Toddler Anxiety Affects Creativity in 5-Year-Old Children: The Chain Mediating Role of General Cognition and Mastery Motivation

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Abstract

Early childhood anxiety is a common mental health problem that affects the development of central executive function, and the development of cognitive abilities manifested through central executive function typically reflects the process of creative problem-solving. This study adopted a longitudinal design to investigate the long-term effects of toddler anxiety on preschool creativity and its underlying mechanisms. Ninety-six families from Beijing (42 boys, 54 girls) participated in this study. When children were 1 and 2 years old, mothers completed the Chinese version of the "Emotional and Social Development Assessment Scale for 12-36 Month Old Toddlers" and a family basic information questionnaire. At age 2, children' s general cognitive ability was assessed using the Bayley Scales of Infant and Toddler Development; at age 3, mothers reported on children' s mastery motivation; at age 5, children' s creativity was assessed using the Torrance Thinking Creatively in Action and Movement Test. The results indicated that: (1) toddler anxiety (generalized anxiety and separation anxiety) could significantly negatively predict creativity at age 5; (2) general cognitive ability and mastery motivation established a chain mediating effect between toddler anxiety (generalized anxiety and separation anxiety) and preschool creativity; (3) toddler generalized anxiety could also negatively affect creativity performance at age 5 by directly and negatively predicting mastery motivation.

Full Text

Toddlers' Anxiety Predicts Their Creativity at Age 5: The Chain Mediating Role of General Cognition and Mastery Motivation

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Abstract

Childhood anxiety is a common mental health problem that affects the development of central executive functions, which in turn reflect the cognitive processes underlying creative problem-solving. This longitudinal study examined the long-term effects of toddlerhood anxiety on preschool creativity and the underlying mechanisms. Ninety-six families from Beijing (42 boys, 54 girls) participated. At child ages 1 and 2 years, mothers completed the Chinese version of the Infant-Toddler Social and Emotional Assessment and a family demographics questionnaire. At age 2, children' s general cognitive ability was assessed using the Bayley Scales of Infant Development. At age 3, mothers reported children' s mastery motivation. At age 5, children' s creativity was evaluated using the Thinking Creatively in Action and Movement test. Results indicated: (1) Toddlerhood anxiety (both generalized anxiety and separation anxiety) significantly negatively predicted creativity at age 5; (2) General cognitive ability and mastery motivation formed a significant chain mediation between toddlerhood anxiety (both subtypes) and preschool creativity; (3) Toddlerhood generalized anxiety also negatively predicted mastery motivation directly, thereby exerting a negative influence on creativity at age 5.

Keywords: Generalized Anxiety, Separation Anxiety, General Cognitive Ability, Mastery Motivation, Creativity

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Introduction

Anxiety refers to children' s negative emotional experiences or psychological states—such as anger, distress, shame, guilt, and panic—that arise when they perceive internal or external stimuli as threatening or when they cannot achieve certain goals or overcome obstacles (Lin et al., 2003). Research indicates that anxiety emerges as early as 5 months of age and shows a linear increasing trend through early school age (Laurin et al., 2015). Childhood anxiety differentiates into distinct symptom clusters. Both Spence et al.' s (2001) five-factor model

and Sterba et al.' s (2007) three-factor model identify generalized anxiety and separation anxiety as separate subtypes across different age groups, demonstrating good discriminant validity and representativeness. Moreover, clinical studies reveal that children with generalized anxiety disorder account for 38%–58.4% of anxious children, while those with separation anxiety disorder comprise 22.2%–38%—substantially higher than other anxiety subtypes (Kendall et al., 2001). Therefore, this study examines generalized anxiety and separation anxiety as indicators of early childhood anxiety. Generalized anxiety refers to children' s broad concerns about their own behavior, abilities, and future, with increasing prevalence throughout early childhood (Broeren et al., 2013). Separation anxiety refers to acute, anticipatory anxiety experienced when children are separated from attachment figures (Zhang et al., 2009), following an inverted U-shaped developmental pattern that peaks during the preschool years before declining with age (Hale et al., 2008). Generalized anxiety represents trait anxiety—a stable, individual-difference characteristic—whereas separation anxiety constitutes state anxiety, a transient emotional pattern triggered by environmental stress, including physiological arousal and tension (Byron & Khazanchi, 2011).

Anxiety is cognitively significant because it consistently correlates with poorer performance on cognitive tasks, particularly higher-order functions such as creativity (Byron & Khazanchi, 2011). Strong creativity is an essential comprehensive ability for individual development and social progress (Liu et al., 2020). Investigating factors and mechanisms influencing creativity during early childhood provides empirical support for family-level interventions to foster healthy creativity development. Creativity is defined as the cognitive process of generating original (novel) and useful ideas, solutions, or products under specific circumstances (Sternberg et al., 1999). Childhood creativity develops continuously between ages 2–5, reaching a small peak at age 5 before plateauing (Torrance, 1967; Ye & Ma, 2012). Early childhood represents a critical period for creativity development and cultivation (Alfonso-Benlliure et al., 2013). Studies demonstrate that anxiety negatively affects creativity task performance (Acedo-Baquedano & Acedo-Lizarraga, 2012; Byron & Khazanchi, 2011), with stronger inhibitory effects in children than adults (Byron & Khazanchi, 2011). Furthermore, different anxiety subtypes exert varying degrees of influence on creativity (Acedo-Baquedano & Acedo-Lizarraga, 2012; Byron & Khazanchi, 2011; Lu et al., 2005). Thus, examining the long-term effects of these two important yet distinct anxiety subtypes on creativity is warranted.

However, the mechanisms through which childhood anxiety influences creativity remain unclear. Adult studies have preliminarily explained this process through Processing Efficiency Theory and Attentional Control Theory. Processing Efficiency Theory (Eysenck & Calvo, 1992) posits that worry associated with anxiety consumes processing and storage resources within the working memory system, with research demonstrating that anxiety impairs working memory capacity (Ng & Lee, 2015). Attentional Control Theory (Eysenck et al., 2007) further emphasizes that anxiety disrupts attentional control efficiency by impairing inhibitory and shifting functions. Empirical studies show that high-anxiety

individuals perform worse on tasks requiring inhibitory function (Eysenck et al., 2007) and shifting function (Gul & Humphreys, 2014), and exhibit altered brain activity and resting-state functional connectivity in the dorsolateral prefrontal cortex (Basten et al., 2012) and anterior cingulate cortex (Comte et al., 2015; Allen et al., 2019; Barker et al., 2018), indicating poorer control over these functions. However, the applicability of these theories to child populations requires further investigation.

Research has linked childhood anxiety to elevated cortisol levels, with early anxiety predicting higher HPA axis activity eight years later (Greaves-Lord et al., 2010). The neuroendocrine system undergoes rapid development during early childhood, and cortisol—the end product of the HPA axis—plays a crucial role in brain development (Nie et al., 2015). The biological systems model may thus explain how anxiety affects cognitive abilities and subsequently influences creativity development. According to this model, stress-induced anxiety activates the hypothalamic-pituitary-adrenal (HPA) axis, releasing stress hormones (e.g., glucocorticoids) that cross the blood-brain barrier and affect cognition-related brain regions such as the hippocampus, frontal lobes, and amygdala, thereby impairing cognitive function (Lupien et al., 2007). At the behavioral level, higher cortisol levels impair cognitive abilities including memory and vigilance (Lupien et al., 2007; Plotsky et al., 1998). Chronic stress states hinder hormonal regulation flexibility, affecting executive function development (McEwen, 2000; Ramos & Arnsten, 2007). We can therefore infer that early anxiety states exert long-term effects on later cognitive development. Although previous studies have documented negative effects of anxiety on creativity (e.g., Acedo-Baquedano & Acedo-Lizarraga, 2012; Byron & Khazanchi, 2011), most relied on cross-sectional designs with participants from middle childhood to adulthood, with few examining the long-term impact of infant-toddler anxiety on creativity. This longitudinal study investigates the effects of toddlerhood anxiety on preschool creativity and its underlying mechanisms. Given that creativity emerges from basic human information-processing capacities (Dietrich, 2004) and that infant creativity primarily reflects cognitive development rather than genuine creative output (Zhang & Gu, 2004, p. 64), we hypothesized that cognitive ability may mediate the effect of early childhood anxiety on creativity development. According to Piaget' s cognitive development theory, 2-year-olds begin to transition from concrete actions to representational thinking, entering genuine problem situations and consciously exploring, questioning, and seeking answers (Zhang & Gu, 2004, p. 65). Therefore, this study examined 2-year-olds' general cognitive ability as the early cognitive foundation for creativity development, exploring its role in the anxiety-creativity link. We hypothesized that early anxiety might first impair general cognitive ability, subsequently affecting creative performance.

Processing Efficiency Theory suggests that worry reduces cognitive resources in working memory (Eysenck et al., 2007) and may also diminish task engagement and motivation (Barch et al., 2008; Du, 2018). As children transition from toddlerhood to early childhood, cognitive development and accumulated expe-

rience create discrepancies between environmental changes and existing knowledge structures, generating urgent needs to understand others, themselves, and their surroundings (Zhang & Gu, 2004, pp. 64-65). Morgan et al. (1990) termed this need "mastery motivation," which drives individuals to persistently and independently solve moderately challenging problems, skills, or tasks. Harter et al. (1974) proposed that mastery motivation in children manifests as the desire to solve challenging cognitive problems for intrinsic satisfaction, representing a core driver of later cognitive and intellectual development (Hausercram et al., 2001; Macturk et al., 1995). According to mastery motivation developmental theory (Jennings, 1991), the specific goals of mastery behaviors change as infants increasingly focus on different behavioral outcomes, with environmental conditions for eliciting mastery behaviors varying developmentally. Three-year-olds show higher overall persistence and mastery pleasure, transitioning from "mastering behaviors aimed at achieving final outcome goals to complete problem-solving" to "mastering behaviors focused on task difficulty and preference for challenge." Problem-solving-oriented motivation (Jennings, 1991) emerges as a necessary factor for creativity development. Therefore, this study examined 3-year-olds' mastery motivation to explore its role in the transition from lower-level to higher-level cognitive abilities. We hypothesized that early anxiety might exert long-term effects on mastery motivation by undermining curiosity and exploration, thereby affecting creativity development.

Furthermore, Piaget' s (1952) cognitive development theory implicitly incorporates motivational principles: encountering novel stimuli when existing cognitive structures are challenged serves as a prerequisite for advancing to higher cognitive stages. Through assimilation and accommodation, individuals ultimately achieve new equilibrium with their environment. In this process, the emergence of novel stimuli generates motivation: based on previous experiences of adaptive balance, individuals develop expectations for new adaptation levels, and discrepancies between new and old levels create motivation to eliminate inconsistency (Hunt, 1965). Basic cognitive structures constitute prerequisites for motivation, while motivation is necessary for cognitive development (Jennings, 1991; Ulvund, 1980). We therefore hypothesized that children' s general cognitive ability and mastery motivation play a chain mediating role between anxiety and creativity. Given the high prevalence of generalized and separation anxiety in children, this study constructed a chain model from early anxiety → general cognitive ability → mastery motivation → creativity, examining whether different anxiety subtypes exert consistent effects on children' s creativity mechanisms.

To better investigate the effects of early anxiety on later creativity development and its mechanisms, this study also examined and controlled for other factors influencing creativity, including socioeconomic status and maternal sensitivity as distal and proximal environmental variables. Research shows that parental income, education, and maternal sensitivity relate directly or indirectly to children' s mastery motivation (Turner & Johnson, 2003; Young & Hauser-Cram, 2006) and creativity (Shi & Shen, 2007; Zhang et al., 2013). Therefore, we included parental income, education, and maternal sensitivity as covariates when

they showed significant correlations with key variables, to obtain a purer relationship between early anxiety and later creativity development.

In summary, this longitudinal study examined the predictive effects of toddlerhood generalized and separation anxiety on creativity at age 5 and explored underlying mechanisms. The theoretical path model is as follows:

Figure 1. Theoretical Model of Chain Mediation from Anxiety to Creativity

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Method

Participants The sample was drawn from the "Beijing Longitudinal Study of Infant and Toddler Cognitive and Socio-Emotional Development" (BELONGS), initiated in 2010. Healthy 6-month-old infants and their families were recruited through community health service centers, maternal and child health hospitals, and online platforms. Inclusion criteria were: (1) healthy full-term firstborn infants weighing >2500g at birth; (2) maternal age at birth between 20–40 years; (3) mothers married and cohabiting with the child' s father at enrollment; (4) families self-identified as Beijing residents. At 6 months, 95 families were recruited (57 girls, 49 boys). Five families joined at 9 months, one at 1 year, five at 2 years, two at 3 years, and six at 5 years, totaling 114 participating families (61 girls [53.5%], 53 boys [46.5%]). Four families were lost to attrition, yielding a 4.2% attrition rate.

This study conducted assessments at child ages 1 year (T1), 2 years (T2), 3 years (T3), and 5 years (T4) using questionnaire and laboratory methods. Families who completed at least one timepoint were retained, resulting in a final sample of 96 families (54 girls, 42 boys). Chi-square tests revealed no significant differences between retained and excluded families on child gender, paternal income, maternal income, paternal education, or maternal education (all $p >$ .05). Among the 96 families, maternal education was high school or below for 4.4%, college for 55.6%, and master' s or above for 40.1%. Paternal education was high school or below for 2.2%, college for 42.8%, and master' s or above for 45%. Maternal income was below ¥6000/month for 41.9%, ¥6000–10000 for 20.3%, and above ¥10000 for 37.8%. Paternal income was below ¥6000 for 6.6%, ¥6000–10000 for 22.4%, and above ¥10000 for 71%.

At T1, children' s mean age was 1.19 years (SD = 0.07); at T2, 2.10 years (SD = 0.10); at T3, 3.19 years (SD = 0.09); and at T4, 5.09 years (SD = 0.06).

Procedure At each timepoint, questionnaires were administered to assess family demographics. At T1 and T2 (ages 1 and 2), mothers reported children' s generalized and separation anxiety. At T1, free mother-child interaction was videotaped for coding maternal sensitivity. At T2, children and parents visited the laboratory for general cognitive assessment. At T3, mothers reported

children' s mastery motivation. At T4, children' s creativity was assessed in the laboratory. All procedures received parental consent.

Measures Family Demographics Questionnaire (T1). A self-designed questionnaire collected parental income and education. Income was rated on a 5-point scale: 1 = below ¥1500/month, 2 = ¥1500-3000/month, 3 = ¥3000-6000/month, 4 = ¥6000-10000/month, 5 = above ¥10000/month. Education was rated on a 7-point scale: 1 = less than 3 years, 2 = 4-6 years, 3 = middle school, 4 = high school, 5 = associate degree, 6 = bachelor' s, 7 = master' s or above.

Maternal Sensitivity (T1). After obtaining consent and scheduling home visits, two researchers videotaped 15 minutes of free mother-child play with provided toys, avoiding mealtimes and naptimes when children were in good physical and mental condition. The Maternal Behavior Q-Sort (MBQ; Pederson & Moran, based on Ainsworth' s concept of maternal sensitivity) was used to code interaction quality. This study used the 72-item short version revised in 2010 (Moran et al., 2010; Pederson et al., 2009). Q-sorting divided items into nine groups of eight cards each, scored 1 (least characteristic) to 9 (most characteristic). Inter-coder reliability for item-item correlations was 0.71, and reliability for total MBQ scores was 0.90.

Chinese Version of the Infant-Toddler Social and Emotional Assessment (ITSEA; T1 & T2). The Chinese ITSEA (Zhang et al., 2009) measures externalizing, internalizing, dysregulation, and competence domains in children aged 12–36 months. The internalizing domain includes depression, generalized anxiety, fear, obsession, separation anxiety, and withdrawal from novelty. This study used maternal reports of generalized anxiety (4 items, e.g., item 39: "worried, anxious, or tense") and separation anxiety (4 items, e.g., item 38: "cries or clings when you try to leave"). All items were rated 0 ("not true/rarely true"), 1 ("sometimes true"), or 2 ("very true/often true"). Mean scores were computed for each subscale. The scale demonstrates 10–14 day test-retest reliability of 0.78–0.89, split-half reliability of 0.82–0.90, and internal consistency of 0.79–0.88 in Chinese samples (Zhang et al., 2009). Internal consistency in this study was 0.84 at both timepoints. Considering the differential effects of anxiety subtypes on creativity and significant correlations across ages, generalized and separation anxiety scores at ages 1 and 2 were standardized and averaged to create two composite indicators of toddlerhood anxiety.

Bayley Scales of Infant Development (BSID; T2). Developed by Bayley (1930) and revised in 2006 (BSID-III), this scale assesses development in children aged 1–42 months. This study used the cognitive subscale to evaluate general cognitive ability, covering sensorimotor development (e.g., item 1: persistent reaching), exploration and manipulation (e.g., item 28: squeezing toys), object relations (e.g., items 48/53: associative play: self/other), conceptual information (e.g., item 72: conceptual categorization: color), memory (e.g., spatial memory), and other cognitive processes. Examiners selected starting

points based on children' s age and administered items using Bayley materials; completed items scored 1, incomplete items scored 0, with total scores summed. This study used percentile rank scores indicating children' s relative position in the normative sample. The cognitive subscale demonstrates reliability of 0.92–0.99.

Dimensions of Mastery Motivation Questionnaire (DMQ; T3). The DMQ-17 (Morgan et al., 1990) assessed 3-year-olds' mastery motivation via maternal report on a 5-point Likert scale (1 = never, 5 = always) across 45 items measuring overall persistence, mastery pleasure, negative reactions to failure, and general competence. Overall persistence comprised 27 items (e.g., "has a lot of interaction when playing with me or other adults"). Mastery pleasure included 5 items (e.g., "shows excitement when successfully completing something"). Negative reactions to failure included 8 items (e.g., "looks away when unable to do something"). General competence comprised 5 items (e.g., "understands things a bit slowly"). As general competence reflects parental evaluation rather than objective child behavior, following previous research (Morgan et al., 2009), overall persistence, mastery pleasure, and negative reactions to failure were combined into a total mastery motivation score. Internal consistency for the total score was 0.86.

Thinking Creatively in Action and Movement (TCAM; T4). Given that young children primarily express ideas through action (Memmert, 2007; Pagona & Costas, 2008), this study used Torrance's (1981) TCAM to assess preschoolers' motor creativity. Suitable for ages 3–8 (Zachopoulou et al., 2009), TCAM scores both verbal and motor responses and has proven reliable for measuring creative potential in preschoolers (Cooper, 1991; Zachopoulou et al., 2009).

The test comprises four activities: (1) "How many ways can you···?" (2) "Can you move like···(an animal or tree)?" (3) "What other ways can you throw a cup into a wastebasket?" (4) "What can you do with a paper cup?" Activity 2 scores imagination; the other three score fluency and originality. Fluency reflects the number of ideas; originality reflects uniqueness based on normative scoring standards, with each response scored 0–3. Imagination scores range 0–5 on a Likert scale from "no movement" to "very realistic simulation."

Two trained graduate students administered and scored the test individually. For 5-year-olds, 20% of creativity assessment videos were coded for inter-rater reliability; correlations for fluency, originality, and imagination were 0.97, 0.90, and 0.92, respectively. Given high correlations among creativity dimensions, particularly between fluency and originality, principal component analysis was conducted to reduce multicollinearity, yielding a single creativity factor explaining 80.27% of total variance.

Data Analysis SPSS 22.0 was used to screen for outliers, examine distributions, and handle missing data. Descriptive statistics, correlation analysis, and regression analysis were conducted. Mplus 7.0 performed mediation analysis.

Preprocessing procedures were as follows: Boxplots detected no extreme values. Missing data rates ranged from 16.7% to 24.0% across variables (T1 generalized anxiety, T1 separation anxiety, T2 generalized anxiety, T2 separation anxiety, T2 general cognition, T3 mastery motivation, T4 creativity). Little's MCAR test yielded $^{2} = 72.10$, $p = 0.31$, indicating missing data were missing completely at random, satisfying MCAR assumptions. Maximum likelihood estimation with Expectation-Maximization (EM) algorithm was used for imputation in subsequent regression and mediation analyses (Acock, 2005; Widaman, 2006). EM imputation, a maximum likelihood algorithm, assumes missing data contain information relevant to parameter estimation, while parameters help identify most likely missing values.

Correlation and chain mediation analyses were conducted. Mediation used bias-corrected nonparametric percentile bootstrap methods to test the Figure 1 model, which is robust for small to medium samples (Shrout & Bolger, 2002; Hayes, 2013). Ordinary least squares regression estimated total and direct effects of early separation and generalized anxiety on age 5 creativity. For indirect effects, bias-corrected bootstrap confidence intervals (CIs) and standard errors were generated (bootstrap samples = 1000). CIs excluding zero indicated significant indirect effects (Shrout & Bolger, 2002).

Results

Descriptive Statistics and Gender Differences Table 1 presents descriptive statistics including sample size, minimum, maximum, means, and standard deviations. Independent samples *t*-tests revealed no gender differences on any variable (see Table 1). Consequently, gender was not controlled in subsequent analyses.

Table 1. Descriptive Statistics and Gender Differences

Variable	Boys (n=42)	Girls (n=54)	t-value
Age 5 Creativity	0.45±0.37	0.76±0.38	-1.66
General Cognition (T2)	0.41±0.37	0.75±0.47	-0.08±0.99
Mastery Motivation (T3)	0.35±0.31	0.39±0.34	0.05±1.02
Generalized Anxiety (T1&T2)	0.70±0.36	0.65±0.40	0.35
Separation Anxiety (T1&T2)	10.97±2.38	11.35±2.66	-0.08
Maternal Education	137.04±10.74	135.50±10.40	0.57
Maternal Income	30.33±14.90	34.42±18.09	-0.30
Paternal Income	41.27±26.15	46.02±27.43	-0.31

Note: Values represent means ± standard deviations.

Correlations Among Generalized Anxiety, Separation Anxiety, General Cognition, Mastery Motivation, and Creativity Correlation results appear in Table 2. Generalized anxiety at T1 correlated significantly with separation anxiety at T1 ($r = 0.48$, $p = 0.001$) and T2 ($r = 0.42$, $p = 0.001$). T1 generalized anxiety correlated with T2 generalized anxiety ($r = 0.31$, $p = 0.01$) and T2 separation anxiety ($r = 0.26$, $p = 0.03$). T1 separation anxiety correlated with T2 separation anxiety ($r = 0.29$, $p = 0.02$). These results indicate significant correlations among anxiety subtypes within timepoints and moderate temporal stability.

T1 separation anxiety, T2 generalized anxiety, and T2 separation anxiety correlated with T2 general cognition (r = -0.27 to -0.21, $p = 0.03$ to 0.08). Both T2 generalized and separation anxiety showed moderate to strong negative correlations with creativity (r = -0.35 to -0.38, $p = 0.002$ to 0.005). Maternal education correlated with T1 separation anxiety (r = -0.24, $p = 0.04$), and maternal income correlated with T3 mastery motivation (r = -0.30, $p = 0.02$). Consequently, only maternal education and income were controlled in subsequent analyses.

Table 2. Correlations Among Early Childhood Anxiety, General Cognition, Mastery Motivation, and Creativity

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Generalized Anxiety T1	1											
2. Separation Anxiety T1	0.48**	1										
3. Generalized Anxiety T2	0.31*	0.26*	1									
4. Separation Anxiety T2	0.29*	0.42**	0.27*	1								
5. General Cognition T2	-0.21	-0.27*	-0.38**	-0.35**	1							

Variable	1	2	3	4	5	6	7	8	9	10	11	12
6. Mastery Motivation T3	-0.10	-0.22+	-0.39**	-0.38**	0.31**	1						
7. Creativity T4	-0.29*	-0.35**	-0.38**	-0.42**	0.29*	0.57**	1					
8. Maternal Education T1	-0.15	-0.24*	-0.12	-0.08	0.16	0.11	0.08	1				
9. Paternal Education T1	-0.08	-0.05	-0.03	-0.02	0.09	0.05	0.03	0.68**	1			
10. Maternal Income T1	-0.12	-0.15	-0.18	-0.20	0.14	-0.30*	-0.22+	0.42**	0.31**	1		
11. Paternal Income T1	-0.05	-0.08	-0.10	-0.12	0.08	-0.15	-0.10	0.35**	0.45**	0.72**	1	
12. Maternal Sensitivity T1	-0.08	-0.12	-0.05	-0.10	0.18	0.22+	0.25*	0.31**	0.28*	0.15	0.20	1

Note: $+p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. T1 = 1 year, T2 = 2 years, T3 = 3 years, T4 = 5 years.

Hierarchical regression examined predictions of creativity by early anxiety, general cognition, and mastery motivation. Generalized and separation anxiety at 14 and 24 months were combined into two composite indicators. Each model included four steps: (1) maternal education and income at T1; (2) generalized or separation anxiety; (3) general cognition at T2; (4) mastery motivation at T3. Table 3 shows that anxiety explained 17%–20% of creativity variance, general cognition showed no direct significant contribution, and mastery motivation explained 6%–13% of creativity variance.

Table 3. Hierarchical Regression Predicting Creativity

Predictor	Model 1 (Generalized Anxiety)	Model 2 (Separation Anxiety)
Maternal Education T1	0.04 (0.10)	0.04 (0.10)
Maternal Income T1	-0.08 (0.08)	-0.08 (0.08)
Generalized Anxiety T1&T2	-0.40*** (0.11)	—
Separation Anxiety T1&T2	—	-0.42*** (0.11)
General Cognition T2	0.05 (0.04)	0.05 (0.04)
Mastery Motivation T3	0.36*** (0.01)	0.28** (0.01)
ΔR^2	0.17***	0.20***
ΔR^2 (Mastery Motivation)	0.13***	0.06**

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. T1 = 1 year, T2 = 2 years, T3 = 3 years, T4 = 5 years.

Chain Mediation Analysis

Generalized Anxiety and Creativity The chain mediation model for generalized anxiety predicting creativity was saturated. Results showed toddlerhood generalized anxiety significantly negatively predicted general cognition at age 2 (a = -0.30, $p < 0.001$). General cognition at T2 marginally predicted mastery motivation at T3 (d = 0.15, $p = 0.07$), while T3 mastery motivation positively predicted creativity at T4 (b = 0.32, $p = 0.001$). Bootstrap estimation revealed a significant chain mediation effect through general cognition and mastery motivation (B = -0.02, 95% CI [-0.05, -0.002]), indicating the indirect path (generalized anxiety → T2 general cognition → T3 mastery motivation → T5 creativity) was significant (Wen & Ye, 2014). Additionally, toddlerhood generalized anxiety directly negatively predicted age 5 creativity (c' = -0.29, p = 0.003) and negatively predicted mastery motivation (a = -0.27, $p = 0.004$), which in turn predicted creativity. This simple mediation path was significant (B = -0.09, 95% CI [-0.19, -0.03]). No other mediation paths were significant.

Although general cognition and mastery motivation were not correlated in bivariate analyses, their chain mediation was significant, possibly due to suppression effects enhanced by controlling for maternal income and other model variables (MacKinnon et al., 2000).

Figure 2. Chain Mediation Path from Toddlerhood Generalized Anxiety to Preschool Creativity

Note: $+p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. T1 = 1 year, T2 = 2 years, T3 = 3 years, T4 = 5 years.

Separation Anxiety and Creativity The chain mediation model for separation anxiety predicting creativity was also saturated. Toddlerhood separation anxiety significantly negatively predicted general cognition at T2 (a = -0.31, p < 0.001). T2 general cognition positively predicted T3 mastery motivation (d = 0.25, p = 0.01), which in turn positively predicted T4 creativity (b = 0.42, p < 0.001). Bootstrap estimation revealed a significant chain mediation effect (B = -0.03, 95% CI [-0.09, -0.01]), indicating the indirect path (separation anxiety → T2 general cognition → T3 mastery motivation → T5 creativity) was significant. Toddlerhood separation anxiety also directly negatively predicted age 5 creativity (c' = -0.43, $p < 0.001$). No other simple mediation paths were significant.

Figure 3. Chain Mediation Path from Toddlerhood Separation Anxiety to Preschool Creativity

Note: $+p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. T1 = 1 year, T2 = 2 years, T3 = 3 years, T4 = 5 years.

Discussion

Previous research on anxiety-creativity relationships has primarily used cross-sectional designs with older children, adolescents, and adults. This longitudinal study examined long-term effects of two toddlerhood anxiety subtypes (generalized and separation anxiety) on preschool creativity and underlying mechanisms. First, we found that anxiety subtypes showed differentiation during infancy, with moderate concurrent correlations and low-to-moderate temporal stability, indicating both co-occurrence and stability. Second, toddlerhood generalized and separation anxiety and mastery motivation significantly predicted age 5 creativity, whereas general cognition did not directly predict creativity. Chain mediation analyses revealed that general cognition and internal mastery motivation mediated the relationship between both anxiety subtypes and creativity, supporting Ulvund' s (1980) view that motivation plays a crucial role in cognitive development. Additionally, generalized anxiety directly predicted mastery motivation, affecting creativity development.

Correlation analyses showed moderate concurrent correlations between generalized and separation anxiety at ages 1–2, indicating early differentiation with co-occurrence. Cross-time correlations for the same anxiety subtype were low to moderate, suggesting anxiety development in infancy has not reached high stability, consistent with previous research. For example, a study of anxiety trajectories from 0–2 years found that mother-reported infant anxiety emerged at 5 months, with three developmental trajectories: low-stable, moderate-rising, and high-rising groups, showing uneven anxiety development in infancy (Côté et al., 2009). The low correlation for separation anxiety across our two timepoints may reflect influences from parental anxiety (Sterba et al., 2007), child temperament (Bosquet & Egeland, 2006; Guerin et al., 1997), and family socioeconomic status (Gilliom & Shaw, 2004). These modest correlations also suggest plasticity in early anxiety, where family system interventions may reduce anxiety levels. Future research should focus more on young children and investigate developmental trajectories of different anxiety subtypes.

We found that both toddlerhood generalized and separation anxiety directly negatively predicted age 5 creativity, consistent with previous findings (Acedo-Baquedano & Acedo-Lizarraga, 2012; Kircaburun et al., 2020). According to Attentional Control Theory, anxiety impairs inhibitory and shifting functions, disrupting attentional control and negatively affecting higher-order cognition. Our creativity tasks required generating multiple solutions to common problems (e.g., getting from A to B) or alternative uses for common objects (e.g., paper cups). These tasks demand inhibiting habitual thinking, retrieving relevant experiences, shifting attention to the task, and matching experiences with task demands to generate novel solutions. Although Attentional Control Theory was developed to explain concurrent effects of trait anxiety on cognitive performance, our findings extend its applicability, showing that toddlerhood anxiety has long-term negative cognitive effects. Environmental influences on physiology are often chronic and gradual, altering homeostasis to affect health (Nie et al., 2015). According to the biological systems model, stress and adverse experiences trigger HPA axis activation, releasing glucocorticoids that affect brain development. Toddlerhood trait anxiety (generalized anxiety) creates stress responses to broad social environments, causing cortisol dysregulation (Miller et al., 2007) that may affect physical health, behavioral problems, cognition, and emotion regulation (Blair et al., 2011; Chrousos, 2009; Fries et al., 2005; Lopez-Duran et al., 2009; Sapolsky et al., 2000; Zalewski et al., 2012). Separation anxiety, focused on separation from attachment figures, becomes a "potential lifelong source of tension" as children' s understanding deepens with age (Bretherton & Waters, 1985). Separation anxiety peaks at ages 3–5 (Luo, 2002) and persists into adolescence. Although we did not experimentally induce separation anxiety, early separation anxiety sources remained present and negatively predicted creativity at age 5.

Mastery motivation at age 3 also significantly contributed to creativity, consistent with adolescent research (Shi & Shen, 2007). In the creativity framework, Amabile (1996) emphasized that beyond capacity for creative output, produc-

ing novel products depends heavily on intrinsic motivation for task completion (Csikszentmihalyi, 1996). Mastery motivation is a crucial internal motivation emerging in toddlerhood—a complex, malleable process rather than a static trait. Self-Determination Theory (Deci & Ryan, 2000) posits that children are active agents whose behavior is intrinsically motivated, spontaneously exploring environments, mastering skills, seeking challenges, and developing themselves. Three-year-olds' mastery motivation focuses more on goal-oriented behavior, comparing outcomes with goals to evaluate task completion. Children' s self-directed exploration provides positive feedback, enhancing curiosity and exploration desire, which cultivates higher mastery motivation—essential for creativity development (Oden, 1968). We also found simple mediation of mastery motivation between generalized anxiety and creativity: generalized anxiety negatively predicted mastery motivation (Huang et al., 2016), which in turn positively predicted age 5 creativity. This supports the intrinsic motivation hypothesis of creativity (Amabile & Pillemer, 2012) and aligns with previous research (Chen et al., 2021). However, we did not find simple mediation for separation anxiety. Clinically, generalized anxiety involves uncontrollable worry about daily themes for over six months (DSM-IV, APA, 1994), potentially creating attentional biases toward negative emotional information and self-states, increasing motivation to reduce anxiety and directly affecting mastery motivation (Eysenck et al., 2007). Separation anxiety involves abnormal reactions to real or imagined separation from attachment figures (Masi et al., 2001), more focused on caregivers. While this may directly affect cognitive development, it may not directly influence children' s intrinsic desire to explore and understand their environment. Future research could use emotion induction paradigms to trigger separation anxiety and examine its effects on mastery motivation and cognitive task performance.

Regarding cognition-creativity relationships, we found no direct prediction from general cognition to creativity, but chain mediation showed general cognition affected creativity through mastery motivation. These results support Ulvund' s (1980) view that motivation is important in cognitive development. Ulvund argued that both Piaget' s cognitive development theory and Hunt' s discrepancy principle implicitly incorporate motivational principles: cognition and motivation are intertwined processes where encountering discrepancies requires cognitive foundations, while advancing to higher cognitive stages requires motivation. Our findings support this view, showing that age 2 general cognition is a prerequisite for age 3 mastery motivation. Specifically, uneven general cognition development caused by toddlerhood generalized or separation anxiety does not directly predict higher-order creativity but indirectly influences it through age 3 mastery motivation. Previous literature on anxiety-cognition relationships has primarily used Processing Efficiency Theory (Eysenck et al., 2007) and cognitive interference theory (Tobias, 1985), suggesting high-anxiety individuals have deficits in allocating attentional resources, becoming trapped in negative emotional information and struggling to disengage. Low-anxiety individuals allocate more attention to tasks, show stronger attentional control, better inhibit stereo-

typical thinking, and flexibly shift attention, enhancing creativity. Although we did not directly assess cognitive processing, the Bayley cognitive subscale covers exploration, representation, reasoning, and memory—foundational processes for attention allocation and central executive functions. Some researchers suggest anxiety-related worry consumes cognitive resources and demands prefrontal cortex activation; complex cognitive tasks requiring high inter-regional connectivity may be more impaired in children with immature brain development (Byron & Khazanchi, 2011). Our results partially support Processing Efficiency Theory and cognitive interference theory. Additionally, anxious individuals show attentional biases toward negative stimuli (Bar-Haim et al., 2007), and anxious children with impaired general cognition may focus on negative self-feelings, preventing deep task processing and reducing enjoyment of overcoming challenges (Zhang et al., 2011). In complex creativity tasks requiring integration of past experiences and current contexts, high-anxiety children lack sufficient cognitive resources for information processing, consistent with central executive function deficits proposed by Attentional Control Theory (Eysenck et al., 2007). Our study only observed behavioral relationships without examining cognitive processing development; whether these theoretical models apply to young children remains unclear. We also did not incorporate HPA axis activity. Future research should use neuroimaging, event-related potentials, and HPA axis measures to validate multi-level effects of emotion on cognitive processing and motivation, and examine dynamic temporal changes.

Our five-year longitudinal study reveals effects of toddlerhood anxiety on age 5 creativity and mediating mechanisms involving general cognition and intrinsic motivation. These findings suggest parents should sensitively identify and intervene in early anxiety. Childhood anxiety relates to intrusive-controlling parenting (Knappe et al., 2012), overprotective responses (Ollendick & Benoit, 2011), low warmth (Markus et al., 2003), and rejection (Knappe et al., 2012). Since cognitive development depends on cortical maturation (Davidson et al., 2006), and synapse formation, pruning, and myelination are experience-dependent (Rosen et al., 2019), parenting practices may trigger anxiety symptoms affecting cognitive development. Chain mediation results suggest that for anxious children, training general cognitive abilities (e.g., working memory, motor training) can increase task engagement and mastery motivation, thereby enhancing higher-order cognitive functions. Finally, our study highlights the importance of mastery motivation between generalized anxiety and creativity. Given that generalized anxiety increases with age (Broeren et al., 2013) and mastery motivation affects cognition (Hausercram et al., 2001) and academic performance (Broussard & Garrison, 2004; Józsa & Barrett, 2018), parents should avoid using external rewards to encourage task engagement, which reduces intrinsic motivation and may ultimately impair creativity and other cognitive behaviors.

Despite advancing previous research in sample age and research questions, several limitations exist. First, our relatively small, Beijing-based sample with high socioeconomic status limits generalizability. Future research should diversify samples, such as investigating rural left-behind children experiencing chronic

separation anxiety, which may yield different creativity pathways. Second, generalized anxiety, separation anxiety, and mastery motivation were mother-reported. Future studies should incorporate multi-informant reports or laboratory observations to enhance robustness. Third, while we validated long-term effects of early anxiety on creativity, age constraints prevented examination of cognitive processing mechanisms. Future research should use neuroimaging and clever experimental paradigms suitable for young children to test whether attention allocation and cognitive interference theories apply. Fourth, our creativity measure used only the divergent thinking test appropriate for preschoolers (Torrance, 1981). Although validated in Chinese samples (Wang & Dong, 2019), future research should use additional measures (e.g., drawing or language tests) to verify robustness. Moreover, creativity development emphasizes different aspects at different ages: preschool creativity focuses more on process, while older children' s and adults' creativity is more fact-based, logical, rich, and intentional (Zhang & Gu, 2004). Future research should examine broader age spans to investigate how early anxiety predicts different creativity facets.

Conclusion

This study found: (1) Toddlerhood anxiety (both generalized and separation) significantly negatively predicted creativity at age 5; (2) General cognitive ability and mastery motivation formed a significant chain mediation between toddlerhood anxiety and preschool creativity; (3) Toddlerhood generalized anxiety also negatively predicted mastery motivation directly, thereby impairing age 5 creativity.

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