The Effects of Scarcity Mindset on Children's Executive Function in the Context of Poverty Experience and Its Mechanisms

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Abstract

Under the backdrop of rural revitalization, how to comprehensively and effectively measure the post-poverty-alleviation living environment and accurately understand the negative impacts of poverty experience and its dynamics on child development, as well as the underlying mechanisms, has emerged as a critical scientific issue. Given the overlapping and cumulative nature of poverty conditions during child development, more potential poverty-related conditions warrant attention, and how children process and comprehend relevant information following poverty experiences significantly influences their development. This study focuses on school-age children with poverty experience in China, employing scarcity theory as an entry point, aiming to construct a multidimensional poverty model suited to the current context, and to elucidate the mechanisms through which scarcity mindset affects the executive function of impoverished children via attention patterns and neural activity, thereby offering a novel intervention perspective for the cognitive development of children with poverty experience and better supporting the healthy development of rural children in China.

Full Text

Preamble

The Effect of Scarcity Mindset on Executive Function in Children with Poverty Experiences and Its Mechanisms

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Abstract

Against the backdrop of rural revitalization, how to comprehensively and effectively measure the post-poverty-alleviation living environment and accurately grasp the negative impacts and underlying mechanisms of poverty experiences and their changes on child development has become a critical scientific issue. Considering the cumulative and overlapping nature of poverty conditions throughout childhood, there are more potential poverty-related conditions that warrant attention, and how children process and understand relevant information after experiencing poverty significantly influences their development. This study focuses on school-aged children in China who have experienced poverty, using scarcity theory as an entry point. It aims to construct a multidimensional poverty model applicable to the current context and to explain the mechanisms through which scarcity mindset affects executive function in impoverished children from the perspectives of attention patterns and neural activity, thereby providing a new intervention perspective for the cognitive development of children with poverty experiences and better supporting the healthy development of rural children in China.

Keywords: children in poverty; scarcity mindset; executive function

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Introduction

In 2020, as China eliminated primary absolute rural poverty, the nation embarked on a new journey of rural revitalization. The current priority is to effectively consolidate and expand poverty alleviation achievements and integrate them with rural revitalization, while enhancing the endogenous development capacity of formerly impoverished regions and populations (National Rural Revitalization Administration, 2023). Children are the foundation and prerequisite for social progress, and ensuring their comprehensive development in rural areas is both an important dimension for evaluating rural revitalization outcomes and a crucial prerequisite for sustaining these achievements (China Rural Development Foundation, 2023). The Vice Chairman of the China Development Research Foundation stated at the 7th International Symposium on Anti-Poverty and Child Development: "The early development of children in formerly impoverished areas should be incorporated into the national development plan for the next stage of rural revitalization, with coordinated advancement across departments" (China Education News Network, 2021). Therefore, in the context of rural revitalization, effectively measuring the current living environment, accurately understanding the negative impacts of poverty experiences on child development and their underlying mechanisms, and truly eliminating the risk of returning to poverty and breaking the vicious cycle of poverty represent major challenges for China's rural revitalization efforts in early childhood development.

Although poverty negatively impacts individual development, not all children

raised in impoverished families experience hindered futures. These differences stem not only from varying environmental conditions, family upbringing, or personality traits (Lomanowska et al., 2015; Vogel et al., 2021), but also from individuals' scarcity mindset—the psychological processes and beliefs related to poverty information that play a critical role (Mani et al., 2013; Shah et al., 2012). While scarcity theory has not yet been validated in child populations, this framework moves beyond the adverse effects of objective conditions and analyzes poverty issues from a novel perspective of individuals actively constructing their world, offering a new intervention angle for the cognitive development of children with poverty experiences. In summary, based on China's rural revitalization context and focusing on school-aged children with poverty experiences, this study employs a longitudinal design and integrates questionnaires, situational and cognitive experiments, and functional magnetic resonance imaging (fMRI) technology to systematically examine how multidimensional and overlapping poverty experiences and their changing patterns affect children's executive function. Using scarcity mindset as an entry point, we aim to clarify its mediating role in the relationship between poverty and children's executive function and further explore the attentional and neural mechanisms through which scarcity mindset influences executive function in children with poverty experiences.

2.1 The Meaning and Current Status of Child Poverty

Poverty, also referred to as low socioeconomic status (low-SES), has been defined differently across countries and researchers. Specifically, insufficient income or material deprivation constitutes the most fundamental characteristic of poverty, with other adverse conditions such as inadequate institutions, greater exposure to violent crime, and health problems often serving as subsidiary criteria (Haushofer & Fehr, 2014). Since China eliminated absolute poverty in 2020 and embarked on rural revitalization, establishing dynamic and precise mechanisms to prevent returning to poverty has become a key issue. In the "Guiding Opinions on Improving the Dynamic Monitoring and Assistance Mechanism to Prevent Returning to Poverty" issued by the National Rural Revitalization Administration, poverty monitoring uses 1.5 times the national poverty alleviation standard during the poverty eradication period (approximately 6,000 yuan) as the baseline, with provinces determining specific thresholds based on regional price index changes, increases in rural residents' per capita disposable income, and rural subsistence allowance standards, without setting scale limits. Therefore, under the new circumstances of rural revitalization, the income of formerly impoverished families has already exceeded the established absolute poverty line, allowing greater consideration of subsidiary conditions in poverty definitions and adopting a dynamic approach to assess poverty experiences and transformation patterns.

In this regard, UNICEF, in collaboration with international charitable organizations, has redefined child poverty based on children's environmental deprivation,

social exclusion, and individual vulnerability: children living in poverty are deprived of nutrition, water and sanitation, basic healthcare services, housing, education, participation, and protection, preventing them from enjoying their rights, realizing their potential, and participating in society as full members (Wei et al., 2014). According to the 2023 Global Multidimensional Poverty Index report published by the United Nations Development Programme, among the 1.1 billion impoverished people worldwide, more than half are children under 18; in China, although significant achievements have been made in poverty reduction, the child poverty incidence rate is 3.9%, significantly higher than that of adults (National Bureau of Statistics, 2018). Although most children live above the poverty line, they may be experiencing multidimensional deprivation, such as long-term separation from parents, poor parenting practices, family chaos, more stressful events, and poor living environments (Evans & Schamberg, 2009; Kim et al., 2013). These early experiences of material deprivation and educational poverty largely continue to affect children's lives and choices, trapping them in cycles of poverty and causing intergenerational poverty transmission. Therefore, understanding how poverty experiences affect children's cognitive development and exploring the mechanisms underlying this relationship can more effectively mitigate the adverse effects of poverty.

2.2 The Impact of Poverty Experience on Children's Executive Function

Executive Function (EF) is a core component of cognitive processing that demonstrates significant relationships with various behavioral, social, and learning problems, as well as adult health and criminal behavior (Lawson et al., 2018; Müller & Kerns, 2015), making it increasingly important in child education and development research. Although no universally accepted definition fully encompasses the concept of executive function, researchers generally agree that it represents conscious, top-down, high-level cognitive processes that control actions, thoughts, and emotions, and is closely linked to neural systems involving the prefrontal cortex, helping individuals regulate cognition, emotion, and activity, particularly when dealing with novel problems (Diamond, 2013). Most researchers treat it as a multi-component variable, primarily divided into three components: inhibitory control, cognitive flexibility, and working memory (Miyake et al., 2000). These components continue to change throughout childhood, following different developmental trajectories, with some components not yet reaching adult levels even in early adolescence (Davidson et al., 2006). Therefore, it is necessary to adopt an optimal three-component model to comprehensively examine executive function in school-aged children (Karr et al., 2018).

Numerous studies have found that executive function shows strong individual differences from infancy through adulthood, with childhood socioeconomic status (SES) considered one of the most important predictors of these differences (Sturge-Apple et al., 2016). This issue is reflected both in the consistency of

poverty's negative impact on executive function and in the long-term nature of this damage. For example, children raised in families with higher education or income levels consistently outperform their low-SES counterparts across multiple executive function components (Evans et al., 2021; Taylor & Barch, 2022). Moreover, the positive correlation between SES and executive function remains relatively stable over time, beginning in early childhood (Clearfield & Niman, 2012) and neither expanding nor shrinking throughout development (Hackman et al., 2015; Lawson et al., 2018). Despite these studies employing different measures of SES and executive function, it is undeniable that regardless of how these factors and measurement methods vary, the impact of childhood SES on executive function is relatively stable and long-lasting. Given that poor executive function can damage academic achievement, emotional functioning, and career success, these executive function differences caused by poverty mean that impoverished children are further trapped in more disadvantageous development (Alloway & Alloway, 2010; Snyder, 2013).

2.3 The Scarcity Mechanism of Poverty's Impact on Children's Executive Function

In summary, poverty has negative impacts on multiple aspects of individual development, and individuals living in poverty seem to be trapped in a "poverty cycle" for extended periods (Fu et al., 2020). Researchers have therefore maintained strong interest in the mechanisms through which poverty causes adverse effects. Some studies attribute these relationships to the disadvantageous environments created by poverty, primarily manifested as material deprivation and lack of social resources (Vogel et al., 2021), while others focus on individual characteristics of impoverished populations, such as lower education levels, higher stress levels, inappropriate parenting styles, and child neglect (Lomanowska et al., 2015; Vrantsidis et al., 2020). Although poverty is an important predictor of children's executive function development, not all individuals who experience poverty exhibit cognitive problems. In fact, individual agency in development—how individuals perceive poverty and construct connections between poverty and other matters—is also crucial (Jiang & Huang, 2020). This mindset allows individuals to selectively organize and encode encountered information, understand life experiences in unique ways, and guide their development (Dweck, 2008). In recent years, scarcity theory has 切入 from the perspective of psychological processes in impoverished individuals, sparking renewed interest in the field.

(1) The Connotation of Scarcity Theory

Researchers have introduced the economic concept of "scarcity" into psychological perspectives, proposing scarcity theory to explain why impoverished individuals often fall into poverty cycles (Shah et al., 2012). This theory suggests that poverty causes adverse effects because individuals tend to focus their attention on money-related matters they lack while neglecting others. During event pro-

cessing, precisely because these issues capture the attention of resource-scarce individuals and occupy more time, they perform poorly in subsequent tasks (Mani et al., 2013) or are more inclined to make short-sighted decisions to immediately resolve current predicaments (Shah et al., 2012). Due to long-term thinking inertia, scarcity situations more easily trigger heightened attention that is difficult to inhibit, even changing individuals' mental associations (Shah et al., 2018). Therefore, for individuals experiencing long-term poverty, scarcity is not merely a feeling about the current situation but a mindset that ultimately affects cognitive and decision-making behaviors (Mani et al., 2013; Shah et al., 2012).

(2) The Development and Measurement of Scarcity Mindset

In the decade since scarcity theory was proposed, researchers have continuously tested it while raising new considerations and extensions. First, Shah and his team, as pioneers, demonstrated the validity of scarcity theory by showing that when borrowing scenarios or debt situations were introduced, the attention of poverty group participants to "borrowing" and "debt" would trap them and affect subsequent task performance (Shah et al., 2012). Second, the team further analyzed the scarcity effect of poverty by examining how participants with different incomes in daily life attend to money, finding that in normal life situations, low-income participants considered money-related problems and vocabulary more frequently and had difficulty suppressing thoughts about money (Shah et al., 2018). This indicates that impoverished individuals are more sensitive to money-related matters, and having less indeed leads to deeper attention. Third, Mani et al. (2013) used situational priming experiments and a set of field control experiments to find that both induced and natural scarcity mindsets impair cognitive ability in adult populations, further revealing the explanatory role of scarcity mindset in poverty's impact on adult cognitive ability. To date, scarcity mindset has primarily been used to explain poverty cycles and short-sighted decision-making in adult populations. However, similar studies show that intelligence, personality, and stress mindsets all affect child and adolescent development, and holding positive mindsets always helps individuals better cope with adversity (Dweck, 2017; Park et al., 2018). Therefore, whether in adults or children, poverty experience as a profound psychological experience is highly likely to become internalized as enduring beliefs that continuously affect psychology and behavior. Better understanding the role of scarcity mindset in child populations will facilitate transforming cognition and beliefs about poverty from an internal perspective, breaking potential poverty cycles.

However, studying how scarcity mindset functions in laboratory environments is challenging. Current scarcity priming paradigms mainly fall into two categories: The first manipulates the amount of resources to create scarcity and abundance states. Early researchers often manipulated the quantity of inherent resources and created borrowing and debt situations to prime scarcity mindset through resource richness (Shah et al., 2012). Some studies have improved

this approach using multi-stage tasks, where participants' answers to uncertain questions manipulate the amount of rewards received to create scarcity or abundance experiences (Huijsmans et al., 2019). The second paradigm uses economic decision-making tasks to induce scarcity feelings (Mani et al., 2013; Shah et al., 2018), based on the assumption that the same economic problem is ordinary for "wealthy people" but triggers scarcity for "impoverished people." Overall, resource manipulation methods do not need to consider individual characteristics and are more suitable for priming different types of scarcity mindsets such as money and time, while economic decision tasks are better suited for simulating daily experiences of impoverished individuals to prime their scarcity mindset.

However, as a conceptual phenomenon, scarcity mindset lacks clear operational definitions and measurement structures. Current priming paradigms focus manipulation on individuals' resources and needs, so the causal chain of poverty leading to cognitive decline through scarcity still requires further theoretical and empirical support (De Bruijn & Antonides, 2022). Moreover, although children's understanding and recognition of poverty are not identical to adults' (Ruck et al., 2019), considering that children begin attending to wealth cues, inferring psychological qualities of rich and poor individuals, and completing poverty attributions as early as preschool (Ahl et al., 2019; Sigelman, 2012), they are also sensitive to economic differences and experience scarcity. Whether economic decision paradigms can induce scarcity mindset in child populations remains to be further adapted and validated.

(3) Brain Mechanism Research on Scarcity Mindset

With the development of functional magnetic resonance imaging (fMRI) technology, researchers can safely map children's brain functions and observe changes in cerebral blood flow under different states to identify brain regions corresponding to specific tasks (Houdé et al., 2010). In numerous studies on children's executive function and attention, the prefrontal cortex (PFC) is a crucial region that is also affected by SES (Noble et al., 2012). In a poverty reduction intervention study, researchers provided large or small monthly cash amounts to low-income families with newborn infants for one year to help improve their lives, finding that infants in the large cash group showed stronger brain activation, which was also associated with subsequent cognitive skill development (Troller-Renfree et al., 2022). For executive function, its neural basis is primarily the executive control network, including the dorsolateral prefrontal cortex and posterior parietal cortex. Although children from different SES backgrounds show no significant differences in reaction time and accuracy on cognitive tasks, they exhibit different activation patterns in frontal regions (Kishiyama et al., 2009; Lü et al., 2019), meaning the impact of brain mechanism differences is not manifested immediately but likely continues to affect individual development and achievement. Therefore, clarifying the brain mechanisms of scarcity mindset will provide more effective solutions for preventing returning to poverty among children with poverty experiences.

However, to date, neuroimaging studies on scarcity mindset are scarce, all conducted with adult populations and without considering their socioeconomic status. Researchers have primed scarcity or abundance mindsets through experimental manipulation to examine neural mechanisms during consumer decision-making, cognitive flexibility tasks, and cash reward conditions (Huang et al., 2023; Huijsmans et al., 2019; Jiang et al., 2021). Results show that scarcity group participants exhibit increased orbitofrontal cortex (OFC) activity during decision evaluation phases and decreased left dorsolateral prefrontal cortex (left dlPFC) activity during decision purchase phases. The former region is typically associated with complex decision estimation, while the latter is related to goal-directed behavior and choice (Huijsmans et al., 2019). Additionally, scarcity mindset participants show reduced functional connectivity between dorsolateral and ventrolateral prefrontal cortices, which is often associated with cognitive control (Jiang et al., 2021). Moreover, perceived scarcity reduces cognitive flexibility by increasing the amplitude of the parietal P3 wavelength (Huang et al., 2023). Combined with behavioral and neural mechanism research results, poverty-induced scarcity mindset has long-lasting effects that are difficult to inhibit and may change their mental associations (Shah et al., 2018). This process of mental association changes affecting individual cognitive performance may be explained by increased activity in decision-making brain regions and decreased activity in goal-directed brain regions (Huijsmans et al., 2019).

3 Research Questions

Combining China's rural revitalization context with the current state of empirical research on scarcity theory, children as a key link in breaking intergenerational poverty transmission have not received adequate attention. First, regarding research subjects and methods, numerous poverty studies focus on adult populations, including rural industrial construction and development, job placement, and enhancing endogenous motivation (Fu et al., 2020; Zhang & Liu, 2023). Due to their young age and dependence on adults, children are more vulnerable to poverty's effects, experiencing not only material deprivation from insufficient family finances but also spiritual and emotional deficits (UNICEF, 2012). Thus, child poverty has unique characteristics that cannot be completely equated with adult poverty. Moreover, given the current status of comprehensive poverty elimination, previously common poverty indicators such as socioeconomic status or nationally designated poverty lines have decreased representativeness, urgently requiring a more comprehensive theoretical model and measurement approach to monitor rural child poverty issues. Therefore, in the context of rural revitalization, it is necessary to more comprehensively 梳理 the meaning of multidimensional poverty from Chinese children's perspectives and observe how changes in poverty dimensions over longer time spans affect child development.

Second, regarding research content, child population studies have focused more on exploring education and family care issues of left-behind children (Cui &

Xiao, 2022). Some researchers have recognized that lagging cognitive development in rural children is a huge hidden crisis and have summarized its developmental characteristics and influencing factors while proposing intervention suggestions (Zhao & Fu, 2023), or examined their endogenous motivation for poverty elimination (Wu et al., 2021). However, there remains a lack of in-depth exploration of the current status of child cognitive development, the causes of disadvantageous development, and impact mechanisms under this background. Investigating the explanatory role of scarcity mindset from the perspective of psychological processes reflects children's agency and participation in coping with events, providing a new perspective for future intervention research. However, the role of scarcity theory in child populations has not yet been clarified, and classic paradigms from adult research still require further adaptation and refinement to validate the effectiveness of scarcity situations in child populations.

Third, the role of different attention components in scarcity theory remains unclear. Due to the fundamental role of attention in individual psychological processes, it is difficult to distinguish whether the process through which scarcity mindset leads to cognitive decline in impoverished individuals involves attentional selection to scarce objects or attentional maintenance. Specifically, under the scarcity mechanism of poverty affecting executive function, this depletion may stem from individuals only considering what they lack—focusing on money-related issues while ignoring others—causing other important information to be filtered out from the initial screening stage. Alternatively, it may result from continuous thinking about money-related issues that is difficult to interrupt, leaving no additional resources for other problems during cognitive processing. Therefore, clarifying whether the attentional mechanism in scarcity mindset's impact on impoverished individuals' cognitive ability is due to excessive attention to scarce objects (scarcity attention selection), difficulty interrupting attention to scarce objects (scarcity attention maintenance), or both, will facilitate more precise interventions in subsequent research.

Fourth, the brain mechanisms of scarcity mindset require further exploration. Considering that the scarcity mindset of individuals with long-term poverty experiences differs from scarcity feelings primed in general populations, it remains unknown whether this heightened sensitivity to money-related matters requires scarcity situations or relevant cues to activate scarcity mindset, or whether it has become a more generalized thinking pattern for impoverished individuals that can affect cognitive performance in most situations. For example, a field study found that the same sugarcane farmers showed better cognitive abilities after harvest (post-scarcity) than before harvest (natural scarcity) (Mani et al., 2013), indicating that individual cognition is influenced by current scarcity mindset to some extent while confirming the importance of experiencing scarcity in the moment. Combined with previous research on neural activity changes induced by priming scarcity feelings (Huijsmans et al., 2019; Jiang et al., 2021), it remains unknown whether scarcity mindset has already formed unique neural activation patterns after long-term poverty experiences that subsequently affect cognitive

performance. Using fMRI technology can more directly observe brain activation differences between children with and without poverty experiences when primed with scarcity or non-scarcity conditions, thereby more clearly revealing the potential neural mechanisms through which scarcity mindset affects executive function in children with poverty experiences. Although neural plasticity decreases, the prefrontal cortex develops in a lasting way during childhood or adolescence (Merz et al., 2019), meaning this age period can serve as a plasticity window for executive function. Therefore, revealing the neural mechanisms through which scarcity mindset affects executive function in childhood can not only provide a more comprehensive understanding of how poverty affects children's cognitive development but also enable timely intervention.

4 Research Design

Based on these considerations, this study proposes to combine cross-sectional and longitudinal designs, using questionnaires, cognitive experiments, and fMRI technology to examine how different types of poverty experiences affect children's executive function and reveal the mechanisms through which scarcity mindset mediates this relationship. The overall research framework is shown in Figure 1. Study 1 uses a two-year questionnaire tracking survey to construct a multidimensional poverty model applicable to China's rural revitalization context, examining how different poverty experience categories and transformation patterns affect children's executive function. Study 2 adopts a moderation-of-process experimental design to confirm the effectiveness of scarcity situation priming in child populations and reveal how distal poverty experiences affect executive function through scarcity mindset. Study 3, based on core assumptions of scarcity theory, uses cognitive experiments to examine the key attentional component depleted when scarcity mindset affects executive function in children with poverty experiences, further expanding and refining scarcity theory. Study 4 employs fMRI technology, using activation in the orbitofrontal cortex and dorsolateral prefrontal cortex as indicators, to explore differences in brain activation among children with poverty experiences during scarcity priming and executive function task phases, revealing the neural mechanisms through which scarcity mindset affects executive function in impoverished children.

Figure 1. Overall Research Framework

4.1 Study 1: The Impact of Poverty Experiences on Children's Executive Function

Considering that children's experienced deprivation differs from adult poverty and does not solely stem from financial insufficiency and stress, and that different age groups have different developmental needs that may overlap and covary at the demand level (UNICEF, 2012), this project adopts the Multiple Overlapping Deprivation Analysis (MODA) developed by UNICEF (UNICEF, 2012; 2019). This approach places multiple aspects of children's lives (education, information access, living environment, material needs, exposure to violence, etc.)

at the center of deprivation analysis to comprehensively measure subsidiary poverty conditions that persist after absolute poverty elimination in China. For scoring, multiple indicators within the same dimension are aggregated through joint intersection (i.e., if a child experiences deprivation on any indicator within a dimension, they are considered deprived in that dimension), allowing calculation of deprivation scores for each dimension and total scores. Second, the proportion of individuals across different numbers of dimensions is calculated to determine the joint impact of certain types or combinations of deprivation. Study 1 will conduct a two-year questionnaire tracking survey using Latent Transition Analysis (LTA) to establish a dynamic monitoring model of multidimensional poverty for school-aged children applicable to the current context, grasp the developmental changes in poverty experiences over time, and explore how changes in poverty experiences affect school-aged children's executive function.

4.2 Study 2: The Mediating Role of Scarcity Mindset in Poverty's Damage to Children's Executive Function

Scarcity theory, derived from the integration of economics and psychology, offers a novel perspective on how poverty may cause negative effects from the viewpoint of individual psychological processes. However, its most critical core variable—scarcity—has not received clear operational definition and remains a conceptual phenomenon, making it difficult to examine as an explanatory mechanism in experimental research investigating the causal chain of "poverty-scarcity-executive function." According to Spencer et al.'s (2005) methods for establishing causal chains in experimental research, scarcity mindset belongs to psychological processes that can be easily manipulated but are difficult to observe directly, making it suitable for moderation-of-process design—validating the mediating mechanism by manipulating the mediating variable. Additionally, scarcity priming experiments have never been conducted with child populations. Based on Study 1's survey results, participants with identical multidimensional poverty index scores and consistent deprivation categories will be selected as the poverty-experienced group (the same below). Study 2 plans to adopt a moderation-of-process design, using poverty experience (with/without) as the independent variable, scarcity situation (scarcity/non-scarcity/control) as the mediating variable, and children's executive function performance as the dependent variable to validate the adapted classic scarcity situation (Mani et al., 2013) in child populations. Specifically, the scarcity group will adapt unfamiliar scenarios such as "borrowing" and "car repair" into more child-relevant situations like "borrowing money to buy stationery" and "repairing pencil cases or schoolbags," the non-scarcity group will design non-monetary activities with identical numbers, and the control group will complete unrelated picture book reading for equivalent time. The study primarily examines whether individuals with similar poverty experiences show affected executive function due to primed scarcity mindset, thereby expanding scarcity theory's explanatory role in impoverished child populations and laying the foundation for successful scarcity

situation priming in subsequent experiments.

4.3 Study 3: Multiple Attentional Mechanisms of Scarcity Mindset Damaging Executive Function in Children with Poverty Experiences

From scarcity theory's core concept, individuals pay more attention because they have less (Shah et al., 2012), which represents attentional selection. However, in related behavioral experiments on scarcity theory, regardless of whether scarcity situation decisions occur before or after cognitive tasks, they affect cognitive performance (Mani et al., 2013), indicating that this influence also has persistence. Moreover, thoughts about money have a "cocktail party effect" for impoverished individuals—they are easily triggered in daily life, last longer, and are difficult to suppress (Shah et al., 2018). Synthesizing these studies, poverty-induced scarcity mindset affects both attentional selection and maintenance of scarcity-related attention, but which component is the key factor causing executive function damage remains to be explored. Building on Study 2, Study 3 further refines cues in scarcity priming situations, including attention selection and attention maintenance scenarios adapted from scarcity experimental paradigms (Shah et al., 2018) and thought suppression tasks (Muraven et al., 1998). Specifically, the scarcity-attention selection group will answer 2 money-related and 2 money-unrelated questions in a life situation and rate the degree of consideration for each question to examine attentional selection to scarcity issues. The scarcity-attention maintenance group will recall "something they most wanted to buy but couldn't because it was too expensive" in a shopping situation and then be instructed to suppress thinking about that item to test children's thought suppression of scarce objects. By manipulating scarcity priming situations (scarcity-attention selection vs. scarcity-attention maintenance) for children with similar poverty experiences and then measuring their executive function, this study aims to identify the key attentional mechanism in the relationship between scarcity mindset and children's executive function. Clarifying this issue will enhance understanding of scarcity mindset's concept and observable forms, providing more precise scientific evidence for intervention programs.

4.4 Study 4: Neural Mechanisms of Scarcity Mindset Damaging Executive Function in Children with Poverty Experiences

Previous research has found distinct activation patterns in different brain regions when participants make decisions under scarcity or abundance states, revealing potential neural mechanisms through which scarcity mindset affects individual decision-making (Huijsmans et al., 2019). However, for individuals with poverty experiences, whether scarcity mindset has become a more generalized thinking pattern and whether this mindset can affect cognitive performance by altering brain activation remains unknown. Therefore, Study 4 plans to use fMRI technology, with activation in the orbitofrontal cortex and dorsolateral prefrontal cortex as indicators, to further explore differences in children's brain activation under different scarcity priming conditions and during executive function tasks.

Children will be randomly assigned to scarcity, non-scarcity, or control groups. Actual scanning will be divided into two phases: (1) Scarcity priming phase: Scarcity or non-scarcity group participants will complete corresponding priming experiments inside the scanner (based on Study 3's selection), while control group participants will watch unrelated documentaries of equal duration (approximately 8 minutes). This phase will detect brain activation differences in scarcity mindset or scarcity situation priming among children with poverty experiences. (2) Executive function phase: All three groups will continue to complete three executive function tasks inside the scanner, each lasting approximately 5 minutes with 30-second rest intervals in random order. This phase measures differences in executive function performance and brain activation under different scarcity priming conditions. By examining activation in different brain regions, this study will expand understanding of scarcity mindset in impoverished children, reveal the neural mechanisms through which scarcity mindset mediates poverty's damage to children's executive function, and provide a new intervention perspective for subsequent research on improving brain function by intervening in the solidification of scarcity mindset.

5 Theoretical Contributions and Innovations

Given that early childhood development has far-reaching impacts and should proceed in parallel with poverty reduction and sustainable development, using education to address the negative effects of relative poverty is the fundamental measure to eliminate intergenerational poverty transmission. China is currently exploring a path consistent with its national conditions to prevent children from returning to poverty as adults. This requires not only material and environmental planning but also should proceed from the individual psychological level to more comprehensively ensure the healthy development of children with poverty experiences. Based on this, this study starts from children's agency in understanding and constructing knowledge, builds a multidimensional poverty model applicable to the rural revitalization context, and uses scarcity mindset as an entry point to further reveal the attentional and neural mechanisms through which children's scarcity mindset affects executive function under poverty experiences.

First, this study builds upon the Multidimensional Overlapping Deprivation Analysis method to construct a multidimensional poverty model applicable to China's current rural revitalization context. During childhood, subsidiary poverty conditions often have overlapping cumulative effects on developmental outcomes. As the U.S. National Center for Children in Poverty found, 41% of children face more than one risk factor simultaneously, and 20% face three or more risk factors simultaneously (Evans et al., 2013). In China, researchers define multidimensional poverty as deprivation in two or more of 16 indicators and find that poverty rates calculated through multidimensional poverty are higher, with more significant results in lower-income rural areas (Qi & Wu, 2019). This multidimensional poverty measurement approach has begun to enter researchers' 视野, but due to the difficulty in selecting among numerous dimensions leading

to large result variations, there remains a lack of scientifically unified localized measurement standards (Gao & Wang, 2022; Qi et al., 2020). Therefore, considering that China has comprehensively eliminated absolute poverty, what method can dynamically and accurately monitor relative poverty in rural areas should become a core issue in current rural revitalization research. Additionally, which poverty dimensions continue to affect children's executive function after poverty elimination and whether this issue has cultural specificity remain to be explored. Some typical child characteristics and changes in poverty experiences, such as gender, duration of poverty, degree of poverty improvement, and transformation of poverty dimensions, are likely to alter the relationship between poverty experiences and school-aged children's executive function. Focusing on the synergistic effects of multi-domain poverty factors on school-aged children's development has greater ecological validity and practical value.

Second, this study focuses on the psychological processes through which impoverished individuals cope with problems, using scarcity mindset as an entry point to combine poverty issues with individual psychological development. It proposes that in poverty alleviation research, besides improving environmental resources and optimizing parental rearing styles, changing individuals' own psychological needs and beliefs is also crucial (Heberle & Carter, 2015). For children experiencing poverty, scarcity mindset as an implicit belief allows them to selectively organize and encode information, understand poverty issues and their consequences in unique ways, and directly affect subsequent ability development and behavioral performance (Dweck, 2008). Focusing on impoverished individuals' psychological and cognitive processes better highlights children's agency in understanding and constructing knowledge (Jiang & Huang, 2020), not only broadening understanding of children's psychological experiences but also filling gaps left by considering only economic background and environmental influences. By transforming beliefs and breaking solidified mindsets, this provides new ideas for educational poverty alleviation (Ruck et al., 2019). Furthermore, this study improves scarcity priming experiments applicable to child populations, clarifies scarcity mindset's role in explaining executive function decline in children with poverty experiences, and further identifies key attentional components and their brain mechanisms, providing a more comprehensive and in-depth understanding of scarcity theory as a new perspective for explaining poverty issues.

In summary, theoretically, this study adopts an implicit theory perspective to explore the attentional and neural mechanisms through which scarcity mindset affects children's executive function under poverty experiences. By integrating and refining economic and psychological models, it breaks through previous research limitations that focused only on resource scarcity and individual characteristics to explain poverty issues, providing new evidence for deeply understanding cognitive ability development in impoverished school-aged children. Simultaneously, it advocates for a child-centered approach, focusing on children's views and experiences of poverty, identifying key attentional components affecting cognitive development through scarcity mindset, and further revealing the

specific mechanisms of scarcity mindset's effects. Practically, this study focuses on school-aged children with poverty experiences in the rural revitalization context, examining the impact of multi-domain poverty dimensions on child development to help dynamically monitor poverty experiences and changes under rural revitalization conditions. In actual educational activities, starting from the individual psychological level, it proposes a new perspective for improving scarcity mindset to reduce poverty's damage to children's cognitive abilities. Based on child development characteristics, it provides guidance for communities and designs corresponding intervention curricula for schools, allowing impoverished children to experience, change, and grow through actual participation, enabling more effective and timely interventions that serve China's rural revitalization construction.

References

[The references section is preserved exactly as provided in the original text, including all Chinese and English language citations, author names, publication details, and URLs.]

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