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Relations Between Parent EF and Child EF: The Role of Socioeconomic Status and Parenting on Executive Functioning in Early Childhood

Katie Kao and Srishti Nayak
Boston University

Stacey N. Doan
Claremont Mckenna College

Amanda R. Tarullo
Boston University

Executive functioning (EF) in early childhood is well-established as a predictor of developmental outcomes, yet the factors that influence emerging EF abilities and the interplay among these factors in predicting individual differences in EF have not been systematically explored. The present study assessed 3.5 to 4.5 year olds ($N = 117$) and their parent in the Boston Metropolitan Area. We specifically examine parent EF as a contributor to preschool children's EF and the role of parenting in this association. We also explore how distinct dimensions of socioeconomic status (i.e., income, parent education, occupational prestige) may differentially moderate the relationship between parent and child EF. Parent and child EF were related, such that the better parents performed on EF tasks, the better their children performed on EF tasks. Parents who reported using more parental strictness in their parenting had poorer EF. In addition, income was the only SES indicator that moderated the relationship between parent and child EF such that only in lower income households was parent EF closely linked to child EF. Findings indicate that for children in lower income households, who are already at risk for EF deficits, parent EF played a significant role in early childhood EF skills.

What is the significance of this article for the general public?
EF is a critical skill that has far reaching implications for children's adaptive functioning. Mapping the complex relations of parent EF and poverty to child EF will further our understanding of early influences on emergent EF.

Keywords: executive functioning, inhibitory control, cognitive flexibility, socioeconomic status, early childhood

Executive function (EF) skills provide an important foundation for successful learning and adaptation (Meuwissen & Zelazo, 2014). Especially during the preschool years, a period of heightened cognitive plasticity, contextual influences such as parent's own EF, parenting behaviors, and socioeconomic status have the potential to shape the development of EF (Cuevas et al., 2014; Bernier, Carlson, Deschênes, & Matte-Gagné, 2012; Farah et al., 2006). However, despite strong evidence that EF has important implications for young children's social and cognitive functioning (Campbell, Shaw, & Gilliom, 2000; Diamond & Lee, 2011; Schoemaker, Mulder, Deković, & Matthys, 2013), the antecedents of individual differences in EF have not been well established. In the present study, we addressed this gap by examining parent EF

Katie Kao and Srishti Nayak, Department of Psychological and Brain Sciences, Boston University; Stacey N. Doan, Department of Psychology, Claremont Mckenna College; Amanda R. Tarullo, Department of Psychological and Brain Sciences, Boston University.

Correspondence concerning this article should be addressed to Katie Kao, Department of Psychological and Brain Sciences, Boston University, 64 Cummington Mall, Boston, MA 02215. E-mail: katiekao@bu.edu

as a contributor to child EF and the role of parenting characteristics in this association. We also explore how different dimensions of socioeconomic status (SES) may moderate the relationship between parent and child EF.

Development and Measurement of EF

EF reflects a set of higher order cognitive processes that underlie flexible goal-directed behaviors (Garon, Bryson, & Smith, 2008; Miyake et al., 2000; Zelazo, Carter, Reznick, & Frye, 1997). Between 2 and 5 years of age, the prefrontal cortex undergoes dramatic neuronal growth (Diamond, 2002), which coincides with the emergence of individual differences in EF around age 3 (Carlson, Mandell, & Williams, 2004). EF tasks that tap into inhibitory control, the ability to control interfering thought processes (Carlson & Wang, 2007), and cognitive flexibility, the ability to switch between multiple tasks as a function of changing demands (Chevalier, Wiebe, Huber, & Espy, 2011), are particularly difficult for preschool children (Carlson & Wang, 2007; Espy, 2004). During this time, children are increasingly expected to exhibit greater control of their everyday behaviors and adjust their behavior appropriately in contexts outside the home (Wiebe, Espy, & Charak, 2008). Researchers have argued that EF is a unitary, domain general construct that manifest in different ways depending on contextual demands (Duncan & Miller, 2002; Duncan & Owen, 2000). Specifically in preschool aged children, a unitary model of EF has been found to be the best supported using confirmatory factor analysis (Wiebe et al., 2008, 2011; Willoughby, Blair, Wirth, & Greenberg, 2010; Willoughby, Wirth, Blair, & the Family Life Project Investigators, 2012). Taken together, it is critical to assess early markers of EF during the preschool period, when core components of EF are just beginning to emerge and develop rapidly (Carlson et al., 2004; Garon et al., 2008).

Parenting and EF

Recent research has established a strong link between parent EF and child EF in early childhood (Cuevas et al., 2014), adolescence and young adulthood (Jester et al., 2009). Although some studies indicate an association between parent and child EF may in part be due to shared genetic inheritance (e.g., Friedman et al., 2008; Gagne & Saudino, 2010), it is also important to examine the role that parenting may play in this relationship. Parenting quality has been proposed as a potential mechanism underlying the intergenerational transmission of EF. Child EF benefits greatly from sensitive and high quality parenting behaviors such as scaffolding and autonomy support (Bernier, Carlson, Deschênes, & Matte-Gagné, 2012; Bernier, Carlson, & Whipple, 2010; Bibok, Carpendale, & Müller, 2009; Hughes, Ensor, Wilson, & Graham, 2009). In early childhood, parental verbal stimulation, along with warm, positive, responsive, and contingent parenting has been found to predict inhibitory control (Kochanska, Murray, & Harlan, 2000), while negative controlling behaviors, such as overly controlling and strict behaviors have been found to predict poorer delay inhibition (Silverman & Ragusa, 1990).

There is also evidence that parent and child EF are linked with more effective parenting abilities such as scaffolding (Mazursky-Horowitz et al., 2017; Obradović et al., 2017; St. John, Oztahtachi, & Tarullo, 2018). *Scaffolding* refers to the dynamic process through which a social partner helps a child complete a task beyond the child's independent capability (Bibok et al., 2009). Many of the components involved in EF (e.g., inhibitory control, cognitive flexibility) are useful in parenting contexts because parents often need to regulate their reactions and flexibly change their behaviors when faced with the difficult demands of caring for young children (Barrett & Fleming, 2011; Calkins, 2011; Cuevas et al., 2014). Researchers highlight the relevance of EF for coping with parenting demands and responding positively in the context of challenging child behavior (Bridgett, Burt, Edwards, & Deater-Deckard, 2015; Crandall, Deater-Deckard, & Riley, 2015). Parental scaffolding has also been associated with better cognitive flexibility, inhibitory control, and a host of other cognitive skills in young children (for review, see Fay-Stammbach, Hawes, & Meredith, 2014). Parents who provided more scaffolding during a problem-solving task, their children showed greater cognitive flexibility (Matte-Gagne & Bernier, 2011) and better inhibitory control at age 4 (Hopkins, Lavigne, Gouze, LeBailly, & Bryant, 2013). Studies have found that other components of EF, like working memory, are related to harsher reactive parenting (Deater-Deckard, Sewell, Petrill, & Thompson, 2010) and insensitivity (Bridgett, Kanya, Rutherford, & Mayes, 2017), therefore it is important to also examine how inhibitory control and cognitive flexibility may be related to parenting styles. One study used laboratory-based EF assessments and showed that parenting partially mediated the relationship between parent and child EF (Cuevas et al., 2014). However, mothers completed a series of cognitive EF tasks while children completed both cognitive and emotionally eliciting EF tasks. Thus, the EF tasks for mothers and children, tapped into different facets of EF. Building on this finding, it is important to examine how parent and child EF relate when testing the parent and the child on the same EF tasks in the laboratory that capture the same constructs underlying EF.

SES Indicators in Relation to Child EF

There is a growing literature highlighting the link between poverty and poor EF performance in children and adults (Currie, 2005; Malecki & Demaray, 2006). For example, children from lower SES backgrounds have poorer working memory, inhibitory control, and attention skills (Farah et al., 2006; Kishiyama, Boyce, Jimenez, Perry, & Knight, 2009; Noble, Farah, & McCandliss, 2006). Studies have found that SES disparities in EF were mediated by aspects of children's home environment, nutrition, prenatal care, and chronic stress (see for review Hackman & Farah, 2009) suggesting that children in lower income households are already at risk for EF deficits. Given these global risk factors, parents may play a particularly crucial role in EF development for children growing up in poverty. It is possible that SES may influence parent's own EF ability, but it is also possible that lower SES families may have fewer opportunities for joint cognitive interactions with their children due to SES-related factors (e.g., exhaustion from working multiple jobs, less time spent at home, etc.). Higher SES families may have more opportunities to develop children's EF capacities (Noble, McCandliss, & Farah, 2007; Noble, Norman, & Farah, 2005). For example, being able to pick up their child from school and spend more time with their child may create more opportunities for parents to provide scaffolding, which predicts child EF skills (for review, see Fay-Stammbach et al., 2014). In addition to potentially having fewer opportunities to provide scaffolding, lower SES parents may also provide qualitatively different ways of scaffolding (e.g., less rich explanations) with their children that may affect their children's EF (Hoff, Laursen, & Tardif, 2002; Kurkul & Corriveau, 2018; Levine, Suriyakham, Rowe, Huttenlocher, & Gunderson, 2010). Thus, SES may be related to differences in frequency and quality of parent scaffolding, which has links to EF development. Further, parents' ability to provide consistent responsiveness and resources to enrich the child's environment is important for children's EF development. However, the extent of responsivity and enrichment can vary based on SES-related factors (Sarsour et al., 2011). SES disparities in EF are found as early as kindergarten and pervasive throughout early adolescence (Noble et al., 2005; Noble, Wolmetz, Ochs, Farah, & McCandliss, 2006). However, it is still unclear whether these SES differences in EF emerge earlier, especially during the preschool period when EF skills are rapidly developing (Carlson et al., 2004; Garon et al., 2008).

There is some debate on how exactly SES should be operationalized and whether various indicators such as income, parent education, and parent occupational status should be combined as a composite or kept separate (Ursache & Noble, 2016). Some researchers have argued that creating composite scores of SES may not be the most informative because these indicators are theoretically distinct and have differential links to children's development (Duncan & Magnuson, 2012; Duncan, Magnuson, & Votruba-Drzal, 2017; Lipina, 2017). For example, parent education and income have been more robustly associated with developmental outcomes than occupational status (Grindal et al., 2016). Parental education has been related to both academic and behavioral outcomes, whereas income has been more associated with academic success (Duncan & Magnuson, 2003). Thus, these various dimensions of SES may have different implications for children's EF skills and for the association between parent and child EF. The links between different SES indicators and later outcomes may differ based on several potential mechanisms. For example, it could be the case that income levels are related more to academic success based on better accessibility to learning resources, whereas education levels may play a more salient role in parenting and therefore may be related also to children's behavioral functioning.

The Current Study

Emerging EF skills have critical applications, such that EF skills play an important role in later functions needed to succeed in school readiness and later self-regulation abilities. Thus additional exploration of what individual differences influence children's EF development would further our understanding of this crucial cognitive ability. The aims of the current study were (a) to examine the relationship between parent EF and child EF using multiple measures that captured similar constructs for both parent and child; (b) examine the association between parenting and parent EF and determine whether parenting explained the link between parent and child EF; and finally (c) test whether individual SES indicators moderated the relationship between parent and child EF.

Based on past literature, we hypothesized that parent EF would positively correlate with child EF, and that higher parent EF would be associated with lower parental strictness and higher parental warmth. We also expected that parental strictness and warmth would partially mediate the link between parent and child EF. Finally, we predicted that there would be a conditional effect of income and parent education, but not with occupational status, on parent and child EF. In other words, the association between parent and child EF would differ as a function of income and parent education levels.

Method

Participants

Participants consisted of 117 children (68 male) aged 3.5 to 4.5 years (M = 4.18 years, SD = 0.29 years) and their primary caregiver (112 mothers, 5 fathers) aged 23 to 50 years (M = 32.03 years, SD = 5.49 years). Participating children were 50.4% European American, 16.2% Asian, 3.4% Black, 6.0% Hispanic, 1.7% Middle Eastern, and 22.2% multiracial. As reported by the primary caregiver, 74.4% of the families had an annual income of $60,000 or above (see Table 1). In an effort to represent a culturally diverse sample, we recruited families who were fluent in English (n = 99) or Chinese (n = 18). All of the families from Hispanic backgrounds were fluent in English. Out of our sample, 81 children attended preschool. An additional nine children were enrolled in the study but were excluded from the final sample because they did not have a score for either of the EF tasks due to either technical difficulties or refusing to participate in the task.

Procedures

Participants were all from the greater Boston metropolitan area, recruited from a department-maintained database of families who had expressed interest in participating in research, from online advertising, and from community recruitment events. This study was approved by the university institutional review board. Upon arrival, the primary caregiver was told the purpose of the study was to explore how family context influences the development of self-control skills, like paying attention and resisting impulsive behaviors, in preschool children. Once the parent provided informed consent, children completed child-appropriate versions of the Dimensional Change Card Sort, Flanker and a receptive language task. Parents filled out questionnaires and completed adult-appropriate versions of the Flanker, Dimensional Change Card Sort and receptive language task. EF tasks were nonverbal and instructions were provided in either English or Chinese. Parents reported on their income, education, occupation and filled out a questionnaire on parenting attitudes in either English or Chinese.

Measures

Household income. Parents reported on their annual household income by selecting a range (e.g., "$40,000–50,000"). We created two income groups: a higher income group (above $60,000; n = 87) and a lower income group ($60,000 or under; n = 23). Because of Boston's particularly high cost of living, groups were created based on a poverty threshold guided by the Massachusetts Economic Independence Index from the Crittenton Women's Union report (Ames, Lowe, Dowd, Liberman, & Youngblood, 2013). The report states on average in Massachusetts, a family of three needs an income of about $60,000 a year to meet its day-to-day essential expenses without public assistance. Our income

Table 1
Demographic Information

Demographics	*M* (*SD*) or *M* (range)	%
Child demographics		
Age in years	4.18 (.29)	
Race		
Caucasian		50.4%
Black		3.4%
Asian		16.2%
Hispanic		6.0%
Middle Eastern		1.7%
Multiracial		22.2%
Preschool attendance		73.6%
Participating parent demographics		
Age in years	32.03 (5.49)	
Race		
Caucasian		60.9%
Black		4.3%
Asian		20.9%
Hispanic		7.0%
Middle Eastern		1.7%
Multiracial		5.2%
Highest level of education		
High school or less		8.8%
Vocational or trade school		.8%
Community college (2-year)		1.6%
College (4-year)		28.0%
Graduate/professional school		60.8%
Occupational prestige	3.63 (1.00–5.00)	
Nonparticipating parent demographics		
Highest level of education		
High school or less		18.1%
Vocational or trade school		1.7%
Community college (2-year)		9.5%
College (4-year)		18.1%
Graduate/professional school		52.6%
Occupational prestige	3.83 (1.00–5.00)	
Household demographics		
Annual income (% household income over $60,000)		74.4%

group cutoff was a conservative estimate of which families would most likely be economically strained due high living costs in Boston, especially for families with young children where childcare costs and housing costs are elevated. Possible range parents could report for household income was below $20,000 to over $150,000. Our actual range consisted of 9.3% of our sample reporting an income of under $20,000 and 28.0% reporting an income over $150,000. Seven parents declined to provide income information; therefore, these families were not included in an income group.

Parent education. The highest level of education from both parents were coded on a scale from 1 (*no education*) to 10 (*graduate school*). Codes were standardized and averaged to create a combined parent education composite.

Occupational prestige. Occupational prestige was coded for each parent using the Job Zone coding scheme from the Occupational Information Network (O*NET, http://www.onetonline.org/help/online/zones), which ranks U.S. Census-based occupational categories on a 1–5 scale based on the education, experience, and training required. Codes were standardized and averaged to create a combined parent occupational prestige composite.

Parenting Attitudes Toward Child Rearing. The Parenting Attitudes Toward Child Rearing (PACR-II; Easterbrooks & Goldberg, 1984) is a 38-item parent report that measured parental warmth and discipline. Parents indicated the extent of their agreement with each statement on a 6-point Likert scale to yield two subscales: warmth/respect and strictness/over protectiveness. The PACR-II includes items such as "I believe in praising a child when s/he is good and think it gets better results than punishing when s/he is bad" or "I threaten punishment more often than I actually give it." Higher scores on each subscale indicated greater displays of that parenting behavior (α = .70).

Dimensional change card sort. The dimensional change card sort (DCCS) is a well validated measure that assesses cognitive flexibility in children and adults (Zelazo, 2006). Children completed a DCCS task adapted from Espinet, Anderson, and Zelazo (2012). On each trial, a test stimulus was presented in the center of the monitor (e.g., a red ship or a blue rabbit) and the child was instructed to match the test stimulus to one of two target stimuli shown at the bottom of the monitor (a blue ship and a red rabbit; see Figure 1A) based on a sorting rule. Children responded via a response pad placed on the table in front of them, which had images on the buttons matching the two target stimuli, the blue ship and red rabbit. In the shape-color version of the DCCS, as in Espinet et al. (2012), children first were instructed to sort according to shape for eight practice trials and 15 preswitch trials. They then were informed that the rule had changed and instructed to sort according to color for 30 postswitch trials. Children completed one of two versions of the DCCS: shape-color or shape-number. The shape-number test stimuli were one blue rabbit or two blue ships. The stimulus versions were counterbalanced such that half the children were administered shape-color (n = 59), whereas the other half were administered shape-number (n = 58). DCCS versions differed only in the postswitch phase. Regardless of DCCS version, all children completed the same preswitch trials (sort by shape).

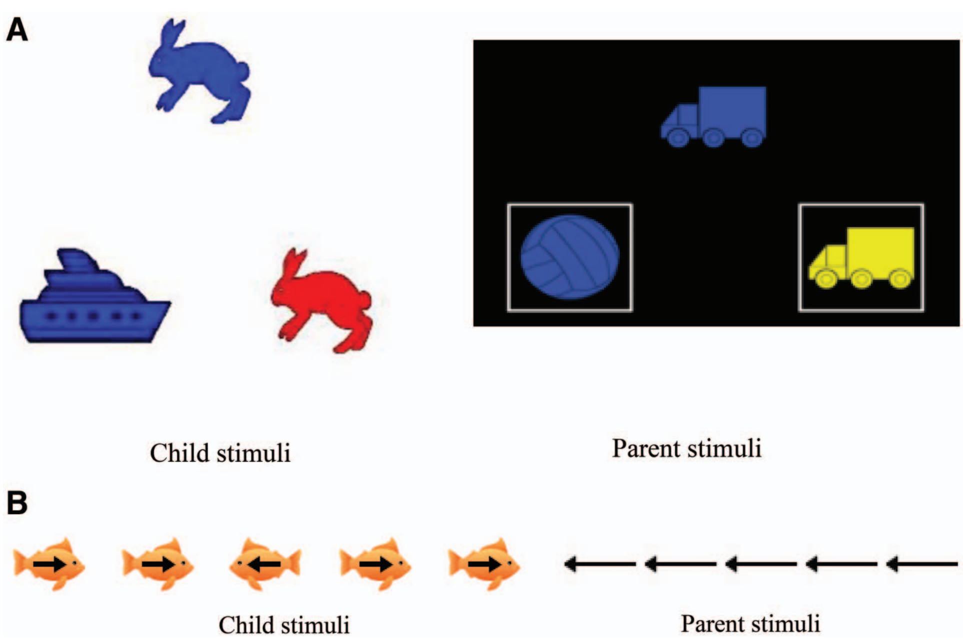

Figure 1. A: Dimensional Change Card Sort (DCCS) task stimuli for children and parents. Children completed a computerized DCCS task adapted from Espinet et al., 2012, while parents completed the adult version of DCCS from the NIH Toolbox Cognition Battery. B: Flanker task stimuli for children and parents. Children completed the Flanker Inhibitory Control and Attention Test from the NIH Toolbox Early Childhood Cognition Battery, while parents completed the adult version. See the online article for the color version of this figure.

Accuracy and reaction time (RT) were computed separately for the preswitch and postswitch phases. Accuracy was the proportion of correct responses. RT was calculated as the mean RT on correct trials only. Trials with RTs <150 ms or >10 s were excluded prior to computing the mean RT. For each condition, only the children who performed above chance on the preswitch phase (at least 11/15 correct, $p < .05$) were included in postswitch analyses. There were 85 children who passed the preswitch ($M = 14.90$ correct trials, $SD = 6.88$).

For parents, the DCCS from the National Institutes of Health Toolbox Cognition Battery (NIHTB-CB; Weintraub et al., 2013; Zelazo, 2006) was administered (normed for ages 7–85) because it was more age-appropriate and adults were likely to hit ceiling effects on the child version. On a computer screen, two target pictures were presented that varied by two dimensions: shape and color (see Figure 1A). Participants were asked to match a series of test pictures (e.g., yellow balls and blue trucks) to the target picture, first according to one dimension (e.g., color) and then, after a number of trials, according to the other dimension (e.g., shape). After four practice trials in each dimension, 30 test trials are administered, in which the participant must change the dimension being matched in a mixed order. For example, after three trials matching on color, the participant may be asked to match on shape in the next trial and then go back to matching by shape. The NIH Toolbox system computed the scoring for each participant, which was based on a combination of accuracy and RT. The current study used the age-adjusted scale score (Slotkin et al., 2012), indicating the participant's overall performance compared to those in the NIH Toolbox nationally representative normative sample within the same age band. Higher scores indicated better DCCS performance or higher levels of cognitive flexibility ($M = 100.67$, $SD = 11.02$, actual range = 64.57–125.31). In the current sample, six participants had missing DCCS scores either due to technical difficulties ($n = 3$) or declining to participate in the task ($n = 3$).

Flanker inhibitory control and attention test. The NIHTB-CB Early Childhood version (normed for ages 3–6) of the Flanker Inhibitory Control and Attention Test (Rueda et al., 2004; Weintraub et al., 2013) was used in the current study. This computerized behavioral measure required children to focus on a central stimulus while inhibiting attention to stimuli (fish) flanking it. On congruent trials, the surrounding fish pointed in the same direction as the central fish, while on incongruent trials the surrounding fish pointed in opposite direction of the central fish (see Figure 1B). The child was asked to place their dominant index finger in the middle of the keyboard arrows and press the right or left arrows on the keyboard corresponding to where the middle fish was pointing. Each child was administered 20 test trials and if the child scored 90% or higher on the fish stimuli, 20 additional trials with arrows were presented. If the child did not pass the practice trials, the task automatically discontinued. In our sample, only two children discontinued the task and 12 children had missing Flanker scores due to technical difficulties. Because the children in the current study were between a narrow age range, we collected our own information on age by months because the NIH Toolbox only allowed the participant's age in years to be entered for the task. In our analyses, we tested children's age in months as a potential covariate to capture any subtle age-related task differences, thus the current study used the unadjusted scale score (Slotkin et al., 2012). Higher scores indicated better Flanker task performance ($M = 75.69$, $SD = 8.09$, actual range = 50.88–106.41).

Parents also completed the Flanker from the NIHTB-CB (normed for ages 7–85). The task was identical to the child version except all stimuli were arrows (see Figure 1B), which parents were given 40 test trials. The current study used the age-adjusted scale score (Slotkin et al., 2012), indicating the participant's overall performance, including accuracy and RT, compared to those in the NIH Toolbox nationally representative normative sample within the same age band. Higher scores indicated better Flanker task performance ($M = 99.26$, $SD = 12.39$, actual range = 66.47–124.86). In the current sample, five participants had missing Flanker scores either due to technical difficulties ($n = 3$) or declining to participate in the task ($n = 2$).

Picture vocabulary test. The child completed the NIHTB-CB picture vocabulary test (normed for ages 3–85). This measure of receptive vocabulary was administered in a computerized adaptive format, so that the next question a participant received depended on his or her response to the previous questions. The child was presented with an audio recording of a word and four photographic images on the computer screen and is asked to select the picture that most closely matches the meaning of the word. This test is a measure of general vocabulary knowledge and is considered to be a strong measure of crystallized abilities, a measure of intelligence that involves both educational experience and EF (Barch et al., 2013; Miyake, Friedman, Rettinger, Shah, & Hegarty, 2001; Salthouse, Atkinson, & Berish, 2003). For our analyses, we used the unadjusted scale score (Slotkin et al., 2012), 12 children did not complete the task because they were not fluent in English and four children did not complete the task due to technical difficulties. Higher unadjusted scores indicated better overall vocabulary ability. (M = 76.58, SD = 8.06, range = 55.82–124.25).

Analysis Plan

In preliminary analyses, we used Pearson correlations to test relations between DCCS and Flanker scores. If correlated, DCCS and Flanker scores were standardized and averaged to form a composite for the parent and for the child, indicating overall EF performance. If parents or children were missing either DCCS or Flanker scores, the score they did have was used for their EF composite. Group differences between the two versions of DCCS were assessed using independent samples t tests. If there were differences in performance between the different DCCS stimuli, DCCS stimulus type would be included as a covariate in further analyses.

Next, Pearson correlations examined child receptive vocabulary and age in relation to child EF. If children's receptive vocabulary or age were significantly correlated with child EF performance, then it would be included as a covariate in further analyses. Children's gender and race were also examined as potential covariates. Group differences between male and female children in EF were assessed using independent samples t tests. Because our largest racial group consisted of European American participants, group differences between European American children and non-European American children in EF were also assessed using independent samples t tests. If there were any significant gender or racial group differences, it would be included as a covariate. Group differences between children who attended preschool and children who did not attend preschool were also assessed using independent samples t tests. If there were any significant differences, it would be included as a covariate.

In the main analyses, we first tested the relationship between parent and child EF, as well as the relationship between parental strictness and parental warmth with parent EF, using Pearson correlations. If either parental strictness or parental warmth was related to both parent and child EF, ordinary least squares regression (Hayes, 2013) was conducted to determine whether the parenting variable mediated the effect of parent EF on child EF. Bias corrected bootstrap confidence intervals at the 95% level based on 5,000 samples were used to test indirect and direct effects. Finally, to examine whether and how the relationship between parent and child EF differed as a function of specific SES components, separate moderation models were conducted where parent EF was the independent variable and child EF was the dependent variable. Income, parent education, and parent occupational prestige were each tested as a moderating factor. Moderation analyses also used ordinary least square path analysis (Hayes, 2013) where significant effects were estimated using bias-corrected bootstrap confidence intervals at the 95% level and based on 5,000 samples.

Results

Preliminary Analyses

Flanker and DCCS performance were positively correlated for children, $r(68) = .32$, $p = .006$; and for parents, $r(106) = .54$, $p < .001$. Thus, DCCS and Flanker scores were standardized and averaged to form EF composites. Child receptive vocabulary was related to child EF performance, $r(99) = .38$, $p < .001$, so therefore was used it as a covariate for further analyses in order to examine unique contributions to children's EF. There were no age, gender differences, racial differences, or differences between children who attended preschool or not, on children's EF performance and therefore these demographic factors were not included as covariates. There was a group difference in performance between the two DCCS stimuli such that children who completed the shape-color version performed better than children who completed the shape-number version, $t(110) = 4.01$, $p < .001$. Therefore, DCCS stimuli type was included as a covariate in further analyses.

Parent EF, Child EF, and Parenting

Correlations of all variables of interest are shown in Table 2. Parent and child EF were positively correlated, $r(113) = .19$, $p = .049$. In addition, parents who reported higher levels of strict and overprotective parenting had poorer EF performance, $r(86) = -.23$, $p = .036$. Parental strictness was not related to child's EF performance; therefore mediation analyses were not performed to test whether parental strictness mediated the relationship between parent and child EF.

Role of SES Indicators on Parent and Child EF

To understand whether the association of parent EF with child EF varied depending on different SES factors, we conducted ordinary least squares path analysis (Hayes, 2013) to determine first, if household income moderated the association between parent EF and child EF. Parent EF was the independent variable, income group was the potential moderator, and the dependent variable was child EF with child receptive vocabulary and DCCS stimuli type were included as covariates. As shown in Figure 2 and Table 3, a conditional process model, $F(5, 87) = 8.65$, $p < .001$, yielded a significant parent EF × income interaction ($b_3 = -.46$, $p = .032$, CI [−.88, −.04]), revealing a conditional effect of parent EF on child EF ($B = .59$, $p = .002$, CI [.22, .95]). In lower income households, better parent EF was associated with better child EF. However, in higher income households, the relationship between parent EF and child EF was no longer significant ($B = .13$, $p = .230$, CI [−.08, .34]). Illustration of the moderation model using simple slopes is shown in Figure 3. Next, to explore whether the association of parent EF with child EF varied depending on other SES indicators, ordinary least squares path analysis was conducted to determine if parent education or occupational prestige moderated the association between parent EF performance and child EF performance. However, these moderation models were not significant.

Discussion

In a sample of preschoolers, we investigated the link between parent and child EF, as well as the role of parenting characteristics and socioeconomic indicators on the association of parent and child EF. To our knowledge, this is the first study to look at a parent and child EF relationship as a function of different SES indicators. First, we assessed whether there was a significant relationship between parent and child EF and between parenting and parent EF. Then, we determined whether parenting partially mediated the association between parent and child EF. Finally, we examined how individual SES dimensions played a role in moderating the relationship between parent and child EF. We found that parent and child EF were positively correlated, and parental strictness and parent EF were negatively correlated. In addition, income

Table 2
Correlations Amongst Measures

Measure	1	2	3	4	5	6	7	8
1. Parent EF	—	.19*	.25**	.19*	.17	−.23*	.15	.01
2. Child EF		—	.28**	.18	.28**	−.06	.15	.39**
3. Household income			—	.67**	.57**	−.01	.14	.11
4. Parent education				—	.68**	−.22*	.22*	.16
5. Parent occupational prestige					—	−.23*	.27*	.06
6. Parental strictness						—	−.17	.09
7. Parental warmth							—	.01
8. Child receptive vocabulary								—

Note. EF = executive functioning.
* $p < .05$. ** $p < .01$.

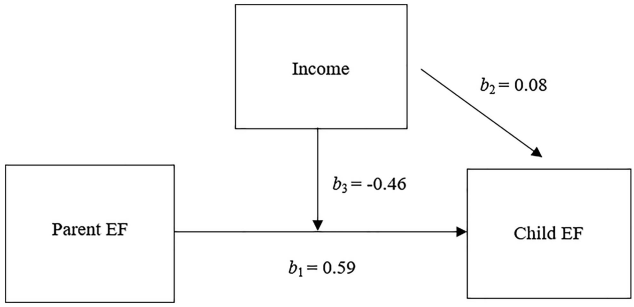

Figure 2. Moderation model of the effect of parent executive functioning (EF) on child EF. Controlling for the effects of income, children's receptive vocabulary, and Dimensional Change Card Sort (DCCS) stimuli type, parent EF had a direct effect on child EF (b_1 = 0.59; CI[0.22, 0.95]). There was a significant Income × Parent EF interaction (b_3 = −0.46; CI[−0.88, −0.04]) yielding a conditional effect of parent EF on child EF.

was the only SES indicator that moderated the relationship between parent and child EF such that only in lower income households was parent EF related to child EF. Findings indicate that the association between parent and child EF may depend on specific SES dimensions such as income.

First we examined potential mechanisms underlying the association between parent and child EF to determine whether it can be explained in part by differential parenting characteristics. Consistent with the literature and our expectations, there was a main effect between parent and child EF, such that better parent EF was related to better EF in the overall sample. Further, our findings highlight that parental strictness was related to parent EF, such that parents who reported using stricter and more overprotective parenting demonstrated poorer EF performance in the laboratory, supporting a growing literature that finds parent EF matters for parenting (for review see, Bridgett et al., 2015; Crandall et al., 2015). EF is a critical aspect for parenting especially when child behavior is challenging, the parent has to use EF to control feelings of frustration and anger to prevent negative reactions (Deater-Deckard, Wang, Chen, & Bell, 2012). Parents use inhibitory control skills to avoid expressing negative reactions such as overly strict parenting, which may also be elicited by disobeying children. Parents also use cognitive flexibility skills to switch on and off between different situations and their corresponding demands (Barrett & Fleming, 2011). Perhaps parents who report having stricter or more overprotective parenting styles may have difficulty with flexibility and view parenting and discipline with more rigidity, which may be reflective of more difficulty with EF tasks. Although parental strictness related to parent's EF, it did not relate to child EF, contrary to our expectations. It might be that parental strictness is not as influential on developing EF as other parenting characteristics such as harsh or insensitive parenting, which have been linked to poor EF in children (Blair et al., 2011; Deater-Deckard, Chen, Wang, & Bell, 2012; Lucassen et al., 2015). The aspect of parenting that we measured in our current study may have more implications for parent's own EF. Future studies should include a comprehensive assessment of multiple parenting character-

Table 3
Model Coefficients and Summary Information for Moderation Model of Parent EF and Child EF

Antecedent		Child EF Coeff.	*SE*	*p*
Parent EF	b_1	.59	.18	.002
Income	b_2	.08	.20	.68
Income × Parent EF	b_3	−.46	.21	.03
Child receptive vocabulary		.03	.01	<.001
DCCS stimuli type		−.58	.15	<.001
Constant		−1.81	.79	.02
R^2 = .33				
F(5, 87) = 8.65, p < .001				

Note. Coeff.= Coefficient; EF = executive functioning; DCCS = dimensional change card sort.

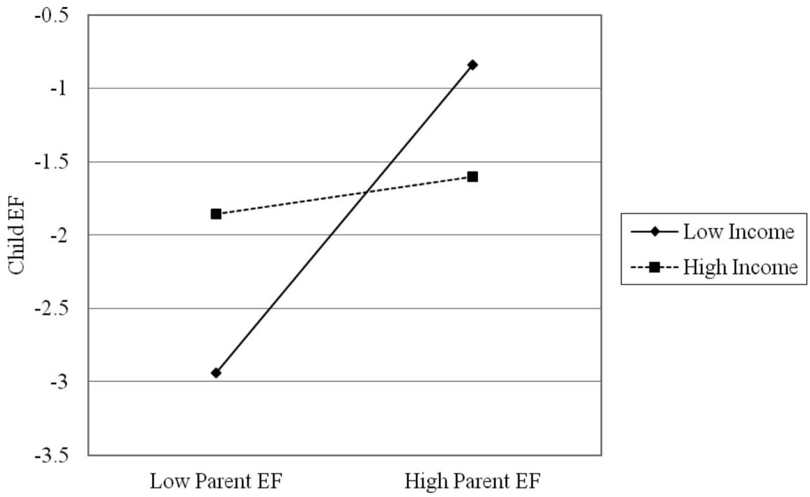

Figure 3. Estimated marginal means for child executive functioning (EF) performance by income levels as a function of parent EF performance 1 *SD* below and 1 *SD* above the mean. Among lower income families, child EF was closely linked to parent EF, whereas for high income families, the slope was flatter.

istics to determine which parenting characteristics are specific to emerging EF skills.

Next, we explored the interplay of individual SES factors on the relationship between parent and child EF. We kept our SES indicators separate rather than forming an overall composite as different SES constructs may have unique links to children's experiences and outcomes (Duncan & Magnuson, 2003). We found that income levels significantly moderated the association between parent and child EF, whereas parent education levels and occupational prestige did not. This suggests that for children facing more economic strain, parent EF served as a protective factor for EF development. It could be that parent EF is particularly protective in lower income households that are likely experiencing both economic and psychosocial stressors—a parent with good EF may be particularly adept at buffering their child from those stressors and possible negative influences of low SES. SES differences in EF that are first observed in early childhood could be early indicators of an enduring EF difference, or perhaps merely a temporary gap that reflects slower EF development in lower income households. Although no conclusive determination can be drawn from the current cross-sectional data, a recent meta-analysis of SES and EF in children and adolescents aged 2 to 18 observed a small-to-medium effect size of SES disparities in EF across this age range (Lawson, Hook, & Farah, 2018), suggesting the SES differences observed in the current study are likely to be enduring. As our finding of income moderating the association between parent and child EF is novel, it will be important for future research to examine whether this interplay persists across development. In addition, parent occupational prestige was related to child EF, further highlighting that different components of SES may have distinct associations with other factors. Perhaps parents who have higher status jobs may have more flexibility in their work schedules which may increase opportunities to foster their child's EF skills through interactions.

Our findings identify that one possible pathway in which child EF is compromised is through parent EF. If parent's own EF is a risk for children's developing EF skills then perhaps helping to improve parent EF is one potential strategy to improve child EF but may not be a long-term solution. Although EF has been improved in adults through training (see, for review, Crandall et al., 2015), these initial effects do not appear to be long lasting or generalizable to other cognitive domains (Melby-Lervåg & Hulme, 2013). Instead, it may be more beneficial for interventions to target parenting. Helping parents improve the foundational skills necessary for effective parenting skills, such as scaffolding, would apply to many daily parent–child interactions with implications for improving child cognitive outcomes (St. John et al., 2018).

Income was the only SES indicator that was a significant moderator of parent and child EF. This supports the argument that SES constructs should be assessed separately as they may be providing distinct information and will differentially relate to children's functioning. This finding has implications for intervention work, demonstrating that different aspects of SES may be sensitive to different interventions (Ursache & Noble, 2016). Based on our finding, it may be critical to provide interventions that help improve EF specifically for families in lower income households. Focusing on improving these particular parents' EF skills may help improve their children's EF, however, this type of intervention will require greater exploration. Future studies should continue to explore the different relationships of individual SES indicators with other social and cognitive outcomes. In addition, parental report on both subjective and objective measures of SES both independently and positively related to children's EF (Ursache, Noble, & Blair, 2015). Thus, in futures studies, measures that capture subjective social status should be incorporated in study designs to parse out the differences among individual's perception of their own SES compared to objective measures. For example, asking the parent whether they perceive themselves as economically strained or have them rank themselves on a SES ladder in relation to their community may capture SES in a more comprehensive manner.

Although findings from our study contribute to the understanding of socioeconomic risk and EF in early childhood, the sample was predominantly low risk. Most primary caregivers had at least a college degree and although a subset of the sample was considered economically strained making it possible to look at income risk groups, parents were mostly well-educated. Our income group cutoff was a conservative estimate of which families would be most likely economically strained due to the high cost of living in Boston and does not account for other information such as household size, child care expenses, housing costs, financial debt, or other family expenses. Future studies should incorporate these additional factors to have a more comprehensive assessment of socioeconomic status.

Another limitation to our current analyses is that we did not include a behavioral parenting measure and did not collect at-home language information. Observing how parents and children interact through free play or a constructive dyadic activity may elucidate whether parents who are better able at providing sensitive parenting have better EF themselves or whether certain high-quality parenting behaviors are contributing to children's emerging EF. In addition, our receptive vocabulary measure is only validated for English or Spanish speakers therefore Mandarin-speaking participants were missing a measure of receptive vocabulary. It would be of interest to conduct these analyses with larger samples of Chinese speakers and a normed Chinese vocabulary measure, to determine if similar associations between EF and receptive vocabulary apply. Future studies would benefit from direct measures of parenting quality and collecting language information (e.g., percentage of primary language spoken or heard at home, other languages spoken or heard) from parents about the language exposure at home.

In addition, our findings were based on the primary caregiver's EF abilities. It is possible that children's EF may be influenced by both parents due to different parenting styles, how much time the other parent spends with the child at home, and the other parents' own EF abilities. Future studies should collect behavioral EF assessments and parenting measures from both parents for a comprehensive understanding of the relationship between parent and child EF. Finally, although we examined EF as a unified construct of inhibitory control and cognitive flexibility, other aspects of EF such as working memory should also be considered in future research.

Conclusion

This study adds to the growing literature seeking to understand the early factors that influence emerging EF abilities important for school readiness and academic success. We examined how parenting behaviors and individual SES indicators contribute to the association between parent and child EF. We found that parenting strictness was associated with parent's own EF and that parent EF was especially important for children in lower income households, who are already at risk for EF deficits. Therefore, targeting parent EF may be a fruitful strategy and would be beneficial to examine this in future research. Additionally, the role of parent EF was not the same for children who face different SES risks. The association between parent and child EF functioned differently depending on income levels, but not other SES indicators such as parent education and occupational prestige. Taken together, these results suggest the need for more nuanced studies to look at how specific individual factors interact with separate EF constructs to understand the etiology of EF deficits and inform targeted intervention.

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