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THE INFLUENCE OF EXECUTIVE FUNCTIONS AND EMOTION REGULATION ON
TEACHER-RATED SOCIAL BEHAVIORS IN MIDDLE CHILDHOOD

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science
at Virginia Commonwealth University

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Abstract

THE INFLUENCE OF EXECUTIVE FUNCTIONS AND EMOTION REGULATION ON TEACHER-RATED SOCIAL BEHAVIORS IN MIDDLE CHILDHOOD

Tennisha Natasha Riley, M.A.

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science
at Virginia Commonwealth University

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2015

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Early social interactions are important to developing and maintaining positive social relationships in childhood. It is well understood that the social development is dependent on a number of developmental changes in both cognition and emotion. While most research has focused on cognitive and emotional models of social behaviors separately, a consideration for research investigating social behaviors is to examine cognitive processing and emotional processing concurrently. The current work focuses on the relationship between the executive processes involved in cognition and emotion regulation, and the influence on adaptive (social skills) and maladaptive (aggressive behavior) social behaviors. Specifically, the reformulated social behavioral model developed by Lemerise & Arsenio (2000) , as well as integrative model

of social-cognitive-affective behavior (Beauchamp & Anderson, 2010) will guide this work and help specify the relationship between specific executive functions (working memory, inhibition, and cognitive flexibility), emotion regulation, and children's social behaviors in middle childhood.

The Influence of Executive Functions and Emotion Regulation on Teacher-Rated Social Behaviors in Middle Childhood

Early social interactions are important to developing and maintaining positive social relationships in childhood, and have implications for social outcomes in adulthood. The display of positive social behaviors is often linked to greater perspective taking, empathetic understanding and higher peer ratings (Beauchamp & Anderson, 2010). Social behaviors stabilize over time (Coie & Dodge, 1983), such that children who display more positive social behaviors also have a greater likelihood of positive relationships as adults across multiple contexts, including close friendships and positive intimate partner relationships (Larson, Whitton, Allen, & Hauser, 2012). Longitudinal studies that have focused on increasing positive social skills in childhood have found that early intervention is effective in preventing mental health problems and criminal behavior in adulthood, and place children on positive life trajectories (Hawkins, Kosterman, Catalano, Hill, & Abbott, 2005).

In contrast, early maladaptive social behaviors, such as aggression, have negative influences on social relationships in childhood and throughout later development (Kokko, Tremblay, Lacourse, Nagin, & Vitaro, 2006). In general, prolonged overt aggression has been linked to adult mental health problems and criminal behavior. The various forms of overt aggression (physical and verbal aggression) tend to lead to negative social pathways. For example, physical aggression often leads to social adjustment problems, mental health co-morbidity, and academic failure in middle childhood (Ostrov et al., 2009), and continues into intimate partner violence, criminal behavior, and further social adjustment problems in adulthood (O'Donnell et al., 2006; Raine et al., 2006). Verbal aggression displayed in early peer settings is

just as problematic as it has been linked to more internalizing problems, such as anxiety and depression (Bergsmann, Van De Schoot, Schober, Finsterwald, & Spiel, 2013).

Social development is dependent on a number of developmental changes in both cognition and emotion. For example, changes in cognitive perspectives, such as theory of mind, allow for advanced skills in social understanding, perspective taking and empathy (Fahie & Symons, 2003), all of which are important to maintaining positive social interactions. In addition, research in neurobiological processes has found that particular regions of the frontal lobe (i.e. orbitofrontal cortex, ventromedial prefrontal cortex) are responsible for higher order cognitive processing and reasoning ability, and that development in these structures influence social interactions (Beauchamp & Anderson, 2010). For example, developmental changes in the prefrontal cortex have been shown to facilitate better decision-making in the social context (Steinberg, 2005).

Shifts in emotional knowledge, understanding, and expressiveness have also been associated with the development of social behaviors. Camras & Shuster (2013) found that emotional development has an influence on social behaviors across childhood and is preceded by the understanding of emotions, emotion knowledge and expressiveness. In a study examining the development of emotion and social behaviors, reserachers found that emotional knowledge in early childhood predicted later pro-social behaviors and maladaptive behaviors into middle childhood (Camras & Shuster, 2013). Similar to the development of brain regions implicated in cognitive processing, the developmental shifts in the brain regions responsible for emotional processing also influence behaviors in the social context. Both the amygdala and the orbitofrontal cortex are associated with emotional processing, and thus social interactions (Gross, 2002; LoPresti et al., 2008). Research notes that the developing amygdala forms a relationship

with various frontal lobe structures over time, to enhance emotional understanding and expressiveness in social interactions (LoPresti et al., 2008).

Several theoretical models have emerged from research regarding the development of social behaviors. Social-cognitive behavioral models, such as Social Information Processing (SIP), as well as social-cognitive neuroscience models provide a framework for examining how cognitive processing is implicated in the development of social behaviors. These theoretical frameworks have primarily focused on cognitive deficits and the development of maladaptive behaviors in social environments. For example previous literature has identified that children who display more maladaptive social behaviors tend to have faulty cognition when assessing their level of aggressive involvement in conflict (Milburn, Niwa, & Patterson, 2014; Orobio de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002). Specifically, children with deficits related to cognitive processing often believe their level of aggression to be “necessary” within social interactions. Children who use maladaptive social behaviors also tend to display attribution biases (attributing hostility within social interactions to their peers having malice intent), which frequently results in their display aggressive behaviors (Lochman & Dodge, 1998).

Neuroscience models of social behaviors have primarily focused on injury and brain disorder research, which links damage to particular brain regions to social deficits. Both Yeates et al. (2007) and Beauchamp & Anderson (2010) have utilized research in brain injury (i.e. Traumatic brain injury; TBI) and deficits in social brain networks (i.e. autism and schizophrenia diagnosis) to formulate integrative social neuroscience models. These integrative models utilize social cognitive neuroscience to better explain social behaviors. For example, children with traumatic brain injury (TBI) tend to have deficits in social problem-solving skills (Yeates et al.,

2007). In addition research has found that the mirror neuron system, which provides information about the goals and intentions of others, is likely involved in social-cognitive processes such as theory of mind and helps explain social deficits in children diagnosed with autism (Beauchamp & Anderson, 2010).

More recent work in psychophysiology and neurobiology has found associations between emotion and social competence as well (Beauchamp & Anderson, 2010; Yeates et al., 2007; Yeates & Selman, 1989). For example, Granic, Meusel, Lamm, Woltering, & Lewis, (2012) found higher levels of dorsomedial activation (part of the brain involved in emotion regulation processes) during a challenging social interaction task among a sample of eight to twelve year olds. Research utilizing the polyvagal theory emphasizes the role of the autonomic nervous system as the underlying process of emotion regulation and social behaviors (Graziano & Derefinko, 2013; Porges, 2003). Research has indicated that vagal withdrawal, indicative of good emotion regulation, is associated with social functioning (Graziano & Derefinko, 2013). For example, Scarpa, Haden, & Tanaka (2010) have identified specific aggression and emotion regulation (heart-rate-variability: HRV) profiles.

While most research has focused on cognitive and emotional models of social behaviors separately, a consideration for research examining social behaviors is to assess cognitive processing and emotional processing concurrently. Both cognitive and emotion regulation processes are implicated in the processing of social information, and contribute to adaptive and maladaptive social behaviors, as well as long term behavioral trajectories. Lemerise & Arsenio (2000) provide a framework that enables researchers to examine both the cognitive and emotional components of social behavior. Their model expands Dodge's original SIP model (Dodge & Coie, 1987) to include basic emotions, as well as the process of emotion regulation—

an adaptive and dynamic process. In their revision, the ability to recognize and appropriately label emotions affects social interactions, in that one must be able to acknowledge and understand others' emotions in order to respond effectively to social stimuli (Izard et al., 2001; Lemerise & Arsenio, 2000). In addition, research indicates that emotional competence in early childhood has implications for long-term social competence such that children with higher levels of emotion expressiveness, emotion regulation, and emotional knowledge showed higher levels of social competence in later years (Denham et al., 2003).

The conglomerate relationship between cognition and emotion is also present in integrative models of physiology and neurobiology (Beauchamp & Anderson, 2010; Yeates et al., 2007), suggesting the brain structures responsible for both reasoning and emotion are dependent on one another to make social decisions. However, to date, few studies have examined the relationship between the cognitive and emotional components of social behavior. Furthermore, of the few existing studies that consider both cognition and emotion most have focused on static (as opposed to process – emotion regulation) components, such as language/verbal ability, emotion knowledge and emotion recognition (Izard et al., 2001; Mostow, Izard, Fine, & Trentacosta, 2002). While the acquisition of such skills as language and emotional knowledge is important to social understanding and building relationships (Cook, Greenberg, & Kusche, 1994), it is likely that the dynamic relationship between cognition and emotion regulation have a more fundamental influence on social behavior.

The current work focuses on the relationship between the executive processes involved in cognition and emotion regulation, and examines their influence on adaptive (social skills) and maladaptive (aggressive behavior) social behaviors in middle childhood. The existing literature examining cognitive and emotional processes related to aggressive behavior has been somewhat

inconsistent. Much of the literature has identified that deficits in cognitive functioning and emotion regulation are linked to aggressive behavior and in particular, reactive forms of aggression (Raine et al., 2006). However, more goal-directed aggression (both physical and relational) has shown strong positive associations with cognitive skills such as sustained attention, and has also been linked to higher emotion regulation ability (Hubbard, McAuliffe, Morrow, & Romano, 2010; Muñoz, Frick, Kimonis, & Aucoin, 2008). As such, the current study examines whether the addition of emotion regulation to models that link cognition and social behavior may help reconcile these inconsistencies. The reformulated social behavioral model developed by Lemerise & Arsenio (2000) which incorporates emotion in social information processing, as well as the integrative model of social-cognitive-affective behavior (Beauchamp & Anderson, 2010) guide the current work and help specify the relationships among specific executive functions, emotion regulation and children's social behaviors in middle childhood.

Literature Review

Social Behaviors: Multiple Definitions, Components and Outcomes

Broadly defined, social competence refers to one's effectiveness in social interactions, as well as one's effective analysis and utilization of one's resources to meet developmental needs (Rose-Krasnor, 1997). An individual can therefore be considered socially competent if their behavior in social contexts predicts important social outcomes, such as acceptance by peers and positive regard by important others (e.g. parents and teachers) (Gresham, 1985). A consistent question in the literature is whether social competence is a stable skillset that an individual does or does not possess (i.e. a trait) defined by Yeates & Selman (1989) as "the development of social-cognitive skills and knowledge" or whether it is better understood as a more fluid process

that is dependent on context, as exemplified in Wolf & McNamara's (2013) definition of social competence as “the ability for individuals to adjust their social behaviors flexibly.”

Social competence has been operationalized in the literature as: (1) popularity, acceptance or regard among peers (as measured by sociometric status); (2) relational (assessed in terms of the quality of relationships, often using parent ratings); (3) functional (assessed as a process taking into account social goals and tasks, frequently measured in terms of context-specific outcomes that result from exhibiting particular social behaviors); and (4) social skills (measured in terms of overt behaviors, such as politeness or helpfulness). Each of these constructs can be examined as a measure of social competence, as a dimension of social competence, or as an outcome of social competence.

While researchers have primarily focused on a single measurement approach, social competence may be conceptualized as being comprised of each of these interdependent constructs (Rose-Krasnor, 1997). Identifying social competence as a multidimensional construct seems to be most appropriate for several reasons. First, it implies that to be competent individuals need to possess skills that are adaptive and context-specific. It also implies that there exists a regulatory process that provides a child with information regarding what the appropriate behavioral response is under particular social conditions (Crick & Dodge, 1994; Dodge, Pettit, & McClaskey, 1986). Lastly, it acknowledges the fact that social interactions are transactional. That is, the effectiveness of a social behavior is contingent on the individual's goal and the response from others involved. As such, the individual learns from and develops new behaviors as a consequence of such transactions (Sameroff, 2009). Gresham (1985) recommends a social validity approach and defines social competence as a set of social skills or “behaviors” that, within a given situation, predict important social outcomes... including peer acceptance,

significant others' judgments and other social behaviors known to consistently correlate with sociometric status and others' judgments (p.7).” The emphasis on behaviors in this definition is essential, as it provides a more objective measure of what an individual does within a changing social context. The focus of the current study is the examination of behaviors (social skills and aggression) in the social context present in schools.

Social skills. Social skills are discrete, goal-directed behaviors that allow for effective interaction within one's social environment (Warnes & Sheridan, 2005). Social skills are typically measured through peer nominations, informant ratings, or direct observations. Peer nomination or sociometric status depends on peer regard and peer acceptance. Rose-Krasnor (1997) notes that the bi-directional influence of peer acceptance and social skills may cloud the ability to correlate sociometric status with specific social behaviors. That is, positive social skills may result in higher rated peer acceptance and/or higher rated peer acceptance may result in an increase in a child's use of positive social skill behaviors. Additionally, when assessing social competence it has been difficult for researchers to distinguish between social skills that are necessary for likability, and skills that are necessary for building and sustaining relationships (Rose-Krasnor, 1997). It is important to note that popularity or likeability is not always the most desirable outcome, considering that youth who display deviant behavior are often popular within deviant peer groups. This is illustrated by a study by van de Schoot, van der Velden, Boom, & Brugman, (2010) who used latent class analysis to examine subgroups of peers identified through peer status in a large sample of pre-adolescent youth. Their results indicated that even youth who reported high levels of anti-social behavior were present among popular status groups identified by peers.

Specific social skills that have been identified through informant ratings include, friendliness, smiling, cooperating, respecting peer norms and communicating clearly (Coie et al., 1982). In a multi-informant (teacher, parent and student) qualitative study, Warnes & Sheridan (2005) identified an additional set of social skills endorsed by all informant groups as important indices of social competence, including compromising, being empathetic, being respectful of others and their property, helping others with their personal work, not verbally hurting others, having a positive and happy disposition, being loyal and reliable to friends, and being outgoing and friendly. Fifth grade student informants in this study also identified being trustworthy, giving praise and compliments to others, and being funny as important social skills.

Social competence requires not only the development of a skill set (social skills) but also the appropriate utilization of these skills (performance) in social settings. Deficits or excesses in behavior can indicate poor social skills (Gresham, 1985). Deficits can be examined in terms of skill deficit, which indicates a lack of knowledge or practice, or a performance deficit, which indicates a deficiency in the quantity or quality of exhibiting social behavior. Some researchers have suggested that social competence can be considered on a continuum with social skills at one end and aggressive behavior at the other. Others suggest that social skills and aggressive behaviors represent different ways of functioning within social contexts or different strategies for navigating social contexts that are not mutually exclusive (Pulkkinen, 1984). As such, it is possible for individuals to exhibit both social skills and aggressive behavior (Kokko et al., 2006). Social skills and aggression have both shown to significantly influence peer ratings of social competence (Coie, Dodge, & Coppotelli, 1982) as well as peer acceptance. For example, peer-identified prosocial behavior (cooperation) and aggression both predict membership in rejected, neglected, popular and controversial peer groupings (Coie & Dodge, 1983). In the current study,

social skills and aggression are therefore considered, albeit separately, as social outcomes. The subsection following discusses aggression as a maladaptive social behavior.

Aggressive behavior. Aggression is generally defined as behavior that is intended to harm or hurt others in some manner (Helmsen, Koglin, & Petermann, 2012). However, defining aggression is complex, because it encompasses a multitude of characteristics that explain the various forms it can take (overt versus relational) and functions (proactive versus reactive) it can serve in social interactions. Overt aggression entails behaviors that are intended to physically hurt or harm another (hitting, biting, kicking, pushing and forcibly taking things) while relational aggression includes behavior designed to enhance one's own social status by diminishing another's status (social exclusion, friendship withdrawal threats, ignoring, spreading rumors; Grotper & Crick, 1996). The focus in the current study is on the overt form of aggression, which can be identified as both physical and verbal. Physical aggression includes behaviors such as hitting, kicking, or pushing (Bergsmann et al., 2013) and has been closely linked with lower levels of academic competence and popularity (Xie, Cairns, & Cairns, 2002). Verbal aggression is typically expressed as name-calling or taunting (Bergsmann et al., 2013), and involves the attacking of another's self-concept (Roberto, Meyer, Boster, & Roberto, 2003). The primary effects of verbal aggression includes others' hurt feelings, embarrassment, frustration and deterioration of relationships and is often linked to social exclusion (Roberto et al., 2003). Furthermore, those who display more overt forms of aggression are less likely to be characterized as 'friendly' or 'smiles often' when rated by peers (Xie et al., 2002).

In terms of function, proactive aggression is goal-directed behavior that is deliberate and initiated without provocation, whereas reactive aggression is defined as behavior that is retaliatory in response to frustration or provocation (Dodge & Coie, 1987; Raine et al., 2006)

whether real or perceived (Lochman & Dodge, 1998; Lochman & Wells, 2002). Proactive aggression in the social context can be complex, since it hinges on how one defines the success of their behaviors (Rose-Krasnor, 1997). For example, to a child that is physically aggressive toward a peer in order to achieve their goal of obtaining a game or toy, getting the object indicates the behavior was successful, even though a maladaptive social behavior – aggression – was utilized. Studies also show that children who display proactive aggression (goal-oriented with the intent to harm) appear to chose more instrumental goals and view verbal and physical aggression more positively in the social setting (Crick & Dodge, 1996). These results suggest that external rewards for behavior prompt children to view their aggression as effective in social contexts, despite its maladaptive nature (Coie & Dodge, 1983).

Social Behavior in the School Context

When children enter school, peers become increasingly important in the development of social behaviors. The amount of time spent in school and outside of the home significantly increases and provides an environment in which interaction with age-level peers is inevitable. The school as an external environment to the home engages children in interaction with unknown children and adults, allowing for the adaptability of learned skills and behaviors (Lynch & Cicchetti, 1997). In addition, it provides an environment in which children are able to implement, practice, and adjust social behaviors (Warnes & Sheridan, 2005; Ziv, 2013). Furthermore, the school context provides another window—through teachers—into students’ social lives and interactions with peers (Achenbach, McConaughy, & Howell, 1987; Johnston & Pelham, 1986; Winsler & Wallace, 2002).

Assessing social behavior in school. Interactions in the school social context are easily accessible to teachers, who observe children’s social behaviors daily, and in multiple settings

(e.g. classroom, playground, and hallways during transition). Research has found that teachers and parents agree on child social behaviors at low to moderate levels (Achenbach et al., 1987), with higher agreement on observable problem behaviors such as aggression, than internalizing behaviors and social skills (Major & Seabra-Santos, 2015; Winsler & Wallace, 2002). However teachers tend to be more accurate in rating social behaviors. For example in a study assessing the convergence of teacher and parent ratings on social behaviors, Winsler & Wallace (2002) found generally low agreement between teachers and parents. When compared to observable behaviors in the classroom teachers' ratings of social behaviors were more accurate than parents' (Winsler & Wallace, 2002). Results from many studies confirm that ability of teachers to accurately assess student social behaviors. Social behavior scales such as the teacher version of the social skills rating scales (SSRS-T) have proven to be reliable measures of social behavior (Elliott, Gresham, Freeman, & McCloskey, 1988). For example, Johnston & Pelham (1986) found that teacher ratings of aggression using these scales predicted specific profiles of peer ratings of students in first, second, third grade.

Teachers and other informants tend have better agreement when rating problem behaviors than positive social skills. This is likely due to the extensive amount of literature on problem behaviors and social deficits, as well as the complex definition of what behaviors constitute positive social skills (Rubin & Rose-Krasnor, 1992). However, construct validity studies demonstrate that teacher-rated social skills are as accurate as teacher-rated problem behavior. In study comparing social skills rating scale and the revised problem behavior checklist, Elliott, Gresham, Freeman, & McCloskey (1988) found that not only were teachers able to distinguish between behaviors relative to the two scales, but observable behavior of social skills and teacher-ratings provided evidence of construct validity.

In sum, the results of previous studies indicate that the school environment is a unique environment in which social interactions are best measured by those who are more engaged and better able to observe in peer interactions—teachers. As such, in the current study, teacher ratings of social behavior in the classroom are utilized.

Developmental Course of Social Behavior in the School Context

The development of social behaviors does not begin in middle childhood. What is observed in middle childhood is often a continuation of a developmental process that begins in infancy, influences behaviors during that stage of development and also sets the stage for future trajectories. Further, social behaviors do not develop in a vacuum and are understood as a part of a socialization process that includes modeled behavior exhibited by those most proximal in a child's environment (Bandura, 1977), in this case peers in the school context. Friends provide children with social information, emotional support, instrumental aid, affection, self-validation, companionship and opportunities for learning conflict resolution (Ostrov et al., 2009; Rose-Krasnor, 1997; Stormshak, Bellanti, & Bierman, 1996).

The literature on the development of prosocial behaviors or social skills is scant, but the expectation is that these behaviors will improve with age, with children displaying more prosocial behaviors and less aggressive behaviors over time. There is some evidence that there is an increase in prosocial behavior in early childhood, but research primarily shows stability in middle childhood (Durkin, 2001). Other areas of research indicate a decline in prosocial behavior as children move from middle childhood to adolescence, but this is mostly dependent on contextual influences such as parenting on peer relationships (Mounts, 2002), as well as shifts in neurological and biological development (puberty) during this critical age (Steinberg, 2005).

Generally, use and efficiency of prosocial skills vary across age due to developmental shifts in cognition and emotion (Beauchamp & Anderson, 2010). During early stages of development (toddlerhood), incidents of hitting, kicking, and biting between peers are already present in children's social interactions (Flanders et al., 2009). However, as children develop and their social context changes, and the level of aggression towards peers is expected to taper off (Flanders et al., 2009). This transition is typically seen when children have an increase in peer relationships through the school context, where they are explicitly taught and expected to adhere to new social rules. The shift to more socially appropriate interactions has important implications for the development of socialization skills in the context of peers. While most children appropriate the necessary skills to understand social rules and decrease levels of aggression, others continue on a trajectory of aggression throughout the lifespan. Physical aggression and verbal aggression have unique developmental pathways, and their use of such behaviors change with age. For example, Xie et al. (2002) found developmental trends in relational aggression, noting that social forms of aggression were most prominent in 7th graders as compared to their younger 4th grade cohort. In this case it may be that older children find relational forms of aggression to be more effective in their desired goals while maintaining a level of social acceptance, as relational aggression requires the complex manipulation of various social networks (Crick & Grotpeter, 1995; Xie et al., 2002).

Gender differences in social behavior. After the age of five and continuing into middle childhood, children become aware of sex differences, develop gender-role identity, and start to exhibit a strong affiliation with same-gender peers (Crombie, 1988). In early childhood, peer groups tend to be small for both boys and girls (Crombie, 1988). However, approaching middle childhood, boys are consistently found to develop larger peer groups than girls (Crombie, 1988;

Feiring & Lewis, 1991). Girls develop friendships that are more exclusive and intimate (Eder & Hallinan, 1978). It seems likely that such gender differences will also play a role in the initiation, maintenance and continued development of social behaviors, and that different skills may be needed to join specific groups, maintain relationships, and acquire social status for boys and girls.

Despite the long-standing recognition that boys and girls form peer groups that differ in size and support, there have been few studies examining whether these differences impact the development of social behaviors. In a review of childhood social relationships, Crombie (1988) suggests that social skills necessary for entering peer groups may differ for boys and girls as a result of group size. Similarly, differences in the level of skill necessary to maintain a dyadic relationship versus large group involvement were evident (Crombie, 1988). Feiring & Lewis (1991) assessed characteristics of peer networks and socially competent behaviors (as rated by parents and teachers) in a small sample (N=75) of children in early and middle childhood. Their hypothesis was that socially competent behaviors and skills would vary depending on the structure of the peer group. Results of this study suggest that boys and girls both tend to have an increase in the number of same-sex peer contacts over time, and that number of interactions with cross-sex peers does not differ. Correlation analysis revealed that the small same-sex peer structure of girls was significantly associated with all measures of teacher-rated socially competent behaviors. In this and other studies, girls demonstrate higher of social skills related to emotional and intimate support, than do boys (Feiring & Lewis, 1991). Further, among girls relational aggression (use of malicious verbal behavior) is closely linked with social status (Grotperter & Crick, 1996). In contrast, boys in middle childhood are more likely to use physical and forcible aggression for social goal attainment, which is typically power or popularity (N.

Crick & Dodge, 1996; McQuade, Achufusi, Shoulberg, & Murray-Close, 2014; Ostrov et al., 2009; Xie et al., 2002).

In an analysis of relational and physical aggression within peer groups, Xie, Cairns & Cairns (2002) assessed social relationships between 510 students from two age cohorts (4th grade and 7th grade). Using semi-structured interviews and correlation analyses, the researchers show that aggressive behavior depends on gender-specific configurations of peer groups. That is, physical aggression was most prominent in male-male relationships, and social aggression in female-female relationships. Interestingly, no significant gender differences were noted for either physical aggression or social aggression when assessed in cross-sex relationships (Xie et al. 2002).

In sum, middle childhood is marked by changes in children's social environment that influence the development of adaptive (social skills) and maladaptive social behaviors (aggression). The importance of particular social behaviors shifts as children's social environments increasingly include peers and other non-familial adults (Warnes et al., 2005).

The Role of Cognition in the Development of Social Behaviors

By middle childhood, children have made substantial developmental gains in cognitive processes that have a bearing on the development of socially competent behaviors. Children now understand the perspective of others, as theory of mind has crystalized (Beauchamp & Anderson, 2010; Best & Miller, 2010) and they demonstrate substantial improvements in problem solving ability (Rodkin, Ryan, Jamison, & Wilson, 2013). Middle childhood is also marked by developmental changes in the brain. Neuroimaging work has linked development and function of prefrontal cortex to cognitive processes involved in social behavior, as individuals with damage to these areas have shown significant deficits in social functioning (Yeates et al., 2007). These

new developments in cognition allow for more structured peer groups that require positive social behaviors in order to maintain peer relationships. Furthermore, a substantial amount of literature demonstrates the link between deficits in executive functions and the inability to develop and maintain positive social relationships among children with ADHD (Barkley, 1997; Hummer et al., 2011), previous brain injury (Beauchamp & Anderson, 2010; Yeates et al., 2007), and those diagnosed with autism spectrum disorders (Beauchamp & Anderson, 2010). For example, in a sample of clinical referred children with attentional and behavioral difficulties, teacher and parent ratings of social problems were negatively related to overall executive functioning (Fahie & Symons, 2003).

Faulty cognitive processing can influence aggressive behaviors as well. For example, Lochman & Dodge (1998) placed a sample of aggressive and non-aggressive boys in dyads to complete a conflict interaction task. They found that aggressive boys were more likely to attribute aggression within the task to their partner and perceived their own aggressive behavior as low. Study results are indicative of how attribution of conflict is likely the result of faulty processing of external cues, as well as confirmation of such perceptions through previous interactions (Lochman & Dodge, 1998). Thus, it is imperative that we understand the underlying cognitive components of social development.

The Social Information Processing Model (SIP) proposed by Crick & Dodge (1994), serves as the foundation for more recent research in social-cognitive development of childhood social behaviors. For example, Lochman & Wells (2002) social-cognitive model and Weiner's attribution theory both describes a process through which cognitive attributions (locus, stability, and controllability) of social cues influence behavioral response decisions (Weiner, 1985). In addition, the Interpersonal Negotiation Strategies Model (INS) proposed by Selman et al. (1986)

suggest that individuals undergo an evaluative process when confronted with a social problem, and that strategies used to address the problem may vary by context. The Social Information Processing model is a six-step model that explains the interpretation, understanding, and recall of social experiences in order to decide and implement the best social response (Dodge & Crick, 1994). The model uses several cognitive processes such as working memory, long-term data storage, adjustment, and planning. The steps in the model use these processes both independently and collectively in a complex manner, thus implicating higher order cognitive processes such as executive functions. Social-cognitive models have stimulated research in neurobiological science that explores specific brain structures responsible for social-cognitive processing, and thus behavioral decisions.

Social-cognitive neuroscience integrates what we know about brain structure and development with the study of children's social development (Yeates et al., 2007). For example, research has indicated that higher order social skills tend to rely on frontal regions of the brain and that these regions are continuously developing through childhood into adolescence and early adulthood (Beauchamp & Anderson, 2010). Gallagher & Frith (2003) also demonstrate that theory of mind elicits activity in the medial prefrontal cortex (memory), as well as in the superior temporal sulcus (gaze perception), and temporoparietal junction (comprehension of language, and attentional information). In review of the literature, Yeates et al., (2007) suggest that brain regions known to regulate cognitive-executive function overlap with those necessary for social-cognitive functioning. For instance, lesions to the dorsolateral frontal regions of the brain have been shown to lead to deficits in executive functions (Cummings, 1993).

Executive functions and social behavior. The primary role of executive functions in social interactions is to aid in the adaptation to spontaneous and changing social environments,

and to help inhibit behavior responses that may be maladaptive (Barkley & Lombroso, 2000). Barkley & Lombroso (2000) specifically define executive functions as the processes through which external cues are transformed into internal representation and control of behavior. This definition overlaps with steps previous outlined in the social-cognitive and social-cognitive neuroscience models of behavior, that suggest that social cues influence behavioral responses through interpretation (Lochman & Wells, 2002; Weiner, 1985). The current literature on executive functions is vast and defines a wide variety of processes. From a social-cognitive perspective the core executive functions of working memory, cognitive flexibility, and inhibition are critical to success in social interactions in middle childhood (Beauchamp & Anderson, 2010; McQuade, Murray-Close, Shoulberg, & Hoza, 2013). The core executive functions and their contribution to social behaviors are discussed below.

The role of working memory in social functioning is related to how children interpret cues from peers, as well as how they select appropriate behavioral responses. Working memory is the simultaneous process of storing and processing information, and has a significant influence in reasoning (Baddeley, 2006, 2012). Children are actively holding the information they have received and interpreted to access previous behaviors relative to their social goal. Here working memory guides what behavioral response should be made based on new information and previous schemas, which guides the ability to function effectively within social interactions. In a study of 115 fourth and fifth grade students, McQuade et al., (2013) found that poor working memory was associated with deficits in social functioning, and more specifically that aggressive behavior and low conflict resolution mediated the relationship between working memory and social functioning. Similarly, Kofler et al. (2011) examined working memory deficits among children with and without Attention Deficit/Hyperactive Disorder (ADHD) diagnosis, and found

that among sample of boys (aged 8-12), deficits in working memory to have a direct effect on social problems. More specifically ADHD symptoms (inattention and impulsivity) mediated the relationship between working memory and social functioning.

Inhibition is the ability to control one's behavior, attention, thoughts and/or emotions (Diamond, 2013), and requires self-regulation and attention to multiple stimuli. Frequently, deficits in inhibition and social behaviors are examined within ADHD populations. However, the importance of inhibition control in non-diagnosed children yields important implications for everyday social interactions. Lack of inhibition, has been linked to reactive aggression in the social context (Ellis, Weiss, & Lochman, 2009). Specifically, Ellis et al. (2009) found that in a sample of 83 boys (aged 9-12) inhibition directly influenced aggressive behaviors, and that planning and appraisal mediated this relationship. In addition, research has indicated that inhibition supports higher order executive functions such as working memory and task-switching (Blackwell, Chatham, Wiseheart, & Munakata, 2014; Diamond, 2013). More specifically, inhibition helps regulate and guard possible distractions, therefore supporting effective processing and behavioral outcomes.

Cognitive flexibility includes the ability to change one's perspective in the spatial sense, as well as interpersonally (Diamond, 2013). This executive function process prepares individuals to adapt to changes in the environment. Middle childhood is filled with changes in interactions, as group rules and goals shift often in the social context. While cognitive flexibility has not specifically been studied in middle childhood, it is relevant to self-regulation strategies and working memory, which have strong associations with social-cognitive processing involved in social behaviors. For example, in a sample of young adults Cohen et al. (2008) found that the regulation strategy of developing "if-then" statements (linking the desired goal to possible future

cues) significantly reduced deficits in task-switching accuracy. Cognitive flexibility is the process of holding multiple rule sets (or goal-related options) in one's working memory that influences behavioral responses in the social context. Blackwell et al. (2014) also found that children who were effective in task switching showed greater ability to decrease interference control (i.e. ability to focus on the desired goal). This result implies that task switching may be linked to working memory and the ability to only attend to information that is important to the desired outcome. Although research using the social-cognitive models suggests that cognition, and more specifically executive functions play a role in socially competent behaviors, questions remain about the process through which this relationship occurs, and the influence of emotion.

The Role of Emotion Regulation in the Development of Social Behavior

Emotion regulation plays a supportive role in the adaptation and organization of behavioral responses in social settings (Rubin & Rose-Krasnor, 1992). Children make decisions about ways to respond within the social context based on their understanding and regulation of emotion, as well their expectations for others' responses (Berkovits & Baker, 2014). In Beauchamp & Anderson's (2010) review of social functioning literature, they note that emotion regulation entails a process of encoding information, an alteration of that information, and thus emotional responding. Emotion regulation is defined as the ability to monitor, evaluate, and modify emotional reactions, to accomplish a desired goal (Thompson, 1994). This definition emphasizes that emotion regulation is an adaptive process and implies that one must go beyond basic emotional knowledge and understanding, and utilize adaptive skills in order to accomplish a desirable outcome. It is the adaptive nature of emotion regulation that makes it distinct from the simple display of emotions when considering its role in social interactions.

However, few studies have looked at the dual influence of emotion and cognition on social functioning, which is perplexing given that previous research on brain development reveals that particular areas of the brain inform both thought and emotion—particularly the prefrontal cortex (PFC), orbitofrontal cortex (OFC), and the amygdala (LoPresti et al., 2008). Children with more socially adapted behaviors are better able to encode emotionally distressing cues as more positive, attend to more positive feelings, and regulate negative feelings (Kagan, Reznick, & Snidman, 1987). The field of neuroscience has also contributed to a greater understanding of brain structures involved in emotional processing of social cues. Interactions between the frontal lobe and anterior cingulate (emotional appraisal) have been implicated in the regulation of emotions (Beauchamp & Anderson, 2010). Research in brain injury has found that damage to the orbital and ventromedial prefrontal cortex results in deficits in self-regulation, emotion, and thus social behavior. Fox (1994)'s review of the literature suggests that disinhibition and excitation of particular cortical masses are involved in the underlying process of emotion regulation as well.

Physiological measures (heart rate, blood pressure, skin conductance) have provided conclusive evidence of the role of emotion regulation in social behaviors. Physiological arousal as an index of emotion regulation has linked greater levels of heart rate variability to the use of adaptive emotion regulation and coping strategies, while lower levels of heart rate variability have been linked with emotion dysregulation and anxiety. Calkins, Graziano, & Keane (2007) found that children at risk for externalizing behavior showed higher level of poor emotion regulation as evidence by low vagal control. Furthermore, emotion regulation adaptability is strongly linked to the development of socially competent behaviors. For example, in a sample of three and four year olds, Denham et al. (2003) examined the associations between emotional

competence (emotion knowledge, emotion regulation and emotion expressiveness) and social competence (social skills and aggressive behaviors). Their findings suggest that not only does emotional competence influence social competence concurrently, but also establishes stability in social competence through new social interactions as children enter kindergarten (Denham et al., 2003). Emotion dysregulation significantly predicts increases in social problems, such as disruptive behaviors year after year in typically developing children aged 7-9 years old (Berkovits & Baker, 2014). This study and others in the literature identify emotional processing as playing a central role in children's trajectory toward continual aggressive and disruptive behavior.

Deficits in particular social skills are also influenced by emotion regulation, in that the ability to process emotions accurately likely leads to behavioral responses that are more socially appropriate. In an examination of emotion regulation (intensity, negative emotionality and coping) and socially competent behaviors, Eisenberg et al. (1993) found that emotion regulation was positively associated with teacher rated social skills and peer sociometric status for boys in preschool. Their results indicate the appropriate coping of emotion invokes positive social interactions, and aids in the process of building and maintain relationships. Similarly, Monopoli & Kingston (2012) found that among middle school students emotion regulation had a direct effect on socially competent behaviors, as measured by the Behavioral Assessment System of Children (BASC-2).

In sum, a large amount of research indicates that our understanding of typical and atypical social development is vastly improved when we understand the cognitive and emotional underpinnings of social behavior. Deficits in cognitive ability and emotional understanding have

been linked to difficulties in social relationships, and often contribute to a continued trajectory of aggression (Raine et al., 2006).

Emotion Regulation as a Mediator Between Cognitive Function and Social Behavior

In one of the few studies to examine the relationship between cognition, emotion, and social behavior, Mostow et al. (2002) modeled a pathway between verbal ability and social competence in a sample (N = 201) 1st and 2nd grade students. Based on the differential emotions theory (Izard, 2001), the researchers hypothesized that the relationship between cognition and social competence would be influenced by both emotional knowledge and social skills. The differential emotions theory suggests that emotions are adaptive and contingent on internal and external cognitive stimuli (Abe & Izard, 1999). Children's verbal ability, emotional knowledge and social competence (based on sociometric peer acceptance status) were assessed, and their teachers provided ratings of each child's social skills. They first hypothesized that due to the need to express and understand emotions during social interactions, emotional knowledge would mediate the relationship between verbal ability and social competence. Secondly, they hypothesized that the relationship between emotional knowledge and social competence would be further explained through social skills. The results of the study confirmed that social skills mediated the relationship between emotional knowledge and overall social competence, as measured by peer acceptance (Mostow et al., 2002).

Previous studies consistently show a link between executive functions and social functioning (McQuade et al., 2014) yet only a few studies have examined how emotion processes may influence the relationship between cognitive skills and socially competent behaviors (Mostow et al., 2002). Thompson's (1994) review indicates that faulty processing in both cognition and emotion may result in negative social interactions with peers. Children who are

better able to regulate emotions, may also be better able to think through social interactions and respond in socially competent ways. Neurophysiological models have also implicated that brain regions responsible for cognitive and emotional processing play a dynamic role in social behavior decision making (Beauchamp & Anderson, 2010). Furthermore, while strong theoretical frameworks exist – social-cognitive models (Crick & Dodge, 1994; Dodge & Coie, 1987), social-emotional models (Riggs, Jahromi, Razza, Dillworth-Bart, & Mueller, 2006) and neurophysiological theory (Beauchamp & Anderson, 2010) – to explain social behaviors, few researchers have examined cognition and emotion in the same model to enable a better understanding of social behaviors in middle childhood.

Current Study and Research Questions

The current study explores the influence of executive functions and emotion regulation on social behavior during middle childhood in a predominantly African American, sample of children living in low-income urban communities. The study sought to answer four main research questions: 1) Do executive functions (inhibition, working memory and cognitive flexibility) influence children's social behaviors (social skills and aggressive behavior)? 2) Does emotion regulation influence children's social behaviors? 3) Does emotion regulation mediate the relationship between executive functions and social behaviors? 4) Is the proposed meditational model a better fit for social skills or aggression, and does it explain more of the variance in social behavior for boys or for girls?

Similar to the Mostow et al. (2002) study, the current study utilizes social-cognitive theories that integrate emotion processes (i.e. Lemerise & Arsenio's, 2000 integrated social-information processing model, and Izard et al. 2003 Differential Emotions Theory). However, the current study differs in a few important ways. First, it examines the effect of cognitive skills

on two dimensions of social behavior: social skill and aggression. The study will therefore add to the limited literature linking cognition and emotion regulation to prosocial behavior, and to previous literature that has consistently shown links between deficits in cognitive ability and maladaptive social behaviors, such as aggression, and peer rejection (Lochman & Wells, 2002; McQuade et al., 2013). While we need to understand how deficits in cognition and emotion lead to maladaptive behaviors, it is also imperative that we understand the mechanisms through which cognition and emotion influence prosocial behavior. Understanding whether the mechanisms involved in pro-social and anti-social behaviors are different or similar will enable researchers to develop more targeted interventions.

Secondly, unlike Mostow et al. the current study examines higher order cognitive processes (executive function) and emotion as an adaptive process (emotion regulation). This is in contrast to Mostow et al., whose study examined verbal ability and emotional knowledge. While the acquisition of such skills as language and emotional knowledge are important to social understanding and building relationships (Cook et al., 1994), the dynamic process between executive functions and emotion regulation may better predict social behavior. The proposed model could inform research about how typically developing children with verbal and emotional ability harness their skills in the social context.

Lastly, the current study will examine the proposed model for gender differences. Girls and boys in middle childhood vary in how they form social relationships, which may influence the social skills they develop and the role that cognitive and emotional processes play in social contexts. As previously mentioned, girls demonstrate more prosocial skills (Feiring & Lewis, 1991) while boys tend to be rated higher in overt aggression by both parents and teachers (Ostrov & Godleski, 2010). Due to these differences, the current study explores whether the proposed

model with emotion regulation mediating the relationship between executive functions and social behavior is a better fit for girls or boys.

Study Hypotheses

Hypothesis 1: Executive functions will be associated with teacher ratings of social outcomes (social skills and aggression).

Hypothesis 2: Emotion regulation will be associated with teacher ratings of social outcomes (social skills and aggression).

Hypothesis 3: Emotion regulation will mediate the relationship between executive functions and social outcomes (social skill and aggressive behavior)

Hypothesis 4: The proposed meditational model will be a better fit for girls when the outcome is social skills.

Hypothesis 5: The proposed meditational model will be a better fit for boys when the outcome is aggressive behavior.

Method

Participants

The current study included 371 (mean age in years = 9.50, SD = .89) typically developing 2nd ($n = 3$, .8%), 3rd ($n = 170$, 46.1%), 4th ($n = 134$, 36.3%) and 5th grade ($n = 62$, 16.8%) students enrolled in a longitudinal study exploring the impact of playing chess on executive functioning, behavioral and academic outcomes. Demographic information was obtained from school records and as reported by families. Approximately 89% of families identified the student as Black, 6% as Hispanic, 3% as White, and the remaining 2% as Asian/Asian Pacific or other. An equal distribution of boys and girls made up the sample population. While income

information was not obtained, the majority of the participants involved in the study qualified for free or reduced lunch as defined by the United States Department of Agriculture guidelines ($n=283$, 90.8%) indicating participants' families earned between \$15,730 - \$29,101 per two-person household (USDA federal register, 2014).

Measures

Executive functions. Participants completed a cognitive battery, which included several measures of executive function (see appendix 1). The current study uses measures assessing core executive functions: cognitive flexibility, inhibition and working memory. Assessments were developmentally appropriate and shown to be reliable for middle childhood participants. Each executive function measure consisted of several trials and is designed to assess participant's response time, accuracy and efficiency. Participants' efficiency scores on executive function measures are used in the current study. Efficiency scores are calculated by dividing the participant's accuracy on the task by the participant's response time on correct trials.

Cognitive flexibility. A figure-matching task (Ellefsen, Shapiro, & Chater, 2006), was used as a measure of cognitive flexibility. The measure consists of 4 blocks of 32 trials, in which participants must follow a rule set to match objects by their shape (circle or triangle) or color (red or blue). For each block there is a specific rule (1) match color only, (2) match shape only, (3) alternating, (4) alternating-runs. The blocks are presented to participants in no particular order and are counterbalanced across participants and assessment time points. The display rule is indicated at the top of the screen and participants must use the left and right arrows on the computer keyboard to make a selection as quickly as possible. The task is designed as a measure of attention shifting, rule-guided behavior, and response inhibition. This measure of cognitive flexibility has shown to be age appropriate for middle childhood age range, as Ellefsen et al.

(2006) have found that similar patterns of increase response time or switch cost occur both in 7-year-old primary school children and University students.

Inhibition. A sustained attention task for children (Servera & Cardo, 2006) was used to assess response inhibition. The task consists of 300 trials in which the stimulus (numbers 0-9) were presented on a computer screen, one at a time for approximately 250ms. Participants were instructed to press the space bar on the computer keyboard as quickly as possible each time a number is presented, except when the number 4 is presented. This task is designed to measure response inhibition or the ability to discontinue a dominant response to allow a subdominant response. The participants must continue through the end of the 300 trial task. In a sample of 11-year-old children, Servera & Cardo (2006) found evidence of validity and reliability in this measure of continuous performance, noting that improvements in performance on the Children's Sustained Attention Task increased with age and significantly predicted inattention within this age group.

Working memory. Working memory was assessed using an adapted version of a spatial span measure known as corsi blocks (Corsi, 1972; Milner, 1971). For this task, participants were presented with 16 empty boxes placed spatially on a computer screen. Participants were then instructed that they would view a series of boxes light up one at a time. The goal of the task is to click on the boxes in the exact same order as they were lit. The boxes that are lit begin with a simple pattern and become more complex as the participant progresses. This is the "forward" phase of the task. There is a second phase of the task in which the participants view a series of lit boxes one at a time, but then must click on the pattern of boxes in the reverse order and is noted at the "backward" phase. Within each phase, the task ends when a participant is unsuccessful at replicating the pattern more than five trials in a row. Participant's efficiency scores were

calculated on both the forward and backward phase of the task. In the current study, the working memory score represents the sum of efficiency scores on the forward and backward tasks.

Social behaviors. Social behavior was assessed using the Behavioral Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus). The BASC-2 is a widely used measure for the assessment of childhood behaviors, both problematic and adaptive. The measure is available for ratings to be performed by parents, teachers and through self-report. BASC-2 is comprised of four composite scales (Internalizing Problems, Externalizing Problems, Behaviors Symptom Index and Adaptive Skills) and an additional seven content scales. Each item on the measure is rated on a four-point scale of frequency with the responses (0=never, 1= sometimes, 2=often, 3=almost always). The raw score items are summed and standardized to t-scores using the provided BASC-2 assessment software. Standardized scores are derived for the four composite scales, as well as their corresponding primary scales and content scales. The BASC-2 manual provides extensive psychometric properties of each scale, as well as cut off scores for clinical significance. For this study, parent-ratings of emotional self-control were used as research indicates parents to be better raters of children's internalizing behaviors and functioning (Major & Seabra-Santos, 2015; Stanger & Lewis, 1993). For behaviors observable in the social context amongst peers (i.e. aggression and social skills) teacher ratings were used.

Social skills. The Social Skills Composite scale (ASC) consists of the primary scales of adaptability, social skills, leadership, study skills and functional communication. The primary scale of social skills was used as an assessment of social competence for each participant. The BASC-2 social skills primary scale captures social adaptation through interpersonal indices, by identifying behaviors such as complimenting and encouraging others.

Aggression. Within the Externalizing Problems Composite Scale (EPC), are three primary scales of hyperactivity, aggression and conduct problems. The primary scale of aggression was used to assess teacher-rated aggressive behavior. Aggression on the BASC-2 is measured as a tendency to bring physical or emotional harm to others or their property. The aggression scale on the BASC-2 assesses both verbal and physical aggression forms. Verbal aggression items include behaviors such as verbally threatening others and name calling, while physical aggression items include hitting other and breaking possessions. The scale provides greater weight to verbal aggression, as this behavior is likely observed more frequently in the social context.

Emotion regulation. Emotion regulation was assessed using parent ratings of emotional self-control on the Behavioral Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus). As previously described, the BASC-2 is comprised of four composite scales and an additional seven content scales. Parent ratings on the emotional self-control content scale were used as the measure of emotion regulation. This content scale indicates a parent's perception of their child's ability to regulate affect and emotions in response to environmental changes. The measure is comprised of six items that are rated by parents on a four-point scale of frequency (0=never, 1= sometimes, 2=often, 3=almost always), and includes items such as '*gets upset when plans are changed*'. From here forward, the measure of emotional self-control will be referred to as emotion regulation.

Procedures

Participants in this study were enrolled in an experimental training study in which children learned how to play chess and engaged in chess-related activities during an afterschool program. Changes in their executive functioning, behavioral outcomes and academic

achievement were monitored over the course of one intervention year, and one follow-up year. Participants were recruited from public schools located in two urban southeastern cities whose administration had agreed to participate in the study and host an after-school chess program. Students were recruited to participate through flyers sent home, teacher announcements, and advertising during the schools' open house prior to the start of the school year. Virginia Commonwealth University's Institutional Review Board approved the study, and parental consent and child assent were obtained prior to study enrollment.

Data were collected during the school year at five different time points. Three time points occurred during the year in which participants were involved in chess related activities (T1—baseline, T2—mid-intervention, and T3—post-intervention). The remaining time points occurred at follow-up the year after the program was complete. In the current study, only T1 baseline data was analyzed, in order to reduce the possible effects of the chess intervention on changes to students' executive functioning ability. At each time point measures of executive function were obtained through computer-administered tasks over a 60-minute period. Participants completed assessments by logging into a secure Internet site, using a random identification number. The computer tasks are managed through a secure-server at the University of Cambridge, thus enabling privacy and confidentiality. Research assistants were available to help instruct participants on how to complete each task. In addition, participants wore headphones and instructions were given via computer prior to each task. Additionally, small instruction reminders were given to prompt participants when needed. Research assistants were responsible for making sure the participants followed instructions and remained on task, and completed each task fully. Assessments took place in a quiet environment at the participant's school or in an on-campus

University computer classroom. Participants received a \$15 gift-card at each time-point of assessment, totaling \$75 for complete participation.

The BASC-2 behavioral assessments were distributed to participants' parents and teachers at time-points 1, 3 and 5. For the current study, only parent and teacher data from T1 baseline was used, in order to address any effects of the chess intervention on social behaviors. Rating forms were presented in a secure envelope, and either provided to the student for parent version of the assessment, or provided directly to the teacher for the teacher version of the BASC-2 assessment. Parents completed the rating scale and returned with the participant to school, while teachers returned assessment forms for both themselves and the parent to the project coordinator to maintain confidentiality. Raw scores for rating scales were then entered into the BASC-2 assist software. The software allows for double entry of scores, converts raw scores into standardized t-scores ($M= 50$, $SD= 10$), and also creates content scales to be used for further interpretation. Teachers received \$10 compensation for completion of every student rating form completed at each time-point.

Results

In preparation for analysis, the distribution of data was examined for missing data points, outliers, and issues of normality for all study variables. Due to the longitudinal nature of the study, missing data points for particular variables were expected. To adjust for missing data, pair-wise deletion was used when necessary in order to maintain sufficient power for the data analysis in SPSS. In addition, Mplus statistical software was used to run the proposed mediation models. Mplus uses maximum likelihood parameter estimates, which is robust to non-normality and non-independence of multivariate observations in calculating model estimates (Muthén & Muthén, 2015).

The data was first examined for univariate outliers. Standardized values were calculated for each study variable. With a sample population greater than $N = 80$, participants identified as outliers (i.e. standardized z-score $< \pm 3$; Cohen, Cohen, West, & Aiken, 2013) were removed from the sample data set. In addition, outliers were examined of multivariate composite normality. The mahalanobis distance (D^2)—a multidimensional standardized z-score—was computed for each variable. Multivariate variables are considered outliers when the mahalanobis distance between each case and the group centroid mean exceeded the chi-square value for K the degrees of freedom, K representing the number of variables (Meyers, Gamst, & Guarino, 2006). With caution to not eliminate non-influential observations, outliers were examined to ensure they were not the result of data entry error. Twenty-one univariate outliers, and ten multivariate outliers were detected. These participants were excluded from further analysis, thus decreasing the sample population from $N = 371$ to $N = 340$. A priori statistical power analysis was conducted using G*power analysis software (Erdfelder, Faul, & Buchner, 2007) to determine adequate sample size for the preliminary analysis to be conducted in SPSS v.23. Results from the power analysis revealed a sample size larger than 100 participants to be sufficient for the statistical methods used in the preliminary analyses.

When examining the distribution of data, teacher-ratings of aggression were substantially positively skewed. To adjust for the skewed distribution a logarithmic transformation was performed using Tabachnick & Fidell (2007) guidelines for data transformation. After the transformation teacher-rated aggression was normally distributed. Descriptive statistics (means and standard deviations) for all study variables are represented in Table 1.0 for the total sample population and for gender groups.

Correlations were run to assess associations among study variables within the total sample and within gender groups, tested at an alpha level of $p < .05$. In addition, cohort and gender effects were assessed using, multivariate analysis of variance (MANOVA). Hierarchical regression was used to assess the degree to which executive functions and emotion regulation predict teacher-ratings of social behavior (aggression and social skills).

In order to answer the proposed research questions and hypothesis testing, data were imported into Mplus 7.31 (Muthén & Muthén, 2015). Striener's (2005) sample size criteria were used to determine whether the study sample size was adequate for path analysis, after removal of outliers. With k indicating the number of variables and $[(k^2 - k)/2]$ representative of the number of parameters in the model (Streiner, 2005), the current path analysis model includes 10 parameters. Using Kline's (2011) recommendation of a minimum of 10 cases per model parameter the estimated adequate sample size for the current path analysis is 100 participants. The current study sample size consists of 340 participants.

Two path analyses were conducted using Mplus 7.31 (Muthén & Muthén, 2015) for the total study sample. Model fit was assessed using the maximum likelihood estimate parameter with cut-off criteria suggested by Hu & Bentler (1999); Browne & Cudeck (1993); non-significant Chi-square (χ^2) value, root mean square error of approximation (RMSEA) $< .08$, and comparative fit index (CFI) $\geq .95$. In addition direct effects and indirect effects of study variables were examined to assess whether emotion regulation would mediate the relationship between executive function and teacher-rated social behaviors. To examine the influence of gender on the proposed pathways, multiple group models were conducted in which the χ^2 value and the Bayesian Information Criterion (BIC) were compared for a constrained and an unconstrained model. In the constrained model, path coefficients were set to be equal across gender, while in

the unconstrained model path coefficients were free to vary. A non-significant χ^2 difference value and improvement in BIC is indicative of the constrained model fitting no better than the unconstrained model, and thus no gender differences.

Correlation analysis

Correlation analysis revealed positive moderate associations among executive functions for the sample as a whole (see Table 1.0). In addition, the association between parent-rated emotion regulation and social behaviors was consistent with the research literature, such that higher scores on emotion regulation were associated with higher scores on social skills and lower scores on of aggression. Associations among executive functions and social behaviors (aggression and social skills) were also examined. For the total sample population, working memory was positively associated with social skills and negatively related to aggression.

Table 1.0.

Correlations for Total Sample

	1	2	3	4	5	6
1 Age	–					
2 Working Memory	.15*	–				
3 Inhibition	.12*	.33**	–			
4 Cognitive Flexibility	.06	.23**	.25**	–		
5 Emotion Regulation	-.15*	.05	-.01	.08	–	
6 Aggression	-.00	-.19*	-.11	-.05	-.26**	–
7 Social Skills	-.11	.17*	.11	.13	.25**	-.47**

Correlational analyses were run separately for each gender (see Table 1.1), associations among executive functions were positive and moderate for both groups. Gender differences were evident in the relationship between emotion regulation and social behavior. Specifically, parent-

rated emotion regulation had a negative moderate association with aggression for boys, and a positive moderate association with social skills for girls. For boys, the association between cognitive flexibility and social skills was positive and moderate, whereas for girls a significant negative correlation emerged between working memory and aggression, and a significant positive correlation between inhibition and social skills.

Table 1.1.

Correlations By Gender

	1	2	3	4	5	6
1 Age	–					
2 Working Memory	.16	–				
3 Inhibition	.07	.32**	–			
4 Cognitive Flexibility	.05	.30**	.32**	–		
5 Emotion Regulation	-.03	-.07	-.07	.20	–	
6 Aggression	-.02	-.11	-.08	-.14	-.35*	–
7 Social Skills	-.09	.16	.04	.23*	.23	-.42**
	-.11	.17	.21*	.07	.26*	-.50**

Cohort and Gender Differences on Study Variables

Given that participants in the current study were recruited from two different geographical locations, a multivariate analysis of variance (MANOVA) was conducted with executive functions (working memory, inhibition, and cognitive flexibility) as dependent variables. One of the three executive function variables violated the Levene's test of equality of error variance, as such Pillai's Trace test was used as a more conservative estimate of the F-statistic. Results revealed significant differences between cohorts, Pillai's Trace = .12, $F(3, 236) = 10.24$, $p < .01$, partial eta squared = .12. Univariate post-hoc test revealed differences between cohorts on working memory $F(1, 238) = 6.73$, $p = .01$, inhibition $F(1, 238) = 25.13$, $p < .001$, and cognitive flexibility $F(1, 238) = 9.04$, $p = .003$, with higher scores evident for Cohort B than for Cohort A. A second MANOVA was conducted testing cohort effects on emotion regulation, aggression, and social skills. Significant differences in between cohorts emerged, Wilks' $\Lambda = .93$, $F(3, 120) = 2.83$, $p = .04$, partial eta squared = .07. Examination of univariate post-hoc test revealed that Cohort B had lower scores on teacher's ratings of aggression, $F(1, 122) = 8.09$, $p = .005$.

Multivariate analyses of variance were also conducted to examine gender effects. The overall model was significant, Wilks' $\Lambda = .97$, $F(3, 236) = 2.76$, $p = .04$, partial eta squared = .03, and univariate post-hoc tests revealed that boys and girls differed on inhibition, $F(1, 238) = 6.61$, $p = .01$, such that boys showed higher levels of efficiency on the inhibition task than girls. A second MANOVA was conducted to assess differences in emotion regulation, aggression, and social skills. No significant differences emerged between boys and girls on these variables.

Regression Analysis

To assess the degree to which executive functions and emotion regulation predict social behavior, hierarchical linear regression analyses were performed for each endogenous variable. Working memory, inhibition, cognitive flexibility, emotion regulation and gender were entered simultaneously into the model. The model predicting teacher ratings of social skills was significant [$F(5, 118) = 3.05, p = .01, R^2 = .12$], and emotion regulation was the only significant predictor in the model $\beta = .23, t(118) = 2.64, p = .01$. A second linear regression analysis was conducted with teacher ratings of aggression as the criterion. Again, the model was significant [$F(5, 118) = 3.67, p < .01, R^2 = .13$]. For the model predicting aggression, emotion regulation $\beta = -.24, t(118) = -2.76, p = .01$, and gender $\beta = -.19, t(118) = -2.17, p = .03$ emerged as significant predictors.

Table 2.0.

Regression Coefficients Predicting Social Skills

	<i>Unstandardized Coefficient</i>		<i>Standardized Coefficient</i>
	<i>B</i>	<i>SE B</i>	<i>b</i>
Emotion Regulation	.26	.10	.23
Gender	2.60	1.70	.14
Working Memory	.81	.65	.12
Inhibition	.00	.00	.07
Cognitive Flexibility	.04	.04	.08
R^2			.12
p			.01

Table 2.1.

Regression Coefficients Predicting Aggression

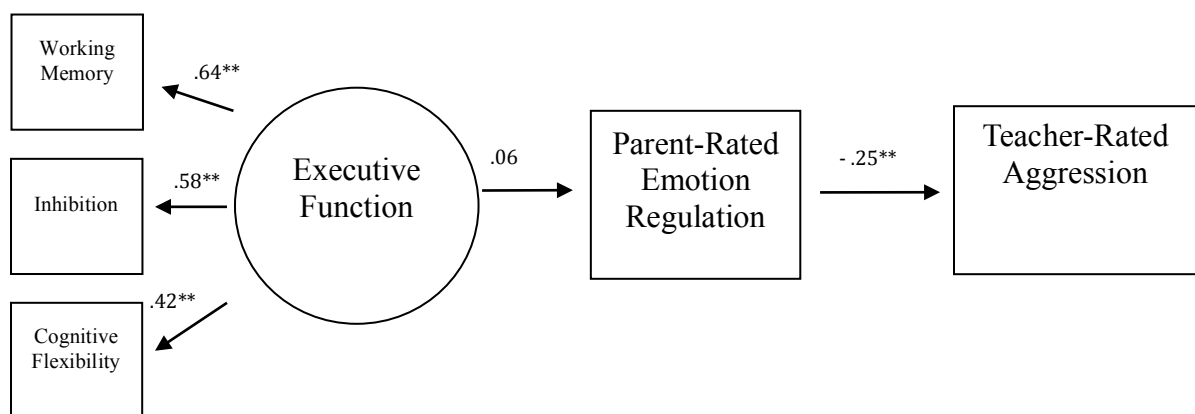
	<i>Unstandardized Coefficient</i>		<i>Standardized Coefficient</i>
	<i>B</i>	<i>SE B</i>	<i>b</i>
Emotion Regulation	-.00	.00	-.24
Gender	-.02	.01	-.19
Working Memory	-.01	.00	-.15
Inhibition	.00	.00	-.09
Cognitive Flexibility	.00	.00	.01
R ²			.14
<i>p</i>			.00

Model Analyses

Structural equation modeling (SEM) was conducted to test the first three hypotheses. In the first model SEM was conducted to examine whether executive functions are associated with aggression (**hypothesis 1**), whether emotion regulation is associated with aggression (**hypothesis 2**), and whether emotion regulation mediates the relationship between executive functions and aggression (**hypothesis 3**). Executive functioning was structured as a latent variable, composed of the observable assessments of working memory, cognitive flexibility, and inhibition. The latent executive function variable was constructed in order to account for the strong associations between the three executive functions. Executive function was then entered into the first model to assess the direct effect on teacher-rated aggressive behaviors, with emotion regulation entered as a mediator of this relationship (see Figure. 1.0). The overall model was a good fit [N = 334, $\chi^2 = 72.65$ (4), $p = .71$; RMSEA = .00; 90% CI [0, .06]; CFI = 1.00]. Examining the associations among study variables, working memory, inhibition, and cognitive flexibility all loaded onto the

latent variable of executive function, identifying a good executive function latent structure. The relation between executive function and emotion regulation was not significant ($\beta = .06, Z = .58, p = .06$). However, the relation between executive function and aggression ($\beta = -.24, Z = -2.27, p = .02$), and aggression and emotion regulation ($\beta = -.25, Z = -2.87, p < .00$) were statistically significant.

Table 3.0 displays the path coefficients for the total, direct, and indirect effects of the model. The direct effect of teacher-rated aggression on executive function was significant ($\beta = -.24, Z = -2.27, p = .02$). However, the indirect effect of teacher-rated aggression on executive function through emotion regulation was not significant ($\beta = -.02, Z = .03, p = .057$). Results of the analysis align with the previous literature suggesting that executive functioning influences aggressive behavior such that higher levels of executive function predict lower levels of aggression. In addition, the model evidenced a significant negative relation between emotion regulation and aggression, such that high scores on emotion regulation predicted lower scores on aggression.



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

Figure 1.0. Structural Equation Model of Executive Function Predicting Aggression

The second model analysis was structured similarly but examined the first three hypotheses in relation to teacher's ratings of social skills (see Figure 1.1). The second SEM model was conducted to examine whether executive functions are associated with social skills (**hypothesis 1**), whether emotion regulation is associated with social skills (**hypothesis 2**), and whether emotion regulation mediates the relationship between executive functions and social skills (**hypothesis 3**). Executive function was structured as a latent variable comprised of working memory, inhibition, and cognitive flexibility, predicting teacher's ratings of social skills. Emotion regulation was entered as a mediating variable. Results of the analysis indicated the overall model as a good fit [N = 334, $\chi^2 = 1.60 (4), p = .81$; RMSEA = .00; 90% CI [.00, .05]; CFI = 1.00]. The relation between executive function and emotion regulation was not significant ($\beta = .05, Z = .45, p = .07$). However, the relation between executive function and social skills ($\beta = .26, Z = 2.53, p = .01$), and social skills and emotion regulation ($\beta = .23, Z = 2.74, p = .01$) was significant.

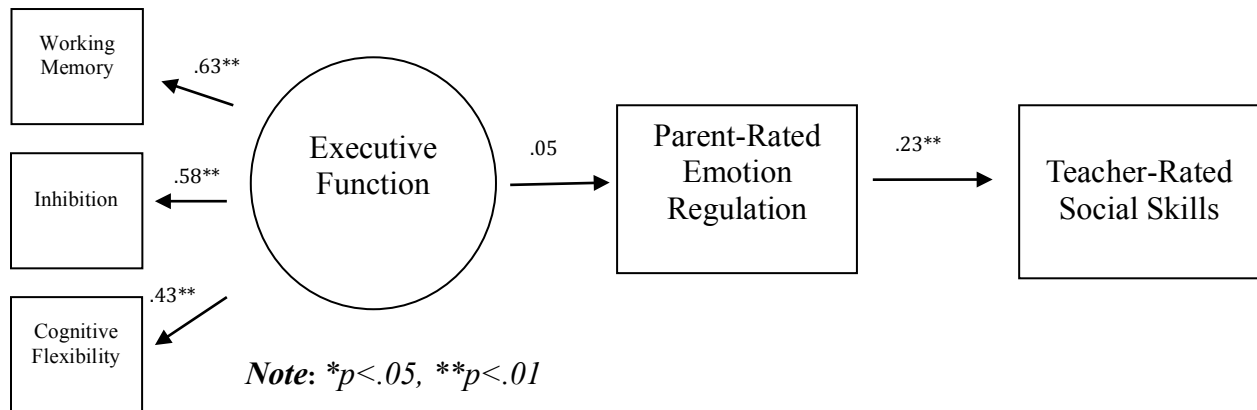


Figure 2.1. Structural Equation Model of Executive Function Predicting Social Skills

The direct effect on social skills of executive function was significant ($\beta = .26, Z = 2.53, p = .01$). The indirect effect on social skills of executive function through emotion regulation was not significant ($\beta = .01, Z = .46, p = .06$). Results of the analysis align with the previous

literature suggesting that executive functions influence social skills such that higher levels of executive function predict higher levels of social skills. In addition, the model evidenced a significant positive relation between emotion regulation and social skills, such that high scores on emotion regulation predicted higher scores on teacher ratings of social skills.

Table 3.0.

Standardized Path Coefficients: Direct, Indirect, and Total Effects

Effects	β	S.E.	<i>p</i>
Model 1: Teacher Rated Aggression			
(Effects from Executive Function to Teacher-Rated Aggression)			
Total Effect	-.25*	.10	.02
Direct effect of executive function on teacher-rated aggression	-.24*	.10	.02
Direct effect of executive function on emotion regulation	.06	.10	.56
Direct effect of emotion regulation on teacher-rated aggression	-.25**	.09	.00
Indirect effect of executive function on teacher-rated aggression	-.01	.10	.56
Model 2: Teacher Rated Social Skills			
(Effects from Executive Function to Teacher-Rated social skills)			
Total Effect	.27*	.10	.01
Direct effect of executive function on teacher-rated social skills	.25*	.11	.02
Direct effect of executive function on emotion regulation	.04	.09	.65
Direct effect of emotion regulation on teacher-rated social skills	.26**	.10	.01
Indirect effect of executive function on teacher-rated social skills	.01	.02	.65

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

Gender Differences in the Proposed Models

Multiple group models were conducted to examine whether the proposed model predicting social skills would be a better fit for girls (**hypothesis 4**), and whether the proposed model predicting aggression would be a better fit for boys (**hypothesis 5**). Multiple group models were conducted in which an unconstrained model where path coefficients were allowed to vary was compared to a constrained model in which path coefficients were set to be equal across gender. For both the unconstrained and constrained model, the path coefficients between executive functions as a latent variable were set to be equal. However, in the unconstrained model, the path coefficients between executive function and social behaviors (i.e. aggression and social skills), executive function and emotion regulation, and emotion regulation and social behaviors were free to vary. This method ensured that the latent structure of executive function remained the same, but gender would be assessed as a moderating variable on the hypothesized pathways.

The fit for comparing boys and girls in the multiple group models was determined by examining the differences in comparative fit index (CFI), root mean square estimate approximation (RMSEA), χ^2 difference test, and improvement in the Bayesian Information Criterion (BIC). The unconstrained model for teacher-rated aggression fit the data well, [N = 334, $\chi^2 = 19.25$ (12), $p = .94$; RMSEA = .04; 90% CI [0, .09]; CFI = .93]. However, the χ^2 difference between the constrained and unconstrained models ($\chi^2_{\text{diff}}^{\text{value}} = 2.11$, $df = 3$) was not significant. The non-significance of the χ^2 difference, in addition to the improved BIC value (8770.291, 8785.36) provides evidence that the model for both boys and girls fit equally well, suggesting no gender differences in the association among the study variables (see Table 4.0).

Multiple group models were also conducted to assess gender differences among teacher-rated social skills. The unconstrained model for teacher-rated social skills did not fit the data well [N = 341, $\chi^2 = 43.74$ (12), $p = .01$; RMSEA = .07; 90% CI [0.04, .10]; CFI = .90]. Comparison of χ^2 values of the constrained and unconstrained model revealed no significant gender differences.

Table 4.0.

Chi-Square Test and Overall Fit Indices of Structural Equation Model By Gender

Model	χ^2	df	CFI	RMSEA	BIC	χ^2_{diff} value
Teacher-Rated Aggressive Behaviors						2.11 (3) $p = .51$
Gender - Unconstrained	17.14	12	.92	.05	8785.36	
Gender - Constrained	19.25	15	.93	.04	8770.29	
Teacher-Rated Social Skills						.58 (3) $p = .85$
Gender - Unconstrained	16.74	12	.93	.05	10811.50	
Gender - Constrained	17.32	15	.97	.03	10794.83	

Exploratory Latent Profile Analysis

As previously mentioned, emotion regulation is defined as the ability to monitor, evaluate, and modify emotional reactions, to accomplish a desired goal (Thompson, 1994). Considering this definition, emotion regulation is less about skill and more about adaptability to the environment and one's desired goal. An exploratory latent profile analysis was conducted to assess whether subgroups defined by differences in executive functions and emotion regulation exist in the sample population. Mplus 7.3 (Muthén & Muthén, 2015), uses a mixture distribution

model to specify latent profile groups, a person-centered method that allows for the identification of categorical classes based on profiles of scores across a set of continuous variables. For the current study, latent profiles were derived from the manifest variables of executive function (i.e. working memory, inhibition, cognitive flexibility), parent-rated emotion regulation, aggression, and social skills. The previous latent executive function variable was not used, in order to explore which executive functions may contribute to varied profiles of social behaviors.

A sequence of models exploring different numbers of profiles was conducted beginning with one profile, and increased until either 1) the number of participants in each group reached below $N = 10$ or 2) or the analyses no longer provided interpretable model fit indices. To examine model fit of each group analysis, the following criteria suggested by Collins, Fidler, Wugalter, & Long, (1993) was examined; a statistical model comparison of Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC) and the sample size adjusted Bayesian Information Criteria (aBIC) between all models, a mean group assignment probability $<.80$, entropy approaching the value of 1, and group membership sizes no smaller than $N = 10$.

Results of the analysis revealed a model consisting of four profiles produced good model fit indices (*see Table 6.0*) but low sample size numbers for comparison. Table 6.0 indicates the model fit indices for analysis examining all membership groups as well as the entropy value (i.e., classification accuracy). Values terms were then created in which mean differences among groups determined whether participants were relatively “high” or “low” on scores of specific executive functions, emotion regulation, aggression, and social skills. This was determined by assessing whether mean values for each group were above or below the mean. Figure 2.0 displays the standardized mean values of working memory, inhibition, cognitive flexibility, emotion regulation, social skills and aggression for each group membership profile. As

expected, analysis revealed significant differences between class membership groups Wilks' $\Lambda = .03$, $F(18, 229) = 29.43$, $p < .001$, partial eta squared = .68.

Group one had scores of low working memory, high inhibition, high cognitive flexibility, low emotion regulation, low social skills, and high aggression. Assessing all profile groups, group one can be characterized as high in executive function, low in emotion regulation and social skills, and high in aggression. Group two scores were below average on working memory, inhibition, and cognitive flexibility, but above average on emotion regulation, social skills and aggression. Group two profiles can be characterized as low executive function, high emotion regulation and social skills, and high aggression. Group three can be characterized as low executive function, low emotion regulation, low social skills but high aggression. Finally, group four can be characterized as high executive function, high emotion regulation, high social skills, and low aggression.

Table 5.0.

Fit Indices and Entropies for Latent Class Mixture Modeling Analyses

Equation Model By Gender

Number of Classes	Smallest Group N (%)	AIC	BIC	aBIC	Entropy
1	91 (100%)	3406.91	3436.90	3399.03	–
2	23 (26%)	3333.98	3381.48	3321.51	.95
3	11 (12%)	3316.17	3381.17	3299.11	.95
4	9 (10%)	3306.61	3389.11	3284.95	.96

Note: $N = 90$. AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria , aBIC = sample-size adjusted Bayesian information criterion.

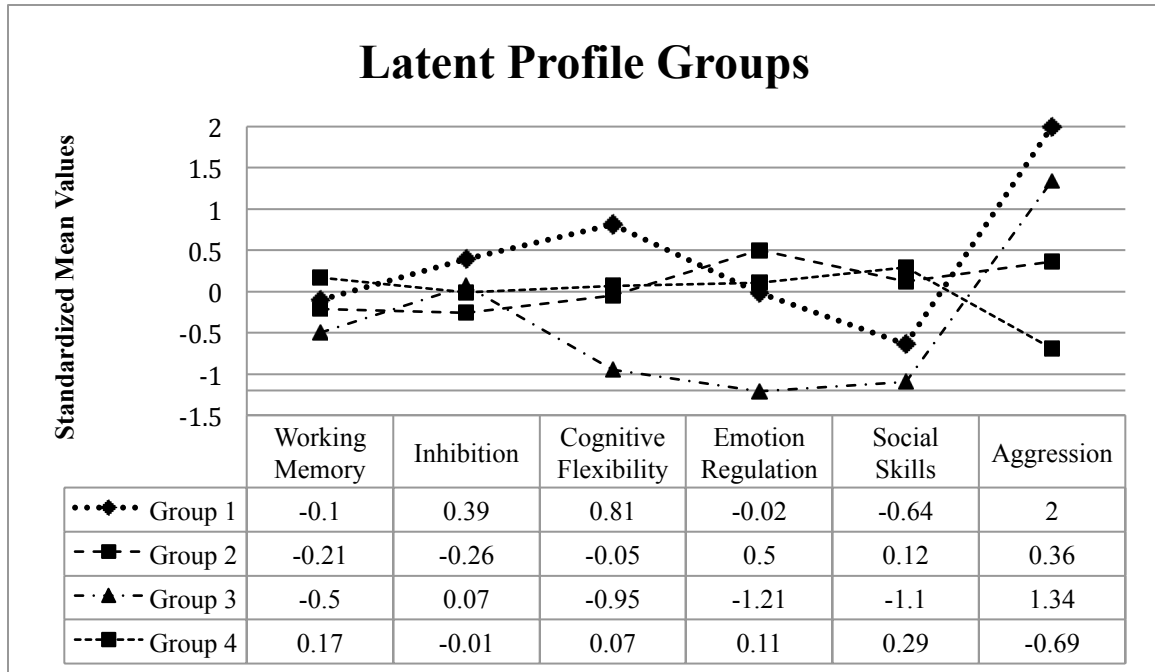


Figure 2.0. Mean Values for Latent Profile Groups

Discussion

The current study sought out to examine the association between executive functions and social outcomes (i.e. aggression and social skills), and the degree to which the ability to regulate one's emotions (emotion regulation) influenced this relationship. Aligned with previous literature, significant negative associations emerged between executive function and teacher-rated aggression. In addition, there was a significant negative association between emotion regulation and teacher-rated aggression. Contrary to the proposed hypothesis model, the relation between executive function and teacher's ratings of social skills and aggression was not mediated by emotion regulation. However, examination of the direct and indirect effects of each model, revealed direct effects of executive function on social behaviors and direct effects of

emotion regulation on social behaviors. Specifically, there was a significant positive relation between executive function and teacher's ratings of social skills, and a significant positive relation between emotion regulation and teacher's ratings of social skills. Regarding aggression, there was a significant negative relation between executive function and teacher's ratings of aggression, and a significant negative relation between emotion regulation and teacher's ratings of aggression. The final hypotheses examining the potential moderating impacts of gender were not significant.

This study adds to the current body of literature examining the roles of cognition and emotion on social behaviors in several ways. First, the study takes into consideration the combined influence of cognition and emotion, which has been encouraged by integrative models of social behaviors (Beauchamp & Anderson, 2010; Yeates & Selman, 1989). Second, the current study examines emotion with regards to one's ability to adapt to social changes through measurement of emotion regulation, which by definition considers changes to one's environment (Zeman, Cassano, Perry-Parrish, & Stegall, 2006). This is one of the first studies to examine emotion as a process instead of emotion as an individual ability characteristic (i.e. emotional knowledge or emotion expressiveness), in a model predicting social behaviors. In addition, the study not only examines maladaptive social behaviors such as aggression, but also considers what executive function and emotion regulation can tell us about positive social behavioral outcomes (i.e. social skills). The study also contributes to the body of literature that examines gender differences in social outcomes (Feiring & Lewis, 1991). Finally, the study examines these associations in a sample of typically developing African American children. Previous literature primarily examines association between executive function and social outcomes through a deficits lens, concentrating on children with developmental and intellectual disabilities.

Executive Functions and Social Outcomes

The first hypothesis sought out to examine whether executive function is associated with social behaviors (i.e. aggression and social skills). The results of the current study are consistent with previous findings suggesting that deficits in executive functioning predict higher levels of aggressive behavior (McQuade et al., 2013; Riccio, Hewitt, & Blake, 2011). The total effect for the structural equation model estimating teacher-rated aggression was significant, in addition to the direct effect of executive function on aggression. Correlation analysis indicated that higher levels of working memory are associated with lower levels of aggression for the total sample population. Similar to McQuade et al. (2013) the current study highlights the importance of working memory in social functioning among typically developing students in middle childhood. Efficiency in working memory requires one to process incoming cues, and then use that information to develop sequences necessary for behavior response (Diamond, 2013). The findings in reference to working memory and aggression, as well as the previous literature support the social-cognitive model, as well as neurobiological model suggesting that incoming processing and reasoning ability are implicated in social decision making around aggressive behavior (LoPresti et al., 2008; Thornton & Conway, 2013).

Similar results were found for teacher's ratings of social skills. The total effect for the structural equation model estimating teacher-rated social skills was significant, in addition to the direct effect of executive function on social skills. Correlation analysis also indicated that higher levels of working memory are associated with higher levels of social skills for the total sample population. Social skills and competency are typically examined from the maladaptive perspective within the literature. The current study contributes to the literature in which executive functions has been examined among general social skills, instead of maladaptive

behaviors (McQuade et al., 2013; Riggs et al., 2006). It is important to examine positive social behaviors, as highlighting more prosocial behaviors within the literature can have a significant impact on intervention development. Primarily interventions are aimed to improve skill set of children with deficits, understanding positive social skills of typically developing children could ensure interventions are targeting appropriate behaviors and increase effectiveness.

Emotion Regulation and Social Outcomes

The second study hypothesis examined relations between emotion regulation and social behaviors (i.e. aggression and social skills). Structural equation modeling revealed a significant positive relation between emotion regulation and social skills, and a significant negative relation between emotion regulation and aggression. In addition, correlation analysis for the total sample population indicated similar results with higher levels of emotion regulation showing positive associations with social skills, and negative associations with aggression. The results from the current study model make an addition to the literature by highlighting the adaptive nature of emotion (Gross, 1999), by examining emotion regulation as a process that is based on one's environment. While children may possess the ability to recognize and express emotion, their ability to adapt those emotions in a dynamic environment may be more influential. Researchers have shown significant relationships between emotional knowledge, perspective taking, and emotion expressiveness (Denham et al., 2003; C. Izard et al., 2001; Mostow et al., 2002) and social outcomes. However, the relationship is mostly studied among children with developmental delays and emotion deficits (Beauchamp & Anderson, 2010; Geurts & Verté, 2004). Characteristics of individual ability identify little about children's ability to use acquired skills, and develop a sufficient behavioral response. This study contributes to our understanding of that emotion process. Many studies focus deficits in executive functions that lead to aggression,

conduct problems and disruptive behaviors (Ellis et al., 2009; Riccio et al., 2011; Schoemaker et al., 2012).

The Roles of Cognition and Emotion on Social Outcomes

The structural equation models tested the third hypothesis about whether emotion regulation played a mediating role in the relationship between executive functions and social behaviors (i.e. aggression and social skills). While the models were identified as a “good” fit, examination of indirect effects revealed that emotion regulation did not mediate the relation between executive function and social skills nor aggression. Instead, the results suggest that emotion regulation plays a larger role in social outcomes (English, John, Srivastava, & Gross, 2012; Helmsen et al., 2012; Monopoli & Kingston, 2012). However, more recent literature has recognized the importance of the combining influence of cognition and emotion in explaining decision-making, and social outcomes. Integrative models of social behaviors suggest that the while cognitive ability and emotional processing have distinct effects on social behaviors the two systems rely greatly on one another to process social information and develop appropriate behavioral responses (Beauchamp & Anderson, 2010; Yeates & Selman, 1989). The model results are contrary to the hypothesis proposed by integrative models.

Regression analysis were also conducted to analysis were also conducted to assess the relationship between executive function, emotion regulation, and social outcomes. These analyses sought out to examine individual contributions of specific executive functions. The analysis for both social skills and aggression were significant. However, the contributing coefficient for both social skills and aggression was emotion regulation. In addition, gender was a significant in predicting aggression. The regression models emphasize the role of emotion

regulation in social outcomes, and that this likely differs for boys and girls when considering aggression.

The results of analyses for hypothesis three are in contrast to one of the only studies to date that examined emotion as a mediator of cognition and social skills. Mostow et al., (2002), found that the relationship between cognitive ability (verbal language) and social skills was mediated by emotion knowledge in a sample of first and second graders. There are two major differences between the current study and Mostow et. al., (2002). First, the current study utilizes a dynamic measure of emotion (i.e. emotion regulation) that assesses a child's ability to process emotion through environmental changes (BASC-2; Reynolds & Kamphaus). Second, the mentioned study uses a sample of children younger than the current study. The acquisition of emotional knowledge, assessed in the Mostow et al. (2002) study, is essential to social skills during the developmental phase of early childhood. This is largely due to the start of school as a new environment and experiences of new social interactions with peers. However, during middle childhood emotion knowledge has crystalized and the ability to process emotion knowledge in a changing environment may more important for social skill development during this developmental phase.

Gender Differences in Social Outcomes

In the final two hypotheses, the effect of gender was examined in the proposed structural equation models. The hypothesis for gender differences was based on the previous literature on peer group formation. It was hypothesized that due to the size and structural differences between boy and girl peer groups in middle childhood (i.e. boys tend to have larger peer networks and girls more intimate and exclusive relationships) varied skills in executive function and emotion regulation would necessitate development and maintenance of peer groups. Model results

indicated a good fit for the relation among executive functions and social skills, as well as the relation among executive functions and aggression for both boys and girls. However, when constrained and unconstrained models were compared to determine gender effects, analysis revealed no significant differences between boys and girls. The results are contrary to the hypothesis that boys and girls may differ due to peer group construction in middle childhood (i.e. boys develop larger peer groups, while girls develop smaller peer groups).

Correlation analysis however did reveal significant gender differences. For boys higher levels of cognitive flexibility were associated with higher levels of social skills. Cognitive flexibility requires the ability to switch between means of problem-solving (Lewis & Carpendale, 2009), and is considered higher-order executive functioning. The relationship between cognitive flexibility and social skills is appropriate as social skill competency involves effective use of information in dynamically changing social interactions (Beauchamp & Anderson, 2010). Specifically for boys this may be essential in navigating the multiple social interactions that occur within their larger peer groups. For girls, higher levels of working memory was associated with lower levels of aggression, and higher levels of inhibition were associated with higher levels of social skills. Both working memory and inhibition require a level of information processing that then helps develop appropriate behaviors response (Diamond, 2013). The associations among social behaviors, and working memory, and inhibition for girls identify that teachers' view girls who are better able to thoroughly think through their behavioral responses as more socially competent. Having thoughtful process in social interactions, and engaging less in impulsive behavior may prove useful for girls because disruption in social relationship could cost them losing intimate relationships due to small peer group numbers. In addition, inhibition has been shown to support working memory by keeping mental work space

free from distraction (Diamond, 2013). It is no wonder that working memory and inhibition both influence social skills for girls and the need to focus on more intimate relationships with peers.

In addition, while the multiple groups model revealed no significant differences between boys and girls on the relation between emotion regulation and social behaviors. Correlation analysis revealed that higher scores on parent's ratings of emotion regulation was associated with lower scores on aggression for boys, and high scores on social skills for girls. Again, these results align with the previous literature indicating the importance of emotion in social outcomes (English et al., 2012; Helmsen et al., 2012; Monopoli & Kingston, 2012). Interestingly, the significant associations possibly identify gender bias in parent's perceptions of girls and boys in that they may be able to better recognize aggression in boys and social skills in girls.

Exploratory Latent Profile Analysis

Exploratory latent profile analysis was conducted to assess whether profiles, characterized by particular executive functions, emotion regulation, social skills, and aggression exist in the sample population. Analyses was based on the literature in aggression and antisocial behaviors that has identified aggression profiles in which executive functions such as attention and inhibition increase the likelihood of aggression (Helmsen et al., 2012). Four groups emerged from the latent profile analysis. Based on the other groups in the model, group one can be characterized as high on executive function, low on emotion regulation and social skills, yet high on aggression. Group one likely fits the previous literature noting that goal-oriented aggression entails a higher cognitive skill set (Camodeca, Goossens, Schuengel, & Terwogt, 2003; Hubbard et al., 2002). Group two can be characterized as having low executive function skills, but high in emotion regulation, social skill, and aggression. Within this profile, emotion regulation seems to be the driving force for social behavior. However, students in this group may engage in

aggression due to the lack of executive functioning ability. In addition, their profile fits students who may be reactively aggressive due to lack of information processing.

For group three, their profile may be characterized as low executive function, emotion regulation, and social skills but high aggression. The profile for group three appears to fit cognitive and emotional deficits, which contribute to low social skills scores and high scores on aggression. Group three is well characterized in the literature and illustrates the lack of ability in both information processing and emotion regulation that leads to maladaptive behaviors. Finally, group four had the lowest scores on aggression. The profile for group four can be characterized as having high executive function and emotion regulation, and good social skills. Group four is the ideal, in that students are scoring high across cognitive and emotional domains and exhibit more pro-social behaviors. The exploratory work in the current study has important implications for intervention development. For example, profiles of students high in aggression may warrant different intervention approaches depending on whether they are high or low in their executive functioning ability. A good approach for those high in executive functioning may be to capitalize on their skills and facilitate their engagement in leadership roles thus enabling them to utilize their executive function ability in a more constructive manner.

Limitations

While the current study adds to the body of literature examining emotion regulation and executive functions associated with social outcomes, there are also several study limitations to consider. A number of issues are relevant in reference to measures that were used in the current study, specifically the use of teacher and parent ratings of social outcomes and emotion regulation. The same reporting measure was used to assess social outcomes and emotion regulation. It is likely that use of the same measurement tool contributes to some amount of

covariance between the variables (i.e. emotion regulation, aggression, and social skills). While previous research has identified teachers to be the best raters of childhood social behavior in the classroom (Winsler & Wallace, 2002), and parents to be better raters on internalizing behaviors (Major & Seabra-Santos, 2015) multiple measures and/or direct assessment of child behaviors may provide a better picture of the relations among executive functions and social outcomes. Further, recent efforts by researchers studying emotion regulation have moved toward assessment of emotion processes through physiological and neurobiological mechanisms (Appelhans & Luecken, 2006; Gross, 1999). Autonomic response, physiological mechanisms and neurobiological mechanisms provide a more naturalistic measure emotion processing that is free of bias.

Furthermore, the measurement tool for assessing emotion regulation, aggressive behavior, and social skills is primarily used in clinical assessment (Reynolds & Kamphaus, 2004: BASC-2). The study sample of typically developing children adds to the body of literature in ways that help us understand how emotionally competent children use emotion in the social context. However the use of a clinical assessment tool provides issues with normality and interpretation, such that students are not rated as having clinical level aggressive behavior. A measure intended to assess more classroom social behaviors of typically developing children would address this study limitation.

Finally, the results of the modeling analyses do not support previous findings in the literature suggesting aggression in the social context being gender dependent (Xie et al., 2002), as well as the literature suggesting higher social skills among girls (Feiring & Lewis, 1991). For the current sample population, peer group size was not assessed. Further examination of the proposed model may benefit from including group size differences in a multi-level model

analysis. This may also be a limitation in the latent profile analysis, which was constrained by low sample size. Future analyses should explore how profile membership differs based on gender, and the extent to which these profiles can be used to predict important school-related outcomes.

Implications and Future Directions

The current study results emphasize the need to assess cognition and emotion as dynamic collective processes, in the role social outcomes. Social environments are constantly changing based on the individuals in context, and so an adaptive measure of both cognition and emotion provide a wealth of knowledge. For example, the current study suggests that once typically developing children are beyond the acquisition of emotion related skills, the ability to regulate emotions in social context is more important to social outcomes. Most of what we know about emotion regulation and cognitive decision making has come from the literature examining adolescent's and risk behavior (Steinberg, 2005). It is essential that future research also examine adaptive processing in middle childhood, as social competence is stable across development. The research efforts in middle childhood could result in early intervention for adolescent and young adult risk behaviors.

While the current study does not provide much evidence of emotion regulation mediating the relationship between executive functions and social behaviors, this may be related to issues with measurement. Future work should explore new ways of assessing emotion regulation. Assessing emotion regulation is difficult, and the definition is ever-changing (Gross, 1999; Koole, 2009; Shields & Cicchetti, 1997). Improvement in the methodology of the current study could include objective measures of regulation that are free from rater and context bias. In particular, measures of heart rate and heart rate variability which have proven to be good

indicators of emotional responding (Appelhans & Luecken, 2006) in other work, could be applied here. In addition, advanced statistical analysis could provide a better picture of how student profiles (i.e. high in cognitive ability and emotion regulation) may contribute differently to social behavior outcomes.

The overall model assessing gender differences in social outcomes was not confirmed, but future research should consider whether boys and girls differ in social behavior based on the composition of their peer groups. In addition, teacher ratings may be influenced by social gender norms and investigating whether this plays a role in the observed non-significant findings in the current study is warranted.

Conclusion

While the current study did not confirm prior work by Mostow et al (2002), regarding emotion mediating the relationship between cognition and social outcomes, the current study makes some key contributions to the literature. Firstly, it provides further evidence for deficits in executive function contributing to aggression, and good executive functioning contributing to social skill. In addition, the study highlights the importance of emotion regulation in social behaviors. Emotion regulation skills have been shown to be flexible (Gyurak, Gross, & Etkin, 2011), and findings from the current study suggest these skills are an important target intervention to prevent or address aggression. Supporting emotion regulation can affect social outcomes in ways that cognitive ability and lack of emotion knowledge, due to developmental delays or injury cannot.

While the current study was not able to confirm gender differences in social outcomes (aggression or social skills), further exploration is needed. There is lack of research exploring gender differences in antecedents to social behaviors, despite previous suggestions of the peer

group differences (Feiring & Lewis, 1991). The implications of the current study highlight the importance of moving beyond individual differences and deficits that lead to social outcomes, and instead focusing on how children adapt and bring their unique skill sets to bear in their social contexts

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Appendix 1

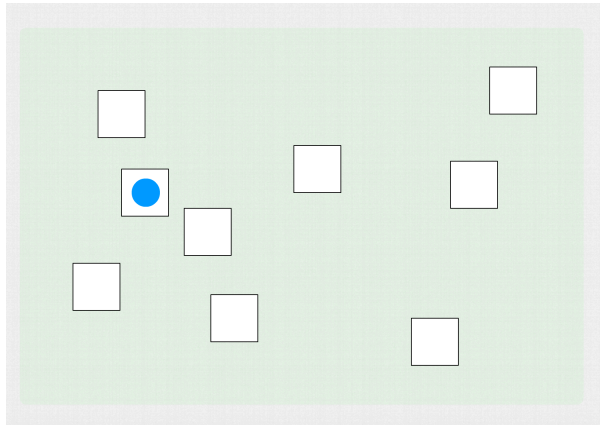
Measures of Executive Function

Inhibition: This task is designed to measure response inhibition or the ability to discontinue a dominant response to allow a subdominant response. The task consist of 300 trials in the stimulus (numbers 0-9) are presented on a computer screen, one at a time for approximately 250ms. Participants are instructed to press the space bar on the computer keyboard as quickly as possible each time a number is presented, except when the number 4 is presented.

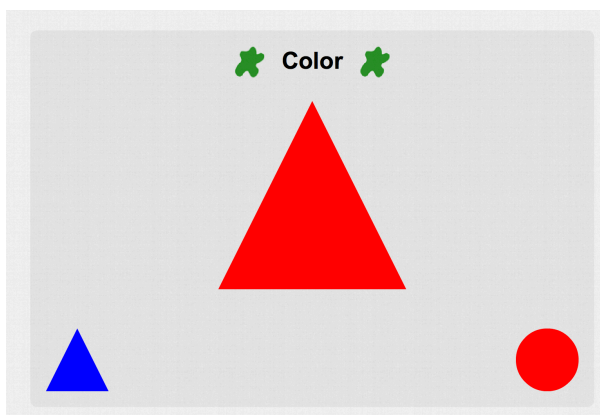


Working Memory: This task is a measure of one's ability to hold information in storage while recalling information needed to complete pattern recall. In this measure participants are presented with 16 empty boxes placed spatially on a computer screen. Participants are then instructed that they will view a series of boxes light up one at a time. The goal of the task is to click on the boxes in the exact same order as they were lit. A second phase of the task in which

the participants view a series of lit boxes one at a time, but then must click on the pattern of boxes in the reverse order.



Cognitive Flexibility: The task is designed as a measure of attention shifting, rule-guided behavior, and response inhibition. The measure consists of 4 blocks of 32 trials, in which participants must follow a rule set to match objects by their shape (circle or triangle) or color (red or blue). For each block there is a specific rule (1) match color only, (2) match shape only, (3) alternating, (4) alternating-runs.



Appendix 2

Measures of Social Outcomes

Social Skills Subscale Teacher Rated BASC-2

Each item on the measure is rated on a four-point scale of frequency with the responses (0=never, 1= sometimes, 2=often, 3=almost always).

Social Skills:

- Says please and thank you.
- Congratulates others when good things happen to them.
- Compliments others.
- Makes suggestions without offending others.
- Shows interest in other's ideas.
- Encourages others to do their best.
- Tries to bring out the best in others.
- Offers help to other children.

Aggressive Behavior Subscale Teacher Rated BASC-2

Each item on the measure is rated on a four-point scale of frequency with the responses (0=never, 1= sometimes, 2=often, 3=almost always).

Aggression:

- Argues when denied own way.
- Loses temper too easily.
- Bullies others.
- Calls other children names.
- Hits other children.
- Threatens to hurt others.
- Defies teachers.
- Seeks revenge on others.
- Annoys others on purpose.
- Teases others.

Appendix 3

Measure of Emotion Regulation

Emotional Self-Control Parent Rated BASC 2

Each item on the measure is rated on a four-point scale of frequency with the responses (0=never, 1= sometimes, 2=often, 3=almost always).

- Is easily upset
- Acts out of control
- Loses temper easily
- Has poor self control
- Shows feelings that do not fit the situation
- Changes mood quickly

Appendix 4

Sample Population Demographics

Age Years	
<i>M</i> (SD)	9.50 (.89)

Total Sample	
<i>N</i>	371

Gender	Male	Female
<i>N</i> (%)	191 (52%)	180 (48%)

Ethnicity	Black	White	Hispanic	Other
<i>N</i> (%)	324 (89%)	9 (3%)	20 (6%)	13 (2%)

Grade	2nd	3rd	4th	5th
<i>N</i> (%)	3 (.8%)	170 (46.1%)	134 (36.3%)	62 (16.8%)

Free-Reduced Lunch	Yes	No
<i>N</i> (%)	283 (90.8%)	88 (9.2%)

Vita

Tennisha Natasha Riley was born on March 8, 1985 in Columbia, South Carolina. She received her Bachelor of Science degree in Psychology from Florida State University, Tallahassee, Florida in December 2006. Tennisha has also received a Master of Arts in Marriage and Family Therapy from LaSalle University, Philadelphia, Pennsylvania in August 2009. After completing her graduate education Tennisha worked as Multisystemic Therapist in the central Florida area. While working as a therapist, she returned to developing her research interest and began an individual study at the University of South Florida. Tennisha now attends Virginia Commonwealth University in Richmond, Virginia, and is a doctoral student in the Developmental Psychology program. She currently works in a research lab that focuses on cognitive, emotional, and social development in the context of schools.