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Fathers Matter: The Role of Father Autonomy Support and Control in Preschoolers' Executive Function Development

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Abstract

Although previous work has shown that mothers' parenting influences the development of child executive function (important self-control skills developed in the preschool years) the role of fathers' parenting has not been thoroughly investigated. We observed fathers' autonomy support and control in dyadic play with their 3-year-old children (N pairs = 110), and measured father and child EF independently with laboratory tasks. We found that fathers' controlling parenting was significantly inversely related to the child EF composite, above and beyond family income and child verbal ability. These results are consistent with the hypothesis that fathers are important for the development of EF in their children, and suggest fathers should be included in both research and parenting interventions.

Keywords

Executive Function; Parenting; Fathers; Autonomy Support; Preschool

Children's early experience with caregivers is proposed to be an important force in shaping brain development (Bos, Fox, Zeanah, & Nelson, 2009; Carlson, 2009; NICHD Early Child Care Research Network, 2000). Various aspects of parenting are known to be important precursors to later cognitive development. One cognitive outcome that is being studied extensively is executive function. Executive function (EF) refers to higher level thinking skills, such as inhibition, working memory, and mental flexibility, that allow for goal-directed behaviors (Carlson, Zelazo, & Faja, 2013). Research is emerging on aspects of mother-child interactions that support EF development, but little is known about the role of father-child interactions. This paper examines the relation between father autonomy support/control and EF development in typically developing preschoolers.

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Executive function shows rapid development in the preschool years, and continues to mature through adolescence (Carlson et al., 2013). EF is a key component of school readiness and academic achievement. Children who have better EF skills tend to have higher math and literacy scores in elementary school (e.g., Blair & Razza, 2007) and are able to learn more from a given amount of instruction (Benson, Sabbagh, Carlson, & Zelazo 2013). Outcomes associated with high EF persist across the lifespan, including education level, income, social skills, and mental and physical health (Mischel et al., 2011; Moffitt et al., 2011). Because EF has such significance in children's lives, it is important to establish its antecedents and to understand influences on its development. A number of variables pertaining to the family, including socioeconomic status (SES), parent education level, language use, and parenting behaviors, have all been implicated in EF development (Carlson et al., 2013).

Soviet psychologist Lev Vygotsky's theory provides an explanation of why parenting behaviors would influence child EF development. He proposed that interpersonal interactions can structure thinking processes, which the child can learn from and then enact intrapersonally, without the help of the adult (Wood, Bruner, & Ross, 1976). He believed that scaffolding was the mechanism by which these external processes became internal. This process seems very relevant to EF, as parents are initially responsible for regulating their infant in many domains (e.g. hunger, sleep, emotions), and this external regulation needs to be gradually internalized for children to develop EF. Parent-child interactions are an important context in which children can experiment with their emerging self-regulation skills (Giesbrecht, Müller, & Miller, 2010). Warm and responsive caregiving predicts a variety of cognitive and social outcomes, and parents who set up a predictable environment allow their children to form organized expectations of the world, which is believed to be an important early step in developing EF (Carlson, 2003). In light of Vygotsky's theory and empirical studies of mother-child interactions, Hartup (1987) suggested that meta-cognitive processes (which encompass EF) are the aspect of cognitive development most likely to be influenced by social relationships.

Studies have focused on various aspects of parenting in relation to EF. In this paper, we will focus on autonomy support and its opposite, controlling parenting. Self-Determination Theory (Deci & Ryan, 1980; 2000) proposes that autonomy is one of three universal psychological needs (the other two being relatedness and competence). This theory suggests that autonomy support is the most important aspect of parenting for the development of independent action (Joussemet, Landry, & Koestner, 2008). Work following this tradition has shown that when adults provide a sense of autonomy rather than control a child's behavior, this facilitates self-regulation of behavior (Grolnick & Farkas, 2002; Grolnick & Ryan, 1989).

In keeping with this idea, autonomy support/control is found to be the aspect of parenting most consistently predictive of child EF (Bernier, Carlson, Deschenes, Matte-Gagne, 2012; Bernier, Carlson, & Whipple, 2010; Fay-Stammach, Hawes, & Meredith, 2014; Sethi, Mischel, Aber, Shoda, & Rodriguez, 2000). Autonomy support refers to guidance from an adult that facilitates the child's success and sense of mastery, as opposed to the adult taking over and controlling the task, or letting the child struggle on his/her own (Deci & Ryan, 2000; Grolnick & Farkas, 2002). Adults support children's autonomy by taking their

perspective, respecting their pace, and ensuring they play an active role in completing the task. Adults can also provide children with choices, suggestions, and opportunities to use their own approaches, rather than make the decisions, give directions, and lead the task (Matte-Gagné & Bernier, 2011; Stefanou, Perencevich, DiCintio, & Turner, 2004). When parents ask questions that draw their child's attention to new aspects of the problem, they help create psychological distance between the child and the problem, which can facilitate self-regulation (Giesbrecht, Müller, & Miller, 2010). Scaffolding, which refers to helping children just enough so they are able to use their own skills toward the successful completion of a task, is a central component of autonomy support (Bernier et al., 2010). Autonomy supportive interactions provide children with successful problem-solving experiences and practice with skills such as making decisions that require reflection and the identification and correction of errors. This practice is expected to enhance EF skills, which rely on reflective thinking and self-regulation (Zelazo, 2004).

Nearly all previous studies of autonomy-supportive parenting and child EF have included only mothers. There is a striking gap in our knowledge about the effect fathers have on children's EF and how fathering may have similar or different effects from mothering. Fathers have become more involved with their young children's care, which is redefining the roles of both fathers and mothers as parents (Cabrera, Tamis-LeMonda, Bradley, Hofferth, & Lamb, 2000). This cultural shift needs to be integrated into theories of child development and incorporated into research by including fathers when studying children to fully understand the context of development (Cox & Paley, 2003; Lamb & Lewis, 2010).

There is evidence that father interactions provide children with unique, enriching experiences that do not occur in mother-child interactions (Grossman, Grossman, Kindler, & Zimmermann, 2008). Fathers tend to be more playmates and mothers more caregivers for their children. Furthermore, fathers' play tends to be more physical, and their games more vigorous, state-disrupting, idiosyncratic and unpredictable, whereas mothers' play involves more visual stimulation and predictable activities (Lamb, 2004). Father interactions may be a particularly important context for EF development, because high arousal and excitement levels may be more cognitively stimulating for children (Grossman et al., 2008). Children who have a lot of interaction with both parents, especially with parents who differ in their parenting style, may be exposed to a wider range of stimulation. This may require greater mental flexibility and frequent rule switching when interacting with different parents (Lamb, 2004), which could in turn promote EF. Indeed, children with two supportive parents have been found to score highest on cognitive development tasks (Ryan, Martin, & Brooks-Gunn, 2006). In a classic study by Harlow, Harlow, & Suomi (1971), father Rhesus monkeys were confined to "play pens" with their nuclear family, which would not be a typical arrangement for male adult monkeys. They found the father monkeys engaged in reciprocal play much more than mother monkeys did, and monkeys raised in the presence of both their parents, rather than just their mother, were more intelligent, confident, socially adept, and *mentally flexible*. It was "as if learning to handle a multitude of social relationships had built their brains to handle other challenges well, too" (Blum, 2002, p. 203).

Although fathering has not been studied extensively, the existing research suggests fathers are likely to have an influence on child EF. Most of this research has not focused

specifically on EF skills, but on broader aspects of cognitive development and other outcomes. Having an emotionally invested, attached father is associated with better well-being, cognitive development, and social competence (Cabrera et al., 2000). Bronte-Tinkew and colleagues (2008) found that father involvement, including cognitively stimulating activities, physical care, paternal warmth, and caregiving activities, was associated with a lower likelihood of infant cognitive delay. Fathers' and mother's supportive parenting at 2 years old independently predicted language and cognitive outcomes over the next year (Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004). Mothers and fathers have been found to be equally effective in their scaffolding abilities with their 2-year-olds in problem solving and literacy interactions, and scaffolding behaviors from both parents were related to success on the task (Connor, Knight & Cross, 1997). Easterbrooks and Goldberg (1984) found father characteristics to be most related to the cognitive outcome of child problem solving in a jigsaw puzzle task, whereas mother characteristics were most related to the social outcome of child attachment status. In older children, supportive, non-restrictive fathering has been associated with higher IQ, math, and reading scores, independently of mothers' parenting (Coley, Lewin-Bizan & Carrano, 2011). In a review of longitudinal evidence on the effect of father engagement, Sarkadi and colleagues (2008) concluded that father engagement enhances cognitive, social, and behavioral outcomes. Thus, the hypothesis that high quality fathering is related to positive cognitive development has a body of supporting evidence.

Research is just beginning to emerge on fathering and EF specifically. Self-reports of parenting behaviors (e.g. monitoring, discipline, and autonomy) from both mothers and fathers have been significantly linked to child inhibition capacities measured with lab tasks (Roskam, Stievenart, Meunier, & Noel, 2014). Also, two studies have found that father parenting in toddlerhood during play interactions was linked to EF at 3 years. Bernier et al. (2012) found this while measuring mutually responsive play at 18 months, and Towe-Goodman and colleagues (2014) found this when measuring sensitive fathering at 24 months. These findings suggest that quality of fathering is an important contributor to the development of child EF in the preschool years. However, no studies have yet been done that measure father autonomy support in relation to EF, or directly observe father parenting past toddlerhood.

A Preliminary Study

Before doing a full-scale investigation of father parenting quality, we were interested in measuring the level of father involvement typical of fathers in a modern, middle-class U.S. population from which we would be drawing our sample, and how it compares to mother involvement. It is likely fathers vary in their involvement with their children, and that the balance of mother and father involvement varies across families. To study this, we measured parent involvement of both mothers and fathers using a survey that asked about a number of different activities parents do with their children. Surveys were given to the parents of 84 children (48 boys and 36 girls) between the ages of 29 and 61 months ($M = 43$ months) in a Midwestern metropolitan area. The sample was primarily Non-Hispanic Caucasian and college-educated. The survey included items that were related to cognitive stimulation (e.g., read books, sing songs or rhymes), warmth (e.g., tell child you love him/her, show physical

affection), and play (e.g., play inside with toys or games, play imaginary games). There were 9 items rated on a 5-point scale (Never to More than once a day; see Table 1). An Involvement Total score was created by summing these questions. Parents also gave estimations of amount of time spent with their children in different situations (adapted from Cabrera, Fagan, & Farrie, 2008 and Easterbrook & Goldberg, 1984).

Results showed that mothers were generally more involved than fathers (Unpublished Master's Thesis Data). This was shown when comparing averages in the Involvement Total score and on almost all of the involvement items, although less so on variables pertaining to weekends. However, on every item there was a substantial number of families for which the father scored higher than the mother. Nineteen percent of families had fathers who scored as high as or higher than the mother on Involvement Total. On the individual items, the percentage of families that had a father who scored equal to or higher than the mother averaged 48%. Involvement Total scores between the mother and father of an individual child were not significantly correlated, nor were the majority of the involvement items, suggesting that in this sample, parents neither had similar behaviors nor compensated for what the other parent does not often do, but seemed to have largely independent patterns of involvement.

Overall, these results provided evidence against looking only at mothers as a representation of a child's parenting experience. Children are likely to have two different patterns of involvement from their mother and father, and in some cases, fathers may be more involved than mothers. It is important to note that the family patterns of involvement found here are not likely representative of all populations, but can give some information about middle class, Caucasian families in Midwestern American suburban/metropolitan communities in the year 2013.

The Current Study

To summarize, most work done on parenting and EF has included only mothers. To our knowledge, no research has yet been done investigating the link between observed father autonomy support and child EF. The main purpose of this paper was to contribute to filling the gap in research on fathering and child EF. The focus was on preschool children, as this is a time of marked EF development (Carlson, 2005). We investigated the quality of father-child interactions, measured by autonomy support and control, and its relations to father and child EF.

The results from our preliminary study provided evidence that fathers in samples such as these are substantially involved with their children, yet not necessarily in the same ways as mothers, and therefore support the viewpoint that fathers need to be included in child development research. Quality of interactions has been found to matter more for child cognitive development than simply the amount of time a father spends with his child (Easterbrooks & Goldberg, 1984). Therefore, in this study we observed father-child dyadic interactions in the laboratory, focusing on father autonomy support. Autonomy support was rated for father-child interactions during a difficult jigsaw puzzle. Child EF was measured with four laboratory tasks. Father EF was also measured, using two computerized tasks. We

hypothesized that fathers who showed high autonomy supportive and low controlling behaviors would have children with more advanced EF skills, over and above the effects of demographics, child verbal ability, and father EF. We also expected Father EF to be related to child EF, because EF has been shown to be highly heritable (Friedman, et al., 2008), as well as to fathering behaviors, as behaving in an autonomy-supportive, non-controlling way would rely on EF skills such as inhibitory control, planning, and flexibility. Additionally, we administered the involvement survey used in the preliminary study to these fathers, to investigate relations between father involvement, father parenting, and child EF.

Method

Participants

The participants were 110 (53 female, 57 male) children and their fathers from a Midwestern metropolitan area. Six additional children were recruited, but were excluded because of non-compliance or video technical problems. The children ranged in age from 35 to 41 months, with a mean of 37.68 months ($SD = 1.68$), and were primarily Non-Hispanic Caucasian (90%). Family income in the last year ranged from \$25,000-\$49,000 to over \$200,000 with the mean and median corresponding to \$100,000 – \$124,999 ($Mode = \$75,000$ to \$99,999). The fathers averaged 36 years of age (range = 26 – 52). Most fathers (83%) had an education level of a college degree or higher. All of the fathers were the biological parent of the child, and all but 1 currently lived with the child and were married to the child's mother (4 fathers did not report their marital status). When asked about the child's primary caregiver, 59% reported mother, 11% reported father, and 30% reported equal mother and father care. Of the 89 fathers who reported their jobs, three reported at-home father or homemaker.

Procedure

The father-child dyads took part individually in one videotaped laboratory session, lasting between 60 and 90 minutes. The children were tested on the Peabody Picture Vocabulary Test and four executive function measures: Bear/Dragon, Delay of Gratification, Minnesota EF Scale, and Gift Delay. While the children completed these tasks, the fathers completed two EF tasks on a laptop computer from the NIH Toolbox: Flanker and Dimensional Change Card Sort (DCCS). Following the EF tasks, the dyads together worked on a jigsaw puzzle that was designed to be more difficult than the children could complete alone. Videos of the puzzle task were later coded for autonomy support and control. The father-child dyads also did a 10-minute free play episode during the session, which will not be reported on in this paper. The children were tested by one of two female experimenters.

Measures

Child tasks

Peabody Picture Vocabulary Test – IV (Dunn & Dunn, 2007): The PPVT is a measure of receptive vocabulary. The experimenter stated a word, and the children chose one of four pictures that best matched the word. The task continued until children answered incorrectly on 8 of 12 words in a set. The PPVT correlates highly with verbal intelligence measures

such as the verbal subscale of the Stanford-Binet IV (Hodapp, 1993) and the Wechsler Preschool and Primary Scales of Intelligence (revised; WPPSI-R) (Carvajal, Park, Logan & Page, 1992). Four children did not complete the PPVT.

Bear/Dragon (Reed et al., 1984; Kochanska et al., 1996): The Bear/Dragon task is a simplified Simon Says game, which we modified further to include several levels of difficulty. Children were first given various actions to practice (e.g. touch your tummy). The task then began with Level 1, and subsequent levels were given if children completed 8/10 items correctly. This task involved a “nice bear” puppet and a “naughty dragon” puppet, voiced by the experimenter in distinct voices. Children were directed to do what the bear said, but not to do what the dragon said. In level 1, 5 commands were given from the bear, and then 5 commands from the dragon with the experimenter holding the child's hands on the table. Level 2 was the same, except children were directed to sit on their hands during the dragon trials. In level 3, 10 commands were given, alternating from the bear and the dragon (the original version of the task). In level 4, children were first given 5 commands alternating from the bear and the dragon. The rules were then reversed, and they were given 5 more commands after being directed to do what the dragon said but not what the bear said. Children were given scores of 0-4 representing the highest level passed. Inter-coder reliability on 18% of the cases was ICC = 1.00. Two children refused to complete Bear/Dragon, and six others were missing because of video malfunction.

Delay of Gratification (Mischel, Shoda, & Rodriguez, 1989): Children were first given practice using a bell to make the experimenter return to their table. Children then selected their favorite treat from three choices, and the experimenter placed a small amount of treats on one plate and a larger amount on another. Children were asked which plate they would rather have. Most (88%) of the children chose the plate with more treats after little or no coaching. The experimenter then explained that she was going to go do some work in the corner, and the children would get the large pile of treats if they waited until she came back, but the small pile of treats if they rang the bell. Children were checked for their understanding of the rules (90% answered correctly), and if they answered incorrectly the rules were repeated and the question asked again. Children were then positioned in front of the treats with the bell between the two plates. The experimenter left the table and, given the young age of the participants, sat in a chair behind the child, appearing to work. The experimenter returned after 10 minutes or when the child rang the bell, ate a treat, or left the table. The score used from this task was the time until the child's first transgression: touched or rang the bell, touched the plate or the treats, ate a treat, or left the table. Children were given a score of 600 seconds if they never transgressed in the 10 minutes. This variable is more sensitive to variation in behavior than simply time to ring the bell. Coder reliability on 18% of cases was ICC = .860. Two children had invalid data for Delay of Gratification due to un-cooperation, and six were missing because of video issues.

Minnesota Executive Function Scale – Early Childhood (Carlson & Schaefer, 2012): The Minnesota Executive Function Scale is a measure of cool executive function, tapping working memory, inhibitory control, and set shifting. This task was adapted and expanded from the Dimensional Change Card Sort Task (Zelazo, 2006) by Carlson (2012; Beck,

Schafer, Pang & Carlson, 2011) and is currently provided as a computerized tablet game (MEFS; Carlson & Zelazo, 2014). In the original table-top version used here, children were shown two opaque boxes with target cards on them. They were instructed to sort cards into the boxes by a dimension: shape or color. The EF scale consists of seven levels of varying complexity. For each level, in part A children were instructed to sort cards based on a specific dimension, and for part B they had to switch the sorting rule. At the higher levels, children were required to switch flexibly multiple times. If children performed accurately on at least 4 out of 5 trials for both rule sets, they passed the level and moved up to a more complex level. They continued on to higher levels until they failed. If children failed the first level administered, they moved down to the previous level until they passed. Highest level passed was the dependent variable. Two children did not complete this task. The Minnesota EF Scale is reliable (Beck et al., 2011) and valid (e.g., Carlson & Harrod, 2013; Hostinar et al., 2012), and has been shown to predict school readiness and grade 1 math achievement (Carlson & Harrod, 2013; Hassinger-Das, Jordan, Glutting, Irwin & Dyson, 2014).

Gift Delay (Kochanska et al., 1996): In the Gift Delay task, the experimenter told children they would receive a present, but the experimenter wanted it to be a surprise and so instructed them not to peek while it was being wrapped. The child's chair was turned so their back was to the experimenter, and the experimenter noisily wrapped the present for one minute. Children were scored for the severity of their worst transgression: 0 = turned body around, 1 = turned head, 2 = did not peek. Coder reliability on 18% of cases was ICC = .770. Data were missing for 10 children due to video issues.

Father tasks

DCCS (Weintraub et al., 2013): The NIH Toolbox Dimensional Change Card Sort tested fathers' ability to flexibly switch between rules and resolve cognitive conflict. It was adapted from the traditional DCCS (Zelazo, 2006) for computer use as part of the NIH Toolbox Cognitive Battery: Measuring Executive Function and Attention (Weintraub et al., 2013). The fathers were shown how to sort cards by pressing the appropriate computer keys, and given practice trials. They then had to sort cards based either on color or shape, rapidly and flexibly switching between rules. Participants received scores based on accuracy and speed (possible range = 0-10). Data were missing for 13 participants due to computer malfunctions ($N = 11$) or because the child's behavior would not allow the father to complete the task ($N = 2$).

Flanker (Weintraub et al., 2013): The Flanker task also is part of the NIH Toolbox Cognitive Battery: Measuring Executive Function and Attention (Weintraub et al., 2013). It tests the ability to selectively attend to stimuli and ignore conflicting information. Fathers viewed a computer screen that showed five fish with arrows pointing to the left or right. They were instructed to press the arrow button that matched the direction the middle fish is pointing. On some trials, all the fish pointed in the same direction, but on other trials the middle fish pointed a different direction from the other four fish. The more advanced level of the task replaces the fish with arrows. Participants received scores based on their accuracy and speed (possible range = 0-10). Data were missing for 12 participants due to computer

malfunctions ($N = 10$) or because the child's behavior would not allow the father to complete the task ($N = 2$).

Note that these measures of EF were not administered to children because previous pilot testing in our lab and others suggested they were too difficult for young preschoolers (see Akshoomoff et al., 2014).

Jigsaw puzzle dyad task: At the end of the session, the experimenter brought a 24-piece jigsaw puzzle into the room and gave the following instructions to the father: “We want to see what (child's name) can do by him/herself, but feel free to give him/her any help that you want to. I'll be back in a little bit!” The experimenter then left the room, and returned after 10 minutes, or when the dyad had completed the puzzle (this occurred for 19 dyads).

Puzzle task coding: Videos of the puzzle task were coded using Whipple, Bernier & Mageau's (2011) autonomy support coding scheme. Father behavior was coded on 4 scales reflecting the extent to which the father 1) intervened according to the child's needs and adapted the task to create an optimal challenge for the child; 2) encouraged his child in the pursuit of the task, gave useful hints and suggestions, and used a tone of voice that communicated to the child that he is there to help; 3) took his child's perspective and demonstrated flexibility in his attempts to keep his child on task; and 4) followed his child's pace, provided the child with the opportunity to make choices, and ensured the child played an active role in the completion of the task. Each of the scales was rated for autonomy support, (1 = *not autonomy-supportive* to 5 = *very autonomy supportive*) as well as for control, which reflected providing too much help, taking over, or controlling the task (1 = *not controlling* to 5 = *very controlling*). Fathers were rated high on control if they exhibited behaviors such as intervening too early or excessively, using a stern or sarcastic tone of voice, rigidly not tolerating any departure from the task, and if they made the decisions and did much of the work themselves instead of allowing their child to do the work. The autonomy support scales were all significantly inter-correlated (r s ranged from .557 to .735). The alpha for the 4 autonomy support scales was .885, indicating these could be combined into one scale. For the control scales, 4 of the 6 inter-correlations were significant (r s ranged from .171 to .833). The alpha for the 4 control scales was .770, indicating they could be combined into a single scale (Kline, 1999). Data were missing for 9 dyads because of video issues.

Surveys: Fathers filled out two surveys, the first about demographic information, and the second the involvement survey used in the preliminary study.

Results

Preliminary Analyses

Table 2 presents descriptive statistics for the child EF and father parenting variables. All of these variables showed acceptable variation, although Delay of Gratification scores occurred most frequently near 0 or at 600 seconds (i.e., bimodal distribution), and the Bear/Dragon and Gift Delay tasks showed signs of a floor effect. Father control also showed signs of a

floor effect, with 24% of the fathers scoring a 1 (the lowest score possible) and 41% scoring 1.5 or lower, and the frequencies tapering off toward higher scores.

The four child EF tasks were inter-correlated (r s ranging from .230 to .393, p s all $< .05$). When submitted to a Principle Component Analysis, all 4 tasks loaded onto a single factor (FUPC), with loadings of .629 or higher, representing 48.7% of the total variance. Therefore, these measures were combined to form a child EF composite variable ($\alpha = .648$), with the standardized scores of all tasks with valid data averaged for each child. The parenting dimensions of father autonomy support and father control were inversely correlated ($r = -.705$, $p < .001$).

We next examined whether sociodemographic variables (child gender, child age, mother education, father education, father age, and family income) were related to child EF or father parenting variables. Results are shown in Table 3. Family income was the only sociodemographic variable linked to both child EF and father parenting.

Our next step was to examine relations between father EF and child EF scores. The two father EF tasks, the NIH Toolbox DCCS and the Flanker, were inter-correlated ($r = .355$, $p < .001$). Flanker scores were left-skewed. Contrary to our expectations, neither of the father EF tasks was related to any of the child EF tasks, and therefore they were not retained as covariates in further analyses. The Flanker task was related to father autonomy support and control, but the DCCS was not related to parenting (see Table 3).

We next examined the relations between children's verbal intelligence and their EF performance. The PPVT was correlated with the EF composite, the Bear/Dragon and Minnesota EF Scale tasks, and father autonomy support and control (see Table 3). Because language is one mechanism through which parenting is thought to influence child EF skills (Clark et al., 2013; Hammond et al., 2012; Matte-Gagne & Bernier, 2011), we used Age-Standardized PPVT as a control in our subsequent analyses.

We were also interested to see if father involvement was related to child EF or father parenting. Father Involvement Total was not related to any of the child EF tasks. It was related to father autonomy support ($r = .277$, $p = .006$), but not to father control.

In our main analyses, we used family income and age-standardized PPVT scores as covariates, as these variables were linked to both child EF and father parenting.

Main Analyses

Table 4 presents the bivariate correlations between the child EF tasks and the two father parenting dimensions, as well as the partial correlations when accounting for family income and age-standardized PPVT scores. Results of the partial correlations showed both father autonomy support and father control were associated with the EF composite. When looking at partial correlations for individual tasks, both parenting dimensions were related Delay of Gratification, and father control was related to the Minnesota EF Scale. Father autonomy support was bivariate correlated with Bear/Dragon, but this did not hold up after

accounting for income and child verbal ability. Gift Delay was not associated with either of the parenting dimensions.

We then ran regression analyses to examine the relations between father parenting and child EF. Because we performed multiple regressions, we adjusted the alpha level for significance to $p < .01$ for the following analyses. Table 5 presents the results of the hierarchical regression analyses predicting the EF composite. Autonomy Support and Control were entered in separate regressions because of their high collinearity ($r = -.705, p < .001$). In the following tables, covariates are presented as Block 1, autonomy support as Block 2a, and control as Block 2b. The autonomy support model predicted 28.2% of the variance in the EF composite, with parenting as a marginally significant predictor contributing a unique 5.4% over and above income and child verbal ability. The control model predicted 29% of the variance in the EF composite, with parenting as a significant predictor contributing a unique 6.2% over and above the covariates.

To confirm that the associations between quality of father parenting and child EF were not due to simply the amount of time the father spends with the child, we ran the regressions predicting the EF composite with father involvement total as an additional predictor in Block 1. The second step of the regressions was still significant for both autonomy support ($F \text{ change} = 6.94, p = .010$) and control ($F \text{ change} = 7.23, p = .008$), and the new Betas for autonomy support and control were .256 ($p = .010$) and $-.260$ ($p = .008$), respectively, showing that controlling for father involvement did not attenuate the association between quality of parenting and child EF.

Because correlations indicated the relations between parenting and child EF composite might have been primarily due to the Minnesota EF Scale and Delay of Gratification tasks, we also conducted regressions for those tasks separately. The results of these regressions are presented in Tables 6 and 7. When predicting the Minnesota EF Scale, the autonomy support model accounted for 18.7% of the variance, with parenting as a marginally significant predictor contributing a unique 3.9% over and above the covariates. The control model accounted for 21.9% of the variance, with parenting as a significant predictor contributing 7.1% over and above the covariates. When predicting Delay of Gratification, the autonomy support model accounted for 16.3% of the variance, with parenting as a significant predictor contributing 8.5% over and above covariates. The control model accounted for 22.6% of the variance, with parenting as a significant predictor contributing a full 12.1% over and above covariates.

Discussion

There has been a dearth of research on the role of fathers in the development of EF, an important set of neurocognitive skills that prepare children for school and life achievement. The present study aimed to address this gap. The main finding was that fathers' parenting behavior in a dyad task was associated with their 3-year-old children's EF skills. Father control was a significant predictor (negatively) of the EF composite, and father autonomy support was a marginally significant predictor (positively), above and beyond family income and children's age-standardized verbal ability. When looking at individual tasks, this pattern

was similar for the Minnesota EF scale. For the Delay of Gratification task, both autonomy support (positively) and control (negatively) were significant predictors. These results suggest that father parenting is an important variable to consider when examining EF development in children.

Although this research is correlational and not causal, it appears that controlling fathering may be particularly detrimental to EF development. Control and autonomy support were highly inversely correlated. However, low scores on autonomy support represent the omission of positive behaviors such as good suggestions and actively getting the child involved, whereas high scores on control represent the commission of negative behaviors such as criticism (e.g., "No, that's the wrong place" in a stern tone) or interference (e.g., placing puzzle pieces for the child). It seems that the commission of these negative behaviors may be even more detrimental for EF development than the omission of positive behaviors by fathers. Controlling behaviors take the active role out of the child's hands, giving them less opportunity to act on their environment and monitor their own behavior. This reflects the idea proposed by Rogoff (1990) that the "freedom to err" is critical for cognitive development. It also aligns with Self-Determination Theory research showing that autonomy supportive, non-controlling guidance leads to self-determined and self-regulated action (Deci & Ryan, 2000). Fathers who are not controlling may provide contexts in which EF skills such as monitoring one's own work, persisting through difficulties, and planning ahead can be practiced by the child rather than directed by the parent.

The associations between father control and child EF may seem surprising, given the distribution in this sample, as most fathers were not controlling (41% scored a 1.5 or lower on a 1 – 5 scale). But it seems that the control variable may be acting in a somewhat dichotomous fashion, in that fathers who were at all controlling had children with lower EF scores.

As a continuation of the preliminary study, we also examined how father involvement is related to child EF and father parenting. Father involvement totals were not related to any of the child EF tasks. This is consistent with other research that shows the quality of father-child interactions is much more important than the amount of time they spend together (Easterbrooks & Goldberg, 1984). However, father involvement was related to father autonomy support. As this is a correlational result, there are multiple interpretations. It is possible that fathers who spend more time with their children learn to be more attuned to their child and are therefore more autonomy supportive. It is also possible that fathers who are more autonomy supportive have more positive interactions with their children, and therefore spend more time with them. When father involvement was added as a covariate in the regressions predicting the child EF composite, father autonomy support and control were both still significant predictors above and beyond the covariates, indicating that the association between quality of father parenting and child EF held above and beyond how involved the father was. Further work needs to be done to clarify the relation between father involvement and quality of parenting.

We were also interested in the relation between father and child EF. Contrary to our expectations, father EF performance on the NIH Toolbox DCCS and Flanker tasks was not

correlated with child EF performance. One possibility is the children in this sample were at the beginning of developing their EF (M age = 37.68 months), and a correlation between father and child EF would be more likely with older children. In future research, it would be ideal to include the same measure of EF for both children and parents. Nonetheless, father Flanker task performance was associated with father autonomy support and control. This suggests autonomy supportive parenting relies somewhat on parent EF skills. Parents need to slow their pace to match their child, give their child the chance to work, plan ahead to meet the child's needs, and be flexible in changing tactics when things are not working.

This study expanded on the previous work done with mothers. We found father autonomy support and control were both associated with child EF, similar to what previous work has found when looking at mother-child interactions (Bernier, Carlson, Deschenes, Matte-Gagne, 2012; Bernier, Carlson, & Whipple, 2010; Sethi, Mischel, Aber, Shoda, & Rodriguez, 2000), although in the current study autonomy support was a marginally significant predictor of the EF composite after correcting to an alpha level of $p < .01$. Most previous studies with mothers have examined either autonomy support or control. The current study examined both aspects together and found that high control was more predictive than low autonomy support. Future research should examine whether this is also the case for mother-child interactions, or if this pattern is specific to fathers.

The results found here support the idea that cognitive skills are impacted not only by the mother-child relationship, but also more broadly by the social context of multiple caregivers in which children are developing. Overall, it appears that children's cognitive development is not shaped only by interactions with one primary caregiver. The quality of father parenting, even when fathers are not as involved as mothers, may play an important part in creating an environment that supports child EF development. These findings have implications for including fathers in both basic research and prevention/intervention studies. Researchers should be careful not to assume that studying only mothers adequately measures a child's parenting experiences. This echoes the call for inclusion of fathers in research that has been made by others (Cabrera et al., 2000; Cox & Paley, 2003; Lamb & Lewis, 2010). It would be beneficial in future studies to include both mothers and fathers to look more closely at similarities and differences and to have a fuller picture of children's caregiving. Our findings also suggest including fathers in interventions, especially programs targeting child cognitive development, may be more beneficial than working with mothers alone. Teaching both fathers and mothers about best parenting practices may give children the greatest chance at a good start.

The study presented here had a number of limitations. The sample size of 110 was modest. The correlational design does not provide information about causal inferences, and we do not have information about whether these results would hold after controlling for mother parenting. Future studies should include both mothers and fathers when looking at child outcomes. Fathers should also be included in longitudinal designs to examine the impact of father parenting over time. Finally, intervention studies with both fathers and mothers are needed to establish causal relations between parenting behavior and child EF development.

In this study, father parenting was not correlated with Bear/Dragon or Gift Delay above and beyond covariates. Bear/Dragon may be showing a floor effect, as about 40% of the children tested could not pass the lowest level. It is unclear why parenting was unrelated to Gift Delay. It appears that the Minnesota EF Scale and Delay of Gratification tasks were age appropriate and captured a range of variation in behavior, and this may be why those tasks were most strongly related to father parenting. Future studies should include a variety of tasks to examine if there are clear patterns of EF tasks that are related to father parenting.

Conclusions

Previous research has suggested that fathers are important for child cognitive outcomes, but no studies have conducted a direct assessment of father autonomy support/control as a predictor of child executive function. This study tested the relations between father autonomy supportive and controlling parenting and preschool children's EF, and found father parenting was related to a composite of the child EF tasks, as well as 2 of 4 individual tasks, above and beyond covariates. The cultural ideal of fathers being “helpers” to mothers in parenting has given way to the ideal of co-parenting (Cabrera et al., 2000), and this trend should be embraced in parenting research. High-quality father parenting may be an important resource for putting children on a pathway for successful cognitive and socio-emotional development.

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- This study showed that father parenting is related to child executive function.
- Controlling fathers have children with lower executive function.
- The father parenting results are similar to previous findings with mothers.

Table 1
Questions Asked in the Involvement Survey

Question
How many times per week do you typically engage in the following activities with your child?
1 Sing songs or nursery rhymes
2 Read books
3 Tell stories
4 Play inside with toys or games
5 Hug or show physical affection
6 Tell child you love him/her
7 Let child help you with household chores
8 Play imaginary games with child
9 Tell child you appreciate what they did
For this section, write your answer in the blank.
How many hours do you spend alone with your child
On a typical week day?
On a typical weekend day?
How many hours do you spend playing with your child
On a typical week day?
On a typical weekend day?
How many hours do you spend in caregiving for your child
On a typical week day?
On a typical weekend day?

Table 2
Mean, Standard Deviation, and Range for Child Executive Function (EF) and Father Parenting Measures

Variable	N	Mean	Standard Deviation	Observed range	Theoretical range
Child EF					
Bear/Dragon	103	1.81	1.72	0 - 4	0 - 4
MN EF Scale	108	2.57	1.30	0 - 5	0-7
Delay of Gratification	102	301.95	261.35	0 - 600	0 - 600
Gift Delay	101	1.05	0.88	0 - 2	0 - 2
EF Composite (z scores)	110	-0.02	0.69	-1.34 - 1.25	
PPVT-Stand	110	115.08	16.98	38-156	M=100, SD=15
Parenting Quality					
Father Autonomy Support	101	3.59	0.93	1.33 - 5	1 - 5
Father Control	101	1.90	0.80	1 - 4.33	1 - 5
Father Involvement Total	106	33.63	6.18	15 - 45	9-45
Father EF					
Flanker	98	9.55	.554	6.34-10.0	0-10
DCCS	97	7.80	1.14	2.50-9.84	

PPVT-Stand = Age-standardized PPVT score.

Table 3
Bivariate Correlations between Sociodemographic Variables and Child EF and Father Parenting

	Bear/Dragon	MIN EF Scale	Delay of Gratification	Gift Delay	EF Composite	Father Autonomy Support	Father Control
Child Gender	.186 ^a	.072	-.125	.146	.125	-.198 [*]	.134
Child Age	.174 ^a	.258 ^{**}	.024	.269 ^{**}	.267 ^{**}	.166 ^a	-.067
Mother Education	-.062	-.041	-.179 ^a	.020	-.071	-.174 ^a	.157
Father Education	-.125	-.130	-.138	-.143	-.208 [*]	-.104	.231 [*]
Father Age	.097	.128	-.149	-.183 ^a	-.004	-.119	-.006
Family Income	.324 ^{**}	.335 ^{**}	.325 ^{**}	.213 [*]	.437 ^{**}	.180 ^a	-.185 ^a
PPVT-Stand	.305 ^{**}	.256 ^{**}	.023	.042	.275 ^{**}	.243 [*]	-.293 ^{**}
Father Flanker	.109	.038	.074	.205 ^a	.129	.279 ^{**}	-.234 [*]
Father DCCS	-.026	.009	-.134	-.146	-.123	.034	.014
Father Involvement Total	.040	.090	-.015	-.121	-.014	.277 ^{**}	-.181 ^a

^a
 $p < .10$,

^{*}
 $p < .05$,

^{**}
 $p < .01$. PPVT-Stand = Age-standardized PPVT score.

Bivariate (Upper Right) and Partial (Lower Left) Correlations Between the Child EF Tasks and Father Parenting Dimensions**Table 4**

	1.	2.	3.	4.	5.	6.	7.
1. Bear/Dragon	--	.321**	.248*	.233*	.656**	.201*	-.140
2. MN EF Scale	.238*	--	.369**	.230*	.708**	.299**	-.354**
3. Delay of Gratification	.182 ^a	.344**	--	.393**	.730**	.296**	-.358**
4. Gift Delay	.134	.221*	.306**	--	.674**	.077	-.047
5. EF Composite	.587**	.688**	.702**	.640**	--	.308**	-.333**
6. Father Autonomy Support	.165	.202 ^a	.328**	.101	.304**	--	-.705**
7. Father Control	-.060	-.304**	-.378**	-.028	-.296**	-.672**	--

Note. Ns range from 97 – 101 in bivariate correlations and degrees of freedom range from 94 – 100 in partial correlations controlling for Age-Standardized PPVT and Income

^a
 $p < .10$,

*
 $p < .05$,

**
 $p < .01$

Table 5
Summary of Regression Analyses Predicting the Child EF Composite

Block	β	R ²	DF	F Change
1. Covariates		22.9%	--	2, 94
Family Income	.392 [*]			13.92 [*]
PPVT-Stand	.213 ^a			
2a. Autonomy Support Regression		28.2%	5, 4%	1, 93
Family Income	.358 [*]			6.98 ^a
PPVT-Stand	.160			
Autonomy Support	.242 ^a			
2b. Control Regression		29.0%	6, 2%	1, 93
Family Income	.352 [*]			8.11 [*]
PPVT-Stand	.142			
Control	-.264 [*]			

^a $p < .05$,

^{*} $p < .01$. PPVT-Stand = Age-standardized PPVT score.

Table 6
Summary of Regression Analyses Predicting the Minnesota EF Scale

Block	β	R ²	DF	F Change
1. Covariates		14.8%	--	2, 92
Family Income	.305*			7.98*
PPVT-Stand	.195 ^a			
2a. Autonomy Support Regression		18.7%	3, 9%	1, 91
Family Income	.274*			4.36 ^a
PPVT-Stand	.142			
Autonomy Support	.208 ^a			
2b. Control Regression		21.9%	7, 1%	1, 91
Family Income	.261*			8.26*
PPVT-Stand	.123			
Control	-.281*			

^a $p < .05$,

* $p < .01$. PPVT-Stand = Age-standardized PPVT score.

Table 7
Summary of Regression Analyses Predicting Delay of Gratification

Block	β	R ²	R ²	DF	F Change
1. Covariates		10.4%	--	2, 91	5.31 [*]
Family Income	.318 [*]				
PPVT-Stand	.028				
2a. Autonomy Support Regression		16.3%	8.5%	1, 90	9.46 [*]
Family Income	.276 [*]				
PPVT-Stand	-.070				
Autonomy Support	.313 [*]				
2b. Control Regression		22.6%	12.1%	1, 90	14.13 [*]
Family Income	.262 [*]				
PPVT-Stand	-.068				
Control	-.368 [*]				

^a $p < .05$,

^{*} $p < .01$. PPVT-Stand = Age-standardized PPVT score.