AN ABSTRACT OF THE DISSERTATION OF

Shauna L. M. Tominey for the degree of Doctor of Philosophy in Human Development and Family Studies presented on May 28, 2010.

Title: "And When They Woke Up… They Were Monkeys!" Using Classroom Games to Improve Preschooler's Behavioral Self-Regulation

Abstract approved:

_____

Megan M. McClelland

Behavioral self-regulation has emerged as an important predictor of academic success as early as preschool. Few studies, however, have examined ways to improve children's behavioral self-regulation in preschool, prior to formal school entry. This dissertation includes two studies examining a pilot intervention using classroom games to improve behavioral self-regulation with 65 prekindergarteners. Study 1 examined if participating in the intervention group significantly improved behavioral self-regulation and early academic outcomes. Results indicated that participation in the intervention predicted significant gains on a direct measure of behavioral self-regulation for children beginning the year with low levels of these skills. Additionally, intervention participation predicted significant reading gains in the overall sample of children. Study 2 examined quantitative and qualitative factors related to intervention effectiveness. Results suggest that low maternal education significantly predicted that children would begin the year with low

behavioral self-regulation and thus be in the group most likely to benefit from intervention participation. Moreover, qualitative analyses indicated that children from low-income families had more difficulty paying attention and exhibited more off-task behaviors during intervention sessions, which may have contributed to the smaller behavioral self-regulation gains they experienced in comparison to their more-advantaged peers. Together these studies support the effectiveness of a pilot behavioral self-regulation intervention and provide implications for future applications of the intervention, including increasing the number of intervention sessions and embedding behavioral self-regulation activities into prekindergarten classrooms as a means of facilitating academic achievement.

"And When They Woke Up… They Were Monkeys!"
Using Classroom Games to Improve Preschooler's Behavioral Self-Regulation

by

Shauna L. M. Tominey

A DISSERTATION

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

Presented May 28, 2010
Commencement June 2010

Doctor of Philosophy dissertation of Shauna L. M. Tominey presented on May 28, 2010.

APPROVED:

_____

Major Professor, representing Human Development and Family Studies

_____

Chair of the Department of Human Development and Family Sciences

_____

Dean of the Graduate School

I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

_____

Shauna L. M. Tominey, Author

ACKNOWLEDGEMENTS

I would like to thank my advisor, Megan McClelland, for her dedicated mentorship. Megan played an integral role in helping me become the professional I would like to be. Time and time again, Megan went above and beyond the call of duty to cultivate my interests and inspired the creation of this intervention project. She also encouraged and provided me with opportunities to publish, present, teach, and, of course, learn.

I would also like to thank the other members of my committee. Kate MacTavish had a profound impact on my desire to include a qualitative component in my dissertation and provided invaluable feedback throughout the process. Sharon Rosenkoetter shared my enthusiasm for the project and encouraged me to share it, as well as my other passions, through international adventure and collaboration. Alan Acock was an inspiring methods instructor and fueled my love for statistics as well as for teaching.

The members of my family have also provided tremendous love and support throughout this process. My mom has always been my number one cheerleader and helped provide me with the energy to complete this daunting task with her amazing cooking at our weekly family dinners. My dad inspired me to return to school because he saw in me a "teacher of teachers." My sister, Stacey, provided much needed relief throughout the day with her "What are you doing?" phone calls. My desire to spend more time with her, and my niece, Lily, helped me finish in a timely manner. My husband, Colin, never stopped believing I was capable of seemingly impossible feats and his strength in these beliefs helped me rise to the occasion.

CONTRIBUTION OF AUTHORS

Megan McClelland secured funding for the pilot intervention that was the focus of the two studies presented in this dissertation. Additionally, she advised in the design of the studies, data analysis, and assisted with writing both manuscripts.

TABLE OF CONTENTS

LIST OF TABLES

DEDICATION

I dedicate this dissertation to my best friend and husband, Colin, and our beautiful daughter, Winter.

"And When They Woke Up… They Were Monkeys!"
Using Classroom Games to Improve Preschooler's Behavioral Self-Regulation

INTRODUCTION

For most children in the United States, kindergarten is the first academically-focused classroom environment to which they are exposed. In recent years, legislation, such as No Child Left Behind, has placed increasing emphasis on academic accountability in the U.S. public education system. As a result, teachers are adopting a strong academic focus to ensure children are reaching required benchmarks on mandated standardized tests as early as kindergarten (U.S. Department of Education, 2010). Although most children navigate the transition to kindergarten successfully, a significant number of children are entering school without the necessary skills to succeed in classroom environments (Blair, 2002; Rimm-Kaufman, Pianta, & Cox, 2000). In one study, forty-six percent of kindergarten teachers reported that at least half of the children in their classrooms lacked skills that they considered necessary for functioning effectively in the classroom (Rimm-Kaufman et al., 2000). Teachers in this study reported that self-regulation skills, and specifically behavioral aspects of self-regulation, were those most important for success transitioning to kindergarten. Numerous studies support the notion that children's behavioral self-regulation skills are critical predictors of early academic success (Blair, 2002; Cooper & Farran, 1988; Eisenberg, Smith, Sadovsky, & Spinrad, 2004; Ladd, Birch, & Buhs, 1999; McClelland, Cameron, Wanless, & Murray, 2007; Valiente, Lemery-Chalfant, & Castro, 2007). Moreover, early academic skills are often cumulative so children who lack the behavioral self-regulation skills necessary to acquire them may be at risk of experiencing achievement gaps that persist

throughout their schooling (Entwisle & Alexander, 1993).

Although an abundance of research supports the relation between the behavioral aspects of self-regulation and academic success (Blair & Razza, 2007; Liew, McTigue, Barrois, Hughes, 2008; McClelland, Acock, & Morrison, 2006; Valiente et al., 2007), few studies have examined ways to improve these skills prior to kindergarten entry. In order to ensure all children enter kindergarten with the self-regulatory skills required to succeed in academically-focused classroom environments, it is critical to develop and implement interventions prior to kindergarten entry to help children develop and practice these skills. Although not all children attend preschool, an estimated 83.2% of children attend early education programs (Denton Flanagan & McPhee, 2009) so interventions in preschool settings would likely reach a majority of children during an important period of self-regulation development. Research suggests that it is during preschool that numerous developmental changes occur related to the development of self-regulation, including brain maturation in the pre-frontal cortex (Blair, 2002), making preschool an ideal time for intervention. This dissertation focuses on a pilot intervention study using classroom games to promote the behavioral aspects of self-regulation over the prekindergarten year.

Defining Behavioral Self-Regulation

Numerous definitions have emerged to describe the components comprising self-regulation (Cole, Martin, & Dennis, 2004; Kochanska, Murray, & Harlan, 2000; Rueda, Posner, & Rothbart, 2005; Zelazo, Muller, & Goswami, 2002). In general, there is consensus that self-regulation is a multi-dimensional construct that includes both the regulation of emotion and the regulation of behavior. The focus of this study is on the behavioral aspects of self-regulation, specifically executive function and the integration

of executive function into behavior. Executive function relates to the conscious control of thoughts and actions (Happaney, Zelazo, & Stuss, 2004) and consists of attention, working memory, and inhibitory control; skills essential for planning and executing goal-directed activities (Blair, 2002). Together, these skills are important for successful functioning in classroom settings (Baumeister & Vohs, 2004; McClelland, Cameron, Connor, Farris, Jewkes, & Morrison, 2007; McClelland, Cameron, Wanless, et al., 2007).

Attention is important for helping children filter information, ignore distractions, and switch focus from one task to another (Rothbart & Posner, 2005; Rueda et al., 2004). Within the classroom, attention helps children determine what information is important when receiving multiple sources of stimulus, listen to their teacher, and stay on task. In addition to attention, working memory contributes to a child's focusing abilities by allowing them to remember single and multi-step instructions; a skill critical for completing tasks (Adams, Bourke, & Willis, 1999). Inhibitory control is defined as stopping a dominant response and choosing to respond with a potentially less dominant, but more adaptive behavior (McClelland, Cameron, Wanless et al., 2007). Examples of inhibitory control in the classroom include remembering to raise a hand instead of automatically shouting out a response and putting school supplies away when the bell rings rather than immediately running outside to play. Though some studies attempt to separate attention, working memory, and inhibitory control into distinct components, this study emphasizes the integration of the three. Arguably, the use of working memory would be impossible without adequate attention skills. Additionally, the use of inhibitory control skills has been found to rely heavily on both an individual's ability to pay attention and access their working memory. The classroom games presented in this pilot

intervention focused on the integration of attention, working memory, and inhibitory control into behavior.

Behavioral Self-Regulation and Academic Achievement

Research suggests that children who lack strong behavioral self-regulation skills have difficulty benefiting from structured classroom settings (Alexander, Entwisle, & Dauber, 1993; Ladd, 2003). Specifically, children's behavioral self-regulation has been found to predict their work habits (Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009) and their ability to benefit from independent learning activities (Kegel, van der Kooy-Hofland, & Bus, 2009). Moreover, self-regulation (and specifically the behavioral components of self-regulation) emerges as a predictor of children's academic achievement as early as preschool (Blair & Razza, 2007; McClelland, Cameron, Connor et al., 2007). Early behavioral self-regulation has also been found to predict academic achievement in kindergarten, throughout elementary school (Liew et al., 2008; McClelland et al., 2006; Valiente et al., 2007), and even high school and college completion (McClelland, Piccinin, & Stallings, 2010; Vitaro, Brendgen, Larose, & Tremblay, 2005). Teachers report, however, that there is high variability in the self-regulatory skills of children entering kindergarten (Lin, Lawrence, & Gorrell, 2003).

Family Environment and Behavioral Self-Regulation Development

Behavioral self-regulation first emerges in the context of the home and family environment. Throughout childhood, self-regulation shifts from an internal to an external process (Kopp, 1991). In infancy, parents and caregivers provide regulation through acts, including feeding and soothing. It is through the responsiveness of parents in these repetitive tasks that children begin to regulate their own behaviors. For example, infants

demonstrate behavioral self-regulation by turning their head away from unwanted stimuli. Parenting practices promoting the development of autonomy (e.g., authoritative parenting) have been found to predict behavioral self-regulation in children (Bernier, Carlson, & Whipple, 2010). Specifically, parents who provide opportunities for children to make and follow-through with their own decisions increase autonomy and, as a result, provide children with opportunities to practice behavioral self-regulation.

Children at Risk for Poor Self-Regulation

Research documents that children from disadvantaged backgrounds are especially at risk for entering kindergarten with low levels of behavioral self-regulation (Howse, Lange, Farran, & Boyles, 2003). Specifically, children from low-income families have more difficulty regulating their attention and behavior than their more-advantaged peers (Evans & Rosenbaum, 2008; Howse et al., 2003). In addition, children from low-income families are likely to experience an accumulation of risk factors that have been linked to poor behavioral self-regulation and academic outcomes, including a lack of resources (financial and educational), little parent-child quality time, and high rates of authoritarian parenting and punitive discipline (Dearing, Berry, & Zaslow, 2006). Studies suggest, however, that self-regulation (and specifically behavioral self-regulation) may mediate the effects of risk factors on academic outcomes (Buckner, Mezzacappa, & Beardslee, 2009; Dearing, McCartney, & Taylor, 2009; Sektnan, McClelland, Acock, & Morrison, in press), making children from disadvantaged backgrounds an especially important population to target for behavioral self-regulation intervention. The sample of children included in the present study had a significant number of children from low-income families (43%, $n = 28$), measured by their enrollment in the Head Start program.

Measuring Behavioral Self-Regulation: Head-Toes-Knees-Shoulders Task

The present studies focus on children's behavioral self-regulation (the integration of attention, working memory, and inhibitory control) as measured by a direct task: the Head-Toes-Knees-Shoulders Task (HTKS) (McClelland, Ponitz, Messersmith, & Tominey, in press; Ponitz, McClelland, Matthews, & Morrison, 2009). Resembling children's games, such as Simon Says, the HTKS is a relatively easy assessment to administer to children. During the assessment, children are asked to first respond to a set of instructions (e.g., "Touch your head") and then to perform behaviors opposite of the given instructions (e.g., touch their toes in response to the command, "Touch your head."). Children are required to pay attention and use their working memory to remember four sets of paired commands. Additionally, children must use inhibitory control skills to stop themselves from performing a spoken command ("Touch your knees.") to do the opposite instead (touch their shoulders).

Previous research has supported both the construct validity and the predictive validity of the HTKS. Specifically, studies have found significant relations between children's HTKS scores and parent- and teacher-rated behavioral self-regulation (McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2009). Moreover, children's HTKS scores significantly predict children's early academic achievement and growth in reading, math, and vocabulary (McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2009). Although research supports the link between the behavioral self-regulation skills measured by the HTKS and children's academic achievement, little research has focused on helping children improve these specific skills as a means of promoting school readiness and academic achievement. The pilot intervention presented in this dissertation

presents a set of classroom games that have been designed to help children practice the behavioral self-regulation skills measured by the HTKS.

Using Games and Play to Practice Behavioral Self-Regulation in Preschool

The increasing emphasis on academic accountability through standardized testing in the public education system (U.S. Department of Education, 2010) has led to teachers adopting a strong academic focus even in early elementary classrooms. Research is showing, however, that without adequate behavioral self-regulation skills, children may not be able to benefit from academically-focused curricula (Howse et al., 2003; McClelland, Morrison, & Holmes, 2000). A curriculum that focuses solely on academic skills in early years may actually hinder children's ability to perform well later in school. In their position statement on developmentally appropriate practices, the National Association for the Education of Young Children (NAEYC) states that play is a critical vehicle for developing numerous skills, including self-regulation, language, cognition, and social competence (Connor, Ponitz, Phillips, Travis, Glassney, & Morrison, 2008; NAEYC, 2008). In addition, research has documented the importance of play in the development of children's self-regulation (Berk, Mann, & Ogan, 2006; Elias & Berk, 2002; Gioia & Tobin, 2010). Children who have difficulties with behavioral self-regulation are those who, by definition, have trouble paying attention, following instructions, and exhibiting self-control. These children are often difficult to engage in academically-focused classroom learning activities. Using play and appealing classroom games may help engage children who have difficulty with behavioral self-regulation skills.

The first author developed the games used in the pilot intervention from previous

experience working in early childhood classrooms (Tominey & McClelland, 2008). The games used in the intervention playgroups had been previously piloted in prekindergarten classrooms with children of varying developmental needs. Games that were chosen for use in the intervention emphasized behavioral self-regulation and had previously shown high levels of engagement among children with demonstrated difficulty engaging in classroom activities. Each of the games included music and/or movement components. Although little research has been conducted examining the relation between music and movement and engagement, interventions using music and movement activities, such as dance, have been effective at improving preschoolers's skills, including social competence (Lobo & Winsler, 2006). Additionally, classroom teachers participating in the study reported that using music and movement in their classroom activities often resulted in high levels of involvement.

Intervention Research

A number of intervention studies have emerged in recent years focusing on school readiness and regulatory abilities prior to kindergarten entry (Bodrova & Leong, 2009; Diamond, Barnett, Thomas, & Munro, 2007; Domitrovich, Cortes, & Greenberg, 2007; Pears, Fisher, & Bronz, 2007). Studies that have focused on improving specific aspects of behavioral self-regulation have focused on individualized computer-based tasks (Dowsett & Livesey, 2000), but these skills do not easily translate to behavior in classroom settings. Classroom-based intervention studies, however, have primarily focused on broad constructs of self-regulation (Bodrova & Leong, 2009; Diamond et al., 2007), usually in combination with academic intervention, which has not allowed for investigation of the relation between improving self-regulation and the resulting effect on academic achievement. These studies have also required intensive teacher-training, which, in pilot

studies, may strongly impact the fidelity of implementation.

The pilot study presented in this dissertation was unique in that it focused on helping children improve specific behavioral aspects of self-regulation, allowing for an examination of the link between practicing these skills and academic outcomes. The present study used games that were variations of traditional children's games, requiring minimal training for implementation and thus increasing the likelihood of fidelity of implementation. In addition, the games used in this pilot intervention required few materials, all of which are commonly found in preschool classrooms (e.g., construction paper, classroom musical instruments, CD player).

Theoretical Framework

Relational developmental systems perspective was used as the theoretical framework in the present studies. This theory describes development as a series of bidirectional and integrated relationships between an individual and multiple environmental levels (Lerner, 2006; Lerner & Overton, 2008; Overton, 2006). Studies have found that the development of self-regulation occurs in this fashion. Numerous factors play a role in the development of self-regulation, including brain development in the prefrontal cortex (Blair, 2002), parenting, and home environment (Magnuson, 2007; McClelland, Cameron, Wanless et al., 2007; Raikes, Robinson, Bradley, Raikes, & Ayoub, 2007). Two concepts from relational developmental systems perspectives are especially relevant to the studies presented in this dissertation: the concepts of equifinality and relative plasticity. Within a relational developmental systems framework, equifinality refers to beginning with different starting points (e.g., one child from a low-income family and one child from a high-income family), but having the same end result

(e.g., both children developing strong self-regulatory skills, resulting in high levels of academic achievement). Although living in the same community and attending the same child development centers, children participating in the pilot intervention came from varied family economic backgrounds. Classrooms within the child development center attended by the majority of participants included children from middle- and upper-income families who paid tuition as well as children from low-income families who attended at no cost through enrollment in the Head Start program. This diversity in family backgrounds is important to consider in the development of a pilot intervention. Studies have shown that children from low-income families are more likely than their more-advantaged peers to have poor self-regulation (Evans & Rosenbaum, 2008; Howse et al., 2003). We expected to see varying levels of behavioral self-regulation abilities among children participating in the study because of the high number of children from low-income families. We hoped that through intervention, children assigned to the treatment group would have the opportunity to practice behavioral self-regulation skills and that this experience would lead to similar outcomes for all children: improved behavioral self-regulation skills, which can help them benefit from classroom learning activities.

Relative plasticity refers to the capacity for developmental change, while acknowledging that capacity varies across individuals and is not limitless (Lerner, 2006). This capacity for developmental change may be affected by numerous factors, including genes, experiences, and stage of development. Studies have found evidence of relative plasticity in children's behavioral self-regulation levels and growth. For example, research suggests that children experiencing risk factors (e.g., low-income and limited English proficiency) not only enter preschool with lower levels of behavioral self-

regulation than their peers, but that children improve these skills at different rates related to the number of risk factors experienced (Wanless, McClelland, Tominey, & Acock, under review). Studies have also found that initial levels of behavioral self-regulation can impact the strength of intervention effects (Connor et al., 2008). In the present dissertation, we expected that the strength of the effects of treatment group participation might vary across children depending on individual factors, including initial level of behavioral self-regulation, or family factors, such as maternal education or income.

Overview of Pilot Intervention Study

The focus of the two studies presented in this dissertation was on a pilot behavioral self-regulation intervention. Seventy-four prekindergarten children participated in the intervention study. Children in the study were four-years-old and attending preschool in classrooms across two child development centers in Oregon. During fall of their prekindergarten year (time 1), children's behavioral self-regulation and academic outcomes were assessed over a four-week period. During winter of the prekindergarten year, half of the children were randomly selected to participate in a series of sixteen playgroup sessions including games designed to help children practice behavioral self-regulation skills. In the spring (time 2), children's behavioral self-regulation and academic outcomes were re-assessed.

Study 1

The first manuscript presented in this dissertation details the games and procedures used in the pilot intervention study. In this study, we tested the effects of intervention treatment group participation on children's behavioral self-regulation gains (measured by the HTKS) over the prekindergarten year. We tested for intervention

effects in the overall sample, as well as for a subset of children who began the year with low levels of behavioral self-regulation (below the 50th percentile) as previous studies have found varying intervention effects based on children's initial skill levels (Connor et al., 2008). Additionally, the study examined the relation between intervention treatment group participation and children's academic outcomes. Previous studies have found significant relations between children's HTKS scores and parent- and teacher-ratings of behavioral self-regulation (McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2009). Studies have also found that children's HTKS scores significantly predict academic outcomes (McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2009). This study was the first to test an intervention designed to improve specific aspects of behavioral self-regulation and relations between intervention participation, HTKS gains, and academic outcomes.

Study 2

The second manuscript builds upon findings from the first study by examining factors that impacted the effectiveness of the pilot behavioral self-regulation intervention. First, we examined quantitative factors that predicted intervention effectiveness. Varying effects of the intervention were found for children beginning the year with low versus high levels of behavioral self-regulation so we examined demographic factors (child age, gender, family income, and maternal education) that predicted group membership (low versus high) at the beginning of the year. Previous studies suggest that these variables predict children's self-regulation abilities (Evans & Rosenbaum, 2008; Howse et al., 2003) and we expected to find evidence of this in the present study. Second, we analyzed and coded observational field notes from the intervention playgroup sessions to identify

patterns of behavior that could explain varying patterns of intervention effectiveness based on family income level (children enrolled in Head Start versus children not enrolled in Head Start). Previous research has indicated that children from low-income families experience difficulties paying attention and regulating their behavior (Evans & Rosenbaum, 2008; Howse et al., 2003) and these difficulties may help explain the decreased intervention effects experienced by these children in comparison to their more-advantaged peers.

Together, results from both studies are expected to inform the future development and refinement of this and similar behavioral self-regulation interventions. The development of effective behavioral self-regulation interventions may play a critical role in helping children enter school with skills essential for academic success.

Red light, purple light:

Findings from a randomized trial using classroom games to improve behavioral self-regulation

Shauna L. M. Tominey

Megan M. McClelland

Oregon State University, Department of Human Development and Family Sciences.

Funding for this study was supported by Oregon State University.

Abstract

The present study examined the effectiveness of a pilot self-regulation intervention with sixty-five preschool children. Using classroom games, the study examined if participating in the treatment group significantly improved behavioral aspects of self-regulation and early academic outcomes. Half of the children were randomly assigned to participate in sixteen playgroups during the winter of the school year. Behavioral aspects of self-regulation and early achievement were assessed in the fall and spring. Participation in the treatment group was significantly related to self-regulation gains in children who started the year with low levels of these skills. Children in the treatment group also demonstrated significant reading gains compared to children in the control group. The findings from this study provide preliminary evidence for the effectiveness of the intervention for improving preschoolers's behavioral self-regulation and reading achievement and has the potential to inform preschool curricula emphasizing behavioral self-regulation as a means of facilitating school readiness.

Every year, many young children transition from preschool to a more structured and academically-focused kindergarten environment. Although most children navigate this transition successfully, it can be problematic for those who have not developed the self-regulation critical for success in a classroom setting. In recent years, there has been an increasing emphasis on accountability for children's academic achievement in the U.S. public education system, in part because of legislation, such as No Child Left Behind. As a result, pressure is being placed on teachers at all grade levels to adopt a stronger academic focus to ensure that children reach required benchmarks on mandated standardized tests (U.S. Department of Education, 2009). Recent research documents that children are entering kindergarten and elementary school with varying levels of self-regulation, and that these skills are key predictors of children's success in early academic achievement (Blair, 2002; Cooper & Farran, 1988; Eisenberg, Smith, Sadovsky, & Spinrad, 2004; McClelland, Cameron, Wanless, & Murray, 2007; Valiente, Lemery-Chalfant, & Castro, 2007). In particular, children who have difficulty with the behavioral aspects of self-regulation may not have the skills necessary to benefit from classroom learning environments (Howse, Lange, Farran, & Boyles, 2003; McClelland, Morrison, & Holmes, 2000). Academic skills learned in early elementary school tend to be cumulative so children who lack behavioral self-regulation in early childhood may be at risk of poor academic achievement throughout formal schooling (Entwisle & Alexander, 1993). Studies suggest that self-regulation emerges by preschool as an important predictor of academic outcomes making preschool an ideal time to introduce interventions aimed at improving the behavioral aspects of self-regulation (Blair & Razza, 2007; McClelland, Cameron, Connor et al., 2007).

It is clear that behavioral self-regulation is necessary for academic success, but there is less research on how to improve specific aspects of these skills prior to kindergarten entry. Studies have shown that preschool children can improve behavioral self-regulation in individual laboratory training sessions and on computer-based tasks (Dowsett & Livesey, 2000), but few studies have focused on similar interventions in classroom settings. It is crucial for researchers to develop interventions promoting behavioral self-regulation in preschool that can be easily implemented by teachers to ensure that children enter kindergarten with the skills they need to be academically successful. The present study examined the effectiveness of a pilot intervention using classroom games designed to strengthen children's behavioral self-regulation over the prekindergarten year.

Defining Behavioral Self-Regulation

The focus of this study is on the behavioral aspects of self-regulation (i.e., attention, working memory, and inhibitory control), skills that are essential for planning and executing goal-directed activities (Blair, 2002). Attention is defined as the ability to switch focus from one object or task to another as well as the ability to ignore distractions (Rothbart & Posner, 2005; Rueda, Posner, & Rothbart, 2004). Working memory refers to a child's ability to hold information in memory long enough to complete a task (Adams, Bourke, & Willis, 1999). Working memory is an essential component of following-through with instructions, especially when completing a multi-step task. Inhibitory control is the ability to stop a dominant response (e.g., shouting an answer to a question) in order to demonstrate a less automatic, but more adaptive behavior (e.g., raising a hand and waiting to be called on) (McClelland, Cameron, Wanless et al., 2007; Rennie, Bull,

& Diamond, 2004). Literature supports the notion that the integration of attention, working memory, and inhibitory control are important for success in classroom settings (Baumeister & Vohs, 2004; McClelland, Cameron, Connor et al., 2007; McClelland, Cameron, Wanless et al., 2007). The classroom games piloted in this study were designed to help children practice the integration of these components into the behavioral aspects of self-regulation that are needed in classroom settings.

The Importance of Behavioral Self-Regulation for School Success

Research suggests that children's behavioral self-regulation predicts academic outcomes in preschool (Blair & Razza, 2007; McClelland, Cameron, Connor et al., 2007) and elementary school (Liew, McTigue, Barrois, & Hughes, 2008; McClelland, Acock, & Morrison, 2006; McClelland et al., 2000; Valiente et al., 2007), as well as high school graduation and college completion (McClelland, Piccinin, & Stallings, 2010; Vitaro, Brendgen, Larose, & Tremblay, 2005). In one study, kindergarten behavioral self-regulation, as rated by teachers, predicted children's academic achievement over the kindergarten year (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003). Moreover, research has found that, kindergarten learning-related skills (including behavioral self-regulation and social competence) predicted children's literacy and math skills between kindergarten and sixth grade, and growth in literacy and math from kindergarten to second grade (McClelland et al., 2006; McClelland et al., 2000).

Studies also indicate that children with poor behavioral self-regulation have difficulty succeeding in classroom settings (Alexander, Entwisle, & Dauber, 1993; Ladd, 2003). In a recent study testing computer- and book-based phonological skills training programs for five-year-olds, children with strong self-regulatory skills showed significant

improvement in phonological skills from independent classroom learning activities, but children with below average self-regulation did not (Kegel, van der Kooy-Hofland, & Bus, 2009). Moreover, in another study, children with poor behavioral self-regulation skills exhibited lower performance than their higher-rated peers on reading and math between kindergarten and sixth grade, even after controlling for child IQ and parent education level (McClelland et al., 2006). Together, these results suggest that behavioral self-regulation is an important predictor of academic success throughout schooling and that children with poor behavioral self-regulation may be especially at risk.

Behavioral Self-Regulation in the Preschool Years

For many children, preschool is the first classroom environment in which they are asked to demonstrate behavioral self-regulation (Phillips, McCartney, & Sussman, 2006). It is also during the preschool years that a number of developmental changes occur that facilitate the development of self-regulation, including brain maturation in the prefrontal cortex, an area associated with the development of the behavioral aspects of self-regulation (Blair, 2002). In addition, research shows that self-regulation in preschool predicts academic achievement in both preschool (Blair & Razza, 2007; McClelland, Cameron, Connor et al., 2007) and kindergarten (Howse, Lange, et al., 2003). One study found that preschool children who had difficulty with behavioral self-regulation scored lower on a measure of cognitive achievement than peers with high levels of these skills (Bronson, Tivnan, & Seppanen, 1995). Another study found that behavioral self-regulation, measured by a direct task, significantly predicted emergent literacy, vocabulary, and math skills over the prekindergarten year. Moreover, gains in preschool behavioral self-regulation significantly predicted gains in these academic measures over the

prekindergarten year (McClelland, Cameron, Connor et al., 2007).

Together, these studies provide evidence that behavioral self-regulation emerges by preschool as an important predictor of academic success, making preschool an ideal time to introduce interventions aimed at improving these skills. Although not all children receive formalized care prior to kindergarten entry, an estimated 83.2% of children attend early care and education programs before entering kindergarten (Denton Flanagan & McPhee, 2009). Interventions in these settings would reach the majority of children at an important period of behavioral self-regulation development. Further, promoting behavioral self-regulation in preschool may help many children develop the skills needed for the transition to school and continuing success in classroom settings.

Family Environment and Behavioral Self-Regulation Development

Prior to school entry, behavioral self-regulation emerges in the context of the family environment. Throughout early childhood, behavioral self-regulation moves from an internal process to an external process (Kopp, 1991). In infancy, Parents and caregivers provide the majority of children's regulation through acts such as feeding and comforting. It is through the responsiveness of parents in these repetitive tasks that behavioral self-regulation becomes internal and children begin to regulate their own behaviors. For example, an infant shows evidence of behavioral self-regulation when sucking on a thumb to self-soothe. Parenting practices that promote the development of autonomy (e.g., authoritative parenting) have been linked to the development of behavioral self-regulation in children (Bernier, Carlson, & Whipple, 2010). Specifically, by providing opportunities for children to make and follow-through with their own

decisions thereby increasing autonomy, parents are providing children with opportunities to practice behavioral self-regulation.

Children at Risk for Poor Behavioral Self-Regulation

Research supports the notion that children from disadvantaged backgrounds, and especially those experiencing multiple risk factors, perform worse than their more advantaged peers on a variety of language, achievement, and school readiness indicators (Dearing, Berry, & Zaslow, 2006). In particular, research documents that children from low-income families are less able to regulate their attention in goal-directed tasks than their peers and are especially at risk for entering kindergarten with poor behavioral self-regulation (Evans & Rosenbaum, 2008; Howse, Lange et al., 2003; Wanless, Sektnan, & McClelland, 2007). In one study, children with an accumulation of risk factors (i.e., English-language learners who primarily spoke Spanish, who had low levels of parent education, and who were the most economically disadvantaged) were at highest risk for entering preschool with low levels of behavioral self-regulation and these low levels persisted through preschool and into kindergarten (Wanless, McClelland, Tominey & Acock, under review). These studies provide evidence that children from disadvantaged backgrounds are especially at risk of entering kindergarten without the behavioral self-regulation needed for academic success. Moreover, studies suggest that behavioral self-regulation may serve as a mediating factor between risk and academic achievement. In one study, kindergarten behavioral self-regulation skills (i.e., attention and inhibitory control) mediated the negative effect between accumulated risk (high levels of maternal depressive symptoms coupled with economic disadvantage) and children's first grade achievement in reading, math, and vocabulary (Sektnan, McClelland, Acock, & Morrison, in press). Thus,

children from disadvantaged backgrounds are an especially important population to target for behavioral self-regulation interventions prior to kindergarten entry.

In addition to finding that children from low-income families are especially likely to exhibit low behavioral self-regulation, studies have found that it is children with poor levels of these skills who are most likely to benefit from behavioral self-regulation intervention. For example, in a study testing the effectiveness of individualizing student instruction on first-graders's behavioral self-regulation, results suggested that an intervention focused on teacher planning and classroom management was most effective at improving behavioral self-regulation for students beginning the school year with low levels of these skills, but no significant effect of the intervention was found on behavioral self-regulation for the overall sample (Connor et al., in press). The present study included children from economically-diverse backgrounds, and high variability in children's behavioral self-regulation abilities was expected, allowing for analysis of intervention effects on children with varying initial levels of these skills.

Measuring Behavioral Self-Regulation and the Head-Toes-Knees-Shoulders Task

Recent research has focused on a relatively new direct measure of behavioral self-regulation, the Head-Toes-Knees-Shoulders task (HTKS), which measures the integration of children's attention, working memory, and inhibitory control (McClelland, Ponitz, Messersmith, & Tominey, in press; Ponitz, McClelland, Matthews, & Morrison, 2009). The HTKS is a short and relatively simple game that asks children to pay attention, remember up to four rules, and to do the opposite (e.g., touch your head when told to touch your toes). Studies supporting the construct validity of the HTKS have found significant relations between children's scores on the HTKS and both parent- and

teacher-rated inhibitory control and attention (McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2009).

Research has also supported the predictive validity of the task. Specifically, children's scores on the HTKS have significantly predicted children's emergent literacy, vocabulary, and math skills in preschool and kindergarten (Matthews, Ponitz, & Morrison, 2009; McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2009). Moreover, one recent study found that children's HTKS scores in the fall of kindergarten significantly predicted spring literacy, vocabulary, and math skills at the end of the school year and gains children made in math skills from fall to spring (Ponitz et al., 2009). Although research has shown that the HTKS is a reliable and valid measure of children's behavioral self-regulation, less research has focused on helping children improve these specific behavioral aspects of self-regulation (i.e., the integration of attention, working memory and inhibitory control). The present study examined the effectiveness of a set of classroom games that helped children practice these aspects of behavioral self-regulation (measured by the HTKS).

Intervention Research

In recent years, there has been growing interest in the development of school readiness interventions. Interventions targeting specific aspects of self-regulation have primarily focused on individualized training sessions in laboratory settings or on computer-based tasks (Dowsett & Livesey, 2000), however, these techniques do not translate easily to a classroom context. In addition, many of the interventions that have been implemented in classroom settings have examined broad constructs of social-emotional skills, often in combination with academic intervention, rather than specifically

focusing on behavioral self-regulation (Raver, 2002). In addition, these interventions often require extensive teacher training and materials for implementation. For example, the Tools of the Mind program focuses on the development of social, emotional, and behavioral self-regulation skills in addition to curriculum emphasis on literacy and math in preschool. Children in classrooms implementing the Tools of the Mind curriculum have shown significant improvement on computer-based executive function tasks (Diamond, Barnett, Thomas, & Munro, 2007). Moreover, in a recent randomized trial of the Tools of the Mind curriculum, children participating in Tools classrooms exhibited higher levels of executive function than children in control classrooms according to scores on a teacher-reported problem behavior scale (Barnett et al., 2008).

Another program, Promoting Alternative Thinking Strategies (PATHS), targets aspects of cooperation, emotional awareness and communication, self-regulation, self-esteem, and problem-solving in preschool children (Domitrovich, Cortes, & Greenberg, 2007). A study of preschool children receiving the PATHS intervention found that children in the treatment group were rated more socially competent by parents and teachers than children in the control group (Domitrovich et al., 2007). A third study, the Kids in Transition to School Program, examined the impact of playgroups focusing on a wide-range of socio-emotional, self-regulation, and early literacy skills on foster children (Pears, Fisher, & Bronz, 2007). Children participating in the treatment group exhibited significantly higher levels of social competence and self-regulatory skills than children in the control group (Pears et al., 2007).

Although each of these interventions included self-regulation as part of a broader intervention, they did not specifically examine aspects of behavioral self-regulation as a

means of improving school readiness and academic success. Unlike previous studies, the pilot intervention presented in this paper focused on helping children practice specific behavioral aspects of self-regulation (the integration of attention, working memory, and inhibitory control) that have been shown to predict academic outcomes. In addition, the present study used classroom games that were variations on popular children's games, requiring minimal training for implementation and few materials (e.g., construction paper, children's music CDs, classroom musical instruments), all of which are commonly found in preschool classrooms. The present study also examined dosage (the number of intervention sessions attended) as a predictor of behavioral self-regulation gains. Intervention studies including behavioral self-regulation have reported intervention attendance (Pears et al., 2007), without examining the impact of dosage on intervention effectiveness. Other studies of early childhood interventions focusing on behavioral outcomes have shown greater short- and long-term benefits from higher levels of participation (Hill, Brooks-Gunn, & Waldfogel, 2003; Reynolds, Temple, Robertson, & Mann, 2001).

The Present Study

This study investigated whether a pilot intervention using classroom games improved behavioral self-regulation in an economically-diverse sample of preschool children. Additionally, we examined if treatment group participation predicted academic gains over the prekindergarten year. The study had three research questions. The first research question was: *Does participation in a pilot intervention (treatment group assignment and dosage level) lead to greater gains in behavioral self-regulation in the overall sample of prekindergarteners?* Based on research documenting the effectiveness

of broader interventions (Diamond et al., 2007; Domitrovich et al., 2007; Pears et al., 2007), we expected that children who were randomly assigned to the treatment group would show significantly greater gains in behavioral self-regulation over the prekindergarten year than children in the control group. The number of intervention sessions attended (dosage) was also expected to positively predict behavioral self-regulation gains as intervention studies of behavioral outcomes have demonstrated greater benefit for children attending higher numbers of sessions (Hill, Brooks-Gunn, & Waldfogel, 2003; Reynolds, Temple, Robertson, & Mann, 2001). The second research question was: *Do children with low initial behavioral self-regulation show significant growth in these skills based on treatment group assignment and dosage level?* We hypothesized that intervention effects might be especially strong for children with low initial levels of behavioral self-regulation, as has been found in other studies (Connor et al., in press). The present study included children from economically-diverse backgrounds, and based on research finding that children from low-income families are at risk of having low self-regulation (Evans & Rosenbaum, 2008; Howse, Lange et al., 2003), we expected that there would be high numbers of children with low initial levels of these skills. The third research question was: *Does treatment group participation relate to academic outcomes over the prekindergarten year?* We hypothesized that if intervention effects were significant, intervention participation would significantly predict gains in children's academic outcomes over the prekindergarten year. This hypothesis was based on research suggesting that interventions to improve self-regulation may also strengthen early achievement (Barnett et al., 2008; Diamond et al., 2007).

Method

Participants

Participants were seventy-four children within two child development centers in Oregon. Children were selected based on kindergarten eligibility the following year. Approximately half of the children in the study were from low-income families, as measured by enrollment in Head Start (n = 34). The average age at the beginning of the study was 54.5 months (range: 48-60 months). Forty-two of the children were female, and 32 were male. Mothers of children enrolled in Head Start had an average education level of 12.4 years (SD = 2.4) with a range of 6-16 years. Children who were not enrolled in the Head Start program had an average mother education level of 17.1 years (SD = 2.8) with a range of 12-21 years. Three of the children had Spanish as a first language and were administered the tests in Spanish by a native Spanish-speaker. Spanish-speaking research assistants translated English instructions into Spanish for children who had Spanish as a first language.

The majority of children in the study attended preschool in a university child development center and laboratory school (n = 61 out of 74). Placement in the center is available to children paying tuition and also available at no cost to children enrolled in the Head Start program. Approximately half of the children in each classroom paid tuition and half received care at no cost because of enrollment in Head Start. A small number of children participating in the study (n = 13) were attending a program at a second child development center. Across both sites, children were divided amongst eight classrooms. Information on classroom activities was obtained from classroom teachers. All of the classrooms emphasized play during children's free-choice time, but most of the teacher-facilitated activities were academically focused (e.g., learning letters). Although

teachers were familiar with traditional versions of the games used in the intervention, teachers reported that similar games were rarely implemented in any of the classrooms.

Attrition

Initially, 74 children were recruited for participation in the study. Data was obtained for all 74 children at time 1 (fall). At time 2 (spring), data was only obtained for 65 children. The total attrition was 9 children: four children moved over the course of the school year, one child left school early for a family vacation, three children declined to participate in the post-test, and one child was withdrawn from the study because of newly-diagnosed developmental delays. The children who left the study did not significantly differ from the children who completed the study on age or gender (*p*s > .05). A higher percentage of children who left the study were enrolled in Head Start (67%) as compared to the overall sample (43%), although this difference was not statistically significant. All analyses were conducted using the 65 children who participated in all phases of the study.

Measures

Parent Demographic Questionnaire

In the fall of the prekindergarten year, parents completed a background questionnaire in their native language (English or Spanish) containing questions about child's age, gender, whether the child was enrolled in Head Start, and parent education level.

Head-Toes-Knees-Shoulders Task

In the fall and the spring, the Head-Toes-Knees-Shoulders Task (HTKS) was used to assess children's behavioral self-regulation (Ponitz et al., 2009). Children play a game

where they are asked to touch their head or toes, (or knees or shoulders), and then to do the opposite of what the experimenter says. For example, the experimenter instructs children to touch their head (or knees), and instead of touching their head (or knees), children are directed to do the opposite and touch their toes (or shoulders). There are two parts to the task: Part I includes two paired commands (head/toes or knees/shoulders) and Part II includes four paired commands (head/toes and knees/shoulders). The possible score for each item is 0, 1, or 2: 0 denotes an incorrect response, 1 is a self-correct (motion toward the incorrect response, but the child stops and gives the correct response), and 2 points are given if a child gives the correct response without a movement toward the incorrect response. There are 20 test items and scores range from 0 to 40 with higher scores indicating higher levels of behavioral regulation. Recent research has shown that the HTKS is a reliable and valid measure of children's behavioral self-regulation in diverse populations (Ponitz et al., 2008; McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2009). In the present study, interrater reliability on the HTKS was calculated at kappa = .92. Additionally, there was a trend for teacher-rated behavioral self-regulation in the fall to be significantly correlated with children's fall HTKS scores (r = .20, p = .09) and teacher-rated behavioral self-regulation in the spring was significantly correlated with children's spring HTKS scores (r = .24, p < .05).

Academic Outcomes

In the fall and spring, children's academic outcomes were assessed using three sub-tests of the Woodcock Johnson Psycho-Educational Battery-III Tests of Achievement.

Reading. Children's letter skills and developing word-coding skills in English or Spanish were assessed using raw scores from the Letter-Word Identification subtest of the

Woodcock Johnson Psycho-Educational Battery-III Tests of Achievement (Woodcock & Mather, 2000) or the The Batería III Woodcock- Muñoz (Muñoz-Sandoval, Woodcock, McGrew, & Mather, 2005). Previous research has shown high reliability for preschool-aged children on both the English and Spanish versions of the task (Schrank et al., 2005; Woodcock & Mather, 2000).

Vocabulary. Children's expressive vocabulary skills in English or Spanish were measured using the Picture Vocabulary subtest of the WJ-III or The Batería III Woodcock-Muñoz (Muñoz-Sandoval et al., 2005). Previous research has shown reliability on both versions of the task with preschool-aged children at .81 and .89, respectively (Schrank et al., 2005; Woodcock & Mather, 2000).

Math. Children's mathematical operations needed to solve practical problems, including counting objects, reading numbers, and basic addition and subtraction picture-problems, were measured using the Applied Problems subtest of the WJ-III or The Batería III Woodcock-Muñoz (Muñoz-Sandoval et al., 2005). In previous research, both the English and Spanish version of the task have demonstrated reliability for preschool-aged children at .94 and .93, respectively (Schrank et al., 2005; Woodcock & Mather, 2000).

Procedure

In the fall of the prekindergarten year (September), an invitation to participate in the study was mailed to parents of all four-year-olds at the participating preschools. Consent forms were collected from seventy-four families. The study was divided into three phases: pretest (November-December), intervention (January-March), and posttest (April-May).

Pretest. During this phase, children's behavioral self-regulation and academic

outcomes were assessed over four weeks. Children received two of the assessments on each of two different days to prevent fatigue and the order of assessments was randomized. Parents completed questionnaires at this time.

Intervention. During the intervention phase, half of the children in each classroom were randomly assigned to participate in the intervention treatment group. Random assignment at the individual level within classrooms was chosen because of the high variability in class sizes and diversity in child characteristics across classrooms. Additionally, the intraclass correlation on the HTKS in the fall was .06 (see Results section below), showing that limited variance in scores was due to classroom membership and supporting our decision to randomize at the individual level. Children at both sites were frequently taken out of the classroom to participate in individual and small group activities so children were accustomed to leaving the classroom and seeing others leave the classroom throughout the school day. Although there were initial concerns regarding potential contamination effects within classrooms, teachers reported that there was no evidence of children sharing intervention activities with other children in the classroom who were assigned to the control group. In addition, research has found that when contamination effects occur because of changes in children's behavior, children assigned to the control group are more likely to act like children in the treatment group, making detection of intervention effects more difficult. These types of contamination effects, however, are often found to be small or negligible (Rhoads, 2009; Torgerson, 2001).

Children in the treatment group participated in a total of sixteen playgroups over eight weeks. The playgroups were held twice weekly and each session was approximately 30 minutes. Previous research has found significant improvement in children's self-

regulation and social competence in interventions of similar durations (Pears et al., 2007). Each playgroup session had 5-8 children and 2 assistant teachers. The playgroups were held on the same days and times each week as part of the regular preschool day and were scheduled at times chosen by the classroom teachers. The same researcher (the first author) led all of the playgroups to ensure fidelity. The playgroup leader developed the games and had previously worked as an early childhood education teacher (Tominey & McClelland, 2008). Session attendance was recorded for each child. Children in the intervention group attended an average of 11.3 playgroups (range: 5 -16). The most common reason for a child to miss a session was an absence because of illness or vacation. Occasionally, a child would decline to participate on a given day because of involvement in other classroom activities. Other reasons for missing sessions included arriving late for school and unavailable transportation.

Posttest. During this phase, behavioral self-regulation and academic assessments were re-administered to all children. Research assistants were blind to intervention participation; those who assisted with the intervention phase of the study did not test children from classrooms in which they had previously assisted to prevent researcher bias.

Playgroup Session Format

Playgroup sessions were designed to resemble classroom circle times. At the beginning of each session, children sat on mats in a circle and participated in a greeting song that was intended to help children transition to the playgroup setting. Following the greeting song, the playgroup leader introduced and led children in the playgroup activity. At the end of each playgroup session, children sat on mats in a circle and sang a “good-bye

song" before returning to their classrooms. A total of six activities were presented over the 16 sessions (Tominey & McClelland, 2008). As the playgroup sessions progressed, additional instructions were added, making the games increasingly complicated. Each game was repeated at subsequent sessions to ensure that children had multiple opportunities to practice and learn both the basic and increasingly complicated versions of the games. Children were also given opportunity to lead games when appropriate (e.g., select and hold up colors for *Red Light, Purple Light*).

Playgroup Games

In each game, attention and working memory were essential for children to remember and follow through with continually changing multi-step instructions. Children practiced inhibitory control by starting and stopping to different cues (oral and visual), performing specific behaviors in response to cues, and performing opposite behaviors.

Red Light, Purple Light. Like the popular children's game *Red Light, Green Light*, a teacher acted as a "stop light" by standing at the opposite end of the room from the children and holding up different colored construction paper circles to represent stop and go. Children responded to specific color cues (e.g., purple is "stop" and orange is "go") and then opposite cues (e.g., purple is "go" and orange is "stop") as well as to different shapes representing stop and go (e.g., any color circle is "go" and any color square is "stop").

The Freeze Game. Children danced when music played and froze when the teacher stopped the music. Children danced slowly to slow songs and quickly to fast songs, alternating between different slow and fast songs. Children were then asked to respond to opposite cues: dancing quickly to slow songs and slowly to fast songs.

Color-Matching Freeze. Related to the *Freeze Game*, children danced when music played and froze when the music stopped, however, children were asked to perform an additional step before freezing. Teachers taped different colored pieces of construction paper to mats placed on the ground. When the music stopped, the teacher held up a specific color and children were instructed to find and stand on a mat of that color.

Sleeping, Sleeping, All the Children are Sleeping. Children pretended to sleep when the circle leader sang, "Sleeping, sleeping, all the children are sleeping." While children pretended to sleep, the circle leader gave an additional instruction for children to wake up and act out an animal (e.g., "And when they woke up… they were monkeys!"). Additional rules were added to make the game more complicated.

Conducting an Orchestra. The circle leader used a dowel rod as a conducting baton to lead children in playing musical instruments (e.g., jingle bells or maracas). When the conductor waved the baton, children played their instruments. When the conductor put the baton down, children stopped. The conductor then instructed children to play their instruments quickly when the baton moved quickly and slowly when the baton moved slowly. Children were also asked to respond to opposite cues. When the conductor waved the baton, children stopped playing their instruments and when the conductor set the baton down, children played their instruments.

Drum Beats. Children responded to different drum cues with body movements. Teachers chose actions for children to perform while sitting (e.g., clapping or stomping) and while moving around the room (e.g., walking or dancing). For example, children were instructed to walk quickly to fast drumming, slowly to slow drumming, and freeze

when the drumming stopped. Teachers also asked children to respond to opposite cues (walk slowly to fast drum beats and quickly to slow drum beats) and associated different actions with specific drum cues (e.g., hopping to fast drum beats and crawling to slow drum beats).

Results

Analytic Strategy

Prior to answering our research questions, we analyzed descriptive statistics and bivariate correlations for the entire sample (N = 65). To ensure that there were no initial differences between the treatment and control groups at time 1, t-tests and tests of proportion were used to test for differences between groups on demographic variables and initial academic and behavioral self-regulation scores. Two separate multiple regression analyses were then run to answer the first research question. The first regression analysis examined predicted gains in behavioral self-regulation scores (spring HTKS score minus fall HTKS score) for children based on group assignment (treatment or control). The second analysis examined predicted gains in behavioral self-regulation scores based on dosage of intervention (number of playgroup sessions attended). Although children were nested in nine classrooms, the intraclass correlation for the difference in HTKS scores was 0.06, so multi-level modeling was not used in the analyses.

The same analytic plan from the first research question was used to answer the second research question examining the subgroup of children with low initial behavioral self-regulation scores. Low behavioral self-regulation was defined as having an initial HTKS score below the 50th percentile (fewer than 6 points out of 40 on the HTKS; n =

31). Although previous research has shown significant intervention effects on self-regulation for children in the bottom 25th percentile (Connor et al., in press), to maximize our sample size and statistical power, we included children below the 50th percentile in this study. This decision was based on research finding that in applied research, not finding an effect that exists because of power limitations (Type II error) is more likely, than finding a significant effect due to chance (Type I error) (e.g., Cohen, 1988, Lipsey, 1996). Thus, we chose a higher cut-off score (the 50th percentile) for the low initial behavioral self-regulation group. To answer this research question, descriptive statistics were examined for children with low initial scores. Within this subgroup, differences between demographic variables and initial scores were tested for children in the treatment and control groups. Finally, two separate multiple regression analyses were run predicting gains in behavioral self-regulation scores; the first based on group assignment and the second based on dosage of intervention.

Prior to testing the third research question, multiple regression analyses were used to determine if children's behavioral self-regulation in the fall predicted fall reading, math, and vocabulary outcomes in the overall sample (N = 65). Paired t-tests were used to determine if there were significant gains in children's academic outcomes over the prekindergarten year and multiple regression analyses were used to determine if intervention participation predicted gains in academic outcomes in both the overall sample and the subgroup of children with low initial behavioral self-regulation scores (n = 31). Gains in academic outcomes were calculated by subtracting children's scores in the fall from their spring scores on each measure.

Descriptive Statistics

Table 1.1 presents the bivariate correlations for children in the overall sample. As expected, there was high variability in initial behavioral self-regulation for children in the overall sample (*N* = 65). At time 1, the average HTKS score was 11 points (*SD* = 12, range = 0 – 37 points) with a skewness of .75 and kurtosis of 2.17. The skewness and kurtosis were not indicative of a non-normal distribution (Kline, 2005). On average, children in the overall sample gained 11 points on the HTKS over the prekindergarten year. In the subgroup of children with low initial behavioral self-regulation scores, there was little variability in HTKS scores at time 1 (*M* = .5 points, *SD* = 1.2, range = 0-5).

In the overall sample, the average HTKS score at time 2 was 22.3 points (*SD* = 13, range = 0-38). At time 2, there was substantial variability in HTKS scores for children in the low initial behavioral self-regulation group. In this subgroup of children, the average HTKS score at time 2 was 16.9 points (*SD* = 13.6, range = 0 – 35) with a skewness of .04 and kurtosis of 1.4, indicating a normal distribution (Kline, 2005). Over the course of the year, children with low initial behavioral self-regulation gained 16.3 points over the year. Table 1.2 summarizes the remaining descriptive statistics for children in the overall sample and for those with low initial behavioral self-regulation.

Tests of Initial Differences Between Groups

T-tests were used to examine initial differences between children in the treatment and control groups on the following variables: maternal education, child age, school absences, academic achievement scores (reading, vocabulary, and math) and fall HTKS scores. Additionally, tests of proportion were used to examine differences between the proportion of children enrolled in Head Start in each group and the proportion of gender in each group. No significant differences were found between the treatment and control

group in either the overall sample or in the low initial behavioral self-regulation group on any of these variables in the fall (see Table 1.2).

Research Question #1: Does participation in a pilot intervention (treatment group assignment and dosage level) lead to greater gains in behavioral self-regulation in the overall sample of prekindergarteners?

In the overall sample of children, multiple regression analyses did not show that either treatment group assignment or dosage of the intervention (number of playgroup sessions attended) predicted gains in HTKS scores from fall to spring after controlling for child age, gender, family income, and fall HTKS scores. Specifically, for the overall sample of children, intervention participation did not significantly predict gains in HTKS scores, $t(59) = 0.49$, $p > 0.05$ nor did the number of intervention sessions attended, $t(59) = .81$, $p > 0.05$. Although not significant, the regression coefficients were in the expected direction, showing small substantive gains in behavioral self-regulation for children participating in the playgroups (intervention: B = 1.34, ß = .06 and dosage: B = .19, ß = .09). In both analyses, of the control variables, only family income (measured by Head Start enrollment) and initial HTKS score significantly predicted HTKS gains, $t(59) = -3.49$, $p < 0.01$ and $t(59) = -5.17$, $p < 0.001$, respectively. Children from low-income families were predicted to gain 10.32 fewer points than their peers over the school year (ß = -.40), whereas, having a higher HTKS score at the beginning of the year predicted smaller gains over the course of the year (ß = -.59). Maternal education level was not included as a control variable because of the high correlation between maternal education and family income ($r = .66$).

Research Question #2: Do children with low initial behavioral self-regulation scores show significant growth in these skills based on treatment group assignment and dosage level?

Although treatment group assignment and dosage were not significantly related to behavioral self-regulation gains in the overall sample, significant relations were found for children with low levels of behavioral self-regulation in the fall. For these children, treatment group participation significantly predicted self-regulation gains over the prekindergarten year after controlling for child age, gender, and family income, $t(26) = 2.23$, $p < 0.05$, $\beta = .34$ (see Table 1.3). Children with low initial behavioral self-regulation in the treatment group were predicted to gain 9.2 more points over the year on the HTKS than children in the control group, which was a difference of approximately one standard deviation. The only significant control variable in the analysis was family income, $t(26) = -3.90$, $p < 0.01$, $\beta = -.58$. Children from low-income families were predicted to gain 15 fewer points on the HTKS than their more advantaged peers, a difference greater than one standard deviation on the task.

The dosage of the intervention also significantly predicted children's behavioral self-regulation gains over the prekindergarten year for children with low fall behavioral self-regulation scores, $t(26) = 2.50$, $p < 0.05$, $\beta = .37$. Specifically, for each additional intervention session attended, children were expected to gain nearly 1 additional point (.84 points) on the HTKS task over the year. If children attended the average number of intervention sessions (11.3 sessions), they were expected to gain an additional 9.5 points on the task, which is the equivalent of an increase of .8 standard deviations on the task. Family income was found to be the only significant control variable in the model, $t(26) =$

-3.73, $p < 0.01$, $\beta = -.54$. Children from low-income families were predicted to gain 14.3 fewer points than their peers, a difference of more than one standard deviation on the task.

Research Question #3: Does intervention treatment group participation relate to academic outcomes over the prekindergarten year?

For children in the overall sample ($N = 65$) fall behavioral self-regulation significantly predicted fall academic achievement (reading: $t(60) = 2.09$, $p < .05$, $\beta = .23$; math: $t(60) = 2.54$, $p < .05$, $\beta = .29$; and vocabulary: $t(60) = 4.67$, $p < .001$, $\beta = .53$) when controlling for child age, gender, and family income. Specifically, for each additional standard deviation children scored on the HTKS, they were predicted to score an additional 1.1 points in reading, 1.3 points in math, and 1.8 points in vocabulary in the fall. Family income was also a significant predictor of fall reading ($t(60) = -4.36$, $p < .001$) and math scores ($t(60) = -3.05$, $p < .01$), but not vocabulary scores. Children from low-income families were predicted to score 3.2 fewer points in math and 4.5 fewer points in reading than children from more advantaged families. We did not examine relations between self-regulation and achievement in the fall in the low behavioral self-regulation group because of the lack of variability in fall behavioral self-regulation in this group of children.

For children in the overall sample ($N = 65$), intervention assignment ($t(60) = 2.32$, $p < .05$) and the number of intervention sessions attended ($t(60) = 2.24$, $p < .05$) significantly predicted gains in children's reading scores over the prekindergarten year when controlling for child age, gender, and family income. Children who participated in the treatment group were predicted to gain 2 more points (a difference of .57 standard

deviations) on the reading assessment than children in the control group. Moreover, for each additional playgroup session attended, children were predicted to gain .16 points in reading. Children in the treatment group who attended the average number of sessions (11.3) were predicted to gain 1.8 more points in reading than children in the control group (a difference of .52 standard deviations). Family income was also a significant predictor of change in reading score ($t(60) = -2.02$, $p < .05$). Specifically, children from advantaged families were predicted to gain 1.72 more points (a difference of .5 standard deviations) in reading than children from low-income families over the year. In the overall sample, there was no significant relation between intervention assignment and change in math ($t(60) = -.20$, $p > .05$) or vocabulary scores ($t(60) = -.45$, $p > .05$) over the prekindergarten year.

A similar trend for treatment group participation predicting reading gains was present for children with low initial behavioral self-regulation. Within the low group, children in the treatment group were predicted to gain 2.27 more points in reading than children in the control group (a difference of .72 standard deviations). The effect size for reading gains based on intervention participation was slightly greater for children in the low group than for the overall sample, and this difference was marginally significant ($t(26) = 1.94$, $p = 06$). In addition to intervention participation, a significant dosage effect was found. For each additional playgroup session attended, children with low initial behavioral self-regulation were predicted to gain an additional .21 points in reading ($t(26) = 2.24$, $p < .03$). As in the overall sample, there were no significant relations between intervention participation (treatment group or dosage) and change in math ($t(26) = -.10$, $p > .05$) or vocabulary scores ($t(26) = -.08$, $p > .05$) for children in the low group.

Discussion

In the present study, we investigated the preliminary effectiveness of an intervention using classroom games to improve preschoolers's behavioral self-regulation. Although previous research focusing on specific aspects of self-regulation has shown that these skills can be improved through practice in individual training sessions (Dowsett & Livesey, 2000), this study examined a set of games that could be implemented by teachers in classroom settings. Unlike previous classroom studies, the intervention games focused on specific behavioral aspects of self-regulation that have been shown to predict children's academic achievement (McClelland et al., 2007; Ponitz et al., 2009), using classroom games resembling popular children's games and requiring few materials. In the study, we examined intervention effectiveness for the overall sample and for a subgroup of children with low initial levels of behavioral self-regulation. We also tested whether treatment group participation significantly predicted academic outcomes over the prekindergarten year.

Treatment group participation and gains in behavioral self-regulation in the overall sample of prekindergarteners and in children with low initial self-regulation

Contrary to expectations, there were no significant differences in behavioral self-regulation gains between the treatment and control groups in the overall sample, although significant results were found for children with low initial behavioral self-regulation. It should be noted, however, that positive effect sizes were found for children participating in the treatment group. The small effect sizes found coupled with the small sample size, may have contributed to our inability to detect significant differences between children in the treatment and control groups.

We did find that participation in the treatment group significantly predicted gains in behavioral self-regulation for children beginning the year with low initial levels of these skills. Previous studies have found significant intervention effects on self-regulation gains for children with low initial self-regulation (Connor et al., in press) and for children with risk factors linked to poor self-regulation (e.g., children in foster care) (Pears et al., 2007). In the present study, within the low group, a significant dosage effect was found in addition to a treatment group effect. For children with low initial behavioral self-regulation, the more intervention sessions attended, the greater the predicted gains in these skills. Previous studies have also found that parents and children participating in early childhood interventions focused on behavioral outcomes often exhibit greater short- and long-term benefits from higher levels of participation (Hill, Brooks-Gunn, & Waldfogel, 2003; Reynolds, Temple, Robertson, & Mann, 2001).

The Importance of Family Income for Behavioral Self-Regulation Gains

In the overall sample and in the sample of children with low initial behavioral self-regulation, family income was a significant predictor of self-regulation gains over the prekindergarten year. Children from low-income families began and ended the year with lower behavioral self-regulation than their peers. These results support previous findings that family income is an important predictor of children's self-regulation (Evans & Rosenbaum, 2008; Howse, Lange et al., 2003; Sektnan et al., 2009; Wanless et al., 2007). In the present study, family income was significantly correlated with maternal education (r = .66), indicating that income may not have been the only factor contributing to low behavioral self-regulation scores for children in the study. Research has shown that children and families who are economically disadvantaged not only have fewer economic

resources available (Lareau, 2003), but are also likely to experience an accumulation of risk factors that affect child outcomes (Dearing et al., 2006). These potential risk factors include fewer family resources (e.g., economic and academic), less parent-child quality time, higher rates of authoritarian parenting and punitive discipline, and higher rates of chronic illness than children in more advantaged families (Dearing et al., 2006). Research also suggests that behavioral self-regulation mediates the effect of risk factors on academic outcomes (Dearing, McCartney, & Taylor, 2009; Sektnan et al., in press), highlighting the importance of targeting children from low-income backgrounds for intervention, as they may be especially at-risk for exhibiting poor behavioral self-regulation at school entry (Wanless et al., under review). In the present study, children who exhibited the greatest self-regulation gains (children in the treatment group from more advantaged families) may have had the most opportunity to explicitly practice paying attention, remembering instructions, and demonstrating inhibitory control through intervention participation and having exposure to resources and family processes that promoted strong self-regulation at home (Dearing et al., 2006; Lareau, 2003).

Behavioral self-regulation, treatment group participation, and academic outcomes over the prekindergarten year

In the overall sample, prior to the intervention, children's fall behavioral self-regulation predicted fall academic achievement in math, reading, and vocabulary. Specifically, higher levels of behavioral self-regulation predicted higher scores on each of these academic outcomes. These findings add to the growing body of research showing that behavioral self-regulation is an important component of academic success as early as preschool (Matthews et al., 2009; McClelland et al., 2007; Ponitz et al., 2009). In

addition, family income significantly predicted fall academic achievement. Children from low-income families began the year with lower levels of math and reading than their more advantaged peers. Previous research has also documented socioeconomic status as an important predictor of early achievement (Sektnan et al., in press; Wanless et al., under review).

Importantly, participation in the intervention treatment group significantly predicted reading gains in the overall sample of children. The focus of the intervention games was on the integration of attention, working memory, and inhibitory control, which together have been found to predict academic outcomes in preschool and kindergarten, including reading (McClelland et al., 2007; Ponitz et al., 2009). Explicitly practicing these skills may have improved children's ability to benefit from classroom literacy exposure and instruction over the prekindergarten year. It is important to note that children in the treatment group did not receive additional direct instruction in reading, as none of the playgroup games involved letters, words, or reading activities. These significant results were found even though intervention participation was not significantly related to behavioral self-regulation gains in the overall sample. The effect sizes for children in the treatment group, however, were positive and in the expected direction, which suggests that intervention-related self-regulation gains may have been present, but the small sample size may have hindered our ability to detect them.

A similar trend was found for children with low initial behavioral self-regulation. In this subgroup, treatment group participation significantly predicted gains in behavioral self-regulation. Within the low group, there was also a significant trend for intervention participation and number of intervention sessions attended (dosage) to significantly

predict reading gains. These findings lend additional support to the explanation that intervention participation may have improved children's behavioral self-regulation, giving them an improved ability to benefit from classroom literacy instruction.

It is possible that the significant effect of the intervention (treatment group and dosage) on reading, but not math and vocabulary gains, is due to the explicit focus on literacy instruction in prekindergarten classrooms. Previous research demonstrates that children are exposed to more literacy-rich instruction prior to kindergarten compared to other academic subjects (Connor, Morrison, & Slominski, 2006; Miller, Kelly, & Zhou, 2005; NICHD ECCRN, 2002). In support of this, teachers in the present study reported that emergent literacy skills (e.g., letter recognition) were often the focus of classroom learning activities, whereas math and vocabulary were rarely explicitly taught. Thus, children in the treatment group may have been better able to take advantage of instructional opportunities in the classroom by being able to pay attention, remember instructions, and control their behavior more effectively during literacy activities compared to children in the control group.

Limitations and Future Research

Although the present study supported the preliminary effectiveness of a pilot behavioral self-regulation intervention in preschool, there were a number of limitations. The primary limitation was the small sample size. With a final sample size of 65 children, the power to detect a significant effect was limited, although significant effects were still found. Most notably, children with low levels of self-regulation in the fall (below the 50th percentile) benefited from participation in the intervention and from higher numbers of intervention sessions. The small sample size also limited the ability to perform statistical

analyses on subgroups within the treatment and control groups, such as by family income. Additionally, the relation between treatment group participation and reading gains in children with low initial behavioral self-regulation was substantively identical to the results found in the overall sample, but may have lacked statistical significance because of the small sample size of this subgroup.

A second limitation of the study was that only one direct measure of self-regulation was used to measure gains in behavioral self-regulation across the prekindergarten year. The classroom games were designed to help children practice the skills measured by the HTKS. To further establish intervention effectiveness and generalizability of effects, future research should incorporate additional measures of behavioral self-regulation to examine the relation between intervention-related improvement in these skills and performance on related tasks. Although numerous studies have linked HTKS levels and gains to teacher ratings of child behavior and academic outcomes (Matthews et al., 2009; McClelland & Morrison, 2003; Ponitz et al., 2009), no other studies have examined intervention-related gains and child outcomes.

A third limitation of the study is that the scope of this pilot intervention was limited to playgroup sessions including child involvement. It was clear from the results that family income significantly predicted children's behavioral self-regulation and academic scores across the year. The significant effect of family income on child outcomes highlights the need for interventions to extend beyond the child level to include family characteristics. Numerous family factors and processes (NICHD ECCRN, 2003), including parenting (Calkins, 2004) and home learning environment (McClelland & Wanless, 2006), have demonstrated significant relations with the development of

children's self-regulation. Future interventions should include parent and family involvement to maximize gains in self-regulation for all children. Finally, participants should be followed longitudinally with more time points to examine the potential long-term effects of the intervention on children's behavioral self-regulation and academic achievement.

Practical Implications and Conclusions

The results of the present study support the preliminary effectiveness of a prekindergarten behavioral self-regulation intervention. Results indicated that a set of classroom games was effective in helping children with low initial behavioral self-regulation improve scores on a direct measure of attention, working memory, and inhibitory control; skills that have been found to predict academic outcomes. In addition, participation in the treatment group significantly predicted gains in reading scores over the prekindergarten year. The games used in the study were implemented in playgroup settings with classroom materials and could easily be implemented by teachers in small and large groups of children within classrooms. Previous intervention studies using classroom activities implemented by teachers (e.g., PATHS, Tools of the Mind) have been found to effectively improve child outcomes, including aspects of self-regulation and academic achievement (Diamond et al., 2007; Domitrovich et al., 2007). The present intervention, however, provides a unique opportunity to improve behavioral self-regulation with limited training and without expensive materials, increasing the potential to use the intervention on a larger scale.

The present study has the potential to inform preschool curricula emphasizing behavioral self-regulation as a means of facilitating school readiness. The development of

interventions that can be translated to classroom settings and easily implemented by teachers is critical to ensure that all children enter school with the behavioral self-regulation skills they need to be ready to learn.

Table 1.1

*Bivariate Correlations for Children in the Overall Sample (*N = *65)*

Variables	1	2	3	4	5	6	7	8
1. Child age (months)	–							
2. Child gender[a]	.31*	–						
3. Head Start status[b]	.09	.18	–					
4. Mother education[c]	-.09	-.31*	-.65***	–				
5. Fall HTKS	-.01	-.17	-.37**	.33*	–			
6. Spring HTKS	-.05	-.02	-.52***	.22	.50***	–		
7. HTKS difference	-.04	.16	-.16	-.12	-.46***	.52***	–	
8. Math difference	-.20	.03	-.02	.04	.19	-.08	.08	–
9. Reading difference	-.03	-.12	-.28*	.45***	.29*	.32**	.03	.11
10. Vocabulary difference	-.06	.02	-.15	.14	-.12	-.00	.14	-.03
11. Intervention group[d]	-.11	.05	-.07	.12	.07	.14	.05	.01
12. Number of sessions	-.09	.06	-.08	.04	.05	.18	.10	.03
13. School absences	-.07	.01	.17	-.13	-.10	-.24[†]	-.12	-.13

Table 1.1 *continued* Variables	9	10	11	12	13
9. Reading difference	–				
10. Vocabulary difference	.06	–			
11. Intervention group[d]	.28*	-.04	–		
12. Number of sessions	.28*	.01	.94***	–	
13. School absences	-.05	.01	.07	-.08	–

[a]Child gender: 0 = *female*, 1 = *male*. [b]Head Start status: 0 = *not enrolled in Head Start*, 1 = *enrolled in Head Start*. [c]For correlations including mother education, $n = 55$. [d]Intervention group: 0 = *control*, 1 = *treatment*.

$^{\dagger}p < 0.1$. $*p < .05$. $**p < .01$. $***p < .001$.

Table 1.2

*Descriptive Statistics for Children in the Treatment and Control Groups in the Overall Sample (*N *= 65) and in the Subgroup of Children with Low Fall HTKS Scores (*N *= 31)*

	Overall Sample (N = 65)			Children with Low Initial HTKS Scores (n = 31)		
Variables	Control (n = 37) M (SD)	Treatment (n = 28) M (SD)	Total (N = 65) M (SD)	Control (n = 19) M (SD)	Treatment (n = 12) M (SD)	Total (n = 31) M (SD)
Child age in months	54.9 (3.9)	54.1 (3.2)	54.6 (3.6)	54.9 (4.3)	54.2 (3.6)	54.6 (4)
Child gender[a]	.38	.43	.4	.37	.58	.45
Head Start status[b]	.46	.4	.43	.58	.5	.55
Mother education[c]	15.1 (3.8)	15.9 (3.1)	15.4 (3.5)	13.5 (3.5)	15.1 (3.1)	14.1 (3.4)
School absences	5.5 (4.3)	6.2 (5.6)	5.8 (4.9)	5.4 (4.7)	8 (6.8)	6.4 (5.7)
Fall HTKS	10.2 (12.4)	12 (12.1)	11 (12)	.37 (.9)	.9 (1.8)	.58 (1.3)
Spring HTKS	20.7 (13.5)	24.4 (12.6)	22.3 (13)	13.5 (12.8)	22.3 (13.6)	16.9 (13.9)
Difference in HTKS	10.4 (12.5)	11.7 (13.8)	10.97 (13)	13.2 (12.8)	21.3 (12.9)	16.3 (13.3)

Table 1.2 *continued*

Fall reading	7.7 (4.3)	8.6 (5.1)	8.1 (4.6)	6.3 (3.7)	6.3 (3.9)	6.3 (3.8)
Spring reading	9.8 (5.6)*	12.7 (7.3)*	11.1 (6.5)	7.9 (4.8)	9.8 (5.2)	8.6 (4.9)
Difference in reading	2.1 (2.5)*	4.1 (4.3)*	2.9 (3.5)	1.7 (2.5)	3.4 (3.9)	2.35 (3.2)
Fall math	12.2 (4.2)	13.4 (4.9)	12.7 (4.5)	10.1 (3.9)	11.8 (4.7)	10.7 (4.2)
Spring math	14.9 (3.7)	16.2 (4.6)	15.5 (4.1)	13.6 (3.5)	15.2 (4.5)	14.2 (3.9)
Difference in math	2.76 (2.5)	2.79 (1.7)	2.77 (2.2)	3.53 (1.9)	3.42 (2.1)	3.48 (1.9)
Fall vocabulary	15.4 (3.2)	16.4 (3.5)	15.8 (3.3)	14.2 (2.5)	14.7 (2.5)	14.4 (2.5)
Spring vocabulary	16.7 (2.9)	17.5 (3.6)	17.8 (3.2)	15.5 (2.7)	16 (2.7)	15.7 (2.6)
Difference in vocabulary	1.32 (2.4)	1.14 (2.8)	1.25 (2.6)	1.37 (1.9)	1.33 (2.8)	1.35 (2.2)

[a]Child gender: 0 = *female*, 1 = *male*. [b]Socioeconomic status: 0 = *not enrolled in Head Start*, 1 = *enrolled in Head Start*. [c]For descriptive statistics including Mother education, $n = 55$ in the Overall sample and $n = 23$ in the low-HTKS subgroup.

$^{\dagger}p < 0.1$. $*p < .05$. $**p < .01$. $***p < .001$.

Table 1.3

*Multiple Regression Results Examining Intervention Group and Number of Intervention Sessions to Predict Change in HTKS Score Over the Prekindergarten Year in the Subgroup of Children with Low Initial HTKS Scores (*N *= 31)*

	Analysis 1 (Intervention Group)			Analysis 2 (Dosage)		
Variable	*B*	*SE B*	ß	*B*	*SE B*	ß
Child age (months)	.82	.59	.25	.73	.56	.22
Child gender[a]	-7.58	4.73	-.29	-7.14	4.56	-.27
Head Start status[b]	-15.14	3.88	-.58**	-14.26	3.83	-.54**
Treatment group[c]	9.21	4.13	.34*	-	-	-
Number of sessions	-	-	-	.84	.33	.37*
R^2		.45			.47	
F		5.26**			5.75**	

[a]Child gender: 0 = *female*, 1 = *male*. [b]Head Start status: 0 = *not enrolled in Head Start*, 1 = enrolled in Head Start. [c]Treatment group: 0 = *control*, 1 = *treatment*.

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

Table 1.4

*Multiple Regression Results Examining Intervention Group and Number of Intervention Sessions to Predict Change in Reading Scores Over the Prekindergarten Year in the Overall Sample (*N = *65)*

	Analysis 1 (Intervention Group)			Analysis 2 (Dosage)		
Variable	*B*	*SE B*	ß	*B*	*SE B*	ß
Child age (months)	.05	.12	.06	.05	.12	.05
Child gender[a]	-.76	.90	-.11	-.76	.91	-.11
Head Start status[b]	-1.72	.85	-.24*	-1.70	.85	-.24*
Treatment group[c]	1.97	.85	.28*	-	-	-
Number of sessions	-	-	-	.16	.07	.27*
R^2		.16			.15	
F		2.81*			2.71*	

[a]Child gender: 0 = *female*, 1 = *male*. [b]Head Start status: 0 = *not enrolled in Head Start*, 1 = enrolled in Head Start. [c]Treatment group: 0 = *control*, 1 = *treatment*.

$^{\dagger}p < 0.1$. $*p < .05$. $**p < .01$. $***p < .001$.

References

Adams, A. M., Bourke, L., & Willis, C. (1999). Working memory and spoken language comprehension in young children. *International Journal of Psychology, 34*, 364-373.

Alexander, K. L., Entwisle, D. R., & Dauber, S. L. (1993). First-grade classroom behavior: Its short- and long-term consequences for school performance. *Child Development, 64*(3), 801-814.

Barnett, W. S., Jung, K., Yarosz, D. J., Thomas, J., Hornbeck, A., Stechuk, R., et al. (2008). Educational effects of the Tools of the Mind curriculum: A randomized trial. *Early Childhood Research Quarterly, 23*(3), 299-313.

Baumeister, R. F., & Vohs, K. D. (2004). *Handbook of self-regulation: Research, theory, and applications.* New York, NY, US: Guilford Press.

Bernier, A., Carlson, S. M., & Whipple, N. (2010). From external regulation to self-regulation: Early parenting precursors of young children's executive functioning. *Child Development, 81*(1), 326-339.

Blair, C. (2002). School Readiness. *American Psychologist, 57*(2), 111.

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*(2), 647-663.

Bronson, M. B., Tivnan, T., & Seppanen, P. S. (1995). Relations between teacher and classroom activity variables and the classroom behaviors of prekindergarten children in Chapter 1 funded programs. *Journal of Applied Developmental Psychology, 16*(2), 253-282.

Calkins, S. D. (2004). Early attachment processes and the development of emotional self-regulation. In R. F. Baumeister & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 324-339). New York: NY: Guildford Press.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed.).* Hillsdale, NY: Lawrence Erlbaum.

Connor, C. M., Morrison, F. J., & Slominski, L. (2006). Preschool instruction and children's emergent literacy growth. *Journal of Educational Psychology, 98*, 665-689.

Connor, C. M., Ponitz, C. C., Phillips, B. M., Travis, Q. M., Glasney, S., & Morrison, F. J. (in press). First graders' literacy and self-regulation gains: The effect of individualizing student instruction. *Journal of School Psychology*.

Cooper, D. H., & Farran, D. C. (1988). Behavioral risk factors in kindergarten. *Early Childhood Research Quarterly, 3*(1), 1-19.

Dearing, E., Berry, D., & Zaslow, M. (2006). *Poverty During Early Childhood. In Blackwell handbook of early childhood development.* (pp. 399-423). Malden, MA, US: Blackwell Publishing.

Dearing, E., McCartney, K., & Taylor, B. A. (2009). Does Higher Quality Early Child Care Promote Low-Income Children's Math and Reading Achievement in Middle Childhood? *Child Development, 80*(5), 1329-1349.

Denton Flanagan, K., & McPhee, C. (2009). *The Children Born in 2001 at Kindergarten Entry: First Findings From the Kindergarten Data Collections of the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B)* (NCES 2010-005).

National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

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

Domitrovich, C. E., Cortes, R. C., & 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*(2), 67-91.

Dowsett, S. M., & Livesey, D. J. (2000). The development of inhibitory control in preschool children: Effects of 'executive skills' training. *Developmental Psychobiology, 36*(2), 161-174.

Eisenberg, N., Smith, C. L., Sadovsky, A., & Spinrad, T. L. (2004). *Effortful control: Relations with emotion regulation, adjustment, and socialization in childhood.* In R. F. Baumeister & K. D. Vohs (Eds.), Handbook of self-regulation: Research, theory, and applications (pp. 259-282). New York: Guilford.

Entwisle, D. R., & Alexander, K. L. (1993). Entry into school: The beginning school transition and educational stratification in the United States. *Annual Review of Sociology, 19*, 401-423.

Evans, G. W., & Rosenbaum, J. (2008). Self-regulation and the income-achievement gap. *Early Childhood Research Quarterly, 23*(4), 504-514.

Hill, J. L., Brooks-Gunn, J., Waldfogel, J. (2003). Sustained effects of high participation in an early intervention for low-birth-weight premature infants. *Developmental Psychology, 39*(4), 730-744.

Howse, R. B., Calkins, S. D., Anastopoulos, A. D., Keane, S. P., & Shelton, T. L. (2003). Regulatory contributors to children's kindergarten achievement. *Early Education and Development, 14*(1), 101-119.

Howse, R. B., Lange, G., Farran, D. C., & Boyles, C. D. (2003). Motivation and self-regulation as predictors of achievement in economically disadvantaged young children. *Journal of Experimental Education, 71*(2), 151-174.

Kegel, A. T., van der Kooy-Hofland, V. A. C., Bus, A. G. (2009). Improving early phoneme skills with a computer program: Differential effects of regulatory skills. *Learning and Individual Differences, 19*(4), 549-554.

Kline, R. B. (2005). *Principles and Practice of Structural Equation Modeling*. New York, NY: The Guilford Press.

Kopp, C. B. (1991). Young children's progression to self-regulation. In M. Bullock (Ed.), *The development of intentional action: Vol. 22. Cognitive, motivational, and interactive processes* (pp. 38-54). Basel, Switzerland: Karger.

Ladd, G. W. (2003). Probing the adaptive significance of children's behavior and relationships in the school context: a child by environment perspective. *Advances In Child Development And Behavior, 31,* 43-104.

Lareau, A. (2003). *Unequal Childhoods: Class, Race and Family Life*. Los Angeles: University of California Press.

Liew, J., McTigue, E., Barrois, L., & Hughes, J. (2008). Adaptive and effortful control and academic self-efficacy beliefs on achievement: A longitudinal study of 1st through 3rd graders. *Early Childhood Research Quarterly, 23*(4), 515-526.

Lipsey, M. W. (1996). *Design sensitivity: Statistical power for experimental research.* Newbury Park, CA: Sage Publications.

Matthews, J. M., Ponitz, C. C., & Morrison, F. J. (2009). Early gender differences in self-regulation and academic achievement. *Journal of Educational Psychology*, 101(3), 689-704.

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*(4), 471-490.

McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology, 43*(4), 947-959.

McClelland, M. M., Cameron, C. E., Wanless, S. B., & Murray, A. (2007). *Executive function, behavioral self-regulation, and social-emotional competence: Links to school readiness.* In O. N. Saracho & B. Spodek (Eds.), Contemporary perspectives on social learning in early childhood education (pp. 83-107). Charlotte, NC: Information Age.

McClelland, M. M., & Morrison, F. J. (2003). The emergence of learning-related social skills in preschool children. *Early Childhood Research Quarterly, 18*(2), 206-224.

McClelland, M. M., Morrison, F. J., & Holmes, D. L. (2000). Children at risk for early academic problems: The role of learning-related social skills. *Early Childhood Research Quarterly, 15*(3), 307-329.

McClelland, M. M., & Piccinin, A., & Stallings, M. C. (2010). *Relations between preschool attention and sociability and later achievement outcomes.* Manuscript in review.

McClelland, M. M**.,** Ponitz, C. C., Messersmith, E. & Tominey, S. (in press). *Self-regulation: The integration of cognition and emotion.* In R. Lerner (Series Ed.) & W. Overton (Vol. Ed.), *Handbook of life-span development.* Hoboken, NJ: Wiley and Sons.

McClelland, M. M., & Wanless, S. B. (2006, July). *Child and parenting influences on early reading and mathematics skills.* In C. Huntsinger (Convener), Parental Contributions to Young Children's Language, Reading, and Mathematics Development. Paper presented at the 19th biennial meeting of the International Society for the Study of Behavioural Development, Melbourne, Australia.

Miller, K. F., Kelly, M., & Zhou, X. (2005). Learning mathematics in China and the United States: Cross-cultural insights into the nature and course of preschool mathematical development. In J. I. D. Campbell (Ed.), *Handbook of mathematical cognition* (pp. 163-177). New York: Psychology Press.

Muñoz-Sandoval, A. F., Woodcock, R. W., McGrew, K. S., & Mather, N. (2005). *The Bateria III Woodcock- Muñoz: Pruebas de aprovechamiento*. Itasca, IL: Riverside Publishing.

NICHD Early Child Care Research Network (2003). Do children's attention processes mediate the link between family predictors and school readiness? *Developmental Psychology, 39*, 581-593.

NICHD Early Childcare Research Network (2002). The relation of global first-grade classroom environment to structural classroom features and teacher and student behaviors. *The Elementary School Journal, 102*, 367-387.

Pears, K. C., Fisher, P. A., & Bronz, K. D. (2007). An intervention to facilitate school readiness in foster children: Preliminary results from the Kids in Transition to School pilot study. *Social Psychology Review, 36*, 665-673.

Phillips, D., McCartney, K., & Sussman, A. (2006). *Child care and early development.* In K. McCartney & D. Phillips (Eds.), Blackwell Handbook of Early Childhood Development. (pp. 471-489). Malden, MA, US: Blackwell Publishing.

Ponitz, C. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly, 23*, 141-158.

Ponitz, C. C., McClelland, M. M., Matthews, J. M., & Morrison, F. J. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. *Developmental Psychology, 45*(3), 605-619.

Raver, C. C. (2002). Emotions matter: Making the case for the role of young children's emotional development for early school readiness. *Social Policy Report, 16*, 3-18.

Rennie, D. A. C., Bull, R., & Diamond, A. (2004). Executive functioning in preschoolers: Reducing the inhibitory demands of the dimensional change card sort task. *Developmental Neuropsychology, 26*, 423-443.

Reynolds, A. J., Temple, J. A., Robertson, D. L., & Mann, E. A. (2001). Long-term effects of an early childhood intervention on educational achievement and

juvenile arrest: A 15-year follow-up of low-income children in public schools. *Journal of the American Medical Association, 285*, 2339-2346.

Rhoads, C. (2009). The implications of "contamination" for experimental design in education. *Paper presented at the Society for Research on Education Effectiveness, Washington, D.C.*

Rothbart, M. K., & Posner, M. I. (2005). Genes and experience in the development of executive attention and effortful control. *New Directions for Child and Adolescent Development, 109*, 101-108.

Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2004). *Attentional control and self-regulation.* In R. F. Baumeister & K. D. Vohs (Eds.), Handbook of self-regulation: Research, theory, and applications (pp. 283-300). New York, NY: Guilford Press.

Schrank, F. A., McGrew, K. S., Ruef, M. L., Alvarado, C. G., Muñoz-Sandoval, A. F., & Woodcock, R. W. (2005). *Overview and technical supplement (Bateria III Woodcock- Muñoz Assessment Service Bulletin No. 1)*. Itasca, IL: Riverside Publishing.

Sektnan, M., McClelland, M. M., Acock, A., & Morrison, F. J. (in press). Relations between early family risk, children's behavioral regulation, and academic achievement. *Early Childhood Research Quarterly*.

Thompson, R. A., & Lagattuta, K. H. (2006). *Feeling and Understanding: Early Emotional Development.* In Blackwell handbook of early childhood development. (pp. 317-337). Malden, MA, US: Blackwell Publishing.

Tominey, S., & McClelland, M. M. (2008). "And when they woke up... they were monkeys!" Using classroom games to promote preschoolers' self-regulation and school readiness, Conference on Human Development. Indianapolis, IN.

Torgerson, D. J. (2001). Contamination in trials: Is cluster randomisation the answer? *British Medical Journal, 322*(7282), 355-357.

U.S. Department of Education. (2008). *No Child Left Behind.* Retrieved July 6, 2008, from http://www.ed.gov/nclb/landing.jhtml

Valiente, C., Lemery-Chalfant, K., & Castro, K. S. (2007). Children's effortful control and academic competence. Mediation through school liking. *Merrill-Palmer Quarterly, 53*(1), 1-25.

Vitaro, F., Brendgen, M., Larose, S., & Trembaly, R. E. (2005). Kindergarten Disruptive Behaviors, Protective Factors, and Educational Achievement by Early Adulthood. *Journal of Educational Psychology, 97*(4), 617-629.

Wanless, S. B., McClelland, M. M., & Tominey, S. (2010). The influence of risk factors on the development of behavioral regulation in prekindergarten and kindergarten. *Manuscript under review.*

Woodcock, R. W., & Mather, N. (2000). *Woodcock Johnson Psycho-Educational Battery-III.* Itasca, IL: Riverside Publishing Company.

Factors Impacting the Effectiveness of a Prekindergarten Behavioral Self-Regulation Intervention

Shauna L. M. Tominey

Megan M. McClelland

Oregon State University, Department of Human Development and Family Sciences.

Funding for this study was supported by Oregon State University.

Abstract

The present study examined quantitative and qualitative factors related to the effectiveness of a pilot self-regulation intervention using classroom games with 65 prekindergarteners. Previous research (Tominey & McClelland, under review) indicated that participation in a behavioral self-regulation intervention was related to gains in these skills for children who started the year with low behavioral self-regulation. Low family income, however, was related to decreased intervention effects. The present paper examined how child and family factors influenced children's initial levels of behavioral self-regulation and the relation between family income and behavior during the intervention. Results of a logistic regression indicated that maternal education significantly predicted behavioral self-regulation at the beginning of the prekindergarten year. Moreover, qualitative analyses indicated that children from low-income families had more difficulty paying attention and exhibited more off-task behaviors during intervention sessions, which may have contributed to the smaller behavioral self-regulation gains they experienced in comparison to their more-advantaged peers. Findings underscore the importance of targeting children from low-income families and those with low levels of maternal education for self-regulation interventions. Implications for future applications of the intervention include increasing the number of intervention sessions and embedding behavioral self-regulation activities into prekindergarten classrooms.

Self-regulation has been identified as a key predictor of academic success (Blair, 2002; Cooper & Farran, 1988; Eisenberg et al., 2004; McClelland, Cameron, Wanless, & Murray, 2007; Valiente, Lemery-Chalfant, & Castro, 2007). Research documents that children are entering kindergarten with varying levels of self-regulation and that children who have trouble with these skills, especially the behavioral aspects of self-regulation, have difficulties succeeding in academic environments (Howse, Lange, Farran, & Boyles, 2003; McClelland, Morrison, & Holmes, 2000). Moreover, early academic skills are often cumulative and children who enter school with poor behavioral self-regulation risk facing achievement gaps that can persist throughout schooling (Entwisle & Alexander, 1993). Less is known about how to improve children's self-regulation prior to school entry, although a number of interventions have emerged in recent years (Diamond, Barnett, Thomas, & Munro, 2007; Domitrovich, Cortes, & Greenberg, 2007; Pears, Fisher, & Bronz, 2007). Several intervention studies have included behavioral self-regulation as part of broader interventions that included academic intervention, however, few studies have examined specific aspects of behavioral self-regulation as a means of improving school readiness and academic success.

The present study focused on a classroom-based pilot intervention designed to help children practice behavioral aspects of self-regulation, which have been shown to predict academic outcomes (Matthews, Ponitz, & Morrison, 2009; McClelland, Cameron, Connor et al., 2007; Ponitz, McClelland, Matthews, & Morrison, 2009). We examined quantitative and qualitative factors related to intervention effectiveness.

Defining Behavioral Self-Regulation

Behavioral self-regulation, which is defined as the integration of attention, working memory, and inhibitory control into behavior (McClelland, Cameron, Wanless et al., 2007; Ponitz et al., 2008), has been identified as an important predictor of school success. These behavioral components of self-regulation are essential for planning and executing goal-directed activities (Blair, 2002). Within the classroom, attention skills help children filter important information from distractions and switch focus from one task to another (Rothbart & Posner, 2005; Rueda, Posner, & Rothbart, 2005). Working memory refers to the ability to remember information and is essential for following instructions and completing multi-step tasks (Adams, Bourke, & Willis, 1999). Inhibitory control refers to a child's ability to stop a dominant response (e.g., running outside when the bell rings) in order to demonstrate a more adaptive behavior (e.g., putting away toys first) (McClelland, Cameron, Wanless et al., 2007; Rennie, Bull, & Diamond, 2004). Together, these skills are important for success in classroom settings (Baumeister & Vohs, 2004; McClelland, Cameron, Connor et al., 2007; McClelland, Cameron, Wanless et al., 2007). The classroom games used in this study were designed to help children practice the integration of attention, working memory, and inhibitory control.

Importance of Behavioral Self-Regulation for Academic Achievement

Behavioral self-regulation has been shown to predict both short- and long-term academic outcomes. Numerous studies have found that behavioral self-regulation predicts academic achievement in preschool (Blair & Razza, 2007; McClelland, Cameron, Connor et al., 2007) and elementary school (Liew, McTigue, Barrois, & Hughes, 2008; McClelland, Acock, & Morrison, 2006; McClelland et al., 2000; Valiente et al., 2007).

Specifically, studies suggest that children with poor behavioral self-regulation have difficulty succeeding in structured classroom settings (Alexander, Entwisle, & Dauber, 1993; Ladd, 2003). For example, in one study, teacher-rated behavioral self-regulation at school entry predicted children's work habits in the spring of their kindergarten year (Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). Another study found that kindergarten learning-related skills (including behavioral self-regulation) predicted children's literacy and math skills between kindergarten and sixth grade (McClelland et al., 2006; McClelland et al., 2000). Components of behavioral self-regulation, including attention, have also been found to predict high school and college completion (McClelland, Piccinin, & Stallings, 2009; Vitaro, Brendgen, & Larose, 2005).

Improving Children's Behavioral Self-Regulation Through Intervention in Preschool

In recent years, there has been an increasing emphasis on improving children's self-regulatory skills, including behavioral self-regulation, in preschool. An estimated 83.2% of children attend early care or education programs (Denton Flanagan & McPhee, 2009), making it likely that interventions in these settings would reach a majority of children prior to kindergarten entry. Preschool has also been identified as an important period of behavioral self-regulation development because for most children, it is the first classroom environment in which they are asked to demonstrate these skills (Phillips, McCartney, & Sussman, 2006). Additionally, it is during this developmental period that a number of changes occur related to the development of behavioral self-regulation, including brain maturation in the pre-frontal cortex (Blair, 2002). Taken together, these factors make preschool an ideal time to introduce interventions aimed at improving children's behavioral self-regulation.

Several preschool interventions have emerged focusing on self-regulation, social competence, and improving early academic skills. One example of a broad-based program is Tools of the Mind (Bodrova & Leong, 2009; Diamond et al., 2007), which embeds self-regulatory activities into preschool learning activities. In randomized studies, children in classrooms using Tools of the Mind have shown significant improvement on computer-based executive function tasks (Diamond et al., 2007) and higher levels of teacher-reported self-regulatory skills compared to children in control classrooms (Barnett et al., 2008). A second study, the Kids in Transition to School Program, examined the impact of playgroups for preschoolers in foster care focusing on a wide-range of socio-emotional and literacy skills, including self-regulation (Pears et al., 2007). Children participating in the playgroups exhibited higher levels of social competence and self-regulation than children in the control group (Pears et al., 2007). Although each of these interventions included aspects of self-regulation, these studies did not examine the effect of improving specific aspects of self-regulation.

Pilot Behavioral Self-Regulation Intervention

We recently developed and implemented a pilot intervention to improve children's behavioral self-regulation (Tominey & McClelland, under review). The intervention used classroom games that were variations on popular children's games, requiring limited teacher training for implementation. The games required very few materials (e.g., construction paper, children's music CDs, classroom musical instruments), all of which are commonly found in preschool classrooms. Each game included music and movement components to promote engagement. Although little research has examined the relation between music and movement and engagement, one

study found that music and movement activities, such as dance, are effective at improving preschooler's social competence (Lobo & Winsler, 2006). Additionally, classroom teachers in our study reported that the use of music and movement in their classrooms often resulted in high involvement.

A randomized trial indicated that intervention participation (both intervention group assignment and number of sessions attended) predicted significant gains in behavioral self-regulation over the prekindergarten year for children who began the year with low levels of these skills (Tominey & McClelland, under review). Low family income (measured by enrollment in the Head Start program), however, significantly predicted smaller gains in behavioral self-regulation, which resulted in reduced intervention effects for children from low-income families.

Although our results supported the effects of the intervention, they left several unanswered questions regarding intervention effectiveness. The first question was: *What factors predicted that children would begin the year with low behavioral self-regulation and thus be in the group most likely to benefit from intervention participation?* The second question was: *For children in the low initial behavioral self-regulation group, why did children from low-income families experience smaller intervention effects than their more-advantaged peers?* It was these two questions that were the focus of the present study.

Factors Influencing the Development of Behavioral Self-Regulation

Numerous child and family factors have been found to predict the development of behavioral self-regulation. In the present study, we examined age, gender, family income, and maternal education as predictors of behavioral self-regulation group (low or high) at

the beginning of the prekindergarten year. Children in the low behavioral self-regulation group demonstrated significant gains in behavioral self-regulation from intervention participation so identifying which of these factors predicted membership in the low group could help target children most likely to benefit from intervention in future studies.

Age. Numerous studies have identified children's age as a significant predictor of behavioral self-regulation (Morrison, Ponitz, & McClelland, 2010; Ponitz, et al., 2009) where older children have stronger behavioral self-regulation then younger children. Research suggests that the relation between age and the development of behavioral self-regulation is in large part because of brain maturation in the prefrontal cortex (Blair, 2002). Preschool is an important period of growth for brain regions associated with self-regulation so we expected that younger children would begin the year with lower behavioral self-regulation than their older peers.

Gender. Previous studies have found relations between gender and behavioral self-regulation. Specifically, boys often demonstrate more difficulty with self-regulatory skills than girls. Studies of preschool children have found that girls score higher than boys on teacher-rated behavioral self-regulation (Ponitz et al., 2009) as well as on direct measures of these skills (Matthews et al., 2009). In the present study, we examined child's gender, and specifically if being male was a significant predictor of low behavioral self-regulation at the beginning of the prekindergarten year.

Family Income. Family income has been identified as a significant predictor of school readiness skills, including behavioral self-regulation (Howse et al., 2003; Dearing, et al., 2006; Evans 2004; Sektnan, McClelland, Acock, & Morrison, in press; Evans & Rosenbaum, 2008; Wanless, McClelland, Tominey, & Acock, under review).

Specifically, research suggests that children from low-income families have poorer self-regulatory behaviors than their more-advantaged peers (Evans & Rosenbaum, 2008; Howse et al., 2003). In addition to fewer financial and academic resources, children from low-income families are less likely than their more-advantaged peers to experience parenting processes (e.g., autonomy-granting) and parenting styles (authoritative parenting) that promote the development of behavioral self-regulation (Dearing, et al., 2006; Bernier, Carlson, & Whipple 2010). In the present study, we expected to find a higher proportion of children from low-income families beginning the year in the low behavioral self-regulation group than in the high behavioral self-regulation group.

Maternal Education. Studies have found that maternal education significantly predicts the development of self-regulation in early childhood (Bernier et al., 2010). Research suggests that low levels of maternal education are associated with poor behavioral self-regulation. Additionally, research has found links between maternal education and parenting style and sensitivity (Tamis-LeMonda, Briggs, McClowry, & Snow, 2009), which have been linked to the development of self-regulation (Bernier et al., 2010). Although closely related to family income, we expected that we might more easily detect relations between maternal education (a continuous variable) and children's behavioral self- regulation than between family income (a dichotomous variable) and behavioral self-regulation. Thus, in addition to family income, we examined maternal education as a predictor of behavioral self-regulation at the beginning of the prekindergarten year.

Family Income and Intervention Effectiveness

In addition to examining factors predicting behavioral self-regulation levels at the beginning of the prekindergarten year, we examined qualitative data from intervention sessions to help explain the varying intervention effects experienced by children enrolled in Head Start and those not enrolled. Studies have found that family income predicts behavioral self-regulation (Sektnan et al., in press; Wanless et al., under review). Specifically, research suggests that children from low-income families have greater difficulty than their more-advantaged peers with self-regulatory skills, including paying attention and regulating their behavior (Evans & Rosenbaum, 2008; Howse et al., 2003). Although research has demonstrated significant relations between family income and the development of behavioral self-regulation (Howse et al., 2003), few studies have examined the relation between intervention-related behavioral self-regulation gains and family income. Identifying ways to improve behavioral self-regulation through intervention may be especially important for children from low-income families because research suggests that children's behavioral self-regulation skills mediate the relation between risk factors (e.g., low family income, low maternal education) and academic outcomes (Buckner, Mezzacappa, & Beardslee,, 2009; Dearing, McCartney, & Taylor, 2009; Sektnan et al., in press).

The Present Study

The present study focused on identifying factors related to the effectiveness of a behavioral self-regulation intervention with prekindergarteners. The study had two primary goals. First, we examined quantitative child and family factors (i.e., child age, gender, family income, and maternal education) predicting behavioral self-regulation at the beginning of the prekindergarten year. Previous research has documented that

children who start the year with low initial self-regulation (e.g., below the 50th percentile on a direct measure) show significant gains in these skills from intervention participation (Tominey & McClelland, under review). Understanding factors that predicted these initial low levels of behavioral self-regulation may help identify children who will benefit from intervention. We hypothesized that the group of children who began the year with low behavioral self-regulation would include younger children, a higher number of males and children from low-income families, and that children in this group would have lower levels of maternal education than children in the high group based on research documenting the relation between these variables and the development of behavioral self-regulation (Howse et al., 2003; Matthews et al., 2009; Wanless et al., under review).

Second, within the low group, in order to better understand the effects of family income on intervention effectiveness, we analyzed qualitative fieldnotes from the intervention playgroups and coded for patterns of behavior, comparing children based on Head Start enrollment status. We hypothesized that patterns of behavior would emerge from the observational fieldnotes that might explain the smaller gains in behavioral self-regulation made by children from low-income families.

Method

Participants

Participants were 65 prekindergarten children who participated in a pilot behavioral self-regulation intervention (Tominey & McClelland, under review). Twenty-eight of the children were randomly assigned to the treatment group and 37 were randomly assigned to the control group. The average age of child at the beginning of the study was 54.5 months (*SD* = 3.6). Twenty-eight of the children (43%) came from low-

income families, as measured by enrollment in the Head Start program. Thirty-nine of the children were female and 26 were male.

The majority of children in the study attended preschool in classrooms located in a university child development center and laboratory school (n = 53). Placement in the center is available to children paying tuition and available at no cost to children enrolled in the Head Start program. Approximately half of the children in each classroom were enrolled in Head Start. A small number of children participating in the study (n = 12) were attending a program at a second child development center. Children in the study were divided among eight classrooms. Information on classroom activities was obtained from classroom teachers. Teachers reported that they were familiar with games similar to those used in the intervention, but that they rarely implemented these games in their classrooms.

Participants included in the second research question were a subgroup of 31 children from the original sample of 65 with low behavioral self-regulation in the fall of the prekindergarten year. At the beginning of the prekindergarten year, these children scored below the 50th percentile on a direct measure of behavioral self-regulation (fewer than six points out of a possible 40). Nineteen of the children were in the control group and 12 participated in the treatment group. Seventeen of the children (55%) were from low-income families. The average age of child at the beginning of the study was 54.6 months (range: 44-61 months). Seventeen of the children were female and 14 were male.

Attrition

Initially, 74 children enrolled in the study. Over the course of the year, the total attrition was nine children: four children moved, one left school early for a family

vacation, three declined to participate in the post-test, and one was withdrawn from the study by his parents because of newly-diagnosed developmental delays. The nine children who did not complete the study did not significantly differ from the overall sample on any of the measured background variables. The final sample consisted of 65 children; 31 of whom scored below the 50th percentile on the HTKS at the beginning of the prekindergarten year.

Measures

Parent Demographic Questionnaire

In the fall of the prekindergarten year, parents completed a background questionnaire in their native language (English or Spanish) containing questions about children's age, gender, Head Start enrollment, and maternal education. Information on children's age, gender, and Head Start enrollment was also obtained and verified through the child development centers. Parent demographic questionnaires were completed and returned by 55 of the families in the study, reducing the sample size for analyses including maternal education. All of the questionnaires that were not returned (n = 10) were from low-income families and eight out of 10 of the unreturned questionnaires were also from parents of children in the low initial behavioral self-regulation group. The average maternal education for low-income families with children in the low initial behavioral self-regulation group was 11.8 years (SD = 2.3, range = 6–14 years).

Head-Toes-Knees-Shoulders Task

In the fall and spring of the prekindergarten year, the Head-Toes-Knees-Shoulders Task (HTKS) was used to assess children's behavioral self-regulation (Ponitz et al., 2009). The HTKS is a direct measure of behavioral self-regulation that assesses the integration of

attention, working memory, and inhibitory control (McClelland, Ponitz, Messersmith, & Tominey, in press; Ponitz et al., 2009). In this task, children are asked to touch their head or toes (or knees or shoulders), and then to do the opposite of what the experimenter says. The task has two parts: Part I includes two paired commands (head/toes or knees/shoulders) and Part II includes four paired commands (head/toes and knees/shoulders). Each item has a possible score of 0, 1, or 2: 0 denotes an incorrect response, 1 is considered a self-correct (child moves toward the incorrect response, but stops and gives the correct response), and 2 points denotes a correct response without a movement toward the incorrect response. The assessment includes 20 test items, resulting in scores that range from 0 to 40 with higher scores indicating higher levels of behavioral self-regulation. Recent studies suggest that the HTKS is a reliable and valid measure of children's behavioral self-regulation in diverse populations (McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2008; Ponitz et al., 2009). Additionally, studies have found significant relations between parent-rated inhibitory control and attention and children's scores on the HTKS, as well as between teacher ratings of children's behavioral self-regulation in the classroom and scores on the HTKS (McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2009). In the present study, interrater reliability on the HTKS was calculated at kappa = .92.

Observational Data

At the end of each playgroup session, the playgroup leader (the first author) recorded hand-written narratives detailing the activities used in the session as well as notes on each individual child from the time the playgroup session began to the time the child returned to their classroom (Emerson, Fretz, & Shaw, 1995). The notes were a narrative of the playgroup sessions and included individualized descriptions of each child

and their behavior. At the end of each day, the playgroup leader transcribed the hand-written notes into a word processing program. Each day of playgroup sessions generated approximately three pages of single-spaced typed notes, resulting in a total of 50 typed pages of fieldnotes.

Procedure

In the fall of the prekindergarten year (September), invitations to participate were mailed to parents of all four-year-olds in the participating preschools and consent forms were collected from seventy-four families. The study was divided into three phases: pretest, intervention, and posttest.

Pretest. The first phase took place in the fall (November – December). During this time period, children's behavioral self-regulation was assessed using the HTKS over four weeks.

Intervention. The second phase took place over winter term (January-March). During this phase, half of the children in each classroom were randomly assigned to participate in the intervention group. Random assignment at the individual level within classrooms was chosen because of the high variability in number of children from each classroom participating in the study (1-13 children). Additionally, the intraclass correlation on the HTKS for classroom was .06, indicating limited classroom explained variability in behavioral self-regulation and supporting our decision to randomize individually within classrooms. Children at both sites were frequently taken out of the classroom to participate in individual and small group activities so children were both accustomed to leaving the classroom and to seeing others leave the classroom throughout the school day. Although there were concerns regarding potential contamination effects, teachers reported that there

was no evidence of children in the treatment group sharing intervention activities with children assigned to the control group. In addition, studies have found that when contamination effects occur because of changes in students' behavior, children assigned to the control group are more likely to act like children in the treatment group, making detection of intervention effects more difficult. These contamination effects, however, are often found to be negligible (Rhoads, 2009; Torgerson, 2001).

Posttest. The third phase took place in the spring of the pre-kindergarten year (April-May). Children's behavioral self-regulation was re-assessed using the HTKS. During this phase, research assistants were blind to intervention participation; those who assisted with the intervention phase of the study did not test children from classrooms in which they had previously assisted to prevent researcher bias.

Intervention Games

Children randomly assigned to the treatment group participated in a total of sixteen playgroups over eight weeks. The playgroups were held twice weekly and each session was approximately 30 minutes. Previous research has found significant improvement in children's self-regulation and social competence in interventions of similar durations (Pears et al., 2007). The playgroup sessions were held on the same days and times each week as part of the regular preschool day. Times were chosen that best accommodated the needs of classroom teachers and did not interfere with scheduled classroom activities. Each playgroup session had 5-8 children and 2 assistant teachers. The assistant teachers were trained undergraduate student researchers at Oregon State University who were in early childhood or related fields. The same researcher (the first author) led all of the playgroup sessions to ensure fidelity.

The games used in the study were developed by the playgroup leader, who had previously worked as an early childhood education teacher (Tominey & McClelland, 2008). All of the games included music and/or movement components to facilitate engagement and had been previously piloted in classrooms of children with varying ages and developmental needs. The games chosen for use in the study had shown high levels of engagement among children with demonstrated difficulty engaging in classroom activities. Out of the sixteen sessions, children in the intervention group attended 5-16 sessions, with an average attendance of 11.3 sessions. The most common reason for a child to miss a session was an absence because of illness or vacation.

Playgroup sessions were modeled after classroom circle times. Each session began with children sitting on mats and participating in a greeting song intended to help children transition to the playgroup setting. The playgroup leader then introduced the playgroup activity. Following the activity, children returned to their mats to sing a good-bye song and then returned to their classrooms. A total of six activities were presented over the 16 sessions. The activities were designed to help children develop and practice integrating attention, working memory, and inhibitory control, using easy-to-implement classroom games (Tominey & McClelland, under review). The games helped children practice attention and working memory by requiring them to remember and follow through with continually changing multi-step instructions. Children practiced inhibitory control by starting and stopping to different cues (oral and visual), performing specific behaviors in response to cues, and performing opposite behaviors.

For example, in one game, children danced when music played and froze when the teacher stopped the music. Children changed their body movements based on the speed of

the songs (dancing slowly to slow songs and quickly to fast songs). Children were also asked to respond to opposite cues: dancing quickly to slow songs and slowly to fast songs. In another game, which was a variation of the popular children's game *Red Light, Green Light*, a teacher acted as a "stop light" by standing at the opposite end of the room from the children and holding up different colored construction paper circles to represent stop and go. Children responded to specific color cues (e.g., purple is "stop" and orange is "go") and then to opposite cues (e.g., purple is "go" and orange is "stop") as well as to different shapes representing stop and go (e.g., any color circle is "go" and any color square is "stop"). Children were also given the opportunity to lead activities, such as by acting as the "stop light" in the *Red Light, Purple Light* game.

Results

Analytic Plan

First, we examined quantitative descriptive statistics for children based on fall behavioral self-regulation scores (low or high initial behavioral self-regulation group). To answer the first research question, logistic regression analyses were used to determine if child age, gender, Head Start enrollment, and maternal education significantly predicted whether children were in the low or high behavioral self-regulation group in the fall of the prekindergarten year. To answer the second research question, descriptive statistics were examined for children in the low initial behavioral self-regulation group, dividing children by family income and intervention group assignment. Qualitative fieldnotes from the intervention sessions were then read and coded deductively and inductively for patterns of behavior. Specifically, we examined and coded fieldnotes for the twelve children assigned to the treatment group who had low behavioral self-regulation at the

beginning of the prekindergarten year. First, we coded notes for children individually, specifically looking deductively for evidence of attention level and on- versus off-task behaviors. Then, we divided children into groups of family income level (enrollment in Head Start) and looked deductively and inductively for patterns of behaviors within and across these two groups.

Although researchers were not blind to children's Head Start enrollment status, several steps were taken to reduce the likelihood of bias in the recording and coding of fieldnotes. First, a playgroup assistant read through the fieldnotes written by the playgroup leader (the first author) after each session to verify accuracy. Second, the first author read and coded fieldnotes for each child individually before comparisons were made within and across family income groups.

Research Question #1: What factors predicted that children would begin the year with low behavioral self-regulation and thus be in the group most likely to benefit from intervention participation?

There were a total of 31 children in the low initial behavioral self-regulation group (scoring fewer than six points out of a possible 40 on the HTKS) and 34 children in the high group. Descriptive statistics revealed that the average age of children in the low and high initial groups was nearly identical (low group: M = 54.6 months, SD = 4; high group: M = 54.5 months, SD = 3.2). There was a slight (although nonsignificant) difference in gender across the two groups of children with 45% of the low-group being male (n = 14) and 35% of the high group being male (n = 12). Mothers of children in the low group had significantly lower levels of education (M = 14.1 years, SD = 3.4 years) compared to mothers of children in the high group (M = 16.4 years, SD = 3.3 years), t(53)

= -2.56, $p < .05$. Forty percent of mothers with children in the low-group had a high school education or lower, whereas only 18% of mothers with children in the high-group had a high school education or lower. In addition, the proportion of children in low-income families was higher in the low group (55%; $n = 17$) than in the high group (32%; $n = 11$); although this was a trend and did not reach statistical significance ($z = 1.83$, $p = .07$). Maternal education level and low family income were significantly correlated ($r = -.65$, $p < .001$). Because of the high correlation between maternal education level and family income, separate logistic regression analyses were run to determine the effects of each independently on children's initial levels of behavioral self-regulation.

Results of the first logistic regression (see Table 2.1) indicated a trend for family income to significantly predict membership in the high or low initial self-regulation groups ($N = 65$; $z = -1.70$, $p = .08$). Specifically, having low family income increased the odds of children being in the low behavioral self-regulation group by 59%. The second logistic regression indicated that maternal education significantly predicted low versus high group membership ($z = 2.10$, $p < .05$). For every additional year of maternal education, the odds that a child would be in the high behavioral self-regulation group increased by 22%. Child gender was not a significant predictor of low/high group membership in either analysis (ps > .05). Although both logistic regression analyses initially included child age (in months), because of the low variability in children's ages across the groups and the lack of significance ($z = -.29$, $p > .05$ and $z = .23$, $p > .05$, respectively) this variable was removed from the final models.

Research Question #2: For children in the low initial behavioral self-regulation group, how did family income group influence intervention effectiveness?

Descriptive statistics. Descriptive statistics revealed varying patterns of intervention effectiveness when dividing children by intervention group (treatment or control) and family income (Head Start versus non-Head Start) within the low initial behavioral self-regulation group (see Figure 2.1). Specifically, children who were not enrolled in Head Start in the treatment group (n = 6) showed the greatest behavioral self-regulation gains (M = 29.2 points, SD = 4.45), followed by non-Head Start children in the control group (n = 8, M = 20.9 points, SD = 14). Children in Head Start in the treatment group gained an average of 13.5 points (SD = 14.3), and children in Head Start in the control group gained an average of 7.5 points (SD = 8.7). Although children in the treatment group scored higher than children in the control group overall, children not enrolled in Head Start exhibited greater gains in behavioral self-regulation scores than children in Head Start regardless of intervention group.

Additional descriptive statistics for children with low initial behavioral self-regulation, dividing children by family income and intervention group, are presented in Table 2.2. Although group sizes were too small to permit statistical analyses of differences, the descriptive statistics revealed several patterns. The most notable difference is in the HTKS gains over the prekindergarten year across the four groups. Children not enrolled in Head Start in the treatment group demonstrated the greatest gains in behavioral self-regulation over the prekindergarten year, and also demonstrated the least variability in scores (SD = 4.1). The standard deviation of children's behavioral self-regulation in each of the other three groups was double or triple that of the children in this group. Another difference in descriptive statistics is that children in Head Start in

both the treatment and control group had lower average maternal education and higher numbers of school absences than their more-advantaged peers.

Observational analysis. To better understand the varying patterns of intervention effects exhibited by children enrolled in Head Start and those not enrolled, we next examined qualitative fieldnotes from the intervention sessions. Specifically, we focused on qualitative notes of the twelve children with low initial behavioral self-regulation who participated in the treatment group. Six of the children were enrolled in Head Start and six were not. It should be noted that both children enrolled in Head Start and those who were not were integrated in the same classrooms and participated in playgroup sessions together.

From a combination of deductive and inductive coding, several distinct patterns were found in the playgroup session fieldnotes. All of the children participating in the playgroups quickly incorporated the sessions into their weekly routine. By the second playgroup session, most children automatically put down their classroom activities and met the playgroup leaders at the door. Children bonded very quickly with playgroup teachers and demonstrated this by learning their names and showing physical affection (e.g., hugging, holding hands). Teachers and parents of children in the treatment group frequently commented to playgroup teachers on how much children looked forward to the playgroup sessions. Children were actively engaged in the intervention games throughout the playgroup sessions. It was rare for children to decline to participate in any of the games during the sessions though occasionally, children with inhibited or shy personalities would sit and watch for a short period of time before joining in the activities. In addition, there were clear patterns in the level of attention and on- versus

off-task behaviors demonstrated by children during playgroup sessions (described below). Off-task behaviors unrelated to the activities most often occurred during transition periods, such as when children were walking from their classroom to the playgroup room, in between the greeting song and the activity, or while instructions for the games were being explained.

Children enrolled in Head Start. Analyses from our inductive coding revealed that many of the children enrolled in Head Start participating in the treatment group showed a propensity to be easily distracted. It was very common for children to make comments or ask questions unrelated to the playgroup activities. When called upon for suggestions, it was common for children to raise their hands or shout out comments, such as, "Tomorrow is Saturday and we don't come to school," and "What's in those [drawers]?" Additionally, fieldnotes documented that all of the children within this group initiated off-task behaviors on one or more occasion. Examples of off-task behaviors included climbing and standing on chairs at the edge of the room, stacking carpet squares, and crawling under tables. If one child exhibited an off-task behavior, other children in this group often imitated the behavior. Reminders from teachers to return to on-task behaviors were sometimes ignored, sometimes questioned, and sometimes followed. The level of focus demonstrated from session to session was highly inconsistent and varied across children.

From our deductive coding, we found that in the group of children enrolled in Head Start, it was common for children to focus on elements of the games that were peer-related rather than on the rules emphasized by the playgroup leader. For example, numerous children focused on the competitive aspects of the games, rather than accuracy

in following rules; behavior that was rarely demonstrated by their more-advantaged peers. During the *Red Light, Purple Light* game, several children would stop when the stop cue was displayed, but run as fast as they could to "win" when the go cue was displayed rather than performing the specific action that had been instructed (e.g., hop, crawl). Praise from teachers for correctly following instructions did not appear to be as important to children in this group as attention from their peers. These same children were often most interested in making the loudest animal noises during the *Sleeping Game* or when playing instruments during the *Conductor Game*. Additionally, these children needed frequent reminders from playgroup teachers to remember specific cues and start and stop accordingly.

Children not enrolled in Head Start. Children in this group demonstrated a high level of attention and focus that remained consistent from one session to another. The majority of children consistently exhibited on-task behaviors, followed directions, and actively participated in the playgroup games. During the sessions, there were very few instances of off-task behavior demonstrated by children in this group. Occasionally children would imitate off-task behavior of other children, however, they would return to on-task behavior as soon as they were reminded by playgroup teachers to do so. Within this group, only one child initiated off-task behaviors. This child routinely tested the limits of appropriate behavior. For example, during movement activities, he would move to the edge of the designated activity area and wait for teachers to call him back to the central area. When acting out animals during the *Sleeping Game*, he would use aggressive movements and increasingly loud noises, but his behavior quickly de-escalated when asked. Although most children in this group did not initiate off-task

behavior, several of the children did imitate other children's off-task behaviors. Playgroup teachers noted that when asked, however, children in this group immediately stopped off-task behaviors. In general, children not enrolled in Head Start were highly focused on demonstrating accuracy and receiving teacher praise for remembering and following instructions. They often watched for playgroup teacher reactions to their actions.

Discussion

In the present study, we investigated quantitative and qualitative factors related to the effectiveness of a pilot self-regulation intervention. Specifically, we examined quantitative child and family factors (i.e., child age, gender, family income, and maternal education) that predicted low behavioral self-regulation at the beginning of the prekindergarten year, because children in this group showed significant gains in these skills from intervention participation. We also used qualitative fieldnotes from intervention sessions to examine differences in behavior that could explain the varying intervention effects observed between children enrolled in Head Start and children not enrolled in Head Start.

Factors Predicting Low and High Initial Behavioral Self-Regulation Scores

Results indicated that maternal education level was a significant predictor of children's behavioral self-regulation at the beginning of the prekindergarten year. Specifically, lower levels of maternal education significantly increased the odds of children beginning the year with low behavioral self-regulation. There was also a trend for low family income to predict that children would begin the year with low behavioral self-regulation and a higher proportion of children in the low group were from low-

income families than children in the high group. Although maternal education and family income were significantly correlated (r = .66), the greater variability in the maternal education variable (continuous) in comparison to the family income variable (dichotomous) may have made it easier to detect a statistically significant relation with low-group membership. The significant correlation between these two variables (and the significant relation between maternal education and behavioral self-regulation) supports previous research documenting the relation between socioeconomic status (including parent education level and family income) and children's behavioral self-regulation (Evans & Rosenbaum, 2008; Howse et al., 2003; Wanless et al., under review).

Previous studies have also found that maternal education is an important predictor of behavioral self-regulation and specifically that low levels of maternal education are related to poor behavioral self-regulation (Sektnan et al., in press). Studies have linked maternal education to family processes predicting behavioral self-regulation, including parenting style and home environment quality (Magnuson, 2007). Specifically, research has found that mothers with lower levels of education are more likely than mothers with higher levels of education to use an authoritarian parenting style, exhibit negativity in their interactions with children, and provide less stimulating home-learning environments, all of which have been linked to poor behavioral self-regulation (McClelland, Cameron, Wanless et al., 2007; Raikes, Robinson, Bradley, Raikes, & Ayoub, 2007). Additionally, parental support of children's autonomy (which is positively related to maternal education) has been found to predict children's behavioral regulation (Bernier et al., 2010). Taken together, these studies suggest that children who have mothers with low levels of education may not experience many of the family processes at

home that promote the development of behavioral self-regulation during this important period and therefore are more likely to enter preschool with low levels of these skills. These results highlight the importance of targeting children with low maternal education for intervention, as these are the children who may be most likely to have difficulties with behavioral self-regulation at prekindergarten entry.

Although research suggests that age is an important predictor of behavioral self-regulation development (Morrison et al., 2010; Ponitz et al., 2009), in our study, age did not significantly predict behavioral self-regulation scores at the beginning of the prekindergarten year. The lack of a significant relation between age and behavioral self-regulation was likely because of the small variability in the ages of children participating in the study. Also, contrary to research documenting gender differences in behavioral self-regulation development (Matthews et al., 2009), in our sample, gender was not a significant predictor of initial behavioral self-regulation group (low or high). There was a higher percentage of boys in the low group than in the high group, although this difference was not statistically significant.

Family Income and Intervention Effectiveness for Children with Low Initial Behavioral Self-Regulation

Deductive and inductive analyses of the observational fieldnotes revealed distinct patterns of behavior when comparing children in groups divided by Head Start enrollment status. Most notably, from our deductive coding, there were differences in attention level and the frequency of on-task and off-task behavior exhibited by children enrolled in Head Start in comparison to their more-advantaged peers. Children enrolled in Head Start demonstrated high variability in both attention and off-task behaviors and

many of the children in this group were easily distracted. These findings support previous research documenting attention difficulties experienced by children in low-income families (Howse et al., 2003) and may explain why children in Head Start exhibited smaller behavioral self-regulation gains from intervention participation than their peers. In contrast, during intervention sessions, children who were not enrolled in Head Start showed consistent patterns of attention, rarely initiated off-task behaviors and promptly returned to on-task behaviors when asked. Children from higher-income families are likely have exposure to opportunities within the home that promote the development of these skills (Dearing, Berry, & Zaslow, 2006; Lareau, 2003), and this likely contributed to their greater ability to benefit from the intervention games.

A finding that emerged from inductive analyses of the observational fieldnotes was that praise from teachers helped to reinforce positive behaviors during intervention sessions (e.g., staying on task) for children not enrolled in Head Start, but not for many of the children enrolled in Head Start. Studies of elementary school children have documented differences in parent-child interactions and the types of activities promoted by parents of varying levels of social class (Lareau & Weininger, 2008). Specifically, parents from higher social class backgrounds (measured by income and education level) tend to spend more time in direct interactions with children and provide more opportunities for participation in structured adult-led activities, whereas children in families from lower social class backgrounds spend more unstructured time with peers (Lareau & Weininger, 2008; Lareau, 2003). These trends may help explain why children enrolled in Head Start were more likely than their peers to focus their attention on aspects of the games revolving around other children (e.g., competition, making the loudest

sounds); behavior which may have hindered their ability to effectively participate in and benefit from intervention activities. Focusing on aspects of the games revolving around teachers (e.g., listening to and following directions, seeking praise and approval) likely gave children not enrolled in Head Start an advantage over their peers in their abilities to benefit from intervention participation.

Limitations

Although the present study has important implications for future applications of this and similar behavioral self-regulation interventions, there were a number of limitations. The primary limitation was the small sample size. In the present study, although there was a higher proportion of boys in the group of children with low initial behavioral self-regulation than in the high group, this difference was not statistically significant. Previous research has found gender to be a significant predictor of behavioral self-regulation in preschool (Matthews et al., 2009; Ponitz et al., 2009) and it was likely that the small sample size limited our ability to detect a significant effect of gender on behavioral self-regulation. Increasing the sample size in future applications of the intervention may reveal a significant effect of gender on initial behavioral self-regulation skills and support previous research suggesting that boys are more likely than girls to have difficulties with these skills.

Additionally, the final sample size of 65 children limited our ability to perform statistical analyses on subgroups of children, such as by dividing children by family income and intervention group assignment within the group who began the year with low behavioral self-regulation. Qualitative fieldnotes provided additional information on patterns of behavior within the treatment group, however, the groups examined were

small, limiting the generalizability of findings. Future studies should implement the intervention on a larger scale, specifically targeting children who begin the prekindergarten year with low behavioral self-regulation skills. Implementation of the intervention on a larger scale would allow for further quantitative and qualitative analyses of intervention effects and improve generalizability.

A second limitation of the study was that parent questionnaires were only returned by 55 participants, which reduced our sample size for analyses including maternal education. Non-response bias appeared to be a factor as all of the unreturned questionnaires were from families that the child development centers identified as low-income. Additionally, the majority of the unreturned questionnaires (80%) were from families with children in the low initial behavioral self-regulation group making it more likely that these families may have had low maternal education. Future studies should attempt to improve questionnaire response rates among parents, especially within this demographic.

A third limitation was that the only variables collected relating to family factors were family income (measured by enrollment in Head Start) and maternal education. The results of the study found relations between intervention effectiveness and maternal education, specifically that low maternal education predicted low behavioral self-regulation at the beginning of the year. Also, trajectories of behavioral self-regulation over the year showed patterns of intervention-related gains based on family income. Although maternal education and family income relate to numerous family factors and processes that predict the development of behavioral self-regulation (e.g., home-learning environment, parenting style), we did not have information on these variables and

therefore could only speculate about other related mechanisms predicting intervention effectiveness.

Finally, although observational fieldnotes were written and coded as objectively as possible, researchers were not blind to children's Head Start enrollment status. This knowledge may have increased the likelihood of bias being present in the recording and coding of fieldnotes. Although bias can never entirely be eliminated, several steps were taken to reduce bias (Emerson et al., 1995), including having playgroup assistants read fieldnotes to verify accuracy and coding fieldnotes for children individually before making comparisons within and across family income groups.

Practical Implications and Conclusions

The findings from this study have important implications for future applications of a behavioral self-regulation intervention. First, future applications of this or similar behavioral self-regulation interventions should target children with low maternal education, as it is these children who may be most likely to enter preschool with poor behavioral self-regulation. Additionally, the high correlation between maternal education and family income indicates that children with low maternal education are also likely to be from low-income families and thus experience multiple risk factors, making them an important population to target for behavioral self-regulation intervention. Not only are these children likely to begin the year with poor behavioral self-regulation, but they are also more likely than their peers to exhibit significant gains from intervention participation.

Second, although children from low-income families in the treatment group showed significant gains from intervention participation, the smaller intervention effects they experienced compared to their peers may signal the need for home- or school-based

interventions earlier than prekindergarten. Findings from the present study suggest that children from more-advantaged families have skills (e.g., more exposure to interactions with adults and learning activities) that may help them benefit more than their peers from participation in teacher-led games and activities. Promoting maternal education and developing interventions that promote parent-child interactions and high-quality home learning-environments may help all children develop the skills they need to benefit from participation in interventions such as these.

Third, children from low-income backgrounds may also benefit from increased dosage of the intervention. This study's finding that children from low-income families are likely to have difficulty paying attention and staying on-task during intervention sessions suggests that they may require a greater frequency of behavioral self-regulation activities (e.g., greater numbers of intervention sessions, embedding behavioral self-regulation activities into classrooms) than their more-advantaged peers to make equivalent gains in behavioral self-regulation.

The findings from this study may help refine future applications of this or similar behavioral self-regulation interventions. Additionally, the results have the potential to inform preschool curricula that emphasize promoting the development of behavioral self-regulation to ultimately improve academic achievement. The development of behavioral self-regulation interventions that can be easily implemented by teachers in classroom settings is critical to ensure that all children enter school with the skills they need to benefit from classroom learning activities.

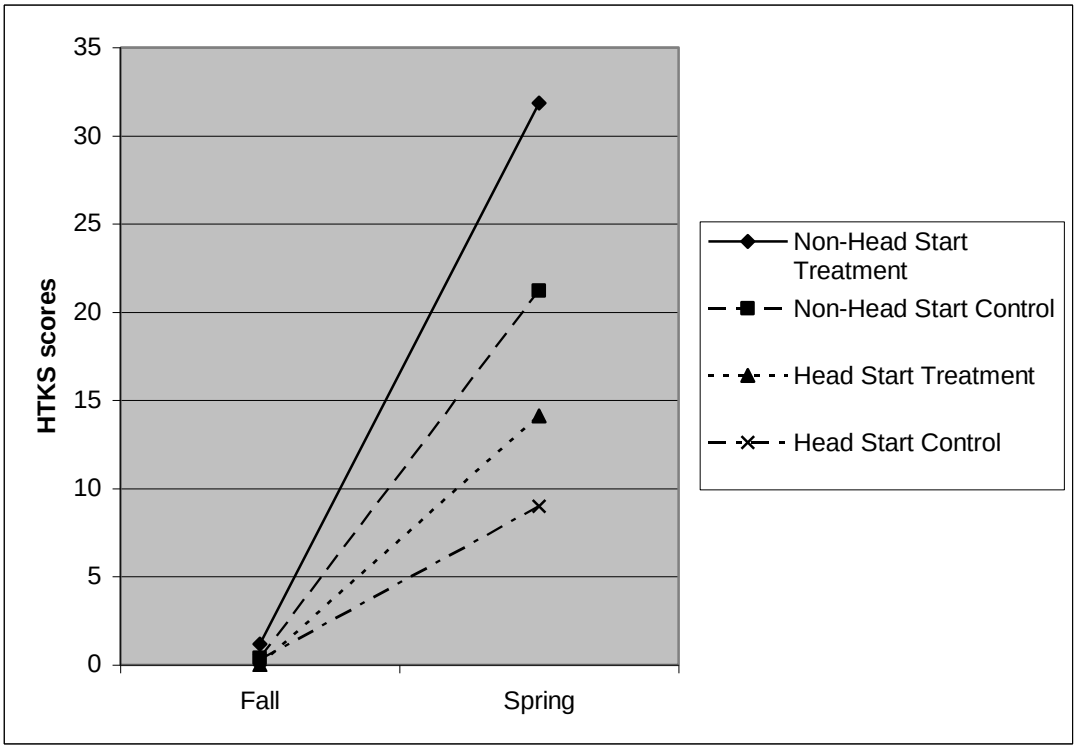

Figure 2.1. Fall and Spring HTKS scores for children based on Head Start enrollment and intervention group assignment for children with low fall self-regulation scores.

Note. HTKS is the Head-Toes-Knees-Shoulders self-regulation task.

Table 2.1

*Logistic Regression Results Examining Family Income and Maternal Education to Predict Low/High Self-Regulation at the Beginning of the Prekindergarten Year (*N *= 65)*

	Model 1			Model 2		
Variable	*B*	*SE B*	e^{Bc}	*B*	*SE B*	e^{B}
Child gender[a]	-.27	.53	.77	-.38	.60	.68
Head Start status[b]	-.89	.52	.41†	-	-	-
Maternal education (years)	-	-	-	.20	.10	1.22*
Constant	.58	-	-	-2.60	-	-
χ^2		3.36			6.76*	
df		2			2	

[a]Child gender: 0 = *female*, 1 = *male*. [b]Head Start status: 0 = *not enrolled in Head Start*, 1 = enrolled in Head Start. [c]e^B denotes the odds ratio.

†$p < .1$. *$p < .05$. **$p < .01$.

Table 2.2

*Descriptive Statistics for Children in the Treatment and Control Groups by Family Income for Children with Low Initial Behavioral Self-Regulation (*N = *31).*

	Treatment Group (n = 12)		Control Group (n = 19)	
Variables	Head Start (n = 6)	Non-HS (n = 6)	Head Start (n = 11)	Non-HS (n = 8)
	M (SD)	M (SD)	M (SD)	M (SD)
Child age (months)	54.5 (3.7)	53.8 (3.9)	55 (4.5)	54.8 (4.2)
Child gender[a]	.5 (.5)	.7 (.5)	.4 (.5)	.4 (.5)
Maternal education[b] (years)	12 (0)	16.2 (2.9)	11.1 (2.7)	15.6 (2.8)
Absences	9.8 (8.2)	6.2 (5.3)	6.4 (5.2)	4 (3.9)
Sessions attended	10.3 (2.3)	12.7 (2.7)	0	0
Fall HTKS	0 (0)	1.8 (2.2)	.4 (.8)	.4 (1.1)
Spring HTKS	13.5 (14.3)	31 (4.1)	7.9 (8.5)	21.3 (14.2)
HTKS gain	13.5 (14.2)	29.2 (4.4)	7.6 (8.7)	20.9 (14.0)

[a]Child gender: 0 = *female*, 1 = *male*. [b]For descriptive statistics including maternal education, n = 23.

References

Adams, A., Bourke, L., & Willis, C. (1999). Working memory and spoken language comprehension in young children. International Journal of Psychology, 34(6), 364-373.

Alexander, K. L., Entwisle, D. R., & Dauber, S. L. (1993). First-grade classroom behavior: Its short- and long-term consequences for school performance. Child Development, 64(3), 801-814.

Barnett, W. S., Jung, K., Yarosz, D. J., Thomas, J., Hornbeck, A., Stechuk, R., et al. (2008). Educational effects of the Tools of the Mind curriculum: A randomized trial. Early Childhood Research Quarterly, 23(3), 299-313.

Baumeister, R. F., & Vohs, K. D. (2004). Handbook of self-regulation: Research, theory, and applications. New York, NY, US: Guilford Press.Bernier, A., Carlson, S. M., & Whipple, N. (2010). From External Regulation to Self-Regulation: Early Parenting Precursors of Young Children's Executive Functioning. Child Development, 81(1), 326-339.

Bernier, A., Carlson, S. M., & Whipple, N. (2010). From external regulation to self-regulation: Early parenting precursors of young children's executive functioning. *Child Development, 81*(1), 326-339.

Blair, C. (2002). School Readiness. American Psychologist, 57(2), 111.

Blair, C., & Razza, R. P. (2007). Relating effortfull control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. Child Development, 78(2), 647-663.

Bodrova, E., & Leong, D. J. (2009). Tools of the mind: A Vygotskian-based early

childhood curriculum. Early Childhood Services: An Interdisciplinary Journal of Effectiveness., 3(3), 245-262.

Buckner, J. C., Mezzacappa, E., & Beardslee, W. R. (2009). Self-regulation and its relations to adaptive functioning in low income youths. American Journal of Orthopsychiatry, 79(1), 19-30.

Cooper, D. H., & Farran, D. C. (1988). Behavioral risk factors in kindergarten. Early Childhood Research Quarterly, 3(1), 1-19.

Dearing, E., Berry, D., & Zaslow, M. (2006). Poverty During Early Childhood. In Blackwell handbook of early childhood development. (pp. 399-423). Malden, MA, US: Blackwell Publishing.

Dearing, E., McCartney, K., & Taylor, B. A. (2009). Does Higher Quality Early Child Care Promote Low-Income Children's Math and Reading Achievement in Middle Childhood? Child Development, 80(5), 1329-1349.

Denton Flanagan, K., & McPhee, C. (2009). The Children Born in 2001 at Kindergarten Entry: First Findings From the Kindergarten Data Collections of the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) (NCES 2010-005). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, D.C.

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

Domitrovich, C. E., Cortes, R. C., & 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(2), 67-91.Eisenberg et al.,

2004;

Emerson, R., Fretz, R. & Shaw, L. (1995). Writing Ethnographic Fieldnotes. Chicago: University of Chicago Press.

Entwisle, D. R., & Alexander, K. L. (1993). Entry into school: The beginning school transition and educational stratification in the United States. Annual Review of Sociology, 19, 401-423.

Evans, G. W. (2004). The environment of childhood poverty. American Psychologist, 59(2), 77-92.

Evans, G. W., & Rosenbaum, J. (2008). Self-regulation and the income-achievement gap. Early Childhood Research Quarterly, 23(4), 504-514.

Howse, R. B., Lange, G., Farran, D. C., & Boyles, C. D. (2003). Motivation and self-regulation as predictors of achievement in economically disadvantaged young children. Journal of Experimental Education, 71(2), 151-174.

Kopp, C. B. (1991). Young children's progression to self-regulation. In M. Bullock (Ed.), *The development of intentional action: Vol. 22. Cognitive, motivational, and interactive processes* (pp. 38-54). Basel, Switzerland: Karger.

Ladd, G. W. (2003). Probing the adaptive significance of children's behavior and relationships in the school context: a child by environment perspective. Advances In Child Development And Behavior, 31, 43-104.Lareau, A. (2003). Unequal Childhoods: Class, Race and Family Life. Los Angeles: University of California Press.

Lareau, A., & Weininger, E. (2008). The context of school readiness: Social class difference in time use in family life. Disparities in school readiness: How families

contribute to transitions in school. In A. Booth & A. C. Crouter (Eds.), Disparities in school readiness: How families contribute to transitions in school. The Penn State University family issues symposia series. (pp. 155-187). New York: NY: Taylor & Francis Group/Lawrence Erlbaum Associates.

Liew, J., McTigue, E., Barrois, L., & Hughes, J. (2008). Adaptive and Effortful Control and Academic Self-efficacy Beliefs on Achievement: A Longitudinal Study of 1st through 3rd Graders. Early Childhood Research Quarterly, 23(4), 515-526.Magnuson, K. (2007). Maternal Education and Children's Academic Achievement during Middle Childhood. Developmental Psychology, 43(6), 1497-1512.

Matthews, J. M., Ponitz, C. C., & Morrison, F. J. (2009). Early gender differences in self-regulation and academic achievement. Journal of Educational Psychology, 101(3), 689-704.McClelland, Acock, & Morrison, 2006

McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. Developmental Psychology, 43(4), 947-959.McClelland, Cameron, Wanless, & Murray, 2007;

McClelland, M. M., Morrison, F. J., & Holmes, D. L. (2000). Children at risk for early academic problems: The role of learning-related social skills. Early Childhood Research Quarterly, 15(3), 307-329.

McClelland, M. M., Piccinin, A., & Stallings, M. C. (2009). Relations between preschool attention and sociability and later achievement outcomes. . Manuscript in review.

McClelland, M. M., Ponitz, C. C., Messersmith, E., & Tominey, S. (2010). Self-

regulation: The integration of cognition and emotion. In R. L. S. Ed.) & B. O. V. Ed.) (Eds.), Handbook of life-span development. Hoboken, NJ: Wiley and Sons.

Morrison, F. J., Ponitz, C. C., & McClelland, M. M. (2010). Self-regulation and academic achievement in the transition to school. In S. Calkins & M. Bell (Eds.), The developing human brain: Development at the intersection of emotion and cognition. . Washington, D.C. : American Psychological Association

Pears, K. C., Fisher, P. A., & Bronz, K. D. (2007). An intervention to facilitate school readiness in foster children: Preliminary results from the Kids in Transition to School pilot study. Manuscript submitted for publication.

Phillips, D., McCartney, K., & Sussman, A. (2006). Child Care and Early Development. In Blackwell handbook of early childhood development. (pp. 471-489). Malden, MA, US: Blackwell Publishing.

Ponitz, C. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. Early Childhood Research Quarterly, 23, 141-158.

Ponitz, C. C., McClelland, M. M., Matthews, J. M., & Morrison, F. J. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. Developmental Psychology, 45(3), 605-619.

Raikes, H. A., Robinson, J. L., Bradley, R. H., Raikes, H. H., & Ayoub, C. C. (2007). Developmental trends in self-regulation among low-income toddlers. Social Development, 16(1), 128-149.

Rennie, D. A. C., Bull, R., & Diamond, A. (2004). Executive Functioning in

Preschoolers: Reducing the Inhibitory Demands of the Dimensional Change Card Sort Task. Developmental Neuropsychology, 26(1), 423-443.

Rhoads, C. (2009). The implications of "contamination" for experimental design in education. *Paper presented at the Society for Research on Education Effectiveness, Washington, D.C.*

Rimm-Kaufman, S. E., Curby, T. W., Grimm, K. J., Nathanson, L., & Brock, L. L. (2009). The contribution of children's self-regulation and classroom quality to children's adaptive behaviors in the kindergarten classroom. Developmental Psychology, 45(4), 958-972.

Rothbart, M. K., & Posner, M. I. (2005). Genes and Experience in the Development of Executive Attention and Effortful Control. New Directions for Child & Adolescent Development, 2005(109), 101-108.

Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2005). The Development of Executive Attention: Contributions to the Emergence of Self-Regulation. Developmental Neuropsychology, 28(2), 573-594.

Sektnan, M., McClelland, M. M., Acock, A., & Morrison, F. J. (in press). Relations between early family risk, children's behavioral regulation, and academic achievement. Early Childhood Research Quarterly.

Tamis-LeMonda, C. S., Briggs, R. D., McClowry, S. G., & Snow, D. L. (2009). Maternal control and sensitivity, child gender, and maternal education in relation to children's behavioral outcomes in African American families. Journal of Applied Developmental Psychology, 30(3), 321-331.

Tominey, S., & McClelland, M. M. (2010). Red light, purple light: Findings from an

intervention using classroom games to improve behavioral self-regulation over the prekindergarten year. Manuscript under review.

Tominey, S., & McClelland, M. M. (2008). "And when they woke up... they were monkeys!" Using classroom games to promote preschoolers' self-regulation and school readiness, Conference on Human Development. Indianapolis, IN.

Torgerson, D. J. (2001). Contamination in trials: Is cluster randomisation the answer? *British Medical Journal, 322*(7282), 355-357.

Valiente, C., Lemery-Chalfant, K., & Castro, K. S. (2007). Children's effortful control and academic competence. Mediation through school liking. . Merrill-Palmer Quarterly, 53, 1-25.

Vitaro, F., Brendgen, M., & Larose, S. (2005). Kindergarten disruptive behaviors, protective factors, and educational achievement by early adulthood. Journal of Educational Psychology, 97(4), 617-629.

Wanless, S. B., McClelland, M. M., Tominey, S., & Acock, A. (2010). The influence of demographic risk factors on the development of behavioral regulation in prekindergarten and kindergarten. Manuscript under review.

CONCLUSION

Research has documented that behavioral self-regulation emerges as an important predictor of academic achievement in children as early as preschool (Blair & Razza, 2007; McClelland, Cameron, Connor et al., 2007). Few studies, however, have examined ways to improve these skills prior to kindergarten entry. With an increasing emphasis being placed on academic outcomes measured by standardized tests in the United States (U.S. Department of Education, 2010), there has been growing interest in finding ways to ensure children are entering school with the self-regulatory skills they need to benefit from classroom learning activities. Using both quantitative and qualitative methods, the present studies tested the effectiveness of a prekindergarten pilot intervention designed to help children practice behavioral self-regulation; skills essential for academic success (Blair, 2002; Cooper & Farran, 1988; Eisenberg, Smith, Sadovsky, & Spinrad, 2004; McClelland, Cameron, et al., 2007; Valiente, et al., 2007). Unlike previous studies, this intervention focused on specific behavioral aspects of self-regulation and used classroom games that required little teacher-training and few materials for implementation.

The two studies included in this dissertation used a combination of quantitative and qualitative measures to evaluate the effectiveness of a pilot behavioral self-regulation intervention. Specifically, the first study quantitatively examined the effects of treatment group participation on behavioral self-regulation and academic outcomes over the prekindergarten year. The second study examined quantitative and qualitative factors (observational fieldnotes) that predicted intervention effectiveness. Together, results support the effectiveness of the intervention for improving children's behavioral self-

regulation and provide valuable information for refining the intervention for use in future studies.

Overview of Findings

Results from Study 1, *Red light, purple light: Findings from a pilot intervention using classroom games to improve behavioral self-regulation*, indicate that participation in the intervention treatment group effectively improved behavioral self-regulation as assessed by a direct measure for children beginning the year with low behavioral self-regulation scores (below the 50th percentile on the HTKS). Separate analyses found that participation in the treatment group, as well as dosage of the intervention (number of playgroup sessions attended), significantly predicted behavioral self-regulation gains over the prekindergarten year. No significant treatment effect was found in the overall sample of children, although means indicated small positive effects of treatment group participation and dosage on behavioral self-regulation skills. Participation in the treatment group did significantly predict gains in reading scores over the prekindergarten year in the overall sample. Taken together, these findings suggest that the intervention may be an effective way to improve behavioral self-regulation prior to kindergarten entry, especially for children who have difficulties with these skills, and that intervention participation may also impact academic outcomes (specifically reading) over the prekindergarten year.

Family income (measured by enrollment in Head Start) was a significant variable in all analyses. Specifically, family income predicted smaller intervention effects for children from low-income families in comparison to their more-advantaged peers. These findings from Study 1 led to several unanswered questions, which were investigated in

Study 2: *What factors predicted that children would begin the year with low behavioral self-regulation and thus be in the group most likely to benefit from intervention participation?* and *For children in the low initial behavioral self-regulation group, why did children from low-income families experience smaller intervention effects than their more-advantaged peers?*

The second study, *Factors impacting the effectiveness of a prekindergarten pilot behavioral self-regulation intervention*, revealed that low maternal education was an important variable predicting whether children would begin the year with low levels of behavioral self-regulation (below the 50th percentile on the HTKS). This was significant because this group of children exhibited the greatest gains from intervention participation. In addition, children with low behavioral self-regulation were more likely to come from low-income families than children beginning the year with high behavioral self-regulation, although this difference did not reach statistical significance. Maternal education and enrollment in Head Start were highly negatively correlated, indicating a strong relation between these two variables. Consistent with previous studies (Matthews, Ponitz, & Morrison, 2009), there was a higher percentage of male children in the low behavioral self-regulation group than in the high group at the beginning of the year, although this difference was also not statistically significant. Child age did not significantly predict membership in the low or high behavioral self-regulation group although this was likely because of the low variability in children's ages across the sample.

Descriptive statistics revealed that although children enrolled in Head Start participating in the treatment group showed greater gains in HTKS scores than their low-

income counterparts in the control group, their behavioral self-regulation at the end of the year was lower than children not enrolled in Head Start in both the treatment and control groups. Additionally, analyses from the qualitative fieldnotes revealed distinct patterns of behavior for children participating in the treatment group based on family income level. Specifically, children from low-income families demonstrated greater difficulty than their more-advantaged peers in paying attention and staying on-task during playgroup sessions. The behavior differences demonstrated by children enrolled in Head Start may have impacted children's ability to benefit from participation in the playgroup sessions, leading to smaller intervention effects. These findings support previous research (Dearing, Berry, & Zaslow, 2006; Evans & Rosenbaum, 2008; Wanless, et al., under review) and highlight the importance of targeting children from low-income families and those with low levels of maternal education for similar interventions, as they are most likely to enter prekindergarten with poor behavioral self-regulation. Moreover, children from low-income families may require a greater frequency of intervention than their more-advantaged peers to receive the same strength of treatment effects.

Together, the findings from Study 1 and Study 2 have the potential to improve future implementations of this and similar behavioral self-regulation interventions. We next address three areas critical to the development and refinement of the pilot intervention: 1) Identifying children most likely to benefit from behavioral self-regulation intervention, 2) Improving intervention effectiveness, and 3) Generalizing intervention effects.

Identifying Children Most Likely to Benefit From Behavioral Self-Regulation Intervention

In the present studies, participants were recruited from two child development centers with child age (4-years-old) as the only eligibility criteria. In order to best utilize resources in future implementations of this intervention, it will be important to use the results from these two studies to target children who are most likely to benefit from this or similar behavioral self-regulation interventions. Results from Study 1 suggested that children who enter prekindergarten with low behavioral self-regulation scores exhibited significant gains from treatment group participation. Study 2 revealed that low maternal education significantly predicted that children would fall into this group and that these children were also likely to come from low-income backgrounds. For children participating in the intervention, there was a strong correlation between maternal education and family income. Taken together, these results point to the need to implement behavioral self-regulation interventions in settings, such as Head Start programs, where there are likely to be high numbers of children from disadvantaged backgrounds (e.g., children with low maternal education and from low-income families). Previous studies also support this notion as research suggests that children from disadvantaged backgrounds are at risk of exhibiting poor behavioral self-regulation and academic difficulties throughout their schooling (Dearing et al., 2006; Evans & Rosenbaum, 2008; Howse, et al., 2003). Additionally, behavioral self-regulation skills have been found to mediate the relation between accumulated risk and academic achievement (Buckner, et al., 2009; Dearing, et al., 2009; Sektnan, et al., in press), making children from disadvantaged families an especially important population to target for behavioral self-regulation intervention.

Improving Intervention Effectiveness

Although Studies 1 and 2 suggest that children with low maternal education and those from low-income families are likely to begin the prekindergarten year with low behavioral self-regulation (and are thus most likely to have significant gains from intervention participation), results from Study 2 suggest that these children experience smaller intervention gains than their more-advantaged peers. Specifically, results from Study 1 suggested that children from low-income families (children enrolled in Head Start) had smaller behavioral self-regulation gains over the prekindergarten year than their peers. Additionally, analyses from observational fieldnotes in Study 2 revealed that children from low-income families exhibited patterns of behaviors that likely reduced their abilities to benefit from participation in the treatment group. Previous research suggests that children from low-income families have more difficulty regulating their attention and behavior than their more-advantaged peers (Howse et al., 2003) and difficulties, such as these, were present in the observational fieldnotes presented in Study 2. During playgroup sessions, children from low-income families had more difficulty paying attention, were more easily distracted, and exhibited more off-task behaviors than their peers. These difficulties experienced by children from low-income families likely reduced their abilities to benefit from intervention participation.

These findings suggest that children from low-income families may benefit from greater frequency of intervention. Findings from Study 1 found that dosage (number of playgroup sessions attended) was a significant predictor of behavioral self-regulation gains. For children in low-income families, receiving a higher dosage of the intervention, which could include attending more sessions or embedding behavioral self-regulation

activities into the school day, may be necessary to make behavioral self-regulation gains equivalent to those experienced by their more-advantaged peers.

Generalizing Intervention Effects

The studies presented in this dissertation focused on one implementation of a pilot behavioral self-regulation intervention, leaving several unanswered questions regarding the generalizability of intervention effects. One of the outcomes of interest in both Study 1 and Study 2 was a direct measure of behavioral self-regulation, the Head-Toes-Knees-Shoulders Task (HTKS). Previous research has found significant relations between the HTKS and teacher-rated behavioral self-regulation (McClelland, Cameron, Connor et al., 2007; Ponitz, et al., 2009) as well as the HTKS and academic outcomes (Matthews, et al., 2009; McClelland, Cameron, Connor et al., 2007; Ponitz et al., 2009). In the present studies, the HTKS was also significantly correlated with teacher-ratings of behavioral self-regulation in spring of the prekindergarten year. In future studies, it will be essential to establish generalizability of intervention effects beyond improved HTKS scores by including an examination of children's classroom behaviors. To do so, future implementations of the intervention should include additional direct measures of behavioral self-regulation, classroom observations of children's behavior, and teacher-ratings of children's behavior.

In addition to establishing generalizability of intervention effects to behavior, it will be critical to further investigate the relation between intervention participation and academic outcomes. Study 1 found a significant relation between intervention participation and reading gains over the prekindergarten year for the overall sample of children. Moreover, although not statistically significant, examination of means indicated

that a similar relation between intervention participation and reading gains was present for children in the low behavioral self-regulation group. Although the effect sizes were greater than those in the overall sample, because of the small sample size, relations between treatment group participation and reading gains were not significant in the low group. Games included in the playgroup sessions did not include any literacy components (e.g., reading letters) so it was unlikely that reading gains were a direct result of participation in the treatment group. It seems more likely that behavioral self-regulation gains acted as a mediator between treatment group participation and reading gains, although we did not find that behavioral self-regulation was a significant mediator. We did find that intervention participation predicted behavioral self-regulation gains for children with low behavioral self-regulation, but there was no significant relation between behavioral self-regulation gains and reading gains. In future research, it will be important to further explore the mechanism behind these observed relations to understand the impact of intervention participation on children's abilities to benefit from classroom learning activities, especially reading.

Limitations

Although the present studies provided evidence supporting the effectiveness of a pilot behavioral self-regulation intervention, there were a number of limitations. Most notably, the small final sample size (N = 65) limited our ability to perform statistical analyses, especially within subgroups of children. Although we did find significant intervention effects in Study 1 for children with low initial behavioral self-regulation, there was no significant intervention effect for children in the overall sample. This lack of a significant effect in the overall sample was likely because of the small effect sizes in

combination with the small sample size, especially for children who began the year with high behavioral self-regulation. Also in Study 1, within the group of children with low initial behavioral self-regulation, the relation between treatment group participation and reading gains was identical to the results found in the overall sample, but lacked statistical significance likely because of the small sample size of this group. In Study 2, qualitative fieldnotes were examined for a small group of children (n = 12), which was further broken down into two smaller groups (n = 6). Though the qualitative analyses provided valuable information that inform the quantitative findings of both Studies 1 and 2, the small group sizes limit the generalizability of these findings. Also in Study 2, only 55 families returned parent questionnaires, further reducing the sample for analyses including maternal education. All of the unreturned questionnaires were from families identified by the child development centers as low-income, indicating the presence of non-response bias.

Future applications of this intervention should use a larger sample size and specifically target children who have low behavioral self-regulation at the onset of the prekindergarten year. With the limited teacher-training and materials required, this intervention would be easily scalable to a larger sample. Implementation of the intervention on a larger scale would allow for further quantitative and qualitative analyses of intervention effects and improve the overall generalizability of the findings.

A second limitation of the studies was that only one direct measure was used to assess behavioral self-regulation over the prekindergarten year. In order to establish generalizability of intervention effects, it will be essential to incorporate additional measures of behavioral self-regulation as well as measures of classroom behavior into

future applications of the intervention. The games used in the study were designed to help children practice the integration of attention, working memory, and inhibitory control; the behavioral self-regulation skills measured by the HTKS. Numerous studies have found significant relations between HTKS level and gains and teacher ratings of child behavior as well as academic outcomes (Matthews et al., 2009; McClelland & Morrison, 2003; Ponitz et al., 2009). This is the first study, however, to examine intervention-related gains and child outcomes.

A third limitation of the studies was the sole focus on child involvement. The results from both studies clearly highlighted the importance of variables such as family income and maternal education on the development of behavioral self-regulation skills. Study 1 found that family income predicted behavioral self-regulation gains over the pre-kindergarten year above and beyond intervention effects, highlighting the need for interventions extending beyond the child level to include family factors. Study 2 found that maternal education predicted low behavioral self-regulation at the beginning of the prekindergarten year and analyses from observational fieldnotes found behavior differences affecting children's ability to participate in the intervention based on family income group (children enrolled in Head Start versus those not enrolled in Head Start). It was clear from these findings that children entered the study with differing ability levels to take advantage of treatment group participation. Future applications of this intervention should include family characteristics to maximize gains in behavioral self-regulation for all children.

A final limitation of the studies was that children were only analyzed at two time points (fall and spring of the pre-kindergarten year). Assessments at additional time

points will be necessary to determine the presence of long-term intervention effects. In future applications of the intervention, participants should be followed over additional time points to test for long-term intervention effects on behavioral self-regulation and academic outcomes.

Implications and Conclusions

The findings from the two studies presented in this dissertation provide support for the effectiveness of a pilot behavioral self-regulation intervention and give important suggestions for refining the intervention for future use. First, future implementations of the intervention should specifically target children entering prekindergarten with low behavioral self-regulation as well as children with low maternal education and from low-income families. Second, as seen in Study 2 as well as in previous studies (Evans & Rosenbaum, 2008), children from low-income families may have difficulty paying attention and staying on-task and require more time practicing behavioral self-regulation skills to make gains equivalent to their more-advantaged peers. It may therefore be beneficial to extend the intervention over a longer period of time and beyond playgroup sessions. In addition to increasing the frequency of activities, activities could be incorporated into other aspects of the classroom, such as circle time, transition times, and classroom learning activities. Third, in order to further test and establish the generalizability of this pilot intervention, it will be critical to replicate the findings from Studies 1 and 2 using a larger sample. Using a larger sample would increase statistical power and improve the ability to find effects of behavioral self-regulation gains on academic outcomes. The limited training required, use of common classroom materials, and group focus make the intervention easily scalable to classroom settings. Lastly, future

implementations of the intervention should include additional measures of behavioral self-regulation to better establish how intervention-related HTKS gains relate to classroom behaviors and academic achievement.

Together, the results from these studies have the potential to inform preschool curricula emphasizing behavioral self-regulation as a means of improving classroom behavior and academic outcomes. The implementation and refinement of prekindergarten behavioral self-regulation interventions play a critical role in ensuring that all children enter kindergarten with the skills they need for classroom success.

BIBLIOGRAPHY

Adams, A. M., Bourke, L., & Willis, C. (1999). Working memory and spoken language comprehension in young children. *International Journal of Psychology, 34*, 364-373.

Alexander, K. L., Entwisle, D. R., & Dauber, S. L. (1993). First-grade classroom behavior: Its short- and long-term consequences for school performance. *Child Development, 64*(3), 801-814.

Barnett, W. S., Jung, K., Yarosz, D. J., Thomas, J., Hornbeck, A., Stechuk, R., et al. (2008). Educational effects of the Tools of the Mind curriculum: A randomized trial. *Early Childhood Research Quarterly, 23*(3), 299-313.

Baumeister, R. F., & Vohs, K. D. (2004). *Handbook of self-regulation: Research, theory, and applications.* New York, NY, US: Guilford Press.

Berk, L. E., Mann, T. D., & Ogan, A. T. (2006). Make-Believe Play: Wellspring for Development of Self-Regulation. Play = learning: How play motivates and enhances children's cognitive and social-emotional growth. In D. G. Singer, R. M. Golinkoff & K. Hirsh-Pasek (Eds.), Play = learning: How play motivates and enhances children's cognitive and social-emotional growth (pp. 74-100). New York, NY: Oxford University Press.

Bernier, A., Carlson, S. M., & Whipple, N. (2010). From external regulation to self-regulation: Early parenting precursors of young children's executive functioning. *Child Development, 81*(1), 326-339.

Blair, C. (2002). School Readiness. American Psychologist, 57(2), 111.

Blair, C., & Razza, R. P. (2007). Relating effortfull control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. Child Development, 78(2), 647-663.

Bodrova, E., & Leong, D. J. (2009). Tools of the mind: A Vygotskian-based early childhood curriculum. Early Childhood Services: An Interdisciplinary Journal of Effectiveness, 3(3), 245-262.

Bronson, M. B., Tivnan, T., & Seppanen, P. S. (1995). Relations between teacher and classroom activity variables and the classroom behaviors of prekindergarten children in Chapter 1 funded programs. *Journal of Applied Developmental Psychology, 16*(2), 253-282.

Buckner, J. C., Mezzacappa, E., & Beardslee, W. R. (2009). Self-regulation and its relations to adaptive functioning in low income youths. American Journal of Orthopsychiatry, 79(1), 19-30.

Calkins, S. D. (2004). Early attachment processes and the development of emotional self-regulation. In R. F. Baumeister & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 324-339). New York: NY: Guildford Press.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed.).* Hillsdale, NY: Lawrence Erlbaum.

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(2), 317-333.

Connor, C. M., Morrison, F. J., & Slominski, L. (2006). Preschool instruction and children's emergent literacy growth. *Journal of Educational Psychology, 98*, 665-689.

Connor, C. M., Ponitz, C. C., Phillips, B. M., Travis, Q. M., Glasney, S., & Morrison, F. J. (in press). First graders' literacy and self-regulation gains: The effect of individualizing student instruction. *Journal of School Psychology*.

Cooper, D. H., & Farran, D. C. (1988). Behavioral risk factors in kindergarten. Early Childhood Research Quarterly, 3(1), 1-19.

Dearing, E., Berry, D., & Zaslow, M. (2006). Poverty During Early Childhood. In Blackwell handbook of early childhood development. (pp. 399-423). Malden, MA, US: Blackwell Publishing.

Dearing, E., McCartney, K., & Taylor, B. A. (2009). Does Higher Quality Early Child Care Promote Low-Income Children's Math and Reading Achievement in Middle Childhood? Child Development, 80(5), 1329-1349.

Denton Flanagan, K., & McPhee, C. (2009). *The Children Born in 2001 at Kindergarten Entry: First Findings From the Kindergarten Data Collections of the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B)* (NCES 2010-005). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

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

Domitrovich, C. E., Cortes, R. C., & 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*(2), 67-91.

Dowsett, S. M., & Livesey, D. J. (2000). The development of inhibitory control in preschool children: Effects of 'executive skills' training. *Developmental Psychobiology, 36*(2), 161-174.

Eisenberg, N., Smith, C. L., Sadovsky, A., & Spinrad, T. L. (2004). Effortful control: Relations with emotion regulation, adjustment, and socialization in childhood. In R. F. Baumeister & K. D. Vohs (Eds.), Handbook of self-regulation: Research, theory, and applications. (pp. 259-282). New York, NY, US: Guilford Press.

Elias, C. L., & Berk, L. E. (2002). Self-regulation in young children: Is there a role for sociodramatic play? Early Childhood Research Quarterly, 17(2), 216-238.

Emerson, R., Fretz, R. & Shaw, L. (1995). Writing Ethnographic Fieldnotes. Chicago: University of Chicago Press.

Entwisle, D. R., & Alexander, K. L. (1993). Entry into school: The beginning school transition and educational stratification in the United States. *Annual Review of Sociology, 19*, 401-423.

Evans, G. W. (2004). The environment of childhood poverty. American Psychologist, 59(2), 77-92.

Evans, G. W., & Rosenbaum, J. (2008). Self-regulation and the income-achievement gap. Early Childhood Research Quarterly, 23(4), 504-514.

Gioia, K. A., & Tobin, R. M. (2010). Role of sociodramatic play in promoting self-regulation. In C. E. Schaefer (Ed.), Play therapy for preschool children (pp. 181-198). Washington, D. C.: American Psychological Association.

Happaney, K., Zelazo, P. D., & Stuss, D. T. (2004). Development of orbitofrontal function: Current themes and future directions. Brain and Cognition, 55(1), 1-10.

Hill, J. L., Brooks-Gunn, J., Waldfogel, J. (2003). Sustained effects of high participation in an early intervention for low-birth-weight premature infants. *Developmental Psychology, 39*(4), 730-744.

Howse, R. B., Calkins, S. D., Anastopoulos, A. D., Keane, S. P., & Shelton, T. L. (2003). Regulatory contributors to children's kindergarten achievement. Early Education and Development, 14(1), 101-119.

Howse, R. B., Lange, G., Farran, D. C., & Boyles, C. D. (2003). Motivation and self-regulation as predictors of achievement in economically disadvantaged young children. *Journal of Experimental Education, 71*(2), 151-174.

Kegel, A. T., van der Kooy-Hofland, V. A. C., Bus, A. G. (2009). Improving early phoneme skills with a computer program: Differential effects of regulatory skills. *Learning and Individual Differences, 19*(4), 549-554.

Kline, R. B. (2005). *Principles and Practice of Structural Equation Modeling*. New York, NY: The Guilford Press.

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(2), 220-232.

Kopp, C. B. (1991). Young children's progression to self-regulation. In M. Bullock (Ed.), *The development of intentional action: Vol. 22. Cognitive, motivational, and interactive processes* (pp. 38-54). Basel, Switzerland: Karger.

Ladd, G. W. (2003). Probing the adaptive significance of children's behavior and relationships in the school context: a child by environment perspective. *Advances In Child Development And Behavior, 31*, 43-104.

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(6), 1373-1400.

Lareau, A. (2003). *Unequal Childhoods: Class, Race and Family Life*. Los Angeles: University of California Press.

Lareau, A., & Weininger, E. (2008). The context of school readiness: Social class difference in time use in family life. Disparities in school readiness: How families contribute to transitions in school. In A. Booth & A. C. Crouter (Eds.), Disparities in school readiness: How families contribute to transitions in school. The Penn State University family issues symposia series. (pp. 155-187). New York: NY: Taylor & Francis Group/Lawrence Erlbaum Associates.

Lerner, R. M. (2006). Developmental science, developmental systems, and contemporary theories of human development. In R. M. Lerner (Vol. Ed.), W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology: Vol. 1. Theoretical models of human development* (6th ed., Vol. 1, pp. 1-17). Hoboken, NJ: Wiley.

Lerner, R. M., & Overton, W. F. (2008). Exemplifying theory, research, and application to promote positive development and social justice. *Journal of Adolescent Research, 23*(3), 245-255.

Liew, J., McTigue, E., Barrois, L., & Hughes, J. (2008). Adaptive and effortful control and academic self-efficacy beliefs on achievement: A longitudinal study of 1st through 3rd graders. *Early Childhood Research Quarterly, 23*(4), 515-526.

Lin, H.-L., Lawrence, F. R., & Gorrell, J. (2003). Kindergarten teachers' views of children's readiness for school. Early Childhood Research Quarterly, 18(2), 225-237.

Lipsey, M. W. (1996). *Design sensitivity: Statistical power for experimental research.* Newbury Park, CA: Sage Publications.

Lobo, Y. B., & Winsler, A. (2006). The effects of a creative dance and movement program on the social competence of Head Start preschoolers. Social Development, 15(3), 501-519.

Magnuson, K. (2007). Maternal Education and Children's Academic Achievement during Middle Childhood. Developmental Psychology, 43(6), 1497-1512.

Matthews, J. M., Ponitz, C. C., & Morrison, F. J. (2009). Early gender differences in self-regulation and academic achievement. Journal of Educational Psychology, 101(3), 689-704.

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*(4), 471-490.

McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. Developmental Psychology, 43(4), 947-959.

McClelland, M. M., Cameron, C. E., Wanless, S. B., & Murray, A. (2007). Executive function, behavioral self-regulation, and social-emotional competence: Links to school readiness. In O. N. Saracho & B. Spodek (Eds.), Contemporary perspectives on social learning in early childhood education (pp. 83-107). Charlotte, NC: Information Age.

McClelland, M. M., & Morrison, F. J. (2003). The emergence of learning-related social skills in preschool children. Early Childhood Research Quarterly, 18(2), 206-224.

McClelland, M. M., Morrison, F. J., & Holmes, D. L. (2000). Children at risk for early academic problems: The role of learning-related social skills. *Early Childhood Research Quarterly, 15*(3), 307-329.

McClelland, M. M., & Piccinin, A., & Stallings, M. C. (2010). *Relations between preschool attention and sociability and later achievement outcomes.* Manuscript in review.

McClelland, M. M**.,** Ponitz, C. C., Messersmith, E. & Tominey, S. (in press). *Self-regulation: The integration of cognition and emotion.* In R. Lerner (Series Ed.) & W. Overton (Vol. Ed.), *Handbook of life-span development.* Hoboken, NJ: Wiley and Sons.

McClelland, M. M., & Wanless, S. B. (2006, July). *Child and parenting influences on early reading and mathematics skills.* In C. Huntsinger (Convener), Parental Contributions to Young Children's Language, Reading, and Mathematics

Development. Paper presented at the 19th biennial meeting of the International Society for the Study of Behavioural Development, Melbourne, Australia.

Miller, K. F., Kelly, M., & Zhou, X. (2005). Learning mathematics in China and the United States: Cross-cultural insights into the nature and course of preschool mathematical development. In J. I. D. Campbell (Ed.), *Handbook of mathematical cognition* (pp. 163-177). New York: Psychology Press.

Morrison, F. J., Ponitz, C. C., & McClelland, M. M. (2010). Self-regulation and academic achievement in the transition to school. In S. Calkins & M. Bell (Eds.), The developing human brain: Development at the intersection of emotion and cognition. Washington, D.C. : American Psychological Association

Muñoz-Sandoval, A. F., Woodcock, R. W., McGrew, K. S., & Mather, N. (2005). *The Bateria III Woodcock- Muñoz: Pruebas de aprovechamiento*. Itasca, IL: Riverside Publishing.

National Association for the Education of Young Children (2008). *Position Statement.* Retrieved July 6, 2008, from www.naeyc.org

NICHD Early Child Care Research Network (2003). Do children's attention processes mediate the link between family predictors and school readiness? *Developmental Psychology, 39*, 581-593.

NICHD Early Childcare Research Network (2002). The relation of global first-grade classroom environment to structural classroom features and teacher and student behaviors. *The Elementary School Journal, 102*, 367-387.

Overton, W. F. (2006). Developmental psychology: Philosophy, concepts, methodology. In R. M. Lerner (Vol. Ed.), W. Damon & R. M. Lerner (Eds.), *Handbook of child*

psychology: Vol. 1. Theoretical models of human development (6th ed., Vol. 1, pp. 18-88). Hoboken, NJ: Wiley.

Pears, K. C., Fisher, P. A., & Bronz, K. D. (2007). An intervention to facilitate school readiness in foster children: Preliminary results from the Kids in Transition to School pilot study. *Social Psychology Review, 36*, 665-673.

Phillips, D., McCartney, K., & Sussman, A. (2006). *Child care and early development.* In K. McCartney & D. Phillips (Eds.), Blackwell Handbook of Early Childhood Development. (pp. 471-489). Malden, MA, US: Blackwell Publishing.

Ponitz, C. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. Early Childhood Research Quarterly, 23, 141-158.

Ponitz, C. C., McClelland, M. M., Matthews, J. M., & Morrison, F. J. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. Developmental Psychology, 45(3), 605-619.

Raikes, H. A., Robinson, J. L., Bradley, R. H., Raikes, H. H., & Ayoub, C. C. (2007). Developmental trends in self-regulation among low-income toddlers. Social Development, 16(1), 128-149.

Raver, C. C. (2002). Emotions matter: Making the case for the role of young children's emotional development for early school readiness. *Social Policy Report, 16*, 3-18.

Rennie, D. A. C., Bull, R., & Diamond, A. (2004). Executive functioning in preschoolers: Reducing the inhibitory demands of the dimensional change card sort task. *Developmental Neuropsychology, 26*, 423-443.

Reynolds, A. J., Temple, J. A., Robertson, D. L., & Mann, E. A. (2001). Long-term effects of an early childhood intervention on educational achievement and juvenile arrest: A 15-year follow-up of low-income children in public schools. *Journal of the American Medical Association, 285*, 2339-2346.

Rhoads, C. (2009). The implications of "contamination" for experimental design in education. *Paper presented at the Society for Research on Education Effectiveness, Washington, D.C.*

Rimm-Kaufman, S. E., Curby, T. W., Grimm, K. J., Nathanson, L., & Brock, L. L. (2009). The contribution of children's self-regulation and classroom quality to children's adaptive behaviors in the kindergarten classroom. Developmental Psychology, 45(4), 958-972.

Rimm-Kaufman, S. E., Pianta, R. C., & Cox, M. J. (2000). Teachers' judgments of problems in the transition to kindergarten. Early Childhood Research Quarterly, 15(2), 147-166.

Rothbart, M. K., & Posner, M. I. (2005). Genes and experience in the development of executive attention and effortful control. *New Directions for Child and Adolescent Development, 109*, 101-108.

Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2004). *Attentional control and self-regulation.* In R. F. Baumeister & K. D. Vohs (Eds.), Handbook of self-regulation: Research, theory, and applications (pp. 283-300). New York, NY: Guilford Press.

Schrank, F. A., McGrew, K. S., Ruef, M. L., Alvarado, C. G., Muñoz-Sandoval, A. F., & Woodcock, R. W. (2005). *Overview and technical supplement (Bateria III*

Woodcock- Muñoz Assessment Service Bulletin No. 1). Itasca, IL: Riverside Publishing.

Sektnan, M., McClelland, M. M., Acock, A., & Morrison, F. J. (in press). Relations between early family risk, children's behavioral regulation, and academic achievement. Early Childhood Research Quarterly.

Tamis-LeMonda, C. S., Briggs, R. D., McClowry, S. G., & Snow, D. L. (2009). Maternal control and sensitivity, child gender, and maternal education in relation to children's behavioral outcomes in African American families. Journal of Applied Developmental Psychology, 30(3), 321-331.

Thompson, R. A., & Lagattuta, K. H. (2006). *Feeling and Understanding: Early Emotional Development.* In Blackwell handbook of early childhood development. (pp. 317-337). Malden, MA, US: Blackwell Publishing.

Tominey, S., & McClelland, M. M. (2008). "And when they woke up... they were monkeys!" Using classroom games to promote preschoolers' self-regulation and school readiness, Conference on Human Development. Indianapolis, IN.

Torgerson, D. J. (2001). Contamination in trials: Is cluster randomisation the answer? *British Medical Journal, 322*(7282), 355-357.

U.S. Department of Education. (2008). *No Child Left Behind.* Retrieved July 6, 2008, from http://www.ed.gov/nclb/landing.jhtml

Valiente, C., Lemery-Chalfant, K., & Castro, K. S. (2007). Children's effortful control and academic competence. Mediation through school liking. . Merrill-Palmer Quarterly, 53, 1-25.

Vitaro, F., Brendgen, M., Larose, S., & Trembaly, R. E. (2005). Kindergarten Disruptive

Behaviors, Protective Factors, and Educational Achievement by Early Adulthood. *Journal of Educational Psychology, 97*(4), 617-629.

Wanless, S. B., McClelland, M. M., Tominey, S., & Acock, A. (2010). The influence of demographic risk factors on the development of behavioral regulation in prekindergarten and kindergarten. Manuscript under review.

Woodcock, R. W., & Mather, N. (2000). *Woodcock Johnson Psycho-Educational Battery-III.* Itasca, IL: Riverside Publishing Company.

Zelazo, P. D., Muller, U., & Goswami, U. (2002). Executive function in typical and atypical development. In Blackwell handbook of childhood cognitive development. (pp. 445-469). Malden, MA, US: Blackwell Publishing.