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Mothers' and Fathers' Sensitivity and Children's Cognitive Development in Low-Income, Rural Families

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Abstract

This study examines associations between maternal and paternal sensitive parenting and child cognitive development across the first 3 years of life using longitudinal data from 630 families with co-residing biological mothers and fathers. Sensitive parenting was measured by observational coding of parent-child interactions and child cognitive development was assessed with the Bayley Scales of Infant Development and the Wechsler Preschool and Primary Scales of Intelligence. There were multiple direct and indirect associations between parenting and cognitive development across mothers and fathers, suggesting primary effects, carry-forward effects, spillover effects across parents, and transactional effects across parents and children. Associations between parenting and cognitive development were statistically consistent across mothers and fathers, and the cumulative effects of early parenting on later cognitive development were comparable to the effects of later parenting on later cognitive development. As interpreted through a family systems framework, findings suggest additive and interdependent effects across parents and children.

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Sensitive and supportive parenting is one of the most consistent and robust predictors of multiple developmental outcomes, including children's cognitive development (Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004). From a family systems perspective (Cox & Paley, 2003; Minuchin, 1985), the effects of both maternal and paternal parenting are likely to be independent and dependent on one another, as well as transactional with the developing child over time, allowing for multiple direct and indirect mechanisms through which sensitive parenting may influence early development. Using longitudinal measures of observed maternal and paternal sensitive parenting and child cognitive functioning during the first 3 years of life, the current study is among the first to rigorously examine the multiple combinations of direct and indirect associations among mothers' and fathers' sensitive parenting and children's early cognitive development.

Sensitive Parenting and Children's Early Cognitive Development

Correlational and experimental studies on animals and humans identify multiple contextual characteristics associated with early cognitive development (see Ramey & Ramey, 1998; Meaney & Szyf, 2005), one of which is the quality of parent-child interactions (Englund, Luckner, Whaley, & Egeland, 2004; Pianta & Egeland, 1994; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004). Dimensions of parenting behaviors that have been associated with child cognitive development include quality of instruction (Englund et al., 2004); linguistic and cognitive stimulation (Chang, Park, Singh & Sung, 2009), physical care (Bronte-Tinkew, Carrano, Horowitz, & Kinukawa, 2008); reciprocal engagement (Hart & Risley, 1992), parent-child synchrony (Treyvaud et al., 2011), and sensitivity and positive engagement (Blair et al., 2011; Tamis-LeMonda et al., 2004; Treyvaud et al., 2011; van Bakel & Riksen-Walraven, 2002; Wijnroks, 1998). Experimental studies designed to increase parental support and responsiveness have further demonstrated the importance of early caregiving on children's cognitive ability (Landry, Smith, & Swank, 2006; Smith, Landry, & Swank, 2006), thus providing both correlational and causal evidence in support of sensitive caregiving effects on children's cognitive development.

Why might parental sensitivity be specifically relevant for children's early cognitive development? To answer this we must consider the many functions of parental sensitivity, including providing both support and care for the child during periods of distress as well as fostering confidence and agency for the child during periods of non-distress (Sroufe, 1978). Parents who are sensitively engaged with their young children provide a stimulating interactive context and a supportive emotional climate for children. Such a dynamic facilitates the child's exploration of her surroundings, a developmentally appropriate pattern of reciprocal verbal and non-verbal exchanges, and reward in response to achievement as well as encouragement in response to failure (Blaire et al., 2011; Mills-Koonce et al., 2011). Theoretically, the security and confidence afforded to children with sensitive and supportive parents promotes well-regulated and self-initiated social and non-social experiences (Sroufe, Egeland, Carlson, & Collins, 2005), effectively increasing the amount of stimulating

experiences that foster cognitive development and the depth of processing applied to these experiences (Piaget, 1952). As such, independent of other structural supports, a sensitive caregiving environment likely provides an optimal emotional context for children's early brain maturation and cognitive development (Bernier, Carlson, & Whipple, 2010).

Although, to date, most studies of parental sensitivity have focused exclusively on mothers, a growing research literature has identified paternal caregiving correlates of children's cognitive development. Studies of mother and father caregiving provide evidence for variation and similarity across mothers' and fathers' parenting behaviors with their young children (e.g., Barth & Parke, 1993; Clarke-Stewart, 1980; Cox, Paley, Payne, & Burchinal, 1999; Lamb, 1978; Parke, 1996; Paquette, 2004; Weinraub, 1978; Youngblade & Belsky, 1992). For example, several domains of parenting have been described as "more common" among fathers than mothers, including teasing (Labrell, 1994), rough-and-tumble play (Fletcher, Sr. George, & Freeman, 2013; Paquette & Dumont, 2013; Parke, 1996), and greater encouragement of risk-taking and sex socialization (Fitzgerald, 1977; Power, 1981). However, research also identifies several points of convergence across parents, including the exploration during play (Power, 1985), developmentally appropriate styles of communication (Belsky, 1984), and general levels of sensitive caregiving (Notaro, & Volling, 1999).

The current study relies on family systems theory to better understand how relationships and inter-dependencies of processes within the family function to link early experiences (i.e., maternal and paternal sensitivity) with later child outcomes (i.e., child cognitive functioning) (Cox & Paley, 2003; Minuchin, 1985). As operationalized in this study, sensitive parenting reflects active emotional, affective, and behavioral engagement with the child characterized by high levels of responsiveness, positive reinforcement and praise, stimulation and animation. This quality of interaction has been associated with more elaborate play and communication during both mother-child (Baumwell, Tamis-LeMonda, & Bornstein, 1997; Tamis-LeMonda, Bornstein, & Braumwell, 2001) and father-child interactions (Shannon, Tamis-LeMonda, London, & Cabrera, 2002). Using comparable measures, Tamis-LeMonda et al. (2004) reported that positive parenting among mothers and fathers accounted for independent variation in children's cognitive abilities concurrently and 1 year later at 36 months. Although it was posited that fathers' and mothers' levels of positive parenting were having both direct and indirect effects on children's outcomes over time, this was not explicitly tested. Similarly, Cabrera, Shannon, and Tamis-LeMonda (2007) reported both comparable levels of positive parenting across mothers and fathers as well as independent associations between concurrent levels of paternal and maternal positive parenting and children's cognitive abilities as assessed by the Bayley Scales of Infant Development (BSID-II) at 24 and 36 months of age. Although some studies used similar measures of sensitive parenting across mothers and fathers, none tested the measurement equivalency of this construct across parents, nor did they explicitly test for indirect effects of parenting across time.

Using a person-oriented approach, Ryan, Martin, & Brooks-Gunn (2006) reported a common clustering of parenting variables across mothers and fathers that were used to create typologies of supportive and non-supportive parents. Cross-classification of these

clusters created groups characterized by two supportive parents, only one supportive parenting (either mother or father), or no supportive parents. Analyses further indicated that the combined effects of mothers and fathers were stronger than their individual effects on children's cognitive development, but also that the effects of having one supportive parent are greater than no supportive parent regardless of the parent's sex (Ryan et al., 2006). A follow-up to this study also reported that additive effects of multiple supportive parents, again independent of parent sex, were found for both math and language achievement (Martin, Ryan, & Brooks-Gunn, 2007). These person-oriented analyses identify distinct associations between maternal and paternal supportive parenting and children's cognitive outcomes, as well as suggest that these associations may be comparable in strength across mothers and fathers.

Independent and Spillover Effects of Parenting across Mothers and Fathers

Research on the associations between children's cognitive development and mothers' and fathers' parenting may imply that the strengths of these associations are comparable, but few studies have explicitly tested these assertions. One notable exception to this is the work of Adamson and Buehler, 2006, who systematically examined parental acceptance and found no evidence for equivalency of measurement across mothers and fathers with their self-reported measure. To our knowledge, no other study has examined this issue using observational measures of common parenting dimensions across mothers and fathers. This is important because, even among common dimensions of caregiving quality, there are likely to be separate contributions of mothers and fathers due to additional independent (although correlated) qualities of parenting between mothers and fathers (Barnett, Deng, Mills-Koonce, Willoughby, & Cox, 2008), as well as differences in mean levels of a given caregiving dimension across parents. For example, mothers and fathers may parent in a comparable way but spend different amounts of time with the child or interact with the child in unique contexts that differentially affect the nature of their influence on their child. Alternatively, fathers may be warm and supportive even in the absence of such characteristics in the mother (Cabrera et al., 2000), resulting in independent but dissimilar effects of each parent on children's development. Furthermore, because mothers, fathers, and children function within a broader family system of multiple dyadic and triadic interactions, it is possible that the effects of one individual on another may be mediated by a third family member. For example, fathers' early caregiving may indirectly influence a child via spillover effects on the mother's caregiving behavior. Another possibility is that mothers' early caregiving may directly influence children's early behaviors, which in turn reciprocally influence fathers' caregiving over time. Thus, the interdependence of maternal and paternal caregiving and the transactional dynamics between parents and children over time may result in multiple mechanisms by which mothers, fathers, and children each make contributions to children's early cognitive development.

Ideally, to examine the independent associations between mothers' and fathers' sensitive parenting and children's cognitive development an appropriate measurement model of sensitive parenting across parents is necessary. Three steps are necessary to accomplish this goal. First, mother-child and father-child interactions should be similar enough that common dimensions of parenting behaviors can be observed across both interactive contexts. Second,

the coding of these behaviors must be conceptually and operationally consistent across mothers and fathers. Third, analytic procedures are needed to explicitly test whether latent constructs of caregiving behavior across parents are in fact comparable in order to adequately assume that any differences in the prediction of child outcomes are due to differences in parental influence as opposed to differences in the measurement properties of the parenting variables. Although this may be a high standard for behavioral research, these criteria are integral for substantiating claims that a common dimension of caregiving behavior is more (or less) influential among mothers than fathers.

Transactional Effects between Parenting and Child Cognitive Development

Sensitive parenting and child cognitive ability likely contribute to bi-directional processes through which parents and children mutually reinforce an optimal parent-child interaction dynamic that supports children's development during the first three years of life. These bi-directional processes likely result in ongoing transactional effects between the qualities of mothers' and fathers' parenting behaviors and children's cognitive development over time. Englund et al. (2004) identified such a transactional effect by demonstrating that the quality of early parental instruction was associated with later child IQ at the transition to school, which in turn was associated with higher academic achievement in 1st grade, and subsequently with greater parental expectations and parental involvement with school, which in turn were associated with greater child achievement in third grade. This study, to our knowledge, is one of the first studies to examine the transactional effects between maternal and paternal caregiving and children's cognitive development starting in early infancy.

Current Study

The first goal of the current research was to establish adequate measurement models of sensitive parenting across co-residential biological mothers and biological fathers in infancy and toddlerhood in order to appropriately examine the relative association of each with children's cognitive development during the first 3 years of life. The second goal of the current study is to test hypotheses regarding concurrent, longitudinal, and transactional associations between co-residential biological mothers' and biological fathers' sensitive parenting and children's early cognitive development in infancy and toddlerhood. Based on previous research, we first hypothesized that measures of maternal and paternal sensitivity in infancy and toddlerhood will predict concurrent measures of child cognitive ability. Second, we hypothesized that measures of maternal and paternal sensitivity in infancy will predict child cognitive development in toddlerhood above and beyond concurrent measures of sensitive parenting at that time. Third, we hypothesized that sensitive parenting of mothers and fathers in infancy will have spillover effects on the opposite parent's sensitive caregiving in toddlerhood, which in turn will influence children's cognitive development at later ages. Fourth, we hypothesized that parenting behavior will have transactional associations with children's cognitive development during the first years of life. Of course, beyond parental sensitivity there are multiple contextual and individual factors that likely influence early cognitive development, including SES (Kopp & Vaughn, 1982; McLoyd, 1998), parental education (Cohen & Parmelee, 1983; Kaufman & Wang, 1992; Sellers,

Burns, & Guyrke, 2002; Roberts, Bornstein, Slater, & Barrett, 1999; Rose & Wallace, 1985), low birth weight (Lawrence & Blair, 2003; Taylor, Minich, Klein, & Hack, 2004), prenatal risk (Bennett, Bendersky, & Lewis, 2008), physical characteristics of the home and the learning materials available to children (Bradley & Caldwell, 1980; Bradley, Whiteside, Caldwell, & Casey, 1993), child sex (Kaufman & Wang, 1992; NICHD ECCRN, 2008; Quereshi & Seitz, 1994; Sellers et al., 2002), and cumulative risk (Liaw & Brooks-Gunn, 1994). As such, the current analyses will include multiple contextual and individual variables as controls in the prediction of early child cognitive development.

Methods

Participants

Recruitment—The Family Life Project was designed to study families in two areas of high child poverty (Dill, 1999), the rural South (eastern North Carolina) and rural northern Appalachia (central Pennsylvania). Stratified sampling procedures were used to recruit a representative sample of 1,292 families who spoke English in the home at the time that mothers gave birth to a child, with low-income families in both states and African American families in North Carolina being oversampled. African American families were not oversampled in Pennsylvania, as the target communities were 95% or more European American. Further details on the Family Life Project sampling plan and recruitment procedures are available in Burchinal, Vernon-Feagans, Cox, and the Family Life Project Investigators (2008).

FLP subsample for current analyses—For the current study we included 630 families that had co-residing biological mothers and biological fathers at the 6 and 36 month home visits, and as such the subsample is representative of families with this specific family structure in these communities. These families constitute approximately 58% of the overall FLP sample (see Table 1 for descriptive statistics of the current subsample). The remaining families are characterized by multiple possible family configurations, such as single parenthood, biological mothers or fathers transitioning in and out of the household, or grandparents serving as primary and/or secondary caregivers for the child. Major demographic differences between the full FLP sample and the current subsample include family race/ethnicity and income-to-needs ratios. Although African American families constitute 42.0% of full sample of FLP families, a disproportionately lower percentage of families from the current subsample were African American (22.2%), $\chi^2 = 232.4$, $p < .001$. Families in the current subsample also reported higher income-to-needs ratios than the other family configurations, $t(1084) = 17.4$, $p < .001$. There were no differences between the current sample and the full sample of FLP families with regard to child sex, state of residency, mothers age, or mothers education.

Procedures

Families received home visits at 6, 15, 24, and 36 months of child age. Family demographics were gathered at each assessment, observations of mother and father parenting behaviors were collected at 6 and 24 months and child cognitive development was measured at 6, 15, and 36 months. At 6 months of age mothers and fathers were video recorded engaging with

their children during a 10 min free play episode using a standardized set of toys (Mills-Koonce et al., 2011; NICHD ECCRN, 1999). Mothers and fathers were asked to play with their children as they normally would if they had 10 min of free time during the day. Mothers and fathers completed this task separately with their children; different sets of toys were used for each parent and for 92% of families the observations of mothers and fathers were made on separate days. At 24 months of age mothers and fathers were observed interacting with their children during a 10 min puzzle completion task in which the child was presented with a series of jig-saw puzzles to complete and the parents were instructed to assist the child in any way that he or she chose (Mills-Koonce et al., 2011). There were a total of 3 puzzles presented sequentially, and each new puzzle was progressively more difficult than the last. Again, mothers and fathers completed this task separately with their children; different sets of puzzles were used for each parent and for 94% of families the observations of mothers and fathers were made on separate days. At each time point, whether mothers or fathers were observed first or second (within or across visits) was determined by the parents' schedules and availabilities. The sets of toys and sets of puzzles were not randomly assigned to mothers and fathers within family because it was preferred to maintain a standard set of toys and puzzles across mothers for the full sample given that only half of the sample included residential fathers.

The Bayley Scales of Infant Development (BSID-II; Bayley, 1993) was administered at 6 and 15 months of child age, and the Wechsler Preschool and Primary Scales of Intelligence (WPPSI; Wechsler, 2002) was administered at the 36 month assessment.

Measures

Parent, child, and family demographic covariates—Mothers reported on parents' age, years of education, child race/ethnicity, child sex, and the weight of the child at birth. Mothers also reported on income from all sources and any income from other household members. This figure was used as an estimate of total household income and divided by the federal poverty threshold, adjusted for number of persons in the home, to compute an income-to-need ratio. An income-to-need ratio of 1.00 or below indicates family income at or below the poverty level, adjusted for family size.

Mothers' and Fathers' Sensitive Parenting—Mother-child and father-child interactions in the free play and puzzle task were coded to assess multiple dimensions of parenting behaviors, including parent's detachment, stimulation, positive regard, and animation directed toward the child (Cox & Crnic, 2002; see also NICHD ECCRN, 1999). Ratings for each code were made on a scale ranging from 1 (*not at all characteristic*) to 5 (*highly characteristic*) at the infancy assessment and ranging from 1 to 7 at the toddlerhood assessment. Scores from the toddlerhood observations were rescaled to a 1-5 range for the current analyses by maintaining the extreme and mean values and collapsing the intermediary values between the minimum and mean (ratings of 2 and 3) and between the mean and maximum (ratings of 5 and 6). Coders were trained and certified as reliable prior to coding the parent-child interactions from this study, and coder reliability for this study was determined by calculating the intraclass correlation coefficients for each pair of coders. A minimum of 30% of all observations were double coded throughout the coding period and

discrepancies in coding were resolved by conferencing. All coding pairs maintained reliability estimates at above r = .80 for all subscales for both mothers and fathers (assessed separately), and all coders maintained reliability estimates at above r = .80 with the gold standard coder. The same coding team and gold standard coder coded mothers and fathers within each time point, and the gold standard coder was the same at each time point. For the purposes of the current analyses, latent variables of maternal and paternal sensitive parenting were created based on observed measures of parental detachment (reversed), positive regard, stimulation, and animation. Specific characteristics of the measurement model of sensitive parenting are provided in the following sections. There were no differences in ratings of mothers or fathers as a function of the day or the order of when they were observed at each time point.

Child Cognitive Development—The Bayley Scales of Infant Development (BSID-II; Bayley, 1993) was administered at 6 and 15 months. The BSID-II is the most widely used measure of cognitive developmental status for children in the first 2 years of life and assesses memory, problem solving, early number concepts, generalization skills, classification abilities, vocalizations, language, and social skills. The Mental Developmental Index (MDI), as derived from the BSID-II, was used as a measure of children's cognitive abilities in infancy; these scores are norm-referenced standard scores (M = 100, SD = 15). The MDI correlates with scores on the McCarthy Scales of Children's' Abilities (r = .79) and the Wechsler Preschool and Primary Scale of Intelligence (r = .73).At 36 months the receptive verbal ability and block design subscales of the Wechsler Preschool and Primary Scales of Intelligence (WPPSI; Wechsler, 1974, 2002) were used to assess child intelligence. This two-test short form has been shown to have the high correlations with full scale IQ scores, r = .88 (Silverstein, 1975).

Analytic Strategy—Analyses proceeded in two phases. In the first phase, measurement models using confirmatory factor analyses (CFAs) were used to establish latent variables of sensitive parenting for mothers and fathers, as well as child cognitive ability at early (6 and 15 month) and later (35 month) assessments. In the second phase, structural equation models (SEMs) were estimated to test hypotheses regarding longitudinal measures of parenting variables and child outcomes. Following preliminary SEM analyses, we re-estimated the SEM model imposing equality constraints on three paths that related child cognitive ability to parental sensitive parenting (early parenting→early cognitive, early parenting→later cognitive, later parenting→later cognitive) to formally test whether the associations between maternal and paternal sensitive parenting and child cognitive development were significantly different from one another and then examined, independent, spillover, and transactional effects across time. Nested likelihood ratio tests provided formal tests of whether added constraints on model parameters resulted in a degradation of model fit. CFA and SEM models were fit using Mplus (version 5.2) using maximum likelihood estimation (Muthén & Muthén, 2000). Missing data were handled using full information maximum likelihood (FIML) estimation. FIML represents statistical “best practice” and make less restrictive assumption than traditional listwise deletion methods (Schafer & Graham, 2002).

Results

Measurement Models

Establishing that maternal and paternal sensitive parenting could be comparably measured based on observations of mother-child and father-child interactions required the estimation of a good fitting measurement model involving six latent variables: early (6 months) and late (24 months) mother and father parenting, as well as early (Bayley MDI scores at 6- and 15-months) and late (WPPSI Block Design and Receptive Vocabulary subtests at 35-months) child cognitive ability. A baseline model, which did not include any parameter constraints, fit the data well, χ^2 (152) = 319.7, $p < .0001$, CFI = .96, RMSEA (95% CI) = .04 (.035 - .048). The model was re-estimated constraining the factor loadings for mothers' and fathers' parenting behaviors to be equal within (but not across) each assessment period (i.e., mother and father parenting factor loadings equal within, but not across, 6- and 24-month assessments). Although this model continued to provide good absolute fit to the data, χ^2 (158) = 335.7, $p < .0001$, CFI = .96, RMSEA (95% CI) = .04 (.036 - .049), a nested likelihood ratio test indicated that the imposition of these constraints resulted in a statistically significant decrement to model fit, $\Delta\chi^2$ (*df*) = 16.1(6), $p = .01$. Based on results from the initial model, we allowed the *stimulation* code, which appeared to be a slightly stronger indicator of parenting behaviors for fathers than mothers, to take on different values for mothers and fathers at early and later assessments. Re-estimating the model with this constraint relaxed resulted in a good fitting model, χ^2 (156) = 322.2, $p < .0001$, CFI = .96, RMSEA (95% CI) = .04 (.035 - .048), which did not differ in fit from the baseline model, $\Delta\chi^2$ (*df*) = 2.5(4), $p = .64$. The CFA model was re-estimated, again, this time imposing constraints on the variances of the latent parenting variables for mothers and fathers within, but not across assessment periods. This model continued to provide good absolute fit to the data, χ^2 (158) = 326.3, $p < .0001$, CFI = .96, RMSEA (95% CI) = .04 (.035 - .047), and did not statistically differ from the baseline model, $\Delta\chi^2$ (*df*) = 6.6 (6), $p = .36$. This final model supported the equivalency of our measurement of sensitive parenting across mothers and fathers and ensured that any differences in the prediction of cognitive outcomes between mothers and fathers was not due to differential measurement properties of the coding system or to differential variation in observed parenting behaviors.

Parameter estimates from this final CFA model indicated that all indicators had statistically significant factor loadings for their respective latent variables and that all latent variables had significant variances. Table 2 provides a synopsis of correlations between latent variables. Across-time, within parent correlations (ϕs = .59 and .50, *p*s < .001, for mothers and fathers, respectively) were larger than within time, across parent correlations (ϕs = .35 and .47, *p*s < .001, for 6- and 24-month assessments, respectively). Moreover, whereas earlier sensitive parenting was modestly correlated with early cognitive ability (ϕs = .20 and .14, *p*s < .001, for mothers and fathers, respectively), the correlations between later sensitive parenting and cognitive ability were larger in magnitude (ϕs = .47 and .46, *p*s < .001, for mothers and fathers, respectively). Early cognitive ability was also moderately positively correlated with later cognitive ability (ϕ = .51, $p < .001$).

Structural Equation Models

Model Fit and Initial Observations—SEM models were utilized to evaluate the contributions of each parent to the prediction of early and later indicators of child cognitive ability, above and beyond each other as well as covariates with established correlations with early child cognitive development (i.e., state of residence, child race, sex, and age at each visit, child low birth weight status, mother and father education, and household income-to-needs ratio). The SEM model fit the data well, χ^2 (304) = 650.7, $p < .0001$, CFI = .93, RMSEA (95% CI) = .04 (.038 - .047) with four noteworthy results. First, parenting behaviors were relatively stable over time, with early parenting behaviors being strongly predictive of later parenting behaviors. Second, despite this stability, early *maternal* parenting behaviors make a significant, albeit small, contribution in the prediction of later *paternal* parenting behaviors and vice versa. Third, net of early and later parenting effects, individual differences in early cognitive ability predict later cognitive ability. Fourth, the set of predictors (including covariates that are not depicted in Figure 1) explain 19% and 53% of the variation in the latent variables representing early and later child cognitive ability, respectively. Also, although not depicted in Figure 1 (to ease interpretation), latent variables representing mother and father parenting behaviors at the 24-month assessment were positively correlated, ($\phi = .28$, $p < .001$).

Covariate Effects—Also not depicted in the Figure (again to ease interpretation), a number of covariates were associated child outcomes. Early cognition was uniquely predicted by state of residence (residing in PA was associated with higher ability, $\beta = .15$, $p = .002$), child sex (male children had lower levels of ability, $\beta = -.14$, $p = .000$), low birth weight status (LBW; low birth weight was associated with lower ability, $\beta = -.11$, $p = .003$), and child age (within the 15-month assessment, older children performed less well than younger children, $\beta = -.21$, $p < .001$). The effect of state was likely a proxy for depth of poverty. The effect for age reflects the fact that, within any visit, child age likely serves a proxy for the ease with which a visit is scheduled (because families were scheduled within 1 week of the child turning 15 and 35 months, children who were older at the time of assessment were from families that were more difficult to schedule) and as such may correlate with other measures of family risk. As a result, child age predicts outcomes even though outcomes use standardized scores that, theoretically, should accommodate age effects.

Later cognition was associated with child race (African American children had lower scores of cognitive ability , $\beta = -.13$, $p = .01$), child sex (male children had lower levels of ability, $\beta = -.16$, $p < .001$), maternal education (higher education was associated with higher levels of ability, $\beta = .16$, $p = .006$), household income (higher levels of household income were associated with higher ability, $\beta = .20$, $p < .001$), and child age (within the 35-month assessment, older children performed less well than younger children, ($\beta = -.09$, $p = .04$). The onset of effects for household poverty, child race, and maternal education and the absence of effects for LBW suggest that later cognition may be more amenable to ecological influences relative to early cognition.

Direct Effects of Maternal and Paternal Parenting—The initial regression coefficients for mother and fathers effects on child cognitive ability (estimated freely) resulted in significant direct effects of mothers early sensitive parenting on early cognitive development (β = .10, 95% confidence interval [CI] = .00 - .20, p = .05) and mothers later sensitive parenting on later cognitive development (β = .15, 95% CI = .02 - .29, p = .03). In contrast, we did not observe significant direct effects for fathers early sensitive parenting on early cognitive development (β = .07, 95% CI = −.03 - .16, p = .15) or from fathers later sensitive parenting to later cognitive development (β = .15, 95% CI = −.02 - .31, p = .08). In order to formally test whether maternal parenting behaviors were stronger predictors of child cognitive ability than are paternal parenting behaviors, we re-estimated the SEM model imposing equality constraints on three paths that related child cognitive ability to parenting behaviors (early parenting→early cognitive, early parenting→later cognitive, later parenting→later cognitive). This model fit the data well, χ^2 (307) = 651.3, p < .0001, CFI = .93, RMSEA (95% CI) = .04 (.038 - .047); moreover, there was no indication that the imposition of these constraints resulted in a degradation of model fit, $\Delta\chi^2$ (df) = 0.6 (3), p = .90, indicating no evidence of differential prediction of child cognitive ability across mothers or fathers. As seen in Figure 1, these results provide support for our first hypothesis that sensitive parenting behaviors for mothers and fathers each contributed to more concurrent predictions of child cognitive functioning in infancy ($\beta_{\text{early parenting}\rightarrow\text{early cognitive}}$ = .08, p = .004) and toddlerhood ($\beta_{\text{later parenting}\rightarrow\text{later cognitive}}$ = .15, p = .001). However, we did not find support for our second hypothesis that early maternal and paternal sensitivity would directly predict later child cognitive functioning above and beyond later measures of parenting behaviors ($\beta_{\text{early parenting}\rightarrow\text{later cognitive}}$ = .004, p = .93).

Given the previous results which indicated that mother, but not fathers, sensitive parenting was a significant predictor of cognitive development, some readers may wonder how we subsequently concluded that mothers and fathers exerted comparable sized effects. This apparent paradox can be resolved by considering the confidence intervals for mother and father effects. Whereas the confidence intervals for the direct effects of father sensitive parenting to child cognitive outcomes included 0, the corresponding confidence intervals for mother effects did not. This explained why mother effects, but not father effects, met conventional standards of statistical significance. In contrast, when we contrasted the magnitude of mother and father effects, we found no evidence for differential effects. This, too, was evident from the previously reported confidence intervals, which were overlapping for mother and father effects. The effects only appear paradoxical if one exclusively focuses on the statistical significance of effects; the effects are not paradoxical when one considers the confidence intervals for each effect.

Indirect Effects of Maternal and Paternal Parenting—Although early parenting behaviors did not *directly* predict later cognitive functioning, we tested whether they *indirectly* predicted later cognitive functioning through their effects on later parenting (i.e., either the autoregressive effect of their early parenting on their own later parenting or the spillover effect of their early parenting on their partner's later parenting) and through their transactional associations with children's cognitive abilities over time. There were a total of five potential indirect effects from early parenting to later cognition (summarized in Table 3)

that suggest parenting carry-forward effects, inter-parental spillover effects, and parent-child transactional effects. First, there were (1) carry-forward effects of parents' sensitivity in infancy on their own sensitivity in toddlerhood and (2) effects of parent's sensitivity in infancy on children's cognitive functioning in infancy that were carried forward to children's functioning in toddlerhood. Second, and in partial support of our third hypothesis, there were spillover effects of mothers' early sensitive parenting to fathers' later sensitive parenting that predicted later child cognitive functioning. The parallel spillover effect from fathers' early sensitive parenting to mothers' later sensitive parenting as a predictor of later child cognitive functioning was only marginally significant ($p = .056$). Lastly, and in support of our fourth hypothesis, there was evidence for transactional effects between maternal and paternal sensitive parenting and child cognition over time. Early maternal sensitivity predicted early child cognition, which in turn predicted later maternal sensitivity, which predicted later child cognition. The parallel transactional effect for paternal sensitivity over time was only marginally significant. However, there was evidence for a hybrid transactional-spillover effect for early paternal sensitivity on early child cognition, which in turn predicted later maternal sensitivity and then later child cognitive functioning. Again, that parallel pathway originating with early maternal sensitivity was only marginally significant.

It is noteworthy that the sizes of all of individual indirect effects were of modest magnitude. Indeed, even the sums of the indirect effects were of modest magnitude ($\beta = .14$ and $\beta = .11$, ps $< .001$, for mother and father effects respectively). However, it is also clear that the sums of the indirect effects from early sensitive parenting to later cognition were comparable in size to the direct effects from later sensitive parenting to later cognition ($\beta = .16$ and $\beta = .15$, ps $= .001$, for mother and father effects respectively). That is, although the magnitudes of effect of sensitive parenting on child cognition are of modest size, they appear to accumulate across both parents and across time to predict individual differences in cognitive ability in early childhood.

Discussion

The current study tested a progression of hypotheses related to the independent direct and indirect associations between maternal and paternal sensitive parenting and children's cognitive development during the first 3 years of life. This is one of the first studies, of which we are aware, that examines the equivalency of measurement of observed sensitive parenting across mothers and fathers in infancy and toddlerhood using a CFA model with factor loadings for mothers' and fathers' constrained to be equal to each other (within but not across time points at 6 and 24 months). This is a very important component of this research (and often an overlooked methodological step in similar analyses) because it explicitly identifies a common dimension of maternal and paternal caregiving that can reliably and comparably be measured during infancy and toddlerhood, and as such we can test for both independent associations across mothers and fathers as well as directly compare the magnitude of these effects. Previous research has applied this methodological rigor to studies of observational assessments of maternal parenting across race/ethnicities (Skinner, MacKenzie, Haggerty, Hill, & Robeson, 2011; Whiteside-Mansell, Bradley, Tresch Owen, Randolph, & Cuace, 2003), but only one study that we're aware of has examined parenting

measurement invariance across mothers and fathers, and this work was based on self-report data (Adamson and Buehler, 2006).

There are two qualifications to this finding that must be addressed. First, one of the indicators of sensitive parenting, *stimulation of development*, was identified as a slightly stronger indicator of sensitive parenting for fathers than mothers and was allowed to take on different factor loadings for mothers and fathers at 6 and 24 months of age. This finding is different from results reported by Ryan et al. (2006) who found that stimulation was more strongly correlated with sensitivity for mothers than for fathers, although these analyses did not include a CFA to test for measurement equivalency in these composite factors across mothers and fathers. The fact that fathers' overall quality of sensitive parenting is better indexed by more supportive instruction and stimulation (as compared to the more emotion- and affect-oriented dimensions of sensitive caregiving) in the current study is not entirely surprising given the tendencies (even in more egalitarian parenting homes) for mothers to emphasize emotional support more than fathers (Deutsch, 2001) and fathers to show equal or greater play behaviors than mothers (Laflamme, Pomerleua, & Malcuit, 2002). However, it should be noted that in the current analyses, allowing stimulation to be a stronger predictor of sensitivity for fathers as compared to mothers only improved the fit of the measurement model; it did not substantively change the overall measurement of the sensitive parenting construct given that the same indicators were used for both parents. The second point to address is that the equivalency of the measurement of sensitive parenting across mothers and fathers was demonstrated within each time point but not across time points. This may be due to developmental differences in children and the nature of parent-child interactions from 6 to 24 months of age, or it may be a result of methodological differences in the observational contexts of parent-child interactions at each age (free play versus puzzle tasks). Regardless of its origin, this limitation on the degree to which we could constrain the measurement model of parenting over time was inconsequential for testing our specific hypotheses.

Our first two hypotheses focused on the direct associations between sensitive parenting and child cognitive abilities in infancy and toddlerhood. Preliminary bivariate correlations between the latent variables in the model indicated that early sensitive parenting was associated with early and later cognitive abilities, and that later sensitive parenting was associated with later cognitive abilities. However, the SEM model indicated that, although the more concurrent associations between parenting and cognitive abilities were statically significant (in support for Hypothesis 1), the direct associations between early sensitive parenting and later cognitive ability was not significant in the presence of later parenting (contrary to Hypothesis 2). Furthermore, the initial SEM model suggested that maternal sensitive parenting was predictive of child cognitive abilities whereas paternal sensitive parenting was not. However, the imposition of equality constraints on these direct pathways indicated that there were no statistical differences in the strength of these associations across parents, and when constrained to be equal these effects were significantly predictive of concurrent child cognitive ability. Importantly, these findings indicate that mothers' and fathers' sensitive parenting may have additive *and* comparable effects on children's cognitive development, which is consistent with Ryan et al.'s (2006) person-oriented analysis suggesting an additive effect of parental support and that the sex of the supportive

parent is inconsequential. Similarly, our findings indicate that a child may additively benefit from two sensitive parents, and that they may benefit from having at least one sensitive parent irrespective of that parent's sex.

Interestingly, although there were no direct associations between early maternal or paternal sensitive parenting and later child cognitive abilities, consistent with family systems theory there were multiple indirect paths suggesting carry-forward, spillover, and transactional associations during these early years of life. These associations were largely symmetrical for mothers and fathers, suggesting that the interdependencies within the family system, as they relate to these constructs at these ages, are fairly well-aligned and reinforce each other over time. Although the individual indirect effects were of modest size, the cumulative sum of these indirect effects of early sensitive parenting on later cognitive abilities was comparable in size to the effects of later sensitive parenting. These finding are significant for two reasons. First, they are an important extension of research previously reported by Cabrera et al. (2007), Shannon et al. (2002), and Tamis-LeMonda et al (2004), each of which identified independent effects of positive parenting by mothers and fathers on children's early cognitive development, but did not explicitly test any of the potential indirect effects of early parenting behaviors across time. Second, whereas the studies described above focused on the effects of parenting on children's cognitive development, these findings support previous research that identified associations between children's cognitive functioning on later parent-child relationship quality (Croft, O'Connor, Keaveney, Grootheus, & Rutter, 2001), and extends that research to examine ongoing transactional effects on later cognitive functioning in children.

The uniqueness of this sample, methodologies, and analyses allow for the explicit testing of hypotheses that have previously been discussed, but rarely subjected to empirical scrutiny. As a result, we have evidence to support the important roles of both mothers and fathers in early child cognitive development, as well as the importance of both early and ongoing effects of sensitive parenting through carry-forward, spillover, and transactional associations within the family system. Without the multiple measures of parenting and child cognitive abilities, we may have concluded that later parenting “washed out” the effects of early parenting rather than observing the transactional processes within the family system that allow the effects of early parenting to carry forward across development. As such, it is arguable that the current findings may have gone undetected if not for an appropriate match between a family systems approach to developmental study and an advanced and developmentally sensitive approach to longitudinal data analysis. Furthermore, these findings raise the possibility that studies reporting possible differential effects of mothers and fathers or only short-term effects of early environmental variables should be interpreted with caution unless their data collection and analysis methodologies support the explicit testing of differential effects or account for various indirect effects such as those presented here.

In addition to the effects of parental sensitive parenting on children's cognitive development, the current analyses also identified several parent, child, and family covariates that were differentially associated with children's cognitive abilities across time. These findings were all consistent with previous research as cited in the introduction. There were two variables

that consistently predicted cognitive abilities across infancy and toddlerhood, child sex and child age at the time of assessment. Males and children who were older at the time of assessment had lower early and later cognitive ability scores. With regard to differential prediction across age, not surprisingly it appears that child characteristics were more predictive early in infancy and environmental characteristics were more predictive later in toddlerhood. Low birth weight was associated with lower levels of cognitive abilities in infancy but not in toddlerhood, whereas African American race, lower levels of maternal education, and lower family income-to-needs ratio were each associated with lower levels of cognitive abilities in toddlerhood but not in infancy. Collectively, and consistent with a developmental science perspective on early cognitive development (Magnusson & Cairns, 1996), these findings likely represent a developmental shift from greater biological mediation of cognitive abilities to more contextual influences on cognitive development as children's cumulative exposure and engagement with their environments increase over time. This is not to say that all environmental influences are similarly constrained, as we previously demonstrated associations between early parental sensitive parenting as having direct and indirect effects on both early and later cognitive development. Certainly there are other environmental factors that influence early cognitive ability as well as other genetic or biologically mediated processes that effect ongoing cognitive abilities across development.

Potential Implications for Practice

The current study suggests that both mothers and fathers should be included, whenever possible, in interventions targeting children's early cognitive development. Although this is not a revolutionary idea for many practitioners and family systems researchers (see Cowan, Cowan, and Knox, 2010), a more novel implication of the current study is that father involvement in targeted interventions, *even in the absence of mother involvement*, can have positive benefits for children's cognitive development. Although the common (and often valid) assumption by many child and family professionals is that mothers serve the role of primary caregiver and, as such, play the dominant role in socializing and stimulating children during the early years of life, the current analyses identify potential independent and additive effects of fathers during this age, meaning that the positive effects of fathers are not constrained by the behavior of the mother. From this perspective, enrolling fathers in and interventions or programs designed to enhance children's cognitive development through modification of the home environment, may have beneficial effects regardless of whether the mother is also formally enrolled or can regularly attend. In support of this supposition, Coley, Lewin-Bizan, and Carrano (2011) recently reported that early warm and stimulating parenting by mothers and fathers exhibited independent associations with children's reading and math skills in middle childhood, suggesting that fathers make independent and early contributions to children's cognitive development that have downstream effects on later school readiness and achievement.

Limitations and Future Directions

Although there are multiple strengths to the current research it is not without limitations. For one, the sample was limited to families with biological mothers and fathers co-residing at 6 and 24 months of child age. Such inclusion criteria exclude a large number of family constellations, including those that may be functionally comparable in many ways to the

families currently studied (e.g., households with a biological mother and an active nonresidential father or a consistent stepfather, a consistent adoptive mother and father, or a biological mother and consistent co-residing grandmother). Those family configurations were not represented in sufficient numbers in this current study, and thus we lacked adequate power to compare and contrast their effects (for examinations of the associations between early cognitive development and caregiver residential transitions and grandparent involvement, see Mollborn, Fomby, & Dennis, 2012). In addition, within the Family Life Project sample families with co-residing biological parents represent the lowest level of socioeconomic risk as compared to other family configurations. Although there is still significant variability across race and economic variables, this subsample was disproportionately white and at higher levels of household income-to-needs ratios (however this is demographically consistent with most population-based studies of co-habiting versus non-cohabiting parents). By not considering the roles of stepfathers or nonresidential fathers we limit the degree to which these findings generalize to more diverse family populations. As such, in addition to evidencing the comparable associations between biological mothers' and fathers' sensitive caregiving, the key point to be taken from these analyses is that early cognitive development is likely to be additively influenced by significant members of the caregiving system. Finally, by limiting the analyses to only families with biological mothers and fathers we cannot eliminate the possibility of gene-environment correlations that may account for both variations in parenting and children's cognitive outcomes.

It should also be noted that these effects are limited to these specific variables as well as this age range (birth to 3 years of age). It has been demonstrated that mothers and fathers have both common and unique parenting behaviors, and that these different interaction qualities and styles have unique effects on children's development. Whereas this study focused on identifying a single dimension of parenting that is similar across mothers and fathers, a more complete assessment of parental effects on children's cognitive development necessitates the inclusion of qualities both common and unique to mothers and fathers. Additionally, this study did not have data on the quantity of maternal and paternal involvement, and as such we were unable to examine whether the effects of mother and father sensitive parenting behaviors were comparable across varying levels of parental involvement. Future research on this topic would benefit from including both quantitative and qualitative dimensions of involvement to better address how amount of care may interaction with different types and dimensions of paternal caregiving behaviors. Related to this topic, given the evidence in support of paternal caregiving on children's development during the first years of life, future research should examine the factors that support early father involvement, including characteristics of fathers, the romantic and co-parenting relationships between fathers and mothers, structural and relational characteristics of the family system, and how these patterns may differ across cultural groups (Cabrera, Hofferth, Chae, 2011; Hohmann-Marriott, 2011). This study is a first step in a longitudinal and comprehensive examination of these processes; the next steps require both diversification of family configurations, examination of alternate domains of parenting styles and behaviors, and extending the study forward beyond early childhood.

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Highlights

- Complex sampling, longitudinal methods and analyses tested developmental hypotheses
- Mother and father sensitive parenting comparably predict early cognitive development
- There were direct, indirect, and transactional effects from both parents to child
- Findings support inclusion for mothers and fathers in interventions on this topic

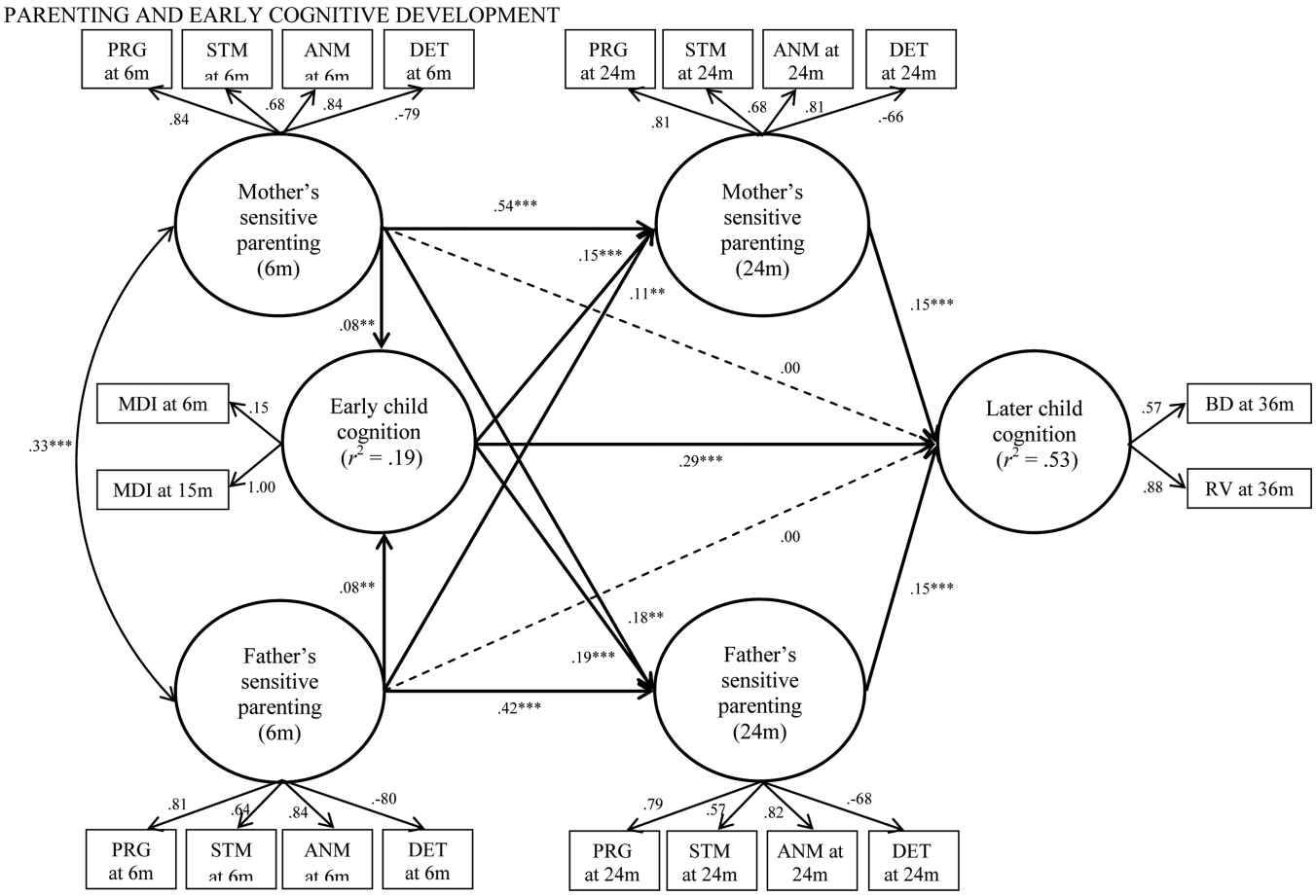

Figure 1.

This model represents the full SEM (excluding the control variables and the covariance between residual variances for father and mother parenting at 24 months) with standardized coefficients and imposed equality constraints on maternal and paternal associations with child outcomes. PRG = Positive regard; STM = Stimulation; ANM = Animation; DET = Detachment; MDI = Mental Developmental Index from the Bayley; BD = Block design from the WPPSI; RV = Receptive vocabulary from the WPPSI. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 1

Descriptive statistics for subsample of co-residing biological mothers and fathers at 6 and 24 months (n = 630)

State (% NC vs. PA)	45.6%
Child sex (% female)	49.5%
Race/ethnicity (% African American)	22.2%
Low-birth weight status (% < 2,500 grams)	6.2%
Mother's mean age (years) at 6 months	28.3 (5.4)
Father's mean age (years) at 6 months	30.8 (6.3)
Mother's mean years of education at 6 months	13.4 (2.1)
Father's mean years of education at 6 months	13.1 (2.3)
Family mean income-to-needs ratio at 6 months	2.5 (1.9)

Table 2

Latent Variable Correlations from Final CFA

Variable	1.	2.	3.	4.	5.
l.Mother sensitive parenting at 6 months	--				
2.Father sensitive parenting at 6 months	.35	--			
3.Mother sensitive parenting at 24 months	.59	.31	--		
4.Father sensitive parenting at 24 months	.34	.50	.47	--	
5.Cognitive ability at 6 & 15 months	.20	.14	.28	.28	--
6.Cognitive ability at 36 months	.37	.21	.47	.46	.51

Note: N = 629; all *ps* < .001

Table 3

Standardized Indirect Effects from Sensitive Parenting at 6 months to Cognitive Ability at 36 Months

	Focal Predictor	
Indirect Effect	**Maternal β (se)**	**Paternal β (se)**
1. Early parenting→Later parenting (self)	.09 (.03)**	.06 (.02)**
2. Early parenting→Later parenting (other)	.03 (.01)*	.02 (.01)+
3. Early parenting→Early child cognition	.02 (.01)**	.02 (.01)**
4. Early parenting→Early child cognition→Later parenting (self)	.002 (.001)*	.002 (.001)+
5. Early parenting→Early child cognition→Later parenting (other)	.002 (.001)+	.002 (.001)*

Note:

*** $p < .001$

+ $p < .06$

* $p < .05$

** $p < .01$