ChinaRxiv

AI translation · View original & related papers at
chinarxiv.org/items/chinaxiv-202504.00083

The Effects of Poverty Experience on Children' s Executive Function: Depletion of Limited Resources and Their Compensation

Authors: Jiang Ying, Ming Hua, Zhang Feng, Ren Yi, Mei Kehan, Huang Silin, Huang Silin

Date: 2025-04-03T00:00:00+00:00

Abstract

In the new process of comprehensively advancing rural revitalization to achieve common prosperity, enhancing the endogenous motivation of children with poverty experience and blocking the intergenerational transmission of poverty remain core issues. This study adopts the theoretical lens of scarcity theory, focuses on the psychological processing mechanisms of children with poverty experience, uses school-age children from a relocated school built for poverty alleviation relocation in a former poverty-stricken county in China as participants, respectively induces scarcity depletion (Study 1) and conducts post-scarcity-depletion compensation (Study 2), to examine whether the depletion and restoration of limited resources can explain variations in executive function among children with poverty experience. The findings reveal: (1) Under conditions of scarcity depletion, only children with poverty experience exhibited more significant declines in executive function, which was jointly explained by depletion of attentional resources and self-control resources; (2) Compensation methods involving monetary and candy rewards can replenish the depleted resources of children with poverty experience, whereas rest and praise methods failed to produce compensatory effects, that is, alleviating attentional scarcity and replenishing self-control energy can compensate for scarcity depletion in children with poverty experience, further restoring executive function performance. This study reveals the limited-resource mechanism through which poverty impairs children' s executive function and provides feasible recommendations for enhancing executive function in children with poverty experience through short-term compensation.

ChinaRxiv 中X

Full Text

The Impact of Poverty Experience on Children' s Executive Function: Depletion and Compensation of Limited Resources

Jiang Ying[1],[2], Ming Hua[2],[3], Zhang Feng[2],[4], Ren Yi[2], Mei Kehan[2], Huang Silin[2]

[1] School of Psychology, Guizhou Normal University, Guiyang 550025, China
[2] Institute of Developmental Psychology, Beijing Normal University, Beijing 100875, China
[3] School of Education and Psychology, University of Jinan, Jinan 250022, China
[4] Psychological Research and Counseling Center, Southwest Jiaotong University, Chengdu 610031, China

Abstract: As China advances rural revitalization to achieve common prosperity, a core challenge remains how to enhance the intrinsic motivation of children with poverty experiences and interrupt the intergenerational transmission of poverty. Adopting the perspective of scarcity theory, this study focuses on the psychological processing mechanisms of children with poverty experiences. Using school-age children from a formerly impoverished county' s poverty alleviation relocation school as participants, we induced scarcity depletion (Study 1) and implemented post-depletion compensation (Study 2) to examine whether the depletion and recovery of limited resources can explain changes in executive function among children with poverty experiences. The findings reveal: (1) In scarcity depletion contexts, only children with poverty experiences showed greater declines in executive function, explained by the combined depletion of attentional and self-control resources; (2) Monetary and candy compensation effectively replenished depleted resources in children with poverty experiences, whereas rest and praise did not, indicating that alleviating attentional scarcity and supplementing self-control energy can compensate for scarcity-induced depletion and restore executive function performance. This study illuminates the limited-resource mechanism through which poverty impairs children' s executive function and provides feasible recommendations for improving executive function in children with poverty experiences through short-term compensation.

Keywords: children with poverty experiences, executive function, scarcity, depletion
Classification Number: B844

Introduction

The goal of eradicating all forms of poverty by 2030 tops the UN Sustainable Development Goals, prompting sustained scholarly attention to effective poverty reduction strategies. Since implementing reform and opening-up policies, China

has achieved remarkable progress in poverty alleviation and is now advancing common prosperity through Chinese-style modernization. Children are both contributors to and beneficiaries of common prosperity. While survival and educational resources for rural children have improved, early poverty experiences continue to affect their learning and daily lives, with a substantial proportion at risk for lagged cognitive development (Evans et al., 2021; 赵鑫, 傅安国, 2023). As active agents interacting with their environment, children' s cognitive beliefs about poverty directly influence their information processing and behavioral performance. Only by focusing on the activation of their intrinsic motivation can external resources work synergistically to break the poverty cycle (傅安国等, 2020). As President Xi Jinping emphasized, poverty alleviation must combine "material support, aspiration building, and intellectual empowerment," highlighting the need to prioritize the agency and psychological factors of impoverished individuals to promote sustainable, shared, and developmental common prosperity. Although poverty' s negative effects become most apparent during later childhood and adolescence, this period's neural plasticity also offers opportunities for intervention (Merz et al., 2019). Therefore, in the context of rural revitalization, accurately understanding the psychological mechanisms through which poverty experiences negatively affect children and developing effective interventions to enhance autonomous capabilities and positive development among impoverished children to truly break the vicious cycle of poverty holds significant importance for the healthy development of rural children in China.

1.1 The Detrimental Effects of Poverty Experience on Children' s Executive Function

Executive function refers to conscious, top-down, high-level cognitive processes that control actions, thoughts, and emotions. Its development spans from infancy to adulthood and influences most attention- and control-related abilities as well as goal-directed daily behaviors (Zelazo, 2020). Due to its strong predictive power for academic ability, problem behaviors, and future achievement (Lawson et al., 2018), executive function has received considerable attention in educational and developmental psychology research. Most studies adopt the comprehensive executive function framework proposed by Miyake et al. (2000), dividing it into three distinct yet interrelated components: inhibitory control, cognitive flexibility, and working memory (Diamond, 2013), which also applies to school-age children and adolescents (Karr et al., 2018). During children' s executive function development, socioeconomic status (SES) during childhood represents a significant source of individual differences in executive function (Sturge-Apple et al., 2016), and this relationship does not change with age. Both cross-sectional and longitudinal studies identify childhood SES as a key predictor of executive function (Lawson et al., 2018). For instance, poverty, particularly low maternal education, constitutes an important risk factor for reduced working memory in children from developing countries (Nugroho et al., 2023), children raised in low-SES families exhibit lower inhibitory or self-control abilities (Taylor & Barch, 2022) and reduced flexible switching capacity

(Suntheimer & Wolf, 2024), and SES effects on executive function persist into adulthood (Evans et al., 2021). Therefore, exploring the internal mechanisms through which poverty experience impairs children' s executive function can enhance our understanding of this relationship and provide a foundation for developing interventions to mitigate poverty' s adverse effects.

1.2 Limited Resource Theory on Poverty's Impact on Executive Function

Research on mechanisms through which poverty impairs children' s executive function has primarily focused on external factors such as material deprivation, parenting practices, and family conflict (Vrantsidis et al., 2020), with few studies examining the crucial role of intraindividual psychological processing, especially among children (Heberle & Carter, 2015). In recent years, limited resource theory has offered a psychological perspective to explain poverty, breaking from traditional approaches in this field. Its core assumption is that individuals possess finite total resources, and resource allocation during tasks directly affects task performance (Bernheim et al., 2015; Shah et al., 2012). Within this theoretical framework, scarcity theory and ego depletion theory are most representative, explaining how poverty affects cognition and behavior through the depletion of attentional and self-control resources respectively, thereby shifting focus from external mechanisms to internal psychological processes.

Scarcity theory and ego depletion theory are closely connected, both centering on "limited resources" as a core premise and often used interchangeably when explaining poverty (Shah et al., 2012; 2018). However, the specific limited resources emphasized by each theory differ (Spear, 2011), and they have not been well distinguished. Specifically, scarcity theory proposes that when facing problems, impoverished individuals tend to focus their attention on money-related events while neglecting others. This excessive attention to money issues persists over time and is difficult to disengage from (Shah et al., 2018), thereby weakening subsequent cognitive performance and leading to short-sighted decision-making that traps individuals in poverty (Mani et al., 2013; Shah et al., 2012). Ego depletion theory, rooted in an individual energy perspective, focuses on the temporary depletion of willpower or self-control when facing temptations or emotional problems (Baumeister & Vohs, 2016). For example, impoverished individuals must resist more temptations from goods or entertainment due to insufficient income, leading to persistent poverty through continuous depletion of self-control resources (Bernheim et al., 2015).

In real-world contexts, however, attention and self-control constitute important components of information processing and likely do not operate independently. Research suggests that attentional scarcity alone may be insufficient to cause cognitive decline (Spears, 2011), and most scarcity paradigms employ consumption or purchasing scenarios (Mani et al., 2013; Shah et al., 2012) that involve not only attention to scarce items but also self-control-demanding decision processes. Accordingly, this study hypothesizes that poverty' s impact on cognition

may involve a more integrated process that first depletes attentional resources and then self-control resources, ultimately causing cognitive decline.

Specifically, during the attentional stage of information input, money-related problems or cues trigger prioritized attention in individuals with poverty experiences, creating a "cocktail party effect" (Shah et al., 2018) that consumes excessive attentional resources. An eye-tracking study found that participants with smaller budgets focused more on menu prices while overlooking truly beneficial discount information (Tomm & Zhao, 2016). During the subsequent encoding and processing stage, this excessive attentional occupation by scarce items persists and is difficult to inhibit (Shah et al., 2018), while the arousal level associated with monetary scarcity increases during deliberation (Cannon et al., 2019), requiring continuous consumption of self-control resources to maintain normal processing of remaining information. When both resources are consumed by money-related information, impoverished individuals have fewer available resources for subsequent tasks, resulting in cognitive decline.

Breaking the poverty cycle and intergenerational transmission must begin with children, as earlier investment in child development yields higher returns (Heckman, 2008). However, studies applying scarcity theory or ego depletion theory to poverty have focused exclusively on adult populations, with no research examining whether children with poverty experiences similarly experience resource depletion during information processing, leading to cognitive decline. Synthesizing previous research, late school age represents both a period when children fully comprehend monetary value and a critical stage for shaping their information processing mindset. Although children can identify others' wealth based on possessions or appearance and distinguish between rich and poor from an early age (Ahl et al., 2019), they only mature in their comprehensive understanding of monetary value and proper use of allowance by late school age (Berti & Bombi, 1981), and both family SES and peers influence children' s views and attitudes toward money (Flanagan et al., 2014). As a profound psychological experience, poverty directly affects how children perceive and construct their world (Heberle & Carter, 2015), gradually forming a scarcity mindset that selectively organizes and encodes information and shapes unique ways of understanding life experiences, further influencing behavior (Dweck, 2008). Therefore, focusing on the psychological processing of poverty issues among late school-age children can better address current challenges in building aspirations and preventing relapse into poverty from a psychological perspective. In summary, this study proposes Hypothesis 1 based on the limited resource model: The detrimental effect of poverty experience on children' s executive function can be explained by the combined influence of attentional scarcity and self-control depletion. Specifically, for children with poverty experiences, scarcity contexts deplete both attentional and self-control resources, leading to greater declines in executive function performance; for children without poverty experiences, scarcity contexts function similarly to normal contexts and do not trigger attentional resource depletion.

1.3 Compensation Strategies Based on Limited Resource Depletion

After identifying the mechanisms through which poverty impairs children' s executive function, whether and how to restore their performance to original levels—or even enhance their executive function—becomes a more critical concern. Ego depletion theory posits that the consumption of psychological energy, like muscle fatigue, requires time for recovery (Muraven & Baumeister, 2000). Based on this, this study proposes that executive function declines caused by poverty may be recoverable through certain short-term compensations. For example, Mani et al. (2013) conducted a field experiment using sugarcane harvest as a time point and first discovered that poverty-induced cognitive decline could be restored after harvest. Additionally, intervention studies that adjust thinking patterns can improve cognitive abilities in impoverished individuals (Browman et al., 2017; See et al., 2022), demonstrating that cognitive abilities in poor individuals can be restored or even enhanced within a brief time frame. However, compared to randomized experiments and intervention programs for impoverished populations developed by some developed countries and international organizations (Mistry et al., 2016; Troller-Renfree et al., 2022), China currently lags in experimental control and intervention studies from a psychological perspective, particularly those involving children with real poverty experiences. Therefore, exploring strategies to protect the cognitive performance of children with poverty experiences based on the limited resource depletion perspective represents an important focus of this study.

Existing depletion compensation research primarily restores depleted cognitive abilities through self-control resource replenishment, such as energy supplementation (Baumeister & Vohs, 2016) or incentives (Boucher & Kofos, 2012). For instance, participants who experienced depletion showed improved self-control performance after brief rest (Tyler & Burns, 2008), and rest durations of 5 or 10 minutes could equally restore cognitive levels (慕德芳, 黄芳, 2019). Consuming glucose beverages (Kennedy & Scholey, 2000), receiving money or even merely mentioning the concept of money (Boucher & Kofos, 2012; Muraven & Slessareva, 2003), or receiving praise (Gunderson et al., 2013) can all compensate for self-control depletion and enhance cognitive performance. However, based on limited resource theory, executive function decline in impoverished individuals may stem not only from self-control resource depletion but also from the unique influence of a scarcity mindset. Therefore, while the aforementioned common self-control depletion compensation methods can replenish depleted self-control resources during encoding and processing stages, whether they simultaneously restore attentional resources or reduce excessive attention to money-related information may be key to compensating for executive function depletion in children with poverty experiences. For example, monetary compensation can alleviate the immediate experience of monetary scarcity, reducing excessive attention and worry about money issues during the attentional stage. High-sugar food intake and praise can shift children' s attention toward more appealing foods or self-affirmation, reducing focus on money-related infor-

mation. However, considering that monetary scarcity easily triggers automatic attention and thinking that is difficult to interrupt and inhibit (Shah et al., 2018), brief rest may still involve continuous attention to and rumination about money-related events, making it difficult to autonomously shift attention and achieve compensation effects. Based on this analysis, Study 2 uses different compensation methods to further validate the role of limited resource theory in explaining executive function in impoverished individuals and proposes Hypothesis 2: Monetary, candy, and praise compensation can all alleviate resource depletion triggered by scarcity contexts and restore executive function in children with poverty experiences, whereas rest cannot compensate.

In summary, this study focuses on children with poverty experiences, examines the limited resource depletion mechanism between poverty experience and children' s executive function, and explores short-term compensation strategies for executive function from the perspective of resource restoration. Specific research questions include: (1) Can limited resource theory explain the negative impact of real poverty experiences on children' s executive function? (2) For children with poverty experiences, can executive function decline caused by scarcity contexts be restored through resource compensation? Through two experimental studies and exploration of four compensation methods, this research aims to provide theoretical and empirical support for subsequently improving cognitive development in children with poverty experiences.

2 Study 1: The Limited Resource Depletion Mechanism of Poverty Experience Affecting Children' s Executive Function

Study 1 employed the classic sequential task paradigm from ego depletion research, first manipulating a depletion task to induce depletion and then using another outcome task to infer the degree of depletion (Carter et al., 2015). This study designed the depletion task as two types of depletion contexts—money-related (scarcity depletion) and money-unrelated (normal depletion)—and included a no-depletion control group. By comparing the executive function of children with and without poverty experiences across different depletion contexts, we examined whether children with poverty experiences experienced greater executive function decline in scarcity depletion contexts involving both attentional and self-control resources.

2.1 Method

2.1.1 Participants Using G*Power 3.1.9.2 software (Faul et al., 2007) to calculate required sample size, a meta-analysis on ego depletion indicated that the typical effect size for successfully inducing depletion ranges from 0.24 to 0.32 (Carter et al., 2015). To achieve statistical power above 80% ($\alpha = 0.05$), at least 171 participants were needed. Considering potential invalid data, this study used convenience sampling to recruit 192 fourth- through sixth-grade stu-

dents from a poverty alleviation relocation school in a formerly impoverished county in China and an elementary school in Beijing, with equal numbers from each school. Among them, all 96 samples from the formerly impoverished county were from households registered in the poverty alleviation system or poverty relocation households[1]; none of the Beijing samples were from urban low-income households. Thirteen problematic data points were excluded (2 children failed to complete all tasks due to time constraints, 5 children' s performance on all three executive function tasks exceeded 3 standard deviations, 3 children had missing manipulation check data due to experimenter error, and 3 children could not understand the task content), resulting in a final sample of 179 children (M = 10.89, SD = 1.45, 55.30% boys) for analysis. Among children with poverty experiences, there were 30 in the no-depletion group, 29 in the scarcity-depletion group, and 29 in the normal-depletion group, totaling 88; among children without poverty experiences, the corresponding numbers were 32, 29, and 30, totaling 91[2]. The entire experiment was approved by the Ethics Review Committee of the Psychology Department at Beijing Normal University (Approval Number: 202010200045), and all research procedures and content complied with ethical standards.

2.1.2 Experimental Design A 2 (poverty experience: yes/no) × 3 (depletion type: scarcity depletion/normal depletion/no depletion) between-subjects experimental design was employed, with children' s scores on the three components of executive function (inhibitory control, cognitive flexibility, working memory) after depletion induction serving as dependent variables.

2.1.3 Experimental Materials **Thinking Task:** Adapted from the white bear depletion experiment (Muraven et al., 1998), this task is widely used in ego depletion research with good reliability and validity (Carter et al., 2015). Participants were randomly assigned to scarcity depletion, normal depletion, or no-depletion groups, each receiving a blank sheet of paper for a 5-minute imagination period. The two depletion groups completed different tasks: the scarcity depletion group was instructed to avoid thinking about money-related matters they had written down, while the normal depletion group was instructed to avoid thinking about white bears. Both depletion groups were required to mark a check (√) on the paper whenever the target thought occurred. The no-depletion group was simply asked to write down anything that came to mind. The number of checkmarks in the thinking task served as an indicator of depletion level, with more checkmarks representing more frequent interruptions and stronger depletion.

Executive Function Tasks: The study used the National Institutes of Health Toolbox (NIH Toolbox), a comprehensive assessment tool developed by the NIH to evaluate cognition, emotion, motor function, and sensory abilities across ages 3-85 (Zelazo et al., 2013). In this study, children were assessed using a 9.7-inch iPad Air, with three tasks selected from the cognitive battery: the Flanker Inhibitory Control and Attention Test, the Dimensional Change Card Sort Test,

and the List Sorting Working Memory Test, measuring the three components of executive function respectively, with a total duration of approximately 15 minutes.

Final scores were calculated by summing reaction time and accuracy to obtain raw scores, which were then compared against NIH Toolbox norms (demographic variables used for correction included gender, age, ethnicity, handedness, and maternal education level). The program automatically generated fully corrected T-scores with a mean of 50 and standard deviation of 10, where higher scores indicated better performance (National Institutes of Health, 2021; Zelazo et al., 2013). Specific tasks were as follows: (1) **Flanker Inhibitory Control and Attention Test (FICA)** measured inhibitory control by presenting five arrows with consistent or inconsistent directions in the center of the screen; children had to quickly press the button corresponding to the direction of the central arrow, with 4 practice trials and 20 test trials. If accuracy fell below 80%, only accuracy was calculated; if accuracy reached 80% or above, raw scores combined accuracy and reaction time. (2) **Dimensional Change Card Sort Test (DCCS)** measured cognitive flexibility by presenting a target image (e.g., a blue ball) in the center and two choice images below; children had to select the image matching the target on a specified dimension, with 4 practice trials and 30 test trials, using the same scoring method. (3) **List Sorting Working Memory Test (LSWM)** measured working memory through two phases: Phase 1 (1-list) required recalling pictures in ascending order within a single category (food or animals); Phase 2 (2-list) mixed food and animal pictures, requiring children to first name foods then animals, both in ascending order. Each phase included 2 practice trials. In formal testing, children had 2 attempts per level; if both failed, testing terminated, with memory load increasing from 2 to 7 items. Working memory raw scores combined both phases, including number of items recalled and recall sequence, with 1 point for each correct item and 1 point for each correct sequential connection between items, using the sum of maximum recall and correct connections at task termination.

2.1.4 Procedure Before the experiment, experimenters explained the procedure and purpose to parents, who along with their children signed informed consent forms and completed a family demographics questionnaire including child' s birth date, parental education levels, employment status, and family monthly income. The formal experiment consisted of two phases. Phase 1, following Shah et al. (2018), used the thinking task to induce different types of depletion. The scarcity and normal depletion groups simulated children' s daily shopping scenarios requiring money consideration versus money-unrelated thinking, respectively, to differentiate self-control related to attentional scarcity from general self-control and compare them against a no-depletion control group. Experienced experimenters led participants into individual classrooms and explained the game rules: "Now we' re going to play an imagination game. You have 5 minutes to write down any images, thoughts, or ideas that come to mind —words, phrases, or sentences are all acceptable." Different rules applied to each

group: the scarcity depletion group first wrote about something they wanted to buy in the past month but hadn' t, including what it was, cost, reasons for wanting it, and why they hadn' t bought it, then completed the thinking task while avoiding thoughts about what they had written; the normal depletion group avoided thinking about "white bears" ; and the no-depletion group simply wrote freely. Phase 2 immediately followed in the same classroom, where children used iPads with pre-installed NIH Toolbox software. After familiarizing themselves with the device operation through on-screen instructions, they completed the three executive function tasks in random order. Experimenters strictly followed scripts to explain each task, with children completing formal testing independently. The procedure is illustrated in Figure 1 [Figure 1: see original paper].

Figure 1. Flowchart of Study 1 tasks

2.2 Results

2.2.1 Manipulation Check of Depletion Level Following previous research (Shah et al., 2018), the number of interruptions was used to measure depletion level. Descriptive statistics for interruption frequency and executive function scores across groups are presented in Table 1 . A one-way ANOVA examined differences in interruption frequency between scarcity and normal depletion groups among children with and without poverty experiences. Results showed no significant main effect of poverty experience ($F(1, 113) = 0.13$, $p = 0.72$), a significant main effect of depletion group ($F(1, 113) = 17.12$, $p < 0.001$, $^2 = 0.13$), and a significant interaction ($F(1, 113) = 7.39$, $p = 0.008$, $^2 = 0.06$). Simple effects analysis revealed that among children with poverty experiences, the scarcity depletion group showed significantly more interruptions than the normal depletion group (MD = 3.38, $t(113) = 4.83$, $p < 0.001$, $d = 1.27$, 95%CI=[1.99, 4.77]), whereas among children without poverty experiences, interruption frequency did not differ significantly between the two depletion conditions (MD = 0.70, $t(113) = 1.01$, $p = 0.32$, 95%CI=[-0.68, 2.08]). Thus, money-related events caused greater depletion for children with poverty experiences, while both depletion types were similar for children without poverty experiences.

Table 1. Descriptive Statistics for Task Evaluation and Executive Function Across Groups

Group	Interruptions	Inhibitory Control	Cognitive Flexibility	Working Memory
With Poverty Experience				

Group	Interruptions	Inhibitory Control	Cognitive Flexibility	Working Memory
Scarcity Depletion (N=30)	4.52 (3.70)	40.07 (6.53)	45.72 (5.74)	43.97 (4.62)
Normal Depletion (N=29)	1.14 (1.57)	46.48 (10.29)	50.07 (7.40)	46.17 (6.46)
No Depletion (N=29)	—	48.80 (11.12)	53.83 (7.80)	49.57 (7.97)
Without Poverty Experience				
Scarcity Depletion (N=32)	3.00 (2.38)	45.21 (9.48)	46.69 (6.65)	50.79 (10.03)
Normal Depletion (N=29)	2.30 (2.58)	44.90 (10.60)	48.43 (9.45)	48.07 (7.78)
No Depletion (N=30)	—	55.47 (11.09)	53.38 (9.67)	48.78 (5.56)

Note: The no-depletion group had no interruption events in the thinking task.

2.2.2 Executive Function Performance Differences Across Depletion Contexts A factorial ANOVA examined the effects of poverty experience and depletion type on children' s executive function. Since executive function scores were standardized after demographic correction, no further control for age, gen-

der, or other demographic variables was applied in subsequent analyses. Results revealed significant main effects of poverty experience on inhibitory control and working memory ($F(1,173) = 5.18$, $p = 0.02$, $^2 = 0.03$; $F(1,173) = 5.92$, $p = 0.02$, $^2 = 0.03$) but not on cognitive flexibility ($F(1,173) = 0.10$, $p = 0.75$). Significant main effects of depletion type emerged for inhibitory control and cognitive flexibility ($F(2,173) = 14.16$, $p < 0.001$, $^2 = 0.14$; $F(2,173) = 13.14$, $p < 0.001$, $^2 = 0.13$) but not for working memory ($F(2,173) = 1.44$, $p = 0.24$). The interaction effect was marginally significant for inhibitory control ($F(2,173) = 2.87$, $p = 0.06$, $^2 = 0.03$), non-significant for cognitive flexibility ($F(2,173) = 0.39$, $p = 0.68$), and significant for working memory ($F(2,173) = 4.20$, $p = 0.02$, $^2 = 0.05$). Simple effects analysis focusing on poverty experience status examined how different depletion contexts affected the three executive function components (see Figure 2 [Figure 2: see original paper]).

For children with poverty experiences, inhibitory control, cognitive flexibility, and working memory scores in the scarcity depletion group were all lower than in the no-depletion group (MD_{inhibitory} = -8.73, t(173) = -3.35, p = 0.003, d = -0.87, 95%CI=[-15.02, -2.45]; MD_{flexibility} = -8.11, t(173) = -3.92, p < 0.001, d = -0.87, 95%CI=[-13.10, -3.12]; MD_{working} = -5.60, t(173) = -2.96, p = 0.01, d = -0.77, 95%CI=[-10.17, -1.04]). Additionally, the scarcity depletion group performed worse than the normal depletion group on inhibitory control (MD = -6.41, t(173) = -2.44, p = 0.05, d = -0.64, 95%CI=[-12.75, -0.08]) and showed a similar trend for cognitive flexibility that did not reach significance (MD = -4.35, t(173) = -2.08, p = 0.11, 95%CI=[-9.38, 0.69]), indicating that scarcity contexts caused greater depletion in inhibitory control.

For children without poverty experiences, both depletion groups performed worse than the no-depletion group on inhibitory control (MD_{scarcity}-no = -10.26, t(173) = -4.00, p < 0.001, d = -1.03, 95%CI=[-16.45, -4.08]; MD_{normal}-no = -10.57, t(173) = -4.16, p < 0.001, d = -1.06, 95%CI=[-16.70, -4.44]) and cognitive flexibility (MD_{scarcity}-no = -6.69, t(173) = -3.28, p = 0.004, d = -0.84, 95%CI=[-11.60, -1.80]; MD_{normal}-no = -4.94, t(173) = -2.45, p = 0.05, d = -0.62, 95%CI=[-9.82, -0.07]), with no significant differences between the two depletion groups (ps > 0.05). Working memory performance showed no significant differences across the three depletion conditions (ps > 0.05). Integrating results from both groups, both depletion contexts affected children' s executive function, but scarcity contexts were associated with greater executive function depletion specifically for children with poverty experiences.

Figure 2. Executive function performance of children with and without poverty experiences across depletion types (*p < .05,* ***p < .01,*** p < .001; error bars represent standard deviations)

2.3 Summary

Study 1 found that children with poverty experiences showed greater executive function decline in scarcity depletion contexts, consistent with Hypothesis 1 and previous findings with adult populations (Shah et al., 2012; Shah et al., 2018). The results indicate that children with poverty experiences exhibited poorer executive function performance after scarcity priming, while children without poverty experiences showed no significant differences between scarcity and normal depletion conditions, demonstrating the combined role of attentional and self-control resource depletion from limited resource theory in explaining the poverty-executive function relationship. On one hand, based on scarcity theory, impoverished individuals involuntarily attend to money-related information during information input (Shah et al., 2018). Due to the limited nature of attentional resources, this excludes attention to other important information, leading to insufficient information for more rational thinking during information processing (Tomm & Zhao, 2016). On the other hand, based on ego depletion theory, when a task requires self-control, it temporarily affects performance on a subsequent self-control task (Baumeister & Vohs, 2016). At this point, impoverished individuals struggle to inhibit their focus on money issues (Shah et al., 2018), increasing cognitive load and requiring greater self-control resource engagement than in normal depletion. For children without poverty experiences, scarcity and normal depletion conditions were similar and did not trigger greater attentional resource depletion, resulting in no further executive function decline. Additionally, scarcity mindset did not affect all three executive function components equally; inhibitory control and cognitive flexibility showed more pronounced declines, possibly because these components involving multiple competitive relationships require more attention and self-control to maintain focus, making inhibition and switching more vulnerable (Eysenck & Derakshan, 2011). Working memory, involving different cortical regions during encoding, storage, and retrieval, can better maintain its function even during interference tasks (Bettencourt & Xu, 2016). Overall, Study 1 provides preliminary evidence that limited resource theory can explain poverty' s detrimental effects on children' s executive function, indicating the joint contribution of attentional and self-control resources. However, due to the universal and fundamental nature of attention in thinking processes, this study could not adequately examine attention and self-control as independent conditions; Study 2 will further validate this through different resource compensations.

3 Study 2: The Compensatory Effect of Resource Restoration on Executive Function Impairment in Children with Poverty Experiences

Study 2 integrated the limited resource model with commonly used effective compensation methods from ego depletion research—energy restoration (rest, sugar supplementation) and incentives (money, praise)—to explore whether executive function decline induced by poverty-related scarcity could be restored through

compensating for depleted resources, further confirming the explanatory role of attentional and self-control resources in poverty's impact on children's executive function within the limited resource framework.

3.1 Method

3.1.1 Participants Research indicates that effect sizes for compensation after ego depletion typically range from 0.29 to 0.42 (Boucher & Kofos, 2012). To achieve statistical power above 80% ($\alpha = 0.05$), at least 162 participants were required. Using convenience sampling, 192 fourth- through sixth-grade students from the same poverty alleviation relocation school who had not participated in Study 1 were recruited, all from households registered in the poverty alleviation system or poverty relocation households. Nine problematic data points were excluded (2 children failed to complete tasks due to time constraints, 5 children did not meet scarcity depletion priming criteria, 2 children's scores on all three executive function tasks exceeded 3 standard deviations), along with 3 participants who did not meet poverty criteria (identified as outliers on all SES indicators using boxplot analysis for this group), resulting in a final sample of 180 children aged 10–14 (M = 11.36, SD = 1.59, 45.60% boys). Specific group sizes were: control group = 31, depletion-no-compensation group = 29, money-compensation group = 30, candy-compensation group = 29, praise-compensation group = 29, and rest-compensation group = 32.

3.1.2 Experimental Design Following Boucher and Kofos (2012), a single-factor between-subjects design was used with six groups: control, depletion-no-compensation, and four post-depletion compensation groups. Children' s executive function after depletion and compensation served as the dependent variable, analyzing whether children who received compensation after depletion performed better than the depletion-no-compensation group and reached the level of the no-depletion group.

3.1.3 Experimental Materials Family demographics, depletion priming materials, and executive function tasks were identical to Study 1. **Manipulation Check:** A self-compiled questionnaire assessed whether depletion was successfully induced (Vohs et al., 2021). Children self-reported their experienced frustration and fatigue levels during the thinking task using 7-point scales, with higher scores indicating greater severity.

3.1.4 Procedure Following Study 1' s experimental flow and basic paradigm, participants were randomly assigned to six groups: control, depletion-no-compensation, and four compensation groups, completing three phases: depletion, compensation, and executive function assessment. In the depletion phase, the control group completed the no-depletion thinking task from Study 1, while the five depletion groups completed the scarcity depletion task and filled out the manipulation check questionnaire. In the compensation

phase, the control and depletion-no-compensation groups skipped this phase, while compensation groups received: (1) **Money compensation:** 20 RMB experimental compensation given in advance; (2) **Candy compensation:** Children selected and ate a preferred chocolate candy and rated their liking; (3) **Praise compensation:** Experimenter provided verbal praise based on the child' s previous task performance; (4) **Rest compensation:** Children rested in their seats for 5 minutes. After compensation tasks, all groups completed the executive function phase using iPads with three randomly ordered executive function tasks. Following the experiment, participants received compensation to alleviate induced scarcity depletion, and the experimental purpose was explained.

3.2 Results

3.2.1 Manipulation Check of Depletion Level One-way ANOVAs examined differences in fatigue and frustration levels between the five depletion groups and the control group, as well as interruption frequency differences among depletion groups. Results showed that the control group experienced significantly lower fatigue and frustration than all five depletion groups (ps $<$ 0.05), with no significant differences among the five depletion groups in fatigue, frustration, or interruption frequency ($F(4,143) = 0.39$, $p = 0.81$; $F(4,143) = 0.17$, $p = 0.95$; $F(4,143) = 0.25$, $p = 0.91$), indicating successful induction of similar levels of scarcity depletion across groups (see Table 2).

Table 2. Descriptive Statistics and ANOVA Results for Task Evaluation and Post-Experiment Executive Function Scores

Group	Fatigue	Frustration	Interruptions	Inhibitory Control	Cognitive Flexibility	Working Memory
Control (N=31)	2.68 (1.43)	1.33 (7.97)	–	47.76 (7.56)	50.50 (10.50)	49.87 (9.78)
Depletion-No-Compensation (N=29)	5.46** (2.66)	6.93** (1.37)	7.68 (5.76)	39.52 (8.46)	44.36 (8.53)	43.67 (7.35)
Money Compensation (N=30)	5.93** (2.83)	6.84** (1.66)	7.84 (5.90)	47.76 (7.68)	50.50 (7.84)	49.87 (7.03)

Group	Fatigue	Frustration	Interruptions	Inhibitory Control	Cognitive Flexibility	Working Memory
Candy Compensation (N=29)	4.49* (1.75)	6.19** (1.31)	7.35 (7.84)	45.66 (7.49)	49.12 (8.55)	48.22 (8.58)
Praise Compensation (N=29)	4.55* (3.53)	5.93** (1.48)	7.71 (7.56)	39.35 (7.73)	46.22 (7.71)	46.05 (7.49)
Rest Compensation (N=32)	3.53* (1.40)	4.65* (1.61)	7.49 (8.55)	41.20 (8.58)	47.24 (7.73)	46.98 (7.71)

*Note: Four compensation groups were compared separately with control and depletion-no-compensation groups. **p < .01, *p < .05*

3.2.2 Compensation Effects of Four Strategies on Executive Function Depletion One-way ANOVAs examined compensation effects for each strategy. Post-hoc results revealed: (1) **Money compensation:** The money-compensation group performed significantly better than the depletion-no-compensation group on all three executive function tasks (MD_{inhibitory} = 8.24, t(87) = 3.78, p < 0.001, d = 0.99, 95%CI=[3.91, 12.57]; MD_{flexibility} = 6.14, t(87) = 3.15, p = 0.002, d = 0.82, 95%CI=[2.27, 10.01]; MD_{working} = 6.20, t(87) = 3.28, p = 0.002, d = 0.85, 95%CI=[2.44, 9.96]) and did not differ significantly from the control group (MD_{inhibitory} = 0.55, t(87) = 0.26, p = 0.80, 95%CI=[-3.71, 4.81]; MD_{flexibility} = 0.42, t(87) = 0.22, p = 0.83, 95%CI=[-3.38, 4.23]; MD_{working} = 1.33, t(87) = 0.72, p = 0.48, 95%CI=[-2.37, 5.03]), indicating that immediate monetary reward compensated for scarcity-induced depletion across all three executive function components (Figure 3a [Figure 3: see original paper]).

(2) **Candy compensation:** Results paralleled the money-compensation group, with the candy-compensation group performing significantly better than the depletion-no-compensation group on all three components (MD_{inhibitory} = 6.14, t(86) = 2.77, p = 0.007, d = 0.73, 95%CI=[1.73, 10.54]; MD_{flexibility} = 4.76, t(87) = 2.44, p = 0.02, d = 0.64, 95%CI=[0.88, 8.64]; MD_{working} = 4.55, t(86) = 2.31, p

= 0.02, d = 0.61, 95%CI=[0.64, 8.46]) and not differing significantly from the control group (MD_{inhibitory} = -1.56, t(86) = -0.72, p = 0.47, 95%CI=[-5.89, 2.78]; MD_{flexibility} = -0.96, t(86) = -0.50, p = 0.62, 95%CI=[-4.77, 2.86]; MD_{working} = -0.32, t(86) = -0.16, p = 0.87, 95%CI=[-4.16, 3.53]), indicating that eating candy compensated for scarcity-induced depletion across executive function components (Figure 3b).

(3) **Praise compensation:** The praise-compensation group did not differ significantly from the depletion-no-compensation group on any executive function component (MD_{inhibitory} = -0.17, t(86) = -0.08, p = 0.94, 95%CI=[-4.57, 4.22]; MD_{flexibility} = 1.86, t(86) = 0.92, p = 0.36, 95%CI=[-2.17, 5.89]; MD_{working} = 2.38, t(86) = 1.16, 95%CI=[-1.69, 6.45]) and performed worse than the control group on inhibitory control (MD_{inhibitory} = -7.87, t(86) = -3.62, p < 0.001, d = -0.94, 95%CI=[-12.19, -3.55]), indicating that praise did not compensate for scarcity-induced executive function depletion (Figure 3c).

(4) **Rest compensation:** Results paralleled the praise-compensation group, with the rest-compensation group not differing significantly from the depletion-no-compensation group on any component (MD_{inhibitory} = 1.68, t(89) = 0.77, p = 0.44, 95%CI=[-2.67, 6.03]; MD_{flexibility} = 2.88, t(89) = 1.52, p = 0.13, 95%CI=[-0.88, 6.64]; MD_{working} = 3.31, t(89) = 1.50, p = 0.14, 95%CI=[-1.07, 7.69]) and performing worse than the control group on inhibitory control (MD_{inhibitory} = -6.01, t(89) = -2.79, p = 0.006, d = -0.70, 95%CI=[-10.29, -1.74]), indicating that 5 minutes of rest did not compensate for scarcity-induced executive function depletion (Figure 3d).

Figure 3. Executive function performance of compensation groups compared to depletion-no-compensation and control groups (a. Money compensation, b. Candy compensation, c. Praise compensation, d. Rest compensation)

3.3 Summary

Results showed that among the four compensation strategies, only direct monetary reward or allowing children to eat candy restored executive function depleted by scarcity priming in children with poverty experiences, partially inconsistent with Hypothesis 2. Beyond the shared motivational boost and positive affect from money and candy that replenish depleted self-control resources (Boucher & Kofos, 2012; Muraven & Slessareva, 2003), these compensation methods also reduced excessive attention to money-related information, reaffirming the importance of limited resource theory in explaining the poverty-executive function relationship. Specifically, monetary compensation directly alleviated the immediate experience of scarcity. A field study using seasonal harvest status found that farmers' cognitive abilities were higher post-harvest than pre-harvest (Mani et al., 2013), demonstrating that scarcity can be directly allevi-

ated through income, consistent with our finding that monetary compensation restored executive function performance. Candy compensation, as a naturally appealing item for children, captured their attention (Luking et al., 2014), distracting them from scarcity concerns while rapidly increasing blood glucose to replenish self-control resources (Scholey & Owen, 2013), thereby restoring executive function. However, while rest compensation shows good effects in general ego depletion research, it proved ineffective for the unique depletion caused by scarcity contexts in children with poverty experiences. This may be because scarcity depletion lasts longer and consumes more resources, making brief rest insufficient for rapid recovery, especially when subsequent tasks still require high attention (Muraven & Baumeister, 2000). The brain may continue ruminating about money issues without genuine rest or energy replenishment (Shah et al., 2018), a habitual thinking pattern that makes it difficult for impoverished individuals to escape the poverty cycle (Shah et al., 2012). This indirectly confirms the joint role of attentional and self-control resource restoration in executive function recovery for impoverished individuals, requiring both reduced excessive attention to money events and replenishment of depleted energy. Furthermore, contrary to expectations, praise did not produce the anticipated compensation effect, possibly because children with poverty experiences are less sensitive to verbal encouragement (Decker et al., 2024), and the praise based on the simple thinking task may have backfired. Children with low self-esteem may interpret praise as overly high evaluation, feeling anxious or doubtful about maintaining such expectations (Brummelman et al., 2016), preventing praise from effectively transferring attention or supplementing energy for subsequent tasks. In conclusion, this study further supports limited resource theory as a mechanism explaining cognitive decline in impoverished children, suggesting that future research should focus on the psychological processing of children with poverty experiences as a potentially new and more operational intervention pathway.

4 General Discussion

This study created child-appropriate scarcity depletion paradigms, integrated and expanded the important explanatory role of limited resource theory in the development of executive function among Chinese children with poverty experiences, and explored potential compensation strategies based on this theory. The findings reveal that temporary executive function depletion in children with poverty experiences can be compensated by alleviating attentional scarcity and supplementing self-control energy, further clarifying the joint contribution of attentional and self-control resources in explaining poverty' s detrimental effects on executive function. Simultaneously, from the perspective of building aspirations and intellectual empowerment, this research better explains the advantages of focusing on children' s internal psychological processes in the context of rural revitalization and how to enhance the intrinsic motivation of children with poverty experiences.

4.1 Explaining Poverty Depletion Through Psychological Processing

Overall, this study found that poverty' s detrimental effects on children' s executive function stem from unique attention to and processing of money-related information. As researchers have proposed, the key to changing scarcity mindset lies in obtaining sufficient slack, which should manifest not only economically but also cognitively (Mullainathan & Shafir, 2013). Clarifying that poverty' s damage to children' s executive function originates from individual psychological processing both expands emerging theories in this field and provides more possibilities for future interventions.

At the theoretical level, this study focused on individual psychological processing to further clarify the debate regarding different resource depletions when applying scarcity theory and ego depletion theory to poverty. Results indicate that both attentional resources emphasized in scarcity theory and self-control resources in ego depletion theory were depleted in scarcity contexts simulating daily shopping. Specifically, scarcity mindset as a unique thinking pattern in impoverished individuals first triggers excessive attention to money-related information during information input, subsequently affecting self-control resources during encoding and processing, leading to temporary executive function decline. However, whether this effect results from resource exhaustion or disruption of normal processing requires further exploration. Based on resource allocation perspectives (Kurzban et al., 2013) and our main findings, children with poverty experiences process money-related information at full capacity when handling information, rapidly consuming attentional and self-control resources that should be reserved for other tasks, leaving fewer available resources for subsequent tasks and weakening executive function performance (Mani et al., 2013). However, we cannot rule out the possibility that individuals cannot inhibit associations with such information during processing (Shah et al., 2018), disrupting smooth information processing and causing executive function decline. Future neuroscience research may clarify this mechanism. At the educational practice level, scarcity mindset can be improved by optimizing the psychological processing of children with poverty experiences. Thinking patterns are highly malleable; for example, process praise can foster growth mindset (Gunderson et al., 2013), and watching videos about stress' s positive effects can induce more positive attitudes toward stress (Crum et al., 2013). These simple mindset shifts effectively mitigate adverse effects of disadvantage (Claro et al., 2016), providing referable experiences for improving scarcity mindset to alleviate poverty depletion. Combined with our findings, reducing attention to scarcity cues and ensuring adequate self-control may consider monetary compensation or energy supplementation as initial reinforcers, such as providing scholarships to motivate students to alleviate material scarcity through effort, or offering necessary high-nutrition foods during breaks to replenish consumed energy and restore optimal cognitive states for the next class. By linking compensation methods with stimulating individual autonomy, improving children' s scarcity mindset and strengthening their intrinsic motivation may prevent relapse into poverty

from a psychological perspective.

4.2 Relationship Between Scarcity-Induced Immediate Depletion and Poverty' s Cumulative Long-Term Effects

Although this study used scarcity contexts to simulate how children with poverty experiences feel when facing money-related events in daily life, examining changes in executive function after scarcity induction and compensation without exploring long-term effects, this immediate depletion and recovery nonetheless demonstrates the role of limited resource theory in explaining poverty' s impact on executive function, offering new insights for developing executive function in formerly impoverished children under the common prosperity agenda. In fact, individuals' psychological processing of environmental information easily forms entrenched thinking patterns that longitudinally affect development (Dweck, 2008), making this immediate-level recovery an opportunity to interrupt poverty' s long-term adverse effects. For instance, numerous training programs can simultaneously improve short-term and long-term executive function (Spawton-Rice & Walker, 2022). Combined with our finding that scarcity-induced temporary executive function decline can be restored through resource compensation, this suggests the possibility of blocking the solidification of this psychological process during childhood to prevent the formation of disadvantageous cognitive processing patterns.

Childhood represents a critical developmental stage in the life cycle. Ensuring that children obtain adequate growth environments and developmental conditions while forming high-level cognitive and non-cognitive abilities is key to China' s rural revitalization (中国发展研究基金会, 2023). As absolute rural poverty in China has been eliminated and a series of policies and assistance programs have been implemented, children' s health and nutrition in formerly impoverished areas have improved, educational resources have significantly increased, and public services are better guaranteed. With substantial progress in external resource provision, focusing on impoverished individuals' agency and internal psychological motivation can more comprehensively prevent potential relapse into poverty. Integrating our findings, the limited resource model can serve as an explanatory mechanism for poverty' s detrimental effects on children' s executive function. Through two fundamental pathways—long-term alleviation of excessive attentional occupation by money-related information and reduction of excessive self-control consumption—resource compensation can be integrated into students' learning lives, enabling immediate compensation to continuously stimulate intrinsic motivation and reduce depletion from poverty experiences at the cognitive level. For example, scholarships could be distributed using variable-ratio reinforcement schedules to alleviate scarcity feelings in small, frequent amounts, continuously motivating children' s self-improvement. Study tours or self-control courses could be organized to scientifically and comprehensively understand poverty and enhance self-control to reduce depletion when thinking about scarcity issues. Through multiple short-term compensations

reducing the arousal level of money-related cues, the formation of long-term scarcity mindset can be blocked, establishing a good buffering mechanism for coping with poverty experiences and more stably improving executive function in children with poverty experiences, thereby accumulating human capital for rural revitalization and steadily advancing common prosperity.

4.3 Limitations and Future Directions

This study applied the emerging limited resource theory in poverty research to reveal the joint role of attentional and self-control resources in poverty' s detrimental effects on children' s executive function, and for the first time explored the compensatory effects of psychological resource restoration on poverty depletion, providing a novel direction and theoretical support for intervention development for children with poverty experiences in the current common prosperity context. However, several limitations exist. First, scarcity experimental paradigms for child populations require further innovation and refinement. Future research should develop more child-appropriate paradigms for both money scarcity induction and ego depletion tasks. Eye-tracking or EEG technology could precisely assess changes in attentional and self-control resources. Second, different compensation methods are not directly comparable, making it difficult to identify optimal strategies. This study exploratorily selected commonly used compensation methods from ego depletion research; future studies should better match different methods, such as comparing rest compensation with free play, designing eye-tracking experiments to capture attentional shifts, or allowing participants to choose among compensation options to implement individualized compensation and exclude preference biases. Using non-norm-referenced scores to assess executive function could better examine compensation strategies of interest to children of different ages and genders, attending to commonalities and differences across groups to ensure optimal compensation effects. Third, short-term compensation methods could be used for interventions with children experiencing poverty. Although this study did not explore long-term effects of compensation strategies, future research could use this as a starting point to first reduce short-term depletion through relatively stable compensation, change individuals' thinking patterns to interrupt habituated cognitive processing under this mindset, and then achieve long-term enhancement of executive function in children with poverty experiences.

5 Conclusion

Children with poverty experiences show poorer executive function performance because of limited psychological resources when processing information. Money-related events trigger a unique sense of scarcity in impoverished individuals, excessively consuming attentional resources, and the difficulty inhibiting thoughts about these events consumes additional self-control resources, leading to temporary executive function depletion. Moreover, this executive function depletion can be restored by alleviating current scarcity feelings and replenishing depleted

energy.

References

Ahl, R. E., Duong, S., & Dunham, Y. (2019). Children employ wealth cues when predicting others' sharing. *Developmental Psychology, 55*(2), 303−314.

Baumeister, R. F., & Vohs, K. D. (2016). Strength model of self-regulation as limited resource: Assessment, controversies, update. *Advances in Experimental Social Psychology, 54*, 67−127.

Bernheim, B. D., Ray, D., & Yeltekin, E. (2015). Poverty and self-control. *Econometrica, 83*(5), 1877−1911.

Berti, A. E., & Bombi, A. S. (1981). The development of the concept of money and its value: A longitudinal study. *Child Development, 52*(4), 1179−1182.

Bettencourt, K. C., & Xu, Y. (2016). Decoding the content of visual short-term memory under distraction in occipital and parietal areas. *Nature Neuroscience, 19*(4), 595−602.

Boucher, H. C., & Kofos, M. N. (2012). The idea of money counteracts ego depletion effects. *Journal of Experimental Social Psychology, 48*(4), 804−810.

Browman, A. S., Destin, M., Carswell, K. L., & Svoboda, R. C. (2017). Perceptions of socioeconomic mobility influence academic persistence among low socioeconomic status students. *Journal of Experimental Social Psychology, 72*, 45−52.

Brummelman, E., Crocker, J., & Bushman, B. J. (2016). The praise paradox: When and why praise backfires in children with low self-esteem. *Child Development Perspectives, 10*(2), 111−115.

Cannon, C., Goldsmith, K., & Roux, C. (2019). A self-regulatory model of resource scarcity. *Journal of Consumer Psychology, 29*(1), 104−127.

Carter, E. C., Kofler, L. M., Forster, D. E., & McCullough, M. E. (2015). A series of meta-analytic tests of the depletion effect: Self-control does not seem to rely on a limited resource. *Journal of Experimental Psychology: General, 144*(4), 796−815.

China Development Research Foundation. (2023). *Child development report in China 2023: Promoting quality development of rural children.* Beijing: China Development Press. [中国发展研究基金会. (2023). 中国儿童发展报告 2023: 促进农村儿童的高质量发展. 北京: 中国发展出版社.]

Claro, S., Paunesku, D., & Dweck, C. S. (2016). Growth mindset tempers the effects of poverty on academic achievement. *Proceedings of the National Academy of Sciences, 113*(31), 8664−8668.

Crum, A. J., Peter, S., & Shawn, A. (2013). Rethinking stress: The role of mindsets in determining the stress response. *Journal of Personality & Social Psychology, 104*(4), 716−733.

Decker, A. L., Meisler, S. L., Hubbard, N. A., Bauer, C. C., Leonard, J., Grotzinger, H., . . . Gabrieli, J. D. (2024). Striatal and behavioral responses to reward vary by socioeconomic status in adolescents. *Journal of Neuroscience, 44*(11), Article e1633232023. https://doi.org/10.1523/JNEUROSCI.1633-23.2023

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*(1), 135−168.

Dweck, C. S. (2008). Can personality be changed? The role of beliefs in personality and change. *Current Directions in Psychological Science, 17*(6), 391−394.

Evans, G. W., Farah, M. J., & Hackman, D. A. (2021). Early childhood poverty and adult executive function: Distinct, mediating pathways for different domains of executive function. *Developmental Science. 24*(5), Article e13084. https://doi.org/10.1111/desc.13084.

Eysenck, M. W., & Derakshan, N. (2011). New perspectives in attentional control theory. *Personality and Individual Differences, 50*(7), 955−960.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175−191.

Flanagan, C. A., Kim, T., Pykett, A., Finlay, A., Gallay, E. E., & Pancer, M. (2014). Adolescents' theories about economic inequality: Why are some people poor while others are rich? *Developmental Psychology, 50*(11), 2512−2525.

Fu, A. G., Zhang, Z. S., Zheng, J. H., Yue, T., Lin, Z. H., Wu, N., & Huang, X. T. (2020). Qualitative research on the endogenous power mechanism for poverty elimination. *Acta Psychology Sinica, 52*(1), 66−88. [傅安国, 张再生, 郑剑虹, 岳童, 林肇宏, 吴娜, 黄希庭. (2020). 脱贫内生动力机制的质性探究. 心理学报, 52(1), 66−80.]

Gunderson, E. A., Gripshover, S. J., Romero, C., Dweck, C. S., Goldin-Meadow, S., & Levine, S. C. (2013). Parent praise to 1- to 3-year-olds predicts children' s motivational frameworks 5 years later. *Child Development, 84*(5), 1526−1541.

Heberle, A. E., & Carter, A. S. (2015). Cognitive aspects of young children' s experience of economic disadvantage. *Psychological Bulletin, 141*(4), 723−746.

Heckman, J. J. (2008). The case for investing in disadvantaged young children. *CESifo DICE Report, 6*(2), 3−8.

Karr, J. E., Areshenkoff, C. N., Rast, P., Hofer, S. M., Iverson, G. L., & Garcia-Barrera, M. A. (2018). The unity and diversity of executive functions: A systematic review and re-analysis of latent variable studies. *Psychological Bulletin, 144*(11), 1147−1185.

Kennedy, D. O., & Scholey, A. B. (2000). Glucose administration, heart rate and cognitive performance: Effects of increasing mental effort. *Psychopharmacology, 149*(1), 63–71.

Kurzban, R., Duckworth, A., Kable, J. W., & Myers, J. (2013). An opportunity cost model of subjective effort and task performance. *Behavioral & Brain Sciences, 36*(6), 661–679.

Lawson, G. M., Hook, C. J., & Farah, M. J. (2018). A meta-analysis of the relationship between socioeconomic status and executive function performance among children. *Developmental Science, 21*(2), Article e12529. https://doi.org/10.1111/desc.12529

Luking, K. R., Luby, J. L., & Barch, D. M. (2014). Kids, candy, brain and behavior: Age differences in responses to candy gains and losses. *Developmental Cognitive Neuroscience, 9*, 82–92.

Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. *Science, 341*(6149), 976–980.

Merz, E. C., Wiltshire, C. A., & Noble, K. G. (2019). Socioeconomic inequality and the developing brain: Spotlight on language and executive function. *Child Development Perspectives, 13*(1), 15–20.

Mistry, R. S., Nenadal, L., Griffin, K. M., Zimmerman, F. J., Cochran, H. A., Thomas, C. A., & Wilson, C. (2016). Children' s reasoning about poverty, economic mobility, and helping behavior: Results of a curriculum intervention in the early school years. *Journal of Social Issues, 72*(4), 760–788.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*(1), 49–100.

Mu, D. F., Huang F. (2019) After depletion: The role of rest in replenishment of self-control resource. *Psychological Development and Education, 35*(6): 657–664. [慕德芳, 黄芳. (2019). 休息对自我损耗的补偿作用. 心理发展与教育, 35(6), 657–664.]

Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin, 126*(2), 247–259.

Muraven, M., & Slessareva, E. (2003). Mechanisms of self-control failure: Motivation and limited resources. *Personality and Social Psychology Bulletin, 29*(7), 894–906.

Muraven, M., Tice, Baumeister, D. M., & Roy, F. (1998). Self-control as a limited resource: Regulatory depletion patterns. *Journal of Personality and Social Psychology, 74*(3), 774–789.

National Institutes of Health. (2021). *NIH Toolbox scoring and interpretation guide for the iPad.* Retrieved September 2, 2024, from https://www.nihtoolbox.org/app/uploads/2022/05/Toolbox_{{{Scoring}}}{{and}}{{{Interpretation}}}{{Gu 5.25.21.pdf

Nugroho, H. W., Salimo, H., Hartono, H., Hakim, M. A., & Probandari, A. (2023). Association between poverty and children' s working memory abilities in developing countries: A systematic review and meta-analysis. *Frontiers in Nutrition, 10*, Article 1067626. https://doi.org/10.3389/fnut.2023.1067626

Scholey, A. B., & Owen, L. (2013). Effects of chocolate on cognitive function and mood: A systematic review. *Nutrition Reviews, 71*(10), 665−681.

See, B. H., Morris, R., Gorard, S., Siddiqui, N., Easterbrook, M. J., Nieuwenhuis, M., . . . Banerjee, R. (2022). A conceptual replication study of a self-affirmation intervention to improve the academic achievement of low-income pupils in England. *Educational Research and Evaluation, 27*(1−2), 83−116.

Shah, A. K., Mullainathan, S., & Shafir, E. (2012). Some consequences of having too little. *Science, 338*(6107), 682−685.

Shah, A. K., Zhao, J., Mullainathan, S., & Shafir, E. (2018). Money in the mental lives of the poor. *Social Cognition, 36*(1), 4−19.

Spawton-Rice, J. H., & Walker, Z. (2022). Do cognitive training applications improve executive function in children with adverse childhood experiences? A pilot study. *Applied Neuropsychology: Child, 11*(3), 373−382.

Spears, D. (2011). Economic decision-making in poverty depletes behavioral control. *The B.E. Journal of Economic Analysis & Policy, 11*(1), 1−42.

Sturge-Apple, M. L., Suor, J. H., Davies, P. T., Cicchetti, D., Skibo, M. A, & Rogosch, F. A. (2016). Vagal tone and children's delay of gratification: Differential sensitivity in resource-poor and resource-rich environments. *Psychological Science, 27*(6), 885−893.

Suntheimer, N. M., & Wolf, S. (2024). Duration of poverty and Ghanaian children' s learning and executive function outcomes. *Applied Developmental Science, 28*(3), 409−425.

Taylor, R. L., & Barch, D. M. (2022). Inhibitory control within the context of early life poverty and implications for outcomes. *Neuroscience & Biobehavioral Reviews. 140.* Article e104778. https://doi.org/10.1016/j.neubiorev.2022.104778

Tomm, B. M., & Zhao, J. (2016, August). Scarcity captures attention and induces neglect: Eyetracking and behavioral evidence. Paper presented at the Proceedings of the 38th Annual Conference of the Cognitive Science Society. Philadelphia, Pennsylvania.

Troller-Renfree, S. V., Costanzo, M. A., Duncan, G. J., Magnuson, K., Gennetian, L. A., Yoshikawa, H., & Noble, K. G. (2022). The impact

of a poverty reduction intervention on infant brain activity. *Proceedings of the National Academy of Sciences, 119*(5), Article e2115649119. https://doi.org/10.1073/pnas.2115649119

Tyler, J. M., & Burns, K. C. (2008). After depletion: The replenishment of the self' s regulatory resources. *Self and Identity, 7*(3), 305−321.

Vrantsidis, D. M., Clark, C. A., Chevalier, N., Espy, K. A., & Wiebe, S. A. (2020). Socioeconomic status and executive function in early childhood: Exploring proximal mechanisms. *Developmental Science, 23*(3), Article e12917. https://doi.org/10.1111/desc.12917

Vohs, K. D., Schmeichel, B. J., Lohmann, S., Gronau, Q. F., Finley, A. J., Ainsworth, S. E., ···& Albarracín, D. (2021). A multisite preregistered paradigmatic test of the ego-depletion effect. *Psychological Science, 32*(10), 1566−1581.

Zelazo, P. D. (2020). Executive function and psychopathology: A neurodevelopmental perspective. *Annual Review of Clinical Psychology, 16*, 431−454.

Zelazo, P. D., Anderson, J. E., Richler, J., Wallner-Allen, K., Beaumont, J. L., & Weintraub, S. (2013). II. NIH Toolbox Cognition Battery (CB): Measuring executive function and attention. *Monographs of the Society for Research in Child Development, 78*(4), 16−33.

Zhao, X., Fu, A. G. (2023, March). Cognitive development of rural chinese children: Characteristics,influencing factors,and intervention measures. *Journal of Capital Normal University (Social Sciences Edition),* (1), 149−159. [赵鑫, 傅安国. (2023, 3 月). 中国乡村儿童认知发展：特征、影响因素以及干预对策. 首都师范大学学报(社会科学版), (1), 149−159.]

Footnotes

1. Households registered in the poverty alleviation system are identified based on national rural poverty standards combined with local urban conditions; poverty relocation households are premised on being registered in the poverty alleviation system while also meeting regional conditions of the relocation area and individual conditions of the relocating family.

2. This study also used a composite SES indicator (M = 0, SD = 1) to validate the poverty and non-poverty groups (using principal component analysis to extract a common factor from parental education, occupation, and family monthly income; missing data were imputed with group means; Noble et al., 2006). The factor explained 81.82% of variance with all factor loadings > 0.83. Results showed that families from impoverished areas scored below average on SES, while Beijing families without poverty experiences scored above average, with significant differences between groups in family monthly income, parental education, and parental occupation.

Note: Figure translations are in progress. See original paper for figures.

ChinaRxiv 中X

Source: ChinaXiv —Machine translation. Verify with original.