The Pennsylvania State University

The Graduate School

College of the Liberal Arts

UNDERSTANDING SELF-REGULATION, LINKS TO SCHOOL READINESS, AND IMPLICATIONS FOR INTERVENING WITH HIGH-RISK CHILDREN

A Dissertation in

Psychology

by

Marcela M. Torres

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

August 2011

The dissertation of Marcela M. Torres was reviewed and approved* by the following:

Karen L. Bierman
Distinguished Professor of Psychology
Dissertation Advisor
Chair of Committee

Cynthia L. Huang-Pollock
Assistant Professor of Psychology

Brian A. Rabian
Associate Clinical Professor

Mark T. Greenberg
Edna Peterson Bennett Endowed Chair in Prevention Research
Professor of Human Development and Psychology

Melvin M. Mark
Professor of Psychology
Head of the Department of Psychology

*Signatures are on file in the Graduate School.

ABSTRACT

School entry presents young children with a new set of social and learning demands theorized to be heavily reliant on the development of self-regulation. Children delayed in their development of self-regulation are at heightened risk for problems when they enter school, including difficulty with learning readiness, problematic relationships with teachers and peers, and behavior problems (Blair, 2002). Conceptually, self-regulation is a multi-faceted construct, reflecting the capacity to control impulses, focus and shift attention, and regulate emotion. This set of skills develops rapidly between the ages of 3-7, dependent upon the maturation of the pre-frontal cortex. Although these skills are inter-related developmentally, studies rarely examine them at the same time, raising questions about the degree to which they represent distinct capacities that make unique contributions to school readiness. Collecting multiple measures selected specifically to tap skills relevant to behavioral, emotional, and attentional regulation, the current study provided evidence for a 3-factor structure of self-regulation and documented unique contributions of behavioral, emotional and attentional dimensions to school readiness. In addition, a pilot study suggested that pre-intervention deficits in these self-regulatory skills attenuated response to an innovative time-limited social competence coaching program, although evidence for the malleability of some self-regulatory skills (emotional understanding) also emerged. Implications for developmental models and intervention designs targeting the self-regulatory deficits and school readiness of at-risk children are discussed.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF FIGURES

ACKNOWEDGEMENTS

This project would not have been possible without the work of an exceptional team of people. It is with deep gratitude and appreciation that I thank the following people for their help and support on this project:

Sandra Stewart, for her coordination of recruitment efforts for both schools and families, data collection efforts across sites, and intervention supervision; Tracy Spalvins and Marcy Shire, for their leadership in heading data collection teams and organizing intervention materials; Anda Nichols, Chris Meyer, Jessie Connell, Cindy Rockey, Ann Krepps, Julia Landis, Heather Chase, and Brad Sizemore, for their additional assistance with data collection and coordination of intervention materials; Harmony Thibodeaux-Lyles, C.J. Powers, Lisa Knudson, Carla Pannizo, Barb Green, and Marcela Gibson, for leading the intervention and control group sessions, with an additional thank you to Lisa Knudson for her art-work; Megan Gotshalk, and the staff at the Penn State Survey Research Center (SRC), for assistance with data entry; and the staff and administration at participating schools for their openness to participation in this project and assistance with coordination of group activities.

In addition, I would like to thank the members of my doctoral committee, Brian Rabian, Cynthia Huang-Pollock, and Mark Greenberg, for their helpful feedback throughout this process, and the mentorship and support they provided throughout my graduate training.

I would also like to thank my advisor, Karen Bierman, for allowing and encouraging me to take on such an ambitious and sizeable project, and for generously offering staff and grant support to undertake it in addition to her incredible encouragement, mentorship, and support throughout my training.

This project was supported by funds from the W.K. Kellogg Foundation.

Chapter 1. INTRODUCTION

As children enter school, they are expected to sustain positive relationships with teachers and peers, listen-and-learn on demand, follow classroom rules, and show appropriate initiative in the classroom (Rimm-Kaufman, Pianta & Cox, 2000). Yet, a significant number of children (up to 20-30% of children living in poverty) start school without the social-emotional and behavioral maturity that fosters "readiness to learn," contributing to delays in school progress and increasing disparities in school attainment (Campbell & von Stauffenberg, 2008; Lengua, 2002; McClelland, Acock & Morrison, 2006; Ryan, Fauth, & Brooks-Gunn, 2006).

Although there are various definitions of school readiness (e.g. Collaborative for the Advancement of Social Emotional and Academic Learning, 2009; National School Readiness Indicators Initiative, 2005), most agree that it reflects broadly a child's capacity for successful engagement in classroom tasks and readiness to learn, positive teacher and peer relationship skills, and inhibition of disruptive or aggressive-oppositional behaviors (Booth & Crouter, 2008). School readiness researchers increasingly have moved towards this broader understanding of school readiness beyond a sole focus on discrete pre-academic (e.g. number and letter) skills (e.g. Blair, 2002; Booth & Crouter, 2008; Raver, 2002), as more evidence emerges for the importance of social-behavioral readiness in supporting academic learning and success.

Conceptually, school readiness depends heavily on the development of self-regulation skills during the preschool years (Blair, 2002), which enables children to organize thinking and behavior with increasing flexibility, decrease dependence on immediate cues, and regulate affective arousal (Barkley, 2001; Derryberry & Rothbart, 1997; Kochanska, Murry

& Harlan, 2000). Similarly, preschool and Kindergarten teachers increasingly have recognized that a child's ability to self-regulate is vital to school readiness, above academic skills alone (Lewit & Baker, 1995). In order to learn content (e.g. reading and math), children need to be able to control distracting behavioral impulses, shift and focus their attention selectively on key pieces of information, and regulate emotional reactivity to sustain engagement in learning tasks (Blair & Diamond, 2008).

Reflecting this recognition, there has been a call for early intervention and educational programming to incorporate activities designed to build self-regulation skills during the pre-kindergarten period and early school years (Blair & Diamond, 2008). Despite some arguments that concentrated instruction in pre-academic skills (e.g. reading and math) may be the best intervention approach towards reducing disparities in achievement over time (Duncan et al., 2007; Lonigan, Burgess & Anthony, 2000), reducing the gaps in school readiness likely requires more than a sole focus on academic knowledge. Empirical evidence is emerging that educational programming to enhance the development of the mental systems that underlie and support self-regulation and adaptive learning behaviors is much needed in efforts to promote school readiness (Blair, 2002; Ladd, Birch, & Buhs, l999; Shonkoff & Phillips, 2000), particularly for children at-risk for delays.

Conceptually, self-regulation is a multi-faceted construct, reflecting the capacities that include the regulation of behavior (capacity for behavioral impulse control and motor control), the regulation of emotion (including the recognition and labeling of emotions, and the capacity to modulate negative arousal and tolerate frustration), and the regulation of attention (capacity to sustain attention and hold information in mind, focus attention on key elements, avoid distraction, and shift attention as needed). This set of skills appears

developmentally interdependent, and advances rapidly between the ages of 3-7, in conjunction with the maturation of the pre-frontal cortex. Although these skills are inter-related developmentally, studies rarely examine them at the same time, raising questions about the degree to which they represent distinct capacities that make unique contributions to school readiness. Understanding more about the nature of self-regulation and how it promotes school readiness, including the degree to which regulatory processes in the behavioral, emotional, and attentional domains make independent and unique contributions to school adjustment would facilitate developmental study of these important skills, and guide the design of interventions.

This project aimed to elucidate the link between self-regulation and school readiness. Multiple measures selected specifically to tap three domains of self-regulation (e.g., regulation of behavior, emotion, and attention) were administered to a normative sample of 194 pre-kindergarten and kindergarten children from participating schools. Teachers reported on the school adjustment of these children, including their learning readiness, relationship skills with teachers and peers, and behavior problems. Then, a sub-group of children with deficits in school readiness was identified, as indicated by low levels of classroom engagement in kindergarten or prekindergarten. These children were randomly assigned to receive a short-term (16 session) intervention designed to promote their social-emotional and self-regulatory skills or a control group that provided academic enrichment. Post-test assessments for this sub-group of children included a re-administration of direct assessments of the self-regulatory skills and teacher ratings. The study had three aims.

Aim 1: The first aim was to test a theoretical model regarding the multi-faceted nature of self-regulation. Specifically, I tested the hypothesis that three dimensions of self-

regulation would emerge distinctly in a factor analysis. *Behavioral regulation* would comprise behavioral impulse control and motor control; *attention regulation* would comprise attentional control, attention set-shifting, and working memory; and *emotion regulation* would comprise emotional understanding and frustration tolerance.

Aim 2: The second aim was to determine whether these three dimensions of self-regulation were associated in significant and unique ways with measures of social-behavioral school readiness, including learning readiness, relationship skills with teachers and peers, and behavior problems. It was hypothesized that the different dimensions of self-regulation would make independent contributions to the prediction of school readiness. In addition, I explored the interactions among self-regulatory processes and their impact on school readiness, in order to further understand how self-regulatory processes work together to support school readiness for at-risk children.

Aim 3: The final aim of the project was to evaluate the impact of a short-term intervention designed to promote social-emotional and self-regulatory skills of a sub-group of children identified with low levels of school readiness. In addition to evaluating the overall impact of the intervention on the school adjustment and self-regulatory skills of these at-risk children using a randomized-controlled design, an additional goal included the examination of the moderation of intervention response based upon the severity of initial self-regulatory skill deficits.

Chapter 2. LITERATURE REVIEW

Self-Regulation

Self-regulation in the present study refers to the processes that underlie and support a child's capacity to engage in adaptive social and learning behaviors required for positive adaptation to environmental demands; in this case, adjustment to school. It involves a multi-faceted and complex set of processes posited to underlie adaptive responding to challenges and learning opportunities (Hughes & Graham, 2002; Smith-Donald, Raver, Hayes, Richardson, 2007). Conceptually, the capacity for self-regulation depends heavily on the development of the prefrontal cortex, which undergoes rapid growth during early childhood (Blair, 2002; Derryberry & Rothbart, 1997; Kochanska et al., 2000). The impact of these self-regulatory processes on school readiness is simultaneously influenced by the temperamental characteristics (patterns of emotional and behavioral reactivity) rooted in the child's biological system. The child's environmental experience also plays a significant role in their capacity for self-regulation.

Therefore, self-regulatory processes more specifically reflect the interplay between the developing prefrontal behavioral, emotional, and attentional self-regulatory skills in modulating behavioral and emotional reactivity or response tendencies. These processes allow for the development of a child's capacity to tolerate frustration, engage in social reciprocity, comply with social demands, and plan and organize their behavior. Children's growing ability to self-regulate at school entry is linked with reductions in problem behaviors (Hann & Borek, 2001) and effective engagement in the classroom (Bierman, Torres, Domitrovich, Welsh & Gest, 2008). Others similarly conceptualize self-regulation as involving the modulation of emotion, attention and behavior systems in response to a

particular situation (Calkins & Fox, 2002; Carlson, 2005; Derryberry, 2002; Rothbart, 2004; Smith-Donald et al., 2007), including the regulation of emotional reactivity, the ability to shift and focus attention, the inhibition of maladaptive behaviors, and control over involuntary, reactivity-based responses in favor of active engagement in adaptive behaviors. Thus, these descriptions of self-regulation involve behavioral, emotional and attentional aspects of development. Yet, many who have studied self-regulation have focused on just one or two of these domains, without fully exploring the degree to which they all work together to support adaptive functioning. The current study aims to explore self-regulation more comprehensively as it relates to school readiness. In this study, I measure self-regulatory processes with an array of tasks, designed to represent the range of behavioral, emotional and attentional self-regulation skills involved in self-directed and goal-oriented behavior relevant for school readiness:

Specifically, I measured behavioral aspects of self-regulation with tasks of *behavioral impulse control* and *motor control*, including the ability to delay, slow-down or inhibit prepotent motor responses. I measured emotional aspects of self-regulation with tasks of *frustration tolerance* and *emotional understanding*, including the capacity to recognize and label emotional states and remain calm in frustrating, problem-solving scenarios. I measured attentional aspects of self-regulation with tasks of *attentional control, attentional set-shifting* and *working memory*, including the capacity for inhibitory control of prepotent attentional responses, the ability to shift attention flexibly as needed, and the capacity to hold and manipulate relevant information in mind to achieve a goal. Each of these processes were posited to be directly related to school readiness outcomes in the current study, and their

interactions were also explored to better understand how they work together to support school readiness.

The Role of Behavioral Self-Regulation in Supporting School Readiness

The capacity to delay an immediate, desired motor response in order to evaluate and choose from an alternative set of responses improves greatly between the ages of 3 and 7 years (Rothbart, 1989). The ease with which young children exhibit behavioral regulation, particularly under highly motivating circumstances (e.g. when faced with a desired object or action), is in part related to individual differences in biologically-driven response tendencies along with cognitive maturation. School entry represents a time of heightened demand on young children's behavioral impulse control and motor control, as the classroom setting often requires children to inhibit pre-potent motor responses, such as waiting for an activity, taking turns, raising a hand before speaking, walking instead of running, and speaking softly instead of yelling. Barkley (2001) put forth a model of self-regulation in which response inhibition (including behavioral impulse control) is particularly important for well-regulated functioning in that it both acts to suppress prepotent responses driven by underlying individual differences in biological reactivity and creates a "space" for alternative responding in support of adaptive, goal-oriented behaviors.

Some empirical evidence has linked *behavioral impulse control*, measured using delay-of-gratification tasks, such as waiting to see a desired prize, and tasks of *motor control*, such as slowing down as much as possible over repeated trials of walking along a line, to various indices of school readiness. For instance, the motor control task, Walk-A-Line Slowly (Kochanska, Murray, Jaques, Koenig, & Vendegeest, 1996) contributed uniquely to social and behavioral readiness for school when examined with other tasks of executive

(attentional) control in a sample of Head Start preschool children (Bierman, Nix, Greenberg, Domitrovich, & Blair, 2008). In addition, performance on delay-of-gratification tasks has been linked empirically to social competence in the preschool environment (Smith-Donald, et al., 2007) Thus, the capacity for behavioral regulation, specifically comprised of behavioral impulse control and motor control, appears to be essential to children's readiness for school, and represents an important domain of self-regulation.

The Role of Emotional Self-Regulation in Supporting School Readiness

The ability to independently modulate the intensity and duration of emotional expressions in accordance with situational demands is also an important developmental task of the preschool years (Cole, Michel, Teti, 1994). Two skills relevant to successful emotion regulation, *frustration tolerance* and *emotional understanding*, were measured and explored in the current study. While the preschool environment provides children with the opportunity to increase their regulatory capacity via exposure to a variety of social and learning challenges, along with this opportunity comes greater exposure to frustrating events. By 3 years of age, children typically have developed some ability to conceal or diminish the expression of negative emotions in disappointing or frustrating situations, according to social expectations (Cole, 1986). The skill with which children exhibit emotion regulation by responding in a socially-appropriate manner to disappointing or frustrating events may play an important role in aiding the normative decline of aggressive behaviors and conflict with teachers and peers during this time period (Eisenberg & Fabes, 1992). Frustration tolerance, in particular, may contribute to success in school by helping children to remain calm in the social and academic problem-solving situations that are abundant in the school environment, in order to successfully create and carry out a plan that will result in an adaptive outcome.

There is some evidence that kindergarten children who are better able to tolerate their frustrations are more successful academically and perform better on standardized tests of literacy and math, in addition to having higher quality relationships with their teachers (Graziano, Reavis, Keane & Calkins, 2007). Additionally, emotion regulation is linked to social competence in preschool and kindergarten (Denham, 2006). Conversely, children who have difficulty tolerating their frustrations may be more likely to experience temper tantrums and display emotional and physical outbursts in response to frustrating events, which are likely to interfere with relationship building and learning opportunities in the classroom.

Emotional understanding, including the ability to recognize and label emotions also contributes greatly to a child's capacity for emotion regulation (Izard & Ackerman 2000). For example, Garner and Power (1996) discovered that children who had higher levels of emotional understanding also had better control over their emotional reactions in a frustrating or disappointing situation than children who had lower levels of emotional understanding. Carlson and Wang (2007) similarly found significant positive correlations between preschool children's emotional understanding and ability to regulate their emotional expression in a disappointing gift task.

Emotional understanding also develops rapidly between the ages of 3 and 7. Children at this time are beginning to use their language and understanding of nonverbal emotional displays, both as a way to communicate their feelings more effectively, and as a basic method for regulating intense emotional reactions (Greenberg & Kushe, 1993). In learning to recognize and verbally label specific emotional states and experiences, children are simultaneously developing a new and important set of self-control strategies (Greenberg & Kusche, 1993; Izard, 2007). Children's ability to control emotional and behavioral reactivity and arousal rests largely with their ability to label and communicate their emotional states

(Hughes, Dunn, & White, 1998). In other words, learning to recognize and verbally label specific emotional states is theorized to help guide children's emotional and behavioral responses to social events, which typically occurs by the time children enter elementary school (Hughes et al., 1998; Greenberg & Kusche, 1993; Izard, 2007; Vygotsky, 1978).

Empirically, preschool and kindergarten children's emotional understanding, measured in terms of recognizing expressions and feelings states and the ability to label and talk about emotions, has proven to be a strong predictor of social as well as academic competence, including successful engagement in peer interactions and classroom activities (Denham et al., 2003; see Izard et al., 2001; Miller et al., 2005; Trentacosta & Izard, 2007). Thus, the capacity to identify and label emotions appears related to the capacity to tolerate frustration and regulate negative arousal, and together these skills comprise the emotional domain of self-regulation. Their role, in relation to school readiness, is to aid children's control of their behavioral and emotional reactivity in order to meet concurrent demands for engagement in adaptive, goal-oriented social and learning behaviors in the classroom.

The Role of Attentional Self-Regulation in Supporting School Readiness

The development of attentional regulation, primarily occurring between the ages of 3 and 7, allows children to more flexibly organize their behavioral responding, while increasing attentional control with the goal of engaging in adaptive social and learning behaviors (Barkley, 2001; Blair & Razza, 2007; Kochanska et al., 2000). Related to the present study, school entry therefore represents an important transition during which developing attentional control, attention set-shifting and working memory skills become more crucial to adaptive, well-regulated functioning (Blair, Zelazo & Greenberg, 2005).

There is some debate regarding the degree to which these aspects of attentional self-regulation, commonly conceptualized as executive functions, represents a unitary construct, particularly in early childhood, or whether it is comprised of distinct cognitive skills that together work to promote adaptive social and learning behavior (Garon, Bryson, & Smith, 2008). Some have recently hypothesized that resolution of "conflict" in cognitive responding, involving *attentional control*, and *attentional set-shifting*, is central to executive functioning (Botnivinivk, Braver, Barch, Carte, & Cohen, 2001; Carlson & Moses, 2001). In addition, the ability to hold and manipulate information in mind to achieve a future goal (*working memory*) is integral to success in selecting a subdominant response over a dominant response (Roberts, Hager, & Heron, 1994). Thus, there is some consensus that executive control generally consists of three main aspects: the capacity to inhibit a prepotent attentional response, the capacity to control and shift attention under conditions of conflict, and working memory. (Barkley, 2001; Blair & Diamond, 2008; Friedman et al., 2006). Furthermore, several researchers have found that tasks representing attentional "conflict" are distinct from other tasks of behavioral impulse control and motor control (which are sometimes also conceptualized as executive functions) in that they factor separately or have differential prediction to child adjustment (Calson & Moses, 2001; Nigg, 2006; Sonuga-Barke, Dalen, & Remington, 2003).

Attentional regulation skills (attentional control, attention set-shifting, working memory) are significantly intercorrelated in early childhood (Carlson, Mandell, & Williams, 2004; Diamond, Prevor, Callender, & Druin, 1997; Friedman & Miyake, 2004; Sonuga-Barke, et al., 2003), prompting speculation that these may reflect a unitary construct in early childhood. Evidence also exists that these aspects of attentional regulation are distinct; these

components show differing developmental trajectories across early childhood (Diamond, 2006) and make unique contributions to children's ability to perform developmentally salient tasks (Carlson, Moses, & Breton, 2002). In a recent review of attentional regulation skills assessed in preschool, Garon and colleagues (2008) argue, that at this age these skills likely reflect a broad unitary construct with discernable components. Whether a unitary construct, or comprised of distinct skills with unique contributions to social-behavioral and learning (or both), the skills underlying attentional regulation work together to support a child's overall capacity for self-regulation. A brief review of each component follows:

Attentional control involves the capacity to interrupt a prepotent, habitual, or reactive response and enact an alternative, subdominant response, in the service of adaptive engagement with the environment (Diamond, 2005). Attentional control plays an important role in supporting self-regulatory capacity, by creating a cognitive delay in responding that allows children to plan, organize and execute future adaptive behaviors (Barkley, 2001; Miyake, et al., 2000). Attentional control has been linked empirically to emerging math and early literacy skills in Kindergarten Children (Blair & Razza, 2007), suggesting that it is an important skill for academic readiness, in addition to behavioral readiness, for school. The ability inhibit prepotent response tendencies may be particularly important for creating the cognitive "space" or opportunity to attend to the relevant aspects of math problems (e.g. noticing a plus sign versus a minus sign), or letter sequences (e.g. noticing when the letter C might be pronounced differently), before trying to solve academic problems.

Attention set-shifting involves the ability sustain and shift attention, maintain concentration, and resist interference and distractions according to situational demands (Posner & Petersen, l990). Children become more skilled at attentional flexibility during the

preschool years which, in addition to supporting adaptive social and learning behaviors, plays an important role in children's ability to regulate their emotional reactivity (Chang & Burns, 2005; Derryberry & Rothbart, 1997). Attentional set-shifting has also been linked empirically to early academic skills, similarly to attentional control (Blair & Razza, 2007). For instance, many academic tasks require the ability to flexibly switch between different but similar types of problem sets.

Working memory allows children to mentally hold and work with information in the environment (Bull & Scerif, 2001). One context in which young children both use and build their working memory skills is during deliberative social role play, which requires children to create mental representations of play scenarios to guide their behavior in a reciprocal manner consistent with play themes and adopted social roles. The increasing complexity and duration of children's social role-playing as they reach elementary school-age, reflects their growing capacity for working memory (Barkley, 2001). Working memory is also related to performance on mathematical problem-solving (Bull & Scerif, 2001; Passolunghi & Seigel, 2001) and reading comprehension (Cain, Oakhill, & Bryant, 2004), such that working memory also has implications for both behavioral and academic school readiness.

All three domains of self-regulation (behavioral, emotional and attentional) theoretically work together to support the child's capacity for successful, goal-oriented behavior in the classroom environment. Consistent with a developmental psychopathology framework, an understanding of the typical, adaptive development of self-regulation is important in informing a full understanding of deficits or delays in self-regulatory processes and their impact on school readiness. The next sections will discuss the typical development

of self-regulation, as well as environmental and biological processes that may influence deficits or delays in self-regulation.

Overview of Typical Development of Self-Regulation

Across infancy and early childhood, children show normative gains in behavioral regulation, including reduction of impulsive behavior, and greater capacity to delay gratification, control motor responding and organize behavior in compliance with social demands. They show improvements in emotional regulation, including the ability to recognize and label emotional expressions, and to understand, empathize with, and respond appropriately to others' emotional displays, and to tolerate frustrations (Calkins, Smith, Gill, & Johnson, 1998). They also show heightened capacity for attentional regulation, and the ability to master cognitive challenges that require working memory, inhibitory control of prepotent attentional responses, and attentional set shifting (Carlson, 2005), which work together to promote self-regulation. Conceptually, the skills associated with behavioral, emotional, and attentional regulation are inter-twined, interfacing with each other to support self-directed and goal-oriented behavior that is responsive to the expectations of the school setting.

These behavioral, attentional, and emotional processes that comprise self-regulation have both environmental and biological influences. The extent to which children can successfully employ self-regulatory processes towards socially-adaptive, goal-oriented engagement in classroom activities at school entry is heavily shaped by both biological and environmental influences. The factors related to successful development of self-regulation, particularly as it relates to school readiness, are discussed further in the following sections.

Environmental Influences on the Development of Self-Regulation

The development of self-regulation in children is dependent from birth on rich environmental stimulation, involving contingent responding, emotional support, attentional support, and verbal stimulation and language input from adults (Campbell & von Stauffenburg, 2008; Landry & Smith, 2008; Shields, et al., 2001), along with continued practice through engagement with peers and shared play experiences as children get older (Bierman, Torres, et al., 2008; Bodrova & Leong, 2006; Vygotsky, 1967). These skills related to self-regulation first begin to develop in infancy, and it is widely documented that parents play a critically important role as a child's first socialization agents, and that parenting practices directly affect children's development of self-regulation (Cummings, Davies, & Campbell, 2000; Fox & Calkins, 2003). Landry and Smith (2007) emphasize the importance of the role of family processes in children's development of self-regulation and eventual readiness for school. They note that parents ideally serve the roles of supporting cognitive development and acting as socializing agents in their children's early years of life. In addition, as children enter school, teachers become important in this same regard to support the development of self-regulation (Shields et al., 2001)

Self-regulatory development is aided though early scaffolding of learning needs, shared engagement with objects in the environment, and use of rich and emotion-focused language, and to some extent by early warm, contingent responsiveness associated with secure attachment, and emotional support (Lengua, Honorado, & Bush, 2007; Li-Grining, 2007). These parenting behaviors are essential in laying the groundwork for children's development of self-regulation and readiness for school, and may be particularly important for children with heightened biological risk, as discussed in the following section.

Kopp (1982) outlined a developmental timeline for the emergence of self-regulatory skills in typically developing children. In her model, young children between 12-18 months are heavily reliant on adults for social cues and assistance in self-regulation. Individual differences in temperament shape the degree to which infants may require support in developing self-regulatory skills. Between 2 to 3.5 years children develop self-conscious, evaluative emotions (e.g. pride, shame, guilt) which begin to internally signal the need to employ self-regulation strategies in response to the social world. By age 5 -7 years, as children are entering school, they are able to make judgments regarding their own behavioral, emotional, and attentional responses, and use past experience, anticipatory planning, and self-monitoring to guide and regulate their behaviors.

As children enter school they begin to form their first friendships (Howes, Hamilton & Philipsen, 1998) providing opportunities for children to engage in more complex and cooperative play sequences (Sebanc, 2003). These experiences are supportive of the development of self-regulation in that behavioral, emotional and attentional regulatory skills are each employed in order to attend to and engage in more complex play and classroom tasks over time. These tasks specifically require behavioral impulse control and motor control to temper desires to grab toys, play or speak out-of-turn, or run around the room at inappropriate times. They require emotional understanding to read the emotional cues of others in social situation in order to respond appropriately and frustration tolerance to remain calm when a frustrating problem-solving situation arises. They lastly require working memory skills to follow and engage in reciprocal play sequences, and attentional control flexibility to stay engaged while responding to the social-emotional and behavioral cues of classmates during active social engagement. Therefore, increased opportunities for

collaborative peer play experiences provide increased support for the development of self-regulation, and vice versa.

As self-regulatory processes are developing, with continual support from parents, teachers, and peer play experiences, externalizing behaviors begin to decrease (Hann & Borek, 2001) and children become better equipped to manage their own emotional and behavioral reactivity, as well as the behavioral, emotional, and attentional demands of the classroom. Yet, just as many early environmental experiences under typical circumstances serve to promote and build self-regulatory development, there are several environmental factors that can contribute to delays in self-regulation and related disparities in readiness for school. For example, there are a number of environmental risk-factors that may hinder parents' ability to provide the most optimal level of social and cognitive stimulation for their children's development of self-regulation. In particular, Campbell and von Stauffenberg (2007) found that children living in single-parent households, particularly minority children, with mothers of lower education and income levels were most likely to have difficulty meeting the regulatory demands of 1st grade, especially if they also had poorer language and cognitive skills. Further, maternal stress or depression, often heightened for single or low-income mothers, is linked with harsh or disengaged parenting strategies that exacerbate children's risk for school un-readiness. The effects of parental stress may be compounded by having children with heightened temperamental impulsivity or biological reactivity, as these children are harder-to-manage and require more parental resources to develop the skills they need for optimal self-regulation.

Poverty associated with single-parenthood, low-income or low educational status more broadly represents a major risk factor for impaired frontal lobe function in children,

deficits in self-regulation and related disparities in school readiness (McLoed, 2008; Shore, 1997). These risks are likely associated with a lack of exposure to both the physical and psychological resources that support self-regulatory development. For example, in addition to the likelihood for decreased parental support or availability under conditions of poverty, lack of nutrition, reduced access to books or computers, lack of exposure to rich language input, and increased likelihood of crowded living conditions all undermine development of self-regulatory skills and contribute to problematic behaviors and underachievement in the school context (Campbell, 1995; Farkas & Hibel, 2008). Risks associated with poverty have been found to be greater for minority children, children of immigrant parents, or children for whom English is not spoken in the home (Farkas & Hibel, 2008).

A comprehensive measurement of environmental influences was outside of the scope of the current project, however I did utilize a sample representing minority children, children for whom English may not be a primary language at home, and children from low-income families (based on demographic information on the entire student body provided by participating school districts) to ensure that data was representative of children who may be experiencing heightened environmental risk for delays in self-regulation and poor school readiness. While not a primary focus of the current project, it is an important research aim to better understand the societal, family, and peer processes associated with children's positive development of self-regulation and their engagement in and readiness for school. Better understanding of the ways in which families and schools can work together to promote children's self-regulatory skills during the transition to school also warrants future research attention.

Biological Influences on the Development of Self-Regulation

Temperament refers to individual differences in characteristic patterns of emotional and behavioral reactivity (Thomas & Chess, 1977; Rothbart, 1989). Most researchers agree that temperament has a strong genetic and biological basis, although the environmental factors described in the previous section and cognitive maturation across early childhood greatly influence the expression of temperamentally-driven patterns of behavior (Rothbart, 2004). During infancy and early childhood, children rely on parents and caregivers to provide opportunities for them to develop an appropriate set of regulatory strategies, including strategies for behavioral, emotional, and attentional regulation. Some children's temperaments, however, make this a harder task for them than for others. Individual differences in biologically-driven reflexive response habits lead some children to experience a relatively higher or lower regulatory load in situations where performance expectations require the suppression and redirection of those reflexive response habits, such as at school. Thus, the task of successful engagement in the classroom, and building and maintaining appropriate relationships with teachers and peers is much harder for some children than others, requiring greater regulatory capacity to manage. Additionally, some caregiver characteristics may make them more or less suited to help children with particular "risky" temperaments develop appropriate regulatory strategies, particularly in the context of environmental stressors. Thus, the notion of "goodness-of-fit" between parent and child characteristics, as well as between broader environmental and child characteristics, also comes into play with regard to the development of self-regulation. As such, children with any type of temperament can develop successful self-regulatory strategies with the appropriate caregiver and environmental supports; however some temperamental styles can

place children at higher risk for delays in self-regulation, particularly if those supports are lacking.

Children with temperamental characteristics associated with surgency, including a tendency towards impulsivity and a sensation-seeking drive, are genetically predisposed to actively explore their environment, to seek out novelty, and to engage in risk-taking activities that elevate arousal (Rothbart, 2004). These children are often more likely to have difficulty with self-regulation (in particular, behavioral self-regulation), placing them at risk for difficulty in the school context (where behavioral compliance is essential), for problems in social interaction, and for psychiatric disorders such as ADHD (Rothbart, 2004; Sonuga-Barke et al., 2005).

Related difficulties are also likely to be present in children who exhibit temperamentally-driven emotional reactivity (Cole, et al., 1994; Rothbart, 2004). This temperamental dimension reflects the level of arousability or reactivity shown in response to environmental stressors or challenges. When reactivity is high, it creates a greater need for regulatory control in order to over-ride maladaptive reflexive or prepotent behavioral and emotional reactions and replace them with more adaptive responses (Börger & van der Meere, 2000; Rothbart, 2004). The level of individual arousal or reactivity to threat or stress is also driven by the hypothalamic-pituitary-adrenal axis (HPA axis), part of the limbic system in the brain responsible for the control or reactions to stress and regulation of mood and emotion. Over-activity of HPA axis related to environmental stress or biological vulnerability drives heightened emotional reactivity. Children who experience stressful early socialization experiences, such as isolation or threat, may experience heightened HPA

reactivity, increasing the frequency and strength of reflexive behavioral, emotional, and attentional reactions that compete with and may over-ride regulatory attempts.

Children who are highly emotionally reactive to environmental stressors have particular difficulty in the face of social and learning challenges, as they are prone to rapid shifts in mood, and angry or volatile outbursts. Thus, these children have greater difficulty tolerating frustration, remaining calm, waiting for assistance or suggestions from others, generating solutions to problems, or thinking flexibly, as these reactions overload their self-regulatory resources, which are conceptualized to be occupied in modulating their heightened emotional response, leaving fewer resources for positive social and learning engagement.

Thus, according to the current model, self-regulation is linked directly to a child's capacity to respond to the social, academic, and behavior demands of school, such that successful regulation of certain temperamentally-driven characteristics is expected to directly contribute to school readiness (Rothbart, 2004). For example, children who experience heightened impulsivity, and thus may have particular difficulty with behavioral impulse control, may find the behavioral and social demands of school more challenging, particularly the demands for aggression control and social cooperation. Alternatively, children with a tendency towards high emotional reactivity, may find demands for active social participation, goal-oriented classroom engagement more difficult. These children likely require more behavioral, emotional, and attentional resources (in addition to caregiver support) to remain calm and in a position to effectively problem-solve and engage with classroom activities.

Self-regulation associated with these temperament-based characteristics has been referred to often in the literature as *effortful control* (Rothbart & Ahadi, 1994). Effortful control has been labeled as the ability to inhibit a dominant response in favor of a

subdominant response, particularly in the presence of immediate cues for reward or punishment. Thus, it has an affective or motivational component important to its conceptualization. In their review of effortful and reactive process in temperament, Derryberry and Rothbart (1997) discuss the idea that effortful control represents individual differences in the ability to regulate negative emotion (eg. frustration and anger) and affectively-driven behavior (e.g. grabbing or physical aggression), which reflects strong temperamental roots as well as early socialization influences. Recent studies have linked teacher ratings of effortful control in Kindergarten with mathematics ability and letter knowledge (Blair & Razza, 2007), suggesting that impulse control and emotion regulation associated with effortful control are important to both social-behavioral and academic school readiness. Additionally, effortful control is viewed as being supported by the neural systems responsible for the development of executive functioning, which also involves attentional regulation, in addition to planning, and the ability to detect errors (Barkely, 2001; Jones, Rothbart, & Posner, 2002).

In sum, self-regulatory skills, primarily integrated and employed through the work of the prefrontal cortex, thus have the dual-role of modulating the temperamentally-based arousal systems including impulsivity and reactivity, along with supporting adaptive social and learning behaviors consistent with environmental demands (Blair et al., 2005; Derryberry & Rothbart, 1997). The frontal lobes are specifically responsible for integrating incoming information about emotions, environmental demands and shifting contingencies, anticipatory planning, and selection and of behavioral responses consistent with environmental demands (see Stieben et al., 2007). Thus, the prefrontal cortex is central to behavioral, emotional, and attentional self-regulation, and children develop the ability to employ these regulatory

processes both for regulating their biologically-driven response tendencies and for the promotion of the social-emotional skills and behaviors required for successful school readiness. As a result, children with heightened temperamental impulsivity and reactivity may need to employ greater self-regulatory capacity, driven by development of prefrontal cortex, to help them inhibit impulses, or temper heightened reactivity for successful engagement in school activities than other children. In sum, the current model suggests that children are rapidly developing self-regulatory capacity across early childhood, and this development is influenced by environmental factors, temperamental and biological factors, and brain maturation. Risk associated with any or a combination of these factors may lead to a delay or deficit in the development of self-regulation. The current project focuses on attentional, behavioral and emotional self-regulatory processes in a sample representative of those with heightened environmental risk.

Exploration of the Interplay of Self-Regulatory Processes and School Readiness

The current model is consistent with existing theories about the role of behavior, attention, and emotion in self-regulation. For example, Blair and Diamond (2008) describe self-regulation as the voluntary cognitive and behavioral process that an individual uses to maintain levels of arousal that are favorable to positive adaptation in social and learning contexts. Smith-Donald and colleagues (2007) similarly refer to self-regulation as involving "modulating systems of emotion, attention, and behavior in response to a given situation or stimulus" (p.174). By these conceptualizations, behavioral, attentional, and emotional self-regulatory processes work in tandem to support adaptive functioning.

Because of the multi-faceted nature of self-regulation, and the various pathways by which deficits in self-regulation may lead to poor school readiness outcomes, it is likely that

children with difficulties in school readiness will emerge with heterogenous patterns of behavior related to different aspects of self-regulation. For instance, children with poor impulse control may have different school readiness problems (e.g. hyperactivity) than children with poor emotion regulation (e.g. internalizing problems) or poor attentional control (e.g. academic learning problems).

It has been suggested that impulse control may be a more primary regulatory process shaped, in part, by the development of other regulatory processes (Kochanska et al., 1996). Children with greater biological risk for poor impulse control (e.g. high temperamental impulsivity) may then particularly need to employ other regulatory strategies (attentional control and emotion regulation) to "compensate" or protect against difficulties associated with poor impulse and motor control. Thus, successful adjustment to school may be more difficult for children with less regulatory control over their impulsivity or activity-level. These children need to employ their developing attentional self-regulation (attentional control, attention set-shifting, and working memory) and emotion regulation (frustration tolerance and emotional understanding) towards supporting and maintaining optimal levels of behavioral responding, more so than children with better behavioral impulse control. Success in the school environment for these children, therefore, places greater overall demand on their cognitive resources. On the other hand, children exhibiting less temperamental impulsivity and/or those who have better control over their impulsivity may need fewer other regulatory resources to successfully navigate the goal-oriented social and learning tasks reflective of school readiness. While it remains an empirical question, there is some evidence to suggest that attentional and emotional regulation may serve as moderators of the relationship between behavioral impulsivity and school readiness.

Elias & Berk (2002) found that engagement in complex sociodramatic play with peers, a task of early childhood theorized to build attentional (Bodrova & Leong, 2006) and emotional competence (Bierman, Greenberg, & CPPRG, 1995) in preschool predicted improvements in behavior only for highly-impulsive children. These findings suggest that the building of attentional and emotional regulation skills may be more important for impulsive versus non-impulsive preschoolers in terms of their behavioral outcomes. On the other hand, solitary play was negatively correlated with improvements in behavior, suggesting that, without the typical opportunities to build attentional and emotional regulatory skills, children with high levels of impulsivity may have more difficulty adjusting the school environment.

Other researchers have focused on the development of emotional regulation as central to the capacity for individuals to regulate high levels of temperamental impulsivity or surgency. Greenberg, Kushe, Speltz (1991) argue that the ability recognize and label emotional states serves to aid children's control of behavioral impulses. Carlson & Wang (2007) discovered that emotion regulation (including emotional understanding) in preschool was significantly positively correlated with behavioral impulse control on a series of delay tasks. Emotional understanding (ability to label emotions and recognize emotional states) and frustration tolerance (ability to modulate negative reactions to disappointing or frustrating situations), both may provide children, particularly those with heightened impulsivity, an important means of both supporting their greater challenge for impulse control, and engaging appropriately with the social and learning tasks of school. More empirical work is needed, however, in examining the potential protective effect of attentional or emotional regulation on the impact of impulsivity on school readiness outcomes.

Thus, given these findings, it is worth exploring empirically whether the presence of age-appropriate attentional and emotional regulation might each buffer the impact of direct measures of impulse control on school readiness outcomes. Few studies have directly examined the interplay between attentional control and emotional regulation and direct measures of impulse control, particularly as it relates to school readiness. Doing so is worthwhile from both a research and intervention standpoint particularly as it relates to children at-risk for problems with self-regulation and school readiness.

Aim 2 of the present study is to test whether these three dimensions of self-regulation were each associated in significant and unique ways with measures of social-behavioral school readiness, including learning readiness, relationship skills with teachers and peers, and behavior problems. A second element of Aim 2 is to explore the extent to which attentional and emotional regulation may moderate the relationships between impulse control and these school readiness outcomes. The role of self-regulation in supporting these domains of school readiness is explored further in the following sections.

Linking Self-Regulatory Processes and Specific School Readiness Outcomes

As stated at the outset, developmental researchers have posited that self-regulatory processes underlie and support the capacity for success in the school context, through the promotion of enhanced learning engagement in the classroom, positive relationships with teachers and peers, and reduction of child risk for behavior problems, and they provide initial data to support this claim (Blair, 2002; Bodrova & Leong, 2006; Fantuzzo et al., 1999; Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Smith-Donald et al., 2007). For example, Fantuzzo and colleagues (1999) found a positive relation between emotional self-regulation and both attention/persistence and attitudes toward learning in Kindergarten.

Additionally, children's attention and executive control, impulse control, and task-based compliance have each been associated with behavior and social skills in the preschool classroom (Smith-Donald et al., 2007).

Just as self-regulation supports school readiness, children delayed in their development of self-regulation are at risk for difficulty in school and psychological adjustment upon school entry, including peer rejection, disruptive behavior problems, conflict with teachers, and low achievement (Blair, 2002; Fantuzzo, et al., 1999; Hamre & Pianta, 2001; Hughes, White, Sharpen, & Dunn, 2000). Therefore, greater understanding of the relationship between self-regulation and school readiness is an important research aim towards informing the prevention of school-related adjustment in children. The following sections review existing findings elucidating a direct link between measures of self-regulatory processes and indices of school readiness.

Learning Readiness

Variously referred to as involving positive *classroom participation* (Ladd et al., 1999), *learning* or *classroom engagement* (Yen, Konold, McDermott, 2004), *approaches to learning* (Fantuzzo, Perry, & McDermott, 2004), learning readiness reflects a child's ability to become an interested, active, attentive, and cooperative partner in classroom learning. Key elements of learning readiness involve the child's capacity to show high levels of self-reliance, motivation and persistence in approaching learning tasks, which in turn, predicts academic achievement (Hughes & Kwok, 2006; Finn, 1993; Ladd et al., 1999; Bierman, Nix, et al., 2008). These skills have been found to contribute to both social and academic success in school (Ladd et al., 1999). For the purposes of this project, learning readiness is measured with teacher ratings reflecting classroom engagement and academic readiness.

Success in a learning context, such as the classroom, inherently requires behavioral regulation, or the ability to delay impulsive behavioral responding and resist temptations (Bembenutty & Karabenick, 2004). For instance, children need to be able to listen and understand the directions before jumping into learning tasks, particularly those which may seem more fun or harder to wait for, in order to experience success. The ability to delay responding in accordance with learning goals increases the likelihood that learning tasks will be successfully completed

Prior research suggests that attentional regulation skills, particularly working memory and attentional control, are associated with positive classroom engagement, with positive correlations emerging between child attentional regulation skills and teacher ratings of classroom participation (Bierman, Torres, et al., 2008). Performance on tasks requiring working memory and attentional control, have also demonstrated associations with academic achievement in kindergarten, including mathematics knowledge, letter knowledge, and emergent literacy skills (Bierman, Torres et al., 2008; Blair & Razza, 2007). These relations were present after accounting for children's level of general intelligence, suggesting that attentional regulation skills show unique prediction to academic achievement at school entry. The Head Start REDI outcome studies demonstrated that child performance on tasks of attentional regulation (Backward Word Span, Peg Tapping, Dimensional Change Card Sort) at the beginning of the pre-kindergarten year predicted gains in language/literacy skills at the end of the year (Bierman, Nix, et. al, 2008) indicating a link between this set of self-regulatory skills at school entry and later academic readiness (Bierman, Domitrovich et al., 2008).

Additionally, Trentacosta & Izard (2007) found that teacher ratings of attention directly predicted academic competence, and that teacher ratings of emotion regulation predicted academic competence indirectly through ratings of attention. They concluded that children who are more skilled at managing their emotions succeed academically because emotion regulation promotes positive attention towards classroom tasks and activities. Emotional understanding, specifically, has also been associated with academic readiness in recent research, such that greater emotional recognition and emotion situation knowledge is associated with better academic performance (Garner & Waajid, 2008; Raver, Garner, & Smith-Donald, 2007; Trentacosta & Izard, 2007).

This set of studies suggests that self-regulatory skills are associated with learning readiness among kindergarten and pre-kindergarten children, and that the dimensions of behavioral, attentional and emotional regulation may each play an important role in promoting learning readiness.

Relationship Skills

The capacity to form positive relationships through active, prosocial, warm engagement with teachers and peers during preschool and kindergarten is related to positive adjustment in elementary school (Ladd, Price, Hart, 1988; Pianta, Steinberg, & Rollins, 1995). Relationship skills develop through positive social engagement. As previously mentioned, children who are engaged with others have more opportunities to practice conflict resolution and prosocial skills in general (Coolahan, Fantuzzo, Mendez & McDermott, 2000), and may also have more opportunity to engage in complex and dynamic play sequences that are important for building self-regulation (Vygotsky, 1933/1966).

Through play with others, preschool children create their own opportunities for learning how to successfully manage relationships and develop social skills (Gottman, 1983). Therefore, social engagement is an important element to the development of relationship skills. Children who are not socially engaged, on the other hand, may have a difficult time developing prosocial skills and creating positive relationships with their teacher and peers (Bierman, 2004). Reflecting the importance of positive peer involvement to school readiness, the development of prosocial behavior (e.g. helping, sharing, taking-turns, social problem-solving) during preschool and kindergarten is predictive of concurrent and later elementary school engagement and academic readiness (Howes et al., 1998; Ladd et al., 1988).

Similarly, a child's capacity to form a positive relationship with his or her teacher appears important to school success, predicting enhanced academic achievement and fewer behavior problems over time (Birch & Ladd, 1997; Garner-Waajid, 2008; Hamre & Pianta, 2001). Positive classroom engagement and positive child-teacher relations are correlated (Birch & Ladd, 1997), and children who show greater classroom engagement elicit higher levels of involvement and support from teachers (Skinner & Belmont, 1993).

Attentional regulation appears to contribute to children's successful interactions with their teachers and their capacity to form positive and supportive relationships with them (Blair, Denham, Kochanoff, & Whipple, 2004). Similarly, measures of attentional regulation, especially working memory and attentional control skills are positively associated with and predictive of teacher-rated pre-kindergarten and kindergarten prosocial behavior (Bierman, Nix et al., 2008; Bierman, Torres, et al., 2008; Smith-Donald et al., 2008). Emotion regulation and understanding have also been linked to prosocial behavior in the

early school years (Eisenberg, et al., 1997; Greenberg et al., 1991). Behavioral regulation is also necessary to forming positive, sustained relationships with teachers and peers, and has been associated in preschool with social competence over time (Mischel, Shoda, & Rodriguez, 1989). The ability to regulate emotional and behavioral reactivity allows for greater capacity to generate and evaluate solutions in the face of normative social conflict.

Based upon these studies, attentional regulation (including working memory and attention set-shifting), emotion regulation (emotional understanding and frustration tolerance) and behavioral regulation (behavioral impulse control and motor control) may play particularly important roles in promoting the child's capacity to form and sustain positive peer and teacher relationships in the early school years.

Behavioral Problems

Just as relationship skills and positive social engagement are positively linked with self-regulatory skills and other aspects of school readiness, behavioral problems, including interpersonal conflict with teachers and peers, hyperactivity, and aggression or opposition, significantly impair preschool and kindergarten children's chances at school success in later elementary school (Gilliam, 2005). For example, student-teacher conflict has negative implications for children's ability to succeed both academically and behaviorally at school (Birch & Ladd, 1997; Garner-Waajid, 2008; Hamre & Pianta, 2001). Similarly, difficulties getting along with peers often co-occur with low levels of classroom engagement (Bierman, Torres et al., 2008; Fantuzzo et al., 1999).

Student-teacher conflict has been found to reflect underlying problems with self-regulation, above and beyond general cognitive delays. Eisenhower, Baker, and Blacher (2007) found that while children with intellectual disabilities tended to have poorer student-

teacher relationship quality at age 6 than typically developing children, rather than reflecting IQ differences between groups, student-teacher relationship quality was more strongly related to early difficulties with self-regulation and behavior problems. In fact, the association between child intellectual disability and student-teacher relationship quality at age 6 was mediated by behavioral self-regulation (delay of gratification) at age 3, and behavior problems at ages 3 and 6, suggesting that behavioral self-regulation plays an important role in predicting later interpersonal competence and relationships with teachers.

Emotional regulation has also been found to negatively predict student-teacher conflict. Shields and colleagues (2001) specifically found a negative association between emotion regulation and student-teacher conflict, and a positive association between emotional lability and student-teacher conflict, in both cases controlling for effects of child age. Similarly, high levels of impulsivity and poor impulse control can contribute to child-teacher conflict (Myers & Pianta, 2008), such that highly impulsive children can be hard-to-manage for teachers and add to strain on both parties' ability to establish a warm, beneficial relationship in a bidirectional and transactional manner (Doumen, et al., 2008)

Self-regulation skills similarly appear to buffer against negative peer interactions by fostering children's ability to inhibit aggressive or disruptive behavior, attend to social cues, and engage in flexible problem-solving with peers (Hughes & Kwok, 2006). Smith-Donald and colleagues (2007) noted that attentive and patient behavior on a one-time assessment of self-regulatory skills, as rated by the assessor, along with children's organized task compliance and attentional regulation were each associated with teacher reports of children's ability to negotiate peer conflict. Conversely, Calkins, Gill, Johnson, and Smith (1999)

found that distress to frustration (poor emotional regulation) was associated with conflict with peers in early childhood.

Hyperactivity in the school environment also impedes students' ability to engage successfully in learning tasks and to work together with peers during both learning and play tasks, therefore posing a risk for positive adjustment to school and school readiness. Clinical levels of hyperactivity have long been related to underlying problems with self-regulation, in particular, behavioral impulse control and recent studies have confirmed that link (Barkley, 1997; Nigg 1999; Sonuga-Barke, et al., 2003). Problems with attentional regulation have also been implicated in the manifestation of hyperactivity (Walcott & Landau, 2004; Nigg, Blaskey, Huang-Pollock, & Rappley, 2002; Sonuga-Barke et al., 2003). Although it has received much less empirical attention, emotional regulation and emotional understanding has also been linked with hyperactivity in children. For instance, Maedgen and Carlson (2000) discovered that children with combined clinical levels of hyperactivity and inattention had greater levels of emotional reactivity characteristic of emotional dysregulation than children only exhibiting clinical levels of inattention.

Aggressive-oppositional behavior problems also impair adjustment at school, and predict to social and academic difficulties (Bierman, Torres et al., 2008; Hughes et al., 2000; Vitaro, Tremblay, Gagnon, & Boivan, 1992). These externalizing problems are associated with poor impulse control and high negative reactivity as children transition from preschool to elementary school (Ladd & Profilet, 1996; Vitaro et al., 1992). On the other hand, children who are able to successfully employ self-regulatory processes towards modulation of reactivity are better able to resolve conflicts without the use of aggression (Vitaro et al., 1992). Specifically, increases in the use of language, particularly emotional knowledge and

verbal communication of feeling states, is associated with more effective conflict management (Greenberg, et al., 1991) and likely contribute to normative decreases in aggression during the preschool years.

Inability to flexibly adapt to changing circumstances is additionally related to high rates of disruptive behavior during the school years (Coie & Dodge, 1998). Specifically, Hughes, White, Sharpen and Dunn (2000) found low executive function skills among highly aggressive preschool children. These attentional deficits may be particularly apparent for aggressive children who do not engage in the social environment (aggressive-withdrawn children), as these children lack the opportunity to practice employing attentional resources towards engagement in alternative conflict management strategies (Bierman, Torres, et al., 2008).

These studies suggest that all three aspects of self-regulation under study may predict (inversely) to interpersonal conflict and externalizing behavior problems in the school context. Behavioral, emotional and attentional regulation may each facilitate the control of aggressive or disruptive impulses, and also support alternative, adaptive means of solving interpersonal conflicts.

Summary: Self-Regulatory Processes and School Readiness

Conceptually, self-regulatory processes, including behavioral regulation (behavioral impulse control and motor control), emotional regulation (emotional understanding and frustration tolerance), and attentional regulation (attentional control, attentional flexibility, and working memory), promote a variety of indices of school and psychological adjustment. However, much of the available research has examined relations between parent- teacher- or observer-rating of behavior thought to reflect self-regulation and other ratings of school

readiness, without directly assessing the degree to which direct assessments of self-regulatory skills underlie and support school readiness.

Direct measurement of self-regulation in children often utilizes carefully controlled scenarios and tasks designed to elicit specific reactions, as well as videotaping and micro-coding of emotional and behavioral responses. These assessments have almost exclusively been limited to lab-based settings, due to the complexity of this type of data collection. Measures of self-regulation in "real-world" settings, such as the classroom, have typically relied on teacher or parent ratings of child behavior, due to space constraints and the difficulty of videotaping in field research. Thus the extent to which findings can inform the influence of self-regulation and school readiness or the design and evaluation of school-based interventions that directly target self-regulation has historically been limited.

Those studies which have directly measured self-regulation have tended to focus on just one domain, or at most two domains, of self-regulation and its relation to adaptive functioning. Research demonstrating specific links between an array of self-regulatory skills associated with the development of the prefrontal cortex and school readiness is just emerging. Recently, Smith-Donald and colleagues (2007) developed and validated a field-based assessment of emotional, attentional, and behavioral self-regulatory skills that includes direct assessment of preschool children. Their protocol was found to reliably measure both behavioral inhibition and executive control (attentional regulation). Aim 1 of the current study employs many of the multi-method, multi-informant strategies validated by Smith-Donald and colleagues (2007) and those used successfully in other field-trials (e.g. Bierman, Domitrovich, et al., 2007). The current project also piloted an additional field-based assessment (adapted from lab-based measures) of emotional regulation (frustration tolerance)

to determine whether it was feasible to collect reliable and valid information in field-based research on children's ability to regulate emotional reactivity.

The first aim of the current project is to contribute to a growing research base by collecting direct assessment measures that represent the range of behavioral, emotional, and attentional skills postulated to represent self-regulation and test the hypotheses that this set of skills are differentiated in a factor analysis. The second aim is to test the hypothesis that these three dimensions of self-regulation will show direct, independent and significant associations with teacher and observer-rated measures of learning readiness, teacher and peer relationships, and disruptive behavior problems in school. In doing so, these first two aims of the current project aimed to provide validation for targeting self-regulatory processes in preventive interventions for children showing low levels of classroom engagement at school entry.

Intervention Approaches Fostering Self Regulation

Based upon a model in which self-regulatory skills play a central role in promoting school readiness, researchers have called for studies to inform the direct promotion of self-regulation in early childhood educational settings as a means of enhancing behavioral compliance, motivation, cooperative participation, self-reliance, and task persistence needed for positive school and psychological adjustment (Fantuzzo et al., 1999; McClelland et al., 2006; Shonkoff & Phillips, 2000; Smith-Donald et al., 2007). The findings highlighted thus far suggest that preschool interventions designed to reduce problem behaviors and promote school readiness should emphasize the promotion of self-regulation, rather than rely on prohibitions and exclusionary controls (e.g., time-out) that might reduce problematic behaviors without building the critical self-regulatory skills needed for long-term adjustment

(Bierman, Miller & Stabb, 1987). However, there remain differences in perspective on the optimal intervention strategies for promoting self-regulation in order to foster school readiness.

Social-Emotional Learning Approaches to Improving Self-Regulation

The Preschool PATHS curriculum. One approach to promoting school readiness directly targets the social-emotional skills thought underlie self-regulation. For example, several "universal" prevention programs have proven effective with preschool children, demonstrating specific positive effects on emotional understanding and broad behavioral, emotional and attentional self-control in randomized trials. One such program, the *Preschool PATHS (Promoting Alternative Thinking Strategies)* Curriculum (Domitrovich, Greenberg, Cortes, & Kushe, 1999) was designed to prevent behavioral and emotional dysregulation in young children and foster social-emotional competence. It is based on a model of development that incorporates behavioral, emotional, and attentional self-regulatory skills towards the organization of behavior around social-emotional competence (The ABCD: Affective- Behavioral-Cognitive-Dynamic model of development) (Greenberg & Kusche, 1993; Greenberg, et al., 1991).

Preschool PATHS includes lessons in which teachers illustrate skill concepts with puppets, pictures, and story examples. It also includes "extension activities" which give children additional opportunities to practice, generalize and internalize skills in naturalistic peer settings. The skill domains targeted by Preschool PATHS include: 1) friendship skills and prosocial behaviors (helping, sharing, taking turns), 2) emotional understanding (recognizing and labeling core feelings), 3) self-control (using the "Turtle Technique" to stop, self-calm, and identify the feeling and problem), and 4) social problem-solving

(identifying the problem, generating solutions, considering consequences, and choosing the best plan). Preschool PATHS thus targets several skills conceptualized as central to self-regulation –behavioral impulse control, emotional understanding, frustration tolerance (e.g. "doing Turtle"), and, to some extent, attentional regulation skills (e.g., anticipatory planning, flexible problem solving).

Two studies testing Preschool PATHS revealed that it is effective in improving social-emotional competence (Bierman, Domitrovich et al., 2008; Domitrovich, Cortes, & Greenberg, 2007). The most recent trial of Preschool PATHS, combined with teacher training to improve language use, specifically showed that it produced gains in child attentional regulation skills (performance on a task (DCCS) measuring attentional control and attentional set-shifting), along with gains in task orientation, vocabulary, emergent literacy, emotional understanding, social problem-solving, social behavior and learning engagement that exceeded gains among children in control classrooms (Bierman, Domitrovich et al., 2008; Bierman, Nix et al., 2008).

The Tools of the Mind Program. Recent research suggests that an alternative universal intervention designed to promote social-emotional and self-regulatory skills may also be effective with preschool children -- the *Tools of the Mind (ToM)* program (Bodrova & Leong, 2006). The premise of this program is that play provides a unique opportunity for developing critical self-regulatory skills (Vygotsky, 1933/1966), and, given the right structure, that the practice of self-regulation can be incorporated into any activity (Bodrova & Leong, 2006). Like Preschool PATHS, ToM is designed to promote self-regulation. However, rather than doing so with lessons and extension activities, ToM uses an "immersion" approach, in which classroom activities and learning activities are re-structured

in ways that, theoretically, support greater self-regulatory skill development. In other words, Tools of the Mind utilizes techniques for "scaffolding" the development attentional regulation, in particular, as part of all classroom activities throughout the day.

Techniques include scaffolding of make-believe play quality so it fosters self-regulatory skill, and integrating self-regulatory components into literacy and math activities. Specific strategies include play planning and social role enactment with emphasis on reciprocal interaction, negotiation, and sustained role playing. Thus, the primary method by which self-regulation and attentional training is approached in Tools of the Mind is through engagement in intentional dramatic play (Vygotsky, 1967). In this program children develop "play plans" with support from teachers that involves a social role and planned behavior (e.g. a firefighter going to put out a fire). Developing play plans requires children to engage in immediate future planning and behavioral organization. Pretend social play also requires children to exercise all three of the core attentional regulation skills, as well as behavioral regulation skills (Blair & Diamond, 2008). Specifically, role-playing requires children to hold their own character role and those of others in mind, exercising working memory. Successful social play also requires children to inhibit behavioral impulses to act out of character, and employ attentional set-shifting skills to flexibly adapt to unexpected changes in play scenarios. In addition, the ToM program uses non-pretend games designed to teach self-regulation and reflective thinking, which involve turn-taking, remembering and carrying out pre-planned behaviors over impulsive behaviors.

Preliminary research evaluating the ToM program shows that children in ToM classrooms performed significantly better on tests of attentional regulation, had higher

assessed vocabulary and fewer teacher-reported behavior problems than control children (Diamond, Barnett, Thomas, & Monroe, 2007; Barnett, Yarosz, Thomas, & Hornbeck, 2007).

Limitations of the Universal Social-Emotional Learning Programs for High-risk Children

Although "universal" preschool programs designed for the teacher to implement universally look promising, there are reasons to expect universal programming alone to be insufficient in meeting the needs of the most high-risk students who enter pre-kindergarten or kindergarten with significant deficits in self-regulation and very low levels of classroom engagement (Bierman et al., 1996). Such children may require additional, intensive coaching using a selective or indicated model of service delivery, in order to bring them up to a normative level of skill.

Evaluation of the Head Start REDI intervention, which utilized the Preschool PATHS curriculum revealed that pre-intervention self-regulatory skills moderated some intervention effects, such that children with lower initial levels of self-regulatory skills (e.g. behavioral inhibition) showed greater gains in social-emotional competence and reduced aggression as a result of intervention than children with high self-regulation skills at school entry (who showed no gains as a result of intervention) (Bierman, Nix et al., 2008). Results suggest that children low in self-regulatory ability may benefit more from interventions designed to promote self-regulation than other children. Importantly, however, the universal intervention was not sufficient to bring the highest risk children up to normative levels on self-regulatory and social-emotional adjustment skill domains, pointing to the importance of indicated interventions to provide intensive support to the highest risk children.

Similarly, Elias & Berk (2002) conducted a quasi-experimental study testing the assumption that sociodramatic play in early childhood contributes in important ways to the development of self-regulation, by examining whether the association between sociodramatic play and self-regulation differed for impulsive versus non-impulsive preschoolers. They found that engagement in complex sociodramatic play predicted improvements in self-regulated behavior during clean-up periods, whereas engagement in solitary play was negatively correlated with improvement in self-regulated behavior during clean-up tasks. Notably, improvements in self-regulation associated with complex sociodramatic play were only present for highly-impulsive children. Findings suggest that interventions involving sociodramtic experiences may be especially important for the most impulsive children, who are delayed in their development of self-regulatory processes.

At the elementary school level, there are a number of indicated intervention programs designed to promote the social-emotional skills of children with school adjustment difficulties (Bierman, 2004), but such programs are rare at the preschool and kindergarten level. For example, in the Fast Track Program designed to prevent conduct disorders (CPPRG, 1992), all children in participating schools received the PATHS Curriculum delivered by their classroom teachers, and children exhibiting high rates of aggressive behavior also received an intensive social-emotional skill training program as a supplemental, indicated service (Friendship Group). The combination of intervention components produced reductions in aggressive behavior, increases in social competence, and improvements in social preference in first grade compared with children in a randomized control group (CPPRG, 1999). The Friendship Groups employed the same intervention techniques as PATHS, with added emphasis on ameliorating deficits in prosocial skills and

more focused time spent practicing self-control skills during actual peer interaction (Bierman, et al., 1996).

Similarly, the Dina Dinosaur School (Webster-Stratton, Reid, & Hammond, 2004) represents an indicated social-emotional skill training program developed for 4-8 year old children with Oppositional Defiant Disorder. Dinosaur School follows a social-emotional learning model similar to that of Preschool PATHS. Skills targeted include prosocial behavior, conflict resolution, perspective-taking, self-control, and communication. Evaluation of Dina Dinosaur School, administered alone, indicates that it effectively improves prosocial social problem-solving skills (Webster-Stratton et al., 2004; Webster-Stratton, Reid, & Stoolmiller, 2006).

While there is some evidence that indicated social skill training programs like the Fast Track Friendship Group and Dinosaur School promote behavioral improvements, no indicated social skill training program has been evaluated in terms of impact on the self-regulatory skills thought to underlie classroom engagement and adaptive approaches to learning (e.g., behavioral impulse control, motor control, frustration tolerance, emotional understanding, attention control and flexibility, and working memory). Also, since existing indicated programs target elementary children (either excluding pre-kindergarten children or including them in the same program designed for elementary children), they include cognitive material and behavioral expectations that may overwhelm the capacities of 4- and 5-year-olds who exhibit significant delays in social-emotional maturity and school readiness.

Summary of Intervention Approaches and Future Research Needs

Evidence suggests that universal social-emotional learning programs can promote self-regulatory skills when used with young children, and that focusing on self-regulation in

early school-based intervention programs may be more important for enhancing readiness at school entry than approaches focused primarily on managing or reducing problem behaviors. Children who show deficits in self-regulation at school entry may be particularly in need of an additional selective intervention designed to foster their self-regulatory skills. It is important, therefore, to identify valid screening methods for identifying the most at-risk children, and aspects of self-regulation which may be most amenable to change via an indicated school-based intervention. Existing social-emotional learning programs provide a solid basis for the design of an indicated program tailored to the needs of 4 and 5 year old children exhibiting poor self-regulation and risk for school readiness problems. New design features might further enhance the impact of these programs for this population and research is needed to document "proof-of-concept" and effectiveness with children this age.

The current study drew on the strengths of the best established programs for promotion of self-regulatory skills and school adjustment (particularly Preschool PATHS, the Fast Track Friendship Group program, and ToM) to create an intensive, short-term pilot intervention for 4- and 5-year old children at high risk for school adjustment problems due to low levels of classroom engagement and perhaps underlying self-regulatory deficits. The intervention program targeted the self-regulatory skills hypothesized to underlie school readiness, emphasizing behavioral, emotional, and attentional regulation using techniques and activities drawn from existing programs and organized according to a developmental scope and sequence, within a "coaching" framework.

Thus, the intervention designed and evaluated as part of Aim 3 of the current study combined components of the Preschool PATHS and Fast Track Friendship Group program with scaffolded, scripted play experiences similar to those used in Tools of the Mind,

organized to address the particular needs of pre-kindergarten and kindergarten children with self-regulatory deficits and poor school readiness.

Aim 3 had the dual-goal of 1) evaluating the impact of this short-term intervention on children's self-regulatory skills and school adjustment in the context of a randomized-controlled design, and 2) exploring the degree to which pre-intervention deficits in self-regulatory skills moderated intervention response.

Hypotheses and Planned Analyses

The current project is comprised of three related study aims:

Aim 1: The first aim was to test the hypothesis that three dimensions of self-regulation (behavioral, emotional and attentional) would emerge distinctly in a factor analysis. This hypothesis was tested via exploratory factor analysis of a variety of direct assessment tasks designed to tap these three dimensions.

Aim 2: The second aim was to test the hypothesis that these three dimensions of self-regulatory skills would be associated in significant and unique ways with measures of social-behavioral school readiness, including learning readiness, relationship skills with teachers and peers, and behavior problems. In addition, the interactions among self-regulatory processes and their impact on school readiness were explored in order to further understand how self-regulatory processes work together to support school readiness for at-risk children.

Individual predictions of three domains of self-regulation to school readiness were tested using partial correlations. To determine unique prediction among the domains of self-regulation to school readiness, and to explore moderation, hierarchical linear regression was employed. All Aim 2 analyses controlled for child age, sex, and intellectual functioning.

Aim 3: The final aim of the project was to evaluate the impact of a short-term intervention designed to promote social-emotional and self-regulatory skills on a sub-group of children identified with low levels of school readiness using a series of ANCOVAS, with pre-treatment functioning, child age, sex, and intellectual functioning controlled.

An additional goal of Aim 3 included the examination of the moderation of intervention response based upon the severity of initial self-regulatory skill deficits. Due to restricted sample size, this was tested by analyzing children with self-regulatory deficits and those with no deficits separately using the same analytic strategy just outline. Lastly, to explore whether *specific* self-regulatory deficits were more amenable to improvement via this intervention, a Chi-Square analysis examined the proportion of children with specific deficits who were remediated as a result of participation in intervention versus control activities.

Implications of the results of Aim 3 analyses for informing intervention strategies to improve school readiness for high-risk children with identified deficits in self-regulation are discussed.

Chapter 3. METHOD

Participants

Participants included 192 children recruited from 22 pre-kindergarten and kindergarten classrooms in 3 school districts in Pennsylvania. Children were excluded from the final sample if they did not speak or understand English to the extent that assessors felt their assessment was not valid (n = 1), and if they were previously identified with significant developmental delays (n = 1).

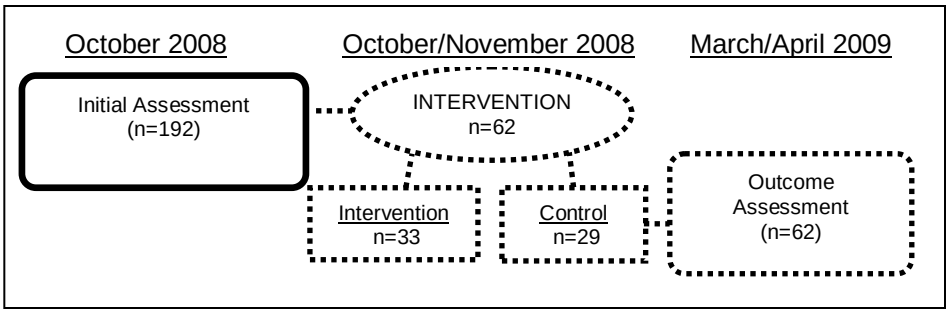
This project aimed to understand risk factors for psychological maladjustment as they apply to children from a variety of backgrounds, particularly children growing up in poverty, including those from under-represented populations. Therefore, efforts to recruit participants concentrated on school districts that serve a high percentage of children who qualify for free/reduced lunch and that include both rural and urban areas (the latter serving populations where there are high concentrations of Hispanic children). The final sample was approximately 72% rural (43 children (22%) were from Bellefonte area schools, 95 (50%) were from Mifflin county schools) and 28% urban (54 children were from Lancaster county schools). The sample consisted of 43% females, and ranged in age from 50 to 81 months. We obtained informed consent for approximately 35% of the children in participating classrooms within the short (six-week) recruitment time-frame.

Within this sample, a sub-sample of 64 children were identified as "at risk" for school adjustment problems, based on low scores on a teacher-rated measure of classroom engagement. These children were randomly assigned (within school) to participate in the 16-session intervention trial (34 intervention + 30 control) and were post-tested later in the year. Two children (1 intervention, 1 control) moved out of the school district within the first

6 sessions of the trial and were replaced with children from their classroom with the next lowest scores. In two other cases (one from each condition), children moved during the second half of the intervention trial and were not replaced. Thus the final sample for the intervention trial included 62 children (33 intervention + 29 control) (See figure 1). This at-risk sample was 31% female, 29% Hispanic, 3% African American, and 68% Caucasian. The age range of the at-risk sample was 50 to 76 months at the time of initial assessment.

Figure 1.

Data Collection Timeline



Recruitment Procedures

Consent forms were sent home to parents of children enrolled at participating schools and entering pre-kindergarten (in the Lancaster schools) or kindergarten (in the Bellefonte and Mifflin County schools). Parents gave consent for children to participate in the initial assessment and, separately, they indicated consent for intervention participation if the child qualified.

Data Collection Procedures

Six weeks after the start of school, teachers completed pre-intervention ratings on the children in their classrooms who had parental permission for study participation. Child assessments were conducted at each child's school and lasted about 45-minutes. These data were used to test hypotheses regarding the relations among the direct-assessments of self-

regulation and teacher ratings of school functioning. Following these assessments, children who qualified as "at-risk" based on low scores on the classroom engagement screen were randomized into intervention and control conditions, and the 16-session intervention protocol began. These children were re-assessed at the conclusion of the intervention trial in the spring using the same teacher ratings and 45-minute child assessment battery (with a few exceptions described below in the *Measures* section).

All assessments were conducted by trained research staff members who were blind to condition, and were not involved in intervention delivery.

Measures

A multi-method, multi-informant approach was employed, including direct assessments conducted with children, teacher ratings, and observer ratings. Measures are described in the following sections and listed below in Table 1.

Table 1

List of Measures, by Domain and Construct

Domain	Construct	Measure[a]
Control Variables (Direct Assessment)		Expressive One-Word Picture Vocabulary Test Wechsler Preschool and Primary Scale of Intelligence – III: Information Subtest
Self-Regulation (Direct Assessment)	Regulation of Behavior	Walk-A-Line Slowly Toy Wrap: Latency to Peek Toy Wrap: Number of Peeks Choose-A-Toy: Reminders to Wait[b] Choose-A-Toy: Touches Toy[b] Choose-A-Toy: Verbal Statements from Child[b]
	Regulation of Emotion	Assessment of Children's Emotion Skills Locked Box: Assessor Ratings of Distress Locked Box: Assessor Ratings of Positive Affect Locked Box: Assessor Ratings of Destructive Behavior[b] Bean Task: Assessor Ratings of Distress[b] Bean Task: Assessor Ratings of Positive Affect[b] Bean Task: Assessor Ratings of Destructive Behavior[b]

(Table 1 continued on the following page)

Table 1 (continued)

List of Measures by Domain and Construct

Domain	Construct	Measure[a]
Self-Regulation (Direct Assessment)	Regulation of Attention	Backward Word Span Peg Tapping Task Dimensional Change Card Sort
School Readiness (Teacher Rated)	Learning Readiness	Classroom Participation Learning Behaviors Scale Conners' Teacher Rating Scale – Short Form: Inattention Academic Competence Evaluation Scale
	Relationship Skills	Social Health Profile: Prosocial Behavior Student-Teacher Relationship Scale: Closeness
	Behavior Problems	Student-Teacher Relationship Scale: Conflict Conners' Teacher Rating Scale – Short Form: Hyperactivity Teacher Observation of Child Adaptation-Revised: Aggression/Oppositional Behavior

[a]Citations for all measures can be found below within the descriptions of each measure.
[b]Collected during the outcome assessment only

Control Variables

Recognizing that child sex, age, and intellectual ability might affect self-regulation scores and school adjustment and confound interpretation regarding their association, the following measures were collected and served as covariates in subsequent analyses. Child sex and age (in months) were recorded by parents on the permission form. The *Information* subtest of the Wechsler Preschool and Primary Scale of Intelligence – III (WPPSI – III; Wechsler, 2002) was administered, and standard scores were used as a proxy for intellectual ability. This subtest requires children to answer questions that address a broad range of general knowledge topics. For children 4-7 years old, performance on *Information* is highly related to Full-Scale IQ, with a correlation of .82 (Wechsler, 2002). The *Expressive One-Word Picture Vocabulary Test* (EOWPVT; Brownell, 2000) was also administered to assess children's verbal ability, and serve as a second proxy for intellectual ability. Children were asked to give the word that best described pictures they were shown. Past research has

demonstrated high levels of internal reliability and predictive validity for this test (split-half reliability r = .92; Bierman, Greenberg et al., 2008; (α = .94; Bierman, Nix et al., 2008).

Self-Regulation

A set of tasks was selected to assess self-regulation skills emphasizing different domains of functioning: 1) those with a primary emphasis on the regulation of behavior (delaying or slowing a motor impulse), 2) those with a primary emphasis on the regulation of aroused emotions (recognizing and labeling emotions; tolerating frustration), and 3) those with a primary emphasis on the regulation of attention and attentional conflict (holding information in mind, or shifting attention to complete a task).

Tasks emphasizing the regulation of behavior. Two tasks were selected that required the delay or slowing of a motor response. The *Walk-a-Line Slowly* task is a motor task that assesses behavioral inhibitory control by requiring children to walk along a line as slowly as they can (Kochanska, Murray, Jacques, Koenig, Vandegeest, 1996). First, children were asked to walk along a six-foot piece of tape on the floor as the assessor timed them. Children were then asked to repeat the task twice, each time walking as slowly as they can. Total scores represented the amount of time that children were able to reduce their speed from the first trial to the third trial (Trial 3 minus Trial 1). This task has demonstrated adequate reliability with preschool children (intraclass correlation = .98) (Smith-Donald et al., 2007).

To assess impulse control, and the capacity to delay acting on an impulse under conditions of prohibition, *Toy Wrap* was administered. In this task, children are told not to peek while the assessor noisily wraps a present meant for the child (Kochanska, et al., 1996). Scores generated include a Delay score (latency to first peek, in seconds), and an Impulsivity

score (number of times peeked). This task has demonstrated adequate reliability with preschool children (intraclass correlation = .90) (Carlson, 2005; Smith-Donald et al., 2007).

Due to concerns that familiarity with the Toy Wrap task would impact performance if repeated for the intervention post-test assessment, it was replaced during this second assessment with the *Choose-A-Toy* task, a modified version of Kochanka et al.'s (1996) Dinky Toys task. For this task, children were presented with a pile of attractive toys, spilled out onto the table in front of them. They were told to place their hands flat on the table, and look at the toys while the experimenter completed some "paperwork". Children were asked not to tell the experimenter which toy they would like to play with or touch any of the toys until the experimenter rang a bell at the end of two minutes. Scores generated included the number of times the child verbalized their choice before the bell, the number of times the child touched a toy before the bell, and the number of verbal reminders to wait from the experimenter. Reminders were given when children asked questions about the toys during the two minutes. These three scores were averaged, standardized, and reversed, for a total measure of impulse control. The Toy Wrap and Choose-A-Toy tasks were moderately correlated ($r = .38$, $p < .001$).

Tasks emphasizing the regulation of emotion. To assess emotion regulation, tasks were selected that evaluated the child's ability to label aroused emotions, and tolerate frustration.. The *Assessment of Children's Emotion Skills* (ACES; Schultz, Izard, & Bear, 2004) measures children's recognition and labeling of facial expressions of emotion, and has been used in previous research with preschool children. Children identify the feeling (happy, mad, sad, scared, or no feelings) depicted in 12 photographs of facial expressions. Scores equal the number of correct answers ($\alpha = .57$, Bierman, Torres et al., 2008).

The *Locked Box Task* is designed to elicit negative affect (mild frustration) and assesses the child's capacity to regulate their affect and tolerate this frustration. It was adapted from the preschool version of the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith & Reilly, 1993) for use in field-based assessment for the current study was utilized as a measure of emotional reactivity. In the *Locked Box Task***,** children were asked to select one of three attractive toys to play with. The assessor then placed the toy in a transparent box and locked it with a small padlock. Children were given a set of three keys that do not work and told to work on opening the box while the assessor did some "paperwork" off to the side of the room, and that when they opened the box they could play with the toy. After three minutes, children were told that the assessor made a mistake and given a key that works. This task has been used successfully to elicit negative affect in several studies of temperament and emotional regulation (e.g. Cole, Martin, & Dennis, 2004; Kiel & Buss, 2006). As designed, this task is videotaped and micro-coded for facial affect while the child is alone in room with an observation window. However, given the difficulty of videotaping in field-based assessment, and the risk in leaving children alone in a room with no observation window, assessors instead remained in the room, and rated children's affective responses using a global coding scheme developed for this purpose. Children's frustration tolerance scores included interviewer ratings of negative and positive affect, and disruptive behavior, all during the task.

A decision was made to replace this task for the outcome assessment, because it was expected that familiarity with the Locked Box task would impact performance. To assess frustration at the post-intervention assessment, children were presented with the "bean pot" from the Don't Spill the Beans game manufactured by Hasbo® (see Figure 2), and then given

a bag of 40 plastic "beans". They were told to balance all the beans on the top of the bean pot while the assessor did paperwork for three minutes, and assured that they all should fit. They were told to start over, should the beans spill. After three minutes, assessors told children that they had accidentally given them the bag with too many beans, and helped them to balance a smaller number of beans before moving on to the next task. As with the Locked Box task, children's frustration tolerance scores included interviewer ratings of negative and positive affect, and disruptive behavior, all during the task.

Figure 2

Don't Spill the Beans game

*Tasks emphasizing the regulation of attention***.** We collected three measures reflecting children's attentional regulation skills with demonstrated validity for 4-5 year old children (Carlson, 2005; Bierman, Nix et al., 2008). These measures required children to hold information in mind, and/or shift attention to competing features of the task. *Backward Word Span* is a test of working memory in which children are asked to repeat backwards increasingly long sequences of words (Davis & Pratt, 1996). The practice word list and the first word list each contain two words, and subsequent lists gradually increased to a total of five words. Scores represent the highest number of words a child can repeat correctly.

The *Peg Tapping Task* (Diamond & Taylor, 1996) assesses working memory and effortful control by asking children to remember a rule and inhibit a prepotent response. Children were asked to tap their peg twice when the interviewer taps once, and visa versa. Scores represent the correct number of trials out of 16.

The *Dimensional Change Card Sort* (DCCS; Frye et al., 1995) requires coordination of working memory, inhibitory control, and set shifting skills by asking children to track changing rules and inhibit previously learned responses. Specifically, children were shown target cards that varied along the dimensions of color and shape (e.g. red and blue, rabbits and boats). Upon learning to sort the cards according to one dimension (shape or color), children were asked to change their strategy and sort the cards according to the other dimension. Scores represent the number of trials (out of 6) in which the child correctly shifted sets after the sorting criteria changed.

School Readiness Outcomes

Classroom Engagement-Screen. Teachers completed the *Classroom Participation* measure (Bierman, Domitrovich et al., 2007), assessing self-regulation, compliance, and learning motivation (inter-rater r =.70), and the *Learning Behaviors Scale* (McDermott, 1999; Yen, et al., 2004), a well-validated and nationally-normed measure of academic task orientation. These scales include 15 items that, together with an item asking teachers to rate the extent to which children are "hard-to-manage", comprised a 16-item *Classroom Engagement* measure used to screen children for inclusion in the intervention trial.

Learning Readiness. Two measures (*Learning Engagement* and *Academic Readiness*) were standardized and combined to form the *Learning Readiness* composite. A measure of *Learning Engagement* was created based on an exploratory factor analysis

(Kaiser normalization using varimax rotation) of items from the *Classroom Participation* measure (Bierman, Domitrovich et al., 2007) and items from the *Learning Behaviors Scale* (McDermott, 1999; Yen, et al., 2004) (used as screeners for the intervention trial). The factor analysis also included items from the *Conners' Teacher Rating Scale – Short Form* (Conners, 2000) a nationally-normed, well-validated measure reflecting DSM-IV TR criteria for ADHD (APA, 2000) used in clinical research for children aged 3-17 years. 6 items from the Conners' (reflecting Inattention), 5 items from the Classroom Participation measure, and 6 items from the Learning Behaviors Scale loaded together on one factor, and were combined to create the *Learning Engagement* measure. This measure was then standardized and combined with a standardized teacher-rated measure of *Academic Readiness***,** an abbreviated 4-item version of the *Academic Competence Evaluation Scale* (ACES; DiPerna & Elliott, 1999). The original version of the *Academic Competence Evaluation Scale* was found to have high internal consistency (median a = .95) and test-retest stability (median r = .83) with elementary school children (DiPerna & Elliott, 1999).

Relationship Skills. Two measures (*Prosocial Behavior* and *Student-Teacher Closeness*) were standardized and combined to form the *Relationship Skills* composite. *Prosocial behavior* (e.g. helping, sharing) was assessed using 7 items from the *Social Health Profile* (SHP; Lochman & CPPRG, 1995), with some wording changes making items developmentally appropriate for preschool children. Teachers rated each item using a 6-point Likert scale, ranging from 1 ("Almost never") to 6 ("Almost always"). A summed score was used (α = .94 for the prosocial subscale; Bierman, Torres et al., 2008), and then standardized to combine with the standardized measure of *Student-Teacher Closeness*. Child-teacher relations were assessed using a shortened version (15 items) of the *Student-Teacher*

Relationship Scale (Pianta, 2001), a well-validated, nationally normed measure which assesses teacher-rated Closeness and Conflict with preschool through 3rd grade students using a 5-point Likert scale ranging from "Definitely does not apply" to "Definitely does apply". Two subscales reflecting *Student-Teacher Closeness* (8 items) and *Student-Teacher Conflict* (8 itmes) were created and analyzed separately for the current project. Each had high levels of internal consistency in the current sample ($\alpha = .90$ for the closeness subscale; $\alpha = .94$ for the conflict subscale).

Behavior Problems. Four measures (*Student-Teacher Conflict, Peer Problems, Hyperactivity, and Aggression/Opposition*) were standardized and combined to form the *Behavior Problems* composite. Teacher ratings describing children's peer problems were collected using four items taken from the *Child Behavior Scale: Excluded by Peers subscale* (Ladd & Profilet, 1996). The first item measuring peer liking was reversed-scored and combined with the other three items measuring peer dislike, peer neglect, and peer rejection. Each item is rated on a 6-point scale ("Almost never" to "Almost always"). To assess hyperactivity, teachers also completed an abbreviated version (12 items) of the *Conners' Teacher Rating Scale – Short Form* (Conners, 2000) a nationally-normed, well-validated measure reflecting DSM-IV TR criteria for ADHD (APA, 2000) widely1used in clinical research for children aged 3-17 years. Items are rated on a 4-point Likert scale ("Not at all true" to "Very much true"). The 12-item subscale is designed to assess clinical symptoms of Hyperactivity. Aggressive-oppositional behavior was assessed using seven items taken from the *Teacher Observation of Child Adaptation-Revised (TOCA-R)* (Werthamer-Larsson, Kellam, & Wheeler, 1991). Teachers were asked to rate how often children engaged in specific disruptive or aggressive behaviors using a 6-point Likert scale, ranging from a score

of 1 (“Almost never”) to a score of 6 (“Almost always”). Some wording modifications were made to assure that the items were developmentally appropriate for preschool children. Previous research using this scale revealed high inter-rater reliability for this domain ($r = .72$, $p<.001$; Torres & Bierman, unpublished manuscript). Chronbach’s alpha was also high for these items ($\alpha = .90$; Torres & Bierman, unpublished manuscript), indicating a high level of internal consistency.

Intervention Design

Children were randomly assigned to intervention or control condition playgroups, consisting of 4 children each, who met for 16 sessions over 12 weeks. Intervention groups engaged in activities specifically designed to promote self-regulation and control groups engaged in early reading and literacy activities.

Intervention Group Activities. The intervention utilized a “coaching” framework, that included brief “lessons” (e.g., modeling stories, pictures, and puppet examples) to illustrate skill concepts, similar to the strategy used in the Preschool PATHS and Fast Track Friendship Group programs. Target skills included emotional knowledge (e.g. teaching children to identify emotions in pictures and stories), inhibitory control (e.g. using the “Turtle Technique” to stop, calm down, and verbalize the problem and associated feelings), and friendship skills for cooperation, negotiation, and social problem-solving (supporting the coordination of emotion regulation and inhibitory control, as well as anticipatory planning, and flexible problem solving). The intervention included three kinds of modifications, designed to alter the Fast Track Project Friendship Group/Preschool PATHS intervention approach in order to strengthen its appropriateness for young children with delays in self-regulation and to increase impact on the promotion of self-regulation (see Table 2).

Table 2

Intervention Components

Intervention Components	
Target Skills (Proximal Child Outcomes)	Behavioral Regulation Skills: Inhibiting aggressive or impulsive behaviors, delay of gratification, organization of behavior to meet classroom demands Attentional Regulation Skills: Planning and organizing future behaviors, sustain or shift attention in accordance with demands of environment, and mentally hold and manipulate information in working memory Emotional Regulation Skills : Recognition of feeling faces and words, detecting emotional valence, frustration tolerance and appropriate responding to distressing emotional stimuli
Activities	• Feelings and Friendship stories with activities supporting emotional understanding and feelings games • Scripted play scenarios with children planning / acting out a particular role through deliberative play with peers • Games designed to bolster discrete attentional and behavioral regulation skills, such as a modified "freeze tag" (behavioral inhibition), set-shifting games, and games requiring in working memory skills

First, the intervention sessions were designed to be more active, making explicit use of play-based activities to support skill development, and limiting "sit and listen" time. The cognitive "lessons" used in Friendship Group and Preschool PATHS to introduce skill

concepts (e.g. stories, role plays) were maintained, but shortened and embedded into play-based physical activities to reduce demand on attention skills and to increase active learning opportunities. Second, scripted dramatic play was emphasized to provide an ideal activity scaffold to support practice in social and self-regulatory skills. Second, using an approach similar to the ToM program, sessions emphasized scaffolded pretend play practice. Play experiences were organized to address the particular needs of pre-kindergarten and Kindergarten children with self-regulatory deficits, and focused on scripted play based on familiar characters and stories. Third, the intervention sessions included activities designed to more directly foster practice in attentional regulation skills. Games were modeled after discrete executive function tasks (e.g. DCCS, Walk-A-Line Slowly, Peg Tapping), thus involving working memory and set-shifting ability to master.

Control Group Activities. The control condition involved interactive or dialogic reading, in which group leaders read stories during which they asked questions and prompted children to re-tell or describe pictures and events in the stories. Such reading activities are designed to promote vocabulary, comprehension and narrative skills and provided the opportunity for small-group interaction, without directly targeting social or self-regulatory skills or allowing for the type of complex social interaction that may elicit extensive exercise of children's executive function skills. Stories were specifically selected that were void of emotional themes to prevent direct enhancement of emotional knowledge or understanding. Participation in this group was intended to control for the undue influence of increased adult attention, experience of being part of a small peer group, and time spent out of class on outcomes.

Chapter 4. RESULTS

Descriptive Analyses

Prior to running analyses to test the stated hypothesis, descriptive analyses were conducted for each of the initial assessment measures collected. Means and standard deviations for all measures are reported in Table 3.

Table 3

Means and Standard Deviations for Initial Assessment Measures

Measure	Mean	SD	Minimum	Maximum
WPPSI-III: Information	8.59	(2.61)	4.00	18.00
EOWPVT	85.67	(15.38)	55.00	139.00
Walk-A-Line Slowly	4.91	(6.38)	-5.22	31.29
Toy Wrap: Latency to peek	53.17	(15.30)	0.00	60.00
Toy Wrap: Number of peeks	0.57	(1.49)	0.00	9.00
Assessment of Children's Emotions Scale	8.00	(2.18)	2.00	12.00
Locked Box: Assessor Ratings of Distress	1.80	(0.89)	1.00	4.00
Locked Box: Assessor Ratings of Positive Affect	2.41	(1.64)	1.00	5.00
Locked Box: Assessor Ratings of Destructive Behavior	1.18	(0.47)	1.00	4.00
Backward Word Span	1.71	(0.68)	0.00	3.00
Peg Tapping	12.12	(5.18)	0.00	16.00
Dimensional Change Card Sort	4.57	(2.26)	0.00	6.00
Classroom Participation	4.67	(1.19)	1.00	6.00
Learning Behaviors Scale	2.56	(0.44)	1.25	3.00
Conners' Teacher Rating Scale: Inattention	1.88	(0.89)	1.00	4.00
Academic Competence Evaluation Scale	3.00	(1.36)	1.00	5.00
Social Health Profile: Prosocial Behavior	3.97	(1.07)	1.14	6.00
Student-Teacher Relationship Scale: Closeness	4.13	(0.73)	1.63	5.00
Student-Teacher Relationship Scale: Conflict	1.81	(1.03)	1.00	5.00
Child Behavior Scale: Excluded by Peers	1.77	(0.84)	1.00	5.75
Conners' Teacher Rating Scale: Hyperactivity	1.67	(0.82)	1.00	4.00
TOCA-R: Aggression / Opposition	2.02	(1.11)	1.00	5.86

Exploring Dimensions of Self-Regulation

It was hypothesized that tasks measuring self-regulation skills would show some domain specificity, forming inter-related but distinct clusters of tasks based upon the degree to which the regulation required behavioral delay, attentional conflict, or coping with aroused emotion. To test this hypothesis, the self-regulation measures were subjected to a principal components factor analysis (varimax rotation with Kaiser normalization). As expected, three factors emerged with eigenvalues greater than 1.0. However, two tasks loaded on different factors than hypothesized.

The first factor had an Eigenvalue of 1.65, and explained 16.5% of the variance. It was defined by the three observer ratings of child affect and behavior during the frustration task (Locked Box Task). The second factor had an Eigenvalue of 1.91, and explained 19% of the variance. It was defined by the measures of motor delay vs. impulsivity collected during the Toy Wrap task. The third factor had an Eigenvalue of 2.25 and explained 22.5% of the variance. It was defined by the attentional regulation tasks selected to represent working memory and set-shifting (Backward Word Span, Dimensional Change Card Sort, and Peg Tapping). In addition, Walk-A-Line Slowly and the task of emotional understanding (ACES) loaded on this factor. Together this three component structure accounted for 58% of the total variance, and no measure loaded above .40 on two factors simultaneously. (See Table 4).

Table 4

Factor Loadings for Exploratory Factor Analysis of Self-Regulation Measures

Measure	Frustration Tolerance	Impulse Control	Executive Control
Assessor Rating of Distress during LB Task	**.86**	.03	.13
Assessor Rating of Positive Affect during LB Task	**-.63**	-.06	-.04
Assessor Rating of Destructive Behavior during LB Task	**.67**	-.22	.02
Latency (sec) to First Peek during Toy Wrap Task	-.06	**.94**	.17
Number of Peeks during Toy Wrap Task	.04	**-.94**	-.18
Trial 1 (sec) minus Trial 3 (sec) on Walk-a-Line Slowly	.07	.00	**.58**
Peg Tapping Total Score	-.14	.18	**.77**
Dimensional Change Card Sort Post-Switch Total Score	.17	.18	**.50**
Backward Word Span Total Score	.06	.03	**.78**
Assessment of Children's Emotions Scale Total Score	.06	.13	**.62**

Note. Factor Loadings > .40 are in boldface. LB = Locked Box. Varimax rotation was used.

On the basis of this factor analyses, the behavioral, emotional, and attentional aspects of self-regulation had to be re-conceptualized, and three alternative composite scores reflecting self-regulation were created. Assessor ratings of child affect and behavior during the Locked Box task were averaged to create an index of *frustration tolerance* (with distress and destructive behavior inversely coded and averaged with positive affect, such that high scores represented greater frustration tolerance). This composite tapped the anticipated dimension of emotion regulation, but did not include emotional understanding. Measures of behavioral impulse control during the Toy Wrap task were averaged to create an index of *impulse control* (with "Number of peeks" standardized and inversely coded and averaged

with "Latency to first peek"). This composite tapped the anticipated dimension of behavior regulation, but did not include the Walk-a-line Slowly task representing motor control.

Lastly, scores on the five measures that loaded on the third factor (the attentional regulation tasks, plus Walk-a-Line Slowly and the emotional understanding task) were standardized and averaged to comprise a broad *executive control* composite. This composite primarily tapped the anticipated dimension of attentional regulation, including measures of working memory, attentional control under conditions of conflict, and attention set-shifting, but also included emotional understanding and motor control. To maintain consistency with the results of the factor analyses, the main analyses examining relations between self-regulation skills and school readiness outcomes were completed using these three composites and are presented first. In addition, exploratory analyses were undertaken to "unpack" the executive control composite, and examine the unique contributions of emotional understanding relative to the other executive control measures.

Correlations among self-regulation composites along with means and standard deviations for all self-regulation composites are presented in Table 5. T-tests examining gender differences revealed that only impulse control differed for boys and girls, such that boys had lower impulse control (M = -0.14, SD = 1.14) than girls (M = 0.18, SD = .63), t (190) = 2.49, $p < .05$.

Table 5

Summary of Intercorrelations, Means, and Standard Deviations for Self-Regulation Composites

Composite	1	2	3	*M*	*SD*
1. Frustration Tolerance	--	.05	-.14	3.81	.76
2. Impulse Control	--	--	-.32**	0.00	.97
3. Executive Control	--	--	--	0.00	.66

Note: Impulse Control and Executive Control represent standard score composites; ** $p < .001$

Descriptive Statistics for School Readiness Outcomes

Next, correlations among school readiness composites were computed and they are presented in Table 6, along with means and standard deviations for all school readiness composites. T-tests were also conducted to assess gender differences. Teachers gave girls higher ratings for learning Readiness (girls $M = 0.23$ vs. boys $M = -0.17$, $t\ (189) = 3.10$, $p < .01$) and relationship Skills (girls $M = 0.22$ vs. boys $M = -0.16$, $t\ (189) = 2.89$, $p < .01$.) Conversely, boys were rated by teachers as having more behavior problems ($M = 0.16$) than girls ($M = -0.22$), $t\ (189) = -3.06$, $p < .01$.

Table 6

Summary of Intercorrelations, Means, and Standard Deviations for School Readiness Outcomes

Outcome	1	2	3	*M*	*SD*
1. Learning Readiness	--	.60**	-.56**	0.00	.88
2. Relationship Skills	--	--	-.68**	0.00	.91
3. Behavior Problems	--	--	--	0.00	.88

** $p < .001$

Prediction to School Readiness Outcomes

Next, partial correlations were conducted to examine relations between each domain of self-regulation and concurrent school readiness outcomes, with age, sex, and intellectual functioning controlled. Results are presented in Table 7. Frustration tolerance and executive control were significantly associated with learning readiness and relationship skills. Impulse control was significantly associated with relationship skills and inversely associated with behavior problems.

Table 7

Partial Correlations between Self-Regulation Skills and School Readiness

	School Readiness		
Self-Regulation Skills	Learning Readiness	Relationship Skills	Behavior Problems
Frustration Tolerance	.16*	.23*	-.13
Impulse Control	.14^{+}	.18*	-.26**
Executive Control	.34**	.17*	-.14^{+}

Note. Analyses control for age (months), sex, EOWPT and WPPSI Information subtest.
** $p < .001$; *$p < .05$; $^{+}p < .06$

Hierarchical regressions were then conducted to test the combined and unique contributions of frustration tolerance, impulse control, and executive control to school readiness outcomes, controlling for age, sex, intellectual functioning, and for the other self-regulation skills. One regression was conducted for each domain of school functioning: 1) learning readiness, 2) relationship skills, and 3) behavior problems. The approach was to enter the control variables at step 1, and then enter the set of self-regulation variables at step 2 (frustration tolerance, impulse control, and executive control). The goal was to determine

the extent to which each domain of self-regulation contributed unique variance to the prediction of school readiness outcomes, while accounting for their shared variance. Results are summarized in Table 8.

In predicting learning readiness, the addition of the self-regulation variables at step 2 explained an additional 13% of the variance beyond that accounted for by sex and intellectual functioning. Frustration tolerance and executive control skills each made unique contributions. In predicting relationship skills, the self-regulation skills explained 9% of the variance beyond that explained by sex and intellectual functioning. Frustration tolerance and executive control again each made unique contributions. In predicting behavior problems, the self-regulation skills explained an additional 8% of variance beyond the demographic and intellectual control variables. Only impulse control made a unique contribution. Thus, for all three school readiness outcomes, self-regulation skills accounted for additional variance beyond age, sex, and intellectual ability. Whereas frustration tolerance and executive control appeared to facilitate social and academic engagement, impulse control appeared particularly important for the reduction of behavior problems.

Table 8

Hierarchical Regressions Predicting School Readiness Outcomes with Self-Regulation Skills

	School Readiness Outcomes					
	Learning Readiness		Relationship Skills		Behavior Problems	
Predictors	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.18**		.09*		.05*	
Control Variables[a]						
Step 2	.13**		.09**		.08**	
Frustration Tolerance		.16*		.22*		-.10
Impulse Control		.05		.12		-.24*
Executive Control		.41**		.19*		-.13

Note. N = 190.
[a] Control variables included age, sex, Expressive One-Word Vocabulary Test Standard Score and WPPSI Information
** $p < .001$; * $p < .05$

Exploratory moderation analyses. Next, moderation analyses using hierarchical regression were undertaken to determine whether the newly-conceptualized measures of frustration tolerance and executive control might serve as a buffers against school readiness problems for children with poor impulse control. Two regressions were conducted for each of the following dependent variables: 1) learning readiness, 2) relationship skills, and 3) behavior problems. The approach was to enter the control variables at step 1, the predictor (impulse control) at step 2, the moderator (frustration tolerance or executive control) at Step 3, and the interaction term (impulse control x frustration tolerance or impulse control x executive control) at step 4. The goal was to determine whether frustration tolerance and

executive control each moderated the relationship between behavioral impulse control and school readiness outcomes. Results are summarized in Table 9.

Evidence for frustration tolerance as a moderator of the relationship between impulse control and school readiness was convincing, as moderation was significant for all three school readiness outcomes. The interaction term (impulse control x frustration tolerance) explained 2% of the variance in learning readiness (Step 4: R^2 = .02, β = -.14, p <.05); 2% of the variance in relationship skills (Step 4: R^2 = .02, β = -.16, p <.05); and 4% of the variance in behavior problems (Step 4: R^2 = .04, β = .20, p <.01). For learning readiness and relationship skills, frustration tolerance and impulse control each made unique contributions, and risk was magnified for children who had difficulty in both areas (see Figures 3-4). For behavior problems, children with poor impulse control were at greatest risk if they also had poor frustration tolerance (see Figure 5). Having poor frustration tolerance alone, however, did not appear to add to the risk for behavior problems.

The only evidence for executive control as a moderator of the relationship between impulse control and school readiness emerged in the form of a single, non-significant trend. Executive control appeared to moderate the relationship between impulse control and behavior problems, with the interaction term explaining 2% of the variance (Step 4: R^2 = .02, β = .17, p = .058). The interaction was plotted (see Figure 6) to better understand the relationship between impulse control and executive control in predicting behavior problems. Similar to the pattern of findings for frustration tolerance as a moderator, children with low impulse control appear at increased risk for behavior problems if they also had poor executive control. Having poor executive control did not by itself add to the risk for behavior problems.

Table 9

Hierarchical Regressions Testing Moderation by Frustration Tolerance and Executive Control

	School Readiness Outcomes		
	Learning Readiness	Relationship Skills	Behavior Problems
Predictors	ΔR^2	ΔR^2	ΔR^2
Frustration Tolerance as Moderator			
Step 2[a]	.02^{+}	.03*	.06**
Impulse Control			
Step 3	.02*	.04*	.01
Frustration Tolerance			
Step 4 Impulse Control x Frustration Tolerance	.02*	.02*	.04*
Executive Control as Moderator			
Step 2 [a]	.02^{+}	.03*	.06**
Impulse Control			
Step 3	.09**	.02	.01
Executive Control			
Step 4 Impulse Control x Executive Control	.00	.00	.02^{+}
N	191	191	191

[a] Step 1 for all analyses included the same control variables as in Tables 6-8: age, sex, Expressive One-Word Vocabulary Test Standard Score and Weschler Preschool and Primary Scale of Intelligence: Information Subtest Scaled Score

** $p < .001$; * $p < .05$; $^{+}p < .06$

Figure 3

Plot of the Interaction between Frustration Tolerance and Impulse Control in Predicting Learning Readiness

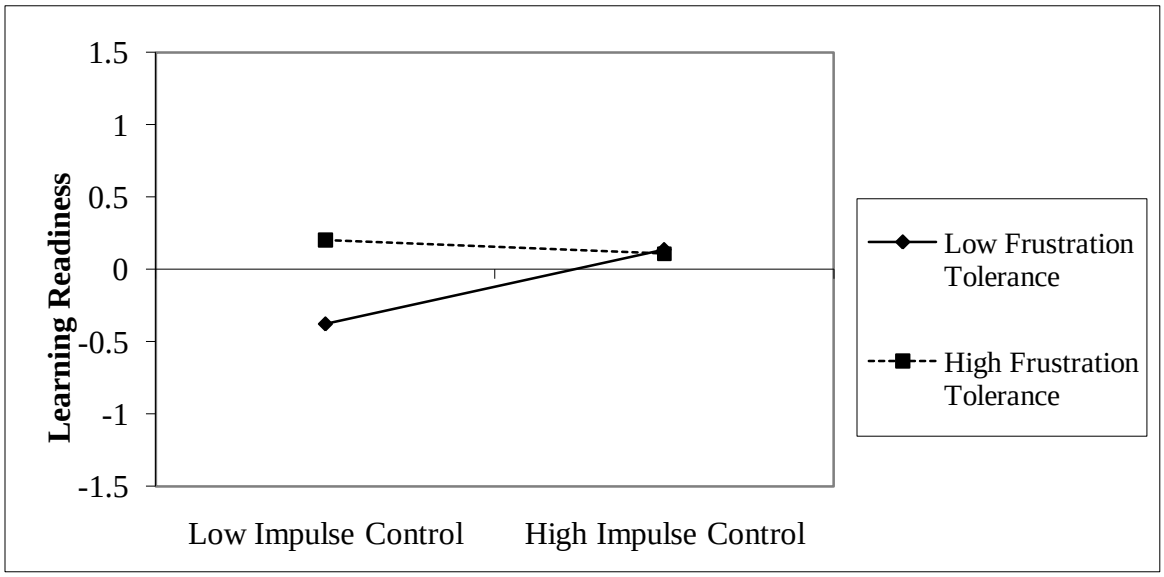


Figure 4

Plot of the Interaction between Frustration Tolerance and Impulse Control in Predicting Relationship Skills

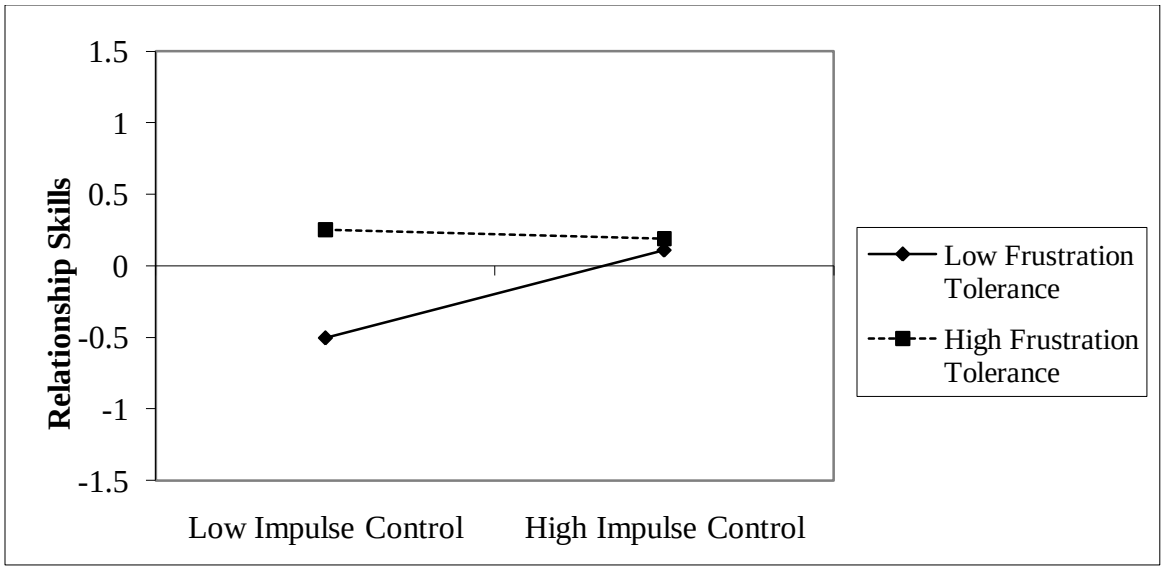


Figure 5

Plot of the Interaction between Frustration Tolerance and Impulse Control in Predicting Behavior Problems

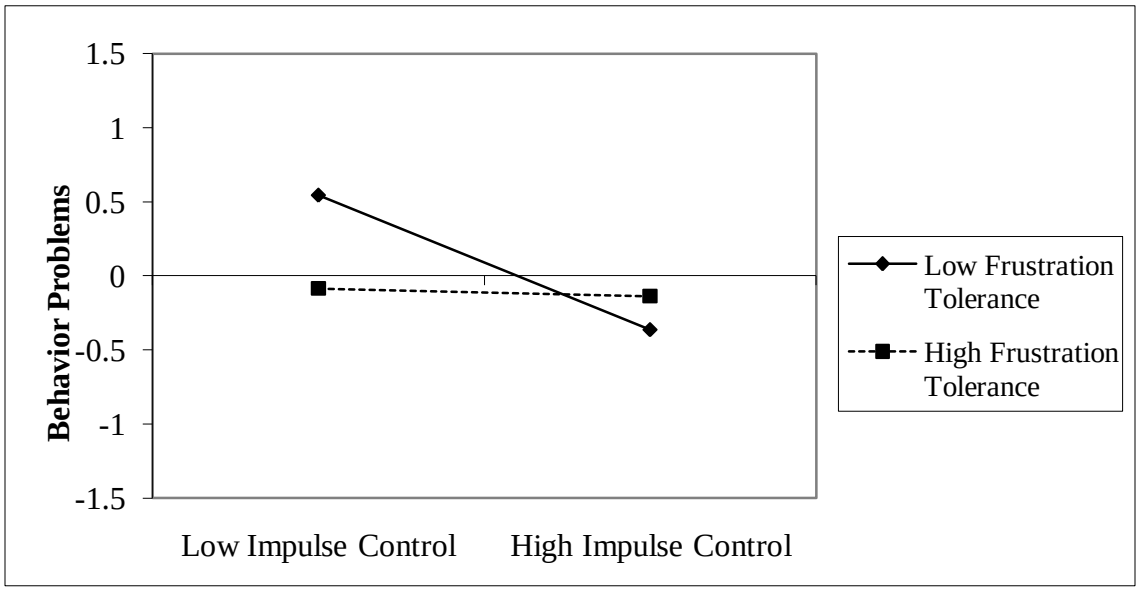
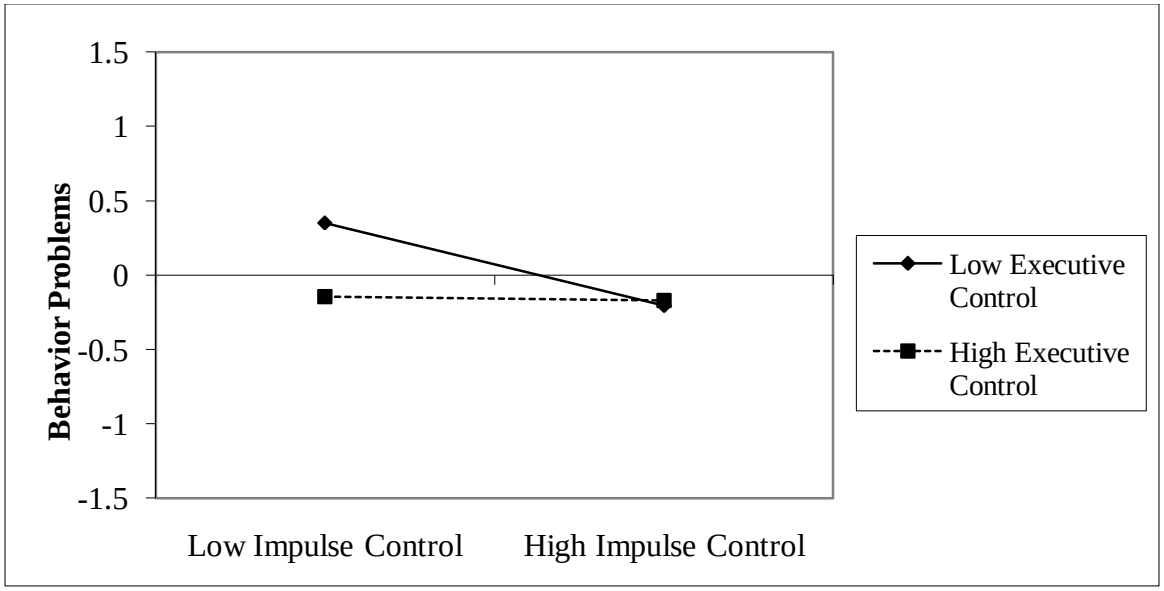


Figure 6

Plot of the Interaction between Executive Control and Impulse Control in Predicting Behavior Problems



Separating Emotional Understanding from Attentional Regulation. Although attentional regulation and emotional understanding in this study loaded together in an exploratory factor analysis and were thus combined into a single composite (executive control), these two constructs have historically been studied separately. Existing literature suggests that attentional regulation skills and emotional understanding may make differential contributions to school readiness and social adjustment, and researchers have documented empirical differences between these two constructs. It is possible that they are separate self-regulatory processes, and share substantial variance because they are both highly related to the same underlying cognitive factors (e.g. development of the prefrontal cortex, intellectual functioning, language development, etc.). To further explore whether these processes make differential predictions in the current sample, exploratory analyses were undertaken, and the previous set of analyses were re-conducted with attentional regulation skills (Dimensional Change Card Sort, Peg Tapping, Backward Word Span, and Walk-A-Line Slowly) and emotional understanding (ACES) scored as two separate self regulatory processes.

First, partial correlations were conducted to determine whether attentional regulation skills and emotional understanding individually predicted school readiness outcomes. As before, all partial correlations control for age, sex, and intellectual functioning. Attentional regulation significantly predicted learning readiness ($r = .31$, $p < .001$), whereas emotional understanding significantly predicted all three school readiness outcomes (learning readiness: $r = .22$, $p < .01$; relationship skills: $r = .31$, $p < .001$; behavior problems: $r = -.20$, $p < .01$).

Next, hierarchical regressions were conducted to test the unique contributions of attentional regulation and emotional understanding (together with the other self-regulatory domains of frustration tolerance and impulse control) to school readiness outcomes,

controlling for age, sex, and intellectual functioning. One regression was conducted for each of the following dependent variables: 1) learning readiness, 2) relationship skills, and 3) behavior problems. The goal was to determine whether attentional regulation and emotional understanding, in particular, contributed *different* unique variance in the prediction of school readiness outcomes. Again, when analyzed as separate self-regulatory processes, attentional regulation contributed unique variance to the prediction of learning readiness only, whereas emotional understanding contributed unique variance to all three domains of school readiness. Results are summarized in Table 10.

Table 10

Summary of Hierarchical Regression Analyses for Self-Regulation Variables Predicting School Readiness Outcomes

	School Readiness Outcomes					
	Learning Readiness		Relationship Skills		Behavior Problems	
Predictors	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.18**		.09*		.05*	
Control Variables[a]						
Step 2	.13**		.15**		.10**	
Frustration Tolerance		.16*		.23*		-.11
Impulse Control		.05		.11		-.23*
Attentional Regulation		.32**		-.03		-.01
Emotional Understanding		.15*		.33**		-.18*

Note. N = 190.
[a] Control variables included age, sex, Expressive One-Word Vocabulary Test Standard Score and Weschler Preschool and Primary Scale of Intelligence: Information Subtest Scaled Score
** $p < .001$; * $p < .05$

Finally, moderation analyses using hierarchical regression were re-conducted with attentional regulation and emotion understanding as separate possible moderators of the relationship between impulse control and school readiness outcomes. Three regressions were conducted for each moderator. The approach was to enter the control variables at step 1, the predictor (impulse control) at step 2, the moderators (attentional regulation or emotional understanding) at Step 3, and the interaction term at step 4. Results are summarized in Table 11.

Results indicate that emotional understanding, but not attentional regulation, emerged as a significant moderator of the relationship between impulse control and behavior problems, such that children who had both poor impulse control and low emotional understanding were most at-risk for behavior problems (see Figure 7). Similar to the combined construct of executive control, difficulty with emotional understanding alone did not confer risk for behavior problems. Thus, it appears that emotional understanding, rather than attentional regulation skills, drives the moderation of the relationship between impulse control and behavior problems when the combined executive control variable is examined as a potential moderator. These results provide evidence for emotional understanding and attentional regulation to be understood as distinct self-regulatory processes, with differential impact on school readiness. Also, the pattern of the interaction was similar to that of frustration tolerance and impulse control, although emotional understanding did not moderate the relationship between impulse control and learning readiness and relationship skills. Thus, there is some indication that important similarities between frustration tolerance and emotional understanding exist, as previously conceptualized, despite their distinct factor loadings.

Table 11

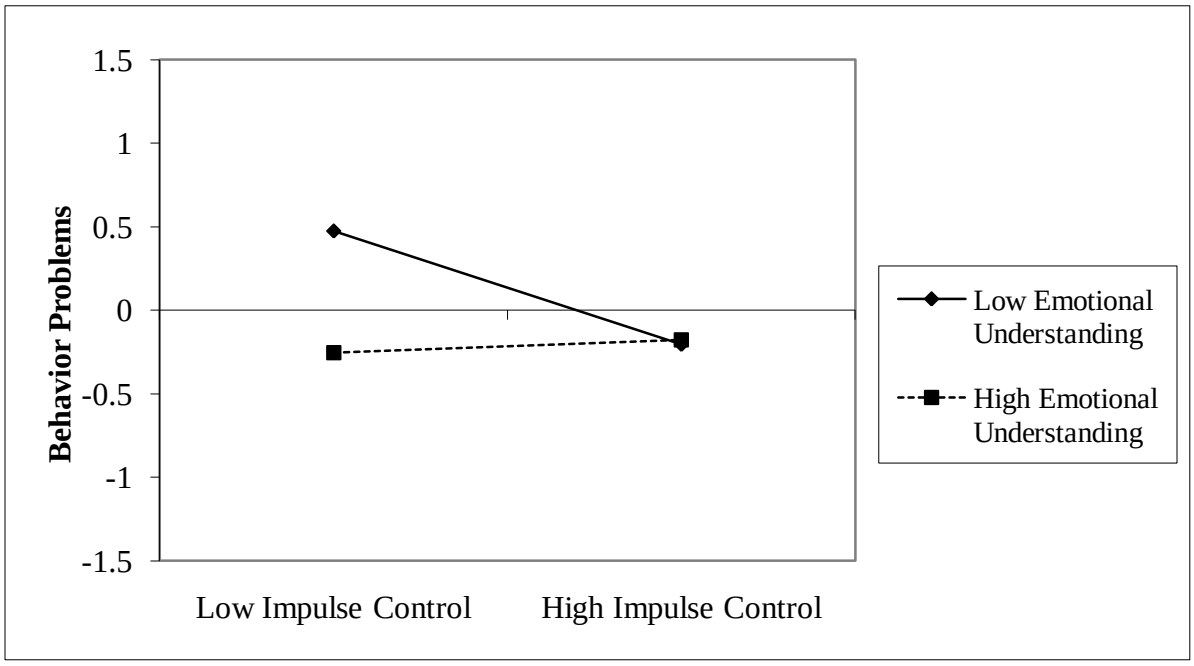
Summary of Hierarchical Regression Analyses Testing Attentional Regulation and Emotional Understanding as Moderators of the Relationship between Impulse Control and School Readiness Outcomes

Learning Readiness			
Predictors	ΔR^2	Predictors	ΔR^2
Step 3[a]	.07**	**Step 3**[a]	.03*
Attentional Regulation		Emotional Understanding	
Step 4	.00	**Step 4**	.01
Impulse Control x Attentional Regulation		Impulse Control x Emotional Understanding	
Relationship Skills			
Predictors	ΔR^2	Predictors	ΔR^2
Step 3[a]	.00	**Step 3**[a]	.08**
Attentional Regulation		Emotional Understanding	
Step 4	.00	**Step 4**	.01
Impulse Control x Attentional Regulation		Impulse Control x Emotional Understanding	
Behavior Problems			
Predictors	ΔR^2	Predictors	ΔR^2
Step 3[a]	.00	**Step 3**[a]	.03*
Attentional Regulation		Emotional Understanding	
Step 4	.01	**Step 4**	.04*
Impulse Control x Attentional Regulation		Impulse Control x Emotional Understanding	

[a] Step 1 for all analyses included the same control variables as in Tables 6-8: age, sex, Expressive One-Word Vocabulary Test Standard Score and Weschler Preschool and Primary Scale of Intelligence: Information Subtest Scaled Score; Step 2 for all analyses included impulse control, and main effects are the same as reported in Table 8; $n = 191$ for all analyses; ** $p < .001$; * $p < .05$; $^{+}p < .06$

Figure 7

Plot of the Interaction between Emotional Understanding and Impulse Control in Predicting Behavior Problems



Impact of the Intervention

The next goal of the present study was to determine the impact of the pilot intervention on children's self-regulation skills and school readiness. First, ANCOVAs were conducted to examine the differences in post-test scores for children in the intervention vs. control group, co-varying child sex, age, intellectual functioning, and pre-treatment scores of the dependent variables. Results are summarized in Table 12, including pre- and post-treatment means and standard deviations.

Table 12

Intervention Effects on Self-Regulation and School Readiness

	Control Group (n = 29)		Intervention Group (n = 33)		Intervention Effect		
Variable	Pre	Post	Pre	Post	F-value	p value	d
Self-Regulatory Processes							
Frustration Tolerance	3.77 (.81)	3.91 (.57)	3.73 (.86)	3.97 (.51)	0.01	.91	.00
Impulse Control	-.11 (1.10)	0.16 (.53)	0.15 (.77)	0.02 (.80)	1.83	.18	-.35
Executive Control	-0.23 (.66)	0.08 (.79)	-0.22 (.71)	0.17 (.74)	0.73	.99	.00
Attentional Regulation	-0.24 (.76)	0.05 (.93)	-0.23 (.74)	0.14 (0.80)	0.05	.81	.00
Emotional Understanding	7.52 (2.09)	8.41 (2.18)	7.62 (2.27)	8.58 (2.17)	0.01	.91	.00
School Readiness Outcomes							
Learning Readiness	-0.63 (0.63)	-0.22 (0.77)	-0.69 (.76)	-0.09 (.81)	0.78	.38	.28
Relationship Skills	-0.49 (1.06)	-0.09 (.95)	-0.54 (.77)	-0.16 (0.79)	0.48	.51	.20
Behavior Problems	0.51 (.93)	0.25 (.78)	0.60 (.90)	0.42 (.89)	1.73	.24	.35

In examining the total intervention and control samples (n = 64), the intervention appeared to have little impact on improving children's self-regulation or school readiness more than the control group. An examination of the means suggests that both groups showed improvement over time. Next, exploratory analyses were undertaken to explore potential intervention effects for children with varying levels of self-regulatory skill deficits. That is, because children were identified for intervention based on teacher ratings, they did not all demonstrate deficits in the direct assessments of self-regulatory skills. To better understand how the intervention impacted children with and without self-regulatory deficits, two groups were created. Both of these groups had deficits in teacher-rated classroom engagement, but

one group exhibited one or more deficits in the targeted self-regulatory processes, whereas the other group did not exhibit any deficits in the targeted self-regulatory processes. Deficits were determined depending on the task (see Table 13).

Table 13

Determination of Deficit in Self-Regulatory Processes

Self-Regulatory Process	Presence of Deficit
Frustration Tolerance	Score of 2 or below on assessor ratings of affect and behavior during the Locked Box task
Impulse Control	Failure to wait the full 60 seconds on the Toy Wrap task without peeking
Executive Control	Deficits in 3 or more of the following tasks: PT: Deficit = score of 12 or below DCCS: Deficit = score of 5 or below BWS: Deficit = score of 1 WLS: Deficit = speeding up between Trials 1 and 3 ACES: Deficit = score of 4 or below (discarding "no feeling" items)

Note: PT = Peg Tapping; DCCS = Dimensional Change Card Sort (post-switch); BWS = Backward Word Span; WLS = Walk-A-Line Slowly; ACES = Assessment of Children's Emotion Scale

Results of intervention impact for the group with self-regulatory skill deficits are presented in Table 14. Ten of the 29 children in the control group had one or more self-regulatory skill deficits, as did 16 of the 33 children in the intervention group. Reflecting the same pattern as the full-sample analyses, inspection of the means suggests that the children improved over time in both self-regulatory skills and teacher-rated adjustment. However, there was no differential advantage of intervention group participation; the ANCOVAs comparing the intervention and control group did not reveal any significant differences.

Table 14

Intervention Effects on Self-Regulation and School Readiness for Children with Self-Regulatory Deficits

	Control Group (n = 10)		Intervention Group (n = 16)		Intervention Effect		
Variable	Pre	Post	Pre	Post	F-value	p value	d
Self-Regulatory Processes							
Frustration Tolerance	3.54 (.76)	4.02 (.57)	3.25 (.75)	3.89 (.41)	0.52	.52	.29
Impulse Control	-0.45 (1.24)	0.08 (.63)	-0.25 (.76)	-0.22 (.86)	1.40	.25	-.46
Executive Control	-0.37 (.67)	-0.19 (.80)	-0.50 (.78)	-0.06 (.91)	0.80	.38	.35
Attentional Regulation	-0.44 (.69)	-0.27 (.88)	-0.49 (.79)	-0.12 (.98)	0.30	.59	.20
Emotional Understanding	7.79 (2.35)	8.37 (2.14)	6.76 (2.49)	8.37 (2.23)	0.64	.43	.29
School Readiness Outcomes							
Learning Readiness	-0.60 (.64)	-0.03 (.81)	-0.99 (.64)	-0.52 (.63)	1.11	.30	.41
Relationship Skills	-0.49 (.82)	0.08 (.94)	-0.73 (.81)	-0.41(.79)	2.66	.13	.60
Behavior Problems	0.50 (.97)	0.22 (.84)	0.56 (1.01)	0.55 (.91)	2.73	.14	.55

Results of intervention impact for the group of children with elevated classroom disengagement but with no self-regulatory skill deficits are presented in Table 15. Nineteen of the 29 children in the control group and 17 of the 33 children in the intervention group had no self-regulatory skill deficits. The results of the ANCOVAs comparing these sub-groups, which controlled for age, sex, intellectual functioning and pre-test scores indicated significant group differences favoring the intervention on the outcomes of learning readiness and relationship skills. Children with adjustment difficulties but no underlying self-

regulatory skill deficits benefitted from intervention, showing significant gains in their learning behaviors in the classroom and in their relations with teachers and peers.

Table 15.

Intervention Effects on Self-Regulation and School Readiness for Children with No Self-Regulatory Deficits

	Control Group (n = 19)		Intervention Group (n = 17)		Intervention Effect		
Variable	Pre	Post	Pre	Post	F-value	p value	d
Self-Regulatory Processes							
Frustration Tolerance	4.20 (.74)	3.70 (.53)	4.21 (.70)	4.04 (.59)	1.03	.32	.46
Impulse Control	0.52 (.10)	0.31 (.18)	.55 (.00)	0.24 (.70)	0.02	.90	.00
Executive Control	0.02 (.57)	0.57 (.49)	0.08 (.51)	0.41 (.45)	2.43	.14	.70
Attentional Regulation	0.14 (.76)	0.66 (.71)	0.06 (.58)	0.40 (.48)	2.14	.16	.67
Emotional Understanding	7.00 (1.50)	8.50 (2.40)	8.60 (1.54)	9.00 (2.19)	0.07	.79	.00
School Readiness Outcomes							
Learning Readiness	-0.70 (.64)	-0.66 (.50)	-0.37 (.76)	0.38 (.73)	7.63	.01*	1.34
Relationship Skills	-0.47 (1.47)	-0.50 (.89)	-0.34 (.71)	0.11 (.69)	4.31	.05*	1.03
Behavior Problems	0.51 (.92)	0.32 (.63)	0.64 (.79)	0.27 (.87)	0.01	.91	.00

*$p < .05$

One additional set of exploratory analyses was undertaken. To better understand how intervention may have impacted children with *particular* self-regulatory deficits, the proportion of children with a particular types of deficit at the pre-treatment assessment were identified. The post-treatment scores for these children were examined in order to identify the proportion with remediation of the skill deficit by the post-test assessment. The criterion used to determine remediation for each deficit area is described in Table 16.

Table 16

Determination of Remediation of Deficit in Self-Regulatory Processes

Self-Regulatory Process	Remediation of Deficit
Frustration Tolerance	Score of 2 or below on assessor ratings of affect and behavior on Locked Box at Time 1; **Score of 3 or better at Time 2**
Impulse Control	Failure to wait the full 60 seconds on the Toy Wrap task without peeking at Time 1; **ability to wait at Time 2 without touching toys, needing reminders, or verbalizing choice.**
Executive Control	Deficits in 3 or more of the following tasks at Time 1, and **a reduction of 2 deficits in the following tasks at Time 2**: PT: Deficit = score of 12 or below DCCS: Deficit = score of 5 or below BWS: Deficit = score of 1 WLS: Deficit = speeding up between Trials 1 and 3 ACES: Deficit = score of 4 or below
Attentional Regulation	Deficits in 2 or more of the attentional regulation tasks at Time 1 (see above);**reduction of 2 deficits at Time 2**
Emotional Understanding	Score of 4 or below on ACES (discarding "no feeling" items) at Time 1; **5 or above on ACES at Time 2**

Note: PT = Peg Tapping; DCCS = Dimensional Change Card Sort (post-switch); BWS = Backward Word Span; WLS = Walk-A-Line Slowly; ACES = Assessment of Children's Emotion Scale

The proportion of children with remediated skill deficits in the intervention and control groups is shown in Table 17. Comparisons were made in the proportion improved at post-treatment using Chi-Square analysis. A near-significant trend (p = .051) suggested that intervention was more likely than the control experience to remediate deficits in the broad executive control domain. When this domain was separated into two domains of attentional regulation and emotional understanding, a significant effect emerged for emotional

understanding only. Thus, for children with a particular deficit in emotional understanding at the pre-treatment assessment, a greater proportion (89%) were remediated as a result of participation in intervention activities, compared to participation in control group activities (33%).

Table 17

Proportion of children with deficits for whom deficit was remediated by intervention versus control activities

Remediation	Intervention *n* (% remediated)	Control *n* (% remediated)	Group Difference X^2 (*df* = 1)
Frustration Tolerance Remediation	8 (75%)	8 (75%)	0.00
Impulse Control Remediation	9 (33%)	10 (50%)	0.54
Executive Control Remediation	7 (43%)	7 (0%)	3.81^{+}
Attentional Regulation Remediation	9 (22%)	7 (14%)	0.16
Emotional Understanding Remediation	9 (89%)	6 (33%)	5.00*

* $p < .05$; $^{+}$ $p < .06$

Chapter 5. DISCUSSION

Structure of Self-Regulation

This study was among the first to undertake field-based measurement of self-regulation with such a wide variety of tasks believed to tap behavioral, emotional and attentional regulation. The first aim of the current study was to examine the structure of self-regulation, in a diverse sample of pre-kindergarten and kindergarten children. Self-regulation was conceptualized as a multifaceted construct, and it was expected that different domains of self-regulation would emerge, representing specific behavioral, emotional, attentional regulatory skills. This hypothesis was tested using an exploratory factor analysis of the direct-assessment measures of self-regulation collected for this project. As expected, multiple factors emerged, however they did not fall completely in line with expectations. Three distinct factors representing impulse control, frustration tolerance, and executive control comprised self-regulation in the current sample. These factors loosely represented behavioral, emotional and attentional domains, however tasks conceptualized as behavioral (Walk-A-Line Slowly) and emotional (ACES) in nature also co-loaded with tasks of attentional regulation. Therefore, the manner in which tasks loaded together was both expected and surprising given the existing literature on self-regulation in early childhood.

Similar to existing research examining delay-of-gratification tasks, working memory tasks, and tasks measuring attentional control and attentional set-shifting, children's performance on the Toy Wrap (behavioral impulse control) task in the current study factored separately from working memory, attentional control and attentional set-shifting. This finding is consistent with existing research conducted by Sonuga-Barke, and colleagues (2003) who found that executive dysfunction and delay aversion factored separately and

made significant, unique contributions to the prediction of ADHD in preschool-age children. Carlson and Moses (2001) similarly found that their measures of inhibitory control, collected in preschool children, yielded two factors (delay and conflict) in an exploratory factor analysis, such that tasks requiring delay-of-gratification loaded separately from those requiring cognitive inhibition of a prepotent response as well as both attentional-set shifting and working memory, to some extent. Nigg (2006) also distinguishes between executive and motivational inhibition of prepotent responses and finds that they predict to risk for different types of psychopathology. Thus, the current findings are consistent with existing literature on the nature of delay (behavioral or motivational impulse control) versus attentional regulation (attentional control, attentional set-shifting, and working memory) such that they represent two distinct self-regulatory processes.

Somewhat inconsistent with previous research, however, the Walk-a-Line Slowly task in the present study did not factor together with the delay task (Toy Wrap), as expected. Instead, it loaded clearly with tasks of cognitive executive function. Investigators have previously conceptualized the Walk-A-Line (and similar tasks) as a task of behavioral inhibition or motor/impulse control separately from attentional regulation skills (Bierman, Nix, et al., 2008; Kieras, Tobin, Graziano, & Rothbart, 2005; Li-Grining, 2007), because it has shown patterns of prediction to school readiness or social adjustment outcomes similar to delay tasks, and because it tends to be more closely related to delay tasks than conflict (executive function) tasks. In their exploratory factor analysis of effortful control at different ages across early childhood, Murray and Kochanska (2002) similarly found that Walk-A-Line Slowly factored together with their delay tasks in preschool age and early school age children. However, only Walk-A-Line Slowly (and not other delay tasks) co-

loaded with tasks similar to the current measures of executive function in early school age. Smith-Donald and colleagues also found that their Balance Beam task (very similar to Walk-a-Line Slowly) loaded together with Pencil (Peg) Tap, suggesting that there might be some shared cognitive demands for both types of tasks. For instance, in the Walk-A-Line Slowly or Balance Beam task, children are asked to walk as slowly as they can, and then in subsequent trials, they are asked to walk even slower, requiring some demands on working memory to hold information about how fast they walked the first time, in order to make sure the next time is slower. Also, while the task itself might be motivating for some children, it is not associated with an explicit reward, therefore may place fewer demands on suppression of motivational impulses than the Toy Wrap task.

Regarding the question of whether attentional regulation skills represent a unitary construct (Garon, et al., 2008), current findings suggest that our measures of attentional control, working memory and attentional set-shifting do load together on a single factor, providing evidence that performance on these types of tasks may not be well-differentiated in early childhood. Wiebe, Epsy, and Charak (2007) similarly found that 2 to 6 year old children's performance on tasks of attentional control and working memory was best accounted for by a single-factor model, using confirmatory factor analysis to compare different models of attentional regulation. Others have also found that non-delay executive function tasks (planning, shifting, working memory) load together in early childhood (Carlson & Moses, 2001; Sonuga-Barke et al., 2003). Thus, it appears that performance on these tasks may not become differentiated into separate factors representing working memory, attentional set-shifting, and attentional control until later in childhood (Brocki & Bohlin, 2004).

Several researchers have argued that most tasks of executive function or attentional regulation, although typically designed to tap one specific process, inherently have both working memory and attentional control demands, despite surface-level differences (Carlson, 2003; Miyake, et al., 2000; Roberts & Pennington, 1996). It may be that for young children, whose attentional regulation skills are still rapidly developing, similarities in cognitive demand drive overall performance more so than for older children whose attentional regulation skills may be more highly developed. In any case, current results indicate that tasks of attentional control, working memory and attentional set-shifting represent a unitary self-regulatory process for pre-kindergarten and kindergarten children.

Of note, the attentional regulation tasks used in this study loaded together onto a third factor (labeled executive control) with a task of emotional understanding. Attentional regulation and emotional understanding have rarely been studied together empirically in terms of their relation to each other as self-regulatory processes, and the literatures regarding their predictions to social-emotional adjustment or school readiness have historically been quite separate (Leerkes, Paradise, O'Brien, Calkins, & Lange, 2008).

Leerkes and colleagues (2008) recently examined the interconnections between cognitive understanding and control and emotional understanding and control using confirmatory factor analysis to determine whether they represented unique or overlapping areas of development in 3.5 year old children. Contrary to the current findings, their analyses found emotional understanding and executive functions (attentional regulation skills) to represent distinct constructs, although there were moderate, significant correlations between their 'labeling of emotions' task and their tasks of executive function (K-ABC digit span: r = .27, p <.01; and Children's Stroop Test: r = .34, p < .01). These associations were similar in

magnitude to the relation between the emotional understanding task and each of the attentional regulation tasks used in the current study (*r*s range from .25 to .39, all $p < .001$). These two studies used different methods (exploratory versus confirmatory factor analysis), and examined a different set of variables together with measures of emotional understanding and attentional regulation (or executive function) which may have accounted for the difference in findings.

With regard to the current findings, it is possible that emotional understanding and attentional regulation share some common underpinnings. For instance, success on both types of tasks may be similarly related to receptive language ability or intellectual functioning (Denham, Zoller, Couchoud, 1994; Villemarette-Pittman, Stanford, & Greve, 2002). From a neurobiological standpoint, the orbitofrontal cortex and the inferior part of the frontal cortex (Brodmann area 47) has been implicated in the recognition of emotional expressions (Sprengelmeyer, Rausch, Eysel, & Przuntek, 1998; Streit, et al., 2003). These areas are part of the prefrontal cortex, also responsible for attentional regulation and decision-making. Thus, both types of skills may develop parallel to each other, corresponding with the development of the prefrontal cortex, which occurs rapidly between the ages of 3 and 7 years.

Another possible interpretation of the current factor loadings is that they represent distinct "hot" and "cool" aspects of self-regulatory processing. The notion of "hot and "cool" executive function has been introduced as a possible means by which to interpret differences in patterns of relations between executive tasks involving delay-of-gratification or inhibition of motivational ("hot") impulses, associated primarily with ventral and medial regions of prefrontal cortex, and attentional tasks involving affectively neutral resolution of

competing ("cool") demands for response, associated primarily with dorsolateral regions (Zelazo & Müller, 2002). In the current study, tasks of attentional regulation, commonly conceptualized as affectively neutral or "cool", loaded together with a task of emotional understanding. Although more difficult to tease apart at a neural level, it is possible that a similar "hot"/"cool" distinction exists with regard to emotional aspects of self-regulation, such that there are "hot" aspects of emotion-related self-regulation (regulation of emotional reactivity), and more "cool" aspects of emotion-related self-regulation (emotional understanding).

While speculative, it may be that emotional understanding loads together with attentional regulation in the current study because they reflect performance under relatively affectively- neutral conditions. Visual processing of facial expressions (particularly negative emotions) may involve some activation of the amygdale and other neural areas responsible for emotion-processing, however the task of verbally labeling emotions is much less affectively "charged" than having to regulate emotional and behavioral responses during a frustrating scenario or suppressing motivational impulses in a reward-focused scenario. Thus, it is possible that the three factors obtained in the current study reflect "cool" self-regulatory processing, and two distinct aspects of "hot" self-regulatory processing. However, more empirical research examining all of these self-regulatory processes using a wider variety of tasks is likely necessary to further explore this possibility.

In sum, it was expected that three factors would emerge representing behavioral, emotional, and attentional regulation skills, yet it was also expected that the processes measured were intertwined with regard to their reliance on behavioral, emotional and attentional resources. Thus, while three factors did emerge, they could not "cleanly" be

labeled as behavioral, emotional, or attentional in nature. Rather, consistent with an organizational or orthogenetic view of development in which "hierarchical integration" of systems (e.g. attentional, behavioral, emotional, etc.) occurs in an increasingly complex manner over time (Cicchetti, 1993), the three factors which emerged overlapped to a great extent with regard to these systems. For instance, while impulse control (one of the factors that emerged in the current study) emphasizes behavioral self-regulation, it likely simultaneously relies heavily on attentional, and emotional self-regulatory skills. Similarly, frustration tolerance, another factor that emerged emphasizing emotional self-regulation, also likely requires behavioral and attentional self-regulation for its success. Attentional regulation tasks co-loaded with tasks designed to tap behavioral and emotional regulation, suggesting evidence for overlap between these regulatory systems.

While there remains more empirical work to be done regarding the interrelation between emotional understanding and attentional regulation, and whether they represent common or distinct self-regulatory processes, current factor loadings suggested that they should be examined together, as was done in subsequent analyses. However, because of the possibility that they are distinct processes with differential prediction to school readiness outcomes, they were also examined separately. These results are discussed in the following section.

Predictions to School Readiness

The second aim of the current study was to test the prediction of self-regulation to school readiness outcomes in a diverse sample of pre-kindergarten and kindergarten children at school entry. Individually, frustration tolerance and executive control were each significantly associated with learning readiness and relationship skills. Impulse control was

significantly associated with relationship skills and was the only self-regulatory process associated (inversely) with behavior problems. These findings suggest that all three domains of self-regulation assessed in the current study are important predictors of school readiness in pre-kindergarten and kindergarten children, but each uniquely predict different aspects of school readiness. In examining unique contributions of self-regulatory skills to school readiness with skills entered into the model all together, a similar pattern emerged such that frustration tolerance and executive control uniquely predicted learning readiness and relationship skills, and impulse control uniquely (inversely) predicted behavior problems. Thus, whereas frustration tolerance and executive control appeared central to social and academic engagement, impulse control appeared particularly relevant to the reduction of behavior problems.

In exploring the differential prediction of attentional regulation and emotional understanding I found that emotional understanding and attentional regulation had different patterns of prediction, such that attentional regulation only predicted learning readiness, while emotional understanding predicted all three domains of school readiness (learning readiness, relationship skills, and behavior problems). These findings are similar to those from the existing bodies of literature on emotional and attentional regulation, while providing additional evidence for the argument that these are distinct processes.

Current findings are thus consistent with existing research regarding the link between self-regulation and school readiness: It makes sense that attentional regulation would be primarily related to learning readiness, as prior research has documented findings that working memory and attentional control are associated with positive classroom engagement and academic achievement in preschool and kindergarten (Bierman, Torres, et al., 2008;

Blair & Razza, 2007). Relationship skills were only predicted by emotional aspects of self-regulation (frustration tolerance and emotional understanding) in the current study. It also makes sense that emotion regulation, as initially conceptualized, related particularly to relationship skills, as learning to recognize the emotions of others might be an important precursor to the development of empathy (Mostow, Izard, Fine, & Trentacosta, 2002), necessary for forming close, reciprocal relationships with others. In addition, the capacity to tolerate frustrations in social situations allows for greater social reciprocity and social problem-solving that contributes to positive relationships with peers. Current findings suggest, similarly to previous research, that preschool and kindergarten children who are better able to tolerate their frustrations and understand the emotions of others have higher quality relationships with their teachers, and greater social competence with peers (Denham et al., 2003; Denham et al., 2006; Graziano et al., 2007).

Impulse control was the only unique predictor of behavioral problems (inversely) in the current study, such that poor impulse control appears to be uniquely related to the development of behavior problems. There is ample evidence supporting these findings, linking poor impulse control to student-teacher conflict (Myers & Pianta, 2008), peer conflict (Bierman, 2004), hyperactivity (Barkley, 1997; Nigg 1999; Sonuga-Barke, et al., 2003), and aggression/opposition (Ladd & Profilet, 1996; Vitaro et al., 1992). It thus appears based on current findings that poor impulse control may be primarily linked to behavioral problems, including interpersonal conflict with teachers and peers.

Emotional understanding, when teased apart from attentional regulation, was also linked inversely (although not uniquely) with behavior problems at school entry. This is consistent with previous research linking emotional recognition and verbal labeling of feeling states with more effective conflict management and normative decreases in aggression

(Greenberg, et al., 1991). Frustration tolerance and attentional regulation did not appear to be directly related to behavior problems in the current study, nor did the broader self-regulatory construct of executive control, although I explored these variables, along with emotional understanding as a moderator of the relationship between impulse control and school readiness outcomes. The goal was to determine if they might buffer the impact of poor impulse control on behavior problems, and to determine if they were necessary components to reduced risk for problems in learning readiness or relationship skills in the presence of low versus high impulse control.

Summary of the Link between Self-Regulatory Skills and their Interplay to School Readiness

Based on the initial factor analysis, frustration tolerance (the proxy for emotional regulation), and executive control (the proxy for attentional regulation) were explored as moderators of the relationship between impulse control (the proxy for behavioral regulation) and school readiness outcomes. Frustration tolerance served as a moderator of the relationship between impulse control and all three school readiness outcomes, such that risk for problems in areas of learning readiness and relationship skills was magnified for children with low frustration tolerance *and* low impulse control. Frustration tolerance also appeared to buffer the negative consequences of poor impulse control on behavior problems. Executive control only marginally moderated the relationship between impulse control and behavior problems, and when teased apart into emotional understanding and attentional regulation, it appeared that only emotional understanding buffered against the negative consequences of poor impulse control on behavior problems.

These findings thus prompt two important and related questions regarding the nature of self-regulation and its link to school readiness:

1) Are emotional understanding and attentional regulation best conceptualized as distinct self-regulatory processes with similar underlying features, or the same process which could be conceptualized broadly (e.g. as executive control in this study)?

2) Are emotional understanding and frustration tolerance best conceptualized as together representing emotional regulation, or are they more likely distinct emotion-related self-regulatory processes?

With regard to the first question, each time emotional understanding was teased apart from attentional regulation it appeared that emotional understanding was the driving factor in most of the significant associations between executive control and school readiness, including serving as the moderator between impulse control and behavior problems. In one case, emotional understanding by itself accounted for additional significant direct predictions (e.g. to behavior problems) not accounted for by executive control. In contrast, attentional regulation only individually predicted learning readiness, and did not by itself act as a moderator between impulse control and school readiness outcomes.

The answer to this first question as addressed by the current findings thus depends on how one defines "distinct" versus "unitary". As Garon and colleagues (2008) point out, some researchers have chosen to use factor analysis, a quantitative approach, to delineate distinctions between their constructs of interest, while others take a more developmental approach, using differential prediction to developmentally salient outcomes or to document differences in timing in development of particular skills. Taking a quantitative approach, executive control should be conceptualized as a unitary construct in the current study,

however, taking a developmental approach all evidence suggests that emotional understanding should be conceptualized as a separate process from attentional regulation with regard to the prediction of school readiness outcomes.

Given the consistent pattern of differential findings in the current study, the large bodies of literature examining these as separate processes, and the fact that outcomes of exploratory factor analytic approaches are easily susceptible to varied results depending on which specific measures are included in the analysis, I argue that the developmental approach in this case is the most appropriate, and that these should be treated as distinct processes. Results from the intervention portion of the study also fall in line with this perspective, as will be discussed in the next section, although more research examining these two processes together in the same studies, particularly with larger samples followed longitudinally, is called for to further clarify this issue.

With regard to the second question, the current factor analysis again suggests that frustration tolerance and emotional understanding are distinct processes, rather than a solitary construct representing emotional regulation. Taking a developmental approach in examining similarities and differences in the prediction of these two variables to school readiness, it appears that both similarities and differences exist. For instance, frustration tolerance and emotional understanding both similarly provide unique contributions to the prediction of learning readiness and relationship skills, however only emotional regulation uniquely predicts to behavior problems. In exploring both of these variables as moderators, they both moderated the relationship between impulse control and behavior problems, while attentional regulation did not emerge as a moderator. Emotional understanding did not, however,

moderate the relationships between impulse control and learning readiness or relationship skills, whereas frustration tolerance was a clear moderator of those relationships.

I argue that these are differentiable components of emotional regulation, albeit similar to one another. Thus, they could both be conceptualized together as aspects of emotional self-regulation however they may reflect subtle distinctions in how emotion-related aspects of self-regulation operate to support adaptive functioning in the school context. There are several features of frustration tolerance and emotional understanding that may contribute to their distinction. Possibilities include: 1) the relative "hot" nature of frustration tolerance versus "cool" nature of emotional understanding, 2) the relative role of verbal intelligence as larger for emotional understanding than frustration tolerance, and 3) the relative likely overlap of temperamental impulsivity with the capacity for frustration tolerance more so than with emotional understanding.

In sum, findings from the current study clearly demonstrate that self-regulation plays a crucial role in social-behavioral and learning readiness at school entry. Moreover, different aspects of self-regulation uniquely predict different aspects of school readiness providing support for the value of taking a comprehensive approach to studying self-regulation and school readiness. Self-regulatory processes interact in significant and unique ways to support school readiness, highlighting potential implications for intervention.

Current findings support the conceptualization of emotional regulation (including both frustration tolerance and emotional understanding) as a potential buffer against risk for problematic school outcomes for children with poor impulse control. This suggests that intervention components specifically targeting emotional understanding and frustration tolerance (such as Preschool PATHS) may have particular importance for children with low

impulse control, as well as intervention components directly targeting behavioral impulse control. Attentional regulation was directly and strongly positively linked with learning readiness. Thus an intervention such as Tools of the Mind, which targets attentional regulation, may be best suited for children with learning problems or difficulty with classroom engagement around learning tasks. The next section will discuss the effects of the pilot-trial of an intervention adapted using components of Preschool PATHS and ToM designed to target behavioral, emotional, and attentional self-regulation and improve school readiness for a sub-sample of at-risk children.

Intervention Effects on Self-Regulation and School Readiness

The final aim of the current study was to design, implement and evaluate a pilot version of a short-term school-based intervention designed to promote self-regulation and school readiness. The intervention adapted components from existing universal preschool programs: Preschool PATHS (Domitrovich et al., 2007) and Tools of the Mind (Bodrova & Leong, 2006). The goal was to modify portions of these interventions for children at-risk for problems in self-regulation and school readiness, utilizing a coaching model similar to the "Friendship Groups" employed in the Fast Track project for children at high risk for maladjustment, involving small-group, and interactive intervention strategies. Because the current study was underpowered to detect anything smaller than a large effect, it was expected that results would guide determination of "proof-of-concept" for this type of intervention approach.

In examining the total intervention and control samples, the intervention appeared to have little impact on improving children's self-regulation or school readiness more than the control group, with both groups showing improvement in self-regulation and school

readiness over time. A different pattern of results emerged, however, when intervention impact was explored separately for children with and without self-regulatory deficits. For children with a self-regulatory deficit, as with the total sample, there was no significant differential advantage of intervention group participation, as children improved via participation in both intervention and control activities. Conversely, children with teacher-rated adjustment difficulties but no underlying self-regulatory skill deficits did benefit from the intervention, showing significant gains in their learning behaviors in the classroom and in their relations with teachers and peers.

Of note, findings relevant to intervention impact did not provide a straightforward answer regarding the benefit of this intervention approach for the children screened as "at-risk" in this study. Because children were screened on teacher-rated classroom engagement, they all had demonstrable behavioral difficulties in the classroom environment. However, not all of these children had underlying deficits in self-regulation as measured by direct assessment. The children without underlying self-regulatory deficits did benefit from intervention (versus control) in the areas of learning readiness (where they had room to grow, by selection) and relationship skills.

These findings are somewhat contrary to existing findings that preschool children low in motor control and behavioral executive functioning benefited more from universal social-emotional learning curriculum (Preschool PATHS) than control activities in a normative sample (Bierman, Nix et al., 2008). It is possible that for children in this study with *both* documented problems with behavioral maladjustment in the classroom and underlying deficits in directly assessed skills, the current intervention approach was not sufficient in its dosage to remediate deficits. The current intervention was much less

comprehensive than the Preschool PATHS curriculum, and was delivered over a shorter time frame, which may have accounted for some of the differences in findings for children with deficits. Thus, while the current intervention was intended to be modified for children with difficulty engaging in school and classroom activities by introducing more interactive play and reducing sit-and-listen time, it may not have been effective enough or comprehensive enough for eliciting engagement from children who were behaviorally at-risk *and* had corresponding self-regulatory deficits.

In examining how the intervention may impacted children with *particular* self-regulatory deficits, it turned out a significantly greater proportion of children with a particular deficit in emotional understanding at pre-treatment assessment were remediated as a result of participation in intervention activities compared to participation in control group activities. In speaking to the questions posed earlier about whether emotional understanding should be regarded as distinct from attentional regulation, it again appears that these constructs are differentiable, and should be treated as separate. This finding also provides evidence for treating emotional understanding as a separate aspect of emotional regulation than frustration tolerance, which was not impacted at all by the current intervention.

Utility of Intervention Approach and Future Directions

Some important information can be gleaned from these results regarding the utility of the intervention approach and future directions for a larger intervention trial. While findings do provide some evidence for "proof-of-concept" of the current intervention approach, results should be interpreted with caution. Finding are likely best understood as a guide for considering how this intervention might be modified to be more effective at targeting a wider range of skills for children with deficits in self-regulation and school readiness, and how

future research trials might be designed to answer more specific questions about the utility of intervention components.

As it appears that children with specific deficits in emotional understanding were most likely to improve in this particular skill as a result of intervention, one could assume based on prior intervention trials of the universal curriculum, that the components of the Preschool PATHS curriculum targeting emotional knowledge and understanding may have been particularly effective for this group of children (e.g. Domitrovich et al.,, 2007; Greenberg & Kusche, 1993). This is promising, considering current findings that emotional understanding, and emotional regulation more broadly, may specifically buffer the impact of poor impulse control on school readiness.

While the intervention, more so than control activities, did improve learning readiness and relationship skills for children with problems in classroom engagement but no underlying self-regulatory deficits, it did not seem to impact children with self-regulatory deficits in the same way. Thus, there may also be some promise of components of the Tools of the Mind intervention for learning readiness, as it was specifically designed to primarily assess attentional regulation skills (Bodrova & Leong, 1996), which were related only to learning readiness in the current study. It seems, however, that the goal to specifically modify universal intervention strategies to address the particular needs of children with self-regulatory deficits was not met by the current approach. The current intervention approach clearly needs further modification to be effective for this group of children at highest risk for problems in school readiness.

Valuable information was also gathered regarding the current measurement approach, particularly as it may be relevant for determining inclusion in selected or indicated

intervention services. It became clear in the final analyses that teacher ratings of "observable" manifestations of problems in self-regulation (i.e. teacher ratings of classroom engagement) should not be substituted for direct assessments of self-regulation, as is often done in studies of self-regulation. Children demonstrating deficits in directly-assessed self-regulation differed in significant ways from children that were screened as having difficulty with classroom engagement, but did not actually have underlying self-regulatory deficits as measured by direct assessment. This discovery speaks to the importance of taking a multi-method, multi-informant approach in assessment strategies of self-regulation in early childhood for both research and intervention purposes.

The current data collection strategy was successful in demonstrating that direct measures of a battery of self-regulation tasks, comprising behavioral, emotional, and attentional components, as well as information about intellectual functioning, can be collected on-site at children's schools reliably and relatively easily and inexpensively. As Smith-Donald and colleagues (2007) have previously called for, field-based assessments, such as this one, should be undertaken more often in future research on the link between self-regulation and school readiness. Field-based assessments would be particularly valuable as a tool for studying these relationships for children from low-income backgrounds or other groups of children whose families typically do not volunteer or get recruited for lab-based research protocols. This was the first study to pilot the use of frustration tolerance tasks "on-site" in schools, based on protocols exclusively used in lab-based settings. There is some promise for this type of measure in field-based settings, as it was reliably collected and served as an important predictor of teacher-rated school readiness. More work may be

needed to modify these measures such that they become more sensitive to capturing change over time, and more amenable to repeated administrations.

Thus, some important next steps involve: 1) careful measurement and screening, using field-based direct assessment rather than relying exclusively on teacher-rated screens of larger groups of children with particular self-regulatory skill deficits, and 2) the use of dismantling research designs to determine which intervention components may work best for which children. Additionally, follow-up consideration of how to best combine or integrate the most effective intervention components to benefit a heterogeneous group of children with different regulatory deficits should be carefully undertaken.

Strengths and Limitations of the Current Study

This study had a number of important strengths: The project was among the first to comprehensively collect direct assessments of an array of skills reflecting behavioral, emotional and attentional aspects of self-regulation, which were found to predict to different aspects of school readiness. In addition, data was collected with a relatively large and diverse sample of children from geographical areas containing higher concentrations of low-income families than might be found in samples recruited for lab-based research. Thus it may be easier to generalize these findings to the larger population, than lab-based findings. Data was collected "on-site" at children's schools, and the intervention was delivered at schools, ensuring a high rate of participation in assessments and intervention sessions. Lastly, the intervention research design was strong, comparing intervention activities with control group activities to account for change due to "common factors" (e.g. pull-out time from class, increased adult attention, participation in peer group activities) as opposed to the "active" ingredients of the intervention.

Although strong in many ways, the study also had a number of significant limitations worthy of consideration. The conceptual model tested using the normative sample in the current project was examined at one single time point. Thus, interpretations about prediction over time are quite limited, such that the model would be best examined with longitudinal data. Unfortunately, given the limitations in scope of a dissertation project, only the children screened for the intervention trial were followed across time. Because this group of children was only one-third of the size of the original sample, and these children participated in small-group pull-out activities, it was not appropriate to test the conceptual model longitudinally using this sub-sample only. Future developmental studies that follow a large normative sample over time (across multiple years) and examine differences in low- versus high-risk children (without intervention) are warranted to better understand how relationships between self-regulation and school readiness hold up over time.

It is possible that while the measures of self-regulation used in the current study are predictive of school readiness outcomes at one time point, they may not be particularly sensitive to capturing change over time. In particular, performance on some of the measures currently used may be affected by familiarity with the task and could not be repeated. Thus more work in developing valid measures of self-regulation that are sensitive to change over repeated presentations is warranted.

Further, while it is fully acknowledged that environmental and familial factors play an important role in the development of self-regulation, they were not measured in the current study. Ideally, with greater resources and fewer time limitations, collecting information from parents would greatly add to the understanding of the link between self-regulation and school readiness. Family resources or parental characteristics should be

explored in future research as potential moderators or mediators of the relationship between self-regulation and school readiness at school entry. Findings could then inform the development of complementary parent-focused intervention components to strengthen supports for child skill development and generalized skill use at home, prior to school entry.

This intervention was delivered by trained interventionists hired specifically for this project. It is possible that children may have benefitted more from an intervention delivered more regularly by their own teachers, guidance counselors, or other school personnel with whom they are familiar. Teacher involvement may also have allowed for more generalization of skills introduced during group time to the classroom at-large. Thus, it is worth exploring in the future how this type of intervention approach could be incorporated into teacher practices, and delivered in a more integrative manner with other school-based services that might be available to children with social or behavioral difficulties.

The size of the intervention study sample is small, which greatly constrained power for testing complex longitudinal relations between constructs over time, and left limited power to detect intervention effects beyond simple pre- to post- change in individual variables. In addition, the scope and time course of this pilot intervention is highly constrained. As previously mentioned, it is best considered a pilot study demonstrating "proof of concept" for the intervention approach. Again, in future research studies, larger sample sizes and extended project time could inform more specific questions regarding development of self-regulation and impact on long-term school adjustment outcomes. Also, current findings suggest that specific intervention components (e.g. emotion "coaching" versus play-based practice) should be isolated and compared individually and in combination using a dismantling design.

Concluding Comments

School entry marks a critical transition in the lives of young children. This time period presents children, particularly those from low-income backgrounds, with a new set of social and learning challenges to which they may have never been previously exposed. Mastery of these challenges is critical to success in the school environment, and appears in the current study to be very much associated with development of behavioral, emotional and attentional aspects of self-regulation. Thus, this study adds to the growing body of research calling for greater attention from researchers, clinicians, educators, and policy-makers alike, to the importance of working together to promote self-regulation in young children and to foster *social-emotional* and *behavioral*, as well as academic, school readiness. Doing so will inevitably reduce risk for life-long problems associated with school failure, and contribute to increased positive school adjustment and general well-being for future generations of children.

APPENDIX A

SUMMARY OF INTERCORRELATIONS FOR ALL MEASURES

	1	2	3	4	5	6	7	8	9	10	11
1. WPPSI-III: Information	1.00	___	___	___	___	___	___	___	___	___	___
2. EOWPVT	.63**	1.00	___	___	___	___	___	___	___	___	___
3. Walk-A-Line Slowly	.31**	.30**	1.00	___	___	___	___	___	___	___	___
4. Toy Wrap – Latency to peek	.19*	.13	.13	1.00	___	___	___	___	___	___	___
5. Toy Wrap – Number of peeks	-.16*	-.13	-.14*	-.87**	1.00	___	___	___	___	___	___
6. Assessment of Children's Emotions Scale	.31**	.40**	.20*	.21*	-.21**	1.00	___	___	___	___	___
7. Locked Box: Distress	.17*	.19*	.16*	.00	-.01	.11	1.00	___	___	___	___
8. Locked Box: Positive Affect	-.06	-.02	-.04	.03	-.01	-.07	-.35**	1.00	___	___	___
9. Locked Box: Destructive Beh.	.08	.00	.01	-.18*	.16*	.04	.46**	-.09	1.00	___	___
10. Backward Word Span	.39**	.43**	.35**	.17*	-.19*	.31**	.16*	-.14	-.01	1.00	___
11. Peg Tapping	.34**	.35**	.25**	.30**	-.31**	.39**	.00	.05	.-.01	.51**	1.00
12. Dimensional Change Card Sort	.30**	.34**	.16*	.21*	-.17*	.25*	.15*	-.11	.03	.26**	.30**
13. Classroom Participation	.19*	.23*	.14	.19*	-.26**	.23*	-.13	.02	-.19*	.18*	.23*
14. Learning Behaviors Scale	.26**	.30**	.12	.19*	-.23*	.30**	-.12	.06	-.13	.16*	.30**
15. Conners' - Inattention	-.20*	-.21*	-.16*	-.19*	.21*	-.26**	.14	.00	.10	-.21*	-.19*
16. Academic Competence	.32**	.36**	.34**	.10	-.14	.30**	-.08	.03	-.05	.35**	.32**
17. Social Health Profile: Prosocial	.21*	.18*	.08	.18*	-.22*	.30**	-.10	.06	-.16*	.20*	.16*
18. Student-Teacher Closeness	.05	.07	-.07	.11	-.10	.27**	-.14	.20*	-.19*	.04	.05
19. Student – Teacher Conflict	-.08	-.01	.07	-.22*	.27**	-.23*	.08	.00	.18*	-.06	-.09
20. Child Behavior Scale – Excluded by Peers	-.08	-.12	-.05	-.25*	.23*	-.18*	.04	-.07	.04	-.12	-.07
21.Conners' - Hyperactivity	-.08	-.03	-.08	-.24*	.26**	-.19*	.13	-.01	.13	-.13	-.15*
22.TOCA-R: Aggression / Opposition	-.04	-.02	-.03	-.21*	.25**	-.12	.12	.01	.12	.00	-.04

SUMMARY OF INTERCORRELATIONS FOR ALL MEASURES (continued)

	12	13	14	15	16	17	18	19	20	21	22
1. WPPSI-III: Information	___	___	___	___	___	___	___	___	___	___	___
2. EOWPVT	___	___	___	___	___	___	___	___	___	___	___
3. Walk-A-Line Slowly	___	___	___	___	___	___	___	___	___	___	___
4. Toy Wrap – Latency to peek	___	___	___	___	___	___	___	___	___	___	___
5. Toy Wrap – Number of peeks	___	___	___	___	___	___	___	___	___	___	___
6. Assessment of Children's Emotions Scale	___	___	___	___	___	___	___	___	___	___	___
7. Locked Box: Distress	___	___	___	___	___	___	___	___	___	___	___
8. Locked Box: Positive Affect	___	___	___	___	___	___	___	___	___	___	___
9. Locked Box: Destructive Beh.	___	___	___	___	___	___	___	___	___	___	___
10. Backward Word Span	___	___	___	___	___	___	___	___	___	___	___
11. Peg Tapping	___	___	___	___	___	___	___	___	___	___	___
12. Dimensional Change Card Sort	1.00	___	___	___	___	___	___	___	___	___	___
13. Classroom Participation	.15*	1.00	___	___	___	___	___	___	___	___	___
14. Learning Behaviors Scale	.20*	.81**	1.00	___	___	___	___	___	___	___	___
15. Conners' - Inattention	-.25*	-.79**	-.78**	1.00	___	___	___	___	___	___	___
16. Academic Competence	.12	.45**	.56**	-.51**	1.00	___	___	___	___	___	___
17. Social Health Profile: Prosocial	.06	.70**	.68**	-.66**	.41**	1.00	___	___	___	___	___
18. Student-Teacher Closeness	.-.04	.51**	.51**	-.45**	.31**	.65**	1.00	___	___	___	___
19. Student – Teacher Conflict	-.05	-.66**	-.60**	.62**	-.17*	-.73**	-.51**	1.00	___	___	___
20. Child Behavior Scale – Excluded by Peers	-.07	-.56**	-.51**	.56**	-.20*	-.70**	-.40**	.64**	1.00	___	___
21.Conners' - Hyperactivity	-.22*	-.66**	-.58**	.79**	-.22*	-.60**	-.29**	.72**	.53**	1.00	___
22.TOCA-R: Aggression / Opposition	-.10	-.70**	-.64**	.68**	-.19*	-.73**	-.41**	.88**	.67**	.77**	1.00

Note. N = 192. Measures 1-12 are direct assessment measures, and measures 13-22 are teacher-rated.
** $p < .001$; * $p < .05$

REFERENCES

American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision.* Arlington, VA: Author.

Barkley, R. A. (1997). *ADHD and the Nature of Self-Control.* New York, NY: The Guilford Press

Barkley, R. A. (2001). The EF and self-regulation: An evolutionary neuropsychological perspective. *Neuropsychology Review, 11,* 1-29.

Barnett, W. S., Yarosz, E., Thomas, J., & Hornbeck, A. (2006). Educational effectiveness of a Vygotskian approach to preschool education: A randomized trial. Rutgers, NJ: National Institute for Early Education Research

Bembenutty, H., & Karabenick, S. A. (2004). Inherent association between academic delay of gratification, future time perspective, and self-regulated learning. *Educational Psychology Review, 16,* 35-57.

Bierman, K. (2004). *Peer Rejection: Developmental Processes and Intervention Strategies*. New York: The Guilford Press.

Bierman, K. L., Domitrovich, C. E., Nix, R. L., Gest, S. D., Welsh, J. A., Greenberg, M., Blair, C., Nelson, K. & Gill, S. (2008). Promoting academic and social-emotional school readiness: The Head Start REDI program. *Child Development, 79,* 1802-1817.

Bierman, K. L , Greenberg, M. T. & CPPRG (1996). Social skills training in the Fast Track Program. In R. D. Peters & R. J. McMahon (Eds.). *Preventing Childhood Disorders, Substance Abuse, and Delinquency.* Banff International Behavioral Science Series, (Vol. 3, pp.65-89). Thousand Oaks, CA: Sage Publications, Inc.

Bierman, K. L, Miller, C. L., Stabb, S. D. (1987). Improving the social behavior and peer acceptance of rejected boys: Effects of social skill training with instructions and prohibitions. *Journal of Consulting and Clinical Psychology, 55,* 194-200.

Bierman, K. L., Nix, R. L., Greenberg, M. T., Domitrovich, C. E. & Blair, C. (2008). Executive functions and school readiness intervention: Impact, moderation, and mediation in the Head Start-REDI Program. *Development and Psychopathology, 20,* 821-843.

Bierman, K. L., Torres, M. M., Domitrovich, C. E., Welsh, J. A., & Gest, S. D. (2008). Behavioral and cognitive readiness for school: Cross-domain associations for children attending Head Start. *Social Development, 18,* 305-323.

Birch, S. H. & Ladd, G. W. (1997). The teacher-child relationship and children's early school adjustment. *Journal of School Psychology, 35,* 61-79.

Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist, 57,* 111-127.

Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology, 20,* 899-911.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development, 78,* 647-663.

Blair, C., Zelazo, P. D., & Greenberg, M. T. (2005). The measurement of executive function in early childhood, *Developmental Neuropsychology, 28,* 561-571.

Blair, K. A., Denham, S. A., Kochanoff, A., Whipple, B. (2004). Playing it cool: Temperament, emotion regulation, and social behavior in preschoolers, *Journal of School Psychology, 42*, 419-443.

Brocki, K. C., & Bohlin, G. (2004). Executive functions in children aged 6-13: A dimensional and developmental study. *Developmental Neuropsychology, 26*, 571-593.

Brownell, R. (2000). *Expressive One-Word Picture Vocabulary Test Manual.* Novato, CA: Academic Therapy Publications.

Bodrova, E. & Leong, D. J. (2006). *Tools of the Mind: The Vygotskian approach to early childhood education, 2nd Edition.* Columbus, OH: Merrill/Prentice Hall.

Booth, A., & Crouter A. C. (Eds.). (2008). *Disparities in school readiness: How families contribute to transitions to school.* New York, NY: Lawrence Earlbaum Associates.

Börger, N, & van der Meere, J. (2000). Motor control and state regulation in children with ADHD: a cardiac response study. *Biological Psychology, 51*, 247-267.

Botvinick, M. M., Braver, T.S., Barch, D. M., Carter, C. S., & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological Review, 108*, 624-652.

Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, switching, and working memory. *Developmental Neuropsychology, 19*, 273-293.

Cain, K., Oakhill, J. & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology, 96*, 31-42.

Calkins, S. D., & Fox, N. A. (2002). Self-regulatory processes in early personality development: A multilevel approach to the study of childhood social withdrawal and aggression, *Development and Psychopathology, 14*, 477-498.

Calkins, S. D., Gill, K. L., Johnson, M.C., & Smith, C. L. (1999). Emotional reactivity and emotion regulation strategies as predictors of social behavior with peers during toddlerhood. *Social Development, 8,* 310-341.

Calkins, S. D., Smith, C. L., Gill, K. L., & Johnson, M.C. (1998). Maternal interactive styles across contexts: Relations to emotional, behavioral, and physiological regulation during toddlerhood. *Social Development, 7,* 350-369.

Campbell, S. B. (2006). *Behavior Problems in Preschool Children, 2nd Edition.* New York, NY: The Guilford Press.

Campbell, S. B. & Stauffenberg, C. (2008) Child characteristics and family processes that predict behavioral readiness for school. In A.Crouter & A. Booth (Eds.) *Early disparities in school readiness: How do families contribute to successful and unsuccessful transitions to school*. Mahwah, N.J.: Lawrence Erlbaum.

Carlson, S. M. (2003). Executive function in context: Development, measurement, theory, and experience, *Monographs of the Society for Research in Child Development, 68,* 138-151.

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology, 28,* 595-616.

Carlson, S. M., Mandell, D. J., & Williams, L. (2004). Executive function and theory of mind: Stability and prediction from ages 2 to 3, *Developmental Psychology, 40,* 1105-1122.

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind, *Child Development, 72*, 1032-1053.

Carlson, S. M., Moses, L. J., & Breton, C. (2002). How specific is the relation between executive function and theory of mind? Contributions of inhibitory control and working memory, *Infant and Child Development, 11*, 73-92.

Carlson, S. M., & Wang, T. S. (2007). Inhibitory control and emotion regulation in preschool children, *Cognitive Development, 22*, 489-510.

Chang, F., & Burns, B. M. (2005). Attention in preschoolers: Associations with effortful control and motivation. *Child Development, 76,* 247–263.

Cicchetti, D. (1993). Developmental psychopathology: Reactions, reflections, projections. *Developmental Review, 13*, 471-502.

Coie, J. D, & Dodge, K. A. (1998). Aggression and antisocial behavior. In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), *Handbook of child psychology: Vol. 3. Social emotional and personality development* (5th ed., pp. 779-862). New York: Wiley.

Cole, P. M. (1986). Children's spontaneous control of facial expression. *Child Development, 57*, 1309-1321.

Cole, P. M., Martin, S. E., & Dennis, T. A. (2004). Emotion regulation as a scientific construct: Methodological challenges and directions for child development research. *Child Development, 75*, 317-333.

Cole, P. M., Michel, M., & Teti, L. (1994). The development of emotion regulation and dysregulation: A clinical perspective. In N.A. Fox (Ed.), The development of emotion regulation: Biological and behavioral considerations. *Monographs of the Society for Research in Child Development, 59* (2-3 Serial No. 240), 53-72.

Collaborative for Academic, Social and Emotional Learning. (2009). Collaborative for Academic, Social and Emotional Learning: Past. Present. Future. Retrieved from http://www.casel.org/downloads/15yrreport.pdf

Conduct Problems Prevention Research Group. (1992). A developmental and clinical model for the prevention of conduct disorders: The FAST Track Program. *Development and Psychopathology, 4,* 509-527.

Conners, C.K. (2000). *Conners' Rating Scales-Revised Technical Manual.* North Tonawanda, New York: Multi Health Systems.

Coolahan, K., Fantuzzo, J., Mendez, J., McDermott, P. (2000). Preschool peer interactions and readiness to learn: Relationships between classroom peer play and learning behaviors and conduct, *Journal of Educational Psychology, 92*, 458-465.

Cummings, E.M., Davies, P.T. & Campbell, S.B. (2000). *Developmental Psychopathology and Family Process: Theory, Research and Clinical Implications.* New York, NY: Guilford Press.

Davis, H. L., & Pratt, C. (1996). The development of children's theory of mind: The working memory explanation. *Australian Journal of Psychology, 47,* 25 – 31.

Denham, S. A. (2006). The emotional basis of learning and development in early childhood education. In: Spodek, B.; Saracho, ON., editors. *Handbook of research on the education of young children.* Mahwah, NJ: Erlbaum, pp. 85-103.

Denham, S. A., Blair, K.A., DeMulder, E., Levitas, J., Sawyer, K., Auerbach-Major, S., & Queenan, P. (2003). Preschool emotional competence: Pathway to social competence? *Child Development, 74,* 238-256.

Denham, S. A., Zoller, D., & Couchoud, E. A. (1994). Socialization of preschoolers' emotion understanding. *Developmental Psychology, 30*, 928-936.

Derryberry, D. (2002). Attention and voluntary self-control, *Self and Identity, 1*, 105-111.

Derryberry, D. & Rothbart, M.A. (1997). Reactive and effortful process in the organization of temperament. *Developmental Psychopathology, 9*, 633-652.

Diamond, A. (2005). Attention-deficit disorder (attention-deficit/hyperactivity disorder without hyperactivity): A neurobiologically and behaviorally distinct disorder from attention-deficit/hyperactivity disorder (with hyperactivity), *Development and Psychopathology, 17*, 807-825.

Diamond, A. (2006). Developmental time course in human infants and infant monkeys, and the neural bases of, inhibitory control in reaching. *Annals of the New York Academy of Sciences, 608*, 637-676.

Diamond, A., Barnett W.S., Thomas, J. & Munro, S. (2007). Preschool program improves cognitive control. *Science, 318*, 1387-1388.

Diamond, A., Prevor, M. B., Callendar, G., Druin, D. P. (1997). Prefrontal cortex cognitive deficits in children treated early and continuously for PKU. *Monographs of the Society for Research in Child Development, 62* (4, Serial No. 252).

Diamond, A. & Taylor, C. (1996). Development of an aspect of executive control: Development of the abilities to remember what I said and to do as I say, not as I do. *Developmental Psychobiology, 29*, 315-334.

DiPerna, J.C. & Elliott, S.N. (1999). Development and validation of the Academic Competence Evaluation Scales. *Journal of Psychoeducational Assessment, 17*, 207-225.

Domitrovich, C. E., Greenberg, M. T., Cortes, R., & Kusche, C. (1999). *Manual for the Preschool PATHS Curriculum*. Pennsylvania State University.

Domitrovich, C. E., Cortes, R. & Greenberg, M.T. (2007). Improving young children's social and emotional competence: A randomized trial of the preschool PATHS curriculum. *Journal of Primary Prevention, 28,* 67-91.

Doumen, S., Verschueren, K., Buyse, E., Germeijs, V., Luyckx, K., & Soenens, B. (2008). Reciprocal relations between teacher-child conflict and aggressive behavior in kindergarten: A three-wave longitudinal study. *Journal of Clinical Child & Adolescent Psychology, 37,* 588-599.

Duncan, G.J., Dowsett, C.J., Claessens, A., Magnuson, K., Huston, A.C., Klebanov, P. et al. (2007). School readiness and later achievement. *Developmental Psychology, 43,* 1428-1446.

Eisenberg, N., & Fabes, R. A. (1992). Emotion, regulation and the development of social competence. In M.S. Clark (Ed.). *Review of Personality and Social Psychology: Vol. 14. Emotion and social behavior.* (pp.119-150). Newburg Park, CT: Sage.

Eisenberg, N., Fabes, R. A., Shepard, S. A., Murphy, B. C., Guthrie, I. K., Jones, S., Maszk, P. (1997). Contemporaneous and longitudinal prediction of children's social functioning from regulation and emotionality. *Child Development, 68,* 642-664.

Eisenhower, A. S., Baker, B. L., & Blacher, J. (2005). Preschool children with intellectual disability: syndrome specificity, behaviour problems, and maternal well-being. *Journal of Intellectual Disability Research, 49,* 657-671.

Elias, C. L. & Berk, L. E. (2002). Self-regulation in young children: Is there a role for socio-dramatic play? *Early Childhood Research Quarterly, 17,* 216-238,

Fantuzzo, J., Perry, M.A., & McDermott, P. (2004). Preschool approaches to learning and their relationship to other relevant classroom competencies for low-income children. *School Psychology Quarterly, 19*, 212-230.

Fantuzzo, J., Stoltzfus, J., Lutz, M.N., Hamlet, H., Balraj, V., Turner, C., & Mosca, B. (1999). An evaluation of the special needs referral process for low-income preschool children with emotional and behavioral problems. *Early ChildhoodResearch Quarterly, 14*, 465-482.

Farkas, G. & Hibel, J. (2008). Being unready for school: Factors affecting risk and resilience. In A.Crouter & A. Booth (Eds.) *Early disparities in school readiness: How do families contribute to successful and unsuccessful transitions to school*. Mahwah, N.J.: Lawrence Erlbaum, pp. 3-30.

Finn, J. (1993*). School engagement and students at risk*. Washington, DC: U.S. Department of Education, National Center for Educational Statistics. (ERIC Document Reproduction Service No. ED 362 322).

Fox, N.A., & Calkins, S.D. (2003). The development of self-control of emotion: Intrinsic and extrinsic influences. *Motivation and Emotion, 27*, 7-26.

Friedman, N. P., Miyake, A. (2004). The relations among inhibition and interference control functions: A latent-variable analysis. *Journal of Experimental Psychology: General, 133*, 101-135.

Friedman, N. P., Miyake, A., Corley, R. P., Young, S. E., DeFries, R. C., & Hewitt, J. K. (2006). *Psychological Science, 17*, 172-179.

Frye, D., Zelazo, P. D., & Palfai, T. (1995). Theory of mind and rule-based reasoning. *Cognitive Development*, *10*, 483 – 527.

Garner, P. W. & Power, T. G. (1996). Preschoolers' emotional control in the disappointment paradigm and its relation to temperament, emotional knowledge, and family expressiveness, *Child Development, 67,* 1406-1419.

Garner, P. W., & Waajid, B. (2008). The associations of emotion knowledge and teacher-child relationships to preschool children's school-related developmental competence. *Journal of Applied Developmental Psychology, 29,* 89-100.

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin, 134,* 31-60.

Gilliam, W. S. (2005). *Pre-kindergarteners left behind: Expulsion rates in state pre-kindergarten systems.* Yale Child Study Center; New Haven, CT.

Graziano, P. A., Reavis, R. D., Keane, S. P., & Calkins, S. D. (2007). The role of emotion regulation in children's early academic success, *Journal of School Psychology, 45,* 3-19.

Greenberg, M. T., & Kusche, C. A. (1993). *Promoting social and emotional development in deaf children: The PATHS Project.* Seattle: University of Washington Press.

Greenberg, M.T., Kusche, C.A., & Speltz, M. (1991). Emotional regulation, self control, and psychopathology: The role of relationships in early childhood. In D. Cicchetti & S.L. Toth (Eds.), *Internalizing and externalizing expressions of dysfunction: Rochester symposium on developmental psychopathology* (Vol. 2, pp. 21-66). Hillsdale, NJ: Erlbaum.

Goldsmith, H. H., & Reilly, J. (1993). Laboratory Assessment of Temperament— Preschool Version. University of Oregon.

Gottman, J. (1983). How children become friends. *Monographs of the Society for Research in Child Development,* 48 (Serial No. 201).

Hamre, B. K., & Pianta, R. C. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development, 72*, 625-638.

Hann, D. M. & Borek, N. (2001). Taking stock of risk factors for child/youth externalizing behavior problems, *National Institute of Mental Health,* pp.99-100.

Howes, C., Hamilton, C. E., Philipsen, L. C. (1998). Stability and continuity of child-caregiver and child-peer relationships. *Child Development, 69*, 418-426.

Hughes, C., Dunn, J., & White, A. (1998). Trick or treat? : Uneven understanding of mind and emotion and executive dysfunction in ``hard-to-manage" preschoolers, *The Journal of Child Psychology and Psychiatry and Allied Disciplines, 39,* 981-994.

Hughes, C. & Graham, A. (2002). Measuring executive functions in childhood: Problems and solutions? *Child and Adolescent Mental Health, 7*, 131-142.

Hughes, C., White, A., Sharpen, J., & Dunn, J (2000). Antisocial, angry, and unsympathetic: "hard-to-manage" preschoolers' peer problems and possible cognitive influences. *The Journal of Child Psychology and Psychiatry and Allied Disciplines, 41*, 169-179.

Hughes, J. N. & Kwok, O. (2006). Classroom engagement mediates the effect of teacher-student support on elementary students' peer acceptance: A prospective analysis. *Journal of School Psychology, 43*, 465-480.

Izard, C. E. (2007). Basic emotions, natural kinds, emotion schemas, and a new paradigm, *Perspectives on Psychological Science, 2,* 260-280.

Izard, C. E., & Ackerman, B. P. (2000). Motivational, organizational, and regulatory functions of discrete emotions. In M. Lewis & J. M. Haviland-Jones (Eds.), *Handbook of emotions* (2nd ed., pp. 253-264). New York: Guilford Press.

Izard, C. E., Fine, S., Schultz, D., Mostow, A., Ackerman, B. P., Youngstrom, E. (2001). Emotion knowledge as a predictor of social behavior and academic competence in children at risk, *Psychological Science, 12,* 18-23.

Jones, L. B., Rothbart, M. K., & Posner, M. I. (2002). Development of executive attention in preschool children. *Developmental Science, 6*, 498-504.

Kiel, E. J., & Buss, K. A. (2006). Maternal accuracy in predicting toddlers' behaviors and associations with toddlers' fearful temperament. *Child Development, 77*, 355-370.

Kieras, J. E., Tobin, R. M., Graziano, W. G., & Rothbart, M. K. (2005). You can't always get what you want: Effortful control and children's responses to undesirable gifts. *Psychological Science, 16,* 391-396.

Kochanska, G., Murray, K. T., & Harlan, E. T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology, 36*, 220-232.

Kochanska, G., Murray, K. T., Jaques, T. Y., Koenig, A. L. & Vendegeest, K. A. (1996). Inhibitory control in young children and its role in emerging internalization. *Child Development, 67,* 490-507.

Kopp, C. E. (1982). Antecedents of self-regulation: A developmental perspective. *Developmental Psychology, 18,* 199-214.

Ladd, G. W., Birch, S. H., & Buhs, E. S. (1999). Children's social and scholastic lives in Kindergarten: Related spheres of influence? *Child Development, 70,* 1373-1400.

Ladd, G. W., Price, J. M., Hart, C. M. (1988). Predicting preschoolers' peer status from their playground behaviors, *Child Development, 59*, 986-992.

Ladd, G. W. & Profilet, S. (1996). The Child Behavior Scale: A teacher report measure of young children's aggressive, withdrawn, and prosocial behaviors. *Developmental Psychology, 32*, 1008-1024.

Landry, S. H., & Smith, K. E. (2008). Family processes that support school readiness: Specific behaviors and contextual conditions that set this process in motion. In A. Crouter & A. Booth (Eds.) *Early disparities in school readiness: How do families contribute to successful and unsuccessful transitions to school*. Mahwah, N.J.: Lawrence Erlbaum.

Leerkes, E. M., Paradise, M., O'Brien, M., Calkins, S. D., & Lange, G. (2008). Emotion and cognition processes in preschool children. *Merrill-Palmer Quarterly, 54*, 102-124.

Lengua, L. J. (2002). The contribution of emotionality and self-regulation to the understanding of children's response to multiple risk. *Child Development, 73*,144-161.

Lengua, L. J., Honorado, E., & Bush, N. R. (2007). Contextual risk and parenting as predictors of effortful control and social competence in preschool children. *Journal of Applied Developmental Psychology, 28*, 40-55.

Lewitt, E. M. & Baker, L. S. (1995). School readiness. *The Future of Children, 2*, 128-139.

Li-Grining, C. P. (2007). Effortful control among low-income preschoolers in three cities: Stability, change, and individual differences, *Developmental Psychology,43*, 208-221.

Lochman, J. E., and the Conduct Problems Prevention Research Group. (1995). Screening of child behavior problems for prevention programs at school entry. *Journal of Consulting and Clinical Psychology, 63*, 549-559.

Lonigan, C. J., Burgess, S. R. & Anthony, J. L. (2000) Development of emergent literacy and early reading skills in preschool children: Evidence from a latent-variable longitudinal study. *Developmental Psychology, 36*, 596-613.

Maedgen, J. W. & Carlson, C. L. (2000). Social functioning and emotional regulation in the attention deficit hyperactivity disorder subtypes. *Journal of Clinical Child & Adolescent Psychology, 29*, 30-42.

McClelland, M. M., Acock, A. C., & Morrison, F. J. (2006). The impact of kindergarten learning-related skills on academic trajectories at the end of elementary school. *Early Childhood Research Quarterly, 21,* 471-490.

McDermott, P. A. (1999). National scales of differential learning behaviors among American children and adolescents. School Psychology Review, 28, 280–291.

McLeod, J. D. (2008). Explaining the gap in school readiness. In A.Crouter & A. Booth (Eds.) *Early disparities in school readiness: How do families contribute to successful and unsuccessful transitions to school*. Mahwah, N.J.: Lawrence Erlbaum.

Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science, 244*, 933-938.

Miller, A. L., Gouley, K. K., Seifer, R., Zakriski, A., Eguia, M. & Vergnani, M. (2005). Emotion knowledge skills in low-income elementary school children: Associations with social status and peer experiences, *Social Development, 14*, 637-651.

Miyake, A., Friedman, N. P., Emerson, M. J., Witski, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex ‘‘frontal lobe’’ tasks: A latent variable analysis, *Cognitive Psychology, 41*, 49-100.

Mostow, A. J., Izard, C. E., Fine, S., & Trentacosta, C. J. (2002). Modeling emotional, cognitive, and behavioral predictors of peer acceptance. *Child Development, 73*, 1775-1789.

Myers, S. S., & Pianta, R. C. (2008). Developmental commentary: Individual and contextual influences on student-teacher relationships and children's early problem behaviors. *Journal of Clinical Child & Adolescent Psychology, 37*, 600-608.

National School Readiness Indicators Initiative (2005). Getting ready: Findings from the National School Readiness Indicators Initiative, a 17 state partnership. Retrieved from http://www.gettingready.org/matriarch/d.asp?PageID=303&PageName 2=pdfhold&p=&PageName=Getting+Ready+%2D+Full+Report%2Epdf

Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry, 47*, 395-422.

Nigg, J. T., Blaskey, L. G., Huang-Pollock, C. L., & Rappley, M. D. (2002). Neuropsychological executive functions and *DSM-IV* ADHD subtypes. *Journal of the American Academy of Child & Adolescent Psychiatry, 41*, 59-66.

Passolunghi, M. C. & Seigel, L.S. (2001). Short-term memory, working memory, and inhibitory control in children with difficulties in arithmetic problem solving. *Journal of Experimental Child Psychology, 80*, 44-57.

Patterson, G. (1982). *Coercive family processes.* Eugene, OR: Castalia.

Pianta, R. C. (2001). Implications of a developmental systems model for preventing and treating behavioral disturbances in children and adolescents. In J.N Hughes, A.M. LaGreca, & J.C. Conoley (Eds.) *Handbook of psychological services for children and adolescents.* (pp.23-41.) New York, NY: Oxford University Press.

Pianta, R. C., Steinberg, M. S., & Rollins, K. B. (1995). The first two years of school: Teacher-child relationships and deflections in children's classroom adjustment, *Development and Psychopathology, 7*, 295-312.

Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience, 13*, 25-42.

Raver, C. C. (2002). *Emotions matter: Making the case for the role of young children's emotional development for early school readiness*, Working Papers 0206, Harris School of Public Policy Studies, University of Chicago.

Raver, C. C., Garner, P. W., & Smith-Donald, R. (2007). The roles of emotion regulation and emotion knowledge for children's academic readiness: Are the links causal? In:

Pianta, RC.; Cox, MJ.; Snow, KL., (Eds.). *School readiness and the transition to kindergarten in the era of accountability*. Baltimore, MD: Brookes Publishing, p. 121-147.

Rimm-Kaufman, S., Pianta, R.C., & Cox, M. (2000). Teachers' judgments of problems in the transition to school. *Early Childhood Research Quarterly, 15*, 147-166.

Roberts, R. J., Hager, L. D., Heron, C. (1994). Prefrontal cognitive processes: Working memory and inhibition in the antisaccade task. *Journal of Experimental Psychology: General, 123*, 374-393.

Roberts, R. J., & Pennington, B. F. (1996). An interactive framework for examining prefrontal cognitive processes. *Developmental Neuropsychology, 12*, 105-126.

Rothbart, M. K. (1989). Temperament and development. In G. A. Kohnstamm, J. A. Bates, & M. K. Rothbart (Eds.), *Temperament in childhood* (pp. 187-247). New York: Wiley.

Rothbart, M. K. (2004). Temperament and the pursuit of an integrated developmental psychology, *Merrill-Palmer Quarterly, 50,* 492-505.

Rothbart, M.. & Ahadi, S. (1994). Temperament and the development of personality. *Journal of Abnormal Psychology, 103,* 55-66.

Ryan, R. M., Fauth, R.C. & Brooks-Gunn, J. (2006). Childhood poverty: Implications for school readiness and early childhood education. In B. Spodek & O.N. Saracho (Eds.) *Handbook of research on the education of children* (2nd ed.) (pp.323-346.) Mahwah, NJ: Erlbaum Associates.

Schultz, D., Izard, C.E., & Bear, G. (2004). Children's emotion processing: Relations to emotionality and aggression. *Development and Psychopathology, 16*, 371-387.

Sebanc, A. M. (2003). The friendship features of preschool children: Links with prosocial behavior and aggression. *Social Development, 12*, 249-268.

Sheilds, A., Dickstein, S., Seifer, R., Giusti, L., Magee, K. D., & Spritz, B. (2001). Emotional competence and early school adjustment: A study of preschoolers at risk. *Early Education and Development, 12*, 73-96.

Shonkoff, J.P., & Phillips, D.A. (Eds.) (2000). *From neurons to neighborhoods: The science of early childhood development.* Washington, DC: National Academy Press.

Shore, R. (1997). *Rethinking the brain: New insights into early development.* New York: Families and Work Institute.

Skinner, E.A. & Belmont, M.J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology, 85*, 571-581.

Smith-Donald, R., Raver, C. C., Hayes, T., & Richardson, B. (2007). Preliminary construct and concurrent validity of the preschool self-regulation assessment (PSRA) for field-based research. *Early Childhood Research Quarterly, 22*, 173-187.

Sonuga-Barke, E. J. S., Dalen, L., Remington, B. (2003). Do executive deficits and delay aversion make independent contributions to preschool attention-deficit/hyperactivity disorder symptoms? *Journal of the American Academy of Child & Adolescent Psychiatry, 42*, 1335-1342.

Sprengelmeyer, R., Rausch, M., Eysel, U. T., & Przuntek, H. (1998). Neural structures associated with recognition of facial expressions of basic emotions. *Proceedings of the Royal Society of London – Series B: Biological Sciences, 265*, 1927-1931.

Stieben, J., Lewis, M. D., Granic, I., Zelazo, P. D., Segalowitz, S., & Pepler, D. (2007). Neurophysiological mechanisms of emotion regulation for subtypes of externalizing children. *Development and Psychopathology, 19*, 455-480.

Streit, M., Dammers, J., Simsek-Kraues, S., Brinkmeyer, J., Wölwor, W. & Ioannides, A. (2003). Time course of regional brain activations during facial emotion recognition in humans. *Neuroscience Letters, 342*, 101-104.

Thomas, A., & Chess, S. (1977). *Temperament and development.* New York: Brunner/Mazel.

Torres, M. M. & Bierman, K. L. (in preparation). Reconsidering relational aggression as a marker of risk for low-income preschool children. Unpublished manuscript. Department of Psychology, The Pennsylvania State University.

Trentacosta, C. J., & Izard, C. E. (2007). Kindergarten children's emotion competence as a predictor of their academic competence in first grade. *Emotion, 7,* 77-88.

Villemarette-Pittman, N. R., Stanford, M. S. & Greve, K. W. (2003). Language and executive function in self-reported impulsive aggression. *Personality and Individual Differences,34*, 1533-1544.

Vitaro, F., Tremblay, R.E., Gagnon, C., & Boivan, M. (1992). Peer rejection from kindergarten to grade 2: Outcomes, correlates, and prediction. *Merrill-Palmer Quarterly, 38*, 382-400.

Vygotsky, L. S., [1933] (1966). Play and its role in the mental development of the child. *Soviet Psychology,12*, 62-76.

Vygotsky, L. S., (1978). *Mind in society.* Cambridge, MA: Harvard University Press.

Walcott, C. M., & Landau, S. (2004). The relation between disinhibition and emotion regulation in boys with attention deficit hyperactivity disorder. *Journal of Child Clinical and Adolescent Psychology, 33*, 772-782.

Webster-Stratton, C., Reid, J., & Hammond M. (2004). Treating children with early-onset conduct problems: Intervention outcomes for parent, child, and teacher training. *Journal of Clinical Child and Adolescent Psychology, 33*, 105-124.

Webster-Stratton, C., Reid, J., & Stoolmiller, M. (2006). Preventing aggression and improving social, emotional and academic competence: Evaluation of Dina Dinosaur classroom curriculum in high risk schools. Unpublished manuscript, University of Washington. Obtained online at http://www.incredibleyears.com

Wechsler, D. (2002). *Wechsler Preschool and Primary Scale of Intelligence - III*. San Antonio, TX: Psychological Corporation.

Wiebe, S., Espy, K.,& Charak, D. (2008). Using confirmatory factor analysis to understand executive control in preschool children: I. Latent structure. *Developmental Psychology, 44*, 575–587.

Werthamer-Larsson, L., Kellam, S., & Wheeler, L. (1991). Effect of first-grade classroom environment on shy behavior, aggressive behavior, and concentration problems. *American Journal of Community Psychology, 19*, 585-602.

Yen, C.J., Konold, P.A., & McDermott, P.A. (2004). Does learning behavior augment cognitive ability as an indicator of academic achievement? *Journal of School Psychology, 42*, 157-169.

Zelazo, P. D., & Müller, U. (2002). Executive function in typical and atypical development. In U. Goswami (Ed.), *Handbook of childhood cognitive development* (pp. 445–469). Oxford, England: Blackwell

Marcela M. Torres

Vita

29 Nash Street #1
New Haven, CT 06511
mmt174@psu.edu

CURRENT POSITION

Psychology Fellowship, *Yale Child Study Center, School of Medicine*,
Early Childhood Specialization

EDUCATION

Ph.D. *Pennsylvania State University*, Psychology	August 2011
M.S. *Pennsylvania State University*, Psychology	January 2007
B.S. *Cornell University, Human Development*	January 2003

PROFESSIONAL HONORS

Research Support Funding: Robert and Ruth Faris Child Psychology Fund	2007-2009
Research Support Funding: Child Study Center Sokolov Endowment Fund	2008
Martin T. Murphy Award for Excellence in Clinical Psychology Graduate Program	2007
Psi Chi Honor Society	2002
Kappa Omicron Nu Honor Society	2001
National Society of Collegiate Scholars	2000
Dean's List, Cornell University	1999-2002

BIBLIOGRAPHY

Bierman, K.L., Torres, M.M., & Schofield, H.T. (in press). *Developmental factors related to the assessment of social skills*. In D. W. Nangle, D.J. Hansen, C.A. Erdley, & P.J. Norton. (Eds.) Practioner's guide to empirically-based measures of social skills. New York: Springer.

PEER REVIEWED ORIGINAL RESEARCH

Bierman, K.L., Torres, M.M., Domitrovich, C.E., Welsh, J.A., & Gest, S. D. (2009). Behavioral and cognitive readiness for school: Cross-domain associations for children attending Head Start. *Social Development, 18*, 305-323.