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Pathways from Maternal Effortful Control to Child Self-Regulation: The Role of Maternal Emotional Support

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Abstract

This study examined the direct and indirect pathways from maternal effortful control to two aspects of children's self-regulation – executive functioning and behavioral regulation – via maternal emotional support. Two hundred and seventy eight children and their primary caregivers (96% mothers) participated in laboratory visits when children were 4 and 5 years, and teachers reported on children's behavior at kindergarten. At the 4-year assessment, maternal effortful control was measured using the Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2007) and maternal emotional support was observed during a semi-structured mother-child problem-solving task. At the 5-year assessment, children's executive functioning was measured using laboratory tasks designed to assess updating/working memory, inhibitory control, and cognitive flexibility, whereas behavioral regulation was assessed via teacher-report questionnaires on children's attention control, discipline and persistence, and work habits. Results from structural equation modeling indicated that, after controlling for child gender and minority status, and maternal education, maternal effortful control was indirectly associated with both child executive functioning and behavioral regulation through maternal emotional support. Maternal effortful control had a direct association with children's teacher-reported behavioral regulation but not observed executive functioning. These findings suggest that maternal effortful control may be a key contributing factor to the development of children's self-regulatory competencies through its impact on maternal emotional support.

Keywords

Maternal effortful control; parenting; self-regulation; executive functions; early childhood

Early childhood constitutes a remarkable time for the development of self-regulation. By five years of age, most children demonstrate an increasing capacity for regulating their own arousal, attention, emotional responses, cognitive processes, and goal-oriented behaviors (see Calkins, 2007; Carlson, Zelazo, & Faja, 2013; Rueda, Posner, & Rothbart, 2004). Extensive research has linked early individual differences in self-regulatory competencies with a range of adaptive outcomes including academic achievement (Graziano, Reavis, Keane & Calkins, 2007; Monette, Bigras, & Guay, 2011; Sasser, Bierman, & Heinrichs, 2015), social-emotional competence (Masten et al., 2012; Portilla, Ballard, Adler, Boyce, &

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Obradovic, 2014), and behavioral adjustment (Mischel et al., 2011; Nigg, Quamma, Greenberg & Kusche, 1999). These findings underscore the importance of understanding the key familial factors that contribute to the development of self-regulation in early childhood as such knowledge can guide prevention and intervention strategies aimed at improving children's adaptive functioning.

Caregivers' ability to engage in emotionally supportive behaviors has long been proposed to play a major role for the development children's self-regulation (see Sroufe, 1996; Calkins & Leerkes, 2011). One premise of this proposition is that, through emotionally supportive behaviors, caregivers can successfully serve as external regulators of their children's physiological arousal, attention, emotions, thoughts, and behaviors, providing opportunities for them to gradually build internal capacities to regulate themselves (Bernier, Carlson, Deschênes, & Matte-Gagné, 2012; Calkins, 2011; Sameroff, 2010). Thus, identifying factors that promote emotionally supportive caregiving is important. Decades of research demonstrated that social-emotional factors such as the way one was parented, personality characteristics, mental health, and contextual sources of stress and support are all important predictors of individual differences in caregiving (Belsky & Jaffee, 2006). Only recently have investigators begun to consider the role of caregivers' attentional and cognitive skills in relation to caregiving behavior (see Crandall, Deater-Deckard, & Riley, 2015). Such work is particularly relevant when considering the links between caregiving and cognitive aspects of children's self-regulation because caregivers' own cognitive functioning could have direct effects on child self-regulation via genetic transmission or could be explained by an impact on the quality of caregiving. In particular, variations in the extent to which caregivers can flexibly control their attention and inhibit their prepotent responses in favor of more adaptive responses may either undermine or support their ability to engage in positive and emotionally responsive behaviors (Barrett & Fleming, 2011; Bridgett, Burt, Edwards, & Deater-Deckard, 2015; Calkins, 2011). Based on this perspective, the primary goal of this study was to examine the direct and indirect pathways from maternal effortful control to two dimensions of self-regulation, executive functioning and behavioral regulation in the context of the classroom, via maternal emotional support.

Self-Regulation in Early Childhood

Self-regulation is a broad and multifaceted construct that involves a range of processes that allow individuals to regulate their arousal, attention, emotion, and cognition to manage goal-directed behaviors (Karoly, 1993; Bridgett et al., 2015; Calkins, Perry, & Dollar, 2016). In this study, we examine two aspects of children's self-regulation: executive functioning and behavioral regulation. Executive functions refer to general-purpose and volitional forms of attentional and cognitive processes, governed largely by the prefrontal cortex, that support a range of competencies including the regulation of emotions, thoughts, and behaviors (Best & Miller, 2010; Diamond, 2013). The three core executive functions that have received much attention are *working memory*, the ability to store and actively manipulate or update information in mind (Baddeley, 1992); *inhibitory control*, the ability to deliberately suppress a dominant response not relevant to the goal (Carlson & Wang, 2007), and *cognitive flexibility*, the ability to flexibly shift across tasks, rules, or operations (Diamond, 2013). Congruent with the maturational timeline of the prefrontal cortex, previous work has demonstrated that children show marked improvements in executive functioning over the course of early childhood (see Carlson et al., 2013). In light of empirical evidence suggesting that basic components of executive functions are not dissociable in early childhood (e.g., Hughes, Ensor, Wilson, & Graham, 2010; Willoughby, Wirth, & Blair, 2012), we examine executive functions as a unitary construct that embodies three of these core components.

Behavioral regulation involves the use and coordination of attentional and cognitive processes to direct, regulate, and plan one's own behaviors. The ability to listen and follow instructions, sustain attention and persist during challenging tasks, inhibit prepotent responses (e.g., shouting out the answers) in favor of more appropriate responses (e.g., turn-taking), and perform self-directed behaviors are all indicators of successful behavioral regulation (Morrison, Ponitz, & McClelland, 2010). Although engaging in such behaviors should be adaptive across multiple contexts including the home, successful behavioral regulation has utmost importance in formal educational settings that demand children to consistently comply with rules and instructions, follow classroom routines, and conform to social demands. Thus, successful behavioral regulation has been considered an important factor that facilitates children's engagement in learning activities and promotes healthy social relationships with peers and teachers, leading to better academic outcomes (Duncan et al., 2007; Morrison et al., 2010; Portilla et al., 2014). Given the ecological importance of the classroom context for examining behavioral regulation, we used teacher ratings of three interrelated indicators of behavioral regulation: *attention control*, the ability to regulate attention and concentrate on tasks; *work habits*, the ability to engage in good work behaviors; and *discipline/persistence,* the ability to persist on tasks and direct behavior based on classroom rules.

Although executive functioning reflects the efficiency of the use of neurocognitive functions and behavioral regulation reflects the regulation of behavior in real-life contexts, both of these aspects of self-regulation are fundamentally integrated with their reliance on shared "top-down" volitional control processes supported by common neural regions such as the prefrontal cortex (Calkins et al., 2016; Carlson et al., 2013; Diamond, 2013). Based on this conceptualization, we used a confirmatory factor analytic approach to examine whether these two aspects of self-regulation are separable but related constructs in early childhood. Using this approach further allowed us to examine the indirect contributions of maternal effortful control on executive functioning and behavioral regulation through maternal emotional support within the same model after accounting for the shared commonality between the two constructs.

Maternal Effortful Control and Emotional Support

An important factor that may influence maternal caregiving behaviors is maternal effortful control, which refers to the regulatory component of temperament that involves attentional processes that enable individuals to voluntarily shift and focus their attention, and inhibit or activate their responses (Evans & Rothbart, 2007). These processes may contribute to mothers' ability to perform emotionally supportive behaviors. For example, greater attentional control may facilitate mothers' ability direct and sustain their attention towards their children's emotional needs, cues, and behaviors, particularly in the context of competing demands. Additionally, inhibitory control may help mothers inhibit their negative responses (e.g., criticism) in favor of more positive responses (e.g., encouragement), allowing them to respond in an emotionally supportive manner. Lastly, the ability to activate positive responses may allow mothers to cope with challenging child behaviors (Barrett & Fleming, 2011).

Recent research evidence is consistent with this view. For example, greater maternal effortful control and self-reported regulation are linked with greater levels of positive caregiving behaviors (Cumberland-Li, Eisenberg, Champion, Gershoff, & Fabes, 2003; Valiente, Lemery-Chalfant, & Reiser, 2007) and lower levels of negative behaviors (Bridgett, Laake, Gartstein, & Dorn, 2013; Valiente et al., 2007). Likewise, more efficient maternal executive functioning – an overlapping construct with effortful control (see Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013) – has been associated with greater maternal sensitivity (Gonzalez, Jenkins, Steiner, & Fleming, 2012) and lower levels of maternal negativity (Cuevas et al., 2014; also see Deater-Deckard, Sewell, Petrill, & Thompson, 2010) particularly among mothers whose children had high behavior problems (Atzaba-Poria, Deater-Deckard, & Bell, 2014). These results suggest that maternal effortful control may contribute to mothers' ability to provide emotional support to their children. Thus, we hypothesized that maternal effortful control would be positively associated with maternal emotional support.

Maternal Emotional Support and Child Self-Regulation

According to several theoretical perspectives, children internalize or build capacities for regulating their cognitive processes and behaviors through interactions with their caregivers (Schunk & Zimmerman, 1997; Sroufe, 1996; Vygotsky 1934/1978). Emotionally responsive caregivers who use verbal encouragement rather than negative and discouraging responses likely provide a supportive environment that allow children to engage in more regulated behaviors. Likewise, emotionally supportive caregivers who model positive, calm and well-regulated responses likely facilitate the development of self-regulation by providing rich opportunities for their children to observe regulated behaviors, such as the ability to inhibit prepotent or reflexive responses in favor of more adaptive ones, and practice them in real-life social contexts.

An emerging body of work provides evidence for the proposed association between caregiver emotional support and executive functioning. For example, children who performed better at an executive function task at age 5 were more likely at age 2 to have mothers who were more responsive and less intrusive than children who performed lower on the task (Graziano, Keane, & Calkins, 2010). Moreover, responsive caregiving at age 3 was associated positively with executive functioning at age 6, controlling for executive functioning at age 3 (Blair, Raver, & Berry, 2014). These studies suggest that maternal emotional responsiveness may contribute to the development of individual differences in children's executive functioning in early childhood.

Though limited in number, previous studies also demonstrated associations between maternal emotional support and children's behavioral regulation. For example, greater maternal emotional support has been associated positively with children's observed ability to persist in challenging tasks at 3 years of age (Mokrova, O'Brien, Calkins, Leerkes, & Marcovitch, 2012). Likewise, maternal emotional support assessed when children were 3 was associated with children's gains in pre-academic skills involving work habits from age 3 to age 4 (Leerkes, Blankson, O'Brien, Calkins, & Marcovitch, 2011). Moreover, in an earlier study, Grolnick and Ryan (1989) demonstrated that maternal autonomy support correlated positively with teacher-rated competence in elementary school children. These studies provide initial support for the proposition that maternal emotional support contributes to the development of children's behavioral regulation. In light of these findings, we examined the associations between maternal emotional support and children's self-regulation outcomes, expecting greater maternal emotional support to be associated with greater child executive functioning and behavioral regulation.

Indirect Pathways from Maternal Effortful Control to Children's Self-Regulation

Although prior work has demonstrated direct pathways from maternal effortful control to maternal emotional support and maternal emotional support to child self-regulation, little work has examined indirect pathways from maternal effortful control to child self-regulation through maternal emotional support. In a recent study, Cuevas et al. (2014) demonstrated that maternal executive functioning (assessed via laboratory tasks) was indirectly associated with children's executive functioning at ages 3 and 4 via observed maternal caregiving behaviors. This study provides some preliminary support for the proposition that maternal effortful control may indirectly contribute to children's executive functioning through maternal emotional support. In a second study, Cumberland-Li et al. (2003) demonstrated a marginally significant indirect association between a self-report of maternal regulation (based on measures of effortful control and personality traits) and both a teacher report of child behavior problems at age 6 and observed child cheating through mothers' self-reported positive expressivity. These authors did not find an indirect influence from the self-report of maternal regulation to mother-rated, teacher-rated, or observed child behaviors through observed parenting. Given the discrepant pattern of results, additional research examining this indirect pathway is warranted.

The Current Study

The goal of this study was to examine the pathways from maternal effortful control to two distinct dimensions of child self-regulation, executive functioning and behavioral regulation, through maternal emotional support. We first used a confirmatory analytic factor approach to examine whether executive functioning and behavioral regulation are two distinct but related constructs at 5 years of age. As such, we expected the three core observed executive functions (working memory, inhibitory control, cognitive flexibility) to load highly on an executive functioning latent construct, and the three teacher-reported indicators of behavioral regulation (attention control, work habits, discipline/persistence) to load highly on a behavioral regulation latent construct. Given that both aspects of self-regulation rely on cognitive control processes, we expected these two constructs to be positively correlated.

Following this preliminary step, we used a structural equation modeling approach to examine the main questions of this study. Our first hypothesis was that greater maternal effortful control would be associated with greater maternal emotional support. Secondly, we expected that greater maternal emotional support would be associated with better child executive functioning and behavioral regulation. Lastly, we expected that greater maternal effortful control would be indirectly associated with better child executive functioning and behavioral regulation through greater maternal emotional support. Based on previous work suggesting that maternal effortful control may be related to children's self-regulation through potential genetic (Friedman et al., 2008) or other contextual factors, we also examined the direct effects of maternal effortful control on children's executive functioning and behavioral regulation.

In testing this model, we considered the role of three potential covariates: maternal education, and child gender and minority status. Lower levels of education may accompany stressful life events which in turn may interfere with the ability to provide emotional support (Tamis-LeMonda, Briggs, McClowry, & Snow, 2009) and undermine children's self-regulation outcomes as a result. Moreover, maternal education may be directly linked with children's self-regulation. For example, mothers who have higher level of education may spend a greater time explaining appropriate ways of behaving in the school setting, which may directly contribute to how their children behave in the school setting. Likewise, child gender and minority status may be linked with caregiver emotional support (see Tamis-Lemonda et al., 2009) and potentially with child self-regulation outcomes (e.g., Matthews, Ponitz, & Morrison, 2009).

Methods

Participants

Participants of this study were 278 children, their primary caregivers (96% mothers), and teachers who were recruited as part of a longitudinal study on physiological, cognitive, and emotional precursors of early academic readiness. Mothers' ages ranged from 19 to 58 (M= 35). Approximately 61% of mothers had a 4-year college degree or had completed higher levels of education. Fifty-five percent of the children were female; and 59% of the children were European American, 30% African American, and 11% other ethnicities with 6.5% of the total sample reporting as Hispanic. Average income-to-needs ratio, calculated by dividing the total family income by the poverty threshold for that family size, was 2.11 (SD = 1.41). Of the 278 participants in the original sample, 249 returned for the 5-year laboratory visit. Mothers who participated in both visits did not differ from those who only participated in the first visit with respect to years of education, effortful control, or observed caregiver behaviors.

Procedure

Participants were recruited from daycare centers, libraries, local establishments (e.g., children's museum, parks), and via participant referral in a mid-sized Southeastern city. Laboratory visits, which lasted for approximately 2 hours, were scheduled with caregivers who either called the research office or returned contact information to be contacted by the researchers. Mothers provided written consent prior to the start of the session. During each visit, children participated in a battery of tasks designed to assess their cognitive and emotional development and caregivers filled out questionnaires. Maternal behaviors during the mother-child interaction task were videotaped. Mothers were asked to complete a consent form to allow us to contact the child's teacher to obtain information about their behavior in the school setting. Teachers were emailed a link to complete the surveys online using Qualtrics in the spring semester of the target children's kindergarten year. Mothers and teachers received monetary compensation for their time, and children selected a small toy at the completion of the visit. All procedures were approved by the university institutional review board.

Measures

Demographics—Mothers reported their age and education, child gender (0 = *boy*, 1 = *girl*), and child minority status (0 = *white, non-Hispanic*, 1 = *other*).

Maternal effortful control—Maternal effortful control was assessed using the effortful control scale of the Adult Temperament Questionnaire Short Form (ATQ; Evans & Rothbart, 2007). The Effortful Control factor is comprised of the scales that measure activation control (7-items; e.g., "I can keep performing a task even when I would rather not do it"), attentional control (5-items; e.g., "When interrupted or distracted, I usually can easily shift my attention back to whatever I was doing before"), and inhibitory control (7-items; e.g., "It is easy for me to inhibit fun behavior that would be inappropriate."). Respondents were asked to rate how well each of the items described them on a 7-point Likert scale ranging from 1 (extremely untrue of you) to 7 (extremely true of you). Effortful control scores were calculated by averaging respondents' responses. Higher scores indicated greater effortful control. The ATQ demonstrates good convergent and divergent validity with reliable subscales (Evans & Rothbart, 2007). The effortful control scale had good internal reliability (α = .78).

Maternal emotional support—Mother-child interactions were observed during a 7-minute long semi-structured planning and problem-solving task. The interactive task was a board game that required mother-child dyads to follow multiple steps to get a bear figurine to a treasure chest. The experimenter explained the game and then left the room. The videotaped interactions were coded by trained coders. The quality of mother–child interactions were rated on 5-point global rating scales (1=low, 5=high) for emotional responsiveness, intrusiveness, and negativity. Emotional responsiveness indicates the extent to which mothers appropriately responded to their children's needs and emotions, appeared to enjoy being with their children, provided positive reinforcement, and minimized potential problems that could disrupt the game. Intrusiveness indicates the extent to which the mother took over the game without allowing the child to explore and experience it on his/her own.

Negativity represents the extent to which the mother displayed negative verbal or non-verbal emotions toward the child, such as irritability, impatience, or direct criticism. Inter-rater reliability was calculated on 42 (15%) double coded cases. Intra-class correlation coefficients ranged from .76 to .91, all $p < .01$.

Child executive functions—We assessed three core dimensions of executive functions: updating/working memory, inhibitory control, and cognitive flexibility.

Inhibitory control: A computerized version of an animal Go/No Go association task (Lahat, Todd, Mahy, Lau, & Zelazo, 2008) was used to assess children's inhibitory control. The task was presented using E-Prime Version 2.0 (PST, Pittsburgh, PA, USA). On each trial, an animal stimulus (cow, horse, bear, pig, or dog) was presented at a central location on the screen. Children were instructed to respond via button-press as soon as they saw each animal (go stimulus) and withhold their responses when they saw a dog (no-go stimulus). Following a brief introduction, children were presented with 10 practice trials composed of 6 go and 4 no-go stimuli. The practice block was repeated until children answered 9 out of 10 correct. The actual task consisted of 144 trials divided into four blocks. Each block contained 27 (75%) go trials and 9 (25%) no go trials. After each correct answer, a yellow smiley face was presented on the screen. After each incorrect answer or responses that occurred after the 1500ms stimulus window, a red frowning face was shown. Participants received a value of .185 (5 points/27 Go Trials) for every correct go stimulus, and a value of .56 (5 points/9 No Go Trials) for every correct no-go stimulus (Zelazo et al., 2013). Using these weighted values, total accuracy scores were calculated for each block, which were then averaged to create a total accuracy score.

Working memory: Children's working memory capacity and updating was measured using the Numbers Reversed test of The Woodcock Johnson III (Woodcock, McGrew & Mather, 2001). Participants were instructed to listen to the experimenter recite a string of numbers (starting with 2 numbers and gradually increasing) and then repeat the numbers backward. In each block, there were 5 different series of numbers with equal number of digits. The task was terminated if participants missed all 5 trials in a given block. An overall accuracy score was calculated by adding children's correct responses (each trial=1 point) such that higher scores reflect more efficient working memory and updating.

Cognitive flexibility: Cognitive flexibility was measured using the computerized version of The Dimensional Card Sort task designed to assess the extent to which children can use rules flexibly to direct their behavior (Espinet, Anderson, & Zelazo, 2012). Children were presented with a fixation screen with stimuli at the bottom that varied across two dimensions: color and shape (e.g., red rabbit and blue boat), and instructed the rules of the game. Following a brief demonstration, the experimenter asked the child to practice on his/her own. During the pre-switch block (15 trials), children were asked to sort a series of test stimuli according to one dimension (i.e., shape) by pressing the corresponding sticker covered button. Next, as part of the post-switch block (30 trials), children were asked to sort the stimuli according to the other dimension (i.e., color). Performance on the post-switch task was scored as the number of correct responses out of 30 trials. The post-switch was followed by a more complex "borders" block of the task (12 trials); children were instructed to sort stimuli on one dimension (i.e., color) if the picture had a border around it but the other dimension (i.e., shape) if the picture did not have a border (Zelazo, 2006). Performance on the borders block was scored as the number of correct responses out of 12. The correlation between children's performance at post-switch and borders tasks was significant ($r = .28$, $p < .01$). These two variables were standardized and averaged to create an overall cognitive flexibility score. Higher scores indicated greater cognitive flexibility.

Teacher-report of child behavioral regulation

Attention control: Children's attention control at kindergarten was assessed via the attention problems subscale (10-items) of The Child Behavior Checklist Teacher Report Form (CBCL-TRF; Achenbach and Rescorla, 2001). The teacher was asked to indicate how well each item described the target child currently or within the last six months using a scale of 0 (not true), 1 (somewhat or sometimes true), and 2 (very true or often true). Example items include, "inattentive or easily distracted" and "can't concentrate, can't pay attention for long." Teachers' ratings on these items were summed and reverse scored such that higher scores indicated better attention control. Items of this scale had good internal reliability (Cronbach's $\alpha = .95$).

Work habits: The work habits scale of The Mock Report Card (MRC) was used to measure teachers' judgments of children's work habits in the classroom setting. Teachers reported on children's classroom work habits (6-items) on a 5-point scale ranging from 1 (very poor) to 5 (very good). Example items include, "works well independently," "works neatly and carefully" and "uses time wisely." Teachers' ratings on these items were averaged to create the work habits scale. Higher scores indicated better work habits. The work habits scale demonstrated good internal reliability ($\alpha = .95$).

Discipline/persistence: Children's discipline and persistence was assessed using the Discipline/Persistence subscale of the Learning Behaviors Scale (LBS; McDermott, 1999; Rikoon et al., 2012). Teachers reported on children's discipline and persistence (8-items) on a Likert-type scale, ranging from 0 (does not apply) to 2 (most often applies). Example items include "sticks to a task with no more than minor distractions," and "tries hard but concentration soon fades and performance deteriorates." Teachers' ratings on these items were summed and reverse scored. Higher scores indicated greater discipline and persistence during activities. The items of this scale had good internal reliability ($\alpha = .82$). The LBS demonstrates internal reliability, convergent and divergent validity, and predictive validity regarding children's future school adjustment (McDermott, Rikoon, & Fantuzzo, 2016; Rikoon et al., 2012).

Results

Preliminary Analysis

As an initial step, we examined the data for missing values, outliers, and normality of distributions. Missing data was handled using full information maximum likelihood (FIML), a modeling technique that uses available data to estimate parameter values that have the highest probability of representing the sample (Little, 2013). Descriptive statistics are presented in Table 1 and correlations are presented in Table 2.

Primary Analyses

Analyses were conducted using confirmatory factor analysis and indirect effects models in Mplus 7 (Muthén & Muthén, 2012). Model fit was evaluated using four fit indices: chi-square, the root mean square error of approximation (RMSEA), Bentler comparative fit index (CFI), and standardized root mean square residual (SRMR). The chi-square value tests whether there are differences between the population and model covariance matrices. RMSEA is a parsimony-adjusted index that allows for the identification of lower and upper confidence intervals. Close-fit hypothesis is supported if RMSEA estimate is lower than. 08, and the test of not acceptable fit can be rejected if the upper confidence interval is lower than .08 (Little, 2013). CFI tests model fit based on a baseline model and values higher than .95 are considered as excellent fit. Lastly, SRMR is a measure of the mean absolute correlation residual and estimates lower than .08 are considered as good fit (Hu & Bentler, 1999).

First, a confirmatory factor analysis was conducted to test the measurement models of the latent variables. This procedure allows for the specification of factor models a priori on the basis of theory or previous empirical work, and then evaluates whether the models fit the data (Kline, 2005). We tested a two-factor model with directly observed executive functions indicators loading on to one factor, and teacher reported behavioral regulation indicators loading onto a second factor. The model fit was good, χ^2 (9, N = 278) = 19.97 $p = .01$, RMSEA= .07 (.04 – .12), CFI = .98, SRMR = .04. Children's executive functioning was associated positively with behavioral regulation, such that greater executive functioning related to greater behavioral regulation at kindergarten. Maternal emotional support was also constructed as a latent factor using three indicators: emotional responsiveness, reversed intrusiveness, and reversed negativity. All indicators loaded significantly on their intended constructs as displayed in Figure 1.

In the structural model, maternal effortful control was specified as an exogenous variable that predicted maternal emotional support, and child executive functioning and behavioral regulation. In a baseline model, maternal education, child minority status, and gender were examined as covariates that predicted maternal emotional, and all paths reached significance. Next, we used a model-building approach to test the effects of the covariates on child outcomes. For parsimony, paths that did not reach significance and improve model fit were not included in the final model (Kline, 2005). The paths from gender to executive functioning and minority status to behavioral regulation were not significant and therefore not included in the final model. Bias-corrected bootstrapping procedure (5,000 draws) was used in evaluating the significance of the indirect pathways from maternal effortful control and maternal education to child outcomes via emotional support. Indirect paths (unstandardized coefficients) with confidence intervals (CI) that do not include 0 are considered statistically significant (Little, 2013).

The model fit of the final structural model was good, χ^2 (55, N = 278) = 87.10, $p = .00$, RMSEA = .05 (.03 – .06), CFI = .97, SRMR = .05. As reported in Figure 1 and Table 3, mothers of girls and white non-Hispanic children, and mothers with higher levels of education were more emotionally supportive. We also examined the direct and indirect effects from maternal education to child outcomes. The direct paths from maternal education to child executive functioning and behavioral regulation were not significant ($B = .03$, $p = .16$; $B = .05$, $p = .22$, respectively) and adding these paths did not improve model fit $\Delta\chi^2 = 3.59$, $\Delta df = 2$, $p = .17$. However, examination of the indirect paths using the parsimonious model suggested that maternal education indirectly related to both self-regulation outcomes via emotional support ($B = .04$, SE = .013, $p = .002$, 95% bootstrap CI [.014, .066] for executive functioning; $B = .046$, SE = .015, $p = .003$, 95% bootstrap CI [.016, .076] for behavioral regulation).

Maternal effortful control was associated positively with maternal emotional support, such that mothers with greater effortful control were more emotionally supportive. The Wald chi-square test, comparing the strength of the paths from maternal effortful control and education to maternal emotional support, was not significant, χ^2 (1, N = 278) = .48, $p = .49$, suggesting that the strength of these paths were similar in magnitude. Moreover, maternal emotional support was associated positively with both child executive functioning and behavioral regulation. The Wald test comparing the strength of the paths from maternal emotional support to these two child self-regulation outcomes was not significant, χ^2 (1, N = 278) = .16, $p = .69$, suggesting that the effect of maternal emotional support on these two child outcomes were similar in magnitude. Importantly, the hypothesized indirect effects from maternal effortful control to child executive functioning and behavioral regulation through maternal emotional support were significant ($B = .054$, SE = .027, $p = .047$, 95% bootstrap CI [.001, .108] for executive functioning; $B = .062$, SE = .029, $p = .030$, 95% bootstrap CI [.006, .118] for behavioral regulation). The direct path from maternal effortful control to child executive functioning was not significant. However, the direct path from maternal effortful control to child behavioral regulation was significant, suggesting that there may be mechanisms beyond maternal emotional support that also explain the relation between maternal effortful control and child behavioral regulation.

Discussion

Caregiver effortful control has been proposed to contribute to the development of children’s self-regulation by influencing caregivers’ ability to engage in emotionally supportive behaviors (Bridgett et al., 2015; Calkins, 2011; Crandall et al., 2015). Based on this proposition, the main goal of this study was to examine the indirect pathways from mothers’ effortful control to child self-regulation through maternal emotional support. Two distinct dimensions of child self-regulation – executive functioning and behavioral regulation – were examined. Consistent with findings of recent work (e.g., Cuevas et al., 2014), results indicated that maternal effortful control was indirectly associated with both child executive functioning and behavioral regulation through maternal emotional support. These findings suggest that maternal emotional support may be one key mechanism through which maternal effortful control may contribute to multiple aspects of children’s self-regulation (Bridgett et al., 2015; Calkins, 2011).

As an initial step, we examined the factor structure of the two child self-regulation outcomes. Congruent with a multidimensional view of self-regulation, results from the confirmatory factor analyses suggested that executive functioning and behavioral regulation are two meaningfully distinct but related dimensions of self-regulation at age 5. Specifically, the three core components of executive functions – working memory, inhibitory control, and cognitive flexibility – loaded highly on the executive functioning latent construct, whereas attention control, work habits, and discipline/persistence loaded highly on the behavioral regulation construct. The positive association between executive functioning and behavioral regulation is consistent with the notion that these two self-regulatory processes may rely on shared volitional control mechanisms mediated by the prefrontal cortex (Diamond, 2013). Evidence for the non-overlapping components of these two dimensions of self-regulation highlights the importance of examining their shared and distinct antecedents.

Consistent with our expectation, maternal effortful control was associated positively with mothers' emotionally supportive caregiving behaviors, such that mothers who reported greater effortful control demonstrated greater emotional support. Importantly, this association was significant after accounting for the paths from maternal education, child gender and minority status to maternal emotional support. Thus, our findings suggest that greater maternal effortful control may contribute to mothers' ability to engage in greater levels of responsive and lower levels of negative and intrusive behaviors. This finding adds to a growing body of research linking caregiver effortful control to emotionally supportive caregiving behaviors (see Crandall et al., 2015) and supports the view that greater effortful control may enhance emotional support by allowing mothers to focus their attention towards their children's needs, and inhibit negative and intrusive responses in favor of more positive responses (see Barrett & Fleming, 2011).

Maternal emotional support was associated positively with both child executive functioning and behavioral regulation. These findings are consistent with a growing body of research suggesting that caregivers who are emotionally supportive may serve as external regulators of their children's emotions and behaviors, gradually allowing them build internal capacities to regulate their own thoughts and behaviors (e.g., Bernier et al., 2012). For example, emotionally responsive caregivers likely provide rich opportunities for their children to observe and practice volitional control strategies necessary for effective cognitive and behavioral regulation (Schunk & Zimmerman, 1997).

Maternal effortful control was also directly associated with teacher reported child behavioral regulation. This finding suggests that there may be mechanisms beyond maternal emotional support that explain the link between maternal effortful control and child behavioral regulation. One possibility is that, mothers with greater effortful control may give greater importance to promoting children's behavioral regulation. As such, they may explicitly explain the importance of having good attention control skills (e.g., focusing on tasks) or work habits, and reinforce these behaviors. Moreover, mothers with greater effortful control may themselves engage in better behavioral regulation (e.g., good work skills) and therefore model these behaviors to their children. However, maternal effortful control was not directly associated with children's observed executive functioning. One explanation for this finding is that effortful control, as assessed via a self-report measure, and child executive functioning, assessed via laboratory-based tasks, may tap distinct aspects of self-regulation. In particular, the self-report measure of effortful control focuses more on effortful control of behavior in real-life contexts (e.g., inhibiting fun behavior), whereas laboratory measures of executive functions focus primarily on cognitive control in emotionally neutral contexts. Although observing their mothers engage in good effortful control skills in real-life contexts may contribute to children's behavioral regulation; such observations may not necessarily directly help them improve their executive functioning. These findings highlight the need for examining which aspects of caregiver self-regulation are linked with different aspects of child self-regulation.

Finally, we found that maternal education was indirectly associated with children's executive functioning and behavioral regulation through its contributions on mothers' emotional support. However, there were no direct links between maternal education and child self-regulation outcomes. This finding supports the idea that maternal emotional support may be a key mechanism explaining the role of maternal education on child self-regulation. It may be that mothers with higher levels of education may experience lower levels of stressful life events and can have access to greater levels of child-care support, which may in turn allow them to interact in more supportive ways with their children and lead to better child self-regulation outcomes.

This study had several noteworthy strengths. In particular, we examined two important dimensions of child self-regulation using laboratory observations and ecologically relevant teacher-report measures; employed a careful observational measure of maternal emotional support; used independent informants or measures across each construct; adopted strong analytical procedures to minimize measurement error; and controlled for several covariates in the model. Additionally, the sample was moderately large and diverse with respect to race and socio-economic status enhancing the generalizability of the results. However, an important limitation of this study was that maternal effortful control was measured via a single self-report measure. Thus, replication of this work using a variety of measures of maternal effortful control, including laboratory-based tasks, is necessary. Similarly, maternal caregiving behaviors were assessed during a single problem-solving task in a laboratory setting, and therefore may not fully reflect how mothers interact with their children during emotionally frustrating tasks or across different contexts. Examining whether caregiving behaviors across other tasks or contexts would yield similar findings is an important avenue for future research. Given that teachers likely vary with respect to how accurately they report on children's behaviors in the classroom setting, relying solely on teacher-report questionnaires for measuring behavioral regulation without direct observation was also a potential limitation of this study. Finally, although this study focused on mothers, it would also be important to examine whether effortful control of other caregivers such as fathers and teachers would be linked with children's self-regulation.

This study provided preliminary evidence for the proposition that maternal effortful control contributes to children's self-regulation by supporting mothers' ability to engage in emotionally supportive caregiving behaviors during a problem-solving task. Maternal effortful control was indirectly associated with two separable dimensions of child self-regulation – executive functioning and behavioral regulation – through maternal emotional support. The direct link between maternal effortful control and child behavioral regulation underscores the importance of examining other potential caregiving or genetic mechanisms that may explain this link. These findings provide valuable information for interventions aimed at increasing maternal emotional support or at influencing child self-regulatory behavior in the early school years. Specifically, they suggest that beyond directly teaching caregivers to be emotionally supportive or using child-focused interventions to boost children's self-regulation, improving caregivers' effortful control may potentially lead to enhancements in caregivers' ability to provide emotional support and lead to better child self-regulation outcomes.

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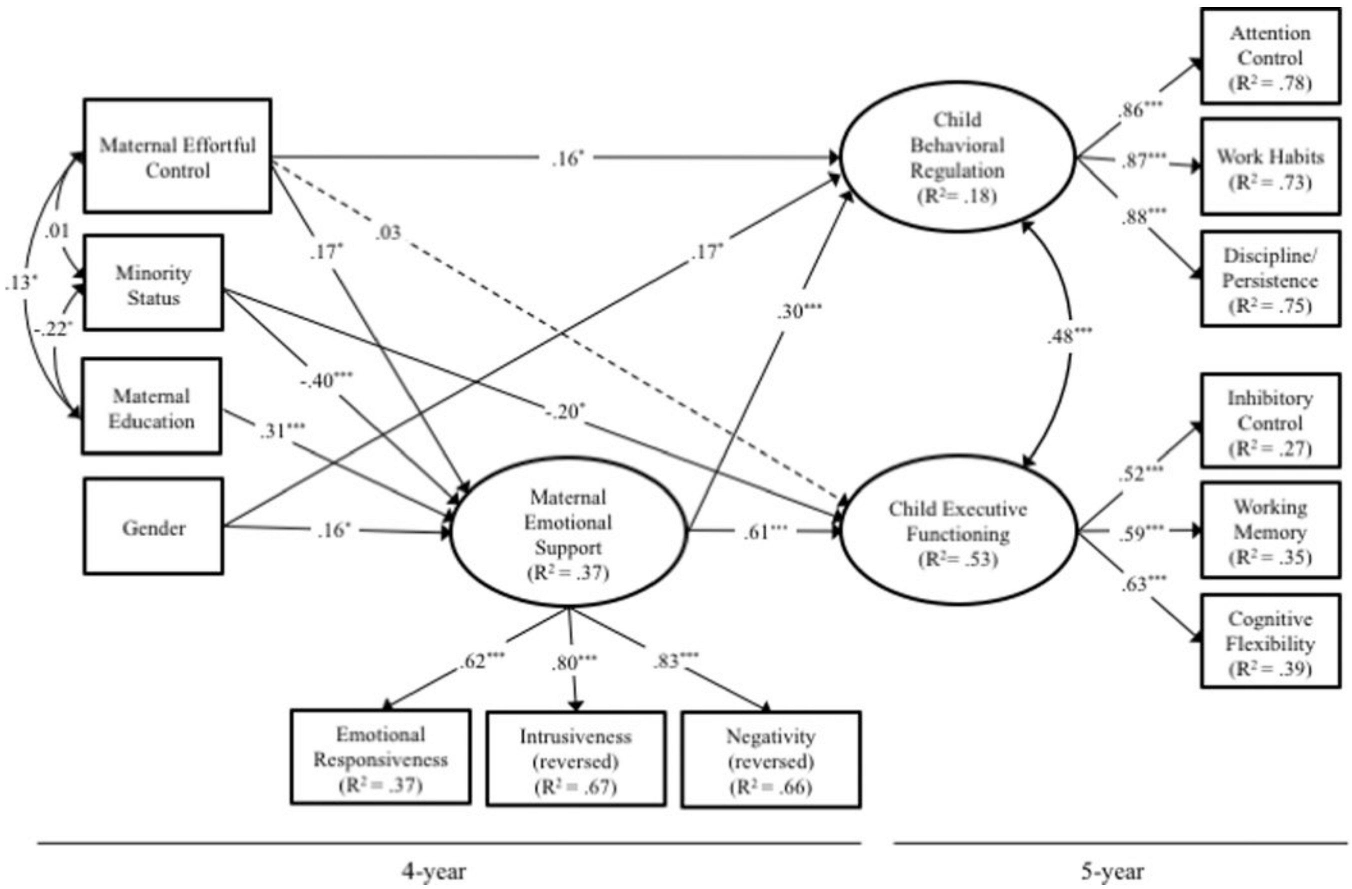

Figure 1.

Standardized estimates of the structural model predicting child self-regulation outcomes. N = 278. *$P < .05$. **$P < .01$. ***$P < .005$.

Table 1

Descriptive information

	N	Alpha/ ICC	Mean	SD	Min	Max	Skewness	Kurtosis
Maternal effortful control 4y	275	.78	4.99	.73	2.37	6.84	−.18 (.15)	−.10 (.29)
Maternal emotional responsiveness 4y	276	.90	3.84	1.03	1.00	5.00	−.49 (.15)	−.57 (.29)
Maternal intrusiveness 4y	276	.89	2.01	1.18	1.00	5.00	.93 (.15)	−.20 (.29)
Maternal negativity 4y	276	.91	1.69	.98	1.00	5.00	1.45 (.15)	1.58 (.29)
Attention problems 5y	220	.90	3.27	4.16	.00	19.00	1.45 (.16)	1.45 (.33)
Work habits 5y	220	.95	3.55	1.06	1.00	5.00	−.35 (.16)	−.74 (.33)
Discipline/persistence 5y	220	.82	3.78	3.41	.00	16.00	1.05 (.16)	.71 (.33)
Inhibitory control 5y	245		9.03	.75	6.41	10.00	−1.39 (.16)	1.77 (.31)
Working memory 5y	249		5.96	3.01	.00	14.00	−.42 (.15)	.00 (.31)
Cognitive flexibility 5y	249		.00	.81	−2.32	1.31	−.78 (.15)	.45 (.31)

Note: Maternal effortful control (mother-report ATQ, 19 items, 1–7 scale); maternal emotional responsiveness, intrusiveness and negativity (observed, 1–5 scale); attention problems (teacher-report CBCL, 10 items, 0–2 scale); work habits (teacher-report MRC, 6 items, 1–5 scale); discipline/persistence (teacher-report LBS, 8 items, 0–2 scale); inhibitory control (observed, Go/No-Go); working memory (observed, WJ numbers reversed); & cognitive flexibility (observed, DCCS post-switch and borders).

Table 2

Correlations among study variables

		1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Gender (1 = girl)	-												
2.	Minority status (1 = minority)	.02	-											
3.	Maternal education	−.01	−.25**	-										
4.	Maternal effortful control 4y	.09	.01	.13*	-									
5.	Maternal emotional resp. 4y	.12*	−.21**	.29**	.14*	-								
6.	Maternal intrusiveness 4y	−.15*	.43**	−.33**	−.15*	−.48**	-							
7.	Maternal negativity 4y	−.07	.36**	−.33**	−.21**	−.53**	.67**	-						
8.	Attention control 5y	.18**	−.20**	.17*	.21**	.16*	−.25**	−.19**	-					
9.	Work habits 5y	.21**	−.15*	.21**	.19**	.19**	−.26**	−.25**	.76**	-				
10.	Discipline/persistence 5y	.28**	−.22**	.13*	.22**	.13*	−.26**	−.20**	.77**	.74**	-			
11.	Inhibitory control 5y	.22**	−.17**	.10	.10	.24**	−.30**	−.31**	.30**	.36**	.36**	-		
12.	Working memory 5y	.04	−.29**	.29**	.15*	.26**	−.39**	−.34**	.35**	.28**	.22**	.23**	-	
13.	Cognitive flexibility 5y	.11	−.37**	.26**	.08	.20**	−.32**	−.28**	.30**	.27**	.27**	.34**	.41**	-

Note: Attention control and discipline/persistence represent reversed scored CBCL attention problems and LBS discipline/persistence scales, respectively.

* $p < .05$.

** $p < .01$.

Table 3

Direct and indirect effects from the structural equation model

Path			Estimate	*SE*	Confidence Interval Lower	Confidence Interval Upper	Standardized Estimate
Total effects							
Maternal effortful control	→	Child behavioral regulation	.27***	.08	.103	.427	.23
	→	Child executive functioning	.08*	.04	.003	.161	.15
Direct effects							
Maternal effortful control	→	Maternal emotional support	.15*	.06	.033	.259	.17
	→	Child behavioral regulation	.23**	.08	.039	.367	.18
	→	Child executive functioning	.03	.04	−.045	.100	.05
Maternal emotional support	→	Child behavioral regulation	.43***	.12	.189	.663	.30
	→	Child executive functioning	.37***	.10	.164	.577	.61
Maternal education	→	Maternal emotional support	.11***	.03	.056	.158	.29
Minority status	→	Maternal emotional support	−.51***	.08	−.661	−.351	−.41
	→	Child executive functioning	−.14*	.07	−.262	−.009	−.18
Gender	→	Maternal emotional support	.19*	.08	.041	.341	.15
	→	Child behavioral regulation	.31*		.075	.540	.17
Covariance							
Maternal effortful control	↔	Maternal education	.16*	.08	.013	.315	.13
	↔	Minority status	.00	.02	−.039	.046	.01
Maternal education	↔	Minority status	−.21***	.05	−.308	−.118	−.25
Child executive functioning	↔	Child behavioral regulation	.13***	.05	.027	.181	.49
Indirect effects							
Maternal effortful control	→	Child behavioral regulation	.06*	.03	.006	.118	.05
	→	Child executive functioning	.05*	.03	.001	.108	.10
Maternal education	→	Child behavioral regulation	.05***	.02	.016	.076	.09
	→	Child executive functioning	.04***	.01	.014	.066	.18

*$p < .05$.

**$p < .01$.

***$p < .005$.