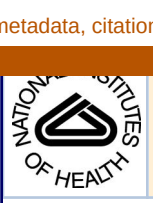

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Fathers' Sensitive Parenting and the Development of Early Executive Functioning

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Abstract

Using data from a diverse sample of 620 families residing in rural, predominately low-income communities, this study examined longitudinal links between fathers' sensitive parenting in infancy and toddlerhood and children's early executive functioning, as well as the contribution of maternal sensitive parenting. After accounting for the quality of concurrent and prior parental care, children's early cognitive ability, and other child and family factors, fathers' and mothers' sensitive and supportive parenting during play at 24-months predicted children's executive functioning at 3-years of age. In contrast, paternal parenting quality during play at 7-months did not make an independent contribution above that of maternal care, but the links between maternal sensitive and supportive parenting and executive functioning seemed to operate in similar ways during infancy and toddlerhood. These findings add to prior work on early experience and children's executive functioning, suggesting that both fathers and mothers play a distinct and complementary role in the development of these self-regulatory skills.

There is compelling evidence that early executive functioning is critical for learning, self-regulated behavior, and mental health (Blair, 2002; Riggs, Blair, & Greenberg, 2004; Zelazo & Muller, 2002), yet research on the family factors contributing to individual differences in early executive functions remains scarce (Bernier, Carlson, Deschenes, & Matte-Gagne, 2012). Referring to a set of higher-order mental processes that allow for flexible, goal-directed behavior, such as working memory (holding and updating information while mentally working with it), attention shifting (shifting cognitive set among distinct but related aspects of a task), and inhibitory control (inhibiting a prepotent response to appropriately complete a task), executive functioning is needed to meet new challenges, resist temptation and distractions, reason and solve problems (Diamond, 2013). Emerging research highlights the importance of social interactions in the development of executive functions, suggesting relationships with caregivers provide the opportunities and support needed for these

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developing skills (Carlson, 2009; Bernier et al., 2012). However, research to date has focused largely on the role of maternal parenting quality; the specific contribution of fathers' parenting in executive functioning development has yet to be investigated. Given evidence that fathers play an important role in children's early development (for a review, see Lamb & Lewis, 2010), this is a notable gap. In this paper, we examine the unique contribution of fathers' and mothers' sensitive parenting during infancy and toddlerhood to children's executive functioning skills at 3-years of age.

Given the wealth of evidence suggesting early environmental experiences shape brain development (e.g., Chugani et al., 2001; Debellis, 2001; Gunnar et al., 2006), there is reason to believe that early caregiver interactions impact the development of prefrontal brain systems linked with executive functions. The prefrontal cortex has an extended period of development after birth (Benes, 2001; Sowell, Trauner, Gamst, & Jernigan, 2002), and there are substantial corresponding changes in executive functioning skills across early childhood (for reviews, see Diamond, 2006; Garon, Bryson, & Smith, 2008). Although rudimentary executive functions (such as working memory and volitional direction of attention) are thought to emerge during the first year of life, children's abilities undergo marked development thereafter, with the ability to perform flexibly and consistently across contexts emerging at the beginning of the preschool period (Diamond, 1991; Garon, et al., 2008). This relatively slow maturation of the prefrontal cortex is thought to provide an extended period of plasticity in which environmental experiences help shape development (Noble, Norman, & Farah, 2005), experiences which have their foundation in early parent-child relationships (Bernier et al., 2012). Indeed, animal studies and work with maltreated children have shown links between deficits in early parental care and impaired development of prefrontal systems (for a review, see Gunnar et al., 2006).

Although the role of caregivers in the development of executive functioning has only recently received attention, a small but growing body of research indicates early mother-child relationships play a vital role (Bernier, Carlson, & Whipple, 2010; Bernier, Carlson, Deschênes, & Matte-Gagné, 2012; Blair et al., 2011; Rhoades et al., 2010). In particular, maternal sensitivity and support is thought to provide an important context for children to learn and develop the skills needed for optimal development of executive functions. Parents that are engaged, attuned to the child's needs, emotionally supportive, cognitively stimulating, and who foster their child's development in a warm manner are thought to promote the self-regulated thought and behavior that define executive functioning, in addition to providing a positive and safe environment for children to practice and master these skills (Carlson, 2009). For example, Bernier, and colleagues (2010) found greater maternal sensitivity, use of mental terms, and support for autonomy at 12–15-months (assessed through global observations, a free-play, and a puzzle task) predicted better performance on executive functioning tasks 6 to 12 months later. Similarly, Hammond and colleagues (2012) found that greater maternal sensitive and supportive scaffolding during a challenging puzzle with their 3-year-olds was linked with subsequent increases in executive functioning. In one of the only related studies involving fathers, Bernier and colleagues (2012) found that a global parenting composite which combined the quality of both mothers' and fathers' interactions between 12- and 18-months (assessed through global observations, a free-play, and a puzzle task for mothers and a free-play task for fathers) predicted

children's executive functioning at age 3, with higher quality parenting linked with better performance on executive functioning tasks. Within the current sample, positive associations between maternal sensitive parenting during free-play at 7-months of age and children's executive functioning at 3-years of age have been found, as well as evidence for both direct and indirect effects of greater maternal parenting quality across 7- 24-months in promoting 3-year-old's executive functioning, and evidence for reciprocal relations between maternal sensitive parenting and executive function development (Rhoades et al., 2010; Blair et al., 2011; Blair et al., in press).

Although paternal and maternal contributions to executive functioning have yet to be examined separately, there is a strong theoretical and empirical rationale for considering the unique impact of fathers' parenting. Consistent with a family systems perspective (Cox & Payley, 1997), child development is inextricably embedded within a network of family relationships, with both mothers and fathers providing independent and interrelated influences. Indeed, evidence suggests fathers' parenting quality has a distinct and important role in early cognitive development and regulatory skills, even after maternal parenting quality is taken into account (Cabrera, Shannon, & Tamis-LeMonda, 2007; NICHD Early Child Care Research Network, 2004, 2008; Tamis-Lemonda, Shannon, Cabrera, & Lamb, 2004). Within the current sample, evidence has been found for fathers' unique contribution to children's general cognitive development across the first 3-years of life, accounting for maternal contributions (Mills-Koonce et al., under review). As noted by Grossman and colleagues (2002, 2008), while mothers provide comfort and security in the face of distress, attachment theory points to the complementary role of fathers in providing sensitive and supportive encouragement for exploration, as well as teaching and gentle challenges during play with their young children. This emphasis on sensitive mentorship during play and encouragement in the face of new or difficult challenges is thought to help children develop and master the skills needed to competently adjust to new demands and adaptively regulate affect and behavior, and thus may be important for the development of executive functions. With widespread recognition that fathers may play a salient role in the early family environment (Lamb & Lewis, 2010), there is reason to believe that the quality of father-child relationships may independently contribute to individual differences in executive functioning skills.

In line with this premise, there is some research suggesting links between paternal parenting quality and the development of skills related to executive functions. For example, Kochanska and colleagues (2008) found that positive, mutually responsive father-child interactions between 7- and 24- months across multiple naturalistic contexts were positively linked with child self-regulation at 52- months. Even after accounting for maternal parenting quality, Karreman, Tuijl, van Aken, and Deković (2008) found significant negative associations between fathers' intrusive and negative parenting during structured and unstructured play and children's concurrent effortful control at 36-months. Similarly, in a sample of alcoholic and non-alcoholic fathers, less paternal warmth during free- and structured-play in toddlerhood mediated the links between paternal alcoholism and children's lower effortful control in preschool, even when maternal parenting was taken into account (Eiden, Edwards, & Leonard, 2004). However, executive functioning is considered only one aspect of self-regulation, and effortful control and executive functioning are

conceptually distinct constructs that are only moderately correlated (Blair & Razza, 2007); the independent contribution of fathers' and mothers' parenting to the development of children's executive functioning has yet to be explored.

Finally, there is reason to believe that paternal parenting quality may be particularly influential in toddlerhood, as opposed to earlier in development. As noted by Carlson (2009), parenting practices may have varying effects on executive functions depending on the age and emerging abilities of the child. Although some basic components of executive functions emerge in infancy, the substantial growth in executive functioning skills across toddlerhood may offer an important window for parental influences (Garon et al., 2008). Further, evidence suggests fathers may be more involved in the toddler years than during infancy (NICHD ECCRN, 2000; Tamis-LeMonda & Cabrera, 2002). As noted by Grossmann and colleagues (2002), this increase in paternal involvement corresponds with toddlers' growing independence, interest in exploration and playful interactions, making paternal support and gentle challenges during play particularly salient during this time. Although prior research on children's general cognitive development suggests comparable effects of paternal parenting quality across infancy and early childhood (e.g., Mills-Koonce et al., under review), whether there are differential effects of fathers' sensitivity in infancy or toddlerhood on executive functions is unknown.

To address these gaps, we sought to explore the longitudinal links between fathers' and mothers' sensitive parenting during play when their children were 7- and 24-months old, and the subsequent development of executive functioning at 3-years of age. Because available empirical evidence suggests early executive functioning is best characterized as a unitary, domain-general construct that may differentiate later in development (Willoughby et al., 2010; Wiebe et al., 2010; Hughes, Ensor, Wilson, & Graham, 2010), and we did not hypothesize differences in the relative contribution of paternal parenting to working memory, inhibitory control, or attention shifting, we conceptualized executive functioning at age 3 as a unidimensional construct. To provide a more stringent test of role of fathers' and mothers' parenting in the development of executive functions, we also controlled for child characteristics (age, sex, race, and general cognitive ability), and family characteristics (marital status, household income), as each of these child and family factors have been linked with differences in executive functioning and parenting (e.g., Blair et al., 2011; Berger, Carlson, Bzostek, & Osborne, 2008; Bernier et al., 2010; Cowan, Cowan, & Kerig, 1993; Coleman et al., 2002; Noland et al., 2003). We hypothesized that both maternal and paternal sensitive parenting during play would significantly predict the development of executive functions, with similar links between executive functions and maternal sensitive parenting across early childhood, and stronger links between fathers' sensitivity and children's executive functioning in toddlerhood in comparison to fathers' parenting in infancy.

Method

Participants

The sample for the current investigation was drawn from the Family Life Project, an ongoing longitudinal study of 1,292 families residing in predominately rural areas in

Pennsylvania (PA) and North Carolina (NC) with a high incidence of chronic poverty. Families were recruited over the course of a year from local hospitals immediately following the birth of a child, oversampling low-income and African-American families to address the overarching goals of the project. For further information on the developmental epidemiological sampling design of the project, see Willoughby et al., (2013).

Because of our focus on maternal and paternal parenting in infancy and toddlerhood, a subsample of families was selected in which the child lived with both parents across the first two years of life. Of the 1,204 children seen at 7-months, 782 (65%) resided with both their biological mother and father. Of these families, 769 (98%) participated at 15-months, and 754 (96%) participated at 24m; however, 122 families were excluded from analyses because the child was no longer living with one of their parents by the 24-month assessment (97% of which were no longer living with their father). Finally, 12 additional families were excluded because the child had no available executive functioning data. Compared to families in stable, two-parent households, families that were excluded because the child no longer lived with one of their parents by 24-months were more likely to be from NC (64% vs. 46% in NC; X^2 (1, N = 782) = 11.40, $p < .01$), identified as Black (47% vs. 22% Black; X^2 (1, N = 782) = 31.66, $p < .01$), to be unmarried (57% vs. 21%; X^2 (1, N = 777) = 63.68, $p < .01$), to have infants of lower general cognitive ability (M = 94.6 vs. 98.2 for MDI; $t(695) = 3.09$ $p < .01$), fewer years of paternal education (M = 11.9 vs. 13.1; $t(777) = 5.65$ $p < .01$), lower income-to-needs ratios (M = 1.49 vs. 2.51; $t(780) = 5.65$ $p < .01$), lower maternal sensitive parenting in infancy and toddlerhood (M =2.77 vs. 3.14; $t(742) = 4.88$ $p < .01$; M = 2.68 vs. 3.19; $t(676) = 6.12$ $p < .01$, respectively), lower paternal sensitive parenting in infancy (M = 2.59 vs. 2.83; $t(585) = 2.52$ $p < .05$), and lower child executive functioning scores (M = 44.7 vs. 55.0; $t(622) = 4.95$ $p < .01$.), but did not differ on gender (48% vs. 47% female, $p = .88$) or paternal sensitive parenting in toddlerhood (M =2.8 vs. 2.9, $p = .19$).

Procedures

Trained research assistants conducted in-home interviews and observations when children were 7-, 15-, and 24-months, and 3-years of age. Videotaped observations of mother-child and father-child semi-structured play interactions were collected on separate days when the child was 7- and 24-months old. An assessment of children's general cognitive ability was collected at 15-months. At 3-years, children were administered tasks designed to assess emerging executive functions.

Measures

Background information—At 7-months, mothers reported on demographic information, including child gender, race, paternal years of education, parental marital status, and the total household income from all sources. The income-to-needs ratio of the family was calculated by dividing the total household income from all sources by the federal poverty threshold for that year, which was adjusted for the number and types of individuals living in the home. An income-to-needs ratio of 1 or below indicates that the family income is at or below the poverty line.

Infant general cognitive ability—At the beginning of the 15-month visit, children were administered the Mental Development Index of the Bayley Scales of Infant Development (MDI, Bayley, 1993). The MDI is a widely used assessment of cognitive development in early childhood, producing norm-referenced standard scores (i.e., $M = 100$, $SD = 15$) that are predictive of later cognitive functioning (e.g., Lemelin, Tarabulsy, & Provost, 2006).

Paternal and maternal parenting quality—Fathers and mothers were filmed playing with their 7- and 24-month olds in a 10-minute play activity on different days. At 7-months, parents were given a standardized set of toys for a free-play activity (i.e., a lights and levers activity center, stacking rings, blocks that rattled), and were instructed to play with their infants as they normally would if given free time during the day. At 24-months, parents and children completed a puzzle task activity, in which three developmentally appropriate, non-connecting puzzles of increasing difficulty (i.e., larger numbers of pieces) were available for the child to play with. Parents were told they could provide any assistance to their child that they thought was needed, and were given the first uncompleted puzzle while seated at a table. If the dyad completed the puzzle, they were presented with up to two additional puzzles. Mothers and fathers were given different sets of toys and puzzles for these interactions.

Mother-child and father-child interactions were coded separately. The current analyses focused on the parental scales of Sensitivity/Supportive Presence, Detachment/ Disengagement, Stimulation of Cognitive Development, Positive Regard, and Animation in interacting with the child (Cox & Crnic, 2002; NICHD ECCRN, 1999). The Sensitivity/ Supportive Presence subscale assessed the degree to which parents consistently displayed responsive, emotionally supportive behaviors that were well-timed, well-paced, and appropriate to the child's cues. The Detachment/Disengagement subscale captures the extent to which the parent was uninvolved or disengaged during the parent-child interaction, including rarely making eye contact or speaking, and rarely responding to the child's vocalizations, bids for attention, or distress, and mechanical or perfunctory behavior. The Stimulation of Cognitive Development subscale captures the parent's effortful attempts to stimulate or teach the child, including focusing the child's attention on the perceptual qualities (e.g., sounds, colors, movements) of objects, verbally responding to and expanding on the child's verbalizations or vocalizations, drawing connections between the task and the child's past experiences, and asking questions that require problem solving. The Positive Regard subscale indexes the parent's positive feelings toward the child, including praise, smiling and laughing with the child, physical affection, and speaking in a warm tone of voice. The Animation subscale measures how animated the parent's face and voice were throughout the activity, including energy, excitement, or interest, such as large facial expressions such as opening the eyes or mouth wide and/or an enthusiastic tone of voice. Global ratings of parent's behavior across the interaction were made on a 1–5 scale, from *not at all characteristic* to *highly characteristic*. Coders were trained until reliability was met on each scale (ICC > .80), with continued reliability checks on a random selection of 20% of the tapes. Informed by an exploratory factor analysis with an oblique rotation (promax), these individual subscales were composited to form an overall *Paternal Sensitive Parenting* and *Maternal Sensitive Parenting* composites (the mean of Sensitivity/Supportive

Presence, Detachment/Disengagement (reverse scored), Stimulation of Cognitive Development, Positive Regard, and Animation; ICC = .87 and .85 at 7-months for mothers and fathers, and .91 for both at 24-months). A high score on the Sensitive Parenting composite indicates the parent was responsive, emotionally supportive, engaged, attentive and warm, showed excitement and interest, and consistently tried to foster the child's earning during play, while a low score indicates the parent rarely responded appropriately to the child's cues, showed a lack of awareness of the child's needs, appeared disengaged, uninterested, made almost no attempts to teach or stimulate the child, was expressionless, impassive, lacking in energy, and flat or negative towards the child.

Child executive functioning—Children's executive functioning was assessed at 3-years using tasks administered in a flipbook format. For each task, knowledge of the requisite shapes, colors, sizes, or items used in the assessment was established beforehand, and examiners first administered training trials for the task and up to three practice trials, as needed. Testing on specific tasks was discontinued if children failed to demonstrate understanding of the task goals. The following provides a brief description of these assessments, for further information on each task and completion rates, see Willoughby et al., (2010).

Working Memory Span (working memory)—For the Working Memory Span task, children were shown an outline of a house, inside of which was a drawing of an animal with a small colored circle above it. The child was first asked to name the animal, and then name the color of the circle. On the next page, there was only the outline of the house, and the examiner asked the child what animal had been in the house (requiring the child to remember the animal after focusing on the color). Children were administered one 1-house trial, two 2- house trials, and two 3- house trials, and the percentage of correct responses across trials was used.

Something's the Same Game (attention shifting)—The Something's the Same game was administered to assess attention shifting (an adaptation of the Flexible Item Selection Task; Jacques & Zelazo, 2001). Children were shown a page with two drawings of objects that were similar in one respect (color, shape, or size). The examiner then pointed out the characteristic on which the items were similar, and flipped the page. On the second page there were the same two items, with a dashed vertical line and a drawing of a third item, which was similar in a distinct way to one of the original two pictures (e.g., if the first two pictures had the same color, the third would be similar in shape or size to one of the pictures). The examiner asked the child to pick which of the original two pictures was similar to the new picture (requiring the child to shift their attention to a new dimension of similarity). The percentage of correct responses across 15 trials was used.

Silly Sounds Stroop (inhibitory control)—Derived from the day-night task (Gerstadt, Hong, & Diamond, 1994), for the Silly Sounds Stroop task children were shown a picture of a cat and a dog on a page, and asked to make the sounds of the dog and then cat. The examiner then told the child that in the Silly Sounds game, cats make the sounds of dogs, and vice versa. The examiner then pointed to the first animal, and asked what sound this

animal makes in the silly sounds game, followed by the next animal. A total of 36 items were presented, with the examiner only flipping the page and pointing to the animal (no verbal prompt about the silly sounds game) after the first 8 items. Percentage correct for the first item on each page was used.

Spatial Conflict (inhibitory control)—In the spatial conflict task (similar to the task used by Gerardi-Caulton (2000)), the child was given a response card with a drawing with car on the left side and a boat on the right. The research assistant turns pages that depict a car or a boat, and the child is instructed to touch a car when they see a car and a boat when they see a boat. Across the first 8 trials, the picture was depicted centrally, giving the opportunity to reinforce the task instructions. For trials 9–22, cars and boats are depicted laterally, with cars always appearing on the left and boats on the right (consistent with the placement on the child's response card, building a propensity to touch the response card based on location (e.g., images on the left always correspond to the child touching the left on their card, and vice versa). For trials 23–35, cars and boats began to be depicted contra-laterally, with cars or boats usually (but not exclusively) appearing on the opposite side as the response card. Contra-lateral responses require inhibitory control from the previously established pre-potent response (spatial location is no longer informative). The percentage of correct responses on contra-lateral trials was used.

Animal Go/No-Go (inhibitory control)—Similar to standard go/no-go tasks, children were given a large, clicking button to press, and were asked to click the button whenever they saw an animal, unless that animal was a pig. The examiner flipped the page every 2 seconds, with a line drawing of seven possible animals. Varying numbers of go trials prior to the no-go trial were presented (one-go, three-go, five-go, one-go, one-go and three-go trials). Percentage correct on no-go trials was used.

An overall *executive functioning* score was calculated by taking the mean percentage of correct responses on available tasks, based on prior work suggesting a one factor solution provided the best representation to the data (Willoughby & Blair, 2011; Willoughby, Wirth, & Blair, 2011; Willoughby et al.; 2010; 2011).

Analytic Strategy

Our questions regarding the links between fathers' and mothers' sensitive parenting during infancy and toddlerhood and children's executive functioning were explored within a path modeling framework, using Mplus (version 5.2, Muthén & Muthén, 1998–2007) with maximum likelihood estimation. Full information maximum likelihood was used to account for missing data.

First, we examined the effects of paternal and maternal parenting quality in infancy on the emergence of executive functioning at 3-years of age; site, child characteristics (gender, race, and general cognitive ability), and father and family characteristics (paternal education, parental marital status and household income) were entered as covariates in this and all subsequent analyses. The data collection site (NC versus PA) was included as a covariate to account for any potential differences due to geographic and cultural variation across sites. Next, we examined the additional effects of parenting quality during toddlerhood,

accounting for prior parenting quality in infancy. Finally, we examined whether the links between parenting and executive functioning differed in infancy and toddlerhood by constraining the paths between executive functioning and parenting to be equal in infancy and toddlerhood (for mothers and fathers, respectively).

Results

Descriptive Statistics

Table 1 presents descriptive information on the sample and bivariate associations between site, child characteristics, family characteristics, parenting quality, and children's executive functioning. In infancy and toddlerhood, both paternal and maternal parenting quality were significantly correlated with children's executive functioning at 3-years of age (for maternal parenting, $r = .28$ and .32, for paternal, $r = .14$ and .32, respectively). However, it should be noted that bivariate associations between executive functioning and fathers' parenting quality in toddlerhood were more than two times as large as those between executive functioning and fathers' parenting quality in infancy. The majority of covariates were significantly correlated with both parenting quality and children's executive functioning (with the exception of child gender and site, see Table 1 for specific bivariate associations). On average, maternal sensitive parenting was greater than that of fathers in infancy ($M = 3.15$, $SD = .73$, $M = 2.83$, $SD = .75$, respectively, $t(453) = 9.84$ $p < .01$), as well as toddlerhood ($M = 3.20$, $SD = .78$, $M = 2.99$, $SD = .69$, respectively), $t(331) = 7.73$ $p < .01$.

Parenting at 7-months and Executive Functioning—In order to examine the unique effects of fathers' parenting quality in infancy on children's executive functioning, paternal sensitive parenting at 7-months of age was specified as a predictor of children's executive functioning at 3-years, along with concurrent maternal sensitive parenting, site, child gender, race, general cognitive ability at 15-months, paternal education, parental marital status and the income-toneeds ratio of the family at 7-months. As can be seen in Table 2, paternal sensitive parenting at 7-months was not a significant predictor of executive functioning, $b = .18$, *n.s*. In contrast, greater maternal sensitive parenting significantly predicted higher levels of executive functioning, $b = 3.68$, $p < .01$.

Parenting at 7- and 24-months and Executive Functioning—Next, we examined the effects of paternal sensitive parenting during toddlerhood on executive functioning, accounting for the effects of prior parenting in infancy, concurrent maternal parenting, site, child gender, race, general cognitive ability, paternal education, parental marital status, and the average income-toneeds ratio of the family across 7- to 24- months. As can be seen in Table 2, greater paternal sensitive parenting at 24-months significantly predicted higher executive functioning, $b = 5.44$, $p < .01$. Maternal sensitive parenting at 24-months also significantly predicted executive functioning, $b = 3.28$, $p < .01$, although the effects of maternal parenting at 7-months was no longer a significant predictor after accounting for more proximal parenting effects, $b = 2.06$, $p = .09$. To examine if there were significant differences the associations between 24-month maternal and paternal parenting on executive functioning, these pathways were constrained to be equal; this model did not significantly reduce model fit compared to a model where these effects were freely estimated, $\Delta\chi^2$ (1) = .

87, *n.s.*, suggesting similar effects for maternal and paternal sensitive parenting in toddlerhood ($b = 4.15$, $p < .01$).

To explicitly test for differences in the effects of father' parenting during infancy and toddlerhood on executive functioning, the pathways for paternal sensitive parenting at 7- and 24-months on executive functioning were constrained to be equal. This resulted in a significant degradation of model fit compared to a model where these effects were freely estimated, $\Delta\chi^2$ (1) = 7.74, $p < .01$, suggesting that the effects of paternal sensitive parenting on executive functioning were significantly greater in toddlerhood. Next the pathways for maternal parenting at 7- and 24-months on executive functioning were constrained to be equal. This model did not significantly reduce model fit compared to a model where these effects were freely estimated, $\Delta\chi^2$ (1) = .35, *n.s.*, suggesting similar effects of maternal parenting on executive functioning during both infancy and toddlerhood (see Figure 1 for completely standardized solution with and without covariates). Taken together, maternal and paternal parenting accounted for over a quarter of the variance in early executive functions. With the exception of cross-lagged linkages between 7- and 24-month maternal and paternal parenting, estimates were largely similar in models with and without covariates; with covariates, neither cross-lagged pathways were significant, whereas cross-lagged paths between both maternal and paternal parenting were significant without covariates.

Post-hoc analyses were conducted to compare the stability of parenting for mothers and fathers, as well as the associations between maternal and paternal parenting at 7- and 24-months. First, we examined the relative stability of maternal and paternal parenting by estimating a model in which the autoregressive pathways across 7- to 24-months were freely estimated ($b = .52$, $p < .01$ and $b = .31$, $p < .01$, respectively), then constrained to be equal; equality constraints resulted in a significant degradation of model fit compared to a model where these effects were freely estimated, $\Delta\chi^2$ (1) = 13.93, $p < .01$, suggesting maternal parenting was more stable than that of fathers. Next, we examined whether the links between concurrent parenting varied over time by freely estimating the covariance between maternal and paternal parenting within time point both 7- and 24-months, and then constraining this covariance to be equal at both time-points; this model did not significantly reduce model fit, $\Delta\chi^2$ (1) = 1.96, *n.s.*, suggesting similar associations between concurrent maternal and paternal parenting during infancy and toddlerhood.

Discussion

Our findings suggest fathers' sensitive parenting in toddlerhood has an independent and prominent role in the emergence of executive functions, contributing to a growing body of evidence suggesting the importance of early caregiving for the development of these skills. Specifically, fathers' sensitive parenting during play at 24-months predicted children's executive functioning at 3-years of age. Notably, these findings emerged after accounting for the quality of concurrent and prior maternal care, children's early cognitive ability, as well as other child and family factors. In contrast, paternal parenting quality during play at 7-months did not appear to make an independent contribution above that of maternal care, although the links between maternal parenting quality and executive functioning seemed to operate in similar ways during infancy and toddlerhood.

Contributing to a large body of literature on the distinct and complementary influence of fathers on children's social, emotional and cognitive development (Parke, 2002), our findings support the hypothesis that paternal parenting in toddlerhood is linked with the early development of executive functions. Although the unique contribution of fathers' sensitive support during play was limited to the toddler period, these findings are in line with prior work suggesting beneficial effects of supportive paternal parenting during toddlerhood and the preschool years on cognitive and regulatory skill development (e.g., Cabrera et al., 2007; NICHD ECCRN, 2004, 2008; Tamis-Lemonda et al., 2004). As noted by Bernier and colleagues (2012), attachment, emotion regulation, and psychobiological theorists collectively support the notion that cognitive regulatory skills emerging in early childhood are intricately tied to caregiver relationships. Paternal and maternal warmth, sensitivity to the child's signals, emotional involvement, facilitation of persistence and focused attention, cognitive stimulation, and encouragement in the face of challenge may set the foundation for the physiological and behavioral regulatory skills needed for executive functions (Bernier et al, 2012). For example, parenting quality for both mothers and fathers has been linked with stress-response system functioning (Gunner et al., 2006; Mills-Koonce et al., 2011), which in turn may alter the development of prefrontal brain regions linked with executive functions (Blair et al., 2011). Similarly, repeated experiences successfully regulating emotion and cognitive challenges with sensitive caregiver support are thought to be critical for the internalization of these skills and the development of independent self-regulation. As fathers may provide sensitive support in different ways or at different times than mothers, or in the absence of maternal support (Cutrona et al. 2000), the independent contribution of mothers' and fathers' sensitive parenting to executive functioning is logical, particularly at a time in which these skills are under rapid development.

Highlighting the complementary contribution of fathers, Grossmann and colleagues (2002) suggest that paternal sensitivity during play is a particularly important context for developing the skills needed for regulating affect, attention, and behavior in the service of goal-directed action. In particular, they note that the higher levels of arousal and challenge often linked with father-toddler play may offer important opportunities for children to practice these regulatory skills. It also likely that fathers who are emotionally supportive and sensitive during play provide daily opportunities for toddlers to practice these skills with support outside of this context (e.g., waiting to eat, attending to directions). Intriguing questions remain regarding how specific aspects of father parenting relate to underlying components of executive functioning, as well as the neural mechanisms underlying these associations. In spite of these questions, these findings provide further evidence that early relationships with caregivers are linked with individual differences in executive functioning.

Although paternal sensitive support during play in infancy did not have an independent, significant effect on children's executive functioning, there are many potential reasons why we did not find evidence for this link. On average, mothers remain the primary caregivers for infants, and this may be particularly true in rural, low-income communities (Manoogian, Jurich, Sano, & Ko, 2013). The increased influence of paternal sensitivity in toddlerhood may reflect higher levels of paternal involvement at this age, compared to infancy, or increases in sensitive paternal parenting over time. Given the lack of significant links between early maternal parenting and subsequent paternal parenting (as well as similar

concurrent linkages in maternal and paternal parenting in infancy and toddlerhood), it is unlikely that the differential effects of paternal parenting are due to fathers parenting more like mothers over time. There were also differences in the characteristics of the parent-child interaction task that may account for some of the differential effects of fathers' parenting across development. During both infancy and toddlerhood, the toys provided were designed to stimulate the use of developmentally appropriate skills with parent's sensitive support, and at both ages parental sensitive support involved following the child's lead and helping to regulate arousal, attention, and affect. However, consistent with the growing capabilities of toddlers, playing with puzzles involved a greater degree of emotional and attentional challenge; it may be this type of challenging play more directly elicits the kind of sensitive support from fathers that is important for emerging executive functions. Whether the differential influence of paternal sensitive parenting during play with their infants and toddlers reflects differential levels of paternal involvement across development, distinct parenting behavior across tasks, or the increased saliency of fathers' sensitive, supportive, challenging play with older children remains open for investigation.

Although not central to the current investigation, it is notable that the links between maternal sensitive support during play and executive functioning at 3-years of age were not significantly different in magnitude during infancy and toddlerhood. This is one of the first studies to compare the independent contribution of sensitive maternal support at 7- and 24-months of age, and the continuity of maternal effects raises interesting questions regarding the pathways through which maternal sensitive support may contribute to the emergence of children's executive functions in distinct ways across early childhood. Understanding the pathways through which sensitive maternal parenting across early childhood may contribute to children's executive functions remains an important area for future research. Additionally, it is notable that paternal sensitive parenting during play was less stable than that of mothers; on average, fathers showed slightly greater improvement in sensitive parenting over time. Although some instability in early paternal sensitivity is consistent with prior work (Brown, Mangelsdorf, & Neff, 2012), whether this change is in part a byproduct of greater paternal involvement (e.g., increased awareness of the child's needs and capabilities), greater paternal comfort in playing with older children, or some other factor remains open to investigation.

A number of limitations should be noted. First, the sample was drawn from a larger representative sample of families residing in poor rural counties, and we selected a subset of families in which the father resided with the mother across the first two years of life. It is unclear whether these findings generalize to more advantaged populations, families with non-residential fathers, or in which the fathers' presence is less stable. Second, although sensitive parenting during play has long been used to assess parenting quality, there may be important differences in parenting within other contexts (e.g., under stressful conditions, routine care (Thompson, 1997)); future studies incorporating assessments of parenting across multiple contexts may provide a more nuanced and complete understanding of parenting and early executive functions. Finally, our results represent a conservative estimate of paternal effects; although controlling for maternal parenting provided a more stringent test of the unique role of fathers' sensitive parenting, there are clearly shared parenting characteristics that may influence executive functions.

Despite these limitations, this study has a number of strengths. While paternal influences on cognitive and regulatory skills have been recognized, this is the first study to document links between the quality of father-child relationships and children's emerging executive functions. The early antecedents of executive functioning remain relatively unexplored (Bernier et al., 2010), particularly in diverse and at-risk populations (but for exceptions, see Blair et al. 2011; Rhoades et al., 2010). Using longitudinal observations of parent-child relationships during infancy and toddlerhood, independent assessments of children's emerging executive functioning at 3-years of age, and accounting for the quality of maternal care, early cognitive skills, demographic, family, and child characteristics, our findings lend greater confidence that the linkages found between father parenting and children's executive functioning are not due other factors.

Taken as a whole, our findings suggest the importance of both paternal and maternal sensitive support for executive functioning in children growing up in rural, economically disadvantaged communities. Although a number of questions remain regarding the mechanisms and pathways through which early caregiving fosters skills such as working memory, attention shifting, and inhibitory control, this study represents an important step in understanding the antecedents of these skills. Further, our findings suggest that interventions targeted to improve the quality of early caregiving relationships for both parents may have important implications for the development of flexible, goal-directed behavior; targeting mother's and fathers' abilities to provide sensitive care for their young children may be particularly important for early executive functioning skills. With prior work suggesting the quality of fathers' parenting is influenced the quality of the interparental relationship (Doherty et al., 1998), and that positive parenting qualities are more likely to spill-over to the other parent-child relationship when marital quality is high (Barnett et al., 2008), interventions targeting the family system more broadly may be particularly beneficial (Cowan et al., 2009). Given that these executive functioning skills have critical implications for cognitive and social development, as well as mental and physical health across the lifespan, this is clearly an important area for future work.

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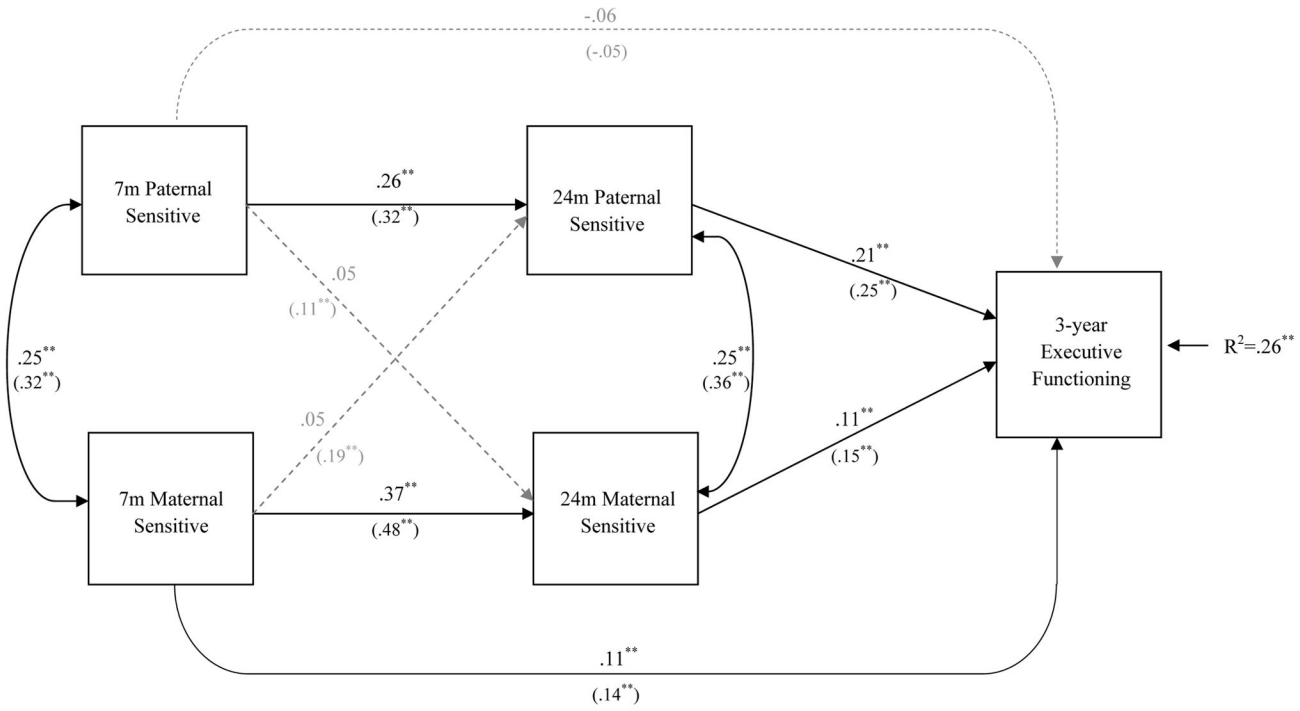

Figure 1.

Parenting quality at 7- and 24-months predicting the children's executive functioning at 3-years (n = 620).

Note: Completely standardized maximum likelihood parameter estimates; $^{\dagger}p < .10$, $^{*}p < .05$, $^{**}p < .01$; pathways for 7m and 24m maternal sensitive parenting constrained to be equal; non-significant pathways for final model with covariates represented by dashed lines, covariates not depicted for clarity; parameter estimates for model without covariates depicted in parentheses

Table 1

Means, Standard Deviations, Frequencies, and Intercorrelations of Primary Study Variables (n = 620).

	M	SD	%[a]	1	2	3	4	5	6	7	8	9	10	11
1. Site[1]			54.7	--										
Child characteristics														
2. Gender[2]			51.0	.10	--									
3. Race[3]			22.2	−.86**	−.04	--								
4. General cog. ability *(15m)*	97.96	10.39		.33**	−.15**	−.31**	--							
Father and family characteristics														
5. Paternal years education *(7m)*	13.15	2.27		.30**	.03	−.39**	.23**	--						
6. Parental marital status[4] *(7m)*			79.2	−.13	−.03	−.17*	.08	.45**	--					
7. Income-to-needs *(7–24m)*	2.44	1.70		.22**	.08	−.51**	.19**	.44**	.57**	--				
Infant parenting quality (7m)														
8. Maternal sensitive	3.15	.73		.19**	−.08	−.36**	.19**	.34**	.21**	.24**	--			
9. Paternal sensitive	2.83	.75		.07	.03	−.31**	.11*	.21**	.12*	.16**	.33**	--		
Toddler parenting quality (24m)														
10. Maternal sensitive	3.20	.78		.13*	.04	−.30**	.29**	.42**	.39**	.32**	.52**	.26**	--	
11. Paternal sensitive	2.99	.69		.10	−.02	−.40**	.25**	.38**	.29**	.27**	.26**	.38**	.44**	--
Child exec. functioning (EF)														
12. 3-year EF	55.03	18.51		.41**	−.09	−.38**	.27**	.29**	.13*	.21**	.28**	.14*	.32**	.32**

Note:

* p < .05,

** p < .01;

[a] Frequency of variable = 1;

[1] 0=NC, 1=PA;

[2] 0=Girls, 1=Boys;

[3] 0=White, 1=Black;

[4]0=not married, 1=married

Table 2

Parenting quality in infancy and toddlerhood predicting the development of children's executive functioning (n = 620).

	Model I: Parenting at 7-months			Model II: Parenting at 7- and 24-months		
	b	**SE**	***p***	***b***	**SE**	***p***
Site[1]	7.25	1.76	<.01	8.50	1.74	<.01
Child characteristics						
Gender[2]	−2.70	1.44	.06	−3.14	1.42	.03
Race[3]	−2.30	2.17	.29	−.74	2.15	.73
General cog. ability *(15m)*	.219	.08	<.01	.12	.08	.12
Father and Family Characteristics						
Paternal years education *(7m)*	.96	.38	.01	.41	.38	.29
Parent marital status[4] *(7m)*	.94	1.95	.63	−.07	1.94	.97
Income-to-needs *(7m)*	.53	.41	.20	--	--	--
Income-to-needs *(7–24m)*	--	--	--	.29	.45	.52
Infant Parenting Quality						
Maternal sensitive *(7m)*	3.68	1.15	<.01	2.06	1.23	.09
Paternal sensitive *(7m)*	.18	1.23	.88	−1.23	1.26	.33
Toddler Parenting Quality						
Maternal sensitive *(24m)*	--	--	--	3.28	1.25	.01
Paternal sensitive *(24m)*	--	--	--	5.44	1.60	<.01

Note:

* p < .05,

** p < .01;

[a] Frequency of variable = 1;

[1] 0=NC, 1=PA;

[2] 0=Girls, 1=Boys;

[3] 0=White, 1=Black;

[4] 0=not married, 1=married