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Executive Functioning Mediates Predictions of Youth Academic and Social Development from Parenting Behavior

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Abstract

Using multiple mediation with bootstrapping, dimensions of executive functioning (i.e., inhibitory control, working memory, set shifting) were tested as mediators of predictions of academic and social outcomes from observed positive and negative parenting in 131 children followed prospectively into early adolescence. Inhibitory control *and* working memory mediated predictions of academic achievement whereas inhibitory control mediated predictions of school competence from positive parenting. Additionally, working memory mediated predictions of negative social preference, but not social competence, from positive parenting. Executive functioning did not mediate predictions from negative parenting. The role of parenting in shaping youth outcomes through executive functioning is considered.

Keywords

parenting; executive functioning; multiple mediation; achievement; social functioning

Adolescent academic and social functioning each predict important developmental outcomes. Academic difficulties in adolescence are associated with poor self-esteem and prospectively predict delinquency (Masten, et al., 2005) whereas positive social relationships buffer against predictions of mortality and disease risk from stress (Cohen, 2004), supporting their centrality to physical and mental health (Uchino, 2006; Umberson, & Karas Montez, 2010). Adolescence is characterized by naturally occurring reductions in youth interest in academic achievement (Dotterer, McHale, & Crouter, 2009) and the concurrent increase in the salience of social relationships (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011). Therefore, developmental considerations must inform efforts to elucidate pathways to academic and social outcomes in early adolescence.

The role of parenting behavior is a widely studied with respect to youth academic and social functioning (Cohen & Rice, 1997; Pettit, Bates, & Dodge, 1997). Consisting of separable positive and negative facets, multiple methods (e.g., self-report, direct observation) measure specific behaviors that reflect these latent constructs. For example, positive parenting

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consists of dimensions of warmth, praise, positive affect, physical affection, monitoring, and involvement (Chronis et al., 2007; Essau, Sasagawa, & Frick, 2006). In contrast, negative parenting may include normative variations in criticism and inconsistent discipline as well as more atypical behaviors such as harsh and corporal punishment (Essau et al., 2006). The predictive validity of these dimensions is suggested by evidence that negative parenting uniquely predicts poor youth outcomes (e.g., bullying/victimization, depression) whereas positive parenting behaviors buffer against negative parenting and numerous risk factors (Dallaire et al., 2006; Lereya, Samara, & Wolke, 2013). Although the specific positive and/or negative parenting behaviors examined varies across studies, these two broad parenting dimensions have amassed considerable support as central to the conceptualization of parenting behavior.

Parenting reliably predicts academic achievement and social functioning across development. In fact, parenting represents a causal factor contributing to academic and social outcomes, because intervention-induced improvements in parenting behaviors have been meta-analytically demonstrated to enhance child functioning in both domains (Kaminski, Valle, Filene, & Boyle, 2008). The association of parenting behaviors with child academic achievement is evident early in development: parent praise of 1- to 3-year-olds' effort predicted an incremental motivational framework (i.e., emphasis on learning rather than performance) at 7–8 years old (Gunderson et al., 2013). In turn, this form of motivation is positively related to gains in academic achievement (Blackwell, Trzesniewski, & Dweck, 2007). The relationship between parent praise and academic functioning is maintained at later stages of development. Specifically, maternal autonomy support (e.g., scaffolding) experienced when children were 5 years old, prospectively predicted school adjustment and reading in third grade (Joussemet, Koestner, Lekes, & Landry, 2005). Furthermore, meta-analysis revealed that parental involvement (e.g., communication with school, support when completing homework) during middle school was positively associated with academic achievement (Hill & Tyson, 2009). Unlike positive parenting, negative parenting, including low warmth and involvement, inversely predicted adolescent academic achievement (Boon, 2007). Similarly, parenting behavior plays an important role in youth social development. Self-reported positive parenting practices (e.g., warmth, responsiveness) were associated with social adjustment (Koblinsky, Kuvalanka, & Randolph, 2006) and social competence (Laible, Carlo, Torquati, & Ontai, 2004) in preschoolers and first graders, respectively. Exposure to both extreme (e.g., abuse, neglect) and normative (e.g., criticism, inconsistent discipline) levels of negative parenting predicts worse social outcomes including bullying, victimization, aggression, and poor social adjustment (Bank, Burraston, & Snyder, 2004; Hart, Ladd, & Burlison, 1990; Haskett & Willoughby, 2007; Lereya, Samara, & Wolke, 2013). Taken together, across multiple designs (e.g., longitudinal, experimental), parenting behavior consistently predicts youth academic and social development. To facilitate innovations in intervention, elucidation of pathways underlying these predictions is essential to promote positive youth outcomes.

Individual differences in child executive functioning (EF) represent a plausible mechanism explaining the relationship between parenting behaviors and youth academic and social development. EF consists of cognitive processes supporting goal-directed behavior (Pennington & Ozonoff, 1996). Three primary subdomains of EF have been well-

characterized: working memory, inhibitory control, and set shifting (Miyake et al., 2000). Working memory consists of mental storage and manipulation of information, inhibitory control involves suspension of a prepotent response, and set shifting represents fluid switching between two separate tasks or demands (Miyake et al., 2000). Like parenting behavior, EF prospectively predicts youth academic, socio-emotional, and behavioral outcomes even with control of potential confounds (i.e., sex, IQ, psychopathology; Clark, Prior, & Kinsella, 2002; Diamantopoulou, Rydell, Thorell, & Bohlin, 2007; Miller, Nevado-Montenegro, & Hinshaw, 2012). Whereas some studies implicate multiple aspects of youth EF with academic functioning (e.g., Best, Miller, & Naglieri, 2011), there may also be unique associations between specific EF dimensions and key academic outcomes. In a large sample of five to 17-year-old youth, multiple subdomains of EF consistently correlated with both math and reading achievement at all ages, although it is unclear whether these associations would survive control of IQ, which was not included in the study (Best, Miller, & Naglieri, 2011). Prospectively, childhood EF predicted academic achievement in young adult females over and above IQ and psychopathology (Miller et al., 2012). The EF dimension of working memory may be particularly relevant given its unique association with preschool academic functioning (Lan, Legare, Ponitz, Li, & Morrison, 2011). At a more granular level, auditory working memory was significantly related to reading and math achievement, but visuo-spatial working memory was related to math achievement only among adolescents with attention-deficit/hyperactivity disorder (ADHD; Rogers, Hwang, Toplak, Weiss, & Tannock, 2011). Overall, given that individual differences in EF reliably predict academic functioning, they constitute strong candidates for pathways underlying predictions of achievement.

Theoretically, it is hypothesized that EF evolved to support social interaction (Barkley, 2001). This hypothesis reflects empirical evidence from youth with neurodevelopmental disorders, for example. Although associations between EF and positive peer nominations (Diamantopoulou et al., 2007) and parent or teacher ratings of social adjustment (Huang-Pollock, Mikami, Pfiffner, & McBurnett, 2009) were reported in school-aged youth, these associations may be better explained by concurrent ADHD. In contrast, variation in EF predicted children's memory for a conversation and detection of verbal cues during a chat room task even with control of ADHD (Huang-Pollock, Mikami, Pfiffner, & McBurnett, 2009). Thus, EF may be more important for particular aspects of social interaction relative to social functioning broadly. In young children with and without autism spectrum disorder, EF is also positively associated with interpersonal interaction (e.g., joint attention; McEvoy, Rogers, & Pennington, 1993). This pattern of findings lends support Barkley's proposal that EF is central to social functioning (2011). Further research is required to clarify the relationship between specific dimensions of EF and diverse aspects of social functioning later in childhood. Moreover, the distinct dimensions of EF should be evaluated simultaneously to determine which aspects of EF contribute to particular outcomes (i.e., academic, social). Identification of specific EF dimensions that are most central to a given outcome will facilitate the development of targeted interventions to enhance academic and social functioning in early adolescence.

EF's sensitivity to parenting behavior further supports EF's role as a putative mechanism. The majority of studies have focused on the relationship between *positive* parenting

behaviors and child EF. For example, controlling for age, sex, and IQ, parental monitoring predicted longitudinal change in child response inhibition, a key component of EF (Roskam et al., 2014); maternal scaffolding similarly predicted toddler EF, even with control of IQ and maternal education (Bernier et al., 2010). Finally, intervention-induced positive parenting improved inhibitory control in adolescents substantiating their plausible association (Brody et al., 2005). Thus, youth EF is consistently sensitive to variation in positive parenting. Despite an emphasis on positive parenting, negative parenting also correlates with youth EF. Latent positive *and* negative parenting variables were uniquely associated with early childhood EF (Blair et al., 2011; see Fay-Stammach, Hawes, & Meredith, 2014 for a key exception) and negative parenting behaviors (e.g., intrusiveness, negative affect) inversely predicted child EF preschoolers (Cuevas et al., 2014). However, the association of parenting with EF has focused on early childhood, despite emerging evidence that parenting continues to predict youth EF through early adolescence (Sosic-Vasic et al., 2017). Specifically, replications and extension of these models across developmental periods are needed. Overall, individual differences in EF are sensitive to early caregiving behavior. Further they constitute compelling mediators underlying predictions of youth academic and social development.

Key methodological improvements are necessary to improve traction on the putative mediational role of EF in predictions of socio-academic development from parenting behavior. First, reflecting its multi-dimensionality (Caron, Weiss, Harris, & Catron, 2006; Dallaire et al., 2006; Ellis, & Nigg, 2009), positive and negative parenting behaviors are differentially associated with academic and social outcomes (Haskett & Willoughby, 2007; Joussemet et al., 2005). Thus, parenting dimensions must be examined simultaneously to identify their *unique* predictions. Second, methodologically, observed parenting behavior increments predictions of child outcomes beyond self-report (Zaslow et al., 2006) and is less vulnerable to biases associated with self-report data (Holden & Edwards, 1989). Measures of observed parenting behaviors should therefore be prioritized. Third, parent and child interactions are bidirectional in nature. Child characteristics, as a result, reliably evoke parenting behavior (Ge et al., 1996; Scaramella & Leve, 2004). Known as “child effects” (Lytton, 1990), associations between parenting behavior and child outcomes must control for child behaviors that elicit different caregiving responses. Finally, although EF and IQ represent distinct constructs, they share considerable variance. As such, there is considerable debate about controlling for IQ in studies of EF because removing IQ-related variance may limit the associations between EF and key outcomes (Barkley, 1997; Dennis et al., 2009). Testing models with and without control of IQ will clarify how relationships are modified with incorporation of IQ. Future studies should simultaneously examine positive and negative observed parenting behavior, control for child effects (i.e., child behavior), and thoughtfully consider the role of IQ in predictive models.

Perhaps the most significant limitation with respect to studies of child outcomes from parenting behavior is that little is known about their putative mediators, thus preventing knowledge about important risk processes (Rutter, 2006). EF and a related temperament-based construct (i.e., effortful control) have been tested as mediators of predictions of externalizing behavior from parenting in multiple samples (Eisenberg et al., 2005; Sulik, Blair, Mills-Koonce, Berry, & Greenberg, 2015). With respect academic and social

development, a latent EF factor mediated predictions of high school achievement from supportive parenting (Bindman, Pomerantz, & Roisman, 2015), and individual differences in child effortful control mediated the association between self-reported positive parenting and youth prosociality (Padilla-Walker & Christensen, 2011). Notably, the distinct dimensions of EF were not examined as *simultaneous* mediators. We contend that multiple dimensions of EF must be simultaneously evaluated (e.g., multiple mediation framework) to facilitate more specific inferences – that is, whether EF dimensions collectively and/or uniquely mediate predictions of outcome. Because EF dimensions may improve with intervention (Diamond & Lee, 2011), they represent strong *modifiable* candidates underlying predictions of adolescent outcomes from parenting behavior. Finally, causal mediation requires temporally ordered predictors (i.e., parenting behavior), mediators (i.e., EF), and outcomes (i.e., academic, social), an infrequent characteristic of existing studies. Indeed, prospective designs should be prioritized in tests of causal mediation (MacKinnon & Fairchild, 2009) enabling the identification of specific targets for intervention.

The aim of the present study was to rigorously evaluate *separable* facets of EF as causal mediators of the association of *observed* positive and negative parenting behavior with youth academic and social outcomes gathered four years later. If dimensions of EF mediate predictions of academic and social functioning from parenting, targeted interventions for EF may mitigate adverse outcomes associated with the experience of negative caregiving behavior. In a sample of 131 five to ten year-old children followed prospectively over four years (i.e., Waves 1–3), we hypothesized that Wave 2 EF dimensions (i.e., set shifting, inhibitory control, working memory) would uniquely mediate the association of Wave 1 parenting behavior with youth academic and social functioning at Wave 3. When significant mediation was identified, we additionally controlled for IQ.

Method

Participants

Families were recruited from a large metropolitan city in the Western United States through advertisements in schools. In total, 131 ethnically diverse (approximately 53% Caucasian) children and their families were invited for a laboratory assessment (i.e., Wave 1; ages 5–10 years). About two years (i.e., Wave 2; ages 7–13 years) after their baseline assessment, approximately 87% of the original Wave 1 families ($n = 114$) completed some portion of the Wave 2 assessment. Finally, approximately 77% of families ($n = 101$) from baseline completed a third assessment (i.e., Wave 3; ages 9–15 years) two years after Wave 2. For the current study, inclusion criteria were English fluency and living with a biological caregiver at least halftime. Children completed subtests from the English version of the WISC-IV to estimate IQ (see measures for more detail) and ensure that each participant had an IQ of at least 70. Additional exclusion criteria included a history of seizures, neurodevelopmental disorder, or other neurological condition. Of the participating parents at baseline, 85% were mothers and the remaining parent participants were all fathers.

There were no significant demographic differences (i.e., child age, sex, ethnicity) between children who participated at Wave 1 and Wave 2. When comparing participants from Wave 1 and Wave 3, there was no difference in baseline age or child sex; however, there was a

significant difference with respect to ethnicity (Fisher's exact test, $p = .05$), such that African American youth were underrepresented at Wave 3. Additionally, youth who returned to participate at Waves 2 and/or 3 had a higher mean IQ ($ps < .001$) than those who did not complete follow-ups. Table 1 summarizes the descriptive statistics for demographic and study variables; Table 2 provides pairwise correlations for the key study variables. There were no significant differences in levels of positive and negative parenting or child noncompliance when comparing children who completed Wave 1 with those who returned at subsequent assessments (i.e., Wave 2, Wave 3; $ps > .15$). Lastly, there were no significant differences in Wave 2 EF scores (i.e., Stroop Color Word, Digit Span Backward, Trail Making Test Part B) among children who participated in Wave 3 versus those who did not complete Wave 3 ($ps > .06$). To address missing data, we used full information maximum likelihood (FIML) estimation, an advanced missing data procedure (outlined further below).

Procedures

Following an initial phone screening, eligible families completed rating scales and a laboratory-based assessment (i.e., Wave 1) conducted by well-trained graduate students in psychology or B.A. level staff. After obtaining informed consent from parents and child assent, youth completed tests of EF and academic achievement as well as interviews to evaluate socio-emotional functioning. Concurrently, parents completed structured diagnostic interviews and rating scales to assess child and family functioning. The family also completed a laboratory-based parent-child interaction (described further below).

Approximately two and four years after Wave 1, all families were invited for laboratory-based follow-ups (i.e., Wave 2, Wave 3), which involved similar procedures to Wave 1, focusing again on child behavior, socio-emotional and academic development, as well as family functioning. Although key constructs and measures were collected at multiple waves (see Figure 1 for details), we prioritized temporally ordered data to strengthen inferences from multiple mediation (Preacher, 2015); therefore, we used Wave 1 observed parenting (i.e., predictors), Wave 2 EF (i.e., mediators), and Wave 3 academic and social functioning (i.e., outcomes). The Institutional Review Board approved all study procedures, including appropriate monetary compensation for participants' time.

Wave 1 Predictors and Cognitive Ability

Observed Parenting and Child Behavior.—At Wave 1, we employed the Dyadic Parent Child Interaction Coding System, a well-validated system used to rate parent-child interaction consisting of child-led play, parent-led play, and cleanup portions (DPICS; Eyberg, Nelson, Duke, & Boggs, 2005). Discrete parent and child behaviors were coded continuously and then composite categories described in the literature were created (Chronis-Tuscano et al., 2008; Eyberg et al., 2001; Li & Lee, 2013). Negative parenting consisted of hostile or critical comments, negative commands, and condescending remarks ($M = 8.06$, $SD = 7.59$). Positive parenting was estimated through counts of parental praise ($M = 12.70$, $SD = 11.83$), including positive attributions for a child's behavior (see Tung, Brammer, Li, & Lee, 2014 for examples of parent praise and negative talk). These positive and negative dimensions of maternal parenting discriminated children with behavior problems from healthy controls across multiple studies (Lee et al., 2010; Chronis et al.,

2007) and have been sensitive to change following parenting inventions in mothers and fathers (Schuhmann, Foote, Eyberg, Boggs, & Algina, 1998). Lastly, child noncompliance was coded when the child ignored or refused parent direct and indirect commands/questions. Child prosocial behaviors, however, were not coded as this task was developed for use primarily in the study of disruptive behaviors (e.g., Chronis-Tuscano et al., 2011). Because families participated in the interaction task for slightly different amounts of time ranging from 21 to 25 minutes, counts of each category were summed and divided by the total number of minutes ($M = 23.86$, $SD = 1.13$) that were coded. Coders were intensively trained to reliability, adhering to the DPICS protocol and the intraclass correlations for each parenting behavior and child noncompliance variable exceeded .70 (see Tung et al., 2014). We evaluated praise and negative talk as separate dimensions of parenting, controlling for child noncompliance to combat child effects. There were no significant differences in levels of observed positive and negative parenting or child noncompliance when comparing mothers and fathers ($ps > .27$).

Cognitive Ability.—At baseline, children completed the Vocabulary, Symbol Search, and Arithmetic subtests of the WISC-IV (Wechsler, 2003). The sum of scaled scores of these three subtests was used to estimate full scale-IQ, given their high correlation with IQ ($r = 0.9$) derived from the complete WISC-IV battery in the normative sample (Sattler & Dumont, 2004).

Wave 2 Mediators

Executive Functioning (EF).—At Wave 2, we administered the child version of the Trail Making Test (Reitan, & Wolfson, 1992). Whereas Trail Making Test A involves drawing lines to connect numbered circles in sequential order from 1 to 15 as quickly as possible without making errors; Trail Making Test B (TMT B) requires individuals to connect numbers 1 through 13 and letters A through L in the proper numerical and alphabetical sequence. The time (*min*) to complete TMT B reflects set shifting (Reitan, & Wolfson, 1992) and the score strongly loads onto a latent factor of this construct (Arán Filippetti & Richaud, 2017). Further, TMT B performance, differentiates youth with ADHD and controls, suggesting its sensitivity to frontal lobe functioning (Martel, Nikolas, & Nigg, 2007). TMT B completion time was used to estimate set shifting in this study. We converted the number of seconds to complete TMT B to minutes and then reverse scored the measure so that higher scores represented better EF.

We also administered the Children's Version of the Golden Stroop (Golden, Freshwater, & Zarabeth, 2003) to assess inhibitory control (Miyake, et al., 2000). Participants first read as many words (i.e., red, blue, green) as possible in 45 sec. In the next condition, they named different colors of ink (i.e., red, blue, green). In the third and final condition (i.e., Color-Word), the names of colors are printed in discordant colors (e.g., "red" is printed in blue ink), and participants named the color of the ink while inhibiting the prepotent response of reading the word. The total score on the Color-Word condition is the number of ink colors named during the 45-second time limit, which we used as an index of inhibitory control. This Stroop color-word score has been shown to correlate with other measures of inhibitory

control (e.g., Stop Signal, Antisaccade) and loaded on to a latent inhibition factor (Arán Filippetti & Richaud, 2017).

Lastly, children completed the Digit Span subtest from the Wechsler Intelligence Scale for Children-IV (WISC-IV; Wechsler, 2003) to estimate working memory. The forward condition requires recall of a string of numbers that were read aloud; the backward condition requires recalling the numbers back in reverse order. The raw score of Digit Span backwards was utilized as an index of working memory as it loads more strongly on to a latent working memory factor, relative to the forward condition (Arán Filippetti & Richaud, 2017).

Wave 3 Outcomes

Academic achievement.—Youth completed the Word Reading and Math Reasoning subtests from the Wechsler Individual Achievement Test Second Edition (WIAT-II; Wechsler, 2002). The Word Reading subtest assesses phonological awareness and decoding whereas Math Reasoning assesses mathematical problem solving. The WIAT-II is a standardized measure that employed a large, nationally representative sample of children (Wechsler, 2002). This measure is independent of the WISC-IV used to estimate IQ at baseline; the WIAT-II is both reliable and valid given its association with external criterion such as youth grade point average (Wechsler, 2002). Given their substantial inter-correlation, $r = .64, p < .001$, we calculated a composite score by totaling the raw z-scores of Word Reading and Math Reasoning to measure overall academic achievement. Further supporting the combination of scores, these WIAT-II subtests correlate at .47 and above in the normative sample for ages 9–15 (Wechsler, 2002). Additionally, these or other WIAT-II subtests assessing reading and math achievement have been combined into single composites in existing studies to gauge overall academic functioning (Marshall, Evans, Eiraldi, Becker, & Power, 2014; Shemmassian, & Lee, 2012; Trentacosta & Izard, 2007). This approach has the added benefit of reducing the number of statistical tests.

Negative social preference.—Social preference is sometimes referred to as popularity and evaluates how well peers like a given child; parents and teachers (rather than peers) can provide these ratings (Dishion, 1990). Parents completed the Dishion Social Preference Scale, a three-item (5-point metric) measure of peer acceptance, rejection, and being ignored (Dishion, 1990). Each item assesses peer acceptance, rejection, and whether peers have a neutral reaction to the child, respectively. For example, parents are asked, “What proportion of ___’s peers (male and female) like and accept him/her” to measure acceptance. Response options range from 1 (very few, less than 25%) to 5 (almost all, more than 75%). In the present sample, the measure demonstrated acceptable reliability ($\alpha = 0.77$). Consistent with prior studies (Humphreys et al., 2013; Lee & Hinshaw, 2006; Owens, Hinshaw, Lee, & Lahey, 2009), we subtracted the reject from the accept rating and then reverse scored the difference to estimate negative social preference, such that higher scores represented low social preference.

School and social competence.—At Wave 3, parents completed the Child Behavior Checklist (CBCL), a well-validated and reliable measure of youth functioning (Achenbach & Rescorla, 2001). This rating scale consists of 113-items evaluating youth behavior over

the prior six months using a 3-point scale (i.e., not true, sometimes true, very true or often true). The CBCL uses normative data for boys and girls ages 6 to 18. Additionally, the CBCL estimates school competence and social competence subscale scores from this measure. The school competence score is derived from four items that assess grades, class placement, repetition of a grade, and school problems. Parents rated youth performance in academic subjects (i.e., reading/English/language arts, history/social studies, arithmetic/math, science, other) using a 4-point Likert scale ranging from “failing” to “above average.” The remaining school competence items use binary “yes” or “no” responses. Based on the standardized manual for the CBCL, school competence score is the total of the average of the academic performance plus the binary responses on the remaining three items.

Social competence was derived from six items that broadly evaluate the number and quality of peer relationships and participation in organizations (Achenbach & Rescorla, 2001). Specifically, the parents list the number of organizations and select how active the youth are in each organization from three response options ranging from less active to more active. Parents also selected the number friends that youth had (i.e., none, 1, 2 or 3, 4 or more) and the number of times per week their child did things with peers outside of school (i.e., less than 1, 1 or 2, 3 or more). For the final two items of the social competence subscale, parents rated their child’s behavior with other children and behavior alone as “worse,” “average” or “better” relative to their peers. The social competence score is the total organizations and mean participation in these organizations plus the number of friends, frequency of contact with friends, behavior with others, and behavior alone. Of note, unlike social preference, social competence captures social skills required to develop and maintain relationships (Achenbach & Rescorla, 2001). The CBCL manual reports the reliability of both the school competence ($\alpha = 0.63$) and social competence ($\alpha = 0.68$) scales to be acceptable (Achenbach & Rescorla, 2001). Because we included child age and sex as covariates, we analyzed the raw scores (rather than *T*-scores) from the school and social competence subscales as additional measures of academic and social functioning.

Data Analytic Plan

We tested whether individual differences in Wave 2 EF (i.e., inhibitory control, set shifting, working memory) mediated the separate predictions of Wave 3 youth academic and social functioning from Wave 1 observed parenting behaviors (i.e., praise, negative talk), controlling for Wave 1 child age, sex, and observed child noncompliance. Wave 2 EF dimensions (i.e., set shifting, inhibitory control, working memory) were entered simultaneously to assess their collective and unique mediational roles of multi-method measures of Wave 3 academic and social functioning. As expected, Wave 3 academic functioning (i.e., WIAT-II, CBCL school competence) and social functioning (i.e., Dishion negative social preference, CBCL social competence) measures were substantially correlated (Table 2). Each outcome was evaluated in a separate model. Finally, when significant mediation was observed, we reproduced the model with additional control of IQ.

We employed multiple mediation with bootstrapping in Mplus 7.0, to discern whether separable facets of Wave 2 EF collectively and uniquely (i.e., controlling for all other mediators) mediated predictions of Wave 3 academic and social outcomes from Wave 1

parenting behavior. Whereas traditional conceptualization of mediation emphasized statistical mediation (Baron & Kenny, 1986), modern approaches do not require a significant total effect of the predictor on the outcome (MacKinnon, Krull, & Lockwood, 2000; Zhao, Lynch, & Chen, 2010). With temporally ordered data, we specifically evaluated evidence of “causal mediation,” consisting of a “chain-reaction” whereby the predictor influences the mediator, which subsequently leads to a change in the outcome (Collins et al., 1998). Multiple mediation is a non-parametric, statistically powerful procedure and bootstraps samples from a dataset k number of times to calculate confidence intervals and estimates of the indirect effects of mediators using percentages of the sampling distributions (MacKinnon et al., 2000), which minimizes Type I error relative to other tests of indirect effects (e.g., Sobel test; Hayes, 2009). We used 10,000 bootstrap simulation samples with 5,000 iterations between each, yielding point estimates and the 95% bias corrected (BC) confidence intervals for each indirect effect. In the present sample, missing data ranged from 36% on the academic achievement composite (i.e., WIAT-II) to 0% on baseline age. Notably, observed parenting data were available for 103 participants as some families did not have time to complete the interaction task. Although observed parenting data were unavailable for 28 participants, they have data on other measures and were therefore included in the models. This approach is consistent with state-of-the-art missing data approaches rather than listwise deletion (Peugh & Enders, 2004). To address missing data, we employed FIML estimation—one such state-of-the-art approach that enhances the accuracy and power of analyses (Schafer & Graham, 2002). As required for the use of FIML (Li, 2013), the sample met the assumption of missing completely at random (MCAR) based on of Little’s test of MCAR [$\chi^2(191) = 217.92, p = .08$].

Results

Prediction and Mediation of Wave 3 Youth Academic Outcomes

We hypothesized that Wave 2 EF would mediate predictions of Wave 3 academic functioning from Wave 1 observed parenting behavior. EF dimensions significantly mediated predictions of academic achievement from baseline *positive* parenting (Table 3; Figure 2). First, there was no significant total effect of Wave 1 positive parenting on Wave 3 academic achievement (i.e., WIAT-II) controlling for negative parenting behavior, Wave 1 child age, sex, and observed noncompliance, with EF dimensions excluded ($\beta = .08, SE = .12, p = .49$). Second, the predictor was related to the mediators: positive parenting positively predicted Wave 2 inhibitory control ($\beta = .15, SE = .08, p = .05$) and working memory ($\beta = .32, SE = .13, p = .01$), but was unrelated to set shifting ($\beta = -.04, SE = .13, p = .74$). Next, all mediators predicted the outcome: Wave 2 inhibitory control ($\beta = .42, SE = .11, p < .001$), working memory ($\beta = .23, SE = .10, p = .01$), and set shifting ($\beta = .41, SE = .21, p = .05$) all positively predicted Wave 3 academic achievement. Third, there was no significant direct effect of positive parenting on Wave 3 academic achievement with inclusion of EF mediators ($\beta = -.04, SE = .09, p = .67$).

After considering the model paths, we calculated the total and specific indirect effects of baseline positive parenting on academic achievement four years later through inhibitory control, working memory, and set shifting using 10,000 bootstrapped samples with 5,000

iterations between each, yielding 95% bias corrected (BC) confidence intervals for each indirect effect. The total indirect effect (i.e., point estimate difference between the total effect and direct effect through the three mediators) did not differ from zero; however, inhibitory control and working memory, but not set shifting, each significantly mediated predictions of Wave 3 academic achievement from baseline positive parenting (Table 3). Specifically, positive parenting at baseline was related to better inhibitory control and working memory two years later; those EF dimensions positively predicted academic achievement at Wave 3. Given the significant mediation, we added control of IQ. Mediation was no longer significant with inclusion of IQ (Table 3). The attenuation of effects with inclusion of IQ is unsurprising given its correlation with EF and academic functioning. In contrast to predictions of academic achievement from positive parenting, no significant direct or indirect effects via EF emerged for predictions of this outcome from negative parenting (Table 3).

We next reproduced the identical model described above but predicted parent-rated Wave 3 youth school competence (i.e., CBCL school competence). First, excluding all three EF dimensions, there was no significant total effect of positive parenting on school competence ($\beta = .00$, $SE = .12$, $p = .97$). Positive parenting positively predicted Wave 2 inhibitory control ($\beta = .15$, $SE = .08$, $p = .05$) and Wave 2 working memory ($\beta = .33$, $SE = .13$, $p < .01$), but not set shifting ($\beta = -.05$, $SE = .13$, $p = .69$). In turn, Wave 2 inhibitory control significantly predicted school competence at Wave 3 ($\beta = .27$, $SE = .13$, $p = .03$), however neither working memory ($\beta = .12$, $SE = .12$, $p = .32$) nor set shifting ($\beta = .08$, $SE = .10$, $p = .45$), were associated with school competence. There was no significant direct effect of positive parenting on school competence when EF dimensions were included ($\beta = -.08$, $SE = .12$, $p = .51$). Bootstrapping analyses demonstrated that inhibitory control uniquely mediated predictions of school competence from baseline positive parenting (Table 3). Thus, positive parenting predicted better inhibitory control and better inhibitory control, in turn, was related to greater school competence approximately two years later. Consistent with predictions of WIAT-II academic achievement, mediation was no longer significant when IQ was added to the model (Table 3). Again, EF did not mediate predictions of school competence from negative parenting.

In summary, inhibitory control significantly mediated predictions of multiple academic functioning measures from observed positive parenting behavior. Working memory significantly mediated predictions of academic achievement, but not school competence, from baseline positive parenting. Inclusion of IQ as a covariate attenuated these effects, and EF dimensions did not mediate predictions of academic functioning from negative parenting.

Prediction and Mediation of Wave 3 Youth Social Outcomes

Next, we evaluated predictions of Wave 3 social functioning (i.e., Dishion negative social preference, CBCL social competence) from Wave 1 observed parenting behavior, controlling for Wave 1 child age, sex, and observed noncompliance. Models examining positive parenting as a predictor controlled for negative parenting and vice versa. Excluding EF from the model, there was no significant total effect of positive parenting on Wave 3 negative social preference ($\beta = -.09$, $SE = .10$, $p = .37$). Second, positive parenting was marginally

positively associated with Wave 2 inhibitory control ($\beta = .15$, $SE = .08$, $p = .06$), and positively predicted working memory ($\beta = .32$, $SE = .13$, $p = .01$). Positive parenting was unrelated to Wave 2 set shifting ($\beta = -.05$, $SE = .13$, $p = .69$). Third, working memory was inversely related to Wave 3 negative social preference ($\beta = -.24$, $SE = .13$, $p = .05$), but inhibitory control ($\beta = .07$, $SE = .16$, $p = .66$) and set shifting ($\beta = .08$, $SE = .09$, $p = .41$) were not. Finally, there was no significant direct effect of positive parenting on negative social preference when EF was included ($\beta = -.02$, $SE = .12$, $p = .87$). Bootstrapping analyses revealed that working memory uniquely mediated predictions negative social preference such that positive parenting was predictive of better working memory, which, in turn, was inversely related to negative social preference at Wave 3 (i.e., indicating better social functioning; Table 3). In contrast, EF dimensions did not mediate predictions of negative social preference from negative parenting (Table 3).

To determine the specificity of working memory as a mediator, we reevaluated predictions of Wave 3 negative social preference, with control of IQ. There was no significant total effect of positive parenting on negative social preference ($\beta = -.10$, $SE = .10$, $p = .34$; Figure 3). Baseline positive parenting was significantly related to Wave 2 inhibitory control ($\beta = .16$, $SE = .08$, $p = .03$) and working memory ($\beta = .34$, $SE = .11$, $p < .01$), but not set shifting ($\beta = -.05$, $SE = .12$, $p = .66$). Next, although inhibitory control ($\beta = .04$, $SE = .16$, $p = .82$) and set shifting ($\beta = .07$, $SE = .09$, $p = .45$) were unrelated to Wave 3 negative social preference, working memory ($\beta = -.26$, $SE = .13$, $p = .04$) inversely predicted negative social preference at Wave 3. There was no significant direct effect of positive parenting ($\beta = -.01$, $SE = .12$, $p = .92$) with EF included in the model. Finally, bootstrapping revealed a significant total indirect effect (Table 3) such that working memory remained a unique mediator of predictions of Wave 3 negative social preference from positive parenting, even with control of IQ.

Next, we tested whether EF also mediated predictions of Wave 3 parent-rated social competence from positive parenting with control of child age, sex, noncompliance, and negative parenting. First, excluding EF from the model, there was no significant total effect of positive parenting on social competence ($\beta = .00$, $SE = .13$, $p = .97$). Positive parenting marginally predicted Wave 2 inhibitory control ($\beta = .15$, $SE = .08$, $p = .06$) and was positively related to working memory ($\beta = .32$, $SE = .13$, $p = .01$). Positive parenting was not associated with set shifting ($\beta = -.05$, $SE = .13$, $p = .69$). Next, Wave 2 inhibitory control ($\beta = -.04$, $SE = .13$, $p = .74$), working memory ($\beta = .06$, $SE = .13$, $p = .62$), and set shifting ($\beta = -.07$, $SE = .11$, $p = .52$), did not predict Wave 3 social competence. Lastly, no significant direct effect of positive parenting on social competence emerged ($\beta = -.02$, $SE = .14$, $p = .87$), and bootstrapping indicated that the relationship between baseline positive parenting and Wave 3 social competence was not mediated via dimensions of EF (Table 3). Again, EF dimensions did not mediate the effect of negative parenting on youth social competence (Table 3). Overall, working memory mediated predictions of negative social preference from positive parenting, with and without control of IQ, but not predictions of social competence.

Discussion

Although parenting behavior reliably predicts youth academic and social development, relatively little is known about the mechanisms underlying these predictions. In a prospective longitudinal study from childhood to early adolescence, we evaluated temporally ordered EF dimensions (i.e., set shifting, inhibitory control, working memory) as collective and unique mediators of predictions of academic and social functioning from observed positive and negative parenting. With control of key covariates (e.g., IQ, child noncompliance), important findings emerged: (1) individual differences in inhibitory control and working memory uniquely mediated predictions of academic functioning from positive parenting behavior (these effects did not survive statistical control of IQ); (2) working memory mediated predictions of negative social preference, but not social competence, from positive parenting, even with control of IQ. These preliminary findings suggest that individual differences in youth inhibitory control and working memory are two mechanisms underlying predictions of academic and social development subsequent to normative differences in positive parenting behavior.

A major innovation in the current study was elucidation of pathways from exposure to naturally-occurring variations in parenting behavior to individual differences in academic functioning. First, positive parenting predicted inhibitory control and working memory approximately two years later, although the effect did not survive stringent control of IQ given its centrality to both EF and academic outcomes (Dennis et al., 2009; Mayes, Calhoun, Bixler, & Zimmerman, 2009). Although there is replicated evidence that positive parenting is associated with youth EF in early childhood (Bernier et al., 2010; Blair et al., 2011; Roskam et al., 2014), the current findings extend this association into middle childhood. With respect to the specific EF dimensions, inhibitory control and working memory predicted academic outcomes in early adolescence, replicating prior studies examining academic achievement across development (Best et al., 2011; Samuels, Tournaki, Blackman, & Zilinski, 2016). Although inhibitory control mediated predictions of both academic outcomes (i.e., achievement, school competence), working memory specifically mediated predictions of academic achievement, which parallels recent evidence. In particular, working memory assessed in kindergarten was related to children's reading, spelling, and mathematics performance in first grade controlling for other dimensions of EF (Vandenbroucke, Verschueren, & Baeyens, 2017). Additionally, a latent updating (working memory) factor was related to English and math performance in a sample of 11 to 12-year-old students (St. Clair-Thompson & Gathercole, 2006). Although working memory correlates with achievement in many academic subjects (e.g., math, reading), inhibition may be relevant to a broader array of academic skills in middle school as our and other studies suggest (St. Clair-Thompson & Gathercole, 2006). Thus, inhibitory control may represent an EF dimension with broad effects on multiple domains of academic functioning.

There are multiple plausible explanations for the centrality of inhibitory control to multiple academic domains. Developmentally, inhibitory control undergoes rapid improvement in early childhood whereas working memory develops in a more linear fashion (Best & Miller, 2010); therefore, inhibitory control may compensate for slower development in working memory and subsequently may be more academically consequential in adolescence. The

factor structure of the EF construct may also lend insight into these results. The architecture of EF suggests that the specific dimension of inhibition is subsumed by a common EF factor (Friedman & Miyake, 2017). Thus, inhibitory control may reflect more general EF traits (e.g., planning/organization) critical to all aspects of academic performance. Future work must test whether unique variance in inhibitory control predicts broad academic functioning with control of a common EF factor. Continued research testing multiple dimensions of EF as mechanisms underlying the relationship of positive parenting and academic development through high school and college is warranted to clarify which aspects of EF should be targeted via intervention to maximize academic achievement in specific subjects and at varied points in development through young adulthood.

There is varied evidence on the nature of EF deficits with respect to social functioning (Clark et al., 2002; Diamantopoulou et al., 2007; Huang-Pollock et al., 2009). We found that even with control of IQ and other EF dimensions, working memory mediated predictions of negative social preference, but not social competence. Notably, the significant prediction of negative social preference from working memory emerged despite a nonsignificant correlation between these measures (Table 3). This suggests the presence of a possible suppression effect (MacKinnon, Krull, & Lockwood, 2000) where the magnitude of the association increased with the inclusion of other dimensions of EF and covariates. Alternatively, the utilization of FIML to address missing data may have improved the power to detect the effect (Schafer & Graham, 2002). As such, replication of our preliminary findings in other samples is an important aim particularly as the relationship between working memory and social functioning in the present study diverges from other evidence during this developmental period. For example, working memory only marginally predicted a social functioning composite measure, including both social preference and social skills in girls (Rinsky & Hinshaw, 2011). However, the use of a composite score of social functioning may obstruct the nuanced relationships between individual EF dimensions and aspects of social functioning, suggesting that careful consideration of both composite and distinct measures of social outcomes in studies is indicated.

The dissociation of working memory from negative social preference versus social competence in the current study reflects theories of social development that sharply separate dimensions such as social skills (e.g., cooperation), affect recognition, and friendship (i.e., reciprocal relationships; Rose-Krasnor, 1997). Experimental designs in young adults reported that the detection of nonverbal social cues was sensitive to working memory (Phillips, Tunstall, & Channon, 2007), suggesting that working memory affects social competence in real time. Given the prospective longitudinal design of the current study, the delay between measurement of EF and social outcomes may explain why working memory did not mediate predictions of social competence. In contrast, we found that working memory did predict social preference, representing popularity, two years later. Taken together, the pattern of results indicates that current working memory may concurrently affect social skills, with subsequent downstream consequences for social preference. This hypothesis should be tested explicitly.

Moreover, EF may not relate specifically to parent-rated social competence. For example, working memory only predicted child social behavior in a chat-room based task, but not

parent- or teacher-report of youth social skills or social preference in children with and without ADHD (Huang-Pollock et al., 2009). Finally, EF measures have been plagued by concerns over their poor ecological validity. Barkley (2001) emphasized that EF evolved to promote social relationships through the monitoring and modification of one's behavior, suggesting that EF represents a key correlate of social development. Critiques of standard, cognitive measure of EF argue that informant report of youth functioning would better capture the construct as it relates to social development (Barkley, 2001).

Alternatively, dimensions of hot, bottom-up, EF may be more central to social functioning given the emotional nature of peer interactions (Zelazo, Qu, & Müller, 2005). The bottom-up processes (e.g., motivation, reward) of hot EF become particularly important during adolescence as there is prolonged development of regions supporting cold EF and increased emotional reactivity activity in the limbic system during this phase of development (Casey, 2015). Thus, interactive influences of hot and cold EF on social functioning should be prioritized in future research. Overall, future studies should incorporate the behavioral paradigms to assess of social functioning and diverse measures of both cold *and* hot EF, to better clarify dimensions of EF as pathways underlying predictions of multiple aspects of social development from parenting.

Notably, set shifting did not emerge as a significant mediator in predictions of academic and social development from parenting behavior. Set shifting has previously been demonstrated to predict mathematics achievement in young children (Clark, Pritchard, & Woodward, 2010). Similarly, set shifting was correlated with social communication in toddlers (Stahl & Pry, 2002). Importantly, testing the *independent* prediction of academic and social outcomes from *multiple* EF dimensions is rarely undertaken. The current findings suggest that when the influence of inhibitory control and working memory are controlled, set shifting no longer affects early adolescent academic and social functioning. Therefore, rather than using resources to develop approaches for enhancing set shifting, interventions to improve academic and social functioning during the early adolescence should instead target inhibitory control and working memory.

If inhibitory control and working memory are further implicated in academic functioning from positive parenting behavior (and other predictors), there are important implications for treatment development. First, interventions to increase parent praise may lead to improvements in youth EF and subsequent outcomes. However, future studies should examine whether the type of praise differentially affects EF. For example, praise for effort predicts more persistence and motivation relative to praise for intelligence (Mueller & Dweck, 1998). Additionally, interventions should directly target youth EF in order to improve academic and social outcomes potentially through the implementation of computerized training interventions, which have been shown to improve child EF (Tamm, Epstein, Peugh, Nakonezny, & Hughes, 2013). However, creation of such EF interventions remains in its infancy and a meta-analysis suggests that training of working memory may not yield improvements in other functional skills (Melby-Lervåg & Hulme, 2013). Therefore, randomized controlled trials should be conducted to directly compare computerized approaches targeting a specific EF domain with training involving physical and social activities, that likewise improve EF during childhood (Diamond & Lee, 2011). If

future work to design EF interventions proves fruitful, improvements in EF may lead to enhanced functioning across multiple domains of youth development.

Although EF mediated predictions of academic and social development from positive parenting, EF did not underlie predictions of these outcomes from *negative* parenting. Therefore, the particular method we used to measure negative parenting may not be relevant for EF development. Specifically, we conceptualized parenting as consisting of two independent dimensions (i.e., positive, negative) of behavior. However, negative parenting behavior (e.g., criticism) may affect EF in combination with positive parenting. Configural approaches to measuring parenting behavior commonly yields four typologies (i.e., authoritarian, authoritative, permissive, neglectful) along dimensions of warmth and control (Baumrind, 1991). An authoritarian parenting style, characterized by high control and low warmth, is related to worse EF in youth in both clinical and nonclinical populations (Hutchison, Feder, Abar, & Winsler, 2016; Potter et al., 2011), suggesting that positive and negative parenting behaviors interact to influence the development of EF. Additionally, the relationship between environmental factors (e.g., parenting) and EF is likely nonlinear (Obradovi , 2016), yet the extant literature has not evaluated a potential quadratic association between the unitary dimension of negative parenting behavior and youth EF. Utilization of configural and nonlinear approaches in investigations of parenting and EF are required to improve current understanding of these relationships and their subsequent effect on academic and social development.

Further research is necessary to elucidate the mechanisms underlying the relationship between *negative* parenting behaviors measured in the present study (i.e., criticism) and academic and social outcomes. Individual differences in child temperament may be more sensitive to the influence of negative parenting. For example, negative affectivity represents and individual's response to stress (Rothbart, Ahadi, & Evans, 2000). In the context of negative parenting (e.g., criticism, hostility), parents model ineffective emotion regulation and exacerbate a child's negative response to stress. Indeed, associations between negative parenting and temperament have been found (Putnam, Sanson, & Rothbart, 2002). Further, temperament predicts child adjustment in conjunction with parenting (Morris et al., 2002), suggesting temperament's potential role as a mediator of the relationship between parenting and youth outcomes. Alternatively, temperament may moderate predictions of youth EF from negative parenting. Specifically, temperament dimensions of behavioral inhibition (i.e., high sensitivity to novelty) and exuberance (i.e., high sensitivity to rearward) moderated the association of maternal attention and EF in toddlers (Conway & Stifter, 2012). Testing conditional mediation with temperament as a moderator is an important extension of our study. Incorporation of temperament will provide an understanding of how youth emotional reactivity and cognitive functioning interact to predict academic and social development.

Several important limitations must be noted. Social functioning was estimated exclusively from parent report, despite the value of teacher ratings of children's social development (Haager, Watson, & Willows, 1995). For the current study, only child noncompliance was coded during the parent-child interaction task. Incorporating prosocial child behaviors is important for future work as positive child behavior evokes parent responses. Next, we utilized laboratory-based measures of EF, despite critiques of ecological validity (Barkley,

2001). Moreover, only a single task was used to assess each EF dimension, despite calls to use latent variable approaches the study of EF (Friedman & Miyake, 2017), requiring at least three tests of each subdomain. Also of note, there were significant differences in IQ and ethnicity between children who did and did not return for follow-ups, which may limit the generalizability of the present results to children with a low IQs and/or underrepresented groups. Finally, we did not consider outcomes beyond academic and social functioning in early adolescence. For example, youth depression, which predicts functional impairment and increased suicide risk (Birmaher, Brent, & AACAP Work Group on Quality Issues, 2007), represents a critical aspect of mental health that is sensitive to EF (Fenesy & Lee, 2017; McDermott, & Ebmeier, 2009). As such, evaluation of depression and other mental health outcomes in the context of the meditational models examined herein represents an important direction for future research.

Using a multiple mediation framework, the current study investigated whether individual differences in aspects of youth EF significantly mediated predictions of youth academic and social functioning from baseline parenting behavior. Inhibitory control and working memory mediated predictions of academic functioning from positive parenting behavior whereas working memory mediated predictions of negative social preference from positive parenting behavior. Developmentally sensitive designs incorporating additional aspects of parent-child interaction (e.g., emotional tone), moderators (e.g., temperament), and prospective follow-up into adolescence and young adulthood will enhance understanding of the roles of EF dimensions as pathways to academic and social outcomes.

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Figure 1.

Measures collected at each Wave with the constructs in parentheses. The measures and constructs from each Wave that were utilized in the present study are in bold text.

Figure 2.

Multiple mediator model of the effect of Wave 1 observed positive parenting on Wave 3 youth WIAT-II academic achievement via Wave 2 EF dimensions controlling for negative parenting as well as child age, sex, and observed noncompliance (beta coefficients). * $p < .05$. ** $p < .01$. *** $p < .001$. † $p < .10$.

Figure 3. Multiple mediator model of the effect of Wave 1 observed positive parenting on Wave 3 youth negative social preference via Wave 2 EF dimensions controlling for negative parenting as well as child age, sex, observed noncompliance, and IQ (beta coefficients). ** $p < .01$. $^{\dagger}p < .10$.

Table 1

Descriptive Statistics of Demographics and Key Variables

Variable	M (SD) or % of Sample	Range	n
Age	7.39 (1.08)	5–10	131
Sex (% Male)	65.65	-	131
Race-Ethnicity			
Caucasian	52.67	-	69
Hispanic	8.40	-	11
African American	5.34	-	7
Asian	3.82	-	5
Mixed/Other/Unknown	29.77	-	39
IQ	108.54 (14.86)	75–144	131
Wave 1 Observed Parenting & Child Non-Compliance			
Positive Parenting (Praise)	0.53 (0.50)	0–2.67	103
Negative Parenting (Negative Talk)	0.34 (0.31)	0–1.52	103
Child Noncompliance	0.14 (0.18)	0–0.9	103
Wave 2 EF			
Inhibitory Control (Stroop CW)	28.77 (7.85)	15–56	104
Working Memory (WISC-IV DSB)	6.88 (1.66)	4–11	105
Set Shifting (<i>min</i> ; TMT B)	–0.78 (0.52)	–4.67– –0.27	104
Wave 3 Academic Functioning			
Academic Achievement (WIAT-II Composite)	0.01 (1.82)	–6.63–2.95	84
School Competence (CBCL)	4.91 (1.26)	2–6	88
Wave 3 Social Functioning			
Negative Social Preference (Dishion)	–3.28 (1.39)	–4–3	87
Social Competence (CBCL)	8.84 (2.20)	2.5–13	90

Note: Descriptive statistics based on observed data (i.e., not using FIML). IQ = estimate of Wechsler Intelligence Scale for Children, Fourth Edition, Full Scale IQ; EF= Executive Functioning; CW = Color-Word; WISC-IV = Wechsler Intelligence Scale for Children, Fourth Edition; DSB = Digit Span Backwards; TMT B = Trail Making Test Part B; WIAT-II = Wechsler Individual Achievement Test, Second Edition; CBCL = Child Behavior Checklist.

Table 2

Pairwise Correlations of Covariates, Predictors, Mediators, and Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	-											
2. Sex (Male = 1)	-.14	-										
3. IQ (WISC-IV)	-.12	.13	-									
4. Child Noncompliance (PCI)	-.17	.16	-.14	-								
5. W1 Positive Parenting (PCI)	-.12	.02	.07	.03	-							
6. W1 Negative Parenting (PCI)	-.15	.18	-.09	.47***	-.05	-						
7. W2 Inhibitory Control (Stroop CW)	.45***	-.18	.39***	-.22*	-.01	-.03	-					
8. W2 Working Memory (WISC-IV DSB)	.02	.01	.33***	-.26*	.28*	-.05	.36***	-				
9. W2 Set Shifting (TMT B)	.24*	.00	.17	-.12	-.09	-.14	.27**	.12	-			
10. W3 Academic Achievement (WIAT-II)	.21	-.04	.71***	-.16	.04	-.01	.57***	.44***	.47***	-		
11. W3 School Competence (CBCL)	-.13	-.21	.50***	-.17	-.05	.01	.24*	.23*	.10	.59***	-	
12. W3 Negative Social Preference (Dishion)	.15	.23	.02	-.03	-.03	.07	.04	-.19	.10	-.07	-.29**	-
13. W3 Social Competence (CBCL)	.08	-.05	.24*	-.04	.00	.01	.02	.04	-.05	.24*	.33**	-.37***

Note: Pairwise correlations based on observed data (i.e., not using FIML). IQ = estimate of Wechsler Intelligence Scale for Children, Fourth Edition, Full Scale IQ; WISC-IV = Wechsler Intelligence Scale for Children, Fourth Edition; W1 = Wave 1; PCI = Parent-Child Interaction; W2 = Wave 2; CW = Color-Word; DSB = Digit Span Backward; TMT B = Trail Making Test Part B; WIAT-II = Wechsler Individual Achievement Test, Second Edition; CBCL = Child Behavior Checklist.

* p .05.

** p .01.

*** p .001.

Table 3

Mediation by Dimensions of EF on Wave 1 Observed Parenting Dimensions with Wave 3 Youth Academic and Social Outcomes

	Without Inclusion of IQ				Controlling for IQ			
	Point Est.	SE	95% BC Bootstrap CI		Point Est.	SE	95% BC Bootstrap CI	
			Lower	Upper			Lower	Upper
Positive Parenting								
WIAT-II Academic Achievement								
Inhibitory Control	.062	.035	.001	.138	.020	.018	-.003	.074
Working Memory	.074	.044	.012	.198	.035	.029	-.005	.120
Set Shifting	-.017	.051	-.151	.066	-.012	.032	-.117	.029
Total	.120	.099	-.088	.307	.044	.053	-.062	.146
CBCL School Competence								
Inhibitory Control	.040	.029	.001	.124	.004	.026	-.043	.066
Working Memory	.039	.045	-.023	.169	-.002	.045	-.098	.085
Set Shifting	-.004	.021	-.062	.025	-.004	.017	-.043	.022
Total	.075	.059	-.026	.212	-.003	.490	-.101	.099
Dishion Negative Social Preference								
Inhibitory Control	.010	.027	-.032	.082	.006	.030	-.041	.086
Working Memory	-.077	.051	-.233	-.009	-.089	.051	-.237	-.017
Set Shifting	-.004	.018	-.052	.023	-.004	.015	-.046	.019
Total	-.071	.050	-.210	.002	-.087	.053	-.222	-.006
CBCL Social Competence								
Inhibitory Control	-.006	.023	-.081	.025				
Working Memory	.020	.046	-.047	.144				
Set Shifting	.004	.023	-.034	.065				
Total	.018	.049	-.088	.112				
Negative Parenting								
WIAT-II Academic Achievement								
Inhibitory Control	.063	.048	-.026	.165				
Working Memory	.028	.038	-.022	.141				
Set Shifting	-.043	.053	-.192	.029				
Total	.048	.103	-.169	.233				
CBCL School Competence								
Inhibitory Control	.041	.042	-.008	.155				
Working Memory	.013	.026	-.012	.113				
Set Shifting	-.008	.024	-.100	.014				
Total	.046	.060	-.066	.174				
Dishion Negative Social Preference								
Inhibitory Control	.010	.030	-.037	.089				
Working Memory	-.028	.039	-.150	.019				
Set Shifting	-.008	.020	-.078	.013				

	Without Inclusion of IQ				Controlling for IQ			
	Point Est.	SE	95% BC Bootstrap CI		Point Est.	SE	95% BC Bootstrap CI	
			Lower	Upper			Lower	Upper
Total	-.026	.047	-.138	.053				
CBCL Social Competence								
Inhibitory Control	-.006	.027	-.102	.029				
Working Memory	.008	.024	-.018	.099				
Set Shifting	.008	.025	-.022	.092				
Total	.009	.042	-.075	.099				

Note: All models entered all parenting dimensions simultaneously and controlled for child age, sex, and observed noncompliance. IQ was added as a covariate only when significant mediation emerged. BC bootstrap CI = bias corrected confidence intervals; Point est. = standardized bootstrap point estimate of the indirect effect. Boldface indicates significant mediation.