			
High suppression	-0.001	0.002	-0.005 to 0.002
Low suppression	0.005	0.002	0.002 to 0.009
responsiveness→need→PE			
High suppression	-0.004	0.006	-0.016 to 0.005
Low suppression	0.015	0.005	0.005 to 0.025

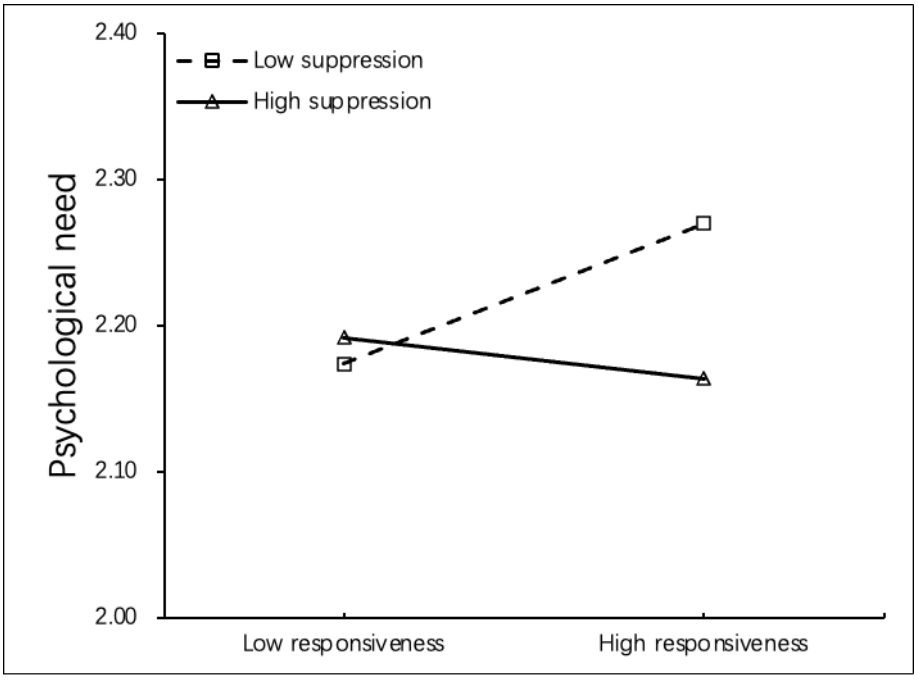

Figure 3. *Moderating effect of expressive suppression on the relationship between PA and psychological need satisfaction.*

Discussion

This study developed a moderated mediation model to examine the indirect effect of parental homework assistance on grit through the satisfaction of basic psychological needs (autonomy, competence, and relatedness), testing emotion regulation as a moderator of this relationship. We found that parental control negatively affected the consistency of interests, and responsiveness positively predicted consistency of interests. Basic psychological needs satisfaction significantly mediated the relationship between parental homework assistance and grit. Specifically, the structuring dimension of parental homework assistance positively influenced both consistency of interests and perseverance of effort through basic psychological needs. Suppression moderated the indirect relationships between the responsiveness dimension of parental homework assistance and grit (i.e., consistency of interests and perseverance of effort), such that the positive association was stronger under low suppression and non-significant under high suppression. Our findings contribute to a comprehensive understanding of grit within Bronfenbrenner's (2005) mesosystem by highlighting the interplay between home-school interactions (i.e., parental homework assistance) and individual factors (i.e., basic psychological needs and emotion regulation) in fostering grit.

Direct Effect of Parental Homework Assistance on Grit

The findings of this study indicate that parental control has a negative effect on the consistency of interests, which was consistent with previous research (e.g., Soenens & Vansteenkiste, 2010; Wei & Liu 2022) and SDT (Deci & Ryan, 1985, 1987). When exposed to high levels of parental control that pressure them to think, feel, and behave in accordance with parental expectations, children's autonomy is significantly undermined (Dumont et al., 2014). Children may find it difficult to maintain their interest toward long-term goals consistently (Deci & Ryan, 1987; Wei & Liu, 2022). However, the lack of a significant effect on perseverance of effort contrasts with the finding of Wei and Liu (2022), who revealed a positive relation among youth in elementary and middle school, but not in high school. One possible explanation is that middle school students, being in the early stages of adolescence, often experience a

heightened need for autonomy and independence. As a result, they may exhibit greater resistance to parental control practices and become less compliant with parental expectations (Scharf & Goldner, 2018; Soenens & Vansteenkiste, 2010; Wei & Liu, 2022).

Parental responsiveness positively influenced the consistency of interests, aligning with SDT (Deci & Ryan, 1985, 1987). Responsiveness, reflecting a parent's dedication and positive attention to the child-rearing process (Grolnick & Ryan, 1989), is key to satisfying children's innate need for relatedness, a core component of SDT. Responsive parents provide warmth, understanding, and attunement to children's needs (Dumont et al., 2014), fostering a sense of connection and belonging. This secure base allows children to feel comfortable to consistently explore their interests. However, parental responsiveness unexpectedly did not significantly predict perseverance of effort. One explanation is that not all parental feedback effectively fosters children's perseverance. When children decide whether to persist, they often weigh expected utilities, including the costs and rewards associated with their efforts, which are frequently communicated through parents' behaviour (Leonard et al., 2020). Research has shown that the nature of parental feedback is critical for promoting perseverance (Leonard et al., 2022). For instance, Lucca et al. (2019) found that praising effort, rather than innate ability, is positively correlated with children's persistence. Furthermore, responsiveness without autonomy support might be less effective in fostering perseverance. Over-responsive parents who do not allow their children to make independent choices or face challenges may hinder the development of self-reliance and independent perseverance (Du et al., 2023).

No direct effects of parental structure on either consistency of interests or perseverance of effort were found in this study. While structure is often viewed as beneficial, its effectiveness may hinge on how it is implemented. If structure is perceived as controlling or rigid, it can undermine children's autonomy and intrinsic motivation (Deci & Ryan, 1985). However, as revealed in our study, it is possible that structure does influence grit, but indirectly by fostering basic psychological needs like competence and relatedness. A supportive environment characterised by structure may help children feel capable and connected, which, in

turn, enhances their grit. The mediation effect through basic psychological needs will be discussed in more detail below.

Mediating Role of Basic Psychological Needs

The study's finding that basic psychological needs fully mediated the relationship between structure and grit (i.e., consistency of interests and perseverance of effort) supports Hypothesis 2 and aligns with the predictions of SDT (Deci & Ryan, 1985, 1987). Parental structure, representing the positive and supportive aspects of parental assistance (Grolnick & Pomerantz, 2009), is crucial in children's homework context. SDT posits that parental structure provides a foundation for the development of competence (Grolnick & Ryan, 1989; Skinner et al., 2005). When parents create a supportive environment by offering guidance and establishing clear routines, they facilitate children's development of effective time management and learning habits, a pattern supported by previous research (e.g., Dumont et al., 2014; Patall et al., 2008). Consequently, this structured environment allows children to experience greater competence, relatedness, and autonomy, which, in turn, fosters intrinsic motivation. As children become more intrinsically motivated through the satisfaction of these basic psychological needs, they are more likely to demonstrate increased consistency of interests and perseverance of effort in pursuing their goals, ultimately leading to higher levels of grit, as demonstrated in previous research (Zhang et al., 2021a).

The study also found that basic psychological needs did not significantly mediate the relationship between either parental control or responsiveness and adolescent grit (i.e., consistency of interests and perseverance of effort). Notably, while basic psychological needs demonstrated a significant positive association with grit, neither parental control nor responsiveness significantly predicted basic psychological needs in our model. The lack of a significant path from parental control to basic psychological needs may be attributed to the self-protective mechanisms that children employ, such as self-regulation, to mitigate the negative effects of controlling parenting (Lindblom et al., 2016). When children experience high levels of parental control, they may develop adaptive strategies to cope with the stress and pressure exerted by their

parents. One such strategy is self-regulation, which allows children to effectively manage their emotions and behaviours in response to external demands. As a result, children may prioritise managing their emotional states over seeking satisfaction of their basic psychological needs, which could explain why parental control does not significantly predict these needs. In addition, one potential explanation for the non-significant effect of parental responsiveness on basic psychological needs could be the moderating role of emotion regulation, which will be discussed in greater detail in subsequent sections.

Moderating Role of Emotion Regulation

Cognitive reappraisal did not significantly moderate the relationship between any dimension (i.e., control, responsiveness, and structure) of parental homework assistance and basic psychological needs. Likewise, expressive suppression did not moderate the relationships between control or structure and basic psychological needs. This may be attributable to the fact that only parental structure had a significant, positive impact on basic psychological needs; control and responsiveness were not significant predictors. As structure itself may create a need-supportive environment, children may have less need to actively engage in emotion regulation strategies like cognitive reappraisal or expressive suppression. Another explanation may lie in the specific context of homework and the age group studied. The adaptiveness of particular emotion regulation strategies, such as cognitive reappraisal, is context-dependent (Troy et al., 2013). Specifically, the degree to which emotion regulation (e.g., cognitive reappraisal) is adaptive depends on the type of stress (Troy et al., 2013). If children already perceive homework as important or are motivated to succeed, their reliance on cognitive reappraisal in response to parental assistance might be less critical. Furthermore, the effectiveness of emotion regulation develops with age (Willner et al., 2022). The mixed evidence regarding reappraisal effectiveness in middle school students, as highlighted in Willner et al.'s (2022) systematic review, suggests that the lack of a moderation effect in our study could also be due to the limited effectiveness of cognitive reappraisal skills within the studied sample.

Expressive suppression was found to moderate the indirect effect of parental responsiveness on grit

(i.e., consistency of interests and perseverance of effort) through basic psychological needs. Specifically, the initially non-significant mediating pathways from responsiveness to consistency of interests and perseverance of effort, via basic psychological needs, became significant under conditions of low expressive suppression, but remained non-significant when expressive suppression was high. This moderation effect can be interpreted through the lens of SDT (Deci & Ryan, 1985, 1987), which posits that the satisfaction of basic psychological needs (autonomy, competence, and relatedness) is essential for intrinsic motivation and well-being. Parental responsiveness, characterised by warmth, understanding, and attunement to children's needs, is generally considered a facilitator of basic psychological need (Dumont et al., 2014). However, the extent to which responsiveness translates into need satisfaction, and subsequently grit, appears to depend on an individual's tendency to suppress emotional expression.

When children are not habitually suppressing their emotions (low expressive suppression), parental responsiveness is more likely to be perceived as genuine and supportive, fostering feelings of relatedness and autonomy (Ryan et al., 2015). This, in turn, bolsters intrinsic motivation and promotes the development of grit. Children who feel understood and validated by their parents are more likely to internalise their parents' values and goals, leading to greater consistency of interests and perseverance of effort. Conversely, when children exhibit high levels of expressive suppression, the positive effects of parental responsiveness on basic psychological needs may be attenuated. Expressive suppression involves inhibiting the outward expression of emotions, which can interfere with genuine emotional experiences and interpersonal connection (Gross & John, 2003). A child who frequently suppresses their emotions may struggle to fully experience the benefits of parental responsiveness, even if the parent is genuinely supportive. This could be because expressive suppression reduces the authenticity of emotional expression, hindering the development of strong interpersonal bonds and a sense of relatedness (Gross & Cassidy, 2019; Larsen et al., 2012). Studies have shown that expressive suppression can lead to decreased social support and impaired relationship quality (Srivastava et al., 2009). In the context of homework, a child with high expressive

suppression might not readily express their struggles or frustrations to a responsive parent, hindering the parent's ability to provide targeted support. This could prevent the child from experiencing a sense of competence and autonomy in their homework, ultimately undermining the development of grit.

Limitations and Future Directions

The current study has some limitations. First, it should be acknowledged that all the measures in this study were self-reported and multi-source information (such as observational data) could deepen understanding of this relationship. Second, parental homework assistance may be sensitive to different cultures. Thus, more research in other cultural settings are necessary to determine the extent to which the findings from the current study can be generalized across different cultural backgrounds. Finally, previous study has shown that children's personality could moderate the relationship between parental involvement and children's development (Creemers et al.,2015). Thus, more personality factors should be included as the moderation factors in future studies.

Conclusion

This longitudinal study examined how the quality of parental homework assistance relates to Chinese adolescents' grit. Parental control negatively predicted consistency of interest, whereas parental responsiveness positively predicted it. Parental structure showed no direct effect on grit, but it was indirectly associated with grit through basic psychological need satisfaction. Expressive suppression moderated the indirect path from responsiveness to grit: the positive effect via need satisfaction was stronger when expressive suppression was low and weaker when it was high. These findings suggest that responsive homework involvement (rather than controlling or merely structured involvement) may foster grit, while high expressive suppression may limit adolescents' capacity to benefit from responsive parenting. Practically, parents should prioritize responsive support and need-supportive structure over control, and educators should help adolescents regulate emotions to maximize the benefits of supportive parenting. Future research should test these associations across cultural contexts and with experimental designs.

List of abbreviations

Abbreviation	Full term
BPNS	Basic Psychological Needs Scales
CAPS	Child Academic and Psychological Development Study
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CI	Consistency of interests; confidence interval
CR	Cognitive reappraisal
EM	Expectation-maximization
ER	Emotion regulation
ES	Expressive suppression
FEDU	Father's education level
MEDU	Mother's education level
PA	Parental homework assistance
PE	Perseverance of effort
RMSEA	Root mean square error of approximation
SD	Standard deviation
SDT	Self-determination theory
SE	Standard error
SEM	Structural equation modeling
SES	Socioeconomic status
SPM	Standard Progressive Matrices
SPSS	Statistical Package for the Social Sciences
SRMR	Standardized root mean square residual
T1	Time 1
T2	Time 2
T3	Time 3
TLI	Tucker–Lewis index

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of Beijing Normal University. All procedures involving human participants were conducted in accordance with the ethical principles of the Declaration of Helsinki. Informed consent to participate was obtained from all adolescent participants and their parents or legal guardians prior to data collection.

Consent for publication

Not applicable.

Availability of data and materials

The datasets analysed during the current study were obtained from the Child Academic and Psychological Development Study (CAPS). These datasets are not publicly available because they are restricted to internal research use. Under the current data access arrangements, the authors are not authorized to share the individual-level data publicly or independently grant access to external researchers.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

BL: Conceptualization, Methodology, Formal analysis, Writing – original draft. DZ: Data curation, Investigation, Writing – review and editing. ZL: Validation, Visualization, Writing – review and editing. LL: Supervision, Project administration, Funding acquisition, Writing – review and editing. All authors read and approved the final manuscript.

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