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Autonomy-Supportive Parenting and Associations with Child and Parent Executive Function

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Highlights

- Autonomy support was associated with executive function in preschoolers.
- Parent executive function was related to autonomy-supportive parenting behaviors.
- Autonomy support mediated the link between parent and child executive function.
- The findings have implications for two-generation intervention approaches.

Abstract

Autonomy-supportive parenting appears to play an important role in children's executive function (EF) development. However, few studies have accounted for parents' EF skills when examining the link between parenting and child EF in families from diverse socioeconomic backgrounds. In the current study, parents and their 3- to 5-year-old children (N = 85 dyads) were assessed in the fall of preschool on well-validated behavioral assessments of EF and participated in a dyadic problem-solving task. We found that parent EF and child EF were correlated, both were associated with autonomy-supportive parenting, and these links were not moderated by socioeconomic status. Autonomy support was a predictor of child EF skills above and beyond parent EF, and bootstrapping mediational analyses confirmed that autonomy-supportive behaviors mediated the link between parent-child EF. These results provide initial evidence for the intergenerational transmission of EF through autonomy support.

Keywords: executive function; autonomy-supportive parenting; socioeconomic status

Autonomy-Supportive Parenting and Associations with Child and Parent Executive Function

Decades of research have documented the importance of executive function (EF) skills for academic success and social competence (e.g., Best, Miller, & Naglieri, 2011; Blair & Razza, 2007; Carlson & Moses, 2001; McClelland, Cameron, Connor, Farris, Jewkes, & Morrison, 2007). EF skills are neurocognitive processes employed in goal-directed actions and are comprised of working memory, inhibitory control, and cognitive flexibility (Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000). Given the importance of EF skills for positive child outcomes, there is immense interest in understanding the factors that influence EF development in the preschool years when these skills are rapidly developing (Carlson, 2005; Diamond & Taylor, 1996). Identifying factors that bolster EF is particularly critical for children from low socioeconomic backgrounds, who tend to have lower EF skills compared with peers from higher socioeconomic families (Noble, McCandliss, & Farah, 2007). Parenting has been linked to EF development in children (for review, see Fay-Stammbach, Hawes, & Meredith, 2014; Valcan, Davis, & Pino-Pasternak, 2017), and prior research has shown that parenting may be a key mechanism for the intergenerational transmission of self-regulation (Cuevas, Deater-Deckard, Kim-Spoon, Watson, Morasch, & Bell, 2014). Few studies, however, have focused specifically on parent EF and relations to both parenting and child EF. Furthermore, these processes are rarely examined in families from lower and middle socioeconomic backgrounds. The present study investigated associations between parent EF, autonomy-supportive parenting behaviors, and early childhood EF skills, as well as the extent to which autonomy support mediated associations between parent EF and child EF during the preschool years. Additionally, we explored whether families' socioeconomic background moderated associations between

parent EF, parenting behaviors, and child EF to examine whether these processes function differently across socioeconomic gradients.

Parenting and Child EF

Parenting behaviors that are autonomy-supportive appear to be uniquely important for bolstering EF development in young children (Bernier, Carlson, & Whipple, 2010). Autonomy support consists of distinct parenting behaviors: (1) providing children with the appropriate amount of help for their skill level (i.e., scaffolding); (2) encouraging and appropriately praising children; (3) taking children's perspectives; (4) following children's lead and providing them with choices (Bernier et al., 2010; Grolnick, Gurland, DeCourcey, & Jacob, 2002; Whipple, Bernier, & Mageau, 2011). Autonomy-supportive behaviors may promote EF development because EF skills are strengthened when children engage in tasks that are challenging, but not overly so (Diamond & Ling, 2016; Ericsson, Nandagopal, & Roring, 2009). Autonomy support works within children's zone of proximal development: this is the area just beyond what they can do on their own, but what they can accomplish with the support of a more knowledgeable social partner (Vygotsky, 1987). EF skills are used during effortful (as opposed to automatic) goal-directed tasks (Miyake et al., 2000), and autonomy-supportive parents ensure that their children are given an opportunity to utilize their EF skills within their zone of proximal development.

Researchers have assessed autonomy-supportive parenting behaviors with preschoolers in a puzzle-building task that is too challenging for children to complete on their own (Bernier et al., 2010; Whipple et al., 2011). To complete a farm puzzle, for example, a child needs to focus on a specific section of the puzzle (e.g., the barn) and use their inhibitory control to ignore the irrelevant pieces (e.g., the horse in the field). With many pieces, a preschooler may become overwhelmed with the number of options, and an autonomy-supportive parent can draw the

child's attention to the barn pieces and move the animal pieces to the side. Here, the preschooler still needs to use inhibitory control to find the correct piece among all the barn pieces, but the parent's support helps ensure the child's capabilities are not overloaded by every possible option. Similarly, an autonomy-supportive parent may remind a child which pieces the child is looking for to ensure the goal is retained in the child's working memory. Finally, if a child is perseverating by continuing to put a roof piece where the barn door is, an autonomy-supportive parent may suggest alternate options to redirect the child's attention, which helps the child practice cognitive flexibility. Autonomy-supportive parents not only support EF skills during a task at hand, but they also support children's sense of competence and self-efficacy by providing children with choices, acknowledging their perspective, and allowing them to feel a sense of accomplishment. Children may take these feelings of self-efficacy to other challenging tasks, which continue to strengthen their EF skills (Bernier et al., 2010). Taken together, autonomy-supportive parents provide both a manageable context for practicing EF skills in a given moment and bolster children's self-efficacy to pursue future opportunities to strengthen their EF skills.

A number of empirical studies have substantiated the theoretical importance of autonomy support for EF development. Hammond, Müller, Carpendale, Bibok, and Liebermann-Finestone (2011) found that scaffolding behaviors, which allow children to work in their zone of proximal development, were positively associated with preschool EF. Furthermore, Bernier and Carlson found that higher levels of autonomy support were both concurrently and predictively linked with higher EF skills in infants and toddlers, and predicted higher EF in preschoolers (Bernier et al., 2010; Bernier, Carlson, Deschênes, & Matte-Gagné, 2012). This relation held after controlling for the children's verbal ability, maternal sensitivity, and maternal mind-mindedness (i.e., the tendency to use mental state terms), suggesting that autonomy support provides a unique

learning context for developing EF skills over and above other types of parenting behaviors. There is also longitudinal evidence that the positive link between early autonomy-supportive behaviors and academic achievement in high school is partially mediated by child EF in the preschool years (Bindman, Pomerantz, & Roisman, 2015). However, none of the aforementioned studies measured parent EF skills, which are associated with both child EF and parenting behaviors.

Parenting and Parent EF

What makes some parents more autonomy-supportive than others? Strong EF skills in parents themselves may be particularly important for employing autonomy support. For example, when autonomy-supportive parents provide children with choices, give children opportunities to try, and allow children to work at their own pace, parents must use their inhibitory control to prevent themselves from completing the task for their children (Meuwissen & Carlson, 2015). Scaffolding behaviors (i.e., providing children with appropriate help) may be most successful when parents can flexibly switch between different approaches to helping their children, rather than perseverating on one suggestion that the children are not understanding (Mazursky-Horowitz, Thomas, Woods, Chrabaszcz, Deater-Deckard, & Chronis-Tuscano, 2018). Finally, parents' working memory is necessary for remembering which strategies and supports they have given their children, as well as keeping the goals of the task in mind (Mazursky-Horowitz et al., 2018; Sturge-Apple, Jones, & Suor, 2017). One study demonstrated that autonomy-supportive behaviors were positively associated with fathers' performance on an inhibitory control task, but were not related to performance on a cognitive flexibility task (Meuwissen & Carlson, 2015). However, there was a ceiling effect in fathers' cognitive flexibility, and the authors concluded

that more research is needed to explore the association between parent EF skills and autonomy support in a sample of mothers and fathers.

Although there is limited research regarding the relation between parent EF and autonomy support, a number of studies have examined aspects of parent self-regulation more broadly. Self-regulation refers to the bottom-up and top-down processes that work together to modulate one's own behaviors; EF has been conceptualized as one top-down aspect of self-regulation (Jones, Bailey, Barnes, & Partee, 2016; Nigg, 2017). Converging evidence suggests that parent self-regulation is positively associated with parental sensitivity, warmth, and involvement, and negatively related to harsh parenting (Azar, Reitz, & Goslin, 2008; Crandall, Deater-Deckard, & Riley, 2015; Deater-Deckard & Bell, 2017; Mazursky-Horowitz et al., 2018; Shaffer & Obradović, 2017; Sturge-Apple et al., 2017; Sturge-Apple, Suor, & Skibo, 2014; Zeytinoglu, Calkins, Swingler, & Leerkes, 2017). Furthermore, there is an emerging literature on parenting behaviors as an important mediator of the relation between parent self-regulation and child self-regulation, as discussed below.

Intergenerational Transmission of Self-Regulation

Bridgett and colleagues synthesized years of research that supports the intergenerational transmission of self-regulation and proposed a conceptual model of possible mechanisms to explain the link between parent and child self-regulation (Bridgett, Burt, Edwards, & Deater-Deckard, 2015). The model incorporates biological influences, such as genetic and epigenetic pathways, from parent to child, as well as the transmission of self-regulation through social influences, such as parenting behaviors, familial dynamics, and the broader ecological context. Indeed, recent empirical evidence has provided support for this model. One study showed that emotional support (i.e., parenting behaviors that serve to externally regulate a child) mediated the

link between maternal effortful control and preschoolers' EF skills (Zeytinoglu et al., 2017). This study, however, used a self-report measure of maternal effortful control and a different set of measures of child EF; it is not clear whether these results would replicate with a performance-based assessment of EF given to both parents and children. A second study by Cuevas, Deater-Deckard, Kim-Spoon, Watson et al. (2014) explored aspects of negative parenting (e.g., intrusiveness, negative affect), behavioral assessments of maternal EF, and EF in preschoolers and found that negative parenting behaviors mediated the link between maternal EF and changes in child EF from 36- to 48-months. This study provided initial evidence that both parent EF and negative caregiving each account for individual differences in child EF in the preschool years. However, the study focused on negative parenting behaviors, and past research has suggested that negative and positive aspects of parenting may have differential effects on EF development. For example, Blair et al. (2011) found that children's cortisol levels partially mediated the effect of positive parenting (e.g., sensitivity, positive regard, scaffolding) on child EF, but this was not the case for negative parenting (e.g., intrusiveness and negative regard). To better understand the intergenerational transmission of EF, it is important to include positive parenting behaviors and assess parent EF with performance-based measures.

Moderating Role of Socioeconomic Status

Although there is initial support for the intergenerational transmission of self-regulation, most of the research thus far has been done with families from high socioeconomic backgrounds. There is a gap in the understanding of how these processes operate across socioeconomic gradients. Several studies have explored how socio-demographic factors moderate associations between parenting and child outcomes. In one review, Bernier and Meins (2008) noted that maternal insensitivity was positively linked to disorganized attachment styles in infants from low

socioeconomic backgrounds, but this association was not apparent in high socioeconomic status families. The authors suggested that infants from low socioeconomic backgrounds may have been exposed to a number of other risk factors (e.g., marital discord, chaos in the home) that made them particularly vulnerable to negative parenting behaviors. In the cognitive domain, Hughes and Ensor (2005) examined positive parenting behaviors and EF skills in 2-year-olds. The sample consisted of families in which one-third endorsed no markers of social disadvantage (e.g., living in a poor neighborhood, head of household had no educational qualifications, etc.), 45% endorsed between 1 and 3 markers of social disadvantage, and about 20% endorsed 4 or more markers. They found that the link between positive parenting and child EF was attenuated after controlling for child age and verbal ability in this socio-demographically diverse sample.

Only two studies, to our knowledge, have examined socioeconomic status as a moderator of autonomy support and child outcomes, though neither study included measures of child EF. McElhaney and Allen (2001) found that for adolescents experiencing high socioeconomic risk (i.e., lived 200% below the poverty line and in unsafe neighborhoods), autonomy was associated with higher levels of delinquency and lower peer competence. Importantly, autonomy was positively associated with social competence in adolescents experiencing low socioeconomic risk. Furthermore, Gutman, Sameroff, and Eccles (2002) examined the impact of cumulative risk on the association between democratic decision-making (i.e., a characteristic of autonomy support) and academic achievement in adolescents. They demonstrated that risk moderated the association between democratic decision-making and academics, such that higher levels of democratic decision-making were associated with academic achievement only in adolescents with fewer risk factors. These few studies indicate that socioeconomic status may be an

important moderator, but there has yet to be a direct examination of socioeconomic status as a moderator of autonomy support and EF skills in young children.

Previous findings are mixed regarding the extent to which parent self-regulation is associated with parenting behaviors in families from low socioeconomic backgrounds. Deater-Deckard, Wang, Chen, and Bell (2012) found that parental working memory and harsh parenting were only negatively associated in households with low levels of chaos, which is more common in families from higher socioeconomic backgrounds (Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005). In a sample of homeless families, parent emotion regulation, but not working memory, was positively related to positive parenting behaviors (Monn, Narayan, Kalstabakken, Schubert, & Masten, 2017). Conversely, Obradović, Portilla, Tirado-Stayer, Siyal, Rasheed, and Yousafzai (2017) found a positive association between maternal working memory and scaffolding behaviors in a sample of low-income families from rural Pakistan. One final study that included families with a range of annual family incomes (e.g., 23% reported less than $50,000 per year and 36% reported over $200,000 per year) found that both parental EF and emotion regulation were positively associated with sensitive and responsive parenting (Shaffer & Obradović, 2017). Although the study measured financial stress, the authors did not explore whether financial stress moderated the link between parent self-regulation and parenting behaviors. To better understand how socio-demographic context influences the relation between parent self-regulation and parenting, it is important to test statistically for moderation effects.

Current Study

The current study had two primary aims: (1) to examine links between parent EF, autonomy support, and child EF, and the extent to which autonomy support mediates the link between parent EF and child EF, and (2) to determine whether relations among parent EF,

autonomy support, and child EF vary as a function of socioeconomic factors within a diverse sample that included lower, middle, and higher levels of socioeconomic status. Given the mounting theoretical support and empirical evidence, we hypothesized that autonomy support would be positively associated with child EF and parent EF. In line with Bridgett and colleagues' (2015) model, we hypothesized that autonomy support would mediate the parent-child EF association.

The second aim of this study was to explore the relevance of autonomy-supportive parenting for child EF development across socioeconomic gradients. The studies that have examined parenting and EF skills in families with diverse socioeconomic backgrounds have found mixed results. The present study examined whether two aspects of socioeconomic status – annual family income and parent education level – would moderate the associations among parent EF, autonomy support, and child EF. This study will add to the growing body of work that has examined the extent to which parenting behaviors differentially affect child outcomes depending on the socio-demographic context (e.g., Bernier & Meins, 2008). Furthermore, it is critical to conduct research with samples from diverse socioeconomic backgrounds to increase the generalizability of findings. If autonomy support is found to be relevant for child EF across a wider range of socioeconomic contexts, then it may become a target for interventions to promote the development of EF and reduce gaps in opportunity and achievement.

Method

Participants

Eighty-five parents (72 mothers and 13 fathers) and their preschool children (44 males, 39 females, 2 not reported) participated. Child ages ranged from 40-65 months (M = 53.92, SD = 6.32). Parents' ages ranged from 21-70 years (M = 33.37, SD = 8.22). Families were recruited

from six schools in a small city in the Midwestern United States. They included all of the schools in the district operating Pre-K programs. Two of the schools were Title I schools (i.e., schools with a large low-income population) and the third served Title I eligible children. The other three schools included some fee-paying parents, with only one of the three schools serving predominantly fee-paying parents. As such, the sample included a range of socioeconomic diversity. Over one-third of families reported an annual income of less than $25,000, 19% reported between $25,000 and $49,999, 23% between $50,000 and $99,999, 6% reported over $100,000; 18% did not report annual income information. By comparison, in the United States in 2016, 14% reported incomes of less than $25,000, 20% between $25,000 and $49,999, 32% between $50,000 and $99,999, 34% over $100,000 (U.S. Census Bureau, 2017). There also was variability in the primary caregiver's highest level of education: 4% did not complete high school, 8% completed their GED, 20% reported a high school diploma, 33% reported completing some college, 8% reported a bachelor's degree, 19% had either some graduate school or a graduate degree, and 8% did not report education information. Nationally, 10% of adults 25 years and older did not complete high school, 29% reported a high school diploma, 27% had some college or a vocational degree, 21% reported a bachelor's degree, and 13% had either some graduate school or a graduate degree (U.S. Census Bureau, 2017). Parents and children were primarily European American, non-Hispanic (70% European American, 22% Black/African American, 4% Hispanic/Latino, and 4% other).

Procedure

Parent-child dyads were recruited through their children's Pre-K program as part of a larger longitudinal school-based intervention study designed to promote EF skills in preschoolers and their parents, but only the baseline assessments were considered in the current study. Not all

children in the larger study had a parent who was willing or able to participate. However, 41% of eligible parents participated along with their children, and this subset of families was included in the present study. Each school mailed an informational letter about the study and a consent form to all families with a child between the ages of 3- and 5-years. Families were excluded from the study if the parents did not speak English. Because parents and children were assessed before the start of the intervention, families who were randomly assigned to either the intervention or control conditions were included in the present study. Children completed a battery of cognitive tasks in the fall at their schools. Trained assessors tested the children on one subtest of the Woodcock Johnson III Tests of Achievement (Letter-Word Identification) and two EF tasks: Head-Toes-Knees-Shoulders (HTKS) and the Minnesota Executive Function Scale (MEFS™). Parents participated in the fall during a parent night at the child's school. They completed an assessment of their EF skills using the MEFS and their parenting behaviors using a dyadic problem-solving task with the child in the intervention. Parents were compensated with a $25 gift card after completing the assessments.

Measures

Head-Toes-Knees-Shoulders (HTKS). The HTKS (McClelland et al., 2014) task requires working memory, inhibitory control, and cognitive flexibility. The experimenter first presented children with two commands: "touch your head" and "touch your toes." Then children were told they were going to play a "silly" game and do the opposite of what the experimenter says. For example, if they were told to "touch your head," children should touch their toes. There were 4 practice trials with feedback and then 10 test trials with no feedback. Children received a 0 on any given trial if they gave an incorrect response (i.e., touching their head when the experimenter asked them to touch their head). Children were given a 1 if they self-corrected (i.e.,

began to touch their head, but then corrected to touch their toes). Two points were given for fully correct responses. If children earned 4 or more points on the 10 test trials, the experimenter continued to Part II. In Part II, the experimenter introduced two new rules: "touch your shoulders" and "touch your knees." As in Part I, children were told to do the opposite of the experimenter's command and were given 4 practice trials. However, the 10 test trials included all of the rules the children had learned thus far (e.g., head, toes, knees, shoulders). If children scored more than 4 points out of 10, they continued to Part III. In Part III, all the rules the children had learned were scrambled, such that when the experimenter told the children to "touch their head," they must touch their knees. Again, children were given 4 practice trials with feedback and 10 test trials. Points were summed from each part for a possible 60 points total. The HTKS task has been shown to be reliable and valid with diverse groups of children, including low-income children (e.g., McClelland et al., 2014). Reliability in the current sample was $\alpha = .84$.

Minnesota Executive Function Scale (MEFS™). The MEFS (Carlson & Zelazo, 2014) is a tablet-based measure of EF that is standardized, reliable, valid, and normed. It can be used with children as young as 2-years-old and throughout the lifespan. The adaptive task consisted of 7 levels of increasing difficulty in which children sorted virtual cards into boxes according to different rules, which required cognitive flexibility, working memory, and inhibitory control. Children sat next to the experimenter, with the tablet in front of them. The MEFS assigned the recommended starting level based on age norms. For example, at the starting level for 4-year-olds, the experimenter presented the children with two boxes displaying different animals in different colors. The experimenter turned over the card in the middle of the screen that matched the boxes by color or shape and demonstrated the sorting rule. The experimenter then turned over

the cards for children to sort by themselves. Children were given two practice trials with feedback. In Part A, children sorted by the rule they learned in the demonstration and practice trials (e.g., shape). If children correctly sorted 4 of the 5 cards, they moved on to Part B and were instructed to sort by the other dimension (e.g., color). If children did not pass Part A, or if they failed to sort correctly on Part B, they moved down one level and continued to move down until they either passed a level or failed Level 1. If children passed Part B, they moved up to the next level, and continued until they failed (total test time under 5 min on average). Final scores were calculated using the MEFS software algorithm based on accuracy and reaction times (possible range = 0-100). The MEFS is normed on a representative sample of 7,410 typically developing children in the U.S. ages 2-13 years (Carlson, 2017).

Parents also were given the MEFS as described above, but because of their age, all participants started at Level 5. Parents were given less scaffolding than children. For example, parents turned over their own cards to sort. Furthermore, in Levels 6 and 7, the experimenter only read the parents a rule reminder one time and then informed the parents that there were two more rule reminders throughout the test trials that they could choose to read themselves. As with the child scores, parent scores on the MEFS accounted for both accuracy and reaction time for a total adjusted score (0-100). The adult norms for the MEFS are based on a representative sample of 553 adult parents of young children in the U.S. (Carlson, 2017).

Dyadic puzzle task. Parents and children were given a puzzle to work on together for 10 minutes. The puzzle consisted of 12-cube puzzle pieces with different animals on each side. To successfully complete the puzzle, parents and children had to first find all of the correct pieces for a single puzzle and then put them together in the correct spatial configuration. The experimenter told the parents:

> This is a cube puzzle. There are pictures of animals on the different sides. We would like you to do the cow puzzle first. If you do finish the cow puzzle, you can choose a different puzzle. We would like to see what your child can do by him or herself, but feel free to provide him or her with any help that you would like. I will be back in a little bit.

The instructions were purposefully vague in an attempt to elicit spontaneous parenting behaviors that may be more reflective of the dyad's typical interactions in more naturalistic settings. After the instructions, the experimenter left the room and came back after 10 minutes to end the task. A number of other studies have used this task to assess autonomy-supportive parenting with preschoolers (Bernier et al., 2010; Matte-Gagné & Bernier, 2011; Matte-Gagné, Bernier, & Gagné, 2013; Meuwissen & Carlson, 2015; Whipple et al., 2011).

The parent-child puzzle task was videotaped and later coded on four dimensions of autonomy support according to the Whipple et al. (2011) coding system: (1) the extent to which the parent intervened according to the child's needs and adapted the task to provide optimal challenge for the child; (2) the extent to which the parent encouraged and praised the child, provided helpful hints and suggestions, and used a tone of voice that communicated to the child that the parent was there to help; (3) the extent to which the parent took the child's perspective and was flexible when attempting to keep the child on task (only coded if the child was off task for more than 5 seconds); and (4) the extent to which the parent followed the child's pace, provided the child with choice, and ensured that the child played an active role in the interaction. Each of the dimensions was coded on a scale of 1 (*not autonomy-supportive*) to 5 (*very autonomy-supportive*). Because there were high inter-correlations among the four dimensions (range from .64 to .85), they were averaged to create one total score of autonomy support as is typical of past studies that have used this coding scheme (e.g., Bernier et al., 2010; Whipple et

al., 2011). Intercoder reliability was established on 30% of the videotaped interactions and was excellent (*ICC* = .93).

Control variables. The schools provided information on child age, which was included as a covariate in the subsequent analyses. The Woodcock Johnson Tests of Achievement III – Letter-Word Identification subtest – was used as a measure of academic knowledge. In this standardized assessment of early literacy, children were asked to find a specific letter on a page with other distractor items (e.g., objects or other letters; Woodcock, McGrew, Mather, & Schrank, 2001). Each trial increased with difficulty, such that the later trials consisted of reading words on the page. The task ended when the children answered at least 6 consecutive questions incorrectly at the end of a given page. If the children answered 6 questions incorrectly before the end of a page, the experimenter continued with the remaining questions on the page. In this case, if the children answered one of the remaining questions correctly, the experimenter continued to the next page and did so until the children answered at least 6 incorrectly at the end of a page. Standard scores, which reflect the children's percentile rank, were created based on the total raw score. Given that academic knowledge and child age are robustly associated with children's EF skills (Blair & Razza, 2007; Carlson, 2005), we included them as control variables to investigate effects that are unique to children's EF skills.

Results

Missing Data

There were some missing data for our variables of interest: annual family income (18% missing), autonomy support (13% missing), parent education level (8% missing), child EF composite and Letter-Word ID (both 5% missing), and child age (2% missing). All 85 parents

completed the EF assessments. To explore the mechanism of the missing data, we examined how the missingness was related to other variables in our data. Parent EF was negatively associated with missingness of autonomy support (r = -.20), annual family income (r = -.25), and parent education level (r = -.20). Missingness of autonomy support was also correlated with Hispanic/Latino ethnic background (r = .32). Finally, missingness of the child EF composite and Letter-Word ID were positively correlated with child gender (rs = .56), such that males were more likely to having missing data. Because the missingness of our variables appeared to be somewhat predictable from other variables in the data, we concluded that the mechanism of missingness is at random (MAR; Little, Jorgensen, Lang, & Moore, 2014). Thus, we multiply imputed missing values by including all variables of interest, as well as racial/ethnic background and child gender as auxiliary variables. The imputation used a fully conditional specification method with 10 iterations; the fully imputed dataset was used in the subsequent analyses.

Preliminary Analyses

Descriptive statistics of the original, non-imputed parent and child tasks are displayed in Table 1. Using the pooled imputed data, bivariate correlations among family socioeconomic variables, parent variables, and child variables are presented in Table 2, with partial correlations controlling for child age displayed above the diagonal. Due to the high correlation between child MEFS and HTKS (r = .42 after controlling for age) we standardized and averaged them to create one EF composite score for each child, which was used in all subsequent analyses. Composite scores, especially in young children, are preferred over a single task in an effort to decrease measurement error (Rushton, Brainerd, & Pressley, 1983).

Main Analyses

Associations among parent EF, autonomy support, and child EF. The first aim of the study was to assess the extent to which parent EF, autonomy support, and child EF were associated. We first sought to replicate the finding that autonomy support is associated with child EF above and beyond child age and academic knowledge, as assessed by Letter-Word ID. To do so, we ran a hierarchical linear regression with child age and child Letter-Word ID performance in Block 1 and autonomy support entered in Block 2. Results from the pooled imputed data are presented in Table 3. Because the model summary information is not given for pooled data, we computed the adjusted R^2 for each block by averaging the R^2 values from the 10 imputed datasets. Child age and Letter-Word ID performance accounted for 34% of the variation in child EF. When autonomy support was included, the model accounted for an additional 9% of the variation in child EF.

Next, we examined the relation between parent EF and autonomy support. Because family income and parent education were correlated with autonomy support and parent EF, we investigated the extent to which parent EF was associated with autonomy support above and beyond these aspects of socioeconomic status. To do so, we ran a hierarchical linear regression with family income and parent education entered in Block 1 and parent EF entered in Block 2 (see Table 4). Block 1 explained 6% of the variance in autonomy support, and the inclusion of parent EF in Block 2 explained an additional 25% of the variation.

Finally, we wanted to determine the influence of parent EF and autonomy support on child EF when both were in the model. As with model 1, we first entered child age and Letter-Word ID as covariates in Block 1. Then we entered parent EF in Block 2, and autonomy support in Block 3. As indicated in Table 5, parent EF explained an additional 4% of the variation in child EF above that explained by child age and Letter-Word ID. When entered in Block 3,

autonomy support explained an additional 6% of the variance. These results provided initial evidence that autonomy support may mediate the association between parent EF and child EF in our sample. To test the mediation, we ran bootstrapping analyses with 10,000 simulations with the PROCESS v3.0 macro in SPSS (Hayes, 2018). To conduct the mediational analyses with the multiply imputed data, we computed estimates for each of the 10 imputed datasets separately and reported the average of those estimates. In the model, parent EF was entered as the independent variable, autonomy support as the mediator variable, and child EF as the dependent variable. Child age and Letter-Word ID were included as control variables. We tested the direct effect of parent EF on autonomy support (Path a), the direct effect of autonomy support on child EF (Path b) and the direct effect of parent EF on child EF (Path c). The association between parent EF and child EF was no longer significant when we added autonomy support as a mediator (Path c'; see Figure 1). Results from this analysis indicate that autonomy support mediated the relation between parent EF and child EF, indirect effect: $\beta = .15$, bootstrapped 95% CI [.04, .29].

Moderating role of socioeconomic status. The second aim of this study was to determine whether the associations between parent EF, autonomy support, and child EF were similar for families with differing socioeconomic statuses. For each of the final models we ran in the previous section we explored whether annual family income or primary caregiver's highest education level moderated the relations (i.e., autonomy support and child EF; parent EF and autonomy support; and parent EF and child EF). In the first model, we regressed child EF on child age, Letter-Word ID, autonomy support, and family income (Step 1) and an interaction term between autonomy support and family income (Step 2). Then, we conducted a similar model, but with primary caregiver's highest level of education rather than family income. Next, we regressed autonomy support on annual family income and parent EF (Step 1) and an

interaction term between parent EF and family income (Step 2); similarly, we ran a second model with parent education instead of family income. In the last set of models, we regressed child EF on child age, Letter-Word ID, parent EF, and family income (Step 1) and an interaction term between parent EF and family income (Step 2); then, we ran a similar model, but with parent education in place of family income. We did not find significant moderation by family income or education level for any of the models.

Discussion

Although many studies have examined associations between child EF and either parent EF or parenting behaviors, a limited number of them have incorporated all three components to parse potential influences on EF development in preschoolers. Furthermore, few studies have investigated whether aspects of socioeconomic status moderate these relations. The current study addressed this gap by exploring associations among parent and child EF and autonomy-supportive parenting behaviors during the fall of the preschool year, as well as the mediating role of parenting in a sample with diverse socioeconomic backgrounds. We found positive associations for each relation we tested: autonomy support-child EF, parent EF-autonomy support, and parent EF-child EF. None of these associations was moderated by family income or parent education, suggesting these processes may act similarly across levels of socioeconomic status, at least within the range of the current sample. Finally, we found that in this sample, when assessed at the beginning of Pre-K, autonomy support mediated the association between parent EF and child EF. In the following discussion, we comment on each relation found in the study and situate our findings into the broader study of EF development.

Parent EF, Autonomy Support, and Child EF

This study provides further empirical support for aspects of the intergenerational transmission of self-regulation model proposed by Bridgett and colleagues (2015), and the findings add to the growing body of work demonstrating links among parent EF skills, parenting behaviors, and child EF skills (Bernier et al., 2010; Bindman et al., 2015; Cuevas, Deater-Deckard, Kim-Spoon, Wang, Morasch, & Bell, 2014; Cuevas, Deater-Deckard, Kim-Spoon, Watson et al., 2014; Deater-Deckard et al., 2012; Hammond et al., 2011; Jester, Nigg, Puttler, Long, Fitzgerald, & Zucker, 2009; Kim, Shimomaeda, Giuliano, & Skowron, 2017; Meuwissen & Carlson, 2015; Obradović et al., 2017; Shaffer & Obradović, 2017). The present findings provide two important contributions to the study of parenting and EF development. First, because past studies on autonomy-supportive parenting did not account for parents' own EF, it was not clear whether autonomy support would explain variation in child EF skills above and beyond that explained by parent EF. Although we cannot speak to the causal nature of autonomy support with the current research design, the results provide additional evidence that suggests autonomy-supportive parenting is important for EF development in the preschool years. Second, this was one of the few studies to directly test whether different aspects of socioeconomic status moderate links between parent EF, autonomy support, and EF skills in preschoolers, which has possible implications for interventions aimed to promote EF development.

Similar Processes Across Socioeconomic Backgrounds

To date, most studies have included samples from high socioeconomic backgrounds, and there have been mixed findings regarding the association between parent EF skills and parenting behaviors in families from low socioeconomic backgrounds. Two studies found null relations such that working memory was not associated with parenting in families with high levels of household chaos (Deater-Deckard et al., 2012) or in families experiencing homelessness (Monn

et al., 2017). However, another study with low-income mothers in Pakistan found that working memory was associated with scaffolding behaviors (one aspect of autonomy support; Obradović et al., 2017). Our results are consistent with the latter study and extend those findings by demonstrating that the link between parent EF and autonomy support was not moderated by either of our indicators of socioeconomic status. One possibility for the mixed findings may be that autonomy support, as well as scaffolding behaviors measured in Obradović et al. (2017), are particularly effortful types of parenting, which require a great deal of top-down control. For example, autonomy support requires parents to follow the pace of their child even if it is painstakingly slow, switch flexibly between different suggestions if their child is not understanding, and hold multiple pieces of information about the task at hand and use them in a way to best support their child. It is possible that strong EF skills are more critical for providing autonomy support compared to more global measures of parenting, such as sensitivity or negative regard. Although our findings are more generalizable than studies that only include families with high socioeconomic status, they may not be applicable to families facing extreme socioeconomic hardships, such as those experiencing homelessness. Future research should explore the links between parent and child EF and autonomy support with samples at the very low end of the socioeconomic spectrum that our study did not capture.

Implications for Practice

In addition to clarifying some ambiguity regarding parent EF, child EF, and autonomy support in the scientific community, these findings have real world implications. Specifically, the current study fits well into the two-generation approach to child development interventions. Two-generation interventions target both parents and children to promote positive child outcomes, rather than only focusing on the child. Shonkoff and Fisher (2013) noted that two-

generation approaches are important because children develop in larger social contexts, so it is necessary to also support the capabilities of parents who are primarily responsible for children's care. Current EF interventions tend to be one-generation approaches in that they focus on the child, primarily through targeted classroom curriculum (e.g., Tool of the Mind; Blair & Raver, 2014; Bodrova & Leong, 2007). An EF intervention taking a two-generation approach would contain both EF training for the child in the classroom, as well as complementary parent training so that children have the opportunity to practice their EF skills at home. EF interventions are beginning to incorporate two-generation approaches with classroom based EF components and parent training (e.g., Mind in the Making and Circle Time Games; Galinsky, Bezos, McClelland, Carlson, & Zelazo, 2017). Results from our study are consistent with an intervention approach that includes parents as a key contributor for bolstering EF development. Furthermore, in contrast to previous research that focused on negative aspects of parenting as a mediator between parent EF and child EF (Cuevas, Deater-Deckard, Kim-Spoon, Watson et al., 2014), we examined positive parenting behaviors. From an intervention perspective, it may be more effective to provide information on what parents can do rather than telling them what not to do. Finally, because parent EF was robustly associated with autonomy support, cultivating parents' own EF may complement training on autonomy-supportive behaviors. Future research should explore the extent to which training parent EF and autonomy support has distal effects on their children's EF skills.

Limitations

The present study had a number of strengths including the direct assessment of parents' EF skills, the inclusion of families with a range of annual family income and educational attainment, the use of multiple behavioral measures of child EF, and the use of an observational

parenting measure. However, there were a number of limitations. Our sample was too small to detect small-to-medium effects. Moderation effects, in particular, tend to be smaller than main effects; it is possible that socioeconomic status moderates some of the processes we examined, but we did not have the power to detect those effects. Additionally, our sample was socioeconomically diverse, but it lacked racial/ethnic diversity. Seventy percent of our families were European American. It is possible that cultural differences and family values may influence the relation between autonomy support and child EF in different racial/ethnic groups at the same level of socioeconomic status. Self-determination theory suggests that autonomy support is relevant across diverse cultural backgrounds (Deci & Ryan, 2013) and research has found that autonomy support is associated with positive youth outcomes in multiple different countries (e.g., Chirkov, Ryan, Kim, & Kaplan, 2003; Marbell & Grolnick, 2013). However, those studies were focused primarily on psychological well-being rather than specific cognitive outcomes. The extent to which autonomy support is associated with EF development across cultures is an open question. Another limitation is that our measure of academic knowledge, Letter-Word ID, requires some degree of EF skills on the part of the child. There is likely overlap in child EF and Letter-Word ID, which could have reduced the variability explained by including the measure as a covariate in our regression models. However, our models still explained a significant portion of variation in child EF skills above and beyond Letter-Word ID performance, which further highlights the robustness of the associations among parent EF, autonomy support, and child EF. The correlational nature of the study is also a limitation. A growing body of correlational evidence suggests that autonomy support may be important for the development of child EF skills, but we cannot know whether it has a causal influence without an experimental design. The next step for research on this topic is a randomized control design to assess whether changes in

autonomy support from an intervention lead to long-term changes in child EF. Finally, because of the cross-sectional nature of the data, our mediational model cannot control for some other third variable that may be responsible for the associations. However, given that this is one of a few studies to examine parent EF in addition to autonomy support and child EF, the initial mediational evidence is an important first step before investing substantial resources for a longitudinal examination.

Conclusion

This study provides support for the intergenerational transmission of EF through parenting behaviors. We demonstrated that autonomy support mediated the link between parent and child EF when examined cross-sectionally in the Fall of preschool. We also found that autonomy support was associated with parent EF and child EF across differing levels of socioeconomic status including the lower and middle levels that are often underrepresented in laboratory-based studies. These findings are important given the increased effort to promote EF skills in preschoolers, particularly those from lower socioeconomic backgrounds who may be at-risk for difficulties in school due to problems with executive functioning. Two-generation approaches to interventions that include both parents and children are a promising approach to promoting preschool EF because children learn strategies to build their EF skills in school while parents receive training about how to provide an optimal social context for their children to practice their emerging skills when they are outside the classroom.

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Table 1

Descriptive statistics for parent and child variables

	n	*M*	*SD*	Task Range	Sample Range
Parent					
MEFS	85	76.08	17.02	0 – 100	45 – 94
Autonomy Support	74	3.41	1.13	1 – 5	1 – 5
Child					
MEFS	82	36.38	13.72	0 – 100	11 – 76
HTKS	79	12.87	17.67	0 – 60	0 – 58
EF Composite	79	.01	.88	-	-1.29 – 2.04
Letter-Word ID	79	94.53	13.17	0 – 200	71 – 147

Table 2

Bivariate (bottom left) and partial (upper right) correlations between parent and child variables (N = 85)

	1	2	3	4	5	6	7	8
1. Family Income	1	.52***	.11	.21	.09	-.01	.05	.08
2. Parent Education	.50**	1	.26*	.25*	.10	.03	.08	.21
3. Parent MEFS	.09	.27*	1	.58***	.17	.40***	.34**	.25*
4. Autonomy Support	.23	.24*	.51***	1	.33**	.36**	.41***	.16
5. Child MEFS	.11	.13	.06	.29**	1	.42***	.83***	.19
6. Child HTKS	.02	.07	.32**	.36**	.56***	1	.85***	.29*
7. Child EF Composite	.09	.14	.23*	.39**	.83***	.88***	1	.29*
8. Letter-Word ID	.07	.20	.22	.12	.21	.30**	.24*	1

Note. Partial correlations controlling for child age in months.

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 3

Regression analyses predicting child EF composite (N = 85)

Variable	*B*	*SE(B)*	*t*-value	Adjusted R^2	ΔR^2
Block 1				.34	-
Child Age	.08	.01	5.56***		
Letter-Word ID	.01	.006	2.28*		
Block 2				.43	.09***
Child Age	.07	.01	5.36***		
Letter-Word ID	.01	.006	1.97*		
Autonomy Support	.24	.07	3.19**		

Note. *$p < .05$, **$p < .01$, ***$p < .001$.

Table 4

Regression analyses predicting parent autonomy support (N = 85)

Variable	*B*	*SE(B)*	*t*-value	Adjusted R^2	ΔR^2
Block 1				.06	-
Parent Education	.12	.11	1.09		
Family Income	.12	.15	.84		
Block 2				.31	.25***
Parent Education	.02	.10	.18		
Family Income	.15	.13	1.15		
Parent EF	.04	.008	4.48***		

Note. *$p < .05$, **$p < .01$, ***$p < .001$.

Table 5

Regression analyses with parent EF and autonomy support predicting child EF composite (N = 85)

Variable	*B*	*SE(B)*	*t*-value	Adjusted R^2	ΔR^2
Block 1				.34	-
Child Age	.08	.01	5.56***		
Letter-Word ID	.01	.006	2.28*		
Block 2				.38	.04*
Child Age	.08	.01	5.79***		
Letter-Word ID	.01	.006	1.75		
Parent EF	.01	.005	2.36*		
Block 3				.44	.06*
Child Age	.08	.01	5.40***		
Letter-Word ID	.01	.006	1.87		
Parent EF	.003	.006	.55		
Autonomy Support	.21	.10	2.18*		

Note. *$p < .05$, **$p < .01$, ***$p < .001$.

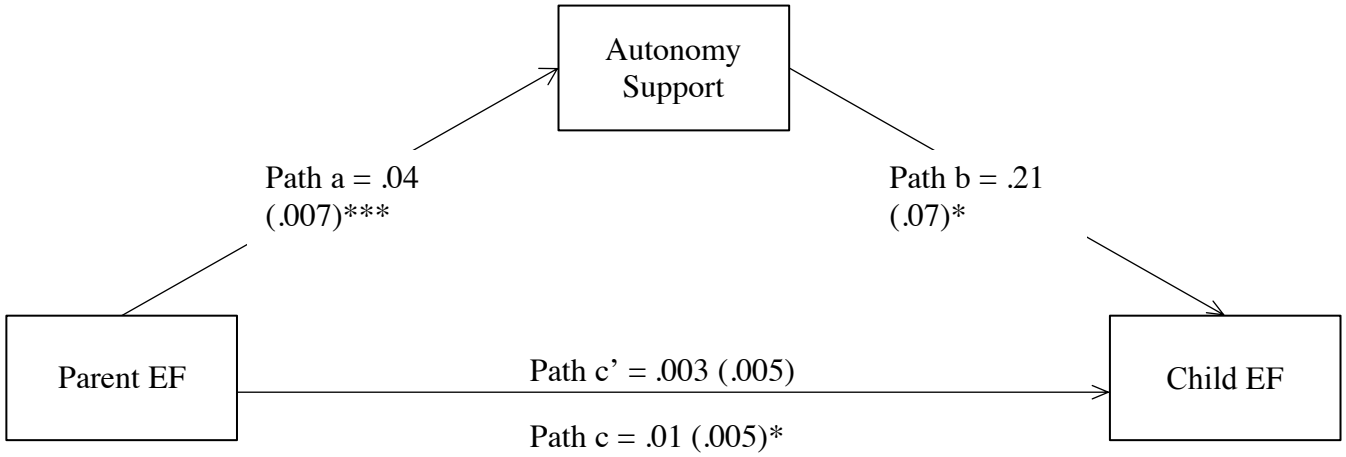

Figure 1. Autonomy support mediated the association between parent EF and child EF, after controlling for child age and Letter-Word ID ($N = 85$). Values represent unstandardized regression coefficients, with standard errors in parentheses. Paths for the control variables (child age and Letter-Word ID) are omitted from the figure.

*$p < .05$, **$p < .01$, ***$p < .001$.

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