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The development of divergent thinking despite poverty: Moderating factors☆

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ABSTRACT

Poverty undeniably negatively impacts cognitive development, yet effects vary across children as a function of associated risk factors. Indeed, adverse childhood experiences may influence development in both risk and promotive ways. For example, unpredictability (i.e., variability of stressors and living conditions) may promote children's divergent thinking by providing opportunities to develop cognitive flexibility. This longitudinal study of 250 children (50% female, 46% Latinx) evaluated relations between poverty from birth to age 4 and children's divergent thinking at age 8 as moderated by residential mobility and gender. The results revealed stark gender differences. Boys followed a traditional cumulative risk model wherein residential mobility exacerbated negative effects of poverty on divergent thinking. However, for girls, poverty was not associated with worse divergent thinking at higher levels of residential mobility, demonstrating its protective role. These findings highlight the need for nuanced models of early childhood risk to clarify individual differences in cognitive development.

Childhood poverty is associated with numerous risk experiences that have negative effects on multiple domains of adjustment, including children's social, emotional, and cognitive development (Evans, 2004; Yoshikawa et al., 2012). Household stress, physical health effects, environmental toxins, and inadequate cognitive stimulation all may contribute to the adverse course of development in poverty (Evans & English, 2002; Guo & Harris, 2000; Johnson et al., 2016), and are particularly critical influences on the development of cognitive skills (Santos et al., 2008). However, theoretical models of cognitive development in adversity also suggest that increased exposure to challenge may have positive effects on cognition, at least in some domains (e.g., learning and memory; Frankenhuis & de Weerth, 2013).

Cognitive flexibility encompasses capacities to shift thinking patterns, both in terms of set-shifting when decision rules change and divergent thinking when solving problems (Ionescu, 2012). These capacities are critical substrates of children's later academic, emotional, and behavioral functioning (Magalhães et al., 2020; Patwardhan et al., 2021; Wang et al., 2021). Thus, it is particularly important to understand whether and when childhood poverty and associated risks influence the development of cognitive flexibility. To that end, the present study sought to investigate prospective associations between early childhood poverty and one specific indicator of school-aged children's cognitive flexibility, divergent thinking, as moderated by both contextual (i.e., residential mobility)

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and individual difference (i.e., gender) factors.

1. Poverty and cognitive development

Poverty has demonstrated negative impacts on cognition in multiple domains (Evans, 2004), including reduced executive functioning (Lipina et al., 2013; Lovallo et al., 2013; Mezzacappa, 2004), lower IQ (Duncan & Brooks-Gunn, 1997; Hamadani et al., 2014; Tomasi & Volkow, 2021), and robust delays in academic achievement (Bradley et al., 2001). Of note, however, executive functioning encompasses numerous cognitive capacities (e.g., task shifting, inhibition, working memory). Thus, researchers have argued that studies should examine the specific components of executive functioning individually (Miyake & Friedman, 2012). This distinction is especially important given some evidence that risk effects may vary across domains of executive functioning (Fay-Stammbach et al., 2014).

Set-shifting and divergent thinking can be understood as behavioral indicators of the broader construct of cognitive flexibility, which is a core facet of executive functioning (Miyake & Friedman, 2012). Specifically, divergent thinking, which is a mode of cognition that generates multiple correct solutions to a problem, has been conceptualized as a cognitive ability that is modulated by the *metacontrol* state of cognitive flexibility (Zhang et al., 2020). Thus, divergent thinking represents an outgrowth of the broader capacity for cognitive flexibility. A wealth of empirical evidence demonstrates shared dopaminergic and cortical activation patterns underlying both divergent thinking and broader cognitive flexibility, as well as numerous shared behavioral markers (e.g., eye blink rates; see Zhang et al., 2020 for review). Therefore, research identifying associations between environmental risk factors and cognitive flexibility speaks directly to the potential influences of environmental risks on divergent thinking.

Consistent with aforementioned relations between poverty and compromised executive functioning, most research points to negative relations between economic risk and cognitive flexibility. Infants from households with low socioeconomic status (SES) show delayed development of cognitive flexibility compared to high SES infants (Clearfield & Niman, 2012), and negative effects of SES on cognitive flexibility are also seen among school-aged children (mean age = 10; Sarsour et al., 2011). In other studies, SES appears to moderate the relation between other risk factors and cognitive flexibility. For example, white matter brain deficits are related to reduced cognitive flexibility among low SES 12-year-old children, but not among their higher SES peers (Ursache et al., 2016). Of note, some research has failed to find significant relations between poverty and cognitive flexibility, despite significant negative effects of poverty on other domains of executive functioning (Pollak et al., 2010).

Research on the neurocognitive effects of SES generally finds robust associations between lower SES and neurocognitive deficits (Farah et al., 2006; Leijser et al., 2018; Pietto et al., 2017). In terms of neuroanatomic differences, lower SES children show reduced volumes of the hippocampus, inferior frontal gyrus, and amygdala, as well as decreased cortical thickness and decreased brain surface area (see Leijser et al., 2018 for review; Tomasi & Volkow, 2021). In terms of functional deficits, lower SES children show reduced activation throughout the executive attention network, including the anterior cingulate and the medial frontal, lateral prefrontal, and parietal cortices (Pietto et al., 2017).

Despite generally negative effects of poverty on cognitive systems, there is significant variation in these effects across specific systems (Leijser et al., 2018). For example, the negative effects of SES are most pronounced for language and memory systems (i.e., prefrontal and medial temporal cortices), with significantly larger effects in these areas as compared to those underlying cognitive control, reward processing, and visual and spatial cognition (i.e., anterior cingulate, ventromedial, parietal, and occipitotemporal areas; Farah et al., 2006; Noble et al., 2005). Though targeted research on poverty and cognitive flexibility is sparse, Harms and colleagues (2018) found that early life stress was associated with reduced activation in the anterior cingulate cortex and right putamen during a cognitive flexibility task.

2. Poverty effects on cognitive development: mediating mechanisms

Negative poverty effects on cognitive development may reflect well-documented associations between poverty and cumulative risk exposure (Evans, 2004), with particularly strong relations between poverty and elevated household adversity/stress (e.g., family turmoil, housing problems, overcrowding; Evans & English, 2002). Indeed, a recent meta-analysis (Andrews et al., 2021) determined that household chaos, which was defined as unstable home routines, inadequate structure, and general frantic activity in the household, was significantly and consistently associated with decreased executive functioning in children from ages 2–17. Importantly, the association between chaos and executive functioning was stronger for the dimension of household instability (i.e., changes in routines, residences, household members) than disorganization (i.e., ambient noise, clutter, overcrowding), suggesting that household chaos negatively affects children's cognitive development by disrupting the predictability and stability of their environment. Additional studies have shown that household chaos and unpredictability have separate, incremental effects beyond those of chronic stress (Marcynyszyn et al., 2008), which also has documented negative effects on cognitive flexibility (Blair et al., 2005; Harms et al., 2018), executive functioning (Lovallo et al., 2013), and overall cognitive ability (Richards & Wadsworth, 2004).

Poverty may also influence cognitive development by undermining children's physical health. Indeed, Guo and Harris (2000) found that infants' physical health at birth explained a significant portion of negative poverty effects on cognitive development. Unsanitary conditions in children's homes and physical environments have also emerged as significant mediators of poverty effects on cognitive development (Guo & Harris, 2000; Santos et al., 2008). Finally, physical neglect is associated with deficits in cognitive development, including slower verbal learning and poorer memory (Dannehl et al., 2017).

Compromised social networks are a final key mechanism underlying poverty effects on cognitive development. Poverty is associated with smaller support networks and less neighborhood capital, which, in turn, are related to fewer opportunities for cognitive

stimulation and reduced parental involvement in school (Evans, 2004). Cognitive stimulation in the home is positively associated with children's executive functioning (Choe et al., 2021), and deficits therein mediate the relation between poverty and cognitive development (Guo & Harris, 2000; Hamadani et al., 2014; Lipina et al., 2013; Santos et al., 2008; Tomasi & Volkow, 2021). A recent review also confirmed that two of the main mechanisms of poverty effects on cognitive development described here, elevated household stress and decreased cognitive stimulation, are associated with altered neural patterns of electrophysiological activity (Pietto et al., 2017). Negative poverty effects on cognitive flexibility are especially concerning, given evidence that they may be especially intractable. For example, a study by Choe and colleagues (2021) found significant relations between cognitive stimulation deficits in the home and reduced cognitive flexibility, yet parent-led executive functioning training using games and activities predicted gains in children's working memory and inhibitory control, but not in cognitive flexibility.

3. Poverty effects on cognitive development: protective factors

Despite broad ranging evidence of the negative impact of poverty and adverse childhood events on cognitive development, more recent studies suggest that such main effect assertions fail to capture the true complexity of these dynamics. Indeed, some have argued that it may be more accurate to think of early life experiences, adversity included, as *shaping* development, rather than *impairing* or *facilitating* development (Frankenhuis & de Weerth, 2013). This perspective not only allows for the understanding that individual differences affect how adverse and promotive environments exert their effects on a given child (e.g., biological sensitivity to context models; Obradović et al., 2010), but also acknowledges the potential for children to garner advantages in specific domains as a direct result of negotiating challenging early life experiences. This view is based on an evolutionary-developmental model (e.g., Belsky, 2008; Frankenhuis & Del Giudice, 2012; Glover, 2011) in which expressed behavior is adaptive based on the desirability of the behavior in the context within which it developed (i.e., adaptive calibration; Del Giudice et al., 2011). For example, children who experience physical abuse may develop enhanced perceptual acuity to nonverbal anger cues in others (Pollak et al., 2000).

A review of studies of early adversity and cognition across multiple domains revealed numerous areas in which children demonstrate *improved* cognitive skills in challenge-relevant domains, particularly learning, memory, and reasoning (Frankenhuis & de Weerth, 2013). In the area of cognitive flexibility and divergent thinking, individuals who experience early life instability and unpredictability may develop enhanced flexibility as a result of necessary and repeated efforts to adapt to uncertainty. Empirical evidence from a recent study confirmed across multiple paradigms and samples that individuals who had more unpredictable early childhoods displayed better cognitive flexibility (i.e., task-shifting) than individuals with less unpredictable childhoods when the context in which the task occurred was uncertain, despite performing worse on inhibition tasks (Mittal et al., 2015). The current study sought to integrate prior studies on poverty and unpredictability to understand whether and when poverty may undermine or enhance cognitive flexibility as indicated by children's divergent thinking.

3.1. Harsh versus unpredictable contexts: the case for residential mobility

As argued by Ellis and colleagues (2009), harshness and unpredictability represent two separate contextual influences that can be distinguished by general severity in the case of harshness and fluctuations in the case of unpredictability risk over time. Harshness refers to the rate at which adversities cause disability or death in a population (i.e., the severity of the stressors), whereas unpredictability refers to the extent to which harshness is variable across the population over time (i.e., the variability of these stressors). It is important to tease apart contextual harshness from unpredictability because they may differentially confer advantage or disadvantage across evolutionarily-relevant domains of cognitive development. As noted earlier, unpredictability has particular relevance for the development of executive functioning generally (Andrews et al., 2021), and perhaps for cognitive flexibility in particular (Mittal, 2015). Thus, this investigation evaluated the moderating influence of residential mobility as an important indicator of contextual unpredictability on predicted relations between poverty and divergent thinking.

Residential mobility refers to the number of times an individual has changed residences over a period of time (Choi & Oishi, 2020). Regardless of whether these moves introduce varying degrees of harsh or protective contexts, residential mobility is generally associated with negative and enduring effects on educational outcomes and cognitive abilities (Choi & Oishi, 2020). Some data suggest that, though residential mobility may be more strongly related to psychosocial than cognitive outcomes, specific effects of residential mobility on cognitive skills may be particularly notable during middle childhood, as compared to early childhood (Coley & Kull, 2016). That said, to our knowledge, no studies have investigated specific effects of residential mobility on children's divergent thinking, nor on the broader construct of cognitive flexibility. Filling this gap is especially important because residential mobility may be a key indicator of contextual unpredictability, rather than harshness, and thus may have special relevance for school-aged children's cognitive flexibility.

3.2. Child gender

Previous research suggests there are gender differences in educational achievement (Evans et al., 2020), which may be driven, in part, by differences in cognitive skills (Downing et al., 2008; Galsworthy et al., 2000). With regard to cognitive flexibility, some research has identified an advantage for females (Kuptsova et al., 2015), but other studies have not found this pattern (Martin & Rubin, 1995; Yu et al., 2020). In addition to potential main effects, gender may moderate the way in which other risk factors affect cognitive development. Although some literature suggests there are not significant gender differences in child physical health effects on educational attainment (Glewwe & Miguel, 2007), or in SES effects on cognitive development (Farah et al., 2006), other studies have

found gender differences in the effects of nutritional status on cognitive achievement, with stronger effects for girls in middle childhood and for boys in adolescence (Le Doc & Behrman, 2021). Given that poverty is linked to physical health and nutrition directly, as noted earlier, poverty may also differentially influence cognitive development by gender. In addition to potential differences in poverty effects by gender, there may be further moderation of residential mobility effects by gender. For example, in a study of adults, residential mobility predicted depressive symptoms more strongly for women than for men (Magdol, 2002).

4. The present study

The current investigation drew on an ongoing study of child development to evaluate relations between early childhood poverty from birth to age 4 and children's divergent thinking at age 8 as moderated by residential mobility from birth to age 4 and/or child gender. This period of development is particularly important given significant advances in the development of children's executive functioning generally (Rueda et al., 2004), and cognitive flexibility specifically (Dick, 2014), between ages 6 and 10. The present study investigated the complex effects of poverty on the development of divergent thinking by testing the following hypotheses: 1) poverty will have a direct negative effect on divergent thinking; 2) this effect will be moderated by residential mobility such that the negative effect will not be as strong for those who experienced more residential mobility because of the potential for unpredictability to engender enhanced divergent thinking, and cognitive flexibility more broadly. Finally, we explored gender moderation of this interaction effect (i.e., a three-way interaction between poverty, residential mobility, and gender), with no specific directional hypotheses.

5. Method

5.1. Participants

Participants were 250 children (50 % male, 50 % female) recruited with their primary caregivers when the children were four years old (M_{age} at time 1 = 49.05 months, $SD = 2.91$). At that time, 91.4 % of primary caregivers were biological mothers, with other primary caregivers including foster/adoptive mothers (3.6 %) and kin caregivers, such as grandmothers (4.8 %). In terms of race/ethnicity, 46 % of children were Latinx, 18 % were Black, 11.2 % were white, 0.4 % were Asian, and 24.4 % were multiracial. The sample was diverse economically, with 28.8 % of the children residing below the poverty line and a total of 73.6 % eligible to receive some kind of government aid.

Children were followed longitudinally, with data for the present report drawn from the initial time point and the age eight follow-up ($M_{age} = 97.36$ months, $SD = 2.88$). Of the 250 children at the first time point, 44 did not provide data for the age 8 assessment when cognitive flexibility was measured. Three children were missing data regarding residential mobility at the first time point. Little's MCAR test revealed that these data were missing completely at random ($\chi^2[5] = 3.064$, $p = .690$), so missing data were handled using full information maximum likelihood estimation in Mplus version 8.5.

5.2. Procedures

Participants were recruited from community-based childcare centers via flyers inviting participation in a study of children's early learning and development. Families were enrolled in the study after a phone screening to ensure children were 1) between 45 and 54 months of age at the initial assessment, 2) proficient in English, and 3) not diagnosed with any developmental disability or delay. Each laboratory visit was three hours in length and consisted of segments in which children and caregivers were assessed separately and segments in which they interacted together. Caregivers were compensated with $75 for completing each assessment and children were given a small age-appropriate gift at each time point. All procedures were approved by the human subjects review board of the participating university.

5.3. Measures

5.3.1. Poverty

At the initial assessment, family financial resources were determined based on the caregiver's reported household income, which included all financial contributions to the household (e.g., salary, child support), divided by the appropriate poverty threshold for the household size and number of children under 18 in the home (U.S. Census Bureau Housing and Household Economics Division, 2007). For example, at the time of data collection, a family of four in which there were two dependent children would have a poverty threshold of $21,027. A hypothetical family of this size with an annual income of $25,000 would therefore have an income-to-needs ratio of 1.19. This ratio was reverse coded to create a poverty variable in which higher numbers indicated more poverty, which was used as the continuous measure of poverty in the study.

5.3.2. Residential mobility

At the initial assessment, caregivers indicated the number of times they had moved residences since the child was born (including moves back and forth to the same location). The total number of moves was rescaled into a residential mobility variable, which was coded as: 0 = 0–2 moves (71.4 % of the sample), 1 = 3 moves (14.8 %), 2 = 4 moves (7.4 %), and 3 = more than 4 moves (6.4 %). This rescaling was informed by a systematic review confirming that residential mobility effects begin to reach significance at 3 or more

moves (Jelleyman & Spencer, 2008), such that distinctions across 0, 1, or 2 moves are not meaningful. This variable was double coded and consensus agreement scores were used when a discrepancy occurred (ICC =0.926).

5.3.3. Divergent thinking

Divergent thinking was measured at age 8 using Wallach and Kogan's (1965) adaptation of Guilford's (1967) Alternate Uses Test. In this task children were asked to name as many things as they could think of that could be done with a series of five basic objects (e.g., chair, key). Following recommendations by Wallach and Kogan (1965), each child was given as much time as needed to complete the task. Divergent thinking was indicated by the flexibility subscale (i.e., the number of unique responses children gave) and summed across the five items (i.e., knife, chair, key, newspaper, and shoe). For example, three unique uses of a newspaper are 1) to read the news, 2) to make paper mache, and 3) to catch dripping paint. Flexibility was double coded and consensus agreement scores were used when a discrepancy occurred (Flexibility ICC =0.888). Although the task was video recorded and the child's answers were transcribed verbatim, coders were only given the transcribed list of answers the child provided. Thus, coders were naïve to the child's gender, ethnicity-race, and duration of task completion.

5.3.4. IQ

Child IQ was included as a covariate given its documented associations with cognitive flexibility broadly (Colzato et al., 2006) and divergent thinking in particular (Chen et al., 2016). At the initial assessment (age 4), children completed two subtests from the Wechsler Preschool and Primary Scale of Intelligence (Wechsler, 2002). In the Block Design subtest, models of red and white blocks were presented by the examiner, and children were asked to recreate identical models with their own blocks. Depending on age, children also completed either the Receptive Vocabulary subtest (i.e., children pointed at pictures corresponding to orally presented words; for children under 48 months) or the Expressive Vocabulary subtest (i.e., words were orally presented for children to define; for children 48 months or older). These scales were prorated and combined according to published guidelines (Sattler, 2008) to form an approximate full-scale intelligence score ($M = 95.17$, $SD = 13.47$).

5.4. Data analytic plan

The current hypotheses were evaluated using a hierarchical linear regression model. In this model, poverty was the independent variable, divergent thinking was the dependent variable, residential mobility and gender were moderators, and child race-ethnicity and IQ were covariates. Although the main effect of poverty (hypothesis 1), two-way interaction between poverty and residential mobility (hypothesis 2), and three-way interaction between poverty, residential mobility, and gender (hypothesis 3) were the focus of these analyses, additional lower-order terms were included in the regression in accordance with statistical best practices (Cohen et al., 2014). Covariates (i.e., child IQ and ethnicity-race) and main effect variables (i.e., poverty and residential instability) were entered in the first step of the regression. All two-way interactions (i.e., poverty by residential mobility, poverty by gender, and residential mobility by gender) were entered in the second step. The three-way interaction of poverty by residential mobility by gender was entered in the third and final step. This analysis followed statistical guidelines for evaluating higher-order interactions, which require that all lower-order terms, including the two-way interactions between all exogenous variables and the main effects of all exogenous variables, are included to ensure proper model specification and accuracy of model inferences (Nelder, 1998; Peixoto, 1990). The lower-order interactions were not interpreted and served only to statistically clarify the three-way interaction of interest. The regression analysis was run in Mplus v.8 so that missing data could be addressed using full information maximum likelihood estimation. However, as traditional linear regression models in which there is only one endogenous variable are just-identified (i.e., have zero degrees of freedom), it is not possible (nor appropriate) to calculate fit statistics for these models.

6. Results

6.1. Descriptive and bivariate analyses

Descriptive statistics and bivariate correlations are presented in Table 1. All variables were sufficiently normal to render parametric

Table 1
Descriptive Statistics and Bivariate Relations between Study Variables.

		1	2	3	4	5	*Mean*	*SD*	*Range*	Skewness
1.	Latinx	–					n/a			
2.	Child IQ	-.037	–				95.174	13.467	61.50–145.00	.402
3.	Child Gender	.051	-.112	–			n/a	–	–	
4.	Poverty	-.194**	-.217***	-.046	–		1.399	1.158	0–3	1.270
5.	Residential Mobility	.354	-.109	.057	.042	–	.488	.886	0–3	1.644
6.	Divergent Thinking	.060	.251***	-.001	-.194**	.084	1.641	.564	0–3.4	.271

*$p < .05$
**$p < .01$;
***$p < .001$;
Point biserial and phi associations were calculated as necessary when using dichotomous variables

statistics appropriate (Afifi et al., 2007). As expected, higher poverty was associated with lower levels of divergent thinking. Residential mobility was not significantly associated with divergent thinking at the bivariate level. Importantly, residential mobility was also not associated with poverty, confirming that these two factors are distinct elements of an individual's experience of environmental risk, rather than overlapping constructs.

6.2. Regression analysis

All continuous variables were centered and entered in a hierarchical linear regression in Mplus v.8 to predict divergent thinking at age 8 from the covariates (i.e., child IQ and race-ethnicity), the child's gender, poverty (i.e., family income-to-needs ratio) at age 4, and residential mobility experienced across the first four years of life. Simple slopes were calculated using SPSS v.25. Table 2 depicts the contributions of the covariates and main study variables to later divergent thinking, as well as the two-way interactions of each moderator (i.e., child gender and residential mobility) with poverty and the three-way interaction of poverty by residential mobility by child gender. The initial main effects model was significant ($p = .015$) and explained 9.3% of the variance in divergent thinking. The full model with interaction terms was also significant ($p = .001$) and explained 16.3% of the variance in divergent thinking. Of note, the three-way interaction among family income-to-needs, residential mobility, and child gender accounted for a significant 4% increase in the variance explained beyond the main effects and two-way interactions.

In the final model, there was a significant direct effect of residential mobility on divergent thinking, such that, after controlling for family income-to-needs and all interactions, increased residential mobility predicted increased divergent thinking. However, as detailed below, this direct effect was qualified by a significant interaction with gender and poverty. In the full model, poverty did not predict divergent thinking significantly. Although there were significant two-way interactions between residential mobility and gender, and between residential mobility and poverty, the significant three-way interaction further qualified these relations. As displayed in Fig. 1, and further clarified by simple slope calculations, the effects for boys were consistent with a cumulative risk model (Appleyard et al., 2005). For boys, the negative effect of poverty on divergent thinking increased as residential mobility increased, with significant negative effects only at relatively high levels of residential mobility (i.e., one standard deviation above the mean; $b = -0.126$, $p = .035$), but not at low levels of residential mobility ($b = -0.076$, $p = .208$). In contrast, for girls, the negative effect of poverty on divergent thinking was significant only at low levels of residential mobility ($b = -0.237$, $p = .001$), and became smaller as residential mobility increased, such that poverty no longer had a significant negative effect on girls' divergent thinking at high levels of residential mobility ($b = 0.087$, $p = .291$).

7. Discussion

The findings from this study clarify the nature of associations of two key potential environmental risk factors in early childhood (i.

Table 2
Hierarchical Regression Analysis Predicting Divergent Thinking.

	b	*SE*	*β*	*p*	R^2 change
Step 1*					
IQ	**.010**	**.003**	**.233**	**.001**	
Latinx	-.002	.020	-.008	.901	
Child Gender	.015	.077	.013	.844	.093
Poverty	**-.073**	**.035**	**-.147**	**.033**	
Residential Mobility	.065	.044	.101	.136	
Step 2					
IQ	**.009**	**.003**	**.228**	**.001**	
Latinx	-.016	.020	-.053	.440	
Child Gender	.000	.075	.000	.998	
Poverty	-.032	053	-.063	.551	.030
Residential Mobility	**.223**	**.073**	**.349**	**.002**	
Child Gender X Poverty	-.056	.068	-.086	.408	
Child Gender X Residential Mobility	**-.239**	**.090**	**-.299**	**.007**	
Poverty X Residential Mobility	.020	.042	.033	.632	
Step 3					
IQ	**.009**	**.003**	**.219**	**.001**	
Latinx	-.028	.020	-.097	.163	
Child Gender	.007	.074	.007	.921	
Poverty	-.022	.052	-.044	.673	
Residential Mobility	**.249**	**.072**	**.389**	**< .001**	.040
Child Gender X Poverty	-.090	.067	-.138	.180	
Child Gender X Residential Mobility	**-.261**	**.089**	**-.327**	**.003**	
Poverty X Residential Mobility	**.161**	**.062**	**.263**	**.009**	
Child Gender X Poverty X Residential Mobility	**-.249**	**.083**	**-.306**	**.002**	
Final Model R^2		.163, $p = .001$			

* All main effects are included in step 1 (including covariates and moderators), all two-way interactions in step 2, and the three-way interaction in step 3

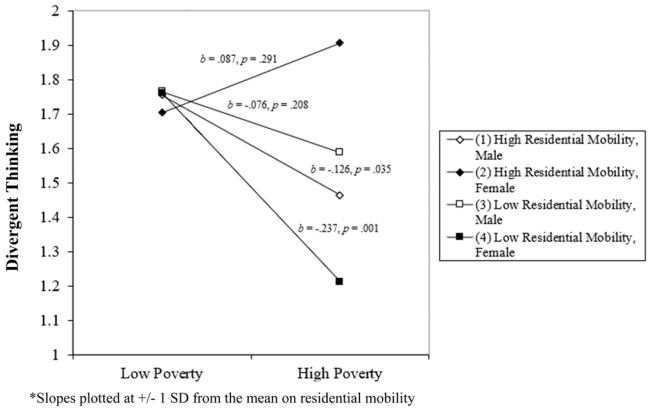

Fig. 1. Divergent thinking as predicted by the interaction between poverty, residential mobility, and gender.

e., poverty and residential mobility) with children's later divergent thinking. Although poverty was associated with less divergent thinking at the bivariate level, this association was qualified by a three-way interaction with residential mobility and gender. For boys, residential mobility served as an additional risk factor, exacerbating the negative effects of poverty on divergent thinking. In contrast, for girls, residential mobility was a protective factor, mitigating the negative effects of poverty on divergent thinking.

The overall negative association between poverty and divergent thinking is consistent with extant literature demonstrating cognitive vulnerabilities among children from low SES backgrounds (Clearfield & Niman, 2012; Sarsour et al., 2011). However, the current study offers a novel contribution because it shows that early childhood poverty effects on divergent thinking, which is an indicator of cognitive flexibility, can be observed well into the school-age years. This finding is consistent with other literature noting that early poverty may pose a threat to later cognitive skill development, with negative ramifications extending well into adulthood (Evans et al., 2021). Importantly, this study also illuminated significant moderators of this relation, which may account for the fact that some prior studies have failed to find a direct effect of poverty on cognitive flexibility (e.g., Pollak et al., 2010).

As expected, residential mobility evidenced a nuanced relation with divergent thinking in contexts of poverty. Although we hypothesized that residential mobility would buffer children against the negative effects of poverty on divergent thinking, the current findings revealed an unexpected difference in these effects by gender. Specifically, girls showed the hypothesized pattern wherein residential mobility was a protective factor, but boys showed an opposite pattern wherein residential mobility exacerbated the negative effects of poverty on divergent thinking.

The buffering effect of residential mobility among girls aligns with prior suggestions that experiences of manageable unpredictability may confer developmental advantages in particular domains (Frankenhuis & de Weerth, 2013; Mittal et al., 2015). Tolerable encounters with change and unpredictability may prompt children to develop flexible thinking and problem-solving skills thereby conferring an advantage in this specific domain of cognitive functioning even as these same challenges may pose risks for adjustment in other domains. Interestingly, prior studies have not shown this effect to be specific to girls. As described earlier, some evidence suggests that girls have higher overall levels of cognitive flexibility than boys, and boys encounter more challenges with at least some components of cognitive flexibility (e.g., task-shifting; Kuptsova et al., 2015). Girls' relatively greater capacity to develop cognitive flexibility may extend to their divergent thinking in ways that give them an advantage in the face of moderate challenges to flexibility (e.g., residential moves). In other words, because they have a stronger foundation of cognitive flexibility at earlier ages, school-age girls may be able to adapt to changing circumstances more easily than boys. This interpretation is consistent with some evidence suggesting that, in terms of temperament, girls are more adaptable than boys at earlier ages (Guerin & Gottfried, 1994). Another possibility is that girls receive more support from parents or others amidst residential moves such that they are better positioned to harness the advantages of these changes which are rendered tolerable and manageable in the context of a supportive environment. A potential implication of this latter interpretation would be that parents and other caregivers may need to offer boys more support in the context of residential mobility so that they, too, can benefit from the potential gains afforded by successfully negotiating these encounters with change and unpredictability.

The finding that residential mobility was an exacerbating risk factor for boys may indicate that they follow a more traditional cumulative risk model (e.g., Appleyard et al., 2005). The fact that this model was apparent only for boys may indicate that residential mobility represents a specific challenge for boys because moves are more disruptive for boys and/or because boys receive less support to manage the disruptions than girls. This pattern is consistent with evidence that boys may be more vulnerable to risk experiences than girls, particularly early in life (Bennett et al., 2007; Biederman et al., 2002; Werner, 1989). Research identifying boys as more at risk for a host of developmental issues from the prenatal period through early childhood suggests that delays in neural development may render boys more vulnerable to other environmental and social adversities (Schore, 2017). This could explain why, as in the present study, early adversity may have a cumulative effect for boys moreso than for girls. As noted earlier, with regard to cognitive flexibility, research indicates that boys have more difficulty with task-switching than girls (Kuptsova et al., 2015), which may also make them more vulnerable to the combined threats of poverty and residential mobility.

7.1. Strengths, limitations and future directions

The important findings from this investigation should be interpreted in light of the limitations of the study. First, the divergent thinking task only examined one specific indicator of cognitive flexibility. Although this conceptualization, and the alternate uses task in particular, are widely accepted methods of identifying and assessing cognitive flexibility (Ionescu, 2012; Rende, 2000), other research has examined task-shifting as an indicator of cognitive flexibility (Braem & Egner, 2018). Thus, it will be important to determine whether the findings identified here generalize to all facets of cognitive flexibility, including task-shifting, or whether they are specific to divergent thinking.

Second, some evidence suggests that behavioral executive functioning tasks may have limited ecological validity (Chaytor et al., 2006). In particular, behavioral versus informant-rated measures may differ in their relation to environmental instability (Andrews et al., 2021). Thus, future studies should include rating measures of cognitive flexibility to determine the extent to which these findings generalize to real world (e.g., classroom) functioning.

Third, just as it is important to extend this work to examine multiple facets of cognitive flexibility (e.g., task-shifting, divergent thinking) using multiple methods, so, too, is it important to examine these relations over more frequent and expansive points of assessment. Although a major strength of this study rests on its examination of early risk influences on cognitive functioning during the critically important period of middle childhood (Dick, 2014; Rueda et al., 2004), future research needs to consider that fluctuations in cognitive flexibility may covary with changes in these predictors over time. As relevant to understanding apparent gender differences in these patterns, it is particularly important to examine if and how cognitive flexibility at earlier versus later ages may be influenced by early risk experiences among girls versus boys.

Finally, future studies would benefit from more specific information about the nature of residential transitions, such as whether families were moving into or out of impoverished communities, as well as the degree of disruption (e.g., distance, stress, school changes) associated with each move. Indeed, a recent study suggested that the effects of residential mobility should be contextualized by poverty, such that moves out of poverty are beneficial for behavioral and cognitive outcomes, but moves into poverty are detrimental (Roy et al., 2014). Future studies should also include measures of the home environment, such as the degree of cognitive stimulation and parenting quality. Additional measures will help to clarify the degree to which children are supported across residential moves, as well as whether support varies across genders.

Despite these limitations, the current findings are bolstered by several important strengths. First, comprehensive data was used to indicate poverty status, including caregiver reports of multiple income sources, while accounting for household composition. Second, the behavioral data used to assess divergent thinking were collected using a well-validated and relevant measure of alternate uses, which has been used in similarly diverse populations (Beaty et al., 2014; Sehic, 2017). Third, the study design supported a longitudinal evaluation of associations between early risk and later cognitive skill development, rather than limited concurrent measurements or retrospective data. Finally, the sociodemographic diversity of the current sample represents a key contribution to the generalizability of the obtained findings with regard to both ethnic-racial and economic variability. The absence of significant differences in poverty levels across ethnic and racial groups in this sample further reduced the likelihood of confounds between these variables.

7.2. Implications

The results of this study highlight the importance of taking a nuanced approach to investigations of child development in contexts of risk. Specifically, it is critical not only to examine multiple risk factors, but also to consider how they may interact with one another and in light of individual characteristics. The starkly different pattern of results across girls and boys in this study indicates that presuming models are consistent across genders can be misleading.

In practice, this study encourages greater recognition of the potential for manageable challenges to provide opportunities for growth. Although it would be very problematic to recommend that individuals experience additional risk, or specifically residential mobility, other experiences that provide similar challenge and variety should be encouraged. Moreover, should such challenges be unavoidable, this study points to the potential for augmented structural supports to offset their negative effects and potentially engender growth. That said, these recommendations await further support from future studies regarding which specific components of residential mobility may confer these advantages and what other contextual factors (e.g., parenting support) may be necessary to realize them.

For educators and practitioners, these findings suggest that we should not shy away from offering children challenging experiences in an appropriately supportive context. For example, shifting student work groups and daily routines may help children develop their cognitive flexibility by supporting abilities to generate novel solutions (i.e., divergent thinking) and adjust to new demands (i.e., task shifting). In addition, this study supports the idea that, when certain types of adversity occur, children should be given tools to appropriately contextualize these experiences as potential sources of strength (e.g., with cognitive restructuring). Ultimately, these results demonstrate that experiences of adversity shape development in complex ways with the potential to confer advantages and disadvantages.

Data Availability

Data will be made available on request.

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