CHILD DEVELOPMENT

Child Development, September/October 2020, Volume 91, Number 5, Pages 1709–1717

Cognitive Stimulation at Home and in Child Care and Children's Preacademic Skills in Two-Parent Families

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This paper used the Early Childhood Longitudinal Study-Birth Cohort (N = 1,258) to examine the influence of hilevels of cognitive stimulation from mothers, fathers, and childcare providers at 24 months and children's pre-academic skills at 48 and 60 months in two parent families. Results from path analysis showed direct positive effects of fathers' early cognitive stimulation on early reading and math skills at 48 and 60 months. There were also two moderated effects: The effects of high levels of maternal stimulation at 24 months on early math and reading skills at 48 months were largest for children also receiving high levels of cognitive stimulation from their childcare providers. Implications for including fathers in studies of the home cognitive stimulation and strengthening the parent-childcare connection are discussed.

American children spend the majority of their early time in two environments, home and child care, where caregivers expose them to an array of formal and informal cognitive stimulating activities (e.g., reading, storytelling) that help them develop the preacademic skills—early reading, math, and literacy—they need for kindergarten (Laughlin, 2013; Lee, Zhai, Brooks-Gunn, Han, & Waldfogel, 2014). However, few studies have examined the ways in which cognitive stimulation from multiple caregivers comes together to promote development, and even fewer studies have examined both the independent effects (main effects) and combined effects (moderation effects) of multiple caregivers. Studies that have tested for main effects of the home environment have typically tested only for maternal effects. The studies that have examined moderation effects have commonly tested two hypotheses. Accumulated advantage hypothesis (aka Mathew effect) posits that children who receive high levels of support from one adult will benefit more from the high levels of support of other adults. In contrast, compensatory hypothesis posits that high levels of support from one adult compensate for the lower levels of support from others (Miller, Farkas, Vandell, & Duncan, 2014).

Overall, findings on how child care and home experiences come together to influence children's development are mixed; some studies find evidence of both accumulated advantage and compensatory effects for math, but not for language skills (Crosnoe et al., 2010; Miller et al., 2014). More importantly, none of these studies have included fathers, and we found no studies that have included all three caregivers: mothers, fathers, and child-care providers. The exclusion of fathers is notable because fathers' contributions to children's development have been observed over and above the contributions of mothers (Baker, 2015; Cabrera, Shannon, & Tamis-LeMonda, 2007) and thus their omission means that we do not have a full picture of how support from all caregivers benefits them, especially children living in two-parent households.

The goal of this study was to extend the investigation of children's experiences at home and in child-care settings by including mothers, fathers, and child-care providers. We ask two questions: (a)

This study was supported by a NICHD grant #R01HD078547-05.

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 0009-3920/2020/9105-0019
DOI: 10.1111/cdev.13380

does the cognitive stimulation children receive at 24 months from each of their caregivers have an independent effect on their preacademic skills at 48 and 60 months, and for which outcomes (main effects hypothesis)? (b) are there home (Mothers × Fathers) and home and child care (Child Care × Mothers and Child Care × Fathers) moderation effects of early cognitive stimulation on preacademic skills at 48 and 60 months (accumulated advantage and compensatory hypotheses).

We use a subsample of the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B) and select children who resided with both parents and were in some form of child care at 24 and 48 months. ECLS-B is one of only a few national studies that collected data from mothers, fathers, and children's child-care providers.

Theoretical Framework

Bioecological system models provide the overarching conceptual framework for this study (Bronfenbrenner & Morris, 1998, 2006). Process, the core of the ecological model, is defined as interactions between individuals and their environment—proximal processes—that directly support skill development across multiple domains. Bronfenbrenner defines person–environment interrelations in terms of micro-, meso-, exo-, and macrosystems. The microsystem is relevant to the current investigation because it defines children's socialization contexts—home and child-care settings—where they interact with their caregivers in ways that help them master the skills necessary to succeed in school (Sheridan, Knoche, Edwards, Bovaird, & Kevin, 2010). In this study, we examine whether differences in children's preacademic skills can be partially explained by their early experiences in these settings. Consistent with Bronfenbrenner's injunction to measure the complexity of social contexts, in this study the family includes mothers and fathers and are expected to have main and moderation effects.

The bioecological system model has focused on main effects and does not predict how interactions among caregivers would affect children's outcomes (Bronfenbrenner & Morris, 2006). In recent years, researchers have tested two possible hypotheses. The *accumulated advantage* hypothesis posits that people benefit more from certain situations when they bring more to those situations (Scales & Leffert, 1999). Children benefit more from the cognitive stimulation they receive in child-care settings when they are better prepared to capitalize on the learning experiences having received high levels of stimulation at home. In contrast, the *compensatory* hypothesis posits that high levels of cognitive stimulation from a caregiver will protect children from the negative effects of low levels of cognitive stimulation from the other caregiver. Support for this hypothesis comes from studies that show that participation in Head Start boosted early math skills the most for children receiving low parental preacademic stimulation (Miller et al., 2014).

Home and Child-Care Cognitive Stimulation and Preacademic Skills Development

Parenting practices and formal and informal activities (e.g., reading a book, telling stories, or singing) provide children with preacademic cognitive stimulation and expose them to language-rich experiences, including vocabulary, the structure of a story, and syntax that are significant predictors of young children's preacademic skills (e.g., Bakermans-Kranenburg, van IJzendoorn, & Bradley, 2005; Gardner-Neblett, Pungello, & Iruka, 2012; Zucker, Cabell, Justice, Pentimonti, & Kaderavek, 2013). These activities also expose children to discussions about numbers, quantity, and concepts such as counting and naming shapes, which predict math skills (Anders et al., 2012; Miller et al., 2014). Overall, these studies offer evidence of main effects between children's participation in cognitive stimulating activities at home during the early years and their early reading, language, and math skills (Baker, 2013, 2015; Farver, Xu, Lonigan, & Eppe, 2013; Leffel & Suskind, 2013; Malin, Cabrera, & Rowe, 2014; Miller et al., 2014; Mol, Bus, & De Jong, 2008).

Multiple studies have also documented main effects of cognitive stimulating activities in child-care settings on children's skills. Children in child-care settings who participate in high levels of cognitive stimulating such as reading, telling stories have stronger preacademic skills than children who participate in these activities less frequently (Belsky et al., 2007; Howes et al., 2008; Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007; Love et al., 2003; Mol et al., 2008; NICHD Early Child Care Research Network & Duncan, 2003).

Potential Moderation Effects of Home and Child-Care Environments

Relatively few studies have examined the interactive effects—accumulated advantage or compensatory—of the cognitive stimulation children receive at home and in child care (e.g., Weigel,

Martin, & Bennet, 2005). In support of the accumulated advantage hypothesis, Crosnoe et al. (2010) found that children in the SEECYD data set who experienced cognitive stimulation in multiple settings (home, child care, and first grade) had higher rates of learning from Grades 1 to 5 than their peers, but only when one of these settings was the home. Children scored higher on math and reading when they were consistently stimulated at home and in child care and they also scored higher on reading when they were consistently stimulated in all three settings (accumulated advantage hypothesis).

Studies that have tested the *compensatory* hypothesis have examined how high levels of cognitive stimulation low-income children receive in child-care settings compensates for the low levels of cognitive stimulation many receive at home. Bradley, McKelvey, and Whiteside-Mansell (2011) found larger compensatory effects of Early Head Start (EHS) on cognitive skills at 36 months and the WJ Letter-Word test at 60 months for children from homes low in cognitive stimulation at 14 months. In contrast, Miller et al. (2014) found the largest compensatory effects of 1 year of HS for children receiving low maternal preacademic stimulation, but only for math. In one of the few studies to include fathers and to test interaction effects between parents, Martin, Ryan, and Brooks-Gunn (2010) found larger benefits of fathers' high levels of cognitive stimulation on children's academic and social outcomes only with lower levels of mothers' cognitive stimulation, a compensatory effect (Martin et al., 2010).

Bioecological theory predicts that proximal processes vary systematically contingent on the developmental outcome. Bradley et al. (2011) found that for cognitive skills, participation in EHS literacy activities compensated for low levels of maternal stimulation. For math, Crosnoe et al. (2010) found accumulated advantage effects, but Miller et al. (2014) found that participation in 1 year of HS compensated for low levels of maternal preacademic stimulation at home. And for language skills, Miller et al. (2014) found no evidence for either hypotheses.

Overall, the literature on how home and child-care environments come together to support children's preacademic skills is inconsistent and does not tell a coherent story. Some studies find evidence for accumulated advantage, whereas others find evidence for compensatory effects for the same outcomes. Additionally, the exclusion of fathers from this research raises questions about the effect of cognitive stimulation from mothers and child-care providers on children's skills if paternal cognitive stimulation were accounted.

Current Study

We test three hypotheses: (1) Higher levels of cognitive stimulation from each caregiver at 24 months will be positively associated with higher scores on children's preacademic skills at 48 and 60 months (main effects hypothesis); (2) the association between high levels of cognitive stimulation from one caregiver at 24 months and preacademic skills at 48 and 60 months will be stronger when children are exposed to high levels of cognitive stimulation from the other caregiver (accumulated advantage hypothesis); and (3) the negative effect of low levels of cognitive stimulation from one caregiver at 24 months on preacademic skills at 48 and 60 months will be compensated by high levels of cognitive stimulation from other caregivers (compensatory hypothesis).

Method

Data Source

The ECLS-B is a national probability sample of 10,700 children born in 2001 (National Center for Education Statistics, 2005). Data were collected on children's birthdates when they were approximately 9 and 24 months and in 2005 and 2006 when they were approximately 48 and 60 months, respectively. ECLS-B collected data using a variety of methodologies. This study uses data from the in-person parent and telephone child-care provider interviews and resident father self-administered questionnaires at 24 and 48 months and direct child assessment at 24, 48, and 60 months.

Analytic Sample

We included in our analytic sample only children who were in some type of child care or preschool arrangement at 24 and 48 months and who resided with their biological mother and father at 9, 24, and 48 months. The final analytic sample size was 1,650. Our sample has a smaller percentage of Black and Hispanic children and a larger percentage of children whose mothers have at least a college education than the full ECLS-B sample (Chernoff, Flanagan, McPhee, & Park, 2007; NICES, n.d.). To protect the confidentiality of ECLS-B participants, all unweighted sample sizes in the text and tables are rounded to the nearest increment of 50.

Additional details about the ECLS-B sample and our analytic sample can be found in Appendix S1.

Measures

Dependent Variables

During data collection at 48 and 60 months, trained staff administered a set of one-on-one standardized assessments of children's early preacademic skills.

Early reading skills were assessed with 85 pooled items, including language-based (e.g., receptive vocabulary) and literacy-based (e.g., letter recognition, letter-sound relationships, phonological awareness, and reading comprehension). Using Item Response Theory (IRT) methods the items were put on the same scale that estimates children's overall reading scores (Najarian, Snow, Lennon, & Kinsey, 2010). The mean reading score was 14.11 and 41.55 at 48 and 60 months, respectively (Table 1). For the full sample, reliability (α) of the IRT-based reading scale scores was .84 and .92 at 48 and 60 months, respectively (Najarian et al., 2010).

Early math skills were assessed with 71 items, including number sense, properties, operations, measurement, geometry, spatial sense, patterns, algebra, and functions. These items were developed for the ECLS-B or selected from the Test of Early Mathematical Ability-3 (Ginsburg & Baroody, 2003) and pooled. Using IRT methods items were placed on the same scale that estimates children's overall math scores at each of the two time points; the mean math scores were 23.77 and 42.63 at 48 and 60 months, respectively (Table 1). For the full sample, reliability (α) of the IRT-based early math scores was .89 and .92 at 48 and 60 months, respectively (Najarian et al., 2010).

Expressive language was assessed with the Let's Tell Stories subtest of the PreLAS 2000 (Duncan & De Avila, 1998). After two short stories were read, children were asked to retell. Responses were tape-recorded, coded, and averaged to create a composite score. The mean score was 2.42 at 48 months and 3.50 at 60 months (Table 1).

Independent Variables

Mother and father cognitive stimulation was assessed during the 24-month home visit by asking parents: how often in a typical week they read to their child, tell them stories, and sing songs to them on a 4-point Likert scale (1 = *not at all* to 4 = *every day*). These three items have been used as an index

Table 1
Participant Characteristics

	All		
	M/%	*SD*	Range
Cognitive stimulation			
Mother cog stimulation at 24 months	9.43	1.92	4–12
Father cog stimulation at 24 months	7.53	2.04	3–12
CC cog stimulation at 24 months	10.04	2.18	3–12
Children's preacademic skills			
Reading skills at 48 months	14.11	7.33	5.47–34.84
Math skills at 48 months	23.77	7.05	4.52–41.55
Expressive language at 48 months	2.42	1.06	0–5
Reading skills at 60 months	41.55	14.54	12.39–82.48
Math skills at 60 months	42.63	10.03	11.06–69.69
Expressive language at 60 months	3.50	0.82	0–5
Child characteristics			
Gender (male)	53%		
Age in months at 48 data collection	52.02	3.95	44.3–65.3
Age in months at 60 data collection	64.64	3.70	56.7–73.8
Cognitive ability at 24 months (BSF-R)	129.45	11.03	93.11–162.85
Kindergarten enrollment	69%		
Ethnicity (Non-Hispanic White)	68%		
Home environment			
Mother education level			
College degree or higher	46%		
Number of books at home at 24 months	58.40	48.70	0–200
Household income at 48 months	9.85	2.54	1–13
CC environment			
Changes in the type of child care			
Center-based at 24 and 48 months	26%		
Home-based at 24 and 48 months	28%		
Any change between 24 and 48 months	46%		
CC education level at 24 months			
College degree or higher	49%		
Number of books in cc at 24 months	55.56	86.24	0–1,000

Note. Data are weighted; CC = child care/child-care providers; Cognitive stimulation includes: singing songs, reading, and storytelling at 24 months. BSF-R = Bayley Short Form–research edition.

of cognitive stimulation and have shown significant associations with children's cognitive and literacy outcomes (Baker, 2015; Bradley et al., 2011; Cabrera, Shannon, West, & Brooks-Gunn, 2006; Koury & Votruba-Drzal, 2014; Martin et al., 2010; Miller et al., 2014). Each parent's responses were summed to construct measures of total amount of mother and father cognitive stimulation at 24 months (M = 9.43 for mothers and M = 7.53 for fathers).

Child-care cognitive stimulation was assessed at 24 months by asking child-care providers the same three questions parents were asked and a composite index was constructed the same way (see above). The mean score was 10.04.

Control Variables

At 24 months, we controlled for: maternal report of household income and education level, child-care providers' education, and type of child-care arrangements from 24 to 48 months (i.e., dummy variable: home–home [reference], center–center, and any change in care type; Bayley, 1993). We also controlled for child's gender, cognition at 24 months using the Mental Scale from the Bayley Short Form–research edition and child's age in months at the time of the 48-month child assessment because of the differences in the timing of the data collection. We used 24 months controls when predicting 60-month outcomes (controlling for child's age at the 60-months child assessment) and children's kindergarten enrollment status in 2006 because roughly 70 percent of children in the ECLS-B sample were enrolled in kindergarten at the time of the 2006 data collection.

Data Analyses

To test our hypotheses of main and moderating effects, we conducted an observed variable path model analysis (Figure S1) using M*plus* 8 (Muthén & Muthén, 2011). Child outcome variables at 48 months were regressed on each caregiver's cognitive stimulation (main effects). To test the moderation effect hypotheses these were centered at their mean values before creating interaction terms and regressed on Mothers × Child Care, Fathers × Child Care, and Maternal × Paternal Cognitive Stimulation at 24 Months. A second but identical model was conducted with child outcomes measured at 60 months, including control variables at 24 and 48 months. We used Full Information Maximum Likelihood (Arbuckle, 1996) to handle missing data. Significant interaction effects were plotted to test how different the slopes of two lines are and an effect size was computed at low, medium, and high level of caregivers' cognitive simulation using Cohen's d.

Results

Descriptive Statistics

Mothers engaged in more cognitive stimulating activities at 24 months than fathers (see Table 1); large effect sizes (d = 0.96). Child-care providers engaged in more cognitive stimulation than mothers (d = 0.30) and fathers (d = 1.19.) Caregivers' cognitive stimulation at 24 months was positively correlated with all three child outcome measures at 48 and 60 months. There was no evidence of collinearity. Table S1 presents bivariate correlations for study variables.

Path Analysis

The 24-to-48-month model demonstrated adequate fit: $\chi^2(25) = 351.72$, $p < .001$; comparative fit index (CFI) = .99; root mean square error of approximation (RMSEA) = .053 (90% CI [.048, .058]); NFI = .98. The 24-to-60-month model also demonstrated adequate fit: $\chi^2(25) = 192.50$, $p < .001$; CFI = .99; RMSEA = .046 (90% CI [.04, .052]); NFI = .99. Figure S1 shows the conceptual model and Table S2 shows the unstandardized and standardized path coefficients. Figure 1 shows the standardized coefficients for hypothesized path model. To address the possibility that our exogenous control variables may account for why mother's literacy support is not directly related to child outcomes, we ran our models with and without the control variables. Our findings did not change; thus, we report findings from a model that included controls.

Main Effects

For expressive language at 48 and 60 months, there were no significant caregivers' main effects at 24 months. But, there were main effects for early reading and math. Fathers' cognitive stimulation at 24 months was significantly and positively associated with children's reading and math scores, at 48 and 60 months.

Moderation Effects: Accumulated Advantage and Compensatory Effects

For expressive language, there were no significant moderation effects at any point in time. But, there was a significant moderation effect between

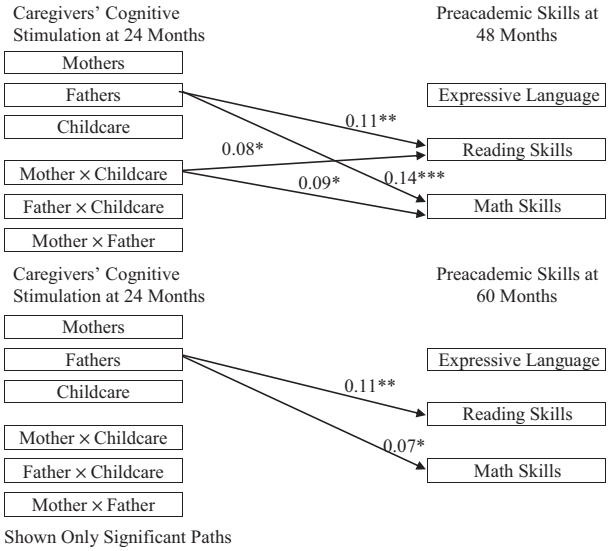

Figure 1. Standardized coefficients for hypothesized path model. *$p < .05$, **$p < .01$ and ***$p < .001$.

high levels of mothers' and child-care providers' cognitive stimulation at 24 months on children's reading and math at 48 months. Figures 2 and 3 show that the positive effects of high levels of mothers' cognitive stimulation on reading and math, respectively, are even greater when children receive higher levels of cognitive stimulation from their child-care providers, consistent with an *accumulated advantage pattern*.

For reading, the results showed medium effects ($d = 0.72$) for caregiver cognitive stimulation when mothers provided low stimulation, and large effects

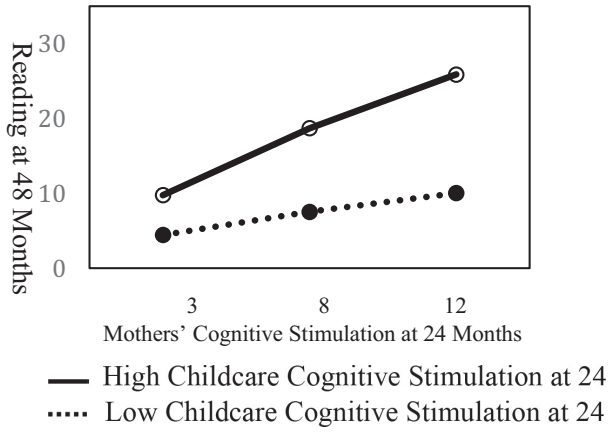

Figure 2. Moderation between mothers' cognitive stimulation at 24 and childcare providers' cognitive stimulation at 24 on children's reading skills at 48 months, consistent with accumulated advantage pattern.
Note. Cohen's *d*s at low mother = 0.72, medium mother = 1.52, high mother = 2.16.

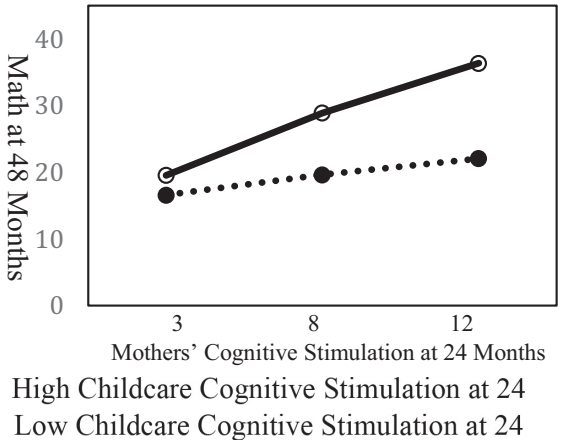

Figure 3. Moderation between mothers' cognitive stimulation at 24 and childcare providers' cognitive stimulation at 24 on children's math skills at 48 months, consistent with an accumulated advantage pattern.
Note. Cohen's *d*s at low mother = 0.42, medium mother = 1.31, high mother = 2.03.

when mothers provided medium ($d = 1.52$) and high levels of stimulation ($d = 2.16$). For math the results showed small effects ($d = 0.42$) for caregiver cognitive stimulation when mothers provided low stimulation, and large effects when mothers provided medium ($d = 1.31$) and high levels of stimulation ($d = 2.03$).

Discussion

In this study we addressed the question of whether children living in two-parent families and attending child-care benefit more academically at kindergarten entry when they are cognitively stimulated by all their caregivers or whether there are protective benefits such that the high levels of cognitive stimulation by one caregiver compensates for low levels of the other. We extend the literature by including children's most influential caregivers: mothers, fathers, and child-care providers and by focusing in two-parent families because fathers in these families are more likely to contribute to children's early cognitive development (Livingston & Parker, 2011). Specifically, our study contributes to the literature in several ways.

First, as predicted by our main effect hypothesis, we found that in two-parent families, children's preacademic reading and math skills are directly related to the quality of their fathers' cognitive stimulation in toddlerhood. Moreover, these effects appear to be enduring over time, both at preschool and kindergarten entry. Overall, our findings align with studies that have examined father effects

(Baker, 2013, 2015; Malin et al., 2014), but do not align with studies of mother effects (Weigel et al., 2005). One possible explanation is that studies of maternal effects on chidlren's skills might have been overestimated as many of these studies did not include the rigorous list of controls included in this study nor did they control for father effects (e.g., Weigel et al., 2005). Alternatively, it is possible that fathers' engagement in cognitive stimulating activities is qualitatively different from mothers'. Indeed, studies have shown that compared to mothers', fathers' reading skills are of higher quality (e.g., fathers ask more *wh* questions), which is associated with children's improved skills (Malin et al., 2014). Future research needs to include both parents to be able to parse out independent effects.

Second, our findings support our accumulated advantage hypothesis that children benefit more from their child-care experience when parents provide higher levels of cognitive stimulation at home. In particular, we found that children's early reading and math skills are strengthened at preschool when both mothers and child-care providers engaged in high levels of cognitive stimulation during toddlerhood. These interaction effects were not observed at kindergarten entry or with fathers. Our finding is partially consistent with studies that school-age children do better in reading and math in first through fifth grades when they are consistently cognitive stimulated at home by their mothers and at school by their teachers during the early years (Crosnoe et al., 2010; Votruba-Drzal, 2006). However, we found no evidence of compensatory effects between mothers and child-care providers and between mothers and fathers as others have found (Bradley et al., 2011; Martin et al., 2010; Miller et al., 2014). One difference between studies that have reported compensatory effects and ours is that we tested this hypothesis in two-parent families, whereas they tested it in low-income families, who are more likely, on average, to provide lower levels of cognitive stimulation than two-parent families. The average quality ratings for mothers and fathers in our study was 9 and 7, respectively (range 4–12), suggesting relatively high levels of cognitive stimulation at home and therefore less need for compensation.

Third, as predicted by bioecological theory that proximal processes vary systematically contingent on the developmental outcome, our findings support the conclusion that the types of informal activities parents engage at home to cognitively stimulate their children matter more for reading and math than they do for the development of language skills. This finding is consistent with what we know about how children learn language, which is through high-quality social interactions than just by the quantity of reading as was measured in this study (Hirsh-Pasek et al., 2015).

Fourth, our findings support the ecological model that children's multiple caregivers influence children in specific and distinct ways. We find evidence that in two parent families, mothers' cognitive stimulation and the way they influence children's skills is different from fathers. In these families, father effects tend to be direct and enduring (both at preschool and kindergarten entry), whereas mother effects tend to be interactive and not as enduring (only at preschool). Our study also shows that when the independent effects of children's most influential caregivers are included in statistical models, the patterns of influence do not completely converge with the patterns reported in the prior literature where only one or two caregivers are included. In two-parent families, mothers and fathers and child-care providers influence their children's readiness for school in unique and combined ways that vary by children's developmental domains.

Limitations and Future Directions

This study has several limitations. Methodologically, we were limited to measures of the *quantity* of cognitive stimulation children receive from caregivers. It would be important to have quality measures of these interactions. Our findings generalize only to two-parent families. Our study did not differentiate between the cognitive stimulation children received from providers in home-based and center-based child-care settings.

Despite these limitations, our findings are important. They emphasize the unique role that mothers, fathers, and child-care providers play in getting children ready for school: Father effects seem to be direct and long-lasting, mother effects seem to be mostly interactive (with child-care providers). Our findings also suggest that child-care centers and other programs for young children should include both mothers and fathers into their early education programs, as these are more likely to pay dividends compared to programs where only mothers are included.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Figure S1. Concept Model
Table S1. Bivariate Correlations
Table S2. Results of Path Analysis