Journal of Family Psychology

0893-3200/18/$12.00 http://dx.doi.org/10.1037/fam0000374

BRIEF REPORT

Parental Executive Function and Verbal Ability Matter for Scaffolding

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Despite the importance of parental scaffolding for later child cognitive outcomes and academic achievement, sources of individual variation in scaffolding are not fully understood. Scaffolding places extensive demands on cognitive capacity, including planning, flexibly shifting, and inhibition. Executive function (EF) is therefore a parental cognitive ability especially important for effective scaffolding. In this study, parents and preschool-aged children completed a challenging puzzle to assess scaffolding. EF and verbal ability were measured for parents and children. Parental verbal ability was used as an index of global higher-order cognitive function. Higher levels of parental EF related to more effective scaffolding, above and beyond parental verbal ability and independent of child cognitive level. These results highlight the significance of considering parental cognitive capacities in future studies to better understand the sources of individual differences in scaffolding.

Keywords: executive function, parenting, preschool, scaffolding, verbal ability

Theoretical and empirical work highlights the importance of parental scaffolding for children's cognitive development (Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2012; Vygotsky, 1978; Wood, Bruner, & Ross, 1976). Scaffolding refers to the dynamic process through which a social partner helps a child complete a task beyond the child's independent capability (Bibok, Carpendale, & Müller, 2009; Wood et al., 1976). Vygotsky (1978) proposed interacting with a more knowledgeable person during problem-solving activities as a primary mechanism for children to develop higher-order cognitive processes.

Vygotsky's theory is supported by empirical evidence, as scaffolding predicts child cognitive development, including executive function (EF; see for review Fay-Stammbach, Hawes, & Meredith, 2014) and problem-solving (Freund, 1990). Yet, less research focuses on understanding how parental individual differences relate to scaffolding. Therefore, identifying what parental factors matter for effective scaffolding is crucial for understanding the processes involved in scaffolding, and may help foster children's cognitive development. As scaffolding of preschoolers predicts academic achievement (Englund, Luckner, Whaley, & Egeland, 2004), assessing what parental factors matter in this developmental period is especially critical.

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The data and ideas on relations between parental executive function and verbal ability with parental scaffolding were presented as a poster at the 2017 conference of the Society for Research in Child Development in Austin, Texas. Data and ideas regarding child cognitive abilities were not presented.

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One reason why parental characteristics may play a role is that scaffolding is a complex process that inherently places cognitive demands on the parent (Bibok et al., 2009; Carr & Pike, 2012; Conner & Cross, 2003; Freund, 1990; Vygotsky, 1978). Thus, scaffolding requires significant parental competence. Vygotsky (1978) proposed the adult should structure the task so the child can learn and complete the task with guidance, which involves planning and organizing. Scaffolding is also cognitively demanding as it is based in part on task difficulty and the cognitive level of the child (Carr & Pike, 2012; Eason & Ramani, 2016). Additionally, it involves respecting the child's rhythm and ensuring the child is an active participant (Bernier, Carlson, & Whipple, 2010).

A parental factor that may be important for scaffolding is EF, a higher-order cognitive capacity that includes cognitive flexibility, monitoring, and inhibitory control (Diamond, 2013). Parents must use EF to scaffold effectively and adjust help based on task demands (Bibok et al., 2009; Conner & Cross, 2003; Freund, 1990). The level of assistance needed varies throughout the task so parents must use cognitive flexibility and monitoring to continually evaluate child progress and adjust accordingly. Further, for a child to work on a task beyond their independent ability, they must encounter errors and problem-solve prior to parent help (Wood et al., 1976). Thus parents must use inhibitory control to override their immediate response to intervene. To characterize the specific role of EF in parental scaffolding, it is important to differentiate EF from global higher-level cognitive functioning. Verbal ability indexes more global cognition and has been used as a proxy for general intelligence (Obradović et al., 2017). Assessing verbal ability and EF allows for specificity in assessing relations between parental EF and scaffolding beyond more global parental cognitive capacity (Obradović et al., 2017).

To our knowledge only two studies have directly examined the role of parental EF in relation to scaffolding (Mazursky-Horowitz et al., 2017; Obradović et al., 2017). Maternal working memory and verbal ability were associated with scaffolding of preschoolers during play with a picture book in rural Pakistan (Obradović et al., 2017). In a study of 5- to 10-year-old children with and without ADHD, better maternal working memory and task shifting related to better scaffolding (Mazursky-Horowitz et al., 2017). Although these studies suggest the importance of EF as a source of individual differences in scaffolding, this is still an emerging area of study. Specifically, to our knowledge, no studies have empirically investigated the parental cognitive abilities important for scaffolding in a challenging, problem-solving task with a preschool sample. This is crucial, as the demands on parental scaffolding may be different depending on the age of the child. In addition, assessing scaffolding in the context of a challenging task is important, as this may be an instance when children most especially depend on parental support.

Further, assessing the role of parental EF for scaffolding would build on the existing literature on how parents' cognitive functioning, including EF, matters for general caregiving (see for review, Bridgett, Burt, Edwards, & Deater-Deckard, 2015; Crandall, Deater-Deckard, & Riley, 2015). Researchers highlight the relevance of cognitive capacities such as EF for dealing with parenting demands and responding positively in the context of challenging child behavior and stress (Bridgett et al., 2015; Crandall et al., 2015). For example, lower maternal working memory related to more harsh reactive parenting (Deater-Deckard, Sewell, Petrill, & Thompson, 2010) and poor maternal EF related to more negative parenting including negative affect and insensitivity (Bridgett, Kanya, Rutherford, & Mayes, 2017). Given the specific importance of scaffolding for child cognitive development (Fay-Stammbach et al., 2014), it is important to build on this literature and assess the specific role of parental EF for scaffolding.

Finally, when considering how parental EF specifically matters for scaffolding, children's cognitive level is also important to consider. Scaffolding is partly based on the child's cognitive level and child cognition may contribute to scaffolding (Carr & Pike, 2012; Mulvaney, McCartney, Bub, & Marshall, 2006). For example, a child at a higher cognitive level may be easier to scaffold as they learn the parent's strategies and need less help. With this child, less assistance would be classified as good scaffolding if the child can progress more independently.

Current Study

Building on Vygotsky's theory, the aim of this study was to assess the specific role of parental EF for scaffolding of preschoolers, above and beyond parental verbal ability. Effective scaffolding is conceptualized to involve higher-order cognitive processes such as flexibly shifting and inhibiting responses (Carr & Pike, 2012; Conner & Cross, 2003; Mulvaney et al., 2006). Therefore we hypothesized that higher parental EF would relate to better scaffolding, above and beyond global cognition, indexed by verbal ability. To address this aim, 3- to 4-year-old children and their parents completed a challenging puzzle to assess parental scaffolding (Hammond et al., 2012). EF and verbal ability were measured for both parent and child.

Method

Participants

Participants included 64 children (25 females) aged 3.5–4.5 years and their parents (58 mothers). Dyads spoke and understood English. Children were singletons with no known hearing, visual, neurological, or developmental disorders (see Table 1 for demographic information). Of 81 dyads who participated, four parents lacked EF and verbal ability scores, three completed the puzzle in unknown languages that we were unable to translate, two scaffolding videos had experimenter error, and eight videos had a technical problem.

General Procedure

Participants were recruited from a department-maintained database of families who expressed interest in participating in research and from online advertising and community recruitment events. This study was approved by the university institutional review board. Upon arrival, parents provided informed consent. Parents and children completed EF and verbal ability tasks. Finally, the parent and child completed a challenging puzzle to assess scaffolding.

Measures

Parental cognitive abilities.

EF-Dimensional Change Card Sort (DCCS). The computerized DCCS from the National Institutes of Health Toolbox Cognition Battery (NIHTB-CB), normed for ages 7–85, assessed cognitive flexibility. Two target pictures were shown that varied by shape and color. Participants matched test pictures to the target picture by shape or color. Before each trial, the word "color" or "shape" appeared indicating the trial sorting rule. Scores were computed by the NIH Toolbox system based on accuracy and reaction time (RT). For all parent cognitive measures, age-adjusted scale scores were used, indicating performance compared with the NIH Toolbox nationally representative normative sample within the same age band. A score of 100 indicates average performance in the national sample. See Table 2 for descriptive statistics of all measures.

EF-Flanker. The NIHTB-CB Flanker Inhibitory Control and Attention Test was used, normed for ages 7–85. Parents saw five

Table 1
Demographic Information

Characteristic	Mean (*SD*) or %
Child age (months)	49.30 (3.70)
Child ethnicity	
Caucasian	56.3%
Black	4.7%
Asian	7.8%
Hispanic	9.4%
Multiracial	21.9%
Parent education	
% with at least a 4 year college degree	81.2%
Annual Income	
% household income over $60,000	76.6%

Table 2
Descriptive Statistics for Study Variables

Variable	*M* (*SD*)	Min	Max	*N*
Scaffolding (1–5)	3.16 (1.43)	1.00	5.00	64
Parental EF				
DCCS	101.11 (10.80)	64.57	124.49	64
Flanker	101.17 (10.81)	78.56	121.85	63
Parental verbal ability	122.51 (18.00)	69.39	153.95	58
Child EF				
Child DCCS (0–1.00)	.84 (.27)	.00	1.00	54
Child flanker	76.74 (8.48)	50.88	106.41	52
Child verbal ability	76.70 (8.26)	55.82	124.25	59

Note. EF = Executive function; DCCS = Dimensional Change Card Sort.

arrows in a line and pressed the left or right arrow buttons on a keyboard based on the direction of the middle arrow. Thus parents had to focus on the central arrow while inhibiting attention to the other arrows. Scores were computed in the NIH Toolbox system comparable to the DCCS. Flanker and DCCS scores were correlated, $r(61) = .474$, $p < .001$ and were standardized and averaged into an EF composite (Cronbach's alpha = .64).

Verbal ability. Parents completed the NIHTB-CB picture vocabulary in which the parent heard a word and selected the picture that matched the word and an oral reading test in which the parent pronounced words. These measures were highly correlated, $r(56) = .794$, $p < .001$ and therefore were combined. The composite score was computed by NIH toolbox by averaging the normalized scores of each test, and then deriving scale scores based on the new distribution.

Child cognitive abilities.

EF-DCCS. Children did a computerized DCCS task (adapted from Espinet, Anderson, & Zelazo, 2012) and sorted bivalent stimuli based on one dimension (preswitch) and then the rule changed and they sorted by another dimension (postswitch). All children sorted by shape for 8 practice trials and 15 preswitch trials. Children then sorted by either number or color for 30 postswitch trials. There were no performance differences between number and color versions.

For each trial, a test stimulus was presented. The child matched the test stimulus to one of two target stimuli shown at the bottom of the monitor, using a response pad. Once the child responded, a fixation cross replaced the test stimulus. The intertrial interval varied from 1–2 seconds. During practice, the experimenter gave verbal feedback. During the task, the child received automatic feedback after each trial and the experimenter reminded the child of the sorting rule every five trials. Accuracy from the postswitch phase (after the sorting rule had changed) was used. Only children who performed above chance on the preswitch phase (at least 11/15 correct, $p < .05$) were included in analyses, 93.1% children met this criterion.

EF-Flanker. We used the NIHTB-CB Early Childhood version of the Flanker. The test is comparable with the parent version, but children saw fish instead of arrows. Each child completed 20 test trials. If the child scored 90% or higher on the fish stimuli, 20 trials with arrows were presented. Two children did not pass the practice trials, so the task automatically ended. Unadjusted scale scores were based on both accuracy and RT. Child DCCS and Flanker scores were not significantly related so they were analyzed separately.

Verbal ability. Children completed the NIHTB-CB picture vocabulary test. This measures receptive vocabulary and uses a computerized adaptive format. The child hears a word and sees four photographs on the screen and selects the picture that matches the meaning of the word. As with the Flanker, we used unadjusted scale scores.

Scaffolding. Parent–child dyads were video recorded as they completed a novel, challenging puzzle (Carpendale, 1999; Hammond et al., 2012) that was unpainted and made of wood. The experimenter showed the dyad the completed puzzle and told the parents to do the puzzle, "just as they would at home." The experimenter then told the child their parent "was going to help them do the puzzle." The experimenter took the puzzle apart, left the room, and returned after 12 min. Interactions were coded for scaffolding from the recorded videos. Five dyads spoke a different language (German, Portuguese, and Spanish) during either part or all of working on the puzzle. These videos were translated before being coded for scaffolding.

Each parent was assigned a score on a 5-point scale based on the proportion of time the parent was appropriately scaffolding (1 = *almost no appropriate support* to 5 = *consistent and appropriate support*; Hammond et al., 2012). Thus, scaffolding was coded holistically based on overall parental scaffolding in the task. This coding scheme was used as scaffolding is dyadic and the appropriate level of assistance varies during the interaction and depends on the child's initial ability and progress. Therefore, the same parental behaviors can be classified as effective or ineffective scaffolding depending on the child. For example, if a child were progressing successfully, appropriate scaffolding would be the parent letting the child take the lead and limiting involvement. Yet if the child were frustrated and unsuccessful, it would be inappropriate for the parent not to help. In this situation, appropriate scaffolding would involve structuring the task for the child. This should involve gradual levels of assistance such as starting with leading questions, then verbal suggestions, and then physical assistance in placing puzzle pieces (Wood et al., 1976). Then, if the child began progressing successfully, the parent could limit assistance.

Two coders were trained based on Hammond et al. (2012). Interrater reliability was assessed by intraclass correlation (ICC) with two-way random, absolute agreement, single measures design. Coders first were trained to a reliability threshold of .80. They discussed videos and came to consensus during training. Twenty percent of videos were doubled coded. The primary coder's scores were used in cases of disagreement. The ICC was .83.

Results

To control for possible effects of child and parent gender, child age, and child EF and verbal ability, we tested their associations with the outcome variable—scaffolding. These variables were not significantly related to scaffolding; therefore, they were not included as covariates. There was a nonsignificant trend of a positive correlation between scaffolding and child DCCS, $r(52) = .254$, $p = .064$. With respect to interrelations of child cognitive abilities, Flanker related to verbal ability, $r(48) = .483$, $p < .001$. See Table 3 for all correlations.

Table 3
Bivariate Correlations

Variable	Scaffolding	Parental EF	Parental verbal ability	Parent gender	Child DCCS	Child flanker	Child verbal ability	Child age	Child gender
Scaffolding	—								
Parental EF	.362**	—							
Parental verbal ability	.442**	.211	—						
Parent gender	−.154	−.089	−.149	—					
Child DCCS	.254†	.018	.136	−.061	—				
Child flanker	.077	.222	.184	−.084	.224	—			
Child verbal ability	.057	−.069	.124	−.048	.186	.483***	—		
Child age	.087	−.070	.167	.002	.457**	.228	.085	—	
Child gender	−.134	−.123	−.263*	−.148	.025	.016	−.218†	−.097	—

Note. EF = Executive function; DCCS = Dimensional Change Card Sort. For gender, female is coded 2 and male is coded 1.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

As the aim of this study was to assess how parental cognitive abilities relate to scaffolding, Pearson correlations assessed relations between parental EF, verbal ability, and scaffolding. Parental EF related to scaffolding, $r(62) = .362$, $p = .003$, as did parental verbal ability, $r(56) = .442$, $p = .001$ such that higher levels of these cognitive abilities related to better scaffolding. Next, scaffolding was regressed on parental EF and verbal ability to assess unique contributions of cognitive variables (see Table 4). The overall model was significant, $F(2, 55) = 9.865$, $p < .001$, and explained 23.7% of the variance in scaffolding. Parental EF, $\beta = .269$, $p = .027$, and parental verbal ability, $\beta = .385$, $p = .002$, each uniquely related to scaffolding, demonstrating higher levels of these cognitive capacities related to more effective scaffolding.

Discussion

Vygotsky emphasized the critical role of interactions with more knowledgeable adults for children's cognitive development and empirical evidence supports this framework (Bernier et al., 2010; Hammond et al., 2012; Vygotsky, 1978). As scaffolding has complex cognitive demands to tailor instruction to the child's needs, we assessed the specific role of parental EF, above and beyond parental verbal ability. Confirming expectations, better parental EF related to more effective scaffolding of preschoolers, controlling for parental verbal ability and independent of child cognitive level. Results suggest cognitive abilities are important to consider in future research to better understand parental sources of variability in scaffolding.

This novel study demonstrates that parental EF is important for scaffolding of preschoolers during a challenging, problem-solving task. This association builds on the broader evidence of the importance of parental EF for positive and negative parenting (Bridgett et al., 2015; Crandall et al., 2015) and on the emerging literature of parental EF and scaffolding (Mazursky-Horowitz et al., 2017; Obradović et al., 2017). Mazursky-Horowitz and colleagues (2017) found better maternal working memory and task shifting related to better scaffolding of 5- to 10-year-old children. Our study shows that additional aspects of EF are important for scaffolding as our EF composite measure included inhibitory control and cognitive flexibility and that parental EF also matters for scaffolding of preschoolers. Overall, given the consistency of our finding with previous studies, parental EF appears to be key for understanding a wide array of caregiving behaviors, including scaffolding.

It is noteworthy that parental EF contributed to scaffolding above and beyond verbal ability. This suggests that it is not just overall cognitive level, but rather specific cognitive capacities that are important. This finding is in line with a study demonstrating the unique effect of parental working memory on scaffolding during play with a picture book, controlling for verbal ability (Obradović et al., 2017). As both parental EF and verbal ability uniquely contributed to scaffolding in the current study, future research should investigate additional cognitive capacities that may be important for scaffolding such as reasoning and strategizing.

It is plausible that child's own cognition may also relate to scaffolding, as children who are more cognitively advanced may be easier to scaffold. Indeed, infant cognitive level predicts scaffolding (Mulvaney et al., 2006) and scaffolding predicts child cognition (Hammond et al., 2012; Landry, Miller-Loncar, Smith, & Swank, 2002). In the current study, scaffolding was unrelated to child Flanker scores, indexing inhibitory control, and verbal ability. There was a nonsignificant trend in the direction that higher scaffolding related to better child DCCS, measuring cognitive flexibility, and it is possible that in a larger sample this relation would be significant. Yet in our small sample, results suggest parental cognitive abilities had a robust relation with scaffolding. Additionally, longitudinal research assessing parent and child cognition and scaffolding throughout early childhood is needed to better understand the interplay of these constructs. Specifically, scaffolding could be important for helping children develop abilities such as EF over time and conversely child cognitive level may influence scaffolding over time.

The extent to which parental cognitive abilities matter for scaffolding may depend on the context and as well as other parental characteristics. We assessed scaffolding while dyads did a puzzle

Table 4
Regression of Scaffolding

Variable	*B*	*SE*	β	Adjusted R^2
Parental executive function	.435*	.192	.269	.237
Parental verbal ability	.031**	.009	.385	

* $p < .05$. ** $p < .01$.

in a quiet room without interruptions. Even in this structured situation, parental cognitive abilities mattered. Parental EF and verbal ability may be even more relevant for scaffolding in daily life, which inherently has distractions. Our task was designed specifically to elicit scaffolding. This does not address the question of how often parents scaffold in daily life. Opportunities to scaffold occur frequently with children, from scaffolding of tying shoes to scaffolding of chores (Hammond & Carpendale, 2015). Other parental characteristics such as coping and patience may relate to the tendency of parents to take advantage of day-to-day scaffolding opportunities. Studies assessing scaffolding in naturalistic settings and measuring additional parental variables are needed to investigate these possibilities.

This study has clinical implications such that interventions to improve parental EF specifically may help improve parental scaffolding. Scaffolding is important for children's cognitive development and academic achievement (Englund et al., 2004; Fay-Stammbach et al., 2014) and EF can be improved in adults through training (see for review, Crandall et al., 2015). Thus it may be beneficial to target intervention efforts on improving EF for parents who are struggling with scaffolding. As many opportunities for scaffolding occur on a daily basis, helping parents improve the foundational skills necessary for effective scaffolding would apply to many daily parent–child interactions with implications for improving child cognitive outcomes.

A limitation of this study is the sample demographics, as nearly all parents were well educated and economically advantaged. Yet even in such a low-risk sample, variation in cognitive abilities related to scaffolding. Future research assessing these constructs in a more diverse sample would allow exploration of whether parental EF and verbal ability serve as protective factors. Stress may affect parents' ability to scaffold effectively and parents with higher cognitive abilities may be better able to cope in challenging environments. Another limitation was that very few fathers were included. Both mothers and fathers contribute to the development of child EF (Meuwissen & Englund, 2016). Thus future research including mothers and fathers is important to assess potential scaffolding differences by parent gender.

This study is the first to report associations between multiple parental cognitive abilities and scaffolding of preschoolers during a problem-solving task. Research and theory highlight the importance of scaffolding for children's cognitive development. These results demonstrate parental EF specifically is key to effective scaffolding in the preschool years and suggest researchers should consider including measures of parental cognitive abilities in future studies to broaden an understanding of how parental characteristics underlie variation in scaffolding.

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Received April 16, 2017
Revision received September 25, 2017
Accepted September 26, 2017 ■