

Original article

The Effects of Children's Temperament on Their Prosocial Behavior: The Parallel Mediating Roles of Executive Function and Paternal Parenting Behavior

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Abstract: To investigate the mechanisms underlying the influence of child temperament on prosocial behavior, this study examined the mediating roles of individual-level executive function and environmental-level paternal parenting behavior. A total of 915 families from a city in East China were recruited as participants, and questionnaire surveys and behavioral tasks were administered. The results revealed that effortful control significantly and positively predicted prosocial behavior. Furthermore, executive function and negative paternal parenting behavior served as parallel mediators in the relationship between effortful control and prosocial behavior, whereas the mediating effect of positive paternal parenting behavior was not significant. These findings indicate that effortful control in preschool children can indirectly promote prosocial behavior through two pathways: an intrinsic cognitive pathway by enhancing executive function, and an environmental pathway by reducing negative paternal parenting behavior. These findings provide empirical evidence for understanding the development of prosocial behavior in early childhood.

Keywords: Temperament; Prosocial behavior; Executive function; Paternal parenting behavior

1. Introduction

Prosocial behavior (PB) is defined as voluntary action undertaken to benefit others, contributing to the establishment and strengthening of interpersonal and group relationships (Eisenberg et al., 2006). It encompasses specific behaviors such as showing care, providing help, demonstrating consideration, acting kindly, and sharing (Goodman, 2001). Prosocial behavior is associated with a range of positive developmental outcomes, including healthy interpersonal relationships, psychological well-being, sound personality development, and social harmony (Van der Graaff et al., 2018; Varma et al., 2023). Early childhood is widely recognized as a sensitive period for nurturing prosocial behavior (Kostelnik, 2008), serving as the foundation for the formation and development of positive character and moral reasoning (Radke-Yarrow et al., 1983). In China, the Early Learning and Development Guidelines for Children Aged 3 to 6 Years emphasize that interpersonal communication and social adaptation constitute the main content of children's social learning and the fundamental pathway for their social development (Ministry of Education of the People's Republic of China, 2012). Thus, understanding the developmental mechanisms of prosocial behavior during this period holds both theoretical and practical significance.

Prosocial behavior in early childhood is influenced by individuals' temperament (Zahn-Waxler et al., 1992) and executive function (EF). Young children with high levels of surgency or effortful control (EC) in temperament tend to exhibit a higher frequency of prosocial behavior (Cassidy et al., 2003; Eisenberg et al., 1996; Hart et al., 2003; Orbán et al., 2025). In contrast, negativity in temperament is inversely associated with prosocial behavior (Guo & Ren, 2015). Furthermore, the positive link between executive function and prosocial behavior is related to enhanced activation of the dorsolateral prefrontal cortex under disadvantageous conditions; children with stronger inhibitory control tend to display a greater tendency toward prosocial behavior (Peng et al., 2025). This positive association with prosocial behavior has also been observed longitudinally (Moriguchi et al., 2020). Parenting behavior represents another factor contributing to individual differences in prosocial behavior among preschoolers, with paternal parenting behavior (PPB) playing a particularly notable role. In dual-parent families, when fathers are more actively involved in caregiving, parents tend to

report higher levels of prosocial behavior in their children (Bernadett-Shapiro et al., 1996). Moreover, the extent of paternal involvement has been found to positively predict young children's prosocial behavior (Liu, 2022). Although existing studies have confirmed the associations between child-level characteristics, environmental factors, and prosocial behavior in preschoolers, several limitations remain. First, much of the research has focused on the frequency of father involvement in relation to children's prosocial behavior (Li et al., 2012; Liu & Lu, 2022), while less attention has been paid to the nature of paternal parenting behavior and their links to prosocial behavior. Second, in the field of child developmental psychology, executive function has been widely established as a key mediating mechanism linking external social environments—such as teacher-child and peer relationships—to young children's prosocial behavior (Wu & Wei, 2025). However, how temperament, as an intrinsic and biologically grounded characteristic, influences prosocial behavior through executive function and paternal parenting behavior remains insufficiently explored, representing a gap in current research.

This study aims to identify how both internal mechanisms and external environments jointly and independently shape the influence of child temperament on prosocial behavior. Specifically, this study examines the mediating roles of paternal parenting behavior as an external environmental factor and executive function as an internal psychological mechanism. Identifying these pathways may help illuminate their collective impact on the development of prosocial behavior in early childhood.

1.1 The Relation Between Temperament and Prosocial Behavior in Young Children

Temperament refers to constitutionally based individual differences in reactivity and self-regulation. Cross-cultural studies involving American, Chinese, and Japanese samples consistently identify three broad dimensions of temperament: surgency, negativity, and effortful control (Rothbart et al., 2001). Temperament plays a significant role in early childhood development, it is associated with young children's social learning and coping strategies. Some children tend to be more responsive to rewards, while others are more sensitive to punishments (Gray, 1970). Furthermore, some children exhibit high wariness toward strangers and adopt avoidant coping styles, whereas others who do not show such wariness may quickly develop trust in strangers if social interactions proceed positively (Kagan & Snidman, 2004). In fact, different temperamental traits in young children elicit distinct responses from others (Scarr & McCartney, 1983; van Zeijl et al., 2007). These interactive patterns, in turn, influence child development (Moilanen et al., 2015).

As young children develop, their engagement in social life gradually increases. Some children exhibit strong prosocial tendencies from very early, while others demonstrate comparatively more difficulty in social adaptation (Lerner & Damon, 2006; Thomas & Chess, 1977). Temperament may serve as a key factor enabling young children to participate in social life more effectively and actively, and to exhibit prosocial behavior such as cooperation, sharing, and helping. It predicts individual differences in prosocial behavior outcomes. Research has established associations between the three core dimensions of temperament (i.e., surgency, effortful control, and negativity) and prosocial behavior (Eisenberg et al., 1996). During the preschool period, children who readily approach novel people and objects and are socially outgoing are more likely to help others. Those high in surgency tend to approach social stimuli more frequently, which provides greater opportunities for social interaction and thereby increases the frequency of learning and practicing prosocial behavior (Hart et al., 2003; Orbán et al., 2025). Moreover, children high in effortful control are better able to allocate attention and translate empathic arousal into actual prosocial actions (Cassidy et al., 2003; Eisenberg et al., 1996), possibly through the regulation of emotion (Eisenberg, 2000; Eisenberg et al., 2006). In contrast, negativity in young children is negatively associated with prosocial behavior (Poole et al., 2025), a link particularly evident in the case of anger (Laible et al., 2000; Strayer & Roberts, 2004). In recent years, scholars have increasingly focused on the interactive effects among temperament dimensions. The combination of moderate-to-low negativity and moderate-to-high effortful control tends to promote socially adaptive behaviors, such as cooperation and prosocial behavior. Individuals with high negativity but poor regulatory capacity often exhibit lower levels of prosocial behavior. However, children with high negativity who possess strong regulatory skills are generally able to manage their negative emotions, thereby becoming more susceptible to empathy and more likely to display helping and cooperative behaviors (Eisenberg & Fabes, 1992). This suggests that effortful control may act as a protective factor for prosocial behavior.

1.2 Executive Function as a Mediator in Children's Prosocial Behavior

Executive function refers to a higher-order cognitive capacity underlying complex thinking—an integrative construct encompassing the control processes that enable individuals to set goals, formulate plans, and select, monitor, and adjust their actions to achieve those goals (Zelazo et al., 2004). Research has established that executive function plays a significant role not only in academic development—such as in mathematics, literacy, and reading (Allan et al., 2014)—but also in shaping social-behavioral outcomes in early childhood. Higher levels of executive function are associated with greater concurrent and subsequent social competence, as it can improve social interaction by reducing maladaptive or aggressive behaviors that may lead to peer rejection (Montroy et al., 2014). Similarly, stronger executive function is linked to fewer externalizing problems (Borella et al., 2010).

The development of executive function is associated with an increase in the frequency of prosocial behavior (Liu, 2024). Young children with well-developed executive function demonstrate more advanced prosocial behavior, exhibiting better emotion regulation and social adaptation (Borella et al., 2010), and executive function has been shown to positively predict prosocial behavior in early childhood (Wang et al., 2025). Furthermore, significant associations exist between child temperament and executive function (Liu & Peng, 2010), particularly between effortful control and surgency (Shen et al., 2023). Higher effortful control is related to stronger executive function (Diamant & Smet, 2024), whereas higher

surgency tends to correlate with lower executive function. Specific temperament dimensions, such as distractibility, persistence, and sensory threshold, can also predict the development of executive function in young children (Gan, 2013). Existing literature has separately established the predictive roles of child temperament on prosocial behavior, and of executive function on prosocial behavior (Lerner & Damon, 2006), implying that executive function may serve as a mechanism linking temperament to prosocial behavior. Recent studies have highlighted executive function as a key mediator between external interpersonal relationships and young children's prosocial behavior (Wu & Wei, 2025). Nevertheless, whether and how children's temperament influences prosocial behavior through their executive function remains inadequately examined and represents a gap in current research.

1.3 Paternal Parenting Behavior as a Mediator in Children's Prosocial Behavior

The family environment also influences the development of prosocial behavior in young children (Lerner & Damon, 2006). With the increasing dissemination of science-based parenting concepts, both researchers and parents have placed greater emphasis on the role of fathers in child-rearing. Paternal parenting behavior refers to both positive and negative parenting practices exhibited by fathers. Positive paternal parenting behavior (PPPB) includes proactive parenting, positive reinforcement, warmth, and supportiveness; Negative paternal parenting behavior (NPPB) encompasses hostility and physical control. Positive paternal parenting behavior can effectively promote children's adaptive behaviors (Li, 2016) and is associated with reduced social withdrawal, fewer depressive symptoms, and better attentional development in children (Ma et al., 2019). In contrast, negative paternal parenting behavior—such as hostility, harshness, control, and intrusive behavior—can undermine the security of father-child interactions, evoke negative emotions like fear and anxiety in young children, and consequently lead to behavioral dysregulation (Blair et al., 2014).

Paternal parenting behavior can predict the development of prosocial behavior in young children. When fathers exhibit higher levels of warmth and support and lower levels of control and harshness, their children tend to demonstrate more prominent prosocial behavior (van der Storm et al., 2022). However, another study indicated that only maternal negative parenting was associated with reduced prosocial behavior in children, whereas no such link was found for negative paternal parenting behavior (Scheuring & Schulz, 2023). This discrepancy warrants further clarification in subsequent research. Moreover, temperament is one of the important factors influencing parents' differential parenting practices. Young children respond differently to the same events, and these responses in turn shape parental behavior and affect the children themselves (Baumgartner & Kiel, 2025). Children's temperamental characteristics—such as high activity level, high predictability, and high persistence—can significantly predict fathers' use of more negative parenting strategies (Zhang et al., 2022). Interactions between fathers and infants with difficult temperament tend to be of lower quality. Nevertheless, effortful control is regarded as a protective factor; children with stronger effortful control can exert a positive influence on their parents' parenting behaviors (Kotila et al., 2014). In fact, existing literature on the child-effects of temperament on paternal parenting behavior remains relatively limited, and the available findings are inconsistent, necessitating further clarification. In summary, current research and discussions suggest that children's temperamental characteristics shape paternal parenting behavior through child-effects, and specific paternal parenting behavior in turn influence the development of children's prosocial behavior. This reveals two important pathways in the relationship between temperament and prosocial behavior. However, these two pathways are not theoretically isolated. Whether paternal parenting behavior serves as a mediating mechanism between temperament and prosocial behavior remains an unanswered question in the existing literature.

1.4 The Current Study

Current research on the mechanisms through which child temperament influences prosocial behavior remains limited. It is still unclear whether individual-level executive function and environmental-level paternal parenting behavior play mediating roles in this relationship. Therefore, this study aims to systematically examine the relationships among temperament and executive function of young children, paternal parenting behavior, and children's prosocial behavior in a sample of Chinese preschoolers. Based on the literature review, a parallel dual-mediation model (Figure 1) was constructed and would be tested in this study. Specifically, the following hypotheses were proposed: (1) temperament significantly predicted prosocial behavior in young children (Hypothesis 1); (2) executive function mediated the relationship between their temperament and prosocial behavior (Hypothesis 2); (3) paternal parenting behavior mediated the relationship between children's temperament and their prosocial behavior (Hypothesis 3).

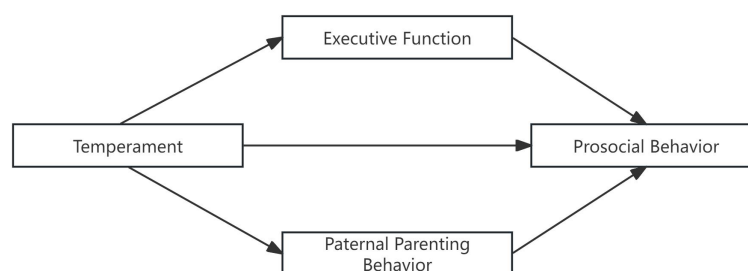


Figure 1. Hypothesized parallel dual-mediation model

2. Method

2.1 Participants

This study recruited 1,153 families and their children's teachers from a city in East China. Paper questionnaires were distributed, and 950 were returned (response rate = 82.40%). After excluding invalid responses, 915 valid questionnaires were retained for analysis (effective rate = 96.32%). In the final sample, 43.5% of children attended urban kindergartens, 51.5% were boys, and 45.1% were only children. The mean age of children was 52.86 months (SD = 6.29). The mean age of fathers was 35.85 years. Regarding fathers' educational attainment, 18.80% had education at or below junior high school, 22.08% had senior high school or technical secondary school, 26.01% had a junior college degree, 27.43% had a bachelor's degree, 4.26% had a master's degree or above, and 1.42% did not report their education. In terms of family socioeconomic background, 18.25% of families reported an annual income below 80,000 RMB, 50.49% reported between 80,000 and 300,000 RMB, 18.36% reported above 300,000 RMB, and 12.90% did not report their income.

2.2 Procedures

After obtaining the approval from the participating preschools, the researchers provided the questionnaires to the classroom teachers, who then distributed the questionnaires to parents for completion at home. The teachers collectively retrieved the completed questionnaires. The executive function tasks were administered in a quiet and unoccupied room within each preschool. All assessments were conducted by graduate students majoring in early childhood education. Each child participant was tested individually, with every session lasting about 10 minutes.

2.3 Measures

2.3.1 *The Very Short Form of the Children's Behavior Questionnaire (CBQ-VSF)*

Children's temperament was assessed using the Very Short Form of the Children's Behavior Questionnaire (CBQ-VSF; Putnam & Rothbart, 2006). This questionnaire, designed for children aged 3 to 8 years, consists of 36 items that measure three dimensions: surgency, negativity, and effortful control. Responses were rated on an 8-point scale ranging from "NA" (not applicable) to 1–7, where 1 indicates "extremely untrue" and 7 indicates "extremely true" Items 13, 19, 20, 22, 26, 29, 31, and 34 were reverse-scored. Higher scores indicate a higher level of the respective temperamental dimension. This questionnaire achieved good measurement results in Chinese samples (Xie et al., 2021). In this study, the internal consistency reliability was as follows: surgency (Cronbach's $\alpha = 0.625$), negativity (Cronbach's $\alpha = 0.656$), and effortful control (Cronbach's $\alpha = 0.697$).

2.3.2 *Chinese Version of the Multidimensional Assessment of Parenting Scale (MAPS)*

Paternal parenting behavior was assessed using the revised Chinese version of the Multidimensional Assessment of Parenting Scale (MAPS; Ahemaitijiang et al., 2020), originally developed by Parent and Forehand (2017). This scale consists of 27 items measuring two broad dimensions: positive paternal parenting behavior (including proactive parenting, positive reinforcement, warmth, and supportiveness) and negative paternal parenting behavior (including hostility and physical control). To enhance cultural appropriateness for Chinese samples, the 7-item "lax control" subdimension was omitted in this revision. Responses are recorded on a 5-point Likert scale ranging from 1 (Never) to 5 (Always). Higher scores on each subscale indicate higher levels of the corresponding parenting behavior. The revised Chinese version has demonstrated satisfactory reliability and validity (Ahemaitijiang et al., 2020). In the current study, internal consistency was good for both positive paternal parenting behavior (Cronbach's $\alpha = 0.859$) and negative paternal parenting behavior (Cronbach's $\alpha = 0.878$).

2.3.3 *The Strengths and Difficulties Questionnaire (SDQ)*

Children's prosocial behavior was assessed using the teacher-report version of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001). This 25-item questionnaire comprises five subscales: emotional problems, conduct problems, hyperactivity, peer relationship problems, and prosocial behavior. A total difficulties score can be derived by summing the first four subscales. Teachers rated each item on a 3-point scale from 0 (Not true) to 2 (Certainly true). Items 7, 11, 14, 21, and 25 are reverse-scored. Higher scores on the prosocial behavior subscale indicate higher levels of prosocial behavior. The SDQ has shown good reliability and validity in previous studies in China (Xie et al., 2021). In this study, the internal consistency for the prosocial behavior subscale was acceptable (Cronbach's $\alpha = 0.854$).

2.3.4 *Executive Function*

Children's executive function was assessed using two widely used tasks: the Day-Night Stroop Task and the Head-Toes Task. Raw scores from both tasks were converted to standardized z-scores and then averaged to create a composite executive function score for each child. This composite score was used in all primary analyses. Both tasks have been validated for use with preschool-aged children and showed good ecological validity for studying developmental correlates of executive function.

Day-Night Stroop Task (Gerstadt, Hong, & Diamond, 1994). This task measured inhibitory control using cards depicting a sun (on a black background) and a moon with stars (on a white background). Children were instructed to say "night" when shown the sun card and "day" when shown the moon card. Following rule explanation and four practice trials, a formal block of 16 trials was administered. One point was awarded for each correct response.

Head-Toes Task (Ponitz et al., 2008). This task assessed inhibitory control, working memory, and attention. Children were instructed to perform the opposite action of a verbal command (e.g., touch their head when told "touch your toes"). After comprehension checks and practice, a formal block of 10 commands was given. Responses were scored as 2

(correct), 1 (self-corrected), or 0 (incorrect), with a maximum score of 20.

2.4 Analyses

This study employed structural equation modeling with a bootstrap approach to test the parallel dual-mediation model. The analytical procedure consisted of the following steps: First, descriptive statistics and correlation analyses were conducted to examine the distribution characteristics of the four study factors (i.e., children's temperament, children's effortful control, paternal parenting behavior, and children's prosocial behavior) and their interrelationships. Second, a parallel dual-mediation model was tested, with temperament as the independent variable, prosocial behavior as the dependent variable, and executive function and paternal parenting behavior (positive and negative paternal parenting behavior) as parallel mediators. Finally, bootstrap sampling with 5,000 iterations was performed to examine the significance of the mediation effects. Analyses were conducted using SPSS 27.0 and AMOS 24.0.

3. Results

3.1 Preliminary Analyses

Table 1 presents the descriptive statistics for all variables across different demographic backgrounds. Among the 915 children, independent-samples t-tests revealed several significant gender differences: boys scored significantly lower than girls on negativity ($t = -2.61, p = 0.009$), effortful control ($t = -5.53, p < 0.001$), and prosocial behavior ($t = -6.02, p < 0.001$), but significantly higher on negative paternal parenting behavior ($t = 3.66, p < 0.001$). In addition, results also showed significant differences by only-child status: only children scored significantly lower than non-only children on negativity ($t = -2.60, p = 0.010$), while scoring significantly higher on positive paternal parenting behavior ($t = 2.91, p = 0.004$). Finally, urban-rural differences were also observed: children from rural areas scored significantly higher than their urban counterparts on negativity ($t = 2.69, p = 0.007$) and prosocial behavior ($t = 2.29, p = 0.022$), whereas they scored significantly lower on positive paternal parenting behavior ($t = -2.76, p = 0.006$).

Table 1. Descriptive Statistics of Study Variables in Demographics ($N = 915$)

Factors/Groups	Surgency	Negativity	EC	EF	NPPB	PPPB	PB
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Gender							
Boys	4.14 (0.69)	3.97 (0.71)	4.94 (0.74)	-0.04 (0.83)	2.13 (0.58)	3.66 (0.56)	2.20 (0.51)
Girls	4.07 (0.75)	4.09 (0.76)	5.20 (0.66)	0.05 (0.80)	1.99 (0.58)	3.72 (0.54)	2.40 (0.52)
Only child status							
Yes	4.13 (0.73)	3.96 (0.74)	5.04 (0.70)	0.00 (0.83)	2.06 (0.61)	3.75 (0.58)	2.30 (0.53)
No	4.09 (0.71)	4.09 (0.73)	5.09 (0.73)	0.00 (0.80)	2.07 (0.56)	3.65 (0.53)	2.30 (0.52)
Location							
Rural	4.11 (0.71)	4.09 (0.74)	5.06 (0.73)	-0.03 (0.81)	2.06 (0.58)	3.65 (0.56)	2.33 (0.54)
Urban	4.10 (0.74)	3.95 (0.72)	5.07 (0.70)	0.05 (0.83)	2.06 (0.58)	3.75 (0.53)	2.25 (0.51)
Total	4.11 (0.72)	4.03 (0.73)	5.06 (0.71)	0.00 (0.82)	2.06 (0.58)	3.69 (0.55)	2.30 (0.52)

Note: EC = effortful control; EF = executive function; NPPB = negative paternal parenting behavior; PPPB = positive paternal parenting behavior; PB = prosocial behavior.

As displayed in Table 2, correlation analyses demonstrated that prosocial behavior was positively correlated with effortful control, executive function, and positive paternal parenting behavior. Meanwhile, prosocial behavior was negatively correlated with negative paternal parenting behavior. No significant associations were found between prosocial behavior and either surgency or negativity. Consequently, these two temperament dimensions were excluded from further analysis. Executive function was positively correlated only with effortful control and prosocial behavior. Negative paternal parenting behavior was significantly associated with all three temperamental dimensions: positively with surgency and negativity, and negatively with effortful control. Positive paternal parenting behavior was only significantly correlated with effortful control.

Table 2. Correlation Analysis of Variables (N=915)

	1	2	3	4	5	6
1Surgency	-					
2Negativity	-0.081*	-				
3EC	-0.090**	0.05	-			
4EF	-0.025	0.01	0.073*	-		
5NPPB	0.148**	0.218**	-0.157**	0.018	-	
6PPPB	-0.047	-0.051	0.359**	0.05	-0.222**	-
7PB	0.035	-0.038	0.100**	0.132**	-0.074*	0.067*

Note: EC = effortful control; EF = executive function; NPPB = negative paternal parenting behavior; PPPB = positive paternal parenting behavior; PB = prosocial behavior. * $p < 0.05$, ** $p < 0.01$

In summary, children with higher levels of effortful control, executive function, and positive paternal parenting behavior exhibited more prosocial behavior, whereas those experiencing more negative paternal parenting behavior showed fewer prosocial behavior. Among the three temperament dimensions, only effortful control showed consistent and significant correlations with the other study variables (i.e., executive function and parenting behavior), subsequent mediation analyses focused specifically on effortful control as the independent temperament dimension of interest.

3.2 Mediation Effect Tests

Path analysis was conducted to test the parallel dual-mediation model (Figure 1). Because positive and negative paternal parenting behavior were examined in two separate parallel mediation models, the results are presented accordingly.

For the model involving negative paternal parenting behavior, the model showed good fit: $\chi^2/df = 1.183$, RMSEA = 0.014, GFI = 0.999, NFI = 0.979, IFI = 0.997, CFI = 0.996 (Figure 2). Path analysis results (Table 3) also revealed effortful control significantly predicted executive function ($\beta = 0.07$, $p = 0.037$), negative paternal parenting behavior ($\beta = -0.16$, $p < 0.001$), and prosocial behavior ($\beta = 0.08$, $p = 0.015$). Executive function positively predicted prosocial behavior ($\beta = 0.13$, $p = 0.001$), whereas negative paternal parenting behavior negatively predicted prosocial behavior ($\beta = -0.06$, $p = 0.047$).

For the model involving positive paternal parenting behavior, the model also showed good fit: $\chi^2/df = 0.602$, RMSEA = 0.000, GFI = 1.000, NFI = 0.996, IFI = 1.003, CFI = 1.000 (Figure 3). Effortful control significantly predicted executive function ($\beta = 0.07$, $p = 0.037$), positive paternal parenting behavior ($\beta = 0.36$, $p < 0.001$), and prosocial behavior ($\beta = 0.08$, $p = 0.028$). Executive function positively predicted prosocial behavior ($\beta = 0.13$, $p = 0.001$). However, the path from positive paternal parenting behavior to prosocial behavior was not significant ($\beta = 0.03$, $p = 0.347$).

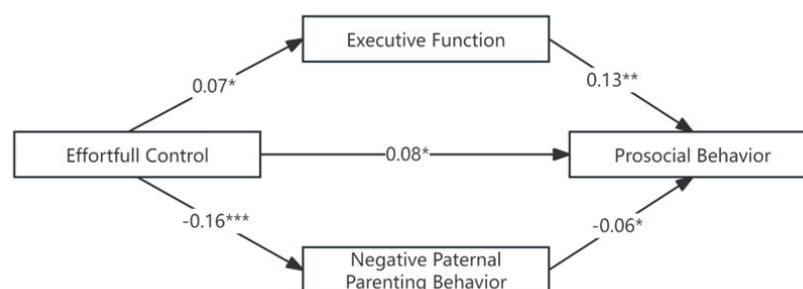


Figure 2. The parallel dual-mediation model(negative paternal parenting behavior). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

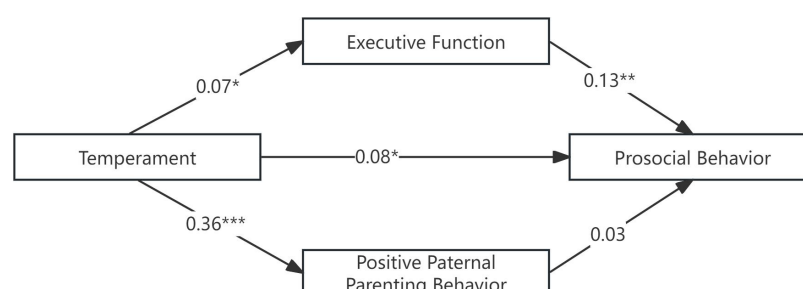


Figure 3. The parallel dual-mediation model(positive paternal parenting behavior). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3. Path Coefficients for the Mediation Model

Path	Positive			Negative		
	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β
EC→EF	0.08	0.04	0.07*	0.08	0.04	0.07*
EC→PPB	0.28	0.02	0.36***	-0.12	0.03	-0.16***
EC→PB	0.06	0.02	0.08*	0.06	0.02	0.08*
EF→PB	0.08	0.02	0.13**	0.08	0.02	0.13**
PPB→PB	0.03	0.03	0.03	-0.06	0.03	-0.06*

Note: EC = effortful control; EF = executive function; PPB = paternal parenting behavior; PB = prosocial behavior. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Mediation tests further clarified these relationships (Table 4). In the model including positive parenting, the total indirect effect was non-significant ($\beta = 0.020$, 95% CI [-0.003, 0.048]). The specific indirect effect via executive function was significant ($\beta = 0.009$, 95% CI [0.001, 0.021]), whereas the indirect effect via positive parenting was not ($\beta = 0.011$, 95% CI [-0.011, 0.036]). Therefore, subsequent analysis focused on the model comprising executive function and negative parenting. Results showed that both specific indirect paths were significant: from effortful control to prosocial behavior via executive function ($\beta = 0.009$, 95% CI [0.001, 0.021]) and via negative paternal parenting behavior ($\beta = 0.010$, 95% CI [0.001, 0.023]). The total indirect effect was significant ($\beta = 0.019$, 95% CI [0.007, 0.035]), and the total effect was 0.100 (95% CI [0.036, 0.163]). The direct effect accounted for approximately 81% of the total effect, indicating partial mediation.

Table 4. Mediation Effect Estimates with 95% Confidence Intervals

Model	Path	<i>B</i>	<i>SE</i>	β	95%CI
Negative	EC→EF→PB	0.007	0.005	0.009*	[0.001,0.021]
	EC→NPPB→PB	0.007	0.005	0.010*	[0.001,0.023]
	total indirect effect	0.014	0.007	0.019**	[0.007,0.035]
	total effect	0.074	0.032	0.100**	[0.036,0.163]
Positive	EC→EF→PB	0.007	0.005	0.009*	[0.001,0.021]
	EC→PPPB→PB	0.008	0.012	0.011	[-0.011,0.036]
	total indirect effect	0.015	0.013	0.020	[-0.003,0.048]
	total effect	0.074	0.032	0.100**	[0.036,0.163]

Note: EC = effortful control; EF = executive function; NPPB = negative paternal parenting behavior; PPPB = positive paternal parenting behavior; PB = prosocial behavior. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4. Discussion

Through a parallel dual-mediation model, this study elucidates the mechanisms by which effortful control influences prosocial behavior in young children. The results support two independent mediating pathways: one through executive function and the other through negative paternal parenting behavior. However, no significant mediating effect was found for positive paternal parenting behavior. This pattern suggests that children with higher effortful control may enhance their prosocial behavior both by strengthening their executive function, thereby enabling more effective prosocial actions, and by eliciting fewer negative parenting practices from their fathers, thus fostering a more supportive familial emotional environment conducive to prosocial development. The non-significant pathway involving positive paternal parenting behavior indicates that paternal supportive and warm behaviors may not serve as a key bridge linking child temperament to prosocial behavior. Their role may be moderated by other factors or involve more complex, non-linear relationships. The primary contribution of this study lies in simultaneously examining and confirming the dual pathways—both intrinsic and environmental—through which temperament influences prosocial behavior. This provides empirical evidence for understanding the multi-layered factors in early socio-emotional development, moving beyond the investigation of a single mediating variable. Furthermore, the asymmetric mediation findings regarding positive versus negative parenting behaviors are instructive. They underscore the necessity of distinguishing between different qualitative dimensions of paternal parenting behavior and suggest that future research should further explore the specific boundary conditions under which positive paternal parenting behavior exerts its effects.

4.1 Temperament and Prosocial Behavior

The results confirmed Hypothesis 1, indicating that effortful control directly and positively predicts prosocial behavior in young children. This suggests that children with higher levels of effortful control are better able to regulate their behavior according to situational demands, thereby achieving more adaptive outcomes. Specifically, stronger effortful control was associated with increased sharing or more positive peer interactions (Zhang et al., 2022), which aligns with prior research (Liu, 2002).

Notably, the direct effect of effortful control on prosocial behavior was stronger than its indirect effects through the examined mediators. This highlights the central role of effortful control—encompassing attentional control, inhibitory control, perceptual sensitivity, and low-intensity pleasure (Rothbart et al., 2001)—in the development of prosocial behavior. The finding underscores both the significant influence of child temperament itself and the importance of individual agency in behavioral shaping. In contrast to some Western studies emphasizing the roles of sociability and emotionality in the development of prosocial behavior (Bandura et al., 2001; Denham, 1986; Hart et al., 2003; Russell et al., 2003), the present study found no significant associations between prosocial behavior and either surgency or negativity. This discrepancy may be interpreted from a cultural perspective. Cultural psychology posits that collectivist cultures place greater emphasis on conformity to social norms and group harmony (Markus & Kitayama, 1991). In such contexts, prosocial behavior may be viewed more as socially expected conduct than as a direct expression of personal disposition. This interpretation aligns with our core finding that effortful control is a stable predictor of prosocial behavior. In other words, within the Chinese cultural context, the enactment of prosocial behavior may rely more on an individual's capacity for self-regulation to overcome personal impulses and align with normative expectations, rather than being primarily driven by emotional reactivity or sociability. Naturally, this interpretation requires further validation through direct cross-cultural comparative studies in the future. These findings provide an empirical foundation for understanding the relationship between temperament and prosocial behavior in early childhood.

4.2 The Mediating Effect of Executive Function on Children's Prosocial Behavior

The results of this study support Hypothesis 2, indicating that executive function partially mediates the relationship between effortful control and prosocial behavior. This finding reveals an intrinsic cognitive pathway from temperament to prosocial behavior: children with higher levels of effortful control, owing to their superior capacities in attentional allocation, inhibitory control, and cognitive flexibility, are better able to plan their actions, suppress selfish impulses, and ultimately engage in more frequent prosocial behavior (Lan, 2023). Consistent with previous research, the present study found no significant associations between executive function and either surgency or negativity (Suor et al., 2019); consequently, these two temperamental dimensions were excluded from the analysis.

The primary contribution of this study lies in its systematic examination and confirmation of the theoretical pathway through which effortful control influences prosocial behavior via executive function in young children. This mediating pathway connects two previously relatively independent lines of inquiry. On the one hand, it extends and specifies the established consensus regarding the positive correlation between effortful control and executive function (Shen et al., 2023), demonstrating that executive function is not merely correlated with effortful control but serves as a key mechanism through which effortful control affects prosocial behavior. On the other hand, it deepens the general conclusion that executive function promotes prosocial behavior (Volckaert & Noël, 2015). While prior research has often directly examined the predictive role of executive function in prosocial behavior (Moriguchi et al., 2020) or treated it as a mediator between external environmental factors and behavior (Wu & Wei, 2025), the question of how executive function—a higher-order cognitive capacity shaped by both innate predisposition and experience—itself is influenced by biologically grounded temperament to affect prosocial behavior had not been sufficiently explored. By addressing this gap, the present study provides empirical support and a foundation for future research in this area.

4.3 The Mediating Effect of Negative Paternal Parenting Behavior on Children's Prosocial Behavior

The findings of this study support Hypothesis 3, revealing that negative paternal parenting behavior partially mediates the relationship between effortful control and prosocial behavior. Specifically, children with lower levels of effortful control are more likely to elicit negative paternal parenting behavior (e.g., hostility, harsh control) from their fathers, which in turn is associated with lower levels of child prosocial behavior. At the same time, effortful control appears to function as a protective factor: children with higher effortful control elicit less negative paternal parenting behavior, thereby indirectly promoting their own prosocial development. This suggests that children with high effortful control not only exhibit fewer externalizing problems themselves but can also influence their parents' behavior to foster a more supportive family environment for socio-emotional growth (Kotila et al., 2014). The present study thus provides evidence that child characteristics can shape behavior through their influence on the environment, with the core mechanism resembling previous findings on the mediating role of paternal parenting behavior between temperament and child problem behaviors (Ma, 2023). These results offer empirical support for the "child effects" model, indicating that children's temperamental traits can actively shape their rearing environment and, consequently, their own behavioral development.

Notably, positive paternal parenting behavior did not show a significant mediating effect in this study. This may imply that, within the context of Chinese paternal parenting behavior, the inhibitory influence of negative paternal parenting behavior (e.g., control, criticism) on children's socio-emotional development is more direct and pronounced than the facilitative effect of positive paternal parenting behavior (e.g., support, warmth). A key reason for the limited

explanatory power of positive paternal parenting behavior may be its weak direct prediction of prosocial behavior. Recent studies offer a potential explanation, suggesting that the link between positive parenting and prosocial behavior is mediated by cognitive reappraisal (Wang et al., 2025) and emotion regulation (Pan et al., 2025). Furthermore, existing research presents inconsistent conclusions. For example, some studies indicate that paternal granting of autonomy can enhance child prosocial behavior, implying that different components of positive paternal parenting behavior may have varying effects on prosocial outcomes—a possibility that warrants further exploration.

In summary, children's intrinsic characteristics are a key factor influencing their prosocial behavior. The findings also demonstrate parallel multiple mediation effects, indicating that both executive function and negative paternal parenting behavior serve as independent pathways linking effortful control to prosocial behavior. This suggests that prosocial development is influenced not only by individual factors but is also closely associated with the environment.

5. Limitations

However, this study also has several limitations that warrant attention in future research. First, regarding measurement methods, the data on paternal parenting behavior primarily relied on maternal reports. Although methodologically common, a single informant may not fully capture the entirety of paternal parenting behavior and could be influenced by the reporter's subjective perceptions. Future studies that integrate father self-reports, naturalistic observations, or third-party assessments (e.g., teacher reports) would help provide a more comprehensive and objective evaluation of parenting behavior (Hawkins et al., 2002). Second, in terms of research design, the cross-sectional data limit causal inferences among the variables. Although the mediation model proposed in this study is theoretically grounded, the directionality and long-term dynamic relationships among the variables still require further verification through longitudinal or experimental designs. Third, concerning measurement tools, the executive function tasks used in this study mainly assessed the inhibitory control component. Future research that incorporates measures of multiple dimensions, such as working memory and cognitive flexibility, would allow a more complete understanding of the mediating role of executive function in the relationship between temperament and prosocial behavior. Finally, the current model examined only partial mediation pathways. The development of prosocial behavior may be influenced by more complex interactions between individual and environmental factors. For example, positive paternal parenting behavior may play a role under specific conditions, such as in interaction with child gender or family socioeconomic status, which deserves further exploration in future studies.

6. Conclusion

In summary, the results supported Hypothesis 1, confirming that temperament (specifically effortful control) significantly and positively predicted prosocial behavior in young children. Hypothesis 2 was also supported, demonstrating that executive function partially mediated the relationship between effortful control and prosocial behavior. Hypothesis 3 was partially supported: negative paternal parenting behavior emerged as a significant mediator, whereas positive paternal parenting behavior did not.

Data Availability Statement

The dataset generated and analyzed during the current study is available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

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