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Predicting School Readiness: Executive Functions, Problem Behaviors and Theory of Mind in Preschoolers

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UNIVERSITY OF MIAMI

PREDICTING SCHOOL READINESS: EXECUTIVE FUNCTIONS, PROBLEM
BEHAVIORS AND THEORY OF MIND IN PRESCHOOLERS

By

Shira Kolnik

A DISSERTATION

Submitted to the Faculty
of the University of Miami
in partial fulfillment of the requirements for
the degree of Doctor of Philosophy

Coral Gables, Florida

June 2010

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BEHAVIORS AND THEORY OF MIND IN PRESCHOOLERS

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Predicting School Readiness: Executive
Functions, Problem Behaviors, and Theory
Of Mind in Preschoolers

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Executive functions (EFs), specifically a child's ability to shift between two stimuli and a child's ability to inhibit a prepotent response, are a child's self-regulatory cognitive processes used towards achieving a goal (Garon, Bryson, & Smith, 2008) and have been found to predict later school readiness (e.g. Blair & Diamond, 2008; McClelland et al., 2007; Pennington & Ozonoff, 1996). The current study examined possible mechanisms, such as problem behaviors and theory of mind (ToM), through which executive functions predict later cognitive and social school readiness. Problem behaviors occur when children are not effectively functioning in social situations, while ToM is a social-cognitive skill that allows a child to understand another person's mental processes (Wellman, 2002). These variables have been found to relate to one another in predicting preschool children's competence in numerous domains (see Carlson, Mandell, & Williams, 2004; Hughes, 1998b). Little research has been done on how these variables may mediate the relation between EFs and cognitive and social school readiness. This short-term longitudinal study assessed the unique contributions of ToM and problem behaviors to cognitive and social school readiness.

Problem behaviors mediated the relation between EF, specifically inhibition, and social school readiness. Both teacher reports and direct assessment of EF revealed that EF, and specifically shifting, were direct predictors of later cognitive school readiness. However, ToM did not mediate any of the relations between EF and either social or cognitive school readiness. These results have several implications for education, including intervening with a child's ability to inhibit in order to improve problem behaviors and later social school readiness, as well as improving children's ability to mentally and behaviorally shift between sets of information in order to improve cognitive school readiness.

This work is dedicated to my parents, Alan and Rina Kolnik, with all of my love.

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CHAPTER 1: INTRODUCTION

Considering the over \$5 billion recently provided for early childhood education in the American Recovery and Reinvestment Act (American Recovery and Reinvestment Act of 2009), there is considerable need for research investigating what exact skills in preschool are important for later success and school readiness. A growing literature demonstrates a strong connection between executive functions and later school readiness (e.g. Blair & Diamond, 2008; McClelland et al., 2007; Pennington & Ozonoff, 1996). Executive functions (EFs) are a child's self-regulatory cognitive processes used towards achieving a goal (Garon, Bryson, & Smith, 2008), which may help a child adapt to the classroom, get along with others, and follow directions. Although research suggests multiple pathways through which EF may influence school readiness, the mechanisms through which this relation may work have not yet been explored. The purpose of this study was to examine possible mediators of the relation between EF and cognitive and social school readiness.

This short-term longitudinal study assessed the unique contributions of theory of mind (ToM) and problem behaviors to cognitive and social school readiness. Problem behaviors occur when children do not effectively function in social situations, while ToM is a social-cognitive skill that allows a child to understand another person's mental processes (Wellman, 2002). These variables have been found to relate to one another in predicting preschool children's cognitive and social competence (see Hughes, 1998b; Carlson, Mandell, & Williams, 2004). Little research has been done on how these variables may mediate the relation between EF and cognitive and social school readiness.

In this study, I tested whether ToM and problem behaviors mediated the relation between early EFs and later cognitive and social school readiness.

School Readiness

In 1990, The National Education Goals Panel introduced school readiness as a goal to prepare American children to enter the educational system (National Education Goals Panel, 1995). School readiness describes how prepared children are, at kindergarten entry, for later schooling. The Goals focused on a broader, more holistic view of what it means to be ready for school than had previously been used, including several competencies beyond academic achievement. School readiness was conceptualized as five domains amenable to curricular intervention: physical well-being and motor development, social and emotional development, approaches to learning, language development, and cognition and general knowledge (National Education Goals Panel, 1995). The concept of school readiness as a multifaceted construct has allowed for a more nuanced view of what domains help support a child's ability to learn in a formal educational setting. Importantly, school readiness does not point to one exact skill that is necessary to succeed; instead, it suggests that a child with strong, mature skills in numerous domains will be better prepared for the transition to the classroom.

All five domains of school readiness must be measured to monitor progress towards the goal that every child is ready to enter kindergarten. Specifically, the cognitive skills necessary to engage in the learning experience and the social skills necessary to negotiate the classroom environment have been suggested as important to a child's ability to succeed in school (Duncan et al., 2007). Both cognitive and social skills are consistently rated by kindergarten teachers as the most important skills for easing the

transition into kindergarten (Rimm-Kaufman, Pianta, & Cox, 2000); therefore, this study will focus on the cognitive and social domains of school readiness.

Cognitive school readiness. Cognitive skills have been the most widely studied outcome with relation to later school achievement. In fact, it has been accepted by much of the academic community that later academic achievement can “be traced to capabilities seen during the preschool years” (National Research Council and Institute of Medicine, 2000, p. 125). Duncan and colleagues (2007), for example, found that, controlling for child and family-level factors, reading and math at school entry predicted reading and math scores as far as fifth grade. The meta-analysis confirmed that school entry math skills such as ordinality and number knowledge were the strongest predictors of later achievement, followed by school entry reading skills such as vocabulary and letter knowledge.

Social school readiness. In catering to the whole child, numerous federally funded programs such as Head Start focus not only on early cognitive skills, but on social skills as well (Duncan et al., 2007). In fact, the National Education Goals Panel specifically points to social and emotional development as a malleable domain in which children may benefit from early intervention (National Education Goals Panel, 1995). Social school readiness is defined through many different aspects: teacher-child interactions, peer relations, cooperative social skills, and the formation of reciprocal friendships (National Education Goals Panel, 1995). Many studies have incorporated differing ways of measuring social skills, from teacher reports of children’s social skills (Fantuzzo, et al., 2007; Ponitz, McClelland, Matthews, & Morrison, 2009) to direct observations of children’s play (McWayne, Fantuzzo, & McDermott, 2004) and

behavioral profiles (Ladd, Birch, & Buhs, 1999). These aspects of social skills all attempt to capture a child's ability to actively and effectively participate in the social setting of a classroom.

The focus on the social domain as an important aspect of school readiness has led to numerous studies examining the predictive ability of social skills to later achievement. Social skills are highly endorsed by kindergarten teachers as essential to adapting to the classroom setting (Rimm-Kaufman, Pianta, & Cox, 2000). Research suggests that, even if not indicative of academic outcomes, social skills are important to the development of later competence (Eisenberg et al., 1997; Masten & Coatsworth, 1998). Social competence has its basis in early childhood interactions, and may shape the trajectory for a child's later development (Masten et al., 1999). A child's early competence in a friendship or a teacher-student relation may shape his later interactions with teachers and peers in a classroom setting (Masten & Coatsworth, 1998). The social-emotional domain and the social adjustment outcomes it predicts, such as school dropout and aggression, may be as important as cognitive outcomes (Denham, 2006). For that reason, having strong social skills lays the groundwork for a child's ability to positively interact with the environment at later stages.

Research continues to examine the variables that play a role in school readiness and the causal ways these variables may affect it. A child's ability to self-regulate has been proposed as a path to later school readiness (Blair, 2002; Blair & Diamond, 2008). Certain EFs in preschoolers, such as working memory and inhibitory control, have even been shown to predict concurrent emerging mathematical skills (Espy et al., 2004). To

better understand antecedents of school readiness, this study will examine the relation between early EFs and later cognitive and social school readiness.

Executive Functions

Executive functions (EF) are a child's self-regulatory cognitive processes used towards achieving a goal (Garon et al., 2008). These overarching functions help manage a child's cognitive, social, emotional, and behavioral responses. EFs are used for difficult tasks that evoke active monitoring, instead of automated responses (Hughes & Graham, 2002). EFs have been conceptualized as one part of general cognition; crystallized cognition encompasses basic knowledge and facts, while fluid cognition, or EF, refers to cognitive-based functions that oversee, or execute, the use of behavioral and cognitive strategies (Blair, 2006).

The executive system can be compared to the operating system of a computer, managing and calling up software to be used towards a solution. The executive system's "software" is used to actively manage a person's attentional systems. It is theorized that EFs are a means of focusing and shifting a child's attention (Garon et al., 2008). Attention has been theorized as an "anterior-posterior model of development" (Mundy, Card, & Fox, 2000; Rothbart, Posner, & Rosicky, 1994). In the first year of life, a child's attention is determined by the automatic posterior parietal "orienting" system, which focuses and shifts a child's attention to external stimuli (Rothbart et al., 1994). Gradually, from about age 2 to 6, a more internally-focused anterior attention system develops which supports and directs the posterior attention system (see Mundy et al., 2000). This anterior system has been called the executive attention system and is theorized to be the center of executive functioning (Mundy et al., 2000). Importantly, it

is theorized that this system is used as an active way to monitor attention. The use of this system in controlling and directing attention is seen as central to a child's ability to think of, plan, and execute goals.

Theoretical models of EF. Research has historically examined both the overarching executive system and the separate components used to regulate responses (see Garon et al., 2008). Although a plethora of names for similarly defined systems has made agreement on an EF model difficult, numerous theories have attempted to specify a model. The unitary model of EF (e.g. Baddeley, 2003) suggests that there is one main attention control system, based on research showing that different EFs are intercorrelated and subject to change at the same time. In comparison, the componential model of EF (e.g. Carlson & Moses, 2001; Diamond, 2006) supports separable EFs, specifically working memory, inhibition, and shifting. This model follows from literature that demonstrates several separate underlying latent EF constructs, as well as variability in the development of various EF skills.

Garon and colleagues (2008) propose that cognitive psychologists have moved towards a theoretical integration of both unitary and componential models, based on Miyake, Friedman, Emerson, Witzki, and Howerter (2000). This theoretical model posits an underlying "maturation of attentional capacity" (Garon et al., 2008, p. 35) which may serve to explain the common variance in the correlated latent EF skills. Miyake and colleagues (2000), using structural equation modeling and confirmatory factor analysis, confirmed that a model with three correlated latent factors (working memory, inhibition, and shifting) fit the data better than a model with completely separate, uncorrelated factors or a model with a second-order latent EF factor. This proposal will use the

Miyake et al. (2000) and Garon et al. (2008) integrative model of EFs in proposing separate but correlated latent factors.

Research of children's EFs has often taken a trickle-down approach from research with adults; many of the tasks and factors used in the study of children's EFs were originally designed for use with adults (Blair, Zelazo, & Greenberg, 2005). These tasks have been simplified from the adult version in order to make them more manageable for children; however, the same basic factors seen in adult research have remained intact. In preschoolers, EF research has focused on the cognitive constructs of shifting, inhibition, and working memory (Isquith, Gioia, & Espy, 2004). A growing body of literature now shows consensus that these factors grow and change in a dramatic fashion during the preschool years (e.g. Carlson, 2005; Garon et al., 2008; Hughes, 1998a). This study will focus on shifting and inhibition.

Inhibition. A child's ability to inhibit a prepotent response in favor of a more acceptable or useful response is called inhibition. Inhibition requires the ability to overcome an automatic or motivationally compelling response, such as eating candy, in favor of a more goal-directed cognition or action, such as waiting in order to get a better treat. In young children, this has been split into simple and complex inhibition; simple inhibition requires little to no working memory ability, while complex inhibition tasks have a heavier working memory load (Garon et al., 2008). Simple inhibition tasks involve the repression of a want or desire (e.g., Kochanska, 2002; Kochanska & Aksan, 1995; Mischel & Ebbeson, 1970). These simple inhibition tasks show a development of basic inhibition from infancy to toddlerhood.

Preschoolers show a greater ability to inhibit during simple tasks, moving many researchers to investigate the more complex skills available to children at that age. Borrowing from adult tasks, most children's complex inhibition tasks involve holding a rule in memory while inhibiting a prepotent response (Garon et al., 2008), such as in a Stroop task. In a modified Stroop task, children from ages 3.5 to 7 showed developmental improvements in performance on this task, which requires children both to hold a rule in their head and to inhibit their visual input in responding (Gerstadt, Hong, & Diamond, 1997). Similarly, even more complex games, such as Simon Says, show an effect of age (Carlson & Wang, 2007). Inhibition continues to develop through preschool, with children gaining higher levels of inhibitory control as they move towards school entry. Inhibition may influence skills necessary in preschool such as not calling out in class, not hitting others, and appropriate classroom control.

Shifting. Shifting may well be viewed as the most complex of the three EF skills. Shifting, made up of the cognitive shifting and the behavioral response-shifting, involves shifting or moving attention from one mental representation to another (Garon et al., 2008). Garon and colleagues (2008) summarize the two phases of any shifting task; in the first phase, children create a mental representation by looking at some stimuli while ignoring others, creating a rule which is held in working memory. In the second phase, children learn a new mental representation, which to some degree will conflict with the previous representation. Shifting therefore makes demands on working memory through the holding of rules, inhibition through the ignoring of distracters and inhibiting of the previously salient rule, and attention shifting through the movement from one representation to another.

Developmentally, children become able to make shifts between increasingly more complex sets as they grow from infancy and into the preschool years. For example, the dimensional card change sort (DCCS; Zelazo, 2006) is a developmentally appropriate version of the widely used adult Wisconsin Card Sorting Test. In the DCCS, a child is given stimulus cards that vary on the two dimensions but in a conflicting pattern to target cards. In the first phase, the child sorts the cards along only one dimension (i.e. color); in the second phase, the child is given a conflicting mental rule, in which they sort the cards along the opposing dimension (shape). This basic shifting exercise has been shown to be developmentally sensitive to age, with 3-year olds only sorting along the first dimension, while children age 4 and above sort along both dimensions (Carlson, 2005; Zelazo, 2006). Increasing the number of dimensions (Deak, Ray & Pick, 2004), the complexity of the rule (border version; Zelazo, 2006), or the motivational salience of the task (Hongwanishkul, Haapaneym Lee, & Zelazo, 2005) have all been shown to make the task more difficult, exposing individual differences in children's shifting abilities as late as 7 years of age. This ability to change from one mental representation to another can be theorized to extend to a number of more complex behavioral outcomes, including the ability to follow new directions, make transitions, or problem solve in the preschool classroom.

Connecting EFs to School Readiness

School readiness has been established as an important goal for children leaving preschool and entering kindergarten. In fact, later academic skills in many domains can be traced to kindergarten skills, which can in turn be traced to abilities in preschool (National Research Council and Institute of Medicine, 2000). However, the precursors of

preschool school readiness are still being studied. Theoretically, early flexible cognitive skills, and specifically EFs, may help bolster later academic knowledge (Blair, 2006). Accumulating research points to such early cognitive processes as important predictors of school readiness.

EF and cognitive school readiness. The relation between early EFs and later cognitive skills is fairly robust. In fact, several studies have demonstrated a predictive relation between early EF skills and elementary school outcomes (see Blair & Razza, 2007; Bull & Scerif, 2001). Further research has begun to investigate whether this predictive relation was found within the preschool year. EFs early in the preschool year seem to have some bearing on academic and cognitive outcomes later in the school year. A study by McClelland and colleagues (2007), which used a behavior regulation measure as a proxy for EF, found that fall behavior regulation predicted spring math, vocabulary and literacy skills within a preschool year. In another study, controlling for age, verbal ability, and maternal education, inhibition accounted for 12% of the variance in preschool mathematics ability (Espy et al., 2004). Inhibition and attention shifting in preschool have also been correlated with verbal ability (Blair & Razza, 2007; Hughes, 1998a). Unsurprisingly, preschool is a time of large and important changes in both EFs and academic skills such as mathematics and literacy (Diamond, 2006; McClelland et al., 2007). The current study will investigate possible pathways through which EFs may work to strengthen cognitive school readiness.

EF and social school readiness. Research has also shown connections between early EFs and later social outcomes. Early research focused on the connections between executive dysfunction and social disturbances. Relations between executive dysfunction

and poor social outcomes have been suggested in such diverse groups as children with attention deficit hyperactivity disorder (ADHD) or conduct disorder, adults with traumatic brain injury, and preschoolers with disruptive behaviors (Hughes, Dunn, & White, 1998; Godfrey & Shum, 2000; see Pennington & Ozonoff, 1996). Consequently, the predictive ability of EF to positive social outcomes was then investigated. In elementary school children, Ciariano, Visu-Petra and Settanni (2007) discovered that EFs positively predicted social competence and negatively predicted non-cooperative behavior a year later. Similar findings found that better executive functioning in elementary schoolers predicted social competence two years later and a decrease in behavior problems two years later (see Riggs, Jahromi, Razza, Dillworth-Bart, & Mueller, 2006 for a review). While strong EFs seem to predict positive social behaviors, executive dysfunction is correlated with social deficits.

This relation has also been examined in preschoolers. Blair (2002) found that EF was significantly and positively related to teacher reports of on-task behavior. Further research has demonstrated a relation between EF and delay of gratification (Carlson & Moses, 2001). Evidence for the connection between strong EF skills and social competence is becoming stronger.

Social Information Processing and EFs

Although this research suggests that early executive functioning plays a role in later social school readiness, questions remain about the process through which this relation develops. Through which mechanisms does EF, a cognitive process, influence school readiness, complex social and cognitive factors? Clear and consistently strong links have been theorized and found between early and later cognitive processes (e.g.

Blair, 2002); in comparison, the links between early cognitive processes and later social outcomes may seem more obscure as the relation moves from the cognitive domain to the social domain. Social information processing theory (SIP; Crick & Dodge, 1994) suggests the steps through which cognitive processes could influence social behaviors.

Social information processing (SIP) theory attempts to break down the steps from receipt of a social stimulus through the reaction to that stimulus. Crick and Dodge (1994) describe six separate steps: encoding of clues, interpretation of cues, clarification of goals, response access or construction, response decision, and behavioral enactment. Each of these steps involves interaction with a cognitive database which includes memory, social rules, social schemas, and social knowledge. Although SIP specifically focuses on children's cognitive schema and interpretation of a situation, the theory generally focuses on the influence cognitive processes have on the social domain. These steps also each call upon various EFs in order to complete the process, which suggests a way in which EFs can affect the process through which social behaviors are exhibited. An example of a social situation will help explain the theory.

Any social cue could work to begin the cycle of social information processing; in this case, a target child with good EF skills has milk spilled on him by a peer. In the first step, encoding the cue, the child senses and perceives the stimulus, as well as his inhibition of non-important information and selective attention to the relevant situation. The second step, interpretation of the cue, actively involves the child's shifting abilities. During this stage, the child sorts through mental representations of social interactions in the past, using shifting to flexibly move from one possible interpretation to the other. For instance, the child must decide whether the peer has spilled milk on him as an accident or

in an attempt to belittle him. Next, the child picks his goal for the interaction; EFs, as cognitive mechanisms activated towards achieving a particular goal, are therefore extremely important after this step. The next step uses memory and representational sets to assess possible responses and outcomes for the situation. A child must use their shifting skills to flexibly look through all of the possible outcomes while inhibiting unimportant sets and decide which is the most likely or desirable outcome. The child then decides on the desired response, based on past and present data called into working memory, and then enacts the chosen decision.

Throughout the process, the child must inhibit his automatic responses while completing the more complex and goal-oriented social processing. Children with externalizing behavior problems often show a lack of inhibitory control (Pennington & Ozonoff, 1996), which may be caused by their inability to inhibit a prepotent response and walk through the entire social information processing cycle. Reacting immediately does not allow time for the other, more conscious decisions that are necessary for a positive social interaction. For instance, a child with poor inhibition skills and a negative cognitive bias may immediately yell at his peer instead of overcoming his bias and realizing that the incident was a mistake. Equally important, shifting skills are necessary at nearly every step of the SIP cycle. Once a child has inhibited his initial response, shifting allows the child to work through possible social scenarios. Shifting is used both to access the current situation through the child's cognitive schema and to imagine possible responses and their outcomes. Weak shifting skills could set the child up for poor social interactions in two ways. First, it could reinforce a child's negative cognitive schema by not allowing him to accurately and effectively find and access other,

contradictory representations of the situation. Weak shifting could also shrink a child's response repertoire by not allowing the child to think of and access as many behavioral responses. Finally, all of these steps are overlaid by a child's working memory skills. A child with poor working memory may not be able to take in all of the salient cues or hold as many representational sets in mind. In all of these ways, strong EFs may help support more positive behaviors. Social information processing theory lays the framework that social and cognitive-social skills are promoted by executive functioning. Those behaviors, whether social or learning related, help move a child towards strong skills that indicate school readiness.

Social-Emotional Context of Learning

EFs could influence school readiness through a number of pathways. Blair and colleagues (2007) suggest that EFs could facilitate the skills that are helpful within the classroom; these skills may enhance later cognitive and social outcomes. These social classroom skills are an important part of the "social-emotional context of learning" (Raver & Knitzer, 2002), which has been theorized to set the stage for later learning in children. Children's learning in preschool largely occurs in a social context, and it is theorized that this social atmosphere contributes to a child's motivation to learn and therefore academic and social outcomes. In fact, numerous inputs from the social environment, such as interactions with teachers, interactions with peers and individual social skills, all may function as the background impetus for a learning environment.

Raver and Knitzer (2002) summarize previous research about the social-emotional context. Children who act in "anti-social" ways are less likely to participate in class and be liked by classmates and teachers, which in turn leads to receiving less

instruction and positive feedback from teachers. In fact, children are more likely to do well on the transition to kindergarten if they can “accurately identify emotions in themselves and others” and “relate to teachers and peers in positive ways” (Raver & Knitzer, 2002, p.7). Both of these skills suggest that an adeptness with understanding others is important to school success. In a study of Head Start preschoolers, Bierman and colleagues (2009) found that prosocial behavior, or getting along with others, and classroom engagement, or positive interactions with peers and teachers, were positively correlated with cognitive school readiness. Children who show antisocial tendencies or problem behaviors are, in contrast, more likely to have poor academic outcomes, school drop-out and delinquency (Raver & Knitzer, 2002). This supports that children’s social abilities, whether strong or weak, influence their cognitive and social outcomes. Children’s cognitive and social skills may be strengthened by strong social-emotional skills and a supportive social-emotional environment, but poor social-emotional skills may negatively affect later outcomes. The current study therefore proposes two skills with social components as potential mediators through which earlier EF may have an effect on school readiness at the end of preschool- ToM and problem behaviors.

Theory of Mind

Theory of mind (ToM) refers to a child’s understanding of how the child’s own and others’ minds work. Piaget’s early studies focused on the egocentrism that he saw as inherent in children’s thinking (Wellman, 2002). From further investigations into children’s thinking processes, it became clearer that the way adults think about themselves and others may be a skill that develops in children. ToM focuses both on what a child generally knows about mental states and specifically on how a child

understands other people's mental states (see Flavell, 1999 for a review). People have cognitions that are separate from the physical world, "basic mental states, desires, percepts, beliefs, knowledge, thoughts, intentions, feelings, and so on" (Flavell, 1999, pp. 23). For instance, false belief understanding, a specific aspect of ToM, is when a child understands that a belief he or someone else holds may in fact be false; for example, a child can understand that Person A is telling Person B a lie, but Person B does not know it is a lie. Children seem to learn about these basic mental states throughout the first few years of life. During this process, children also begin to learn that others also have basic mental states and that others' mental states may differ from their own.

Generally, children's ToM is found to undergo a major developmental shift around the age of four. False belief specifically shifts around this age; four and five-year-olds mostly pass false belief tasks, while children younger than that do not (Wellman, 2002). Although this change was once considered to be stage-like, recent research has shown that the change is more continuous in nature, with children incrementally learning more about various mental states and continuing to gain insight into ToM as late as middle school (Flavell, 1999). However, because an important shift in false belief takes place around the age that children are in preschool, research on the development of ToM has focused on preschoolers.

ToM and EFs. The developmental progression of ToM is especially prominent during the preschool years. The preschool years are also an important time for a child's growing cognitive skills; researchers therefore have studied the links between EF skills and ToM in preschool. Consistent research showed a medium-sized correlation between EF and ToM (see Perner & Lang, 1999 for a review). Findings suggested that EF and

ToM have an important connection as early as three years of age and have a predictive relation longitudinally (Carlson, Mandell & Williams, 2004). In fact, research has increasingly demonstrated the role of EF demands on ToM tasks in 2- to 3-year olds and 4- to 5-year olds (Carlson, Moses, & Claxton, 2004; Hughes, 1998a). Although numerous theories postulated which cognitive process preceded the other (Perner & Lang, 1999), research on the direction of the relation was still uncertain. Hughes and Ensor (2007) designed a two-year longitudinal study to test the directionality of the relation. After controlling for age, verbal ability, and previous ability level, 5 out of 6 models found a predictive relation from EF to ToM, but only 2 out of 6 models found a predictive relation from ToM to EF. The findings suggested that EF skills may underlie development of ToM, but not the other way around. Due to these findings and theory, the current study hypothesizes that EF skills will predict ToM later in the spring semester.

ToM and school readiness. ToM may be an important skill in preschool because of its demand on both cognitive and social functioning. A child's understanding of other's thoughts connects the child's cognitions and cognitive understanding to the social world and social interaction, implicating ToM as an important social-cognitive skill. Astington and Pelletier (2005) theorize about ways in which ToM may support the growth of social and academic skills. They suggest a connection between a child's ToM and his ability to learn based on imitation and based on his knowledge of what he already knows. A child's thinking about his own mind may allow him to understand learning and the need for learning in a classroom-appropriate manner. Learning may occur when a

child recognizes a gap in his knowledge and, through imitation and repetition, learns from a teacher.

Astington and Pelletier (2005) also touch on the idea that ToM may influence the social-emotional domain, which may set the stage for later academic learning. As the social-emotional context for learning suggests, a skill that calls for dexterity in both the cognitive and social world may be important in supporting the learning context. Children learn through play with others, and poor ToM may lead to children being excluded from play because of misinterpreted social cues (Raver & Knitzer, 2002). Children's interactions with teachers may also be shaped by poor ToM, with teachers showing more negative relations with children who have fewer prosocial skills (Raver & Knitzer, 2002). This may lead to fewer opportunities to learn and to children with poor ToM showing less interest in the learning process. These theories suggest that a higher skill level on a social-cognitive skill like ToM may be a pathway to cognitive and social school readiness at the end of preschool. Based on the above research, the current study hypothesizes that ToM will mediate the relation between EF and school readiness skills at the end of preschool.

Problem Behaviors

Children's problematic behaviors in the classroom and with peers may also be a factor in how EFs influence later school readiness. Some studies have shown that early onset of problem behaviors can be indicative of more problematic outcomes later in life than can adolescent onset (Caspi & Moffitt, 1995). In general, research demonstrates that early problem behaviors may be precursors to later problems such as "drug abuse, depression, juvenile delinquency, and school dropout" (see National Research Council

and Institute of Medicine, 2000, pp. 177). Externalizing behaviors in preschool can be described as “noncompliance, aggression toward peers, high activity level, and poor regulation of impulses” (Campbell, Shaw & Gilliom, 2000, pp. 467), and are often associated with later diagnoses of conduct disorder, oppositional defiant disorder, and attention deficit hyperactivity disorder. Internalizing behaviors such as “anxiety, sadness, social withdrawal and fearfulness” (Campbell, 1995, pp. 115) are often associated with later depression and anxiety diagnoses. A review of current literature suggests that such problem behaviors may have a prevalence rate of about 10% in kindergarten, with prevalence estimates ranging from 5 to 33 percent in Head Start preschoolers (Raver & Knitzer, 2002).

Problem behaviors and EFs. Many problem behaviors show a core deficit in self-regulation and emotion regulation as part of their diagnosis or definition (Pennington & Ozonoff, 1996). For instance, ADHD involves a lack of inhibition, in which children are not adequately able to inhibit prepotent responses in order to focus attention on socially appropriate stimuli. Similarly, depression and anxiety, internalizing problems, may indicate problems with emotion regulation. Poor executive functioning has therefore been described as a possible predictor of problem behaviors in preschool.

Much of the research on problem behaviors and EFs depends on populations with clinical symptoms. In a large analysis of various child clinical populations, Pennington and Ozonoff (1996) presented evidence of a significant deficiency in EF in children with conduct disorder and ADHD. Hughes, Dunn, and White (1998) then examined EFs in “hard-to-manage” preschoolers who were found to be in the 90th percentile in hyperactivity; such children were more likely to fail EF tasks than children in a control

group. Longitudinally, research in elementary school children showed that children's inhibitory control and sequencing ability predicted change in externalizing behavior two years later but not internalizing behavior (Riggs, Blair, & Greenberg, 2003). Hughes and Ensor (2008) designed a study to examine the longitudinal predictive ability of EF to problem behaviors in preschoolers. The study found that EF at age 3 predicted problem behaviors at age 4, but problem behaviors did not predict later EF (Hughes & Ensor, 2008). Increasing research supports the important role that EFs play in the development of problem behaviors in the preschool years.

Problem behaviors and school readiness. Problem behaviors during preschool exist and can be accurately predicted; researchers have therefore turned to questions about what those problem behaviors predict. Research shows that clinical disorders in the elementary school years are predictive of later social maladjustment and academic problems (Campbell, 1995). Consequently, research has attempted to determine the effect of problem behaviors and social rejection in preschoolers. Externalizing behavior has been found to correlate with problems in academic achievement in preschool (Arnold, 1997), and a recent study of Head Start children has shown that preschool problem behaviors are predictive of academic outcomes in first grade (McWayne & Cheung, 2009). Children who exhibit problem behaviors may have less favorable interactions with the teacher and may be learning for a shorter period of time, leading to academic difficulties.

Perhaps as importantly, problem behaviors have been linked to problems with social competence. In the same study of Head Start children, McWayne and Cheung (2009) found that preschool behavior problems were also predictive of social competence

in first grade. Further, teacher reports of problem behavior in kindergarten were predicted by earlier parental reports of problem behavior in preschool (Keane & Calkins, 2004). Research also suggests that different profiles of problem behaviors may lead to differential problem behaviors at the end of the year. Children with aggressive/oppositional profiles continued to show aggression problems and peer play difficulties at the end of the preschool year, while children with withdrawn profiles showed a connection with disconnected peer play and lower prosocial, interactive play (Fantuzzo, Bulotsky, McDermott, Mosca, & Lutz, 2003). Because of the importance of the social-emotional context of learning, such problems with peers and teachers may continue to affect a child's academic learning. Research has demonstrated that children who do not have appropriate social competences have fewer teacher interactions, are liked less by other children, and like school less (Denham, 2006). In the current study, it is hypothesized that problem behaviors will mediate the relation between EF and cognitive and social school readiness at the end of the preschool year.

Purpose of the Study

Due to the importance of understanding precursors to school readiness skills, I examined the predictive ability of EF skills to cognitive and social school readiness. In this study, I also examined two potential mechanisms through which EFs affect school readiness. Current research suggests connections between EF and both ToM and problem behaviors, as well as from ToM and problem behaviors to cognitive and social school readiness skills. Therefore, I examined ToM and problem behaviors as mediators of the relation between EF skills and cognitive and social school readiness skills at the end of the year.

Hypotheses

The current study proposed one conceptual model which tested four mediation effects (Figure 1). EFs were collected at the beginning of the spring semester, problem behaviors and ToM were collected in the middle of the semester, and school readiness was collected at the end of the semester. The following four hypotheses were tested.

Hypothesis 1: It was hypothesized that *EFs* would predict *cognitive and social school readiness* (Path C).

Hypothesis 2: It was hypothesized that *EFs* would predict the *mediators (ToM and problem behaviors)*.

Hypothesis 2a. It was hypothesized that *EFs* would predict *ToM* (Path A₁).

Hypothesis 2b. It was hypothesized that *EFs* would predict *problem behaviors* (Path A₂).

Hypothesis 3: It was hypothesized that the *mediators (ToM and problem behaviors)* would predict *school readiness*.

Hypothesis 3a. It was hypothesized that *ToM* would predict *cognitive and social school readiness* (Path B₁).

Hypothesis 3b. It was hypothesized that *problem behaviors* would predict *cognitive and social school readiness* (Path B₂).

Hypothesis 4: It was hypothesized that *problem behaviors* and *ToM* would mediate the relation between *EFs* and *cognitive and social school readiness*.

CHAPTER 2: METHOD

Participants

Participants included 162 preschoolers and their teachers from 17 classrooms and 6 preschools in Miami, Florida. The sample was 56.8% male ($n = 92$) and 43.2% female ($n = 70$). The majority of the sample was Black (31.5%, $n = 51$) and Hispanic (27.8%, $n = 45$), with a small percent White (9.9%, $n = 16$) or other (6.2%, $n = 10$), or missing (24.5%, $n = 40$). Children ranged from 3 to 5 years of age at the beginning of the data collection, $M = 52.64$, $SD = 6.82$. Schools were from a variety of neighborhoods, with median household income in the 2000 U.S. Census based on ZIP code ranging from \$15,363 to \$96,609 (U.S. Census Bureau, 2000). These data were collected in the winter and spring of the 2008-2009 school year. Centers were included if they: a) were located within 20 miles of the Coral Gables campus of University of Miami; and b) had teachers who spoke English. Inclusion criteria for classrooms were if they a) were located in a selected center; b) had at least 5 enrolled children who would be 3 years of age or older on or before February 1, 2009; c) instruction in the classroom was conducted primarily in English.

Procedure

Center directors, teachers, and parents of students were consented. In the winter (T1), teachers answered a demographic questionnaire and questionnaires of children's EFs (BRIEF-P), and children were directly assessed using the EF battery. In the middle of the semester (T2), children were assessed on ToM and teachers reported on children's problem behavior (SSRS-P). At the end of the school year (T3), children were administered measures of cognitive school readiness, verbal ability, and ToM, and

teachers reported on children's social skills (see Table 1 for timeline). Teachers were paid \$25 at the end of T1 and T3 each for participation.

Measures

Demographic information. Child demographic data such as age and sex were gathered from classroom records.

Cognitive school readiness. Cognitive school readiness was assessed using The Bracken Basic Concept Scale- Third Edition: Receptive (BBCS-3R; Bracken, 2006). The BBCS-3R is an assessment made to test basic concept development. A school readiness composite score (SRC) standard score is based on the first five subsets of colors, letters, numbers/counting, sizes/comparisons, and shapes. The SRC has been shown to have high internal consistency of .95 and high test-retest reliability of .86 for children between the ages of 3 and 7 years. In the current sample, internal consistency was found to be high, $\alpha = .97$. The BBCS-3R has been found to be a good predictor of academic ability over a school year (Bracken, 2006).

Social school readiness and problem behaviors. Social school readiness and problem behaviors were assessed using The Social Skills Rating System- Preschool (SSRS-P; Gresham & Elliott, 1990). The SSRS is a measure of children's problem behaviors and social skills. The teacher version of the questionnaire has 40 items that form the Social Skills composite, made up of Cooperation, Assertion, and Self-Control subscales, and Problem Behaviors, made up of Externalizing and Internalizing subscales. Both scales are normed and ratings are given as a standard score. The scale is normed on a group of 4,170 children and shows internal consistency scores between .73 and .94,

with high internal consistency in the current sample, $\alpha = .94$. Test- retest reliability for the scale ranges from .65 to .87.

Executive function. EFs were assessed using a direct assessment battery and the Behavior Rating Inventory of Executive Function-Preschool Version (BRIEF-PV; Gioia, Isquith, Guy, & Kenworthy, 2000). The table below provides all of the EF tasks in the EF battery, as well as their source and what EF they were predicted to test. The battery took between 25 and 35 minutes to administer.

Executive Function Battery

Task	Executive Function	Citation
Knock-Tap	Inhibition	Hughes, 1998
Day-Night	Inhibition	Gerstadt, Hong, & Diamond, 1994
Simon Says	Inhibition	Carlson & Wang, 2007
Statue	Inhibition	Korkman, Kirk, & Kemp, 1998
Dimensional Change Card Sort-Traditional (DCCS)	Shifting	Zelazo, 2006
DCCS-Border	Shifting	Zelazo, 2006
DCCS-3 Dimension	Shifting	Deák, Narasimham, & Legare, submitted

The EF battery measured inhibition using four tasks (Knock-Tap, Day-Night, Simon Says, Statue). The Knock Tap Task assessed a child's inhibitory control through inhibition of the assessor's hand gesture and demonstration of the opposite gesture. The child is given ten congruent trials, where he imitates the examiner, and ten incongruent trials, where he does the opposite motion to the examiner. Knock-Tap is scored as a

percent correct on congruent and incongruent trials. The task has been used with children ages three to five (Hughes, 1998b). In the current sample, internal consistency was good, $\alpha = .85$. The Day-Night Stroop task also measured child's ability to inhibit a prepotent visual cue in order to say the opposite word. Day-night is scored as a percent correct, with 14 trials, and internal consistency was good, $\alpha = .92$. The task has been used on children between the ages of 3.5 and seven and has been shown to be developmentally sensitive to that age range (Gerstadt, Hong, & Diamond, 1994). Simon Says tested inhibitory control by teaching a child ten actions and then asking the child to inhibit those actions when appropriate. Children are given a score of 0 to 3: 0 when they do the wrong motion immediately, 1 when they hesitate before giving a wrong answer, 2 when they hesitate before giving a correct answer, and 3 when they immediately give a correct answer. Simon Says was scored as a percent correct out of all ten trials; internal consistency was fair, $\alpha = .63$. Five-year-olds do better than four-year-olds on this version of the task (Carlson & Wang, 2007). The Statue task was an inhibition task adapted from the NEPSY (Korkman, Kirk & Kemp 1998), in which the child was asked to stand completely still for 75 seconds. A disruption was introduced every 15 seconds, and the child's reactions were scored at each 5 second interval for a movement or eye-opening. Statue is scored as a total of number of movements and eye-openings, for a total possible of 30; internal consistency was fair, $\alpha = .70$.

The EF battery measured attention shifting using three tasks. The Dimensional Change Card Sort- Traditional (DCCS) was a measure of attention shifting used in children aged two and a half to five (Zelazo, 2006). The child was asked to sort cards according to two different dimensions. If the child sorts at least five out of six cards

correctly on the post-change sort, that is considered a pass. The child receives either a pass or a fail, coded as a 1 or 0 respectively. The DCCS-Border is a harder version of the traditional DCCS, used for ages four to seven, in which half of the cards have black borders. The child was told to play one game for cards with a border and another for cards without one. The child receives either a pass or a fail, coded as a 1 or 0 respectively, with a pass being coded as getting more than two-thirds of the card sort correct. Performance on the DCCS has been connected with concurrent measures of ToM (Perner, Lang & Kloo, 2002). The 3-DCCS is a measure of attention shifting used in children aged 2.5 to five and adapted from the traditional DCCS (Deák, Narasimham & Legare, submitted). In this version, the child was asked to sort cards according to three different dimensions. The 3-DCCS was a more complex task than the traditional or border versions, forcing children to shift attention to three different rules. The child receives either a pass or a fail, coded as a 1 or 0 respectively. A pass is coded as getting at least five out of six cards sorted correctly for each dimension change.

The Behavior Rating Inventory of Executive Function-Preschool Version (BRIEF-PV; Gioia, Isquith, Guy, & Kenworthy, 2000) is a pen and paper teacher measure of preschool children's EF behaviors. The BRIEF-P is meant to assess EFs through children's real-world behaviors instead of clinical tasks. The BRIEF-PV is made up of five subscales (inhibit, shift, emotional control, working memory, and plan/organize) which combine to create a global executive composite score. The BRIEF-PV has shown high internal consistency among the subscales (.90-.97). Internal consistency in this sample on the two subscales of interest, Inhibit and Shift, was high, $\alpha = .98$. Test-retest reliability on the scale ranges from .64 to .94. The BRIEF is normed on

302 teachers and shows convergent and discriminant validity with other measures of childhood behavior problems such as the Child Behavior Checklist/1.5-5 and the Behavior Assessment System for Children-Parent Rating Scale.

Theory of Mind. ToM was assessed using two false-belief tasks: the Sally-Anne task and the egg carton task. The Sally-Anne task is a widely used false belief test of ToM. In the task, a child is shown a scenario in which one girl has a false belief about another girl. Sally leaves her ball in a basket and leaves the room. Anne then moves the ball to a box, and Sally reenters the room. The child must pick where Sally will believe her ball is hidden. Children without ToM will believe Sally knows what they know; they will say Sally will look in the box because they know the ball is in the box. Children with ToM will understand that everyone does not know what they know; they will say Sally will look in the basket because that was the last place she saw it, although the child has more information. Children who got the answer correct were considered to have “passed” and were given a score of 1; children who got the question incorrect were considered to have “failed” and were given a score of 0. A study of generally used ToM measures such as the Sally-Anne task found test-retest reliability for most ToM tasks to be kappas between .4 and .7, which did not vary based on cognitive ability (Hughes, Adlam, Happe, Jackson, Taylor, & Caspi, 2000).

The egg carton is a false belief box task used to measure a child’s ToM. The child is shown an egg carton, which when it is opened revealed pencils instead of eggs inside. The child is asked what he thought was in the carton before it was opened. Children who do not have ToM will respond that they thought pencils were in the box, because they cannot differentiate between what they now know and what they knew before. Children

with ToM will respond that they used to think there were eggs in the box, because they understand that although now they know there are pencils in the box, before they thought there were eggs. Construct validity has been assessed by correlating this task with other ToM tasks such as another false belief box task ($r = .41$) and a deception task ($r = .33$) (Hughes, 1998b). Children were given a score of 1 for a pass and a score of 0 for failing. ToM was calculated by adding the two variables together to get a score of 0, 1, or 2.

Language ability. Language ability was assessed using The Woodcock Language Proficiency Battery- Revised (WLPB-R; Woodcock, 1991). The WLPB-R Picture Vocabulary subscale is an assessment made to test basic receptive vocabulary ability. The WLPB-R gives scaled and standardized scores for different age groups and grade levels based on normative levels of performance. THE WLPB-R was normed on a preschool sample of 705 children ages 2 to 5. The Picture Vocabulary subset of the WLPB-R has been shown to have high internal split-half reliability ranging from .84 to .82 for children between the ages of 2 and 4 year and high test-retest reliability of .90. Internal consistency for the current sample was moderate, $\alpha = .79$. The Picture Vocabulary subscale has been found to be strongly correlated at age 3 with concurrent basic concept instruments such as the Bracken Basic Concepts and other measures of receptive language such as the PPVT-R, demonstrating good construct validity.

Data Analysis Plan

For purposes of data reduction, a measurement model was fit for the EF measures; then a structural model testing the mediations was run. For analyses with all continuous variables, model fit was assessed by using standard fit indices such as a chi-square goodness of fit test, comparative fit index (CFI), root mean square error of approximation

(RMSEA), and standardized root mean square residual (SRMR) (Kline, 2005). A non-significant chi-square, a CFI greater than 0.95, an RMSEA less than 0.06, and an SRMR of less than 0.08 are all indicators of good model fit. In models using categorical variables of shifting, traditional model fit indices were not available.

For accurate estimation, structural equation modeling assumes independence of observations; however, because children are nested within classrooms, this assumption may be violated (Kline, 2005). To determine whether the interdependence of observations was a problem, design effects (DEFF) were calculated for all outcomes (Muthen & Muthen, 2009). Muthen & Muthen (2009) use ICCs to calculate a design effect using the equation $DEFF = 1 + (s - 1) \rho$, where s is the average cluster size and ρ is the ICC. If any DEFF is greater than 2, the model should account for clustering. Intraclass correlations ranged from 0.07 for ToM to 0.39 for cognitive school readiness. DEFFs were calculated for all outcome variables from ICCS, with DEFFs of 1.60, 1.92, 4.08, and 4.29 for ToM, problem behaviors, social school readiness, and cognitive school readiness, respectively. Because the school readiness outcomes had DEFFs bigger than 2, clustering was accounted for in all analyses. Mplus is able to account for non-independent observations by adjusting standard errors without modeling at the second level.

Data reduction. A measurement model was fit for the two proposed correlated EF latents of inhibition and shifting (Figure 2). The latent inhibition factor used the four inhibition tasks of the EF battery (Knock-Tap, Statue, Simon Says, and Day-Night) as indicators. A latent shifting factor used the three categorical shifting tasks (Dimensional Change Card Sort [DCCS] traditional version, DCCS border version, and 3-DCCS).

Structural model. A structural model was estimated using the EF predictors, both mediators, and both outcomes simultaneously. Age and verbal ability were included as control variables in the model where needed. Because teacher measures of EF did not load onto the latent factors, the same model was also run with teacher measures of inhibition and shifting as predictors. Mediation of significant indirect effects were tested via the conventional Sobel test (Kline, 2005) and near-significant indirect effects were tested with confidence intervals (CI). A confidence interval was calculated using the assymetrical Empirical M-distribution; if the CI does not include zero, then the indirect effect is significant (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; MacKinnon, Lockwood, & Williams, 2004).

CHAPTER 3: RESULTS

All statistical analyses were conducted using MPlus (Muthen & Muthen, 2007). All continuous data were examined for normality; means and standard deviations are also reported in Table 2. The three shifting direct assessments (DCCS-Traditional, DCCS-Border, DCCS-3) were all coded as dichotomous variables, with children either getting a “0” for failing or a “1” for passing.

Correlations were run between all of the continuous variables (Table 3). Age was significantly correlated with direct assessments of inhibition, $r = .22$ to $r = .41$, $p < .01$, but was not correlated with teacher reports of EF or problem behaviors. Similarly, language ability was significantly correlated with direct assessments of EF, $r = .24$ to $.52$, $p < .01$, but was not correlated with teacher reports of EF or problem behaviors. Direct assessments of inhibition were all significantly correlated with each other, and teacher report of shifting and inhibition were also moderately correlated with each other ($r = .54$, $p < .01$).

Data Reduction

A measurement model was fit for the two correlated EF factors of inhibition and shifting, $n = 153$ (see Figure 2). The four direct assessments of inhibition all loaded significantly on the Inhibition factor, with loadings of 0.83, 0.42, 0.74, and -0.48 for the Knock-Tap, Day-Night, Simon Says, and Statue measures, respectively. Teacher report of inhibition was removed from the Inhibition factor because it did not load significantly, $\beta = -0.14$, $p = .23$. Similarly, teacher report of shifting was not used in the Shifting factor because it did not load significantly on the factor, $\beta = -0.07$, $p = .58$. The three direct assessments of shifting all loaded significantly on the Shift factor, with loadings of 0.83,

0.66, and 0.89 for the DCCS-Tradition, DCCS-Border, and DCCS-3, respectively. The two latent factors were significantly and very highly correlated, $r = .88, p < .001$.

Although the current study proposed two latents, using two latent factors that are so highly correlated ($> .85$) in a single model results in issues with multicollinearity, which would not only make it difficult for each variable to explain unique variance but also may affect interpretation. In such a case, it is suggested to either drop one variable or combine them into one factor (Kline, 2005). Because the latent variables were so highly correlated, a model was run with a combined EF latent variable, with all direct assessments of EF as indicators of one latent (Figure 3). The seven direct assessments all loaded significantly on the EF factor, with loadings of 0.84, 0.67, 0.87, 0.34, 0.72, -0.49, and 0.64 for the DCCS-Tradition, DCCS-Border, DCCS-3, Day-Night, Knock-Tap, Statue, and Simon Says measures, respectively. Because teacher reports of EF did not load onto the latent factor, separate models were run for the direct assessment latent factor and teacher reports of inhibition and shifting to fully capture the effect of EF on school readiness.

Structural Model

Direct assessment model. The structural model was run with one latent factor of EF predicting the school readiness and mediator variables (see Figure 4). Loadings for the latent variables remained significant.

The EF latent factor directly predicted cognitive school readiness, but there were no indirect effects of EF on cognitive school readiness through either ToM or problem behaviors. The EF latent factor significantly predicted cognitive school readiness, $B = 0.66, SE = 0.14, p < .001$ (see Table 4 for all paths), such that children with stronger EF

skills tended to have higher cognitive school readiness scores. EF was also predictive of ToM, $B = 0.01$, $SE = 0.006$, $p = .03$, such that children with better EF skills had better ToM. ToM was predictive of cognitive school readiness, $B = -4.63$, $SE = 1.93$, $p = .02$, such that children with better ToM skills had lower cognitive school readiness scores, controlling for age, language ability, executive functioning, and problem behaviors. There was no indirect effect of EF on cognitive school readiness through ToM, Sobel $z = -1.61$, $SE = 0.04$, $p = .11$, $CI_{Meeker} = (-0.12, 0.03)$; ToM did not mediate the relation between EF and cognitive school readiness. There was also no indirect effect of EF on cognitive school readiness through problem behaviors, Sobel $z = -0.02$, $SE = 0.02$, $p = .98$.

There was no direct or indirect effect of EF on social school readiness. EF was not predictive of problem behavior, $B = 0.003$, $SE = 0.14$, $p = .98$, or social school readiness, $B = 0.09$, $SE = 0.11$, $p = .42$. Problem behaviors were significantly predictive of social school readiness, $B = -0.44$, $SE = 0.08$, $p < .001$, such that children with fewer problem behaviors displayed higher social school readiness. ToM was not predictive of social school readiness, $B = -1.28$, $SE = 1.64$, $p = .44$. There were no indirect effects of EF on social school readiness through problem behaviors or ToM, Sobel_{Problem} $z = -0.02$, $SE = 0.06$, $p = .98$; Sobel_{ToM} $z = -0.73$, $SE = 0.02$, $p = .46$.

Teacher report model. A structural model with teacher reports of inhibition and shifting as predictors adequately fit the data, $\chi^2(1) = 0.70$, $p = .41$; CFI = 1.00; RMSEA = 0.00; SRMR = 0.006 (see Figure 5). There was a direct effect of shifting on cognitive school readiness, but no indirect effects of EF on cognitive school readiness through either problem behaviors or ToM. Teacher report of shifting significantly

predicted cognitive school readiness, $B = 0.35$, $SE = 0.15$, $p = .02$, such that children who were rated as having more difficulty with shifting behaviors had higher cognitive school readiness scores (see Table 5 for all paths). Teacher report of inhibition did not significantly predict cognitive school readiness. Teacher report of inhibition and shifting were not predictive of ToM, $B_{\text{inhibit}} = -0.004$, $SE = 0.004$, $p = .36$, $B_{\text{shift}} = 0.001$, $SE = 0.01$, $p = .90$.

Neither inhibition nor shifting were significant direct predictors of social school readiness. However, problem behaviors mediated the relation between inhibition and social school readiness. Inhibition was significantly predictive of problem behaviors, $B_{\text{inhibit}} = 0.67$, $SE = 0.06$, $p < .001$, such that children who had difficulties inhibiting their behavior displayed more problem behaviors as rated by teachers. Problem behaviors were significantly predictive of social school readiness, $B = -0.32$, $SE = 0.16$, $p = .04$, such that children with fewer problem behaviors displayed higher social school readiness. There was a significant indirect effect associated with inhibition through problem behaviors, $B = -0.21$, $SE = 0.11$, $p = .05$, Sobel $z = -2.01$, $SE = .11$, $p = .04$, such that children who have difficulties inhibiting in the classroom displayed more problem behavior, which in turn predicted lower social school readiness scores. Results indicated that mediation was only significant for inhibition through problem behaviors on social school readiness. Shifting was not predictive of problem behaviors, $B_{\text{shift}} = 0.30$, $SE = 0.18$, $p = .09$. There was no significant indirect effect associated with shifting through problem behaviors on social school readiness, $B = -0.10$, $SE = 0.08$, $p = .22$, Sobel $z = -1.33$, $SE = 0.07$, $p = .18$, $CI_{\text{Meeker}} = (-0.21, 0.08)$.

CHAPTER 4: DISCUSSION

While previous research has focused on whether EFs influence both social and cognitive school readiness, this study helps describe mechanisms through which EFs influence a child's school readiness, above and beyond the effects of age or verbal ability. Overall, results demonstrate that EFs are important predictors of both cognitive and social outcomes and that within-child variables mediate that relation. In this study, there was a direct relation between EF and cognitive school readiness, but no direct relation between EF and social school readiness. Problem behaviors, but not ToM, mediated the relation between teacher reports of inhibition and social school readiness. Neither ToM nor problem behaviors were mediators of the relation between EF and cognitive school readiness.

The Measurement of Executive Function

Contrary to Garon and colleagues' (2008) theorized structure, direct assessments of EF did not reveal two statistically separate latent factors of EF. The two latent factors, using only the direct assessments of EF, were very highly correlated, and became even more highly correlated when controlling for age and verbal ability. Due to issues of multicollinearity, a single latent factor with all direct assessments of EF as indicators was considered more theoretically rigorous than dropping one of the factors. Such a model may more closely suggest a common underlying cause of the correlation between shifting and inhibition as measured by direct assessment (Zelazo & Frye, 1998; Zelazo & Muller, 2002). For example, Zelazo and Frye's (1998) cognitive complexity and control theory views cognitive EF as a unitary construct, based on children's understanding of hierarchical rules. Children's EF progression is described as running in parallel to their

ability to hold and understand two or more rules at once. Garon and colleagues (2008) alternately speculate that attention may explain the relation between EF components, accounting for the correlation between the different components.

Perhaps the current tasks tapped into a more domain-general executive functioning skill and measured some underlying cognitive executive ability. However, numerous previous studies have found that direct assessments of inhibition and shifting load on different factors (e.g. Espy et al., 2004; Hughes, 1998a). The teacher reports of EF help demonstrate that the direct assessment tasks in this study seem to be explaining a common source of variance in executive functioning as opposed to unique variance in shifting and inhibition. Teacher report of EF components did not load significantly onto the latent factor of EF, suggesting a difference in the aspects of EF teachers were reporting compared to what was directly assessed. The BRIEF-P was designed using factor analysis to find differential scales for components of EF, creating subscales that are correlated but are specifically meant to tap into distinct components of EF. It is possible that, in this study, teacher report of shifting and inhibition may explain the unique variance associated with each EF component, while the direct assessments tap into the common variance associated with EF underlying each of the tasks.

Informant discrepancies. Numerous studies in the field of child development have found discrepancies in the report of child skills and behaviors based on informant or method of measurement (see De Los Reyes & Kazdin, 2005). This research has focused on the discrepancies found between teacher, parent, and child reports of the same behavior. De Los Reyes and Kazdin (2005) suggest a theory of informant discrepancies in clinical settings that can be broadened to encompass the differences seen in this study

between teacher report and direct assessment of EF. In this case, teachers bring their own viewpoint to the report of child behavior, while direct assessment may have a different goal in describing child behavior.

The Attribution Bias Context Model (ABC Model; De Los Reyes & Kazdin, 2005) suggests three aspects of the informant's assessment of behavior that may explain discrepancies between reports: informant attributions, informant perspectives, and context. Informant attributions of the cause of a child's behavior may color how that informant reports on a child's behavior. For instance, teachers may be more likely to attribute a child's behaviors to something inherent within the child, such as temperament, while direct assessment may simply be measuring a behavior but not attributing it to any particular characteristic within the child. Informant perspectives of whether a child's behavior is problematic and needs intervention may also be a reason for the discrepancies between teacher reports and direct assessments. De Los Reyes and Kazdin (2005) state that a teacher or parent informant is more likely to think that a child's behavior is problematic and therefore recall negative behaviors. The BRIEF-P, while one of the foremost tools for assessing child EF, is a clinical tool set up to detect problems through child day-to-day behavior. In comparison, the direct assessments of EF were collected as a way of describing and quantifying typical EF. In this study, the BRIEF-P may be tapping into a construct more commonly described as behavior regulation, defined as a child's ability to modulate gross motors behavior (Ponitz, McClelland, Matthews, & Morrison, 2009), while the direct assessment is tapping more directly into cognitive regulation.

Finally, the context and what is seen as the goal of the assessment may be related to informant discrepancies (De Los Reyes & Kazdin, 2005). In this case, the goal of the study and direct assessment is to quantify child behaviors and identify relations between those behaviors. In comparison, teachers may feel that the goal of reporting child behavior is to identify children who need help or to classify if a behavior is acceptable. These two disparate contexts in which the data were collected, one more focused on describing a child's behavior and the other focused on reporting a child's weaknesses and strengths, may lead to differential reporting on the same construct. Previous conceptualizations of informant discrepancies have focused on context, as well, stating that different informants may have access to different behaviors based on the context in which they observe the child (Achenbach et al., 1987). Teacher informants may see child behaviors only in the classroom, while assessors see children only in structured settings with a stranger. This additional context may also be a part of why teachers and assessments describe child behavior differently.

Importantly, the ABC Model specifies that no informant is necessarily more correct or valid than another. Instead, each reporter provides different information based on his or her own perspectives and interpretations of the child within a given context. Generalizing outside of the clinical setting to the current research, each informant or way of measuring behavior may give unique information both about the child's behavior and how that behavior affects important relations in the child's life. The theory suggests that there is no "gold standard" for reporting on child behavior, and that all informants may be reporting on unique aspects of a behavior (De Los Reyes & Kazdin, 2005). Therefore, this study was able to examine unique aspects of EF through models with direct

assessments of a cognitive EF latent construct and with teacher reports of shifting and inhibition based on day-to-day behavior.

Teacher Report Model

Social school readiness. Although it was hypothesized that both problem behaviors and ToM would mediate the relation between EF and social school readiness, only one indirect effect was found in the model. In this study, there was no mediation of EF to social school readiness by ToM, partially because teacher reports of shifting and inhibition were not predictive of ToM. A longer discussion of ToM will be presented in the discussion of the direct assessment model. Teacher report of better inhibition skills predicted lower levels of problem behaviors, which in turn led to higher social skills. There was no direct effect of inhibition, suggesting that the relation between inhibition and social skills is completely mediated by problem behaviors.

Previous research has demonstrated a robust link between EFs and problem behaviors (Hughes & Ensor, 2008; Riggs, Blair, & Greenberg, 2003). Most of the research that has examined the relation between EF and problem behaviors has found a link between inhibition, specifically, and problem behaviors. Children who are more capable of inhibiting inappropriate behaviors may display fewer behaviors that teachers find disruptive in the classroom. Further, an ability to inhibit a reaction or response may make a child more socially capable and desirable amongst peers. Previous work has already demonstrated that problem behaviors predict more problem behaviors and lower social competence (Fantuzzo, Bulotsky, McDermott, Mosca, & Lutz, 2003; Keane & Calkins, 2004; McWayne & Cheung, 2009). Children who have difficulties with social interactions early on tend to also have a harder time with positive social interactions; a

child's ability to interact with others sets the stage for his or her later social learning and interaction (Campbell, 1995). The current findings suggest that the relation between inhibition and social school readiness is mediated completely by problem behaviors; perhaps if a child's problem behaviors could be addressed early enough, even children with poor inhibition can excel in social situations.

Cognitive school readiness. Neither inhibition nor shifting was predictive of ToM, controlling for the other, nor was ToM predictive of cognitive school readiness. Inhibition was also not directly predictive of cognitive school readiness. It is possible that, given the complex relation already seen with inhibition and problem behaviors in social school readiness, perhaps both inhibition and problem behaviors have some influence on cognitive school readiness. However, when controlling for the other, neither has a significant unique effect on cognitive school readiness.

In this model, teacher report of a child's ability to shift flexibly between behaviors was directly predictive of cognitive school readiness, controlling for inhibition, problem behaviors, ToM, language ability, and age, but no indirect effects were found. Surprisingly, better shifting abilities in a child were predictive of lower cognitive school readiness. Previous research has shown that attention shifting may differentially predict various aspects of academic achievement at different points in development. For instance, Blair and Razza (2007) reported a similar negative, but non-significant, relation between better shifting abilities in preschool and poorer academic outcomes, controlling for language ability, inhibition, and ToM in kindergarten. Similarly, a study of EF and mathematical ability in preschool children also reported a negative, but non-significant,

relation between shifting and math after controlling for inhibition, working memory, age, and language ability (Espy et al., 2004).

To explain this relation, it has been suggested that shifting differs from inhibition and working memory in that it may show a more curvilinear or quadratic growth in preschool compared to the more linear growth of inhibition and working memory (Espy et al., 1997; Garon, Bryson & Smith, 2006; Isquith, Crawford, Espy, & Gioia, 2005). Although no research has explored the differential growth patterns of shifting in comparison to other EF abilities, this curvilinear growth in shifting may lead to findings that report a different relation between shifting and cognitive outcomes compared to the relation between linear growth in inhibition or working memory and cognitive outcomes. This negative relation, while small or non-significant, has been reported but not discussed in a few studies, suggesting that this finding, while surprising, may in fact be real. It is difficult to postulate why this relation between behavioral shifting and cognitive school readiness may exist. It is possible that children who have trouble transitioning from one activity to another are given more attention and support by a teacher, leading to more one-on-one time with the teacher. There may be a mechanism from shifting to cognitive school readiness through greater teacher involvement, based on a teacher's perceptions of shifting behaviors. This in turn may lead to better cognitive school readiness as children get more direct attention and instruction from the teacher.

Direct Assessment Model

Social school readiness. As mentioned in a previous section, the EF latent factor comprised of the direct assessments of EF can be interpreted as the common EF ability shared by all of the direct assessment tasks, or a child's domain-general executive

functioning ability. There was no direct effect between EF and social school readiness. This is consistent with the current view that a unitary EF construct "...is generally regarded as nonsocial and domain general" (Hughes & Ensor, 2007, pp. 1447). Perhaps a more general EF cognitive ability is closely tied to a child's general cognitive abilities but has less of an effect on a child's interactions with peers. For example, a child's ability to shift attention between two rules may not affect his interactions with other children who are playing a game with one set of rules, but may influence the child's ability to follow the rules on a test. Additionally, there was no mediation of the relation through either ToM or problem behaviors. As expected from the previous model, displaying fewer problem behaviors was predictive of higher social school readiness, controlling for language ability, age, executive functioning ability, and ToM. This relation has been found previously, with earlier problem behaviors predicting more problem behaviors and less social competence later (e.g. McWayne & Cheung, 2009). EF was also not directly predictive of social school readiness.

Cognitive school readiness. In fact, a child's domain-general EF ability was directly predictive of cognitive school readiness, such that children with strong executive functioning ability also had higher cognitive school readiness. This finding suggests that the more general regulatory capabilities thought to underlie all EFs are closely and directly tied with cognitive abilities. Research has consistently showed that EF is predictive of later cognitive and academic outcomes (Blair & Razza, 2007; Bull & Scerif, 2001; Espy et al., 2004; McClelland et al., 2007). These studies have suggested that regulatory mechanisms may be important in explaining how a child learns within the

classroom; this finding suggests that a child's ability to generally regulate effectively in the classroom leads to better cognitive outcomes for that child.

Higher EF ability was also predictive of better ToM in the direct assessment model. This supports findings by Hughes and Ensor (2007) demonstrating that, for the most part, EF ability is predictive of later ToM. Interestingly, in this study of preschoolers, higher ToM predicted lower cognitive school readiness when controlling for language ability and domain-general EF ability, such that each one-point change in ToM led to a nearly five-point decrease in a cognitive school readiness composite. Although Astington and Pelletier (2005) suggest that ToM may positively influence academic outcomes, no study currently to my knowledge has examined a relation between ToM and cognitive school readiness.

Nonetheless, it was surprising that higher ToM did not predict higher cognitive school readiness. It has been argued that ToM is multi-dimensional and may have both a cognitive component and a social cognition component (Baron-Cohen, 1995; Bull, Phillips, & Conway, 2008; Hughes & Ensor, 2007). Some of the same neural substrates that influence all EFs jointly may also underwrite ToM (Bull, Phillips, & Conway, 2008). It may be that the same general cognitive mechanisms underlie some of the shared variance between cognitive EF and ToM and can explain some of the cognitive demand of both tasks (Bull, Phillips, & Conway, 2008). Sabbagh and colleagues (2006b) propose a hybrid model, in which domain-general EF skills may allow for certain domain-specific ToM experiences. Children's EF abilities may expose them to certain experiences with ToM but not others in the cognitive domain. Perhaps when controlling for general cognitive regulation and language ability, ToM is negatively predictive of cognitive

school readiness because of the social component underlying it. In fact, one of the tasks used, the Sally-Anne task, has a large social component; children see an interaction between others and need to place themselves in someone else's shoes to understand the interaction. This ToM task is designed not only to tap into cognitive ability but also a child's understanding of others; this social component may be what is negatively predicting cognitive school readiness.

Although this seems surprising, it is possible that children who are more aware of their social environment and what others around them are thinking are distracted from the academic domain in preschool. Children's awareness and concern for the social environment may impede their processing of what is taught in the classroom because they are distracted by a new or novel environment (Henderson & Fox, 1998; Rothbart & Jones, 1998). Children may be more focused on the social context of competing with other children or pleasing the teacher than on substantive cognitive material (Rothbart & Jones, 1998). School readiness, in fact, has multiple domains because it is clear that a child can be strong in one domain but not in another. In preschool, when social interaction is increasingly important, it is possible that greater social cognition is predictive of lower school readiness.

In the case of this multi-dimensional ToM construct, it is understandable that there is no mediating effect of ToM on the relation between EF and cognitive school readiness. Perhaps the direct relation between EF and cognitive school readiness and the relation between EF and ToM is reliant on a cognitive regulation mechanism, while the relation between ToM and cognitive school readiness, controlling for EF, taps into a more social cognitive mechanism. In order to further parse apart and test this mediation,

it might be important to use a more complex measure of ToM that separates out the cognitive and social component. Sabbagh and colleagues (2006) attempted to examine a piece of this question by giving children a false belief task, which measures mental representations, and a false photograph task, which measures a physical reality in a picture. These tasks have different cognitive demands and can be trained separately; in fact, children with autism are impaired in false belief but not false photograph tasks (in Sabbagh et al., 2006). Findings showed that EF predicted children's ability on the false belief task but not the false photograph task, suggesting that EF is connected to one aspect of ToM but not all. Sabbagh and colleagues (2006) suggested that the false belief task, similar to the Sally-Anne task, based on abstract representations, may have more of a general EF demand than the more concrete false photograph task, which may be comparable to my egg carton task; this suggests that the two tasks may be providing part of the multidimensionality of ToM seen in this study. The current study, similar to most studies of EF and ToM, only examined one snapshot of ToM ability in children, determining whether they had no, a little, or complete ToM. Research has broken down ToM into more and less complex variations, ranging from false belief tasks to understanding and explanation of others' intentions, others' desires, and others' perspectives (Baron-Cohen, 1995; Wellman, Cross, & Watson, 2001). In order to better understand the multifaceted influence of ToM as a mediator, it may be important to expand these findings to a more complex operationalization of ToM.

In addition, this multidimensional ToM was not predictive of cognitive school readiness in the teacher model, unlike in the direct assessment model. It is possible that, based on the method of report, direct assessments tapped into a more cognitive measure

of EF, while teachers captured a more behavioral measure of EF. Research has shown that although cognitive EF predicts ToM, behavioral and emotional EF do not (Jahromi & Stifter, 2008); this would explain why teacher reports of behavioral EF did not predict ToM. It also helps explain why ToM was not predictive of cognitive school readiness when controlling for teacher reports of behavioral EF but was predictive controlling for a direct assessment of EF. Perhaps a different dimension of ToM was predictive of cognitive school readiness while controlling for behavioral EF, compared to the dimension that was predictive when controlling for cognitive EF. Again, the multifaceted nature of ToM raises questions about what part of ToM is being predicted by shifting and inhibition and what part of ToM is predicting school readiness.

It is important to note that, when controlling for other cognitive components such as EF and ToM, problem behaviors showed a trend but did not significantly predict cognitive school readiness, suggesting that the relation between problem behaviors and cognitive school readiness may be more complex. Previous research has found that the path from problem behaviors in preschool to academic achievement in first grade is mediated by general social, cognitive, and motor competencies in preschool, as well as by approaches to learning (McWayne & Cheung, 2009). This suggests that the path from problem behaviors to later academic outcomes may itself be mediated by complex mechanisms.

Educational Implications

The finding of problem behaviors mediating the relation between inhibition and social school readiness suggests many ways in which interventions based on improving children's EFs can influence social school readiness. Recent research has capitalized on

the “game” structure of EF measures to positively influence children’s executive functioning. In a shift towards a more translational use of EF tasks, many curricula have begun to use games to help support children’s EF (e.g., *PATHS*: Greenberg, Kusche, Cook, & Quamma, 1995; *Tools of the Mind*: Bodrova & Leong, 2007). Specifically, Bodrova & Leong’s (2007) *Tools of the Mind* curriculum uses EF “games” as a tool towards effective change of cognitive and social skills within the classroom. *Tools of the Mind* theorizes that a child’s cognitive inhibition skills can aid in behavioral inhibition, which can be used to modulate behavior in the preschool classroom. In fact, the curriculum has been found to have effects on children’s social, but not cognitive, skills (Barnett et al., 2008). This area of “teaching” inhibition skills, while relatively new, seems both effective at teaching EF skills (Diamond, Barnett, Thomas, & Munro, 2007) and promising. Blair and Diamond (2008) suggest that *Tools of the Mind* affects social outcomes and classroom climate through its focus on EFs and self-regulation. The current finding suggests a pathway, perhaps strengthening children’s executive functioning leads to few problem behaviors, which in turn leads to better social outcomes and classroom climate.

Research on the *Tools of the Mind* curriculum has not found an effect of training executive functioning on cognitive school readiness. Findings from both models in the current study, however, show an effect of EF on cognitive school readiness. Parsing apart EF, the teacher report model and other studies suggest that there is some component of behavioral shifting and flexibility that may be important to a child’s cognitive outcomes, if in a surprising direction. The current finding suggests that perhaps teachers are unclear about the importance or developmental significance of poor shifting and are

treating it differently from other problems in the classroom. This may account for the surprising direction of the finding; if teachers view problems with shifting as behaviorally appropriate or not problematic, maybe they are reacting to them as if they are a behavior to be scaffolded from instead of a behavior to target for intervention. Rothbart and Jones (1998) suggest that an apprenticeship model for training, in which teachers demonstrate appropriate EF to children, may help children learn EF while lowering the general cognitive demand often seen in other EF training programs. This may help children by modeling more appropriate shifting behaviors, in essence focusing on the behaviors teachers would like to change without rewarding them. This would also allow teachers to model appropriate strategies to approach learning within the social environment of a teacher-child interaction, teaching children how to interact with the environment without being distracted by it. An intervention targeting a child's ability to shift and teacher's understanding of it may have an influence on children's cognitive outcomes.

Limitations and Future Directions

There were certain limitations to the current study. First, although longitudinal, the study only spanned the spring semester of a school year. The longitudinal nature of the study allowed for strong mediational inferences to be made; however, future studies should examine these relations over a longer period of time. Perhaps some of the constructs would have even stronger effects on each other over a longer period of time. It is possible that, through canalization, stronger EF skills have a strengthening effect on children's outcomes through these paths and mediators. One strength of the current study is the use of multiple methods to assess EF. However, mediators and outcomes were only collected through one method- cognitive school readiness and ToM were directly

assessed, while problem behaviors and social school readiness were reported by teachers. However, future studies should attempt to assess all variables through both methods to better parse apart relations due to method of assessment.

This study also found some interesting and surprising findings in regards to the multidimensionality of ToM. As previously mentioned, further work should examine the exact relation between various aspects of ToM, EF and cognitive school readiness. Future studies should utilize a larger and more complex battery of ToM tasks to test which facets of ToM relate to EF and which aspects, controlling for concurrent EF, relate to cognitive school readiness. Finally, the current sample was a sample of convenience selected from community preschools that were willing to participate in the study, and therefore findings are not generalizable to other groups. Future studies should attempt to replicate these findings in a representative sample of preschool children.

Conclusions

EFs are complex and unique predictors of many child outcomes in preschool. In this study, EF was found to be predictive of ToM, problem behaviors, and cognitive and social school readiness. Specifically, EF was found to directly predict cognitive school readiness and to indirectly influence social school readiness through problem behaviors. Perhaps by intervening early in a child's ability to inhibit inappropriate reactions, teachers can prevent a child from having problem behaviors, leading to better social school readiness. Also, intervening to teach teachers and students about the importance of behavioral and cognitive shifting and what it looks like may help children's cognitive school readiness. Future interventions may wish to target EF if they want to influence school readiness outcomes to prepare children for kindergarten.

Interventions can capitalize on the game structure of learning EFs to teach children better in-class regulation and boost school readiness.

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TABLES

Table 1

Data Collection Timeline

Time	Measure	Type
Time 1 (February – March)	Executive Function Battery	Direct
	Executive Function (BRIEF-P)	Teacher
Time 2 (April)	Theory of Mind	Direct
	Problem Behavior (SSRS-P)	Teacher
Time 3 (May – June)	Social School Readiness (SSRS-P)	Teacher
	Cognitive School Readiness (Bracken)	Direct
	Language (WLPB-R)	Direct

Table 2

Descriptive Statistics for Continuous Variables

		<i>N</i>	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
EF Direct						
	Knock- Tap	151	73.77	21.46	-0.07	-1.65
	Day- Night	140	60.77	33.77	-0.43	-1.01
	Simon Says	126	59.26	17.55	0.48	-0.17
	Statue	152	13.92	8.63	0.27	-1.08
EF Teacher						
	Inhibit T-score	157	50.32	12.14	1.86	3.40
	Shift T-score	157	47.10	7.99	1.51	1.64
Mediators						
	Problem Behavior SS	155	96.99	13.04	1.20	0.99
	Theory of Mind Total	147	0.42	0.60	1.10	0.20
School Readiness						
	Cognitive Standard Score	148	96.52	16.49	-0.35	0.27
	Social Standard Score	157	104.82	14.73	-0.01	-1.00
Covariate						
	WLPB-R Language	151	457.83	15.74	-0.29	-0.45

Table 3

Correlations between Continuous Predictors, Covariates, and Outcomes

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Knock- Tap	1										
2. Day- Night	0.17*	1									
3. Simon Says	0.40**	0.32**	1								
4. Statue	-0.38**	-0.23**	-0.36**	1							
5. Inhibit - Teacher	-0.12	0.02	-0.09	0.14	1						
6. Shift - Teacher	-0.01	-0.02	-0.01	-0.02	0.54**	1					
7. Problem Behavior	0.01	0.02	-0.05	0.11	0.74**	0.53**	1				
8. Theory of Mind	0.25**	0.07	0.26**	-0.28**	-0.11	-0.05	-0.13	1			
9. Cognitive SR	0.37**	0.19*	0.44**	-0.35**	-0.16*	0.01	-0.20*	0.11	1		
10. Social SR	0.33**	0.00	0.26**	-0.27**	-0.36**	-0.27**	-0.41**	0.12	0.38**	1	
11. Language Ability	0.52**	0.24**	0.37**	-0.43**	-0.13	-0.08	-0.15	0.26**	0.59**	0.45**	1
12. Age	0.41**	0.22**	0.39**	-0.41**	0.00	0.01	0.07	0.11	0.09	0.31**	0.42**

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

Table 4

Paths for Combined Latent Structural Equation Model

Outcome	Predictor	<i>B</i>	<i>SE</i>	<i>p</i>
Cognitive School Readiness				
	EF Latent	0.66	0.14	0.00
	Problem Behavior	-0.16	0.09	0.07
	Theory of Mind	-4.63	1.93	0.02
	Language Ability	0.47	0.09	0.00
	Age	-0.73	0.18	0.00
Social School Readiness				
	EF Latent	0.09	0.11	0.42
	Problem Behavior	-0.44	0.08	0.00
	Theory of Mind	-1.28	1.64	0.44
	Language Ability	0.26	0.11	0.01
	Age	0.39	0.21	0.06
Theory of Mind				
	EF Latent	0.01	0.006	0.04
	Language Ability	0.01	0.00	0.28
	Age	-0.01	0.01	0.59
Problem Behavior				
	EF Latent	0.00	0.14	0.98
	Language Ability	-0.20	0.08	0.01
	Age	0.28	0.20	0.16

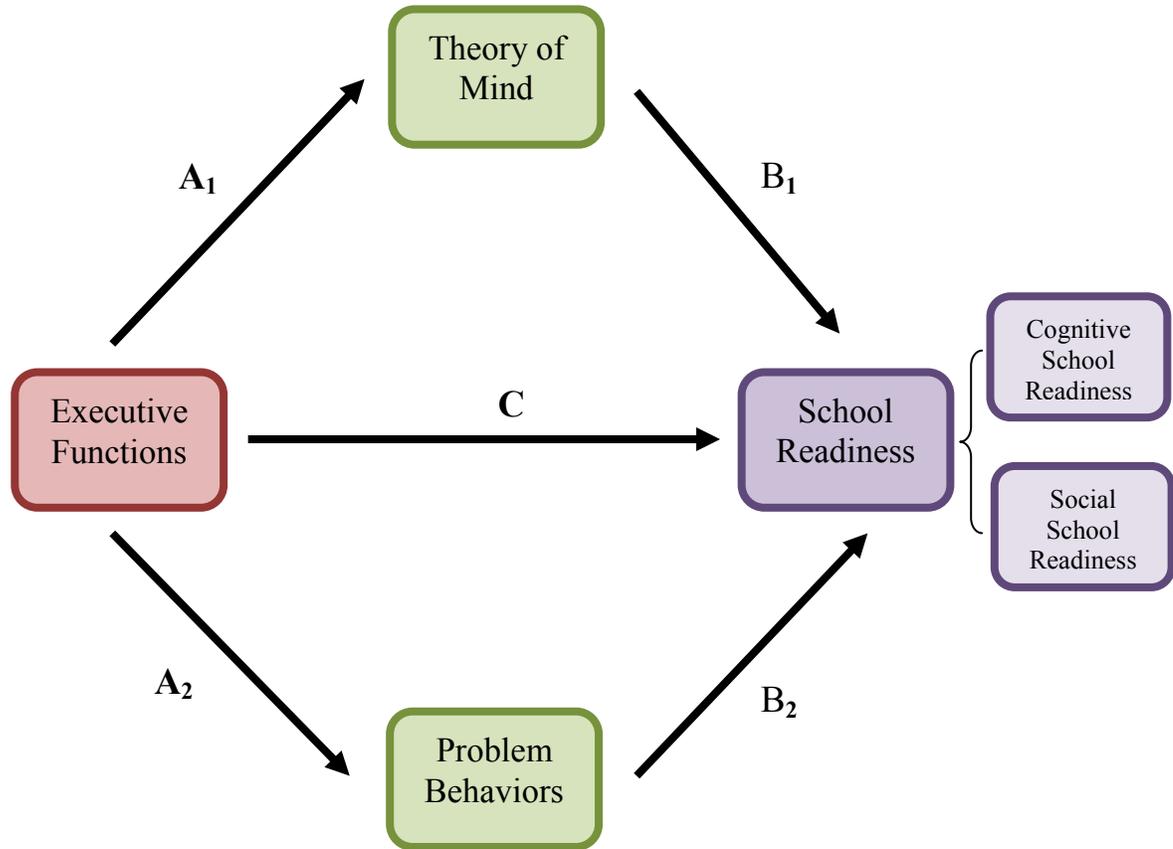
Table 5

Paths for Teacher-Reported EF Structural Equation Model

Outcome	Predictor	<i>B</i>	<i>SE</i>	<i>p</i>
Cognitive School Readiness				
	Inhibition	-0.11	0.09	0.22
	Set- Shifting	0.35	0.15	0.02
	Problem Behavior	-0.17	0.13	0.18
	Theory of Mind	-1.43	2.17	0.51
	Language Ability	0.69	0.09	0.00
	Age	-0.40	0.14	0.00
Social School Readiness				
	Inhibition	-0.11	0.14	0.41
	Set- Shifting	-0.08	0.14	0.57
	Problem Behavior	-0.32	0.16	0.04
	Theory of Mind	-0.65	1.68	0.70
	Language Ability	0.28	0.09	0.00
	Age	0.45	0.23	0.05
Theory of Mind				
	Inhibition	-0.004	0.004	0.36
	Set- Shifting	0.001	0.007	0.90
	Language Ability	0.009	0.003	0.01
	Age	0.001	0.008	0.87
Problem Behavior				
	Inhibition	0.67	0.06	0.00
	Set- Shifting	0.30	0.18	0.09
	Language Ability	-0.09	0.05	0.06
	Age	0.21	0.16	0.18

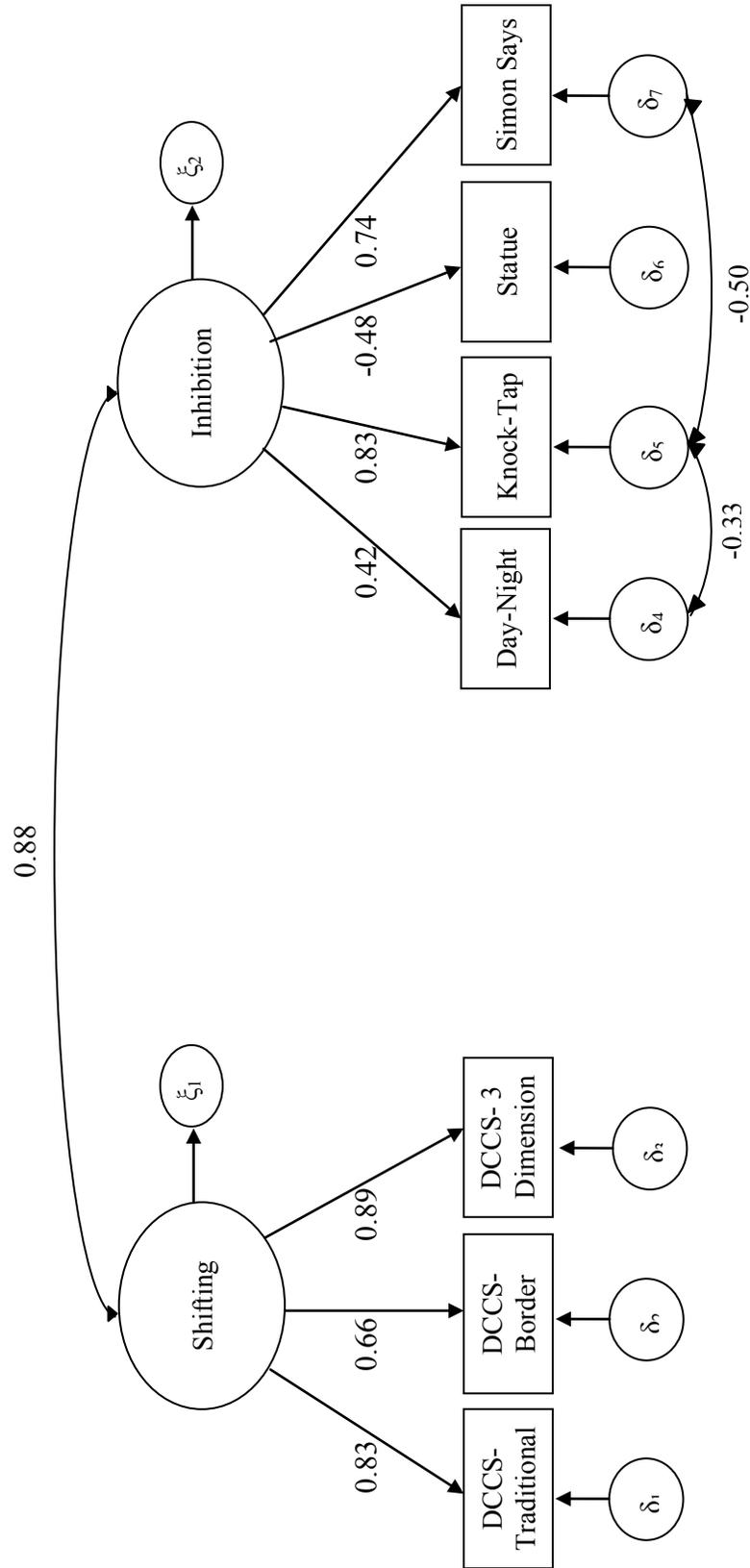
FIGURES

Figure 1. Conceptual mediation model.



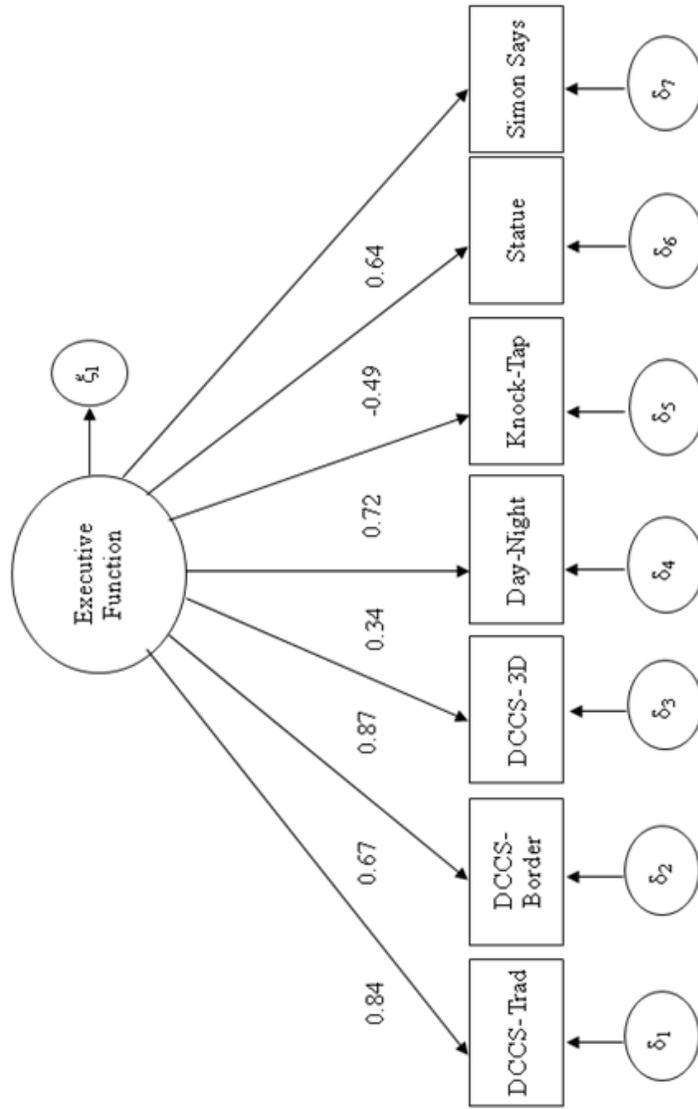
Note. The model shows the theorized relations between all of the variables. All paths were tested concurrently in structural equation modeling (SEM).

Figure 2. EF latent variables of shifting and inhibition.



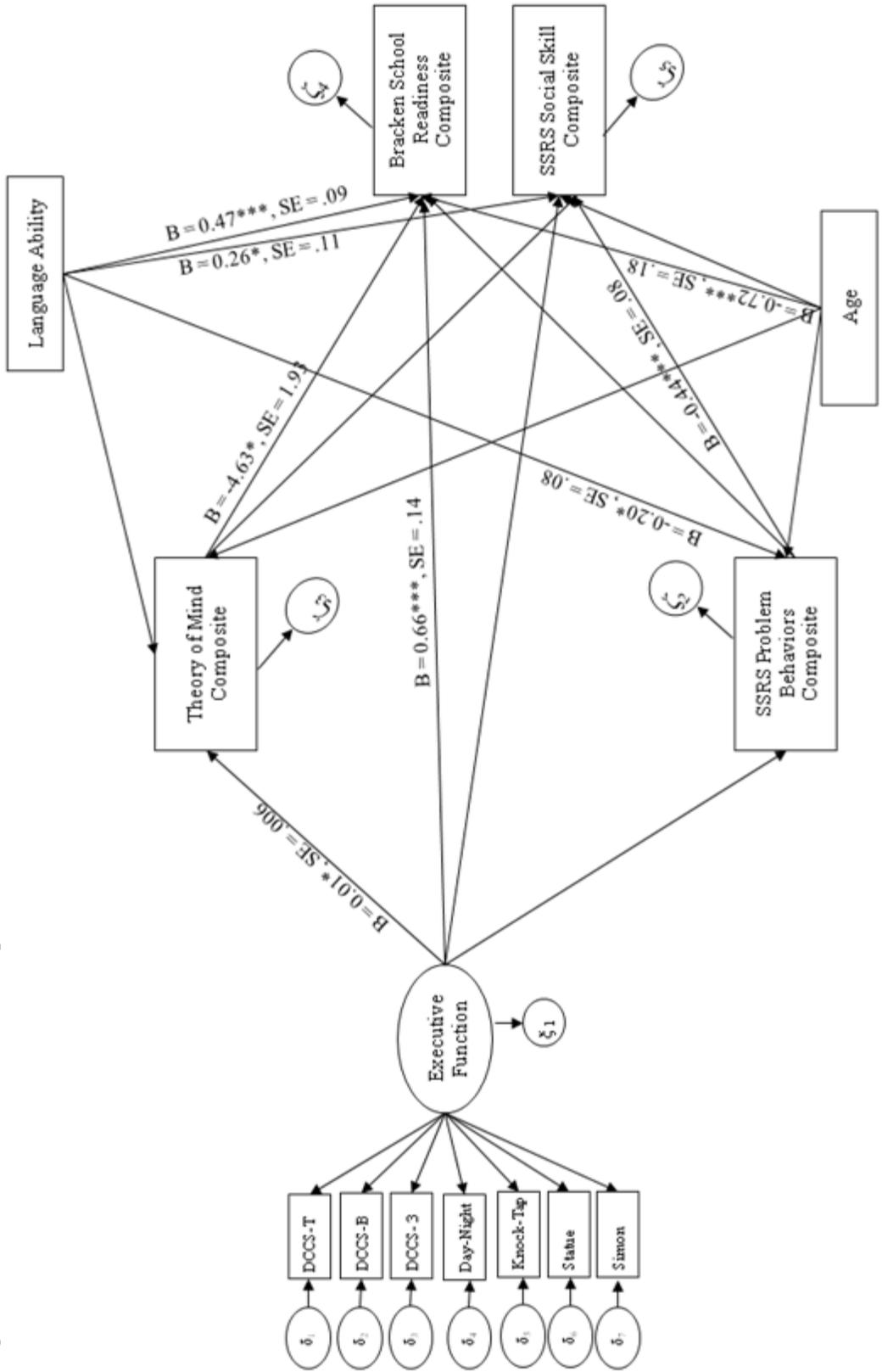
Note. Traditional tests of model fit were not available because categorical variables were used in the measurement model.

Figure 3. Combined EF latent variable.



Note. Traditional tests of model fit were not available because categorical variables were used in the measurement model.

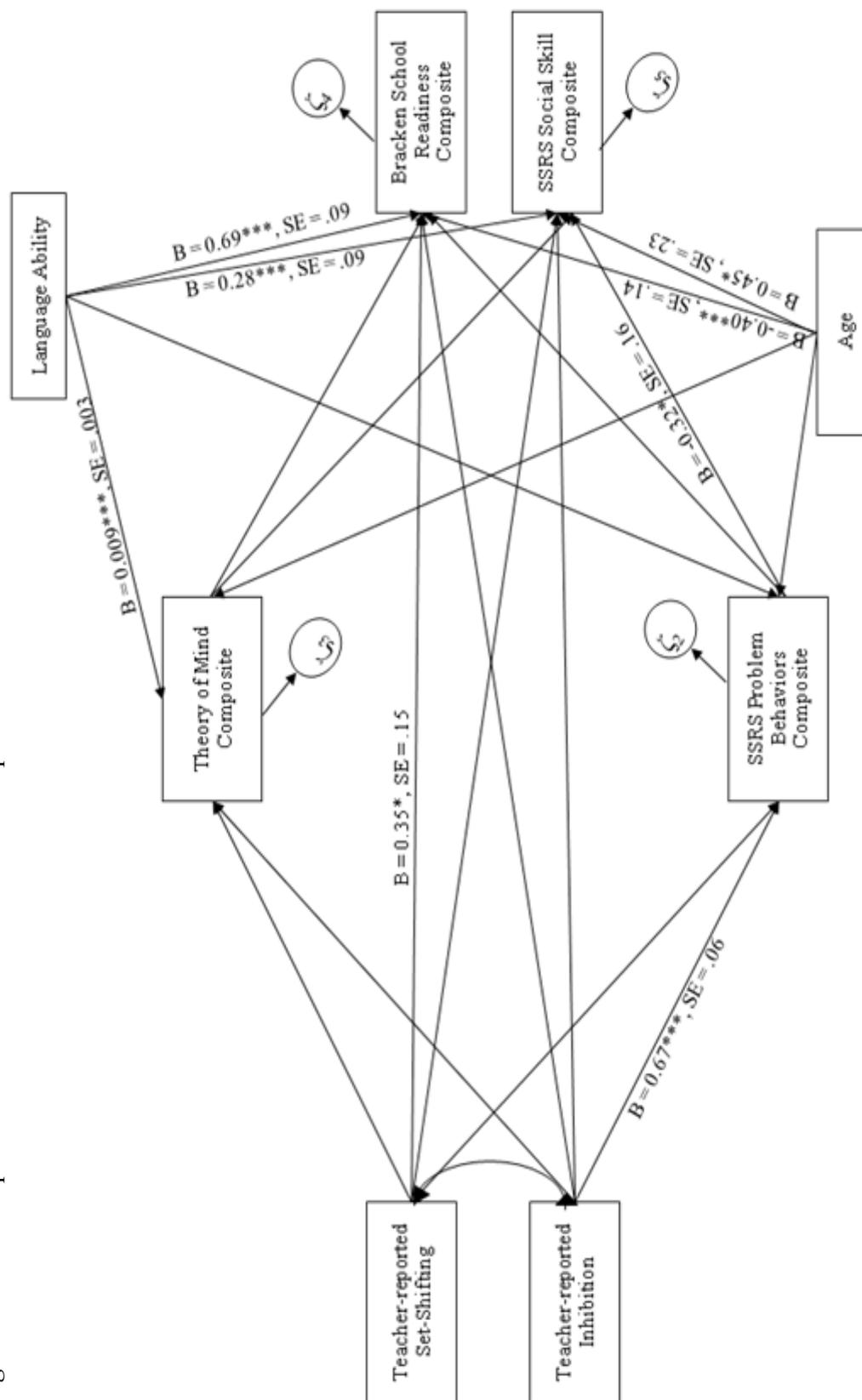
Figure 4. Combined latent structural equation model.



Note. Only significant paths are shown. Path coefficients are unstandardized.

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

Figure 5. Teacher report of executive function structural equation model.



Note. Only significant paths are shown. Path coefficients are unstandardized.

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