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MATERNAL EXECUTIVE FUNCTIONING AND SCAFFOLDING IN FAMILIES OF CHILDREN WITH AND WITHOUT PARENT-REPORTED ADHD

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Abstract

Parental scaffolding robustly predicts child developmental outcomes, including improved self-regulation and peer relationships and fewer externalizing behaviors. However, few studies have examined parental characteristics associated with a parent's ability to scaffold. Executive functioning (EF) may be an important individual difference factor associated with maternal scaffolding that has yet to be examined empirically. Scaffolding may be particularly important for children with attention-deficit/hyperactivity disorder (ADHD) and disruptive behavior disorder (DBD) symptoms due to their core difficulties with inattention, disorganization, EF, and self-regulation, their need for greater parental structure, and higher-than-average rates of parental EF deficits. Yet, little research has examined child ADHD in relation to parental scaffolding. This cross-sectional study examined: (1) the association between maternal EF (as measured by the Hotel Test, Barkley's Deficits in Executive Functioning Scale, and Digit Span) and observed scaffolding, (2) the association between parent-reported child ADHD/DBD symptoms and scaffolding, and (3) the interaction between child ADHD/DBD symptoms and maternal EF in predicting scaffolding. In a sample of 84 mothers and their 5–10 year-old biological children (62% male) with and without parent-reported ADHD, we found that maternal EF, as measured by Digit Span and the Hotel Test, predicted observed maternal scaffolding. However, child ADHD/DBD symptoms did not significantly predict maternal scaffolding controlling for child age, maternal education, and maternal EF, nor did the interaction of maternal EF and parent-reported child ADHD/DBD symptoms. Working memory and task shifting may be key components of parental EF that could be targeted in interventions to improve parental scaffolding.

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Keywords

Parenting; scaffolding; attention-deficit/hyperactivity disorder; executive functioning

Parental scaffolding involves meeting a child at his/her developmental level to support the child in developing emotional and behavioral regulation strategies so that s/he can gradually master goal-directed activities independently (Bibok, Carpendale, & Müller, 2009). In order to effectively scaffold, a parent must provide the temporary supports necessary for a child to master a task, while being conscious not to provide too much or too little support. Parental scaffolding helps the child achieve a goal in the short term, while also teaching self-regulation in the long term. Parental scaffolding robustly predicts child developmental outcomes, including improved self-regulation and peer relationships, and fewer externalizing behaviors (Garstein & Fagot, 2003; Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2012). For example, in a longitudinal study, Smith, Landry and Swank (2000) found that children developed better executive functioning (EF) skills when their parents used verbal scaffolding (i.e., instructive/elaborative utterances) as opposed to directive instructions (i.e., telling the child exactly what to do). Therefore, examination of parental scaffolding is central to improving our understanding of parenting influences on child development.

Given that scaffolding is a strong predictor of child developmental outcomes, it is important to explore parent individual differences that relate to effective scaffolding. Although one study found that higher maternal education was related to a mother's increased use of scaffolding behaviors, no other studies have examined individual parental characteristics associated with effective scaffolding (Neitzel & Stright, 2004). One parental individual difference factor that may be particularly relevant to scaffolding is EF. EF is an umbrella term for a host of cognitive processes and corresponding behaviors that function within an individual to achieve a goal, including planning, working memory (WM), inhibition, mental flexibility, and the initiation and monitoring of tasks (Chan et al., 2008). EF skills such as these underlie an individual's ability to utilize time management, self-organization, emotional self-control, self-restraint, and self-motivation (Barkley, 2011). All of these processes have been shown to impact an adult's ability to succeed occupationally, effectively run a household, and develop and maintain social relationships. In contrast, poor EF has been associated with impairments in problem solving and decision making, greater psychopathology, and poorer response to psychological interventions (Goel, Grafman, Tajik, Gana, & Danto, 1997; Green, Kern, Braff, & Mintz, 2000). However, few studies have examined the relation between EF and parenting.

Parenting requires planning and problem solving skills, flexibility, and the ability to manage multiple demands. As such, EF deficits in the areas of WM, organization, emotion regulation, and planning may interfere with both mothers' and fathers' abilities to parent effectively (Johnston, Mash, Miller, & Ninowski, 2012). Among various aspects of EF, WM has been most often studied in relation to parenting. Conceptually, W allows a parent to maintain and manipulate information about a child's learning environment in order to utilize the most appropriate response in the moment. In one study, Deater-Deckard et al. (2010)

demonstrated that mothers with poorer WM, as measured by Digit Span (a subtest of the Wechsler Adult Intelligence Scale; Wechsler, 2008), exhibited more reactive negativity with their children than mothers with better WM. Additionally, other EF skills such as attention control may be necessary for a parent to switch attention between tasks in order to plan and effectively scaffold (Barrett & Fleming, 2011). EF skills, such as WM and attention control may thus be most directly related to parental scaffolding due in part to the need for parents to consider the child's developmental level while organizing the child's goal-directed activity. Additionally, a parent must be able to adjust a plan in the moment if the chosen strategy is not effective in assisting the child to achieve the goal (which requires cognitive flexibility and initiation/monitoring of tasks). Though these EF components appear to be conceptually linked to effective parental scaffolding, the relation between parent EF and scaffolding has yet to be empirically examined.

While a few studies have examined the relation between parental EF and parenting more broadly, there have been methodological issues that may limit what can be learned from these studies. For example, in the few studies to date that have examined parental EF and parenting (Cuevas et al, 2013; Deater-Deckard et al., 2010; 2012), standard neuropsychological tasks (e.g., Wisconsin Card Sorting Task, Stroop, Digit Span; Frazier, Demaree, & Youngstrom, 2004) were utilized to measure EF, which may not assess more pertinent aspects relevant to parenting and daily life functioning (Barkley & Murphy, 2010). Further, these traditional EF tasks have typically shown poor sensitivity to detecting executive dysfunction and poor ecological validity, as performance on these tasks does not consistently predict how an individual will perform on other EF tasks, self-report EF measures, or in real-world situations that tax the EF system (Barkley & Murphy, 2011; Burgess et al., 1998; Gregory et al., 2002). For instance, Torralva, Gleichgerrcht, Lischinsky, Roca, and Manes (2013) found that adults with high-functioning ADHD who (by definition) performed comparably to healthy controls on traditional neuropsychological tests, experienced real-world impairments in time management, organization, problem solving, self-restraint, self-motivation, and emotion regulation (Barkley, 2011). One potential reason these measures have poor sensitivity to detecting real-world EF deficits is that the examiner provides the structure and organization for these tasks, and monitors the participant's performance during the tasks (Gioia & Isquith, 2004).

In order to address the limitations of traditional EF tests, researchers have sought to develop laboratory tasks that more closely resemble real-life demands that tap multiple EF domains simultaneously (Chan et al., 2008, Chaytor, Schmitter-Edgecombe, & Burr, 2006). One conceptual model of EF from which newer tasks are being developed is the Supervisory Attentional System (SAS) model, which is responsible for regulating non-routine behaviors which require planning, decision-making, and problem-solving, and possibly changing one's behavior to adapt in novel situations (Norman & Shallice, 1986). The SAS is frequently called upon in everyday parenting situations in which a parent needs to adapt his/her plans and expectations in the moment in order to respond to a child's needs. Utilizing EF tests based on the SAS model may thus be highly relevant to parental scaffolding. The current study therefore utilized some of the SAS-informed measures to quantify maternal EF.

The relation between maternal EF and scaffolding may be particularly important to examine among children with attention-deficit/hyperactivity disorder (ADHD) and comorbid disruptive behavior disorder (DBD) symptoms due to abundant research suggesting that interactions between children with ADHD and their parents are more negative than interactions between children without ADHD and their parents (Johnston & Chronis-Tuscano, 2014). Indeed, a great deal of evidence (including experimental studies; e.g., Pelham and Lang, 1999) suggests that children with ADHD place greater demands on, and evoke more over-reactive and inconsistent responses from their mothers and fathers–particularly when they also display oppositional, defiant, and conduct behaviors (e.g., Johnston & Chronis-Tuscano, 2014; Waschbusch, 2002). Moreover, given the high heritability of ADHD, parents of children with ADHD are more likely to have ADHD themselves, which may further contribute to parenting difficulties including inconsistent discipline, inappropriate repetition of commands, and negative parenting control (see Johnston et al., 2012 for a review). These studies highlight the importance of understanding the unique challenges associated with parenting a child with elevated ADHD and/or DBD symptoms.

Despite these challenges, parenting quality is a robust predictor of developmental outcomes for children with ADHD (Johnston & Chronis-Tuscano, 2014). For example, longitudinal studies have shown that over-reactive parenting predicts the development of later oppositional defiant disorder (ODD) symptoms in young children with behavior problems (Harvey et al., 2011). Given that children with the combination of ADHD and conduct problems are at highest risk for serious outcomes, understanding individual differences in parenting quality is an important research agenda which has the potential to mitigate negative developmental outcomes involving high societal cost (Flory, Milich, Lynam, Leukefeld, & Clayton, 2003). However, to date, the relation between parental scaffolding and child ADHD has been examined in only one study. In a study of 6- to 8-year-old boys, child ADHD was related to poorer observed parental scaffolding (defined as parental verbalizations of encouragement, praise, and problem-solving) and greater use of parental negative verbal control strategies (i.e., direct and implied commands, and negative or corrective statements about the child; Winsler, 1998).

Furthermore, examination of associations between parent EF and parenting may be particularly relevant for children with high ADHD/DBD symptoms, who themselves require a great deal of external structure and support, evoke negative responses from caregivers, and whose parents have a greater genetic likelihood of having EF deficits themselves (Epstein et al., 2000). Therefore, given the significant role scaffolding plays in child development (Garstein & Fagot, 2003; Hammond et al., 2012), and the central importance of parenting quality in predicting developmental outcomes for children with ADHD (e.g., Harold et al., 2013), it is imperative to understand parent individual difference factors that are associated with effective scaffolding, alone and in combination with child ADHD and/or DBD symptoms.

Current Study

The current study utilized a multi-method assessment of maternal EF to examine its relation to observed maternal scaffolding in families of 5–10-year-old children with and without parent-reported ADHD. We hypothesized that deficits in maternal EF would be independently negatively associated with observed scaffolding. We also hypothesized that child ADHD/DBD symptoms would be independently negatively associated with observed scaffolding (Winsler, 1998). Additionally, we hypothesized that parent-reported child ADHD/DBD symptoms would interact with maternal EF deficits to predict the greatest deficits in observed maternal scaffolding. We expected that the association between maternal EF and scaffolding would be stronger in the context of parent-reported child ADHD/DBD due to the child's increased need for external structure/support, tendency to evoke negative responses from caregivers, and greater likelihood of maternal EF deficits. Finally, we explored the independent contribution of each EF measure to the prediction of observed maternal scaffolding.

METHOD

Participants

The sample consisted of 84 mothers and their biological 5–10-year-old children with (n = 44) and without (n = 40) parent-reported ADHD. Mothers identified 1 child within their family whom they wanted to participate in the study. We recruited a demographically diverse sample: Thirty-eight percent of child participants were identified as Caucasian, 21% as African-American, and 41% as multiracial, Hispanic/Latino, or Asian. Sixty-two percent of children enrolled in the study were male. Mothers also self-reported a wide range of yearly family incomes ($18,000–$330,000). Participant demographic characteristics are further described in Table 1. Participants were recruited via mailings and/or presentations to local ADHD advocacy groups, parent list-servs, public bulletin boards, schools, university employees, and health providers in the greater Washington, D.C. metropolitan area. The child had to live primarily with their mother, could not have been previously diagnosed with an autism spectrum disorder, and had to have an estimated intelligence quotient (IQ) above 70, estimated from the vocabulary and block design subtests of the Wechsler Intelligence Scale for Children, 4th Ed. (WISC-IV; Wechsler, 2003) or the Wechsler Preschool and Primary Scale of Intelligence, 3rd Ed. (WPPSI-III; Wechsler, 2002). For inclusion in the ADHD group, children had to meet DSM-5 criteria for ADHD according to parent report on questionnaires and a parent diagnostic interview. Children taking stimulant medications were included, but were asked to engage in parent-child interactions while off stimulant medication whenever possible to increase variability in difficult behavior during the laboratory parent-child interaction (PCI). Children of mothers in the comparison condition could not meet DSM-5 criteria for ADHD, ODD or conduct disorder (CD) or have ever been diagnosed with, or medicated for, ADHD.

Procedures

Mothers expressing interest in the study completed a 10–15-minute telephone screen assessing basic inclusion/exclusion criteria. Mothers meeting basic screening criteria were invited to attend a single 2-hour laboratory session with their identified child. Informed consent and assent were obtained from all individual participants included in the study by doctoral students. The laboratory visit consisted of a parent diagnostic interview, administration of EF tasks to the mother, completion of maternal self-report measures, a child IQ screener, and the parent-child interaction. Parent diagnostic interviews and EF tasks were administered by a doctoral student, while child IQ screeners were administered by trained undergraduate and graduate research assistants, all of which was closely supervised by a licensed clinical psychologist. Institutional IRB approval was obtained prior to conducting this study. Eighty-eight mother-child dyads completed the assessment. Two families were excluded due to the child not being biologically related to the mother, which was not disclosed until after the visit. Two more families were excluded due to recording equipment malfunctions leading to missing scaffolding and EF measures. Twenty children (24%) were prescribed medication for their ADHD; 13 children (15%) took their medication on the day of the PCI. Participants were financially compensated $25 at the end of the visit and were invited to a free 2-hour Helpful Parenting Tips workshop. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Measures

Child Assessment Measures—Mothers completed the ADHD module of the Schedule for Affective Disorders for School-Aged Children, Fifth Version (K-SADS; Ambrosini, 2000). The K-SADS has shown excellent test-retest reliability (.63 to 1.00) and concurrent validity of screening items and K-SADS diagnoses (Kaufman et al., 1997). Mothers completed the Disruptive Behavior Disorders checklist (DBD checklist Pelham, Gnagy, Greenslade, & Milich, 1992). On the DBD checklist, the informant indicated the degree to which each symptom of ADHD, ODD, and CD is present, with symptoms rated *pretty much* or *very much* considered clinically significant (Pelham et al., 1992). This measure has shown good internal consistency (.81 to .96) and predictive validity (.69 to .98; Pelham et al., 1992). The coefficient alpha for the DBD checklist in the current study was .95. ADHD symptoms were considered present if endorsed by the mother as occurring to a clinically significant degree on the K-SADS or DBD checklist (Piacentini, Cohen, & Cohen, 1992). Cross-situational impairment necessary for an ADHD diagnosis was evaluated using the Impairment Rating Scale *(IRS;* Fabiano et al., 2006), as well as impairment questions following the ADHD K-SADS module. On the IRS, raters assessed impairment and need for treatment across multiple domains. Ratings were made on a 7-point scale, with scores at or above the midpoint indicating significant impairment. This measure has shown good test-retest reliability (.54 to .76), a moderate to high degree of concurrent validity with other impairment rating scales and behavioral measures, and good convergent and discriminant validity (Fabiano et al., 2006). The coefficient alpha for the IRS in the current study was .91.

Observed Maternal Scaffolding—The present study utilized two observational tasks widely employed in the literature (e.g., Chronis-Tuscano et al., 2013) that were intended to elicit maternal scaffolding: (1) a 5-minute cleanup/organization task in which clothing, toys, papers, and trash were scattered around the room at age-appropriate levels while the parent was instructed to provide verbal, but not physical assistance; and (2) a 10-minute "homework" task that involved the child completing an age-appropriate math worksheet while the mother was instructed to provide assistance as she saw fit.

Scaffolding was assessed using the Parent Child Interaction System (PARCHISY; Deater-Deckard, 2000; Deater-Deckard, Pylas, & Petrill, 1997; Hughes & Ensor, 2009). The PARCHISY is designed to assess global ratings of parent and child behaviors based on a seven-point Likert-type scale (ranging from 1, *none*, to 7, *very frequent/constant*) across 13 categories of behaviors. Our measure of scaffolding was based on a composite of positive control (use of praise, explanation, and open-ended questions), positive affect (e.g., smiling, laughing), responsiveness (responsiveness to child's questions, comments, behaviors), and on-task behavior (persistence with respect to the task that we have given) based on prior research (Hughes & Ensor, 2009; Mazursky-Horowitz, Bell, & Deater-Deckard, 2015). As scaffolding suggests using an optimal level of parental support, parents received lower scores for providing commands when they were not needed (i.e., providing too much support) as well as when opportunities were missed (i.e., providing too little support) based on this coding system. Trained undergraduate and masters level research assistants were trained to code at 80% reliability and maintained reliability with weekly team coding meetings in which coders discussed and resolved any discrepancies of greater than one point on the seven-point scale (Deater-Deckard, 2000). Using this method, prior studies have shown excellent inter-rater reliability ranging from .74 to 1.00 for individual codes (e.g., child non-compliance and maternal positive control; Deater-Deckard, 2000; Deater-Deckard et al., 2001). For the current study, we calculated Fleiss' Kappa statistics for inter-rater reliability for the clean up ($K = .83$, $z = 50.21$, $p = 2\times10^{-16}$) and homework tasks ($K = .85$, $z = 51.76$ $p = 2\times10^{-16}$). For analyses, scaffolding codes were averaged across the cleanup/organization and homework tasks.

Maternal Executive Functioning Measures—Mothers completed three measures of EF. Based on the SAS model, the Hotel Test (Manly et al., 2002), has been described as a more ecologically-valid assessment of EF since it more closely taxes the EF system as it is taxed in daily life (Chan et al., 2008). Mothers had to complete five tasks needed to run a hotel (i.e., writing out customer bills, proofreading the hotel leaflet, sorting money from the charity collection, organizing decks of cards from the casino, and alphabetizing conference name labels) in an allotted amount of time (10 minutes). Mothers had to strategize how to spend their time in order to accomplish the "big picture" goal of doing some work on each of the tasks. Specifically, the Hotel Test required mothers to evaluate the needs of the task (i.e., attempt all five tasks in 10 minutes), plan the most effective approach (i.e., spend two minutes per task), and then consciously shift tasks (i.e., task shifting) to meet the goal. Prior studies have examined both the number of tasks mothers attempted accurately (out of five tasks) and the total time deviation between the amount of time they actually spent on each task and the optimal amount of time spent (i.e., two minutes per task; higher scores referred to a greater time deviation from the optimal amount of time, and therefore poorer performance) (Torralva et al., 2013). While some studies have found that both scores significantly differentiate patient populations from control groups (e.g., Manly et al., 2002), other studies have found that one score is a better predictor than another (e.g., Torralva et al., 2013). In this study, we used both of these scores to determine which score best captured maternal EF as it relates to maternal scaffolding. The Hotel Test has shown good test-retest reliability and sensitivity in detecting EF deficits among groups of high-functioning and low-functioning clinical groups as well as between clinical groups and healthy controls (Manly et al., 2002; Torralva et al., 2009; 2013).

The Barkley Deficits in Executive Functioning Scale (BDEFS; Barkley, 2011) is an 89-item self-report questionnaire included to assess real-world EF impairments, including: Time Management, Self-Organization, Emotional Self-Control, Self-Restraint, and Self-Motivation on a 4-point Likert scale (ranging from 1, *never or rarely*, to 4, *very often)*. The BDEFS has shown good sensitivity by effectively differentiating ADHD, clinical, and community control groups (Barkley, 2011). Additionally, the BDEFS has been shown to associate with measures of deviant behavior including: antisocial acts, crime diversity, and negative driving outcomes (Barkley & Murphy, 2011). This measure has shown good internal consistency (.84 to .96), test-retest reliability (.62 to .90), and discriminant validity (Barkley, 2011). The coefficient alpha for the BDEFS in the current study was .98.

As Digit Span is the only EF measure consistently found to be related to parenting in the literature to date (Deater-Deckard et al., 2010; Deater-Deckard et al., 2012), mothers also completed this task to assess WM. Mothers were instructed to repeat a sequence of numbers administered by the examiner (Wechsler, 2008). Digit Span has shown high internal reliability (.70–.90), moderate test-retest reliability (.50-.70) and good sensitivity to detecting verbal WM deficits (Conway et al., 2005; Owen, Lee, & Williams, 2000).

Data Analytic Plan

A series of hierarchical linear regressions were conducted to examine the independent and interactive effects of maternal EF and parent-reported child ADHD on observed maternal scaffolding, in line with our aims. Because “child effects” on parenting appear to be most pronounced when the child has conduct problems in addition to ADHD, both parent-reported ADHD and DBD symptoms were included in these models. Separate analyses were run for each of the four EF measures (i.e., Hotel Test time deviation and Hotel Test activities attempted, BDEFS, and Digit Span). Child age and maternal education were both entered in the first step of the regression as control variables since both were correlated with scaffolding in the current study as well as in prior research (e.g., Landry, Smith, Swank, Assel, & Vellet, 2001; Neitzel & Stright, 2004). Both maternal EF and total parent-reported child ADHD/DBD symptoms were entered separately in the second step of the regression in order to examine the independent main effects of each of these predictor variables on scaffolding, and to determine the unique variance contributed to the prediction of scaffolding above child age and maternal education. Then, to examine the moderating role of parent-reported child ADHD/DBD symptoms on the association between maternal EF and scaffolding, the interaction of maternal EF and parent-reported child ADHD/DBD symptoms was entered on the last step of the regression (Deater-Deckard et al., 2010). Finally, in exploratory analyses, we examined the best single predictor of scaffolding by including all four EF measures as predictors of observed scaffolding in one model. These analyses were conducted using R (R Core Team, 2015).

Since both Digit Span (N = 39) and BDEFS (N = 69) had a number of missing values, we utilized an imputation procedure following Gelman and Hill (2006) in order to limit the effect this missingness would have on our data analytic plan[1]. We first tested to make sure our outcome variable did not differ as a function of missingness, in order to justify that our data were missing at random (a necessary assumption for multiple imputation procedures). We then built two imputation models by regressing the existing values of Digit Span and BDEFS separately onto the other predictors relevant to these analyses: child's age, maternal education, and parent-reported child ADHD/DBD symptoms. Using these intermediate models, we predicted the missing values of Digit Span and BDEFS based on the existing predictor values for each individual with these missing EF scores.

RESULTS

Preliminary Analysis

Descriptive data and comparisons between the ADHD and control groups are presented in Table 1. As expected, children in the ADHD group demonstrated significantly more parent-reported ADHD/DBD symptoms and functional impairment. Additionally, mothers in the parent-reported ADHD group self-reported greater inattentive symptoms than mothers in the control group. Groups were equivalent on demographic characteristics, with the exception of child gender, child age, and maternal education, such that children in the ADHD group were more often male, older, and had mothers with lower educational attainment. Additionally, based on prior research demonstrating that scaffolding may differ cross-culturally, maternal race was examined in relation to maternal scaffolding (Gauvain, 2005). However, scaffolding was not significantly related to maternal race or to child gender in this sample and therefore neither was included in subsequent statistical models.

Several associations were found with regard to EF measures (Table 2). The Hotel Test time deviation was higher for Caucasian mothers (compared with mothers who were neither Caucasian nor African American); Hotel Test activity attempts were lower for African American mothers and higher for Caucasian mothers; and BDEFS was positively associated with parent-reported child ADHD/DBD.

Scaffolding was negatively associated with child age, parent-reported child ADHD/DBD symptoms, and maternal educational attainment of less than college (Table 2). Scaffolding was positively associated with maternal educational attainment of more than college. Thus, maternal education and child age were included in subsequent analyses.

Main Analyses

The main effects of maternal EF on scaffolding are presented in Table 3[2]. Child age, $\beta = -.17$, $SE = .05$, $p < .01$, maternal education of less than college, $\beta = .65$, $SE = .30$, $p = .03$, and maternal education of more than college, $\beta = .86$, $SE = .27$, $p < .01$, all significantly predicted scaffolding, such that mothers of younger children and mothers with more education demonstrated greater use of scaffolding. This initial step accounted for 22% of the

[1]Results described below were similar when analyses were conducted with both Digit Span and BDEFS prior to imputation.
[2]Analyses were run with and without the 13 children taking medication on the day of the PCI, and results did not differ.

variance in scaffolding in all models. Hotel Test activity attempts and BDEFS were not significant predictors of maternal scaffolding beyond these controls. However, Digit Span significantly predicted maternal scaffolding, $\beta = .24$, $SE = .10$, $p = .02$, such that better performance on Digit Span predicted greater use of scaffolding, beyond the effects of child age, maternal education, and parent-reported child ADHD/DBD symptoms. This second step accounted for an additional 7% of the variance in scaffolding. Additionally, Hotel Test time deviation significantly predicted maternal scaffolding beyond controls, $\beta = -.21$ $SE = .10$, $p = .04$, such that a smaller Hotel Test time deviation (indicating better EF) predicted greater use of scaffolding. This second step accounted for an additional 5% of the variance in scaffolding.

Contrary to hypotheses, parent-reported child ADHD/DBD symptoms did not significantly predict observed maternal scaffolding beyond the effects of child age, maternal education and maternal EF in any of our regression models (with: Hotel Test time deviation: −.19, $SE = .01$, $p = .09$; Hotel Test activity attempts: $\beta = -.17$, $SE = .11$, $p = .14$; BDEFS: $\beta = -.14$, $SE = .11$, $p = .23$; and Digit Span: $\beta = -.18$, SE = .01, p = .10). Additionally, there were no significant interactions between any maternal EF measure and parent-reported child ADHD/DBD symptoms on maternal scaffolding (Hotel Test time deviation: $\beta = -.16$, $SE = .11$, $p = .15$; Hotel Test activity attempts: $\beta = .10$, $SE = .12$, $p = .38$; BDEFS: $\beta = -.03$, $SE = .08$, $p = .75$; and Digit Span $\beta = .02$, SE = .09, p = .79).

We conducted an additional exploratory analysis to determine the amount of variance in scaffolding that could be explained by each of our EF measures when all EF measures were included in the same model (Table 4). Given limited power, this regression was initially conducted without including covariates, revealing Digit Span as the only significant predictor of maternal scaffolding, $\beta = .26$, $SE = .12$, $p = .03$. However, when covariates were included in the regression, no executive function measure significantly predicted scaffolding beyond child age and maternal education.

DISCUSSION

The current cross-sectional study advances what is known about the independent and interactive links between maternal EF, scaffolding, and parent-reported child ADHD/DBD symptoms using a multi-method approach. This study yielded several important findings, including that child age and maternal education both significantly predicted maternal scaffolding, replicating past research (Landry et al., 2001; Neitzel & Stright, 2004; Winsler, 1998). Additionally, maternal EF (as measured by Digit Span and the Hotel Test time deviation) was predictive of observed maternal scaffolding beyond demographic controls. However, parent-reported child ADHD/DBD symptoms did not significantly predict maternal scaffolding beyond the effects of child age, maternal education, and maternal EF; nor did the interaction of maternal EF and parent-reported child ADHD/DBD symptoms.

As hypothesized, maternal EF (measured by Hotel Test time deviation and Digit Span) was related to maternal scaffolding, such that mothers with better EF demonstrated greater scaffolding during laboratory clean up and homework tasks with their children. In line with the SAS model that focuses on strategy allocation in novel situations, the EF skills tapped in the Hotel Test time deviation (i.e., task shifting) may have been particularly relevant to scaffolding, as scaffolding requires parents to evaluate a child's needs in the moment, plan the most autonomy-supportive (i.e., least restrictive) approach possible, and then further adapt that plan if the child requires additional support (Hammond et al., 2012). On the other hand, the Hotel Test activity attempts did not relate to maternal scaffolding, which may be due to that score being more of a global measurement of EF as opposed to the time deviation score being more conceptually related to maternal scaffolding. Additionally, the necessity for mothers to task shift in order to successfully meet the goal of the Hotel Test maps on well to demands placed on parents who may need to constantly shift between competing demands (e.g., helping with homework, cooking dinner) in a limited amount of time in order to meet a parenting goal (e.g., have the children in bed at an appropriate time). Since parenting involves continually allocating attention to meet competing demands, the SAS is constantly being tapped.

Consistent with prior literature, Digit Span predicted observed scaffolding in the present study beyond stringent demographic controls (Deater-Deckard et al., 2010). While Digit Span has been criticized for having poor sensitivity and poor ecological validity (Barkley & Murphy, 2011; Gregory et al., 2002), it is the only EF measure consistently found to be related to parenting in the literature to date (Deater-Deckard et al., 2010; 2012). Digit Span requires mothers to temporarily store and manipulate information (i.e., numbers and letters), without forgetting the most recent list and ignoring potentially distracting information. Digit Span has been conceptualized as a measure of WM capacity, which may be a particularly relevant skill for mothers attempting to scaffold their children's learning since they need to keep in mind the goals of the learning task and be attentive to their children's developmental needs, while ignoring distractors in the environment. However, at the same time it is important to note that both the Hotel Test and Digit Span predicted a relatively small amount of variance in scaffolding, suggesting that other factors not measured in the current study likely contribute to the prediction of scaffolding.

Contrary to our predictions, the BDEFS did not significantly predict maternal scaffolding in this study. This was a surprising finding as the BDEFS purports to measure higher-order dimensions of adult EF that are utilized in daily life, including time management, organization, problem solving, self-restraint, self-motivation, and self-regulation of emotions–all of which are theoretically necessary for successful parental scaffolding (Barkley, 2011). Indeed, the BDEFS has been related to several aspects of real-world functioning in prior studies (Barkley & Murphy, 2010). It is possible that the mothers in our study did not have good insight into their own EF deficits and including a collateral report from a spouse may have yielded different results. However, this is unlikely since mothers of children with parent-reported ADHD reported significantly higher BDEFS scores (i.e., lower EF) than mothers of children without ADHD. This finding appears to fit well with the literature demonstrating that biological parents of children with ADHD are more likely to have EF deficits themselves (Epstein et al., 2000).

Although parent-reported child ADHD/DBD symptoms were negatively correlated with maternal scaffolding in preliminary analyses, child ADHD/DBD did not predict maternal scaffolding when child age, maternal education, and maternal EF were controlled. This was surprising, as prior research found that parents of six to eight-year-old boys with ADHD demonstrated poorer quality scaffolding than parents of boys without ADHD (Winsler, 1998). Our study showed that the age of the child in question and mother's educational attainment might be more important factors to consider when examining maternal scaffolding behaviors than parent-reported child ADHD/DBD symptoms. More specifically, we found that mothers engaged in more scaffolding with younger children, which fits well with the literature showing that younger children tend to require more support than older children (Landry et al., 2001). The wide age range of child participants in the current study (in contrast to Winsler's narrow age range) may have made it more difficult to observe a significant relation between parent-reported child ADHD/DBD symptoms and parental scaffolding. Focusing on a narrower age range (during a developmental time period where parental scaffolding is most salient) may further elucidate parental characteristics that are associated with scaffolding. Additionally, mothers with greater educational attainment demonstrated more scaffolding behaviors. This finding replicated past research showing that higher maternal education was related to a mother's increased use of scaffolding behaviors (Neitzel & Stright, 2004). Neitzel and Stright (2004) speculated that more educated mothers may have additional cognitive resources for managing child behavior and greater knowledge of child development and problem-solving skills, which may allow for greater use of scaffolding behaviors. Additionally, parents who have greater educational attainment may also have less chaotic households which may further contribute to their ability to scaffold. Finally, the interaction of parent-reported child ADHD/DBD symptoms and maternal EF did not significantly predict maternal scaffolding, contrary to our hypotheses.

Also notable was that the BDEFS did not correlate with either of the laboratory EF measures (Digit Span and Hotel Test). This was not surprising, as past literature has demonstrated low agreement between traditional EF tasks and self-report EF measures (Barkley & Murphy, 2011; Burgess et al., 1998). EF is a multi-dimensional construct and thus each measure of EF utilized in the current study may have tapped into different components of EF. For example, the Hotel Test may capture a mother's ability to task shift, while Digit Span may be capturing a mother's W . This idea fits well with past research on the concept of there being a unity and diversity of EF, which states that while various EF components may be correlated with one another, they also represent distinct entities (Miyake et al., 2000). The results of this study emphasize the need for researchers to examine specific EF components that are conceptually linked to particular parenting behaviors as opposed to examining EF and parenting as broader concepts.

Another interesting finding to note is that mothers of children with parent-reported ADHD did not differ from mothers of children without ADHD on most EF measures, except for the BDEFS. This may be due to the BDEFS measure being the only self-report measure of EF, which may more highly correlate with mothers' self-reports of child ADHD symptoms due to shared method variance.

The current study had several strengths. To our knowledge, this is the first study to examine the relation between maternal EF and scaffolding, and the first to examine this relation among children both with and without ADHD. Methodological strengths include using a multi-method assessment of maternal EF as well as an observational measure of maternal scaffolding. By utilizing a multi-method assessment of EF, this study was able to examine the unique contributions of various assessment tools (i.e., an ecologically-valid laboratory task, an ecologically-valid paper-pencil measure, and a traditional laboratory task) and EF skills (i.e., task shifting, higher-order EF abilities, and WM) in the prediction of maternal scaffolding. By utilizing an observational task of maternal scaffolding, this study was also able to control for the potential influences of shared method variance and provide an objective report of maternal scaffolding behaviors. Furthermore, this study included a racially and economically diverse sample, representing the geographic area in which the data were collected.

Although this study had numerous strengths, these findings must be considered in the context of some limitations. First, due to practical limitations, we were unable to match the groups on gender or other socio-demographic variables such as child gender and maternal education. While analyses run with and without child gender as a covariate yielded similar results, future larger studies should attempt to match groups on key demographic variables that may be related to scaffolding and examine gender as a moderator of the relations between maternal EF and scaffolding. Additionally, although this sample reported a very wide annual income range ($18,000–$330,000), the mean annual income ($110,877) was relatively high (DeNavas-Walt, Proctor, & Smith, 2014) as was the average level of educational attainment. Second, this study did not include teacher reports of child ADHD symptoms. Evidence-based assessment of ADHD involves collection of both parent and teacher reports to assess cross-situational impairment (Pelham, Fabiano, & Massetti, 2005). Third, this study included a relatively narrow range of observed maternal scaffolding (i.e., 3.63–6.13 on a scale from 0–7), which does not allow for examination of mothers demonstrating very poor scaffolding. Therefore, future studies should attempt to recruit a larger sample of mothers demonstrating a wider range of scaffolding abilities.

Another limitation of this study is that only mothers were examined. Though fathers have taken on increasing caretaking responsibilities in recent years, mothers continue to typically play a larger managerial role, including structuring their children's daily activities and routines, and caring for children with special needs, including ADHD (72% female; National Alliance for Caregiving, 2009). These managerial roles require the use of one's EF system and thus mothers were targeted in this study. However, research has suggested that mothers and fathers interact with their children differently and utilize different parenting strategies in general, including their use of discipline and emotional support (Lewis & Lamb, 2003). Therefore, future studies should assess individual differences in maternal *and* paternal EF and use of scaffolding behaviors, especially in the context of child ADHD/DBD symptoms.

Additionally, due to the cross-sectional nature of the study, we were unable to evaluate how maternal EF, scaffolding and child ADHD/DBD symptoms impact one another over time. Additionally, since there is a genetic component to EF abilities (Friedman et al., 2008), future studies may benefit from examining genetic contributions of parental EF on child outcomes. Finally, as ADHD is highly heritable, examining maternal ADHD symptoms as they relate to parental scaffolding may be an important line of future research to understand the bidirectional influences parents and children with ADHD have on one another over time (Faraone & Doyle, 2000).

Given the importance of effective scaffolding in predicting child developmental outcomes, knowledge gained from this study has the potential to improve the identification of mothers at risk for ineffective scaffolding and to inform the development and refinement of parenting intervention programs to meet their needs. Specifically, these results suggest that mothers with poorer EF, especially those mothers with lower educational attainment, should be targeted to gain additional support to improve their scaffolding. Families may benefit more from already-established evidence-based parenting programs, if supplemental modules targeting maternal EF and/or scaffolding are included. Research has shown that mothers of children with ADHD, who have ADHD themselves, benefit less from behavioral parenting programs than mothers without ADHD (Wang, Mazursky-Horowitz, & Chronis-Tuscano, 2014). Recent research has thus attempted to address parent ADHD in the context of parenting interventions for children with ADHD (Chronis-Tuscano, Wang, Strickland, Almirall, & Stein, 2016). This research may shed light on ways to incorporate modules targeting maternal EF (specifically WM and task shifting) in the context of parenting interventions for children with ADHD and conduct problems. For example, adding a module targeting maternal EF in parenting situations (e.g., homework time) may provide these mothers with the additional support (e.g., how to stay on-task, shift their attention as needed, and ignore distractors in the environment) necessary to derive maximum gains from evidence-based parenting programs.

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Table 1

Baseline Demographic and Clinical Characteristics by Child ADHD Status

		Comparison (n = 44)	ADHD (n = 40)	Total (n=84)	Test Statistic	p-value
Child Characteristics						
Child Gender n (%)					5.56	.02
	Male	22 (50.0)	30 (75.0)	52 (61.9)		
	Female	22 (50.0)	10 (25.0)	32 (38.1)		
Child Age *M (SD)*		7.0 (1.7)	8.0 (1.6)	7.4 (1.7)	−2.8	.00
Race n (%)					2.18	.70
	Caucasian	16 (36.4)	16 (40.0)	32 (38.1)		
	African-American	9 (20.5)	9 (22.5)	18 (21.4)		
	Hispanic or Latino	2 (4.5)	0 (0.0)	2 (2.4)		
	Asian	2 (4.5)	1 (2.5)	3 (3.6)		
	Multiracial	15 (34.1)	14 (35.0)	29 (34.5)		
Parent Reported Child Symptoms *(SD)*						
	Inattentive	.80 (1.6)	7.2 (2.3)	3.7 (3.7)	−14.6	.00
	H/I	1.6 (1.9)	5.8 (2.5)	3.5 (3.0)	−8.4	.00
	ODD/CD	.64 (1.5)	3.1 (3.2)	1.8 (2.7)	−4.5	.00
	Impairment	.66 (1.0)	2.8 (1.1)	1.7 (1.5)	−9.1	.00
Maternal Characteristics						
Married n (%)		36 (42.9)	29 (34.5)	65 (77.4)	2.24	.53
Maternal Age *M (SD)*		39.8 (5.8)	40.7 (6.0)	40.2 (5.9)	−.67	.19
Maternal ADHD Symptoms *(SD)*	Inattentive	.57 (1.04)	1.55 (2.31)	1.04 (1.82)	−2.47	0.02
	H/I	1.16 (1.57)	1.38 (1.71)	1.26 (1.63)	−0.6	0.55
Family Income *(SD)*		$119,536.6 (62,561.2)	$101,281.2 (58,896.6)	$110,877.0 (61,148.6)	.005	.94
Race n (%)					5.9	.21
	Caucasian	21 (47.7)	19 (47.5)	40 (47.6)		

		Comparison (*n* = 44)	ADHD (*n* = 40)	Total (*n*=84)	Test Statistic	*p*-value
	African-American	12 (27.3)	10 (25.0)	22 (26.2)		
	Hispanic or Latino	3 (6.8)	0 (0.0)	3 (3.6)		
	Asian	5 (11.4)	3 (7.5)	8 (9.5)		
	Multiracial	3 (6.8)	8 (20.0)	11 (13.1)		
Maternal Education *n* (%)					18.7	.01
	High School or Less	0 (0.0)	5 (12.5)	5 (6.0)		
	Some College	1 (2.3)	10 (25.0)	11 (13.1)		
	Bachelor's	14 (31.8)	9 (22.5)	23 (27.4)		
	Master's	21 (47.7)	12 (30.0)	33 (39.3)		
	Doctorate	8 (18.2)	4 (10.0)	12 (14.3)		
Scaffolding *M (SD)*		4.77 (0.34)	4.56 (0.46)	4.67 (0.42)	2.35	.02
Hotel Test time deviation *M (SD)*		313.27 (171.38)	285.55 (158.35)	300.07 (164.90)	.77	.45
Hotel Test activity attempts *M (SD)*		4.23 (1.08)	4.55 (.85)	4.38 (.98)	−1.52	.13
BDEFS *M (SD)*		123.09 (29.00)	149.91 (51.21)	136.70 (43.61)	−2.67	.01
Digit Span *M (SD)*		100.00 (14.24)	99.00 (11.33)	99.51 (12.74)	.24	.81

Note. *M* = Mean; *SD* = Standard Deviation; ADHD = Attention-Deficit/Hyperactivity Disorder; H/I = Hyperactive/Impulsive; CD= Conduct Disorder; and ODD= Oppositional Defiant Disorder; BDEFS = Barkley Deficits in Executive Functioning Scale

Table 2

Correlations Between Parent and Child Characteristics and Frequency of Observed Parenting Behavior

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. Child Gender	–											
2. Child Age	.09	–										
3. Child ADHD/DBD	−.26*	.18	–									
4. Maternal Race (African American vs. Other)	−.02	.10	−.02	–								
5. Maternal Race (Caucasian vs. Other)	.03	−.03	.15	−.60**	–							
6. Maternal Education (college vs. less than college)	−.05	.16	.38**	.07	−.01	–						
7. Maternal Education (graduate degree vs. less than college)	.13	−.08	−.27**	−.14	.03	−.51**	–					
8. DS	−.06	−.24*	.10	−.06	.16	−.03	.05	–				
9. BDEFS total	−.03	.08	.39**	−.05	.15	.17	.05	.13	–			
10. Hotel Test time deviation	−.04	−.06	−.14	.12	−.30**	.15	−.17	−.38**	−.06	–		
11. Hotel Test attempt	−.07	.04	.19	−.24*	.35**	−.15	.18	.21*	.11	−.77**	–	
12. CU/H scaffold	.04	−.35**	−.29**	−.11	.15	−.35**	.26*	.29**	−.10	−.20	.10	–

* $p < .05$.

** $p < .01$, two-tailed

Note. ADHD = Attention-Deficit/Hyperactivity Disorder; DBD = Disruptive Behavior Disorders; DS = Digit Span; BDEFS = Barkley Deficits in Executive Functioning Scale; CU/H = Clean Up/Homework; FT= Free Time.

Table 3

Hierarchical Regression Analysis for Prediction of Scaffolding with Hotel Test time deviation, Hotel Test activity attempts, BDEFS, and Digit Span

Variable	**d.f.**	**F**	R^2	ΔR^2	**SE**	**β**
Step 1:	3, 79	7.34	.22			
Child age					.05	− 17**
Maternal education (less than college)					.30	.65*
Maternal education (more than college)					.27	.86**
Step 2:	5, 77	5.81	.27	.05		
Child ADHD/DBD					.11	−.19
Hotel Test time deviation					.10	−.21*
Step 3:	6, 76	5.26	.29	.02		
Hotel Test time deviation × Child ADHD/DBD					.11	−.16
Step 2:	5, 77	4.92	.24	.02		
Child ADHD/DBD					.11	−.17
Hotel Test activity attempts					.11	.10
Step 3:	6, 76	4.2	.25	.01		
Hotel Test activity attempts × Child ADHD/DBD			.		.11	.10
Step 2:	5, 77	4.70	23	.01		
Child ADHD/DBD					.1	−.14
BDEFS					.11	.01
Step 3:	6, 76	3.88	.24	.01		
BDEFS × Child ADHD/DBD					.08	−.03
Step 2:	5, 77	6.19	.29	.07*		
Child ADHD/DBD					.11	−.18
Digit Span					.10	.24*
Step 3:	6, 76	5.10	.29	<.01		
Digit Span × Child ADHD/DBD					.09	.02

N = 84;

Note. ADHD = Attention-Deficit/Hyperactivity Disorder; DBD = Disruptive Behavior Disorders; BDEFS = Barkley Deficits in Executive Functioning Scale

* $p < .05$,

** $p < .01$

Table 4

Linear Regression Analysis for Prediction of Scaffolding with Hotel Test time deviation, Hotel Test activity attempts, BDEFS, and Digit Span

Variable	d.f.	F	R^2	SE	β
	7, 75	4.14	.28		
Hotel Test time deviation				.17	−.21
Hotel Test activities attempted				.16	−.13
BDEFS				.10	−.06
Digit Span				.11	.17
Child age				.10	−.26*
Maternal education (less than college)				.31	.60
Maternal education (more than college)				.28	.80**

N = 84;

* p < .05,

** p < .01,

*** p< .001

Note. BDEFS = Barkley Deficits in Executive Functioning Scale