

SELF-REGULATION DEVELOPMENT IN EARLY CHILDHOOD: THE ROLE OF
LANGUAGE SKILLS AND PRE-KINDERGARTEN LEARNING BEHAVIORS

By

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To Mama and Daddy, for encouraging me to dream big dreams;

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CHAPTER I

INTRODUCTION

Although increasing attention is being given to the role of children's self-regulation in their early school success, little is known about the key developmental processes that might be related to how children learn to self-regulate. Because of the lack of empirical clarity regarding what might facilitate self-regulation growth, attempts to intervene are based largely on theory, with somewhat mixed results. Therefore, there is a need to investigate the potential correlates of self-regulation in early childhood, and explore how those early skills and behaviors, and the relationships between them, might interact in an early learning environment, like pre-kindergarten classrooms.

Statement of the Problem

Children from low-income backgrounds often begin school already behind their more affluent counterparts on important school readiness skills, placing them at risk of school failure (McLoyd, 1998). As achievement gaps between children from economically disadvantaged backgrounds and their more wealthy peers continue to persist in American schools, more focus is being placed on the importance of early education because of its potential long-term benefits (Campbell & Ramey, 1994). Early intervention is thought to help protect vulnerable children from the risk of school failure by providing enriching early learning experiences that not only foster and develop

children's knowledge and skills, but prepare them for the formal school environment as well.

Early childhood researchers and educators have long embraced the idea that getting children off to a good start early in school can have lasting and important effects on their futures. As children's induction into formal school is beginning earlier, the expectations placed on children when they enter the classroom environment are more demanding. Aspects of school readiness, however, extend beyond the traditional areas of language, literacy, and mathematics to the domain of social and emotional development, including an area that lies at the intersection of behavior and cognition: self-regulation. Though definitions of self-regulation are numerous in the literature (McClelland & Cameron, 2011), there is some agreement that children's early attention, working memory, and inhibitory control skills are core components of self-regulation (Banfield, Wyland, Macrae, Munte, & Heatherton, 2004). Within the classroom environment, self-regulation related to learning may manifest itself as behavioral control, sustained attention, and persistence, as well as following directions and ignoring distractions (Liew, 2012; McClelland & Cameron, 2012).

Growing evidence has established self-regulation as an important component of what it means to be ready for school. In fact, teachers have reported that problems with self-regulation in the classroom, such as following directions and working independently, are quite common at the beginning of kindergarten – more common than problems with academic skills (Rimm-Kaufman, Pianta, & Cox, 2000). A growing body of evidence links self-regulation in early childhood with a host of better school- and life-related outcomes, such as school achievement (Duncan et al., 2007), social competence (Blair,

2002), and even college completion (McClelland, Acock, Piccinin, Rhea, & Stallings, in press). Various studies have demonstrated that children from low-income families are especially at risk of having low self-regulation (Howse, Lange, Farran, & Boyles, 2003; Li-Grining, 2007; McClelland, Cameron, Connor, Farris, Jewkes, & Morrison, 2007; Sektan, McClelland, Acock, & Morrison, 2010). Thus, it may be particularly important to better prepare young children for formal schooling by specifically targeting self-regulation skills, especially in pre-kindergarten programs primarily serving at-risk children. As a consequence, a considerable amount of attention is being paid to young children's self-regulation development, as well as the role the early childhood classroom might play in fostering its growth (see Diamond & Lee, 2011).

The literature regarding the relationship between children's self-regulation and learning consists of studies that have primarily investigated it as a school-entry predictor of children's achievement. These correlational studies have shown that children who enter school with strong self-regulatory skills have better achievement outcomes (Fantuzzo, Bulotsky-Shearer, McDermott, McWayne, Frye, & Perlman, 2007; Ponitz, McClelland, Jewkes, Connor, Farris, & Morrison, 2008). Further, some limited evidence has suggested that growth in these skills corresponds to gains in literacy and math achievement (McClelland et al., 2007). However, little attention has been paid to the prerequisite skills or cognitive capacities that might lay the foundation for children to develop self-regulation, such as their language skills. Thus, an important contribution within this area of research would be to examine the relationship between children's language skills and their development of self-regulatory skills.

Socio-cultural theory suggests that language skills may act as a metacognitive tool that helps facilitate children's understanding of social rules, as well as their interactions with others and the world around them (Vygotsky, 1963). This theoretical framework is supported by evidence from empirical studies that have found that children use language spoken to themselves to focus and control their behavior during challenging tasks (Berk & Garvin, 1984; Winsler, de Leon, Wallace, Carlton, & Willson-Quayle, 2003), and during fantasy play to control themselves and others (Krafft & Berk, 1998). In addition, evidence from the disabilities literature suggests that poor language skills are related to behavior problems in young children (Hooper, Roberts, Zeisel, & Poe, 2003), and with decreased opportunities for social interaction in the classroom (Cohen & Mendez, 2009; Gallagher, 1993; Mendez, Fantuzzo, & Cichetti, 2002). Vygotsky (1978) suggested that opportunities for social interaction help children begin to understand social rules, roles, and expectations, and apply them to their own behavior. Therefore, language skills may be important ingredients for self-regulation growth because they help children internalize social rules and expectations and control their behavior, and because they facilitate the kinds of social interactions thought to be important for self-regulation growth. Accordingly, there is a need to identify what kinds of learning behaviors in the classroom might foster self-regulation development.

Early intervention efforts designed to target young children's self-regulation have occurred either in short-term laboratory training studies (e.g., Rothbart, McCandliss, Saccomanno, & Posner, 2005), or in classrooms following certain curricula purported to target children's self-regulation (e.g., Farran, Lipsey, & Wilson, 2011). While children participating in short-term, computer-based training studies have shown some potential

for improving attention skills, it is unclear how these types of improvements might manifest themselves in a traditional classroom environment. Curricular interventions, on the other hand, are grounded in the classroom learning environment, but have produced mixed results in terms of children's self-regulation gains. The current study is based on the assertion that further investigation into the interplay between early language and self-regulation is needed, specifically with a focus on how language might affect self-regulation growth by either facilitating (for children with stronger language skills), or impeding (for children with weaker language skills), key learning opportunities in the classroom. Understanding these relationships, and the developmental processes that underlie them, will not only build a better understanding of self-regulation in early childhood, but it may also inform strategies for early intervention.

Objectives

The purpose of this study was to investigate the relationship between pre-kindergarten children's early language skills and their self-regulation development. First, the study examined whether children's early language skills predicted the gains they made in self-regulation over the course of the pre-kindergarten year. Second, the study explored whether and how children's language skills were related to specific learning behaviors thought to be associated with self-regulation gains. Finally, the study analyzed the mediating effects of children's learning behaviors on the relationship between their entering language skills and their self-regulation gains. This study hoped to extend prior work in this important area by examining children's self-regulation from a developmental perspective, and with a goal of potentially informing classroom practice. Access to a

large data set provided an unusual opportunity to develop hypotheses from one sample, drawn from the larger data set, and apply them to a second sample, thus strengthening the conclusions reached.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Despite growing interest in young children's self-regulation and its contribution to school and life success, key questions involving the relationships between self-regulation and other cognitive capacities, such as language, remain. This chapter explores several important areas relating to the current body of research in the area of children's self-regulation, including how it is defined and measured, its importance as a facet of early school readiness, and the theoretical framework and empirical evidence linking it to children's early language skills.

Defining Self-Regulation

The current literature regarding research on children's self-regulation includes an array of studies regarding children's early cognitive and emotional control. In fact, because the research regarding self-regulation stems from several different fields, there is considerable variation in how it is defined (McClelland & Cameron, 2011). Some define self-regulation quite broadly: as having control over oneself, from basic biological control mechanisms to the more complex control of emotions and cognition (Vohs & Baumeister, 2004). Others are primarily concerned with emotional regulation; for instance, being able to delay gratification or maintain effortful control over emotional states and responses (e.g., Kochanska, Murray, & Harlan, 2000). Still, those from a

cognitive perspective often define self-regulation as a set of specific cognitive skills, sometimes known as executive function, consisting of attention, working memory, and inhibitory control, that work together to facilitate goal-directed behavior (e.g., Blair, Protzko, & Ursache, 2011; McClelland & Cameron, 2012).

When children enter the early school environment, new and complex demands are placed on their executive function skills, which are developing rapidly during early childhood. Being able to attend effectively facilitates learning because children who have strong attention skills are able to control, focus, direct, and sustain their attention, and ignore distractions (Fan, McCandliss, Sommer, Raz, & Posner, 2002; Rueda, Posner, & Rothbart, 2004). These attention-related capacities have already begun to develop by the time children enter pre-kindergarten – around four years of age (Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). Working memory requires being able to hold key pieces of information in mind and act on that information. Working memory is thought to enhance children’s learning by facilitating rehearsal and transfer into long-term memory (Bull & Scerif, 2001). In the classroom, working memory may facilitate learning because it allows children to hold in mind a set of instructions while performing a task (McClelland & Cameron, 2011). In addition to attention and working memory, executive function also involves the ability to suppress a pre-potent response, which is referred to as inhibitory control (Hughes, 2011). These three skills are thought to be the critical components of self-regulation (Banfield et al., 2004).

Because of the interest in self-regulation as an important component of early school readiness, some have encouraged a more integrated view of self-regulation situated within the school context (e.g., Liew, 2012; McClelland & Cameron, 2012). This

perspective considers both the emotional and cognitive aspects of self-regulation as they work together to facilitate positive learning experiences in a school setting. For example, attending to the teacher, remembering instructions, and controlling behavior are all forms of self-regulation (McClelland & Cameron, 2012) that children perform every day in order to be successful in the complex and demanding environment of the classroom. The current study takes this more integrative approach with a focus on self-regulation as it relates to learning in the early childhood classroom.

Measuring Self-Regulation

As interest in self-regulation as an important ingredient of early school success has grown, so has the interest in how best to measure it. Just as the terms and definitions used regarding self-regulation vary widely, even less consensus exists concerning how these skills are actually assessed in young children (Blair, Zelazo, & Greenberg, 2005; Carlson, 2005; Davidson, Amso, Anderson, & Diamond, 2006). Some measures attempt to isolate and assess distinct executive function skills. For example, attention-related tasks have commonly included matching- or copying-type tasks, such as the Copy Designs Test (Osborn, Butler, & Morris, 1984) or response tasks, like the Continuous Performance Test (Rosvold, Mirsky, Sarason, Bransome, & Beck, 1956). In the Copy Designs Task, children are asked to copy an increasingly complex set of geometric figures. A Continuous Performance Test is computerized and requires children to press a certain button when, and only when, a desired target appears on the screen. Inhibitory control tasks include Stroop-like tasks (e.g., Day/Night, Gerstadt, Hong, & Diamond, 1994), Peg Tapping (Diamond & Taylor, 1996), or Flanker Tasks (Fan et al., 2002). All

of these tasks involve suppressing a dominant response in favor of a non-dominant response – for instance, saying “day” when shown a picture of night-time, or tapping a peg only once, after the experimenter has tapped twice.

It is difficult to design a task that isolates any one component of executive function as these skills are so frequently used in conjunction with one another (Blair & Razza, 2007). Thus, other measures have been developed with a more integrative approach. Two types of integrative measures have emerged: teacher ratings and other, more complex direct child measures. The primary tool used for assessing children’s self-regulation and attempting to relate it to their academic outcomes has been teacher ratings measures (e.g., McClelland, Morrison, & Holmes, 2000). Some teacher ratings assess children’s temperaments or attitudes about learning (e.g., Rothbart, 1981), while others are more applied and attempt to ground ratings of children’s self-regulation in the expectations of the classroom environment (e.g., Cooper & Farran, 1991). These applied measures include items about how a child remembers and follows directions, persists on difficult tasks, shifts between activities, and maintains attention. Teacher ratings measures, unlike individually-administered child assessments, can potentially capture a child’s capacity for self-regulatory behaviors in a meaningful classroom context.

In addition to teacher ratings, more complex, one-on-one assessments of children’s self-regulation have been developed. These measures purport to tap into these same classroom-relevant behaviors and skills during a game-like activity. The primary example of this type of task is the “Head Toes Knees Shoulders” task (HTKS; Ponitz, McClelland, Matthews, & Morrison, 2008). The authors describe the HTKS task as a test

of self-regulation, involving all the components – attention, inhibitory control, and working memory.

Both teacher ratings and direct child assessments have been used as predictors to explore the relationship between self-regulation at school entry and children's academic achievement (Fantuzzo et al., 2007; McClelland et al., 2007; Ponitz et al., 2009). Despite considerable variation in the measures used, evidence from these studies points to self-regulation as an important predictor of achievement.

Self-Regulation and School Readiness

Early literacy and mathematics knowledge have long been accepted as important aspects of school readiness. Mounting evidence suggests that self-regulation also plays a role in children's readiness for school. However, the exact nature of the relationship between self-regulation and school achievement remains unclear. Evidence suggests that these skills make a unique contribution to achievement that is not explained by initial ability alone (e.g., Duncan et al., 2007; McClelland et al., 2000), but this evidence is based largely on correlational findings that cannot tease apart the directionality of this important relationship. Further, studies in this area vary widely in terms of methodology and measurement (LaParo & Pianta, 2000), making it even more difficult to explore the complex relationship between self-regulation and other early academic skills. Further, self-regulation has predominantly been investigated as a school entry predictor or disposition, making it difficult to investigate how it might change and grow over time and in response to schooling.

Teacher ratings of self-regulation. Teacher ratings measures have served as the primary tool for assessing children's self-regulation skills when examining links between these skills and academic achievement. Across multiple studies, teacher ratings of young children's self-regulation have been shown to relate positively to academic outcomes. For example, teacher ratings of children's attitudes toward learning have been shown to be related to children's mathematics outcomes (Fantuzzo et al., 2007). Fantuzzo et al. (2007) found that children who were rated as more regulated in the fall of pre-kindergarten had higher mathematics outcomes in the spring. Other work has shown that children's positive approaches to learning in pre-kindergarten were positively correlated with a general measure of kindergarten academic success as well (McWayne, Fantuzzo, & McDermott, 2004). In a similar study investigating more long-term outcomes, kindergarten children's positive approaches to learning have been shown to predict their third-grade mathematics outcomes (DiPerna, Lei, & Reid, 2007).

Just as self-regulation relates positively to children's academic success, attention problems have been shown to relate negatively to academic outcomes. For example, children whose teachers indicate that they have attention problems have lower literacy-related outcomes (Rabiner, Coie, & The Conduct Problems Prevention Research Group, 2000). Rabiner et al.'s (2000) longitudinal study demonstrated that teacher ratings of kindergarten children's attention problems were negatively related to their Woodcock-Johnson (WJ-R; Woodcock & Johnson, 1989) Letter-Word Identification and Passage Comprehension outcomes. In this study, early-identified attention problems actually predicted children's literacy outcomes into fifth grade.

Aside from attention problems and dispositions toward learning, general measures of children's self-regulation behaviors have also been shown to relate to academic outcomes. For instance, McClelland et al. (2000) demonstrated that teacher ratings of kindergarteners' self-regulation skills predicted unique variance in all academic outcomes measured in second grade, over and above children's initial IQ scores. This study used the Cooper-Farran Behavioral Rating Scale (CFBRS, Cooper & Farran, 1991), which asks teachers to rate individual children on attention, task persistence, following directions, and other self-regulatory skills. This measure places self-regulatory skills specifically within the classroom context, and asks teachers to rate children based on their typical behavior in the classroom. Kindergarten scores on the CFBRS positively predicted a statistically significant amount of variance in second grade achievement, controlling for IQ and other background factors (McClelland et al., 2000).

In a methodologically-rigorous attempt to tease apart various factors contributing to children's school readiness, Duncan et al. (2007) analyzed six large national datasets, all of which contained information about children's skills collected just before school entry (usually kindergarten). Depending on the study, some of the datasets included teacher ratings of children's attention skills and others included teacher ratings of attention problems. (One study included children's scores on a Continuous Performance Task, but all others were teacher-ratings based.) Despite some variability in measurement type and follow-up time points, this study employed a rigorous methodology through which regression analyses were used to assess the relationship between school entry indicators of reading, math, language/verbal ability, attention skills, and social/emotional behaviors and later school achievement. Then, meta-analysis was used to summarize the

findings across all six studies. Duncan et al.'s (2007) results demonstrated that attention skills were second only to math and reading skills in predicting later school achievement. However, social emotional skills, such as internalizing/externalizing problems and aggression, were not related to later achievement (Duncan et al., 2007). More recently, a longitudinal study conducted in New Zealand investigated health, wealth, and criminal behavior among a group of 32-year-olds (Moffitt et al., 2011). This study demonstrated that adults who were rated as having better self-control as young children were more likely to be in better health and have higher socioeconomic status than those with lower self-control ratings. They were also less likely to have engaged in criminal behavior.

Direct child measures of self-regulation. While teacher ratings measures have been the more common measure for examining the relationship between self-regulation and academic achievement, direct child measures are increasingly popular. Direct child measures are inherently appealing because, unlike teacher ratings, they are administered by objective assessors and are sometimes presumed to be more precise estimates of children's functioning. These measures of self-regulation have been shown to correlate with other measures of cognitive functioning in young children. For example, these tasks have been shown to be related to mathematics achievement (Bull & Scerif, 2001; Checa, Rodriguez-Bailon, & Rueda, 2008; Espy, McDiarmid, Cwik, Stalets, Hamby, & Senn, 2004) and reading achievement (Lan, Legare, Ponitz, Li, & Morrison, 2011). Espy et al. (2004) found that preschool children's scores on an inhibitory control task and a working memory task were positively correlated with scores on the Woodcock-Johnson Applied Problems subtest (WJ-R; Woodcock & Johnson, 1989). Bull and Scerif's (2001) study with third-graders found positive correlations between measures of attention, working

memory, and inhibitory control and a measure of mathematics achievement (Group Mathematics Test, Young, 1970). However, they found that “... a large proportion of the variance for each executive function measure [was] shared with the variance predicted by IQ and reading ability” (Bull & Scerif, 2001, p. 283). This finding speaks to the difficulty of distinguishing self-regulation skills from general cognitive ability. This issue is particularly problematic in these types of studies because the self-regulation measures and achievement measures were collected at the same time point with no follow-up. This makes it difficult to parse out how much variance in achievement might be attributable to early self-regulation, as opposed to children’s initial cognitive ability.

To address this problem, more recent work has included school entry measures of both self-regulation and achievement, as well as follow-up academic achievement data. For example, two recent studies (McClelland et al., 2007; Ponitz et al., 2009) used the Heads, Toes, Knees, Shoulders task (HTKS; Ponitz et al., 2008) to assess pre-kindergarten and kindergarten children’s self-regulation. The authors describe the HTKS task as a test of self-regulation, involving attention, inhibitory control, and working memory. In the HTKS task, the experimenter plays a game of “opposites” with the child. When the experimenter says “touch your head,” the child is told to touch his/her toes and vice versa. When the experimenter says “touch your shoulders,” the child is told to touch his/her knees and vice versa. In McClelland et al.’s (2007) study of pre-kindergarten children, fall HTKS scores predicted spring Woodcock Johnson-III (WJ III; Woodcock & Mather, 2000) scores on Picture Vocabulary, Letter-Word Identification, and Applied Problems, even after controlling for fall WJ III scores. In a later similar study with kindergarteners, Ponitz et al. (2009) found that, controlling for child background

characteristics and fall WJ III scores, fall HTKS scores predicted end-of-year WJ III mathematics scores. These two studies attempted to isolate the effects of self-regulation at school entry from children's general academic and cognitive ability, and their findings suggest that, even controlling for entering academic skills, children's self-regulation is an important predictor of achievement.

Entering skills versus growth in self-regulation. Although evidence suggests that self-regulation is an important school entry predictor of achievement, less is known about how these skills might change over time. Perhaps the most important aspect of the McClelland et al. (2007) study is that, unlike the other research in this area, this study considered both children's initial self-regulation, as well as their gains in self-regulation over the course of the year. Like prior work (e.g., McClelland et al., 2000), this study demonstrated that children's entering behaviors and skills predicted their academic outcomes at the end of the prekindergarten year. In addition, by administering the HTKS (Ponitz et al., 2008) task and the WJ III (Woodcock & Mather, 2000) subtests in both fall and spring, McClelland et al. (2007) were able to measure both children's gains in self-regulation and gains in their academic skills. Their results showed that *gains* in self-regulation positively related to gains on the WJ III Letter-Word Identification, Picture Vocabulary, and Applied Problems subtests. This study provides at least preliminary evidence that pre-kindergarten growth in self-regulation is positively related to overall academic growth, regardless of children's initial starting point.

Malleability of Self-Regulation

As discussed, a variety of studies using many different measurement tools points to self-regulation as an important factor in children's academic success in school. However, most studies use only one type of self-regulation assessment, and only a few examine growth in self-regulation. Thus, more work is needed that employs a variety of measurement tools to assess children's self-regulation, and cognitive abilities, over time. Despite the limitations, there is preliminary evidence that children's gains in this important area are positively related to their academic gains, indicating that early intervention targeting children's self-regulation may have benefits for their academic achievement and success.

Given that self-regulation is important for achievement and early school success, one might ask whether self-regulation is actually malleable, and if so, what facilitates its growth and development. In fact, there is a small, but growing, set of research studies examining the effects of various interventions designed to foster self-regulation growth. These interventions have largely fallen into two categories: supplementary and curricular. Supplementary-type activities, like computerized training, sports, and martial arts, have shown some benefits for children's self-regulation, particularly for older children (Diamond & Lee, 2011). There are also curriculum-based approaches that are more commonly integrated into an early childhood classroom setting. Among these are the Chicago School Readiness Project (CSRP; Raver, Jones, Li-Grining, Zhai, Bub, & Pressler, 2011), Head Start Research-Based, Developmentally Informed program (REDI; Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008), and Tools of the Mind (ToM; Bodrova & Leong, 2007). REDI and CSRP focus primarily on improving teachers'

classroom management strategies as a way of fostering better behavioral regulation among pre-kindergarten children. ToM embeds Vygotskian developmental principles into children's everyday activities within the classroom, and focuses specifically on the cognitive components of self-regulation. All of these curriculum-based programs have primarily targeted pre-kindergarten children from economically-disadvantaged backgrounds, as children from low-income families are especially at risk of having low self-regulation (Howse, Lange, Farran, & Boyles, 2003; Li-Grining, 2007; McClelland et al., 2007; Sektnan, McClelland, Acock, & Morrison, 2010).

Thus far, research investigating the effects of both supplementary and curricular programs has been relatively limited. The supplementary programs are largely based on ideological beliefs about how self-regulation develops. The curricular approaches have focused on either the emotional tone of the classroom (i.e., CSR and REDI), or creating classroom activities thought to foster self-regulation (i.e., ToM). Perhaps it is still too early to design large-scale curricular interventions designed to foster self-regulation, when its malleability is still undetermined and the mechanisms underlying its development are still unclear. Thus, an examination of the theoretical framework and empirical evidence concerning self-regulation and its relationship to other cognitive processes may prove helpful.

Language and Self-Regulation

When considering what might foster self-regulation development, both internal processes, like language development, and external environments, like classrooms, should be examined. From a socio-cultural perspective, both aspects are important and

intertwined. Language shapes the way that children understand and interact with the world around them, and how they relate those interactions to their own behavior. Classrooms provide an opportunity for complex social interactions that potentially facilitate self-regulation development. As the first introduction to school for many at-risk children, the pre-kindergarten classroom is a particularly rich environment for considering how self-regulation develops, and its relationship to language.

Language as a Metacognitive Tool

During early childhood, children's self-regulation development coincides with rapid development in language skills, such that language may actually play an important part in how children organize their thoughts, emotions, and behavior (Dickinson, McCabe, and Essex, 2006). Language facilitates children's internalization of social structures and rules through their interactions within the social world around them (Vygotsky, 1962). For example, children's developing language has been linked with perspective-taking and understanding others' emotional states or points of view (Nelson, Skwere, Goldman, Henseler, Presler, & Walkenfield, 2003.) Nelson et al. (2003) write that this

... developmental change is presumed to be the gradual result of interactions between the sense-making child who experiences the world in different ways as increasing knowledge and competence develop, and communicating others in the social world, who support and guide the child in interpreting experience (p. 36).

In other words, as children interact with others, their understanding of others' perspectives and expectations is broadened. This perspective suggests that language helps children understand their experiences, as well as the experiences of others, and it is through language that children relate this information to their own behavior.

According to Vygotsky, children's development of self-regulation is intimately tied to their language development. They use language (at first externally, then internally) to regulate their behavior. For example, Vygotsky suggested that children use self-talk, or private speech, as "an intrapsychological tool for regulating thought and behavior" (Winsler et al., 2003, p. 584). Some evidence indicates that children engage in private speech throughout elementary school (Azmitia, 1992). However, more recent work has shown that, typically, private speech peaks during preschool, and then begins to progressively become more internalized as children age (Winsler et al., 2003). The timing of this peak in private speech coincides with the key years for early childhood self-regulation development.

Research regarding children's use of private speech has suggested that self-talk seems to guide children's cognitive functioning, helping them work through difficult problems. Children's use of private speech may also play a critical role in the shift from other- to self-regulation – from external to internal. Laboratory work has shown that children are more likely to engage in private speech when faced with challenging tasks without adults present (Berk & Garvin, 1984). In a classroom setting, children are more likely to engage in private speech in the classroom when they are engaged in open-ended activities, such as fantasy play. Closed-ended, teacher-directed activities, however, are less likely to elicit children's self-talk (Krafft & Berk, 1998).

Private speech has been shown to relate to expertise and task performance in laboratory studies. Children with a greater level of initial expertise in a certain area are more likely to produce private speech during difficult tasks (Azmitia, 1992). However, research also demonstrates that novice children can learn to apply this skill to unfamiliar tasks (Azmitia, 1992). Further, increased use of private speech has been associated with improved performance, indicating that private speech is a teachable strategy (Azmitia, 1992; Winsler, Diaz, Atencio, McCarthy, & Chabay, 2000; Winsler, Manfra, & Diaz, 2007).

Perhaps children with better language skills develop strategies, like self-talk, that help them regulate their behavior. In turn, these positive self-regulatory skills further enhance their ability to navigate social interactions with others. Conversely, children with weaker language skills may have trouble regulating their behavior – and interacting with teachers or peers. Some have suggested that language difficulties may be an explanatory factor in tracing the root causes of behavior problems, such as aggression or attention-deficit hyperactivity disorder (ADHD; Cohen, Vallance, Barwick, Im, Menna, Horodezky, & Isaacson, 2000; Tannock & Schachar, 1996). Though this relationship is correlational in nature, it further corroborates the link between language and self-regulation development.

Language and behavior problems. Language skills have been shown to predict problem behaviors in children, such as aggression and difficulty fitting in with peers. Gallagher (1993) suggested that children with low language skills might experience difficulty interacting with peers because their actions are often misunderstood or unclear.

These difficulties can follow children into school and affect the way they interact with others and engage in learning opportunities.

Indeed, often language problems and behavioral difficulties are related. In their observational study of children enrolled in Head Start classrooms, Qi and Kaiser (2004) found that language delay was associated with increased physical aggression, as well as disruptive behavior. Their results led them to hypothesize that these behavior problems may arise out of children's unsuccessful attempts at communicating with others. Over time, the frustration children experience from not being able to communicate effectively with peers can have negative consequences for their behavior. For instance, Hooper et al. (2003) demonstrated that expressive and receptive vocabulary skills in kindergarten were correlated with the likelihood of teacher-reported behavior problems into third grade. In fact, as children grew older, their language difficulties were even more highly predictive of problem behaviors. Along the same lines, Dionne, Tremblay, Biovin, Laplante, and Perusse, (2003) found a small but significant correlation between physical aggression and expressive vocabulary among 19-month-olds. In that study, children with more developed expressive language had fewer instances of physical aggression. This study is especially intriguing because the children who were studied were twins who were being raised in the same home with the same parents. Their shared environment provides support for the idea that the aggression problems were attributable to differences in their language skills, rather than other environmental factors.

Work with children diagnosed with ADHD further supports a connection between language skills and self-regulation. Singer and Bashir (1999) posit that "Together, executive functions and self-regulatory processes are central to cognitive, linguistic,

behavioral, and affective control – all of which are fundamental to learning and success in school” (p. 266). One possible explanation for the co-occurrence of language problems and ADHD is that a common underlying problem is related to both. That underlying problem could be difficulties in self-regulation – particularly the core skills of working memory and attention (Cohen et al., 2000; Tannock & Schachar, 1996). Another possible explanation for the comorbidity of language problems and ADHD might be that children with ADHD have difficulty with the type of rule-governed language involved in self-regulatory processes (Westby & Cutler, 1994). Children who have trouble attending and remembering might have additional difficulty internalizing the language they need to self-regulate.

Language and self-regulation in typically-developing children. Evidence supporting a language–self-regulation link among typically-developing young children is preliminary and only recently emerging. Vallotton and Ayoub (2011) investigated the relationship between vocabulary and self-regulation among toddlers at three time points (14, 24, and 36 months). A behavioral rating scale was used to measure children’s self-regulation, and a videotaped parent-child interaction was used to record the extent of children’s vocabulary. They examined the concurrent effects of language skills on self-regulation at each time point, and they also examined whether language skills at 24 months predicted the growth trajectory of self-regulation at 36 months. Their findings demonstrated that vocabulary was a better predictor of self-regulation growth than overall talkativeness (Vallotton & Ayoub, 2011).

These findings linking language skills to self-regulation development are echoed in another study by Fuhs and Day (2011). Unlike Vallotton and Ayoub (2011), who

utilized a behavioral rating scale to measure children's self-regulation, Fuhs and Day (2011) used teacher ratings of self-regulation, as well as direct child measures of inhibitory control and attention shifting. Further, instead of using a count measure of vocabulary, these researchers administered a standardized measure of receptive and expressive vocabulary. All of the self-regulation and vocabulary measures were administered in the fall and spring of pre-kindergarten to a group of Head Start children. Even with the differences in their measurement tools and the age of the participants, Fuhs and Day's (2011) results echo Vallotton and Ayoub's (2011) findings. Their results showed that children's fall verbal ability was predictive of the change in self-regulation over the course of the pre-kindergarten year.

Socio-cultural Theory and Self-Regulation Growth: Implications for Children's Learning Behaviors

Vygotsky's socio-cultural theory suggests that social interaction is a key component of children's overall cognitive development, including self-regulation (1978). The theory thus implies that the social environment has a specific role in facilitating children's self-regulation growth. Accordingly, Vygotsky theorized that social interactions provide a key mechanism by which children learn to regulate their own emotions, behaviors, and cognition. By engaging in the social world, children first attend to, and then begin to take on for themselves, the behavioral expectations of the culture around them. Children become self-regulated by internalizing the rules and external regulators in the world with which they interact (Rohrkemper, 1989). Internalizing those expectations is a critical first step toward developing self-regulation (Vygotsky, 1978). Children's entry into pre-kindergarten represents their first exposure to a formal learning

environment; it is important, therefore, to consider what types of interactions, or learning behaviors, might facilitate their self-regulation growth. Candidates for these facilitative interactions include children's verbal behaviors, their participation in high-level play, and their engagement in the classroom. All of these aspects of learning behaviors are part of how children interact and engage in the social environment of the classroom.

Social interaction and engagement in the classroom. Classrooms are inherently social environments. Vygotsky (1978) suggested that children need opportunities for social interaction to help them begin to understand and internalize social rules, roles, and expectations for behavior. Within the early childhood classroom, social interactions among children can take many forms, but learning-related social interactions, or play, are of particular interest because they may affect children's self-regulation development.

Parten (1932) described types of play among young children as being parallel, associative, or cooperative in nature, and these categories are still widely used in current research (e.g., Farran & Son-Yarborough, 2001). Parallel learning occurs when children are using similar materials or engaging in a similar learning activity, but each is working independently. Associative interactions occur when children are sharing materials and interacting, but there is no distinguishable goal for the group. For example, children might be sharing blocks and talking with each other, but there is no identifiable plan or goal toward which the group is working. Cooperative play, however, involves children working together with some sort of shared goal, rules, and/or organization. Examples of cooperative play might include acting out interactions between customers and workers at a grocery store, but it could also include activities that require collaboration and turn-taking, such as playing games. Associative play and cooperative play require children to

communicate and work with peers. They require children to monitor their own behavior and adapt to the needs and expectations of the group to accomplish a certain task.

Research linking types of play to self-regulation growth in early childhood is limited. Associative and cooperative forms of play potentially provide the most opportunity for children to talk to one another and to learn to take another's point of view (Farran & Son-Yarbrough, 2001), and this social interaction is thought to facilitate self-regulation growth. However, early childhood classrooms, particularly those serving children from low-income backgrounds, may not do enough to foster these kinds of interactions (Farran & Son-Yarbrough, 2001).

Dramatic play, which has both associative and cooperative elements, may be beneficial for children's self-regulation development. An older, but still quite relevant study, found positive benefits of fantasy play on children's language skills and impulse control (Saltz, Dixon, & Johnson, 1977). This study involved three different conditions in which different groups of pre-kindergarten children participated over the course of one school year. In the *thematic-fantasy play* condition, children listened to and discussed a story and then enacted various scenes in the story. In the *socio-dramatic play* condition, children were engaged in enacting every-day types of experiences, such as a visit to the doctor, or a trip to the grocery store. In the *fantasy discussion* condition, children were read the same stories as in the thematic-fantasy play condition, but they did not act out scenes from the stories. Instead, they engaged in question/answer discussions and were asked to re-tell the stories they heard. The study also included a control condition in which children received the same opportunities to meet in a small group as in the other conditions, but the activities were not focused on fantasy or dramatic play. The outcomes

included a measure of children's vocabulary, and measures of memory and impulse control. Overall, the study found positive effects for both the thematic-fantasy play and the socio-dramatic play conditions that were superior to both the fantasy discussion and control conditions in terms of children's vocabulary and impulse control. Of the two conditions, children in thematic-fantasy play group had the highest scores. The authors suggested that dramatic play boosted children's representational skills (e.g., pretending that a table was a bridge in *The Three Billy Goats Gruff* story) and gave them practice enacting roles – both important aspects of self-regulation development, according to Vygotsky.

There is also evidence that social learning interactions play may be particularly beneficial for children with low initial self-regulatory skills. Elias and Berk (2002) analyzed naturalistic observations of pre-kindergarten children's play, as well as their self-regulatory behaviors in the classroom. Children who were initially the most impulsive and least regulated (i.e., not following clean up procedures) showed the most improvement on self-regulation but only if they participated frequently in complex dramatic play. This was despite the fact that low- and high-impulsive children were just as likely to participate in dramatic play. Solitary play, however, resulted in less improvement in self-regulation over time. Although these results were from a relatively small sample of 51 children from middle-income homes, the findings seem to suggest the potential for differential benefits of participation in dramatic play and for social learning interactions – such that, children with low self-regulation skills may actually benefit most from these types of interactions. However, as discussed further in the following section, it

is necessary to consider the potential difficulty lower-skilled children might face initially in becoming involved in high-level play, such as associative or dramatic play.

Language and opportunity for social interaction. Vygotsky theorized that social interactions are important for the development of children's self-regulation, and although limited, research supports this idea. If, it is true that the kinds of social learning interactions in which children are involved in the classroom are important for their self-regulation growth, a logical next step is to consider what skills would enable children to best engage in those types of learning activities. A common ingredient is children's skill with language, which Vygotsky argued is a critical component and building block of self-regulation development.

Language skills might help determine the types of educational experiences children can access. For instance, children with low-language skills may not be as adept in constructing play scenarios and are perhaps not perceived as valuable play partners by other children (Gallagher, 1993). Low-language children, then, may be excluded from the very types of interactions that could potentially improve both their self-regulation and their language skills. This concern is supported by the finding that children with more advanced language skills participate in more positive and advanced forms of social interaction during peer play, but children with lower language skills more often engage in disruptive and inappropriate play (Cohen & Mendez, 2009; Mendez et al., 2002). Finally, children's engagement in positive peer play has been associated with both stronger receptive language skills and emotional regulation (Cohen & Mendez, 2009).

Children's language skills might be particularly important for facilitating the kinds of high-level play utilized, for instance, in the Saltz et al. (1977) study. In fact, while Saltz et al. (1977) demonstrated positive effects for the two dramatic play conditions, these effects were considerably weaker for children who began the school year with the lowest language skills. The results suggest "that the effects of training for thematic-fantasy play and sociodramatic play are most effective only after children have acquired some prior level of intellectual competence" (Saltz et al., 1977, p. 373). Thus, children with low initial skills may have difficulty engaging in the very learning behaviors that actually facilitate self-regulation growth. Conversely, children with strong language skills might gravitate toward those activities more naturally, or be able to participate more fully when given the chance, thereby further strengthening their self-regulation skills as well.

Language, Learning Behavior, and Self-Regulation: A Mediated Model?

It has been well documented in the literature that children with higher self-regulatory skills at the beginning of school tend to score higher on standardized measures of language and literacy achievement as they progress through school (e.g., Duncan et al., 2007; McClelland et al., 2000). It has been difficult to disentangle the exact relationship between academic knowledge/skills and self-regulation because of the distinct possibility that language skills might actually play a critical role in the development of self-regulation in the first place. In fact, from a developmental as well as theoretical perspective, the close alignment of self-regulation and language might suggest a reciprocal relationship between these two important areas (Dickinson et al., 2006).

Because of the complexities involved in measuring both language and self-regulation, research is needed that employs a variety of assessment tools to paint a more complete picture of children's language and self-regulation skills. In addition, it is important to attempt to determine what kinds of initial skills, as well as classroom experiences, might afford children an advantage in developing early self-regulatory skills.

Perhaps, as suggested, high-level play provides crucial opportunities through which children learn to self-regulate – but they need certain language skills in place in order to participate in those kinds of rich interactions. In this case, then it could be said that the language–self-regulation relationship is actually mediated by children's learning behaviors, such as their verbal interactions, the kinds of play in which they participate, and how involved they are in learning opportunities. It is this area that the current study sought to explore. The research hypotheses for the study included:

Hypothesis I: Children's initial language skills will be positively and significantly related to their gains in self-regulation over the prekindergarten year.

Hypothesis II: Children's initial language skills will be positively and significantly associated with their verbal interactions; high-level play; and learning involvement in the classroom setting.

Hypothesis III: Children's classroom learning behaviors will mediate the relationship between entering language skills and growth in self-regulation.

Chapter III

RESEARCH DESIGN AND PROCEDURES

This chapter details information regarding the research design and procedures, including the information about the intervention, participants, measures, and procedures. The chapter concludes with a summary of the research questions, including the analysis plan.

Research Sites, Intervention, and Participants

Research Sites

The data for this study were collected as part of the *Experimental Validation of the Tools of the Mind Pre-kindergarten Curriculum* study, funded by the U. S. Department of Education Institute for Education Sciences. The first cohort, which was the subject of the current study, included a total of 60 pre-kindergarten classrooms representing 45 different schools in five different school districts. The study began in 2009-10 with teacher training, followed by full implementation in 2010-11. All of the measures used in the current study were collected during the 2010-11 school year. Four of the participating districts were located in Tennessee, and one school district was in North Carolina. Schools were blocked by district and randomly assigned to either the *Tools of the Mind* (treatment) condition or the practice-as-usual condition. All classrooms within a single school were assigned to the same condition. The intervention group

included 32 classrooms that implemented *Tools of the Mind* (ToM), and the comparison group included 28 classrooms that conducted practice as usual. More than half of the comparison classrooms were using “Creative Curriculum,” while others used more blended, less defined curricula. The full ToM analytic sample included 828 children across both conditions who were administered at least one fall and one spring assessment.

The Intervention

This study utilized data taken from a larger experimental study investigating the effects of the *Tools of the Mind* (ToM) curriculum (Bodrova & Leong, 2007). The *Tools of the Mind* curriculum is purported to foster the development of children’s self-regulation in the pre-kindergarten classroom. ToM embeds Vygotskian principles of how self-regulation develops through children’s everyday activities and interactions within the classroom, and focuses specifically on the cognitive components of self-regulation. For instance, many ToM activities are designed to encourage children’s use of private speech to guide their actions and behavior. During “graphics practice,” children used speech to guide early handwriting practice, by repeating various instructions to themselves (i.e., “line, dot” to make the letter “i”). ToM activities also helped children transition between other-regulation and self-regulation through the use of “mediators” – specific tangible reminders of their roles in a classroom activity. For example, during “buddy reading,” children took turns reading books to each other. One child had the speaking role and was provided with a card with a picture of lips on it. The other child was the listener and had a card with an ear on it. Halfway through the activity, the children swapped cards and took the opposite role. The goal of both the private speech- and mediator-based activities was

that these external regulators would become less important to children as they internalized the processes/rules for themselves. Finally, a major focus of the curriculum was to engage children in complex pretend play in which they took on specific roles, used role speech, and interacted with others within their roles. ToM specifically incorporated both language-related and social aspects of self-regulation development into classroom activities.

Teachers who were assigned to the ToM condition began training on the curriculum prior to the start of the 2009-10 school year. They were given a year to learn the curriculum and practice implementing parts of it before the full-scale evaluation in 2010-11. The current study did not specifically address the effectiveness of the ToM curriculum. In fact, children's outcomes were indistinguishable between treatment and control classrooms (Farran et al., 2011). In addition, teachers assigned to the experimental condition varied considerably in how fully they implemented the curriculum; there was a wide range of classroom practices across both control and intervention classrooms. Therefore, the current study's analyses examined the full sample of children, without controlling for experimental condition. As children's first exposure to formal schooling, the pre-kindergarten classroom represents an intriguing context for facilitating self-regulation. This study utilized data collected during the course of the effectiveness study in order to explore the relationship between language skills and self-regulation in early childhood.

Participants

The pre-kindergarten programs that participated in the ToM study largely served children from low-income backgrounds. These programs were specifically designed to boost the early school readiness skills for children who were considered at-risk at the start of formal schooling. Some programs operated as part of traditional elementary schools, and others were part of Head Start, in which children's families must not exceed certain income limits in order to enroll. Thus, almost all of the children represented in the current study were from low-income backgrounds.

The overall ToM sample of students (N=828) was ethnically diverse. The sample was 39.1% White; a quarter of the students was Black and another quarter was Hispanic. A significant portion (over 25%) of the sample included children who were identified as English Language Learners (ELL). Because of their limited English proficiency, and the study's focus on language skills, these children were excluded from the study sample. The rationale for doing so was that children whose native language was not English were given English assessments for both language and self-regulation. Thus, an accurate measure of their facility in either domain was not available, and it was not possible to examine how the domains might interact. The final analytic sample consisted of a total of 549 children – the total number of children who were not classified as ELLs, had data from at least one fall and one spring assessment, and had been present for at least two of three classroom observations during pre-kindergarten. The demographic information for the analytic sample is given in Table 1.

Table 1

Study Analytic Sample Demographic Information

	ToM Condition	Comparison Condition	Overall
Mean Age (mos.)	54.0	54.5	54.1
Gender (% female)	47.2	44.4	46.1
Ethnicity (%)			
Black	41.0	31.6	37.2
Hispanic	2.2	2.2	2.2
White	51.2	56.4	53.4
Other	5.6	9.8	7.2

Note. N = 549

Measures

The current study's assessment battery included measures of both children's early language skills and self-regulation that were administered at the beginning and the end of the pre-kindergarten year. In addition, children's learning behaviors were measured using observations of children in their classrooms. These observations were conducted three times during the 2010-11 year. The following sections describe these measurement tools, while the subsequent composite development process is described in Chapter IV.

Language

Standardized measures. The Woodcock-Johnson III Tests of Achievement consist of 22 norm-referenced subtests (Woodcock, McGrew, & Mather, 2001). Three subtests of the WJ III were used to assess children's language skills, including Oral Comprehension, Picture Vocabulary, and Academic Knowledge. The WJ III has established reliability and validity and is appropriate for use with children ages two and older (Woodcock et al., 2001). The Oral Comprehension subtest assesses children's ability to fill in a missing word in a sentence based on semantic and syntactic cues (e.g., "Water looks blue and grass looks _____"). Children's expressive language was assessed using the Picture Vocabulary subtest. In this subtest, children are presented with a series of pictures, and they are asked to supply the correct noun to label the picture. The Academic Knowledge subtest was also administered, and it measures factual knowledge in science, social studies, and humanities. For example, when presented with pictures of a bird, a mouse, a cat, and a fish, children are asked to put their finger on the "one that flies." For the purposes of this study, the Academic Knowledge subtest was used as a language measure because it not only assesses children's subject-matter specific knowledge, but it also requires their understanding of connected text and questions in order to answer correctly.

Traditionally, scores on the WJ III are calculated in two different ways: *W* scores and standard scores. Standard scores are age-adjusted and designed to have a mean of 100 and a standard deviation of 15 (Woodcock et al., 2001). *W* scores are based on a specialized type of Rasch scoring and are adjusted for item-level difficulty. Because *W*

scores are more sensitive to change, they were used in the study's analyses. However, for ease of interpretation, means and standard deviations are presented as standard scores.

Teacher ratings measures. In addition to direct assessments of children's language skills, the study also included teacher ratings of children's language. Teachers used the Adaptive Language Inventory (ALI; Feagans, Fendt, & Farran, 1995) to rate children's language skill and usage in the classroom in relation to their peers. The ALI consists of 18 items on a 5-point scale ranging from well below average (1) to well above average (5). The items focus on children's comprehension, production, rephrasing, spontaneity, listening, and fluency. A sample item from the ALI is shown in Figure 1.

<i>Responds to questions asked of him/her in a thoughtful logical way.</i>				
1	2	3	4	5
Well below average	Somewhat below average	Average for his/her age	Somewhat above average	Well above average

Figure 1. Sample Adaptive Language Inventory (ALI) Item

Self-Regulation

Individual assessments. The ToM study included five individual assessments of children's self-regulation: Peg Tapping (Diamond & Taylor, 1996); Head, Toes, Knees, Shoulders (Ponitz, McClelland, Jewkes, Connor, Farris, & Morrison, 2008); the Dimensional Change Card Sort (Zelazo, 2006); Copy Design (Osborn, Butler, & Morris, 1984), and the Corsi blocks (Berch, Krikorian, & Huha, 1998). These measures are designed to capture a range of children's self-regulatory/executive functioning skills, and

have been used in a variety of previous studies (e.g., Lipsey, Farran, Turner, & Dong, 2012). (See Appendix A for test-retest reliability information for each of the following measures, taken from a recent self-regulation measurement study.)

The Peg Tapping task (Diamond & Taylor, 1996) is a test of inhibitory control. Children are told to tap a wooden peg twice when the assessor taps once and to tap once when the assessor taps twice. The challenge is to inhibit the predominant response of simply copying the assessor's actions. There are a total of 16 items, and each is worth one point for tapping the correct number of times. A higher score on this measure indicates greater inhibitory control; a score of -1 indicates that the task was aborted because the child could not successfully complete the training portion. The Peg Tapping task has been used to assess inhibitory control in young children and has been shown to be positively related to children's social-emotional functioning (Rhoades, Greenberg, & Domitrovich, 2009) and academic outcomes (Blair & Razza, 2007). The predictive validity correlation between Peg Tapping scores at pre-kindergarten entry, and academic achievement outcomes at the end of pre-kindergarten was .56 ($p < .01$) (Turner, Lipsey, Fuhs, Vorhaus, & Meador, 2012).

In Head, Toes, Knees, Shoulders (HTKS; Ponitz et al., 2008), children are asked to play a game of opposites. They are instructed to touch their heads when the assessor says to touch their toes, and to touch their toes when the assessor says to touch their heads. If children pass the first part of the game, then they play a more advanced version which includes commands for knees and shoulders as well. HTKS is a test of inhibitory control because it requires children to inhibit the response of simply copying the assessor, but they also must use working memory and attention skills as well. For each item,

children can score two points for a correct response, one point for a self-corrected response, or a zero for an incorrect response. There are six practice items and 20 test items, for a total possible score of 52, and higher scores indicate stronger self-regulation. HTKS has been used previously with both pre-kindergarten and kindergarten children to measure early self-regulation (e.g., McClelland et al., 2007; Ponitz et al., 2009). HTKS also has strong predictive validity for academic achievement outcomes ($r = .54, p < .01$) (Turner et al., 2012).

In the Dimensional Change Card Sort (DCCS; Zelazo, 2006) task, children are asked to sort a group of cards by one characteristic (e.g., color) and then by a different characteristic (e.g., shape). If they are successful, then another sorting rule is added to make the task more difficult (e.g., sorting one way if the card has a border and another way if there is no border). The DCCS is defined as an attention-shifting task (Garon, Bryson, & Smith, 2008) because children must shift their attention to different characteristics of the card based on which rule they are asked to follow. Higher scores on this measure indicate stronger skills in attention shifting. This task has been used to measure attention shifting in young children in prior research (e.g., Bialystok & Martin, 2004). It has predictive validity for pre-kindergarten achievement ($r = .45, p < .01$) (Turner et al., 2012).

The Copy Designs (Osborn et al., 1984) task is a test of persistence and sustained attention. Children are asked to copy a series of eight geometric designs. They are given two attempts for each design and they are scored based on how well they copy each figure. Children score two points if both attempts are correct, one point if one attempt is correct, and zero if neither attempt was correct. The total possible score is a 16, with

higher scores indicating greater attention and focus. Its predictive validity for pre-kindergarten academic achievement was .41 ($p < .01$) (Turner et al., 2012).

In the Corsi Blocks (Berch et al., 1998) activity, children are asked to point to a series of blocks in the same order as the assessor demonstrates. A second task asks children to copy the administrator's pointing but in reverse order. More difficult items require children to repeat longer patterns with more blocks. This task is a measure of working memory, and it is scored based on the longest pattern span that the child can correctly reproduce. The maximum score for forward span is nine points and the maximum for backward span is seven points. Higher scores indicate a stronger working memory. A similar, but slightly different working memory task was included in a recent self-regulation measurement study. This task had predictive validity ($r = .42, p < .01$) that were similar to other self-regulation assessments (Turner et al., 2012).

Teacher ratings measures. In addition to the child assessments, children's self-regulation was also rated by their teachers using the Cooper-Farran Behavior Rating Scales (CFBRS; Cooper & Farran, 1988). The CFBRS consists of 37 items in two subscales. For the purposes of this study, the Work-Related Skills (WRS) subscale was used as a rating of children's self-regulation. The WRS includes 16 items on a 7-point scale with behavioral anchors at 1, 3, 5, and 7. WRS items assess children's attentiveness, ability to follow directions, and task persistence. An example of a WRS item is shown in Figure 2.

9 LISTENING TO TEACHER GIVING INSTRUCTIONS TO GROUP						
1	2	3	4	5	6	7
Seems to ignore the teacher, is very distracted and distracting		Can maintain attending behavior with frequent reminders from the teacher		Occasionally inattentive' attention is easily regained by a cue from the teacher		Attends to the teacher without reminders

Figure 2. Sample Work-Related Skills (WRS) Item

Child Learning Behaviors

Child observation measure. The current study used data from the Child Observation in Preschool (COP; Farran et al., 2006) to characterize key aspects of children's learning behaviors in the classroom. The COP is a snapshot-based observational system that can be used to record children's behavior in pre-kindergarten across a typical day. Taken together, this collection of snapshots provides a picture of how children spend their time in a classroom (Farran et al., 2006). The COP consists of a total of nine different dimensions, including: whether the child is talking or listening; to whom the child is talking/listening; schedule (e.g., whole group, small group, centers, transition); proximity to others; interaction (e.g., nonacademic, parallel, associative); type of task (e.g., passive instruction, non-sequential, sequential); level of involvement (rated 1-5, low to high); type of materials (e.g., literacy, math, art, music/movement); and learning focus (e.g., literacy, math, dramatic). A sample COP form is shown in Figure 3.

X out	No	Teacher	WG	Teachr	NonAcad	Pass Inst	High	Math	Literacy
	Yes	Child	SG	Child	Parallel	Non Seq	MedH	Literacy	LangArts
	Listen	Sm Grp	Centers	SG	A Ssoc	SeQ	Med	SCience	Reading
	FssCry	SGT	SGC	SGT	A SsocP	Fantsy Dr	MedL	Soc. Studies	Math
		Wh Grp	Transition	WG	Coop	None	Low	Toy	SCience
		WGT	Transitionl	WGT	CoopP	Other		Art	Soc. Studie s
		Self	MealTime	Self	ALone	SOCial		Music/Move	Drama
		No Talk	Other		Onlooker	Disruptive		Dramatic	Other
					SOCial	Disruptive X		Computer	None
					Unocc	TimeOut		Worksheet	
					TimeOut			TV / video	
								Can't Code	
								None	

Time	SW	Verbal	To Whom	Schedule	Prox.	Interact	Type Task	Invol.	Material	Focus
	1									
	2									
	3									

Figure 3. Sample Child Observation in Preschool (COP) form.

At the beginning of each COP observation, the observer recorded identifying information about each child to be observed so that the child could be located throughout the day. Then, the observer began with the first child on the list, observed his/her behavior for a period of three seconds, and then coded the child's behavior across the nine dimensions. Then, the observer coded the behavior of the next child in the class, and so on until the entire class had been coded, and then the observer began again with the first child. Over the course of the day, a total of 20 snapshots (or sweeps) was recorded for each child. The aggregate of these snapshots/sweeps by child provides a picture of how children were spending their time in the classroom. COP observers did not code children during nap times, or when they were outside of the classroom.

Not all of the COP data collected were of interest to the current study. This study was initially concerned with three different conceptually-based areas of children's

learning behaviors in the classroom: Verbal Behavior, High-Level Play, and Involvement. For the purposes of this study, the learning behavior variables were derived from the following COP categories: Verbal/To Whom, Interaction, Type of Task, and Involvement. These categories, and the aspects of children's learning behavior that they represent, are described below in greater detail. In the interest of concision, only the learning behavior codes that are relevant to the current study are described. (For a full description of all COP categories and codes, see Farran et al., 2006).

In this study, the *Verbal/To Whom* category combined two COP dimensions, and captured whether the child was talking or listening, and to whom. This study was concerned with children's verbal interactions in the classroom, so listening to teacher, talking to teacher, listening to child, and talking to child were all included in the analyses. Further, because of the theoretical basis and empirical evidence supporting the use of children's self-talk in developing self-regulation, this behavior was also of interest.

The *Interaction* category coded the nature of children's learning interactions, given whatever type of activity in which they were participating. Associative interactions occurred when a child was working with others (one or more teachers or other children) on a shared activity, trying to accomplish a common goal, or co-creating something together. Examples of associative interactions included: children working in a small group to build a tower in the block center; children acting out a family dinner scenario in the dramatic play center; or children having a brain-storming session about "what policemen do" in whole group. Cooperative interactions were defined as a child working with others (one or more teachers or other children) in a context that included specified steps or rules. The cooperative code was most frequently used when children were

playing either ready-made, or teacher-created games. Two other important codes in the Interaction category were “Non-Academic,” which was used for times when there was no specific learning activity or objective present (such as during transition times), and “Unoccupied” which was used when children were off-task and inattentive despite the fact that there was a learning activity available to them.

The *Type of Task* category captured the nature of the learning task and material in which the child was engaged. Because this study examined children’s participation in high-level play, the Sequential code was of interest. Children’s learning was coded as sequential when the task involved a sequence of steps. An observer coding a child’s behavior as sequential was able to make a general prediction about what the child would do next. Examples included: assembling a puzzle, sorting counting bears by color, “reading” books alone or with a partner, or completing a pattern with blocks. The Fantasy/Drama code was used when children were engaged in dramatic play involving roles and scripts/scenarios taken from everyday life (e.g., children acting out a “restaurant” in which there are customers, servers, and cooks), or fantasy (e.g., children acting out scenes from *Goldilocks and the Three Bears*). The Type of Task category also included codes for children exhibiting disruptive behavior, or being placed in time out.

Children’s *Involvement* was rated on a five-point scale, from low to high. Children were considered to be highly involved (5) when they displayed an intense focus on the activity and would have been difficult to distract from the task. Children who displayed a medium (3) level of involvement (i.e., paying attention or complying but without enthusiasm for the activity) could easily have left the task at hand to do something else. Children who exhibited low (1) levels of involvement were completely

disinterested in the task. The COP also allowed for codes of medium-high (4) and medium-low (2) for children whose involvement fell in between categories.

Procedures

Child assessment and observation data used in this study were collected during the 2010-11 school year. Key steps were taken to ensure data reliability and accuracy in both the administration of child assessments, and in the observation of children in classrooms.

Child assessments. Child assessments were administered by a group of assessors made up of full-time project staff members, graduate students, and additional part-time staff. The assessors were trained during the summer of 2010. The training and certification process included several steps to insure assessor accuracy and reliability. Each assessment was carefully scripted in order to make the administration process as uniform as possible. First, assessors took part in an intensive workshop at the Peabody Research Institute (PRI) where they were introduced to each measure and its script, and given instructions about its administration. Next, they administered practice assessments to PRI certified assessors who provided feedback on their test administration techniques and scoring. Third, they administered assessments to pre-kindergarten-aged children enrolled at an area daycare center that was not participating in the experimental ToM study. These assessments were video-recorded and returned to PRI along with the assessment scoring files. (Assessment records were stored electronically using tablet notebook computers.) Project staff (consisting of certified, experienced assessors) then reviewed each video to ensure proper test administration procedures were followed for

each assessment protocol and script, and they also checked the assessment scoring records for accuracy. The requirement for certification was a score of 85/100 overall. If an assessor made both an administration/script error and a scoring error on one measure, he/she automatically failed certification. Each assessor was given up to three chances to pass the video certification.

Once assessors passed the certification test, then they were assigned children to assess. An additional reliability check was done mid-way through the fall assessment window that required assessors to submit a new video-recorded assessment to make sure they were remaining consistent in their test administration. In addition, assessors received refresher training prior to the second round of assessments in the spring, and they completed another video certification to ensure their scoring and administration of assessments followed protocols and maintained sufficient reliability. Another video reliability check was done mid-way through the spring assessments as well.

Child observations. At the conclusion of the fall assessment window, assessors were trained on using the COP to observe children in classrooms. The observers included individuals who were knowledgeable about pre-kindergarten classrooms and young children. The process for observation training was similar to that of assessment training. Initially, observers were introduced to the COP through a workshop, and they were provided an extensive manual describing each of the COP dimensions (or categories) and giving examples of the types of behaviors most frequently seen in classrooms. They also had practice coding short video clips of children's behavior. Next, they visited the observation booth at a non-study pre-kindergarten where they practiced coding in a small group with an experienced COP coder. Then, they visited additional non-study

classrooms with an experienced COP coder and worked one-on-one to improve coding accuracy and speed. Finally, each coder visited study classrooms with an experienced coder and completed an official COP reliability in which both coders worked simultaneously to code the children in the classroom, but without talking or comparing codes until the end of the observation. The goal was for observers to achieve a minimum of 85 percent agreement across all categories in order to be approved to observe classrooms independently. The one exception was the Involvement category where the minimum for exact agreement between raters was 80%. The observations took place at three times (fall, winter, spring) during the school year, and reliability visits were conducted at the beginning of each observation window to protect against coder drift.

Observation reliability. Reliability for the child observations was established through the reliability visits discussed above. Cohen's Kappa for inter-rater reliability across all observations was .84, indicating strong agreement among observers. Across the three observation periods, the individual field-based reliabilities for the COP Verbal and To Whom categories were .79 and .79, respectively. The reliabilities for Interaction, Type of Task, and Involvement were .88, .77, and .69, respectively. Each pair of COP observers discussed any coding disagreements and reached consensus before turning in their final data.

Assessment procedure. Children were assessed in the fall and spring of the pre-kindergarten year. Assessors began testing children at the beginning of the school day and continued for as long as possible, usually until the end of the school day (nap time or recess, in most cases). Assessments were individually administered to each child, and while the specific locations varied by school, every attempt was made to find a quiet and

somewhat private area (e.g., vacant classrooms, school libraries, unoccupied offices, quiet hallways). In order to keep the assessment session time to around 30 minutes (and reduce the chance of child fatigue), the assessments were administered in two separate sessions on two separate days.

Observation procedure. Observations were conducted three times (fall, winter, spring) during the year in each study classroom. The primary purpose of the observations was to capture how children were spending their time in the classroom. Classrooms were observed for the entire school day. Children were not observed when they were out of the classroom (i.e., during recess, bathroom trips, or specials), or during nap time. Some classes ate meals in their classroom, but others went to a cafeteria for meals. Meal times were only coded if they occurred in the classroom, and only one sweep was completed during meal times. On average, each observer coded between eight and ten classrooms per observation period, and each was assigned to visit different classrooms in both conditions to control for the possibility of an observer effect on ratings. Classroom teachers were aware of the dates of observation well in advance and were simply told that observers wanted to see a typical day in their classrooms. Observers used tablet notebook computers to electronically record their observational data.

Research Hypotheses and Related Analyses

This study examined three primary research hypotheses regarding the relationships between children's language skills, their learning behaviors in the classroom, and their self-regulation gains. Before the study's hypotheses could be tested, however, significant preliminary analyses were conducted to create the necessary

language, self-regulation, and learning behavior composite variables. Through this preliminary work, children's language and self-regulation measures were combined into two separate composites using factor analysis. Further, children's learning behaviors (drawn from the child observational data) were first conceptually grouped, then analytically reduced, to represent learning behaviors that would be most facilitative of self-regulation gains. (This data reduction process is described in Chapter IV.)

Hypothesis I: Children's initial language skills will be positively and significantly related to their gains in self-regulation over the pre-kindergarten year.

The first hypothesis investigated whether children's language skill (assessed in the fall of pre-kindergarten) would be related to their self-regulation gains over the course of the year. It was hypothesized that children's entering language skills would have a significant, positive association with gains in self-regulation.

Regression analysis was used to test this hypothesis. The model used classroom-mean centered variables to isolate child-level differences. The analysis tested for a positive, statistically significant ($p < .05$) relationship between children's initial language skills and their self-regulation gains during pre-kindergarten.

Hypothesis II: Children's initial language skills will be positively and significantly associated with their verbal interactions; high-level play; and learning involvement in the classroom setting.

The second hypothesis investigated whether children's entering language skills influenced how they interacted in the classroom, and the types of activities in which they participated. Initially, the COP variables were grouped conceptually into three different

categories (verbal behavior, high-level play, and involvement). (These categories were further refined in preliminary analyses as described in Chapter IV.) It was hypothesized that children's strong initial language skills would be associated with more frequent participation in the key learning behaviors of interest. Specifically, children with stronger language skills were predicted to participate more frequently in verbal interactions and high-level play, and display higher levels of involvement during learning activities.

Hypothesis II was tested as part of the mediation model detailed under Research Question III. The *a* path coefficients (see Figure 3) tested the relationship between entering language skills and each of the classroom learning behavior variables of interest. The path coefficients were examined to determine if there were statistically significant ($p < .05$) associations between entering language skills and children's verbal interactions, high-level play, and learning involvement.

Hypothesis III: Children's classroom learning behaviors will mediate the relationship between language and self-regulation.

The final hypothesis attempted to tease apart the relationship between language and self-regulation to identify a potential mechanism by which language might facilitate self-regulation growth. According to Baron and Kenny (1986), "a given variable may be said to function as a mediator to the extent that it accounts for the relation between the predictor and the criterion" (p. 1176). In this case, of interest was whether children's learning behavior in the classroom would mediate the relationship between their initial language skills and their self-regulation gains.

As described in the preceding chapter, language and self-regulation are considered closely linked in early childhood. In fact, so closely aligned are these developmental processes that it is difficult to determine the mechanisms by which children develop self-regulation without factoring in the important role that language plays. Examining the language–self-regulation relationship in a mediational framework could improve the understanding of the relationships between these variables. In fact, “...mediators represent part of the causal relationship between the independent and dependent variables often unaccounted for in typical simultaneous regression analyses” (McWayne & Cheung, 2009, p. 280). By considering the possible mediating role that learning behavior in the classroom might play, a more nuanced model of the language–self-regulation relationship could be examined.

Figure 4 depicts the hypothesized mediation model. In Figure 4, a and b represent the mediated (or indirect) effects, and c' represents the effect of children’s language skills on their self-regulation growth, after controlling for the child learning behaviors mediator. Through a mediational approach, this analysis examined if classroom

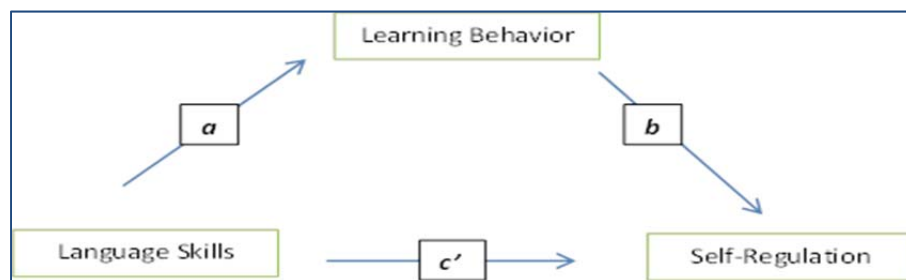


Figure 4. Mediator model (adapted from Baron & Kenny, 1986; Zhao, Lynch, & Chen, 2010).

learning behaviors (i.e., verbal behavior, high-level play, and involvement) explained the effect of language skills on children's self-regulation gains. The essential question involved whether children's learning behaviors differed because of their initial language skills, and if those differences in classroom behaviors explained differences in their self-regulation growth during the pre-kindergarten year.

There is currently debate in the literature regarding the most appropriate analysis strategy for testing mediation with nested data (e.g., Pituch, Murphy, & Tate, 2010; Preacher, 2011). While Pituch et al. (2010) suggest that multilevel modeling (MLM) can be used for testing mediation in 2-level (children within classrooms) nested datasets, Preacher (2011) maintains that multilevel structural equation modeling (MSEM) is necessary. Regardless of the arguments for one type of analysis or another, the basic rationale for using these types of strategies is to appropriately adjust standard errors for nesting because children sampled from within the same classroom are more likely to be similar to one another than children sampled from different classrooms.

The mediational model used for these analyses tested mediation only at the child level, where all of the variables of interest were measured. This model could be tested using structural equation models (SEM) in Mplus software (Muthén & Muthén, 1998-2011). Robust standard errors and a correction for clustering were used to estimate path coefficients, accounting for the nesting of children in classrooms. Further, the mediation model used classroom-mean-centered data in order to isolate the effects for individual children within classrooms (See Chapter IV for more information on this issue). The mediation model was tested using maximum likelihood estimation, as is customary for these types of analyses (See Liew, McTigue, Barrois, & Hughes, 2008 for example).

CHAPTER IV

RESULTS

Descriptive Analyses

The following section presents the descriptive statistics for all of the language, self-regulation, and child learning behavior variables used in the present study. First, the distributions of children's scores on the fall and spring language and self-regulation assessments are described. Then, information about the frequency and variability of the selected child learning behavior variables is presented.

Child Language

Children's language skills were individually assessed in the fall and spring of pre-kindergarten. The language assessments included three standardized subtests of the WJ III: Oral Comprehension, Picture Vocabulary, and Academic Knowledge. Table 2 displays the means and standard deviations of children's fall (Time 1) and spring (Time 2) scores. To ease interpretation, the scores are represented as standard scores, with a mean (M) of 100 and a standard deviation (SD) of 15. Overall, children in this sample scored lower than the mean of the standardization sample on both the Academic Knowledge and Oral Comprehension subtests in the fall. Most of the pre-kindergarten classrooms served children from low-income backgrounds, and this level of performance is typical for that population. On the other hand, children scored at the mean on Picture Vocabulary in both fall and spring of pre-kindergarten, indicating that their vocabulary

knowledge was more similar to the mean of the standardization sample. Children’s scores on the post-test for Academic Knowledge and Oral Comprehension improved over the course of pre-kindergarten, and their scores approached the mean of the standardization sample.

Table 2

Descriptive Statistics for Fall and Spring Language Measures

Source	Fall (Time 1)					Spring (Time 2)				
	N ^a	M	SD	Min.	Max.	N	M	SD	Min.	Max.
Academic Knowledge	547	93.8	13.1	39.2	128.0	536	97.7	11.5	54.0	127.0
Oral Comprehension	547	94.4	11.3	70.0	126.0	537	99.0	11.6	63.0	130.0
Picture Vocabulary	547	100.6	11.7	27.0	136.0	537	101.0	10.0	11.0	125.0
Adaptive Language Inventory	548	3.1	0.8	1.0	5.0	549	3.4	0.9	1.0	5.0

Note: ^a To be included in the study sample, children had to have at least one T1 and one T2 measure, as well two (out of three) classroom observations during the year. These criteria resulted in a total sample of 549 children total children, but because of missing data, the N’s vary by measure.

In addition to standardized assessments, teacher ratings of children’s language usage in the classroom were also collected. Children’s pre-kindergarten teachers rated their language usage on the Adaptive Language Inventory (ALI; Feagans, Fendt, & Farran, 1995) after the first six weeks of school, and again at the end of the year. The

Adaptive Language Inventory consisted of 18 items on a 5-point scale. Scores on the ALI were generated by averaging the individual scores across all 18 items. As shown in Table 2, scores ranged from 1 to 5, with a mean of 3.1 in the fall and a mean of 3.4 in the spring. Per the study sample description in Chapter III, this study excluded children who were designated as English Language Learners. Therefore, the scores presented here represent the variability of language skills among native English speakers.

Child Self-Regulation

Children were also assessed individually at the beginning and end of the pre-kindergarten year on a battery of self-regulation measures designed to assess their working memory, attention, and inhibitory control skills. Table 3 shows the means and standard deviations for the various self-regulation measures. Unlike the WJ III assessments, the individual self-regulation assessments were not standardized. Comparing fall and spring scores revealed that children gained approximately .5 standard deviations on each Corsi Blocks task, as well as the DCCS. Children gained about 1 full standard deviation on both HTKS and Peg Tapping; and on Copy Design, they gained as much as 2 standard deviations between fall and spring.

Children's teachers also rated their self-regulatory and interpersonal skills within the context of the classroom environment using the Cooper-Farran Behavior Ratings Scale (CFBRS; Cooper & Farran, 1988) in the fall and spring of the year. This study used the Work-Related Skills (WRS) subscale of the CFBRS as a measure of children's self-regulation. The WRS mean was 4.7 in the fall and 5.0 in the spring of pre-kindergarten.

Despite the fact that the overall WRS means show little change between fall and spring, there is considerable change as far as how individual children are rated.

Table 3

Descriptive Statistics for Pre- and Post-test Self-Regulation Measures

	Pre-test					Post-test				
	N ^a	M	SD	Min.	Max.	N	M	SD	Min.	Max.
Corsi Blocks–Forward	548	2.5	1.2	0.0	6.0	536	3.1	1.1	0.0	6.0
Corsi Blocks–Backward	547	1.2	1.2	0.0	5.0	536	1.6	1.4	0.0	5.0
DCCS	548	1.4	0.6	0.0	3.0	536	1.7	0.6	0.0	3.0
Copy Design	547	1.0	1.5	0.0	10.0	537	4.6	2.7	0.0	13.0
HTKS	547	11.6	13.6	0.0	52.0	537	24.0	17.0	0.0	52.0
Peg Tapping	547	5.3	5.8	-1.0	16.0	537	10.0	5.4	-1.0	16.0
CFBRS (WRS)	548	4.7	1.2	1.1	7.0	549	5.0	1.2	1.4	7.0

Note: ^a To be included in the study sample, children had to have at least one pre-test and one post-test measure, as well two (out of three) classroom observations during the year. These criteria resulted in a total sample of 549 children total children, but because of missing data, the N's vary by measure. Also, a score of -1 was assigned to children who could not pass the training portion of the Peg Tapping task.

Child Learning Behaviors

Children were observed in their pre-kindergarten classrooms three times during the school year (fall, winter, and spring) using the Child Observation in Preschool (COP; Farran et al., 2006). Of particular interest to the present study were children's talking and listening behaviors, their participation in high-level play, and their involvement in learning activities. As discussed in Chapter III, the COP is a snapshot-type measure, consisting of approximately 20 snapshots (or sweeps) per observation. Descriptive

information regarding children's learning behaviors is listed in Table 4. The proportions were averaged across all available sweeps for each child. For example, if a child were coded as participating in an associative interaction in 10 out of a total of 60 possible sweeps in which he/she was observed, the proportion of sweeps with an associative interaction would be 10/60, or .17. These proportions are represented as percentages of a child's total sweeps in Table 4. The levels of involvement across the day and during learning activities are represented as means on a 1-5 scale, with 1=low involvement, and 5=high involvement.

Verbal behavior. As shown in Table 4, children were coded as listening to the teacher in just over one quarter of their sweeps, with some children being coded as listening to the teacher as much as 53% of sweeps. The proportions of sweeps in which children were coded as talking to other children (9.3%) or talking to the teacher (4.5%) were much smaller. Children were coded as talking to themselves in an average of 6.6% of their sweeps.

High-level play. Of particular interest to this study was children's participation in high-level play, which included associative and cooperative interactions, as well as fantasy/dramatic play and sequential learning activities. As shown in Table 4, children were coded in associative or cooperative interactions in about 10% of their sweeps, with a wide range of variation. (The data are represented in Table 4 as mean proportions, but are discussed here in terms of percentages of sweeps.) They were more frequently coded as participating in sequential activities – 22.9% of all sweeps. Very few children participated in high-level fantasy/dramatic play; in fact, the mean proportion of sweeps coded fantasy/drama was close to zero. Thus, this variable was dropped from the

analysis. (Additional analyses examined instances in which children were playing with dramatic materials as a lower-level form of dramatic play; however, this was unrelated to children's self-regulation gains.)

Table 4

Descriptive Statistics for Child Learning Behaviors (Full Study Sample; N=549)

	Mean	SD	Minimum	Maximum
Child Verbal Behavior				
Self-talk	0.07	0.05	0.00	0.29
Teacher-directed talk	0.05	0.04	0.00	0.23
Child-directed talk	0.09	0.05	0.00	0.24
Listening to teacher	0.26	0.09	0.08	0.53
Listening to child	0.07	0.04	0.00	0.25
High-Level Play				
Associative	0.09	0.05	0.00	0.30
Cooperative	0.01	0.02	0.00	0.11
Fantasy/drama	0.00	0.01	0.00	0.11
Sequential	0.23	0.08	0.02	0.52
Involvement				
Involvement across the day	2.33	0.25	1.60	3.03
Involvement during learning time	2.89	0.26	1.96	3.66
Off-Task Behavior	0.05	0.04	0.00	0.30

Involvement. This study also explored children’s involvement in the classroom. The mean involvement across the day, which included transition times and meal times, was 2.33. The mean involvement during learning time was 2.89. Another measure of children’s involvement in the classroom is the proportion of sweeps in which they were coded as being off-task. Off-task behavior included being unoccupied (when there was an ongoing learning activity available), being disruptive, or being in time out. On average, 5% of all children’s sweeps were coded as being off-task.

Summary of Descriptive Results

The descriptive results demonstrated that the pre-kindergarten children in this sample represented a wide range of entering skills in both language and self-regulation. In addition, children made gains in both language and self-regulation between fall and spring, and there was variability in the amount of gain children made. Finally, there was also variability in the types of learning behaviors in which children engaged in their classrooms.

Preliminary Analyses and Measurement Development

The current study required a considerable amount of measurement development work prior to testing the study’s main hypotheses. This section will present the results of these preliminary analyses, including a description of the cross-validation approach and procedure. This section will also describe the development of the language and self-regulation composites, as well as the process by which child learning behaviors were selected to be used as mediators in the final mediation analysis.

This study employed a cross-validation approach in which a smaller subsample of children was initially selected from the full data set as a “practice” sample. The rationale for this approach was that the smaller practice sample could be used to derive the language and self-regulation composites, and identify the child learning behavior mediators. Then, subsequent analyses could employ these composites to test the research hypotheses – and specifically, the mediation model – with the “cross-validation” sample.

Creating the Practice Sample

Prior to the selection of the practice sample, power analyses were conducted to ensure that if 200 children were removed from the full sample, the remaining sample size of 349 children in the validation sample would be large enough to detect a small-to-moderate effect. The results of these analyses demonstrated that, by the most conservative estimation, a validation sample size of 344 children should be large enough to detect an effect.

In order to ensure that the practice sample was representative of the full study sample, a stratified sampling technique was used. The categories used to create the strata were: gender, ethnicity, age, and a fall self-regulation assessment score. Since gender was already dichotomized (0=female, 1=male), it required no further manipulation. The ethnicity category was collapsed into two groups: white (0) and non-white (1) children. Children’s age was dichotomized as being younger (0) or older (1) than the mean age for the sample. Similarly, children’s fall scores on the Head Toes Knees Shoulders (HTKS) task were also dichotomized as being below (0) or above (1) the mean score for the full sample. This procedure generated 16 different strata in which children could fall – for

example: female, white, younger, low-scoring (FWYL); or male, non-white, older, high-scoring (MNOH). The practice sample was chosen to be representative of the full sample such that each stratum would have the same proportion of children in the practice sample as in the full sample. Children within each stratum were chosen at random to be included in the practice sample, which ultimately included a total of 201 children. The sample of 201 children was distributed across classrooms, with all but 5 (out of 60) classrooms being represented in the practice sample. (For a full listing of the numbers of children by classroom, see Appendix B.)

To ensure baseline equivalence between the practice and cross-validation samples, descriptive data were generated to compare children's demographics and baseline assessment data at Time 1. The gender and ethnic make-up of the two samples was almost identical, as was the average age of each sample (54 months). As shown in Table 5, the two samples of children had remarkably similar performance across all of the pre-test measures. In fact, the means of all the language measures were within one point of each other. As for the self-regulation measures, they were also quite similar with the means being less than .33 points different on any given measure. To be sure that the mean differences were not statistically significant, a t-test was used to compare means from the practice sample and the validation sample. The results showed that the only significant difference in means was for the Corsi Blocks–Forward score. The fall mean Corsi Blocks–Forward score for the practice sample ($M = 2.37$, $SD = 1.32$, $N = 201$) was significantly different from the validation sample ($M = 2.61$, $SD = 1.17$, $N = 347$), $t(546) = -2.19$, $p = 0.03$). Given that this was the only significant mean difference out of all the various language and self-regulation assessments, the two samples were

determined to be comparable. The resulting samples included 201 children in the Practice Sample, and 348 children in the Cross-Validation Sample.

Language and Self-Regulation Composite Development

Once the practice sample was identified, the next step was to develop three composite measures to be used in subsequent analyses. These included: a language composite (based on the WJ III subtests and teacher ratings); and a self-regulation composite (made up of the seven different self-regulation measures and teacher ratings). The following sections will provide details regarding how each of these composites was developed using the practice sample of 201 children. In addition, the process by which the child learning behavior mediator variables were selected will be described.

As discussed in Chapters II and III, the current study recognized that language and self-regulation are likely to be closely linked in early childhood. In fact, there was evidence that some of the self-regulation measures were significantly correlated with the language measures at Time 1 and Time 2 (see Tables 6 and 7). Nonetheless, one of the goals of the current study was to create composite measures to represent language and self-regulation as distinct, but related, constructs in order to test the relationship between them. In order to create these composites, the language and self-regulation assessments and teacher ratings were grouped conceptually, and then each set of assessments was analyzed separately to create the respective composite.

Table 5

Means and Standard Deviations of Language and Self-Regulation Fall (Time 1) Scores for Practice and Cross-validation Samples

	Practice Sample ^a		Cross-Validation Sample ^b	
	M	SD	M	SD
Language Measures				
Academic Knowledge	93.25	13.82	94.08	12.67
Oral Comprehension	94.35	11.42	94.43	11.19
Picture Vocabulary	101.09	10.51	100.24	12.31
ALI	3.10	0.75	3.08	0.76
Self-Regulation Measures				
Corsi Blocks–Forward	2.37	1.32	2.61	1.17
Corsi Blocks–Backward	1.13	1.20	1.23	1.15
DCCS	1.42	0.59	1.35	0.62
Copy Design	0.99	1.45	0.99	1.49
HTKS	11.82	14.13	11.53	13.26
Peg Tapping	5.49	5.96	5.22	5.68
CFBRS (WRS)	4.67	1.16	4.65	1.15

Note: ^a N=201. ^b N=346 for Academic Knowledge, Oral Comprehension, Picture Vocabulary, Corsi Blocks–Backward, Copy Design, HTKS, and Peg Tapping. N=347 for Corsi Blocks–Forward, DCCS, ALI, and CFBRS (WRS).

Language composite. An examination of the zero-order correlations among the four language measures in the full sample (N=549) revealed significant relationships, as shown in Table 6. (Correlations for the practice and cross-validation samples were of similar magnitude; for parsimony, only correlations for the full sample are displayed.)

Correlations among the WJ III assessments were statistically significant ($p < .01$) and ranged from .53 (Oral Comprehension and Picture Vocabulary) to .67 (Academic Knowledge and Oral Comprehension) in the fall and .57 (Oral Comprehension and Picture Vocabulary) to .65 (Academic Knowledge and Oral Comprehension) in the spring. The ALI (teacher ratings measure) was also significantly correlated with each of the WJ III subtests, though those correlations were somewhat lower, ranging from .39 (Picture Vocabulary) to .52 (Oral Comprehension) in the fall and from .40 (Picture Vocabulary) to .58 (Academic Knowledge) in the spring.

Table 6

Pearson Correlations among Measures of Language and Self-Regulation at Time 1 (Full Study Sample; N=549)

	OC	PV	ALI	CBF	CBB	DCCS	CD	HTKS	PT	WRS
Academic Knowledge (AK)	.655	.608	.484	.388	.245	.419	.200	.447	.462	.443
Oral Comprehension (OC)		.526	.517	.359	.296	.389	.216	.495	.450	.436
Picture Vocabulary (PV)			.392	.257	.178	.329	.140	.292	.337	.322
ALI				.347	.271	.293	.274	.358	.404	.770
Corsi Blocks–Forward (CBF)					.259	.328	.277	.344	.417	.402
Corsi Blocks–Backward (CBB)						.257	.170	.216	.245	.269
DCCS							.216	.361	.386	.320
Copy Design (CD)								.235	.323	.267
HTKS									.518	.360
Peg Tapping (PT)										.393

Note. All correlations are significant at $p < .01$.

Table 7

Pearson Correlations among Measures of Language and Self-Regulation at Time 2 (Full Study Sample; N=549)

	OC	PV	ALI	CBF	CBB	DCCS	CD	HTKS	PT	WRS
Academic Knowledge (AK)	.650	.559	.575	.311	.283	.379	.289	.474	.437	.446
Oral Comprehension (OC)		.570	.472	.263	.377	.320	.244	.488	.442	.393
Picture Vocabulary (PV)			.395	.112	.228	.234	.114	.348	.256	.291
ALI				.276	.287	.275	.323	.460	.420	.769
Corsi Blocks --Forward (CBF)					.275	.218	.260	.341	.364	.265
Corsi Blocks --Backward (CBB)						.207	.251	.402	.348	.313
DCCS							.169	.414	.316	.274
Copy Design (CD)								.285	.334	.313
HTKS									.548	.441
Peg Tapping (PT)										.427

Note. All correlations are significant at $p < .01$.

Principal components analysis (PCA) was used to combine the four different language measures into one factor that could be used as a language composite measure in order to preserve parsimony in the results. PCA weights the individual measures (or components) according to the variance explained. Thus, the component that accounts for the most variance in the sample receives the highest weight, and the component that accounts for the least variance receives the lowest weight. These weights are then applied to children's scores on the individual measures (or components), and a factor score is generated for each child. For the purposes of this analysis, those factor scores were then used as a composite measure representing children's language skill. PCA was conducted using fall and spring data separately in order to generate a separate language composite score for each time point. The results indicated that the language measures shared a considerable amount of variance. The results of the PCA for both fall and spring language measures are shown in Table 8. Using a cut-off of eigenvalues > 1.0 , a one-factor solution emerged for both time points. The resulting models accounted for 64% of the variance at pre-test, and 67% of the variance at post-test, and all of the factor loadings were $>.69$ at Time 1 and $>.74$ at Time 2. The corresponding factor scores generated from the PCA became the Time 1 and Time 2 Language Composite scores for each child to be used in subsequent analyses.

Table 8

Factor Loadings for Principal Components Analysis of Fall (Time 1) and Spring (Time 2) Language Measures (Practice Sample; N=201)

	Fall Language Factor	Spring Language Factor
Academic Knowledge	0.87	0.88
Oral Comprehension	0.82	0.82
Picture Vocabulary	0.81	0.82
Adaptive Language Inventory	0.69	0.74

Self-regulation composite. The development of the self-regulation composite followed the same process as described above for the language composite. Based on findings from prior research (e.g., Wiebe, Espy, Charak, 2008), it was anticipated that the self-regulation measures represented a single underlying construct of self-regulation. Indeed, as shown in Tables 6 and 7, the correlations among the self-regulation measures, although not as high as those among the language measures, were all statistically significant. The fall correlations ranged from .17 (between Corsi Blocks–Backward and Copy Design) to .518 (between HTKS and Peg Tapping). Similarly, the spring correlations ranged from .17 (between DCCS and Copy Design) to .55 (between HTKS and Peg Tapping).

Another set of principal components analyses was conducted using fall and spring data separately in order to generate self-regulation composite scores for each time point. The results of the PCA for both fall and spring self-regulation measures are shown in Table 9. Using a cut-off of eigenvalues > 1.0, a one-factor solution emerged for both time

points. The resulting models accounted for 42% of the variance at pre-test, and 41% of the variance at post-test, and all of the factor loadings were $>.46$ at Time 1 and $>.49$ at Time 2. The corresponding factor scores generated from the PCA became the Time 1 and Time 2 Self-regulation composite scores for each child to be used in subsequent analyses.

Table 9

Factor Loadings for Principal Components Analysis of Fall (Time 1) and Spring (Time 2) Self-Regulation Measures (Practice Sample; N=201)

	Fall SR Factor	Spring SR Factor
Corsi Blocks–Forward	0.65	0.52
Corsi Blocks–Backward	0.52	0.63
DCCS	0.66	0.49
Copy Design	0.46	0.59
HTKS	0.72	0.77
Peg Tapping	0.79	0.73
CFBRS (WRS)	0.69	0.72

The resulting language and self-regulation composite scores were examined for normality and outliers. All of the distributions were approximately symmetric, and none was highly skewed. Boxplots were used to check for outliers in the data, and Tukey’s Hinges were used as the basis for identifying outliers. While some children’s spring language scores were identified as being just below the outer bound, they were not deemed extreme enough to affect the results. No other significant outliers were noted. By design, factor scores have mean=0 and standard deviation=1, so descriptive statistics are

not particularly helpful as far as describing the distribution of scores. Overall, the factor scores for all four composites (Language T1 and T2; Self-Regulation T1 and T2) were normally distributed and displayed similar variability. Figure 5 displays a histogram of the self-regulation composite scores at Time 2. They ranged from -2.72 to 2.31, and they were representative of the range and variability of the other composites as well.

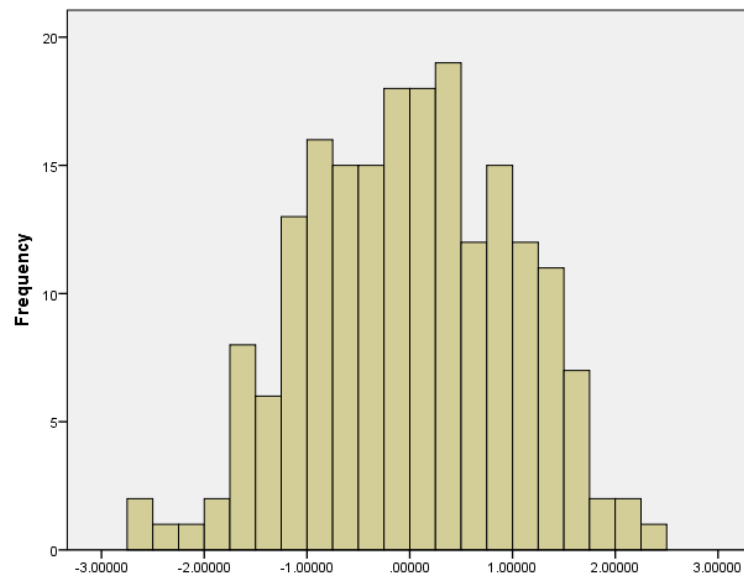


Figure 5. Distribution of children's self-regulation composite scores at Time 2.

Child learning behaviors. A primary goal of the present study was to test whether the types of learning behaviors in which children engaged in the classroom would mediate the relationship between their entering language skills and their self-regulation gains. Before the full mediation model could be tested, however, the key learning behaviors that were most closely associated with self-regulation gains were identified. The process of testing the relationships between these behaviors and self-regulation gain was conducted using the practice sample of 201 children. The behaviors

of interest were grouped conceptually, as detailed in Chapter III, under the categories of Verbal Behavior, High-Level Play, and Involvement. (The mean proportions of sweeps coded in each of the categories, as well as mean involvement, were similar between the practice sample and the overall sample. For parsimony, only data for the full sample are displayed in Table 4.) First, regression analysis was used to predict Time 2 self-regulation from Time 1 self-regulation, and the resulting standardized residuals were saved to represent self-regulation residualized gain scores. Next, correlations were analyzed to check for significant relationships between the learning behaviors of interest and self-regulation gains. These correlations are shown in Table 10.

Verbal behavior. Initially, it was thought that the frequency with which children were observed talking and listening would be related to self-regulation gains. Children's self-directed talk was also of particular interest. However, these analyses revealed that the correlations between self-regulation gains and: self-talk ($r = -.041, p = .57$), teacher-directed talk ($r = -.007, p = .92$), and child-directed talk ($r = -.019, p = .79$) were negative, quite low, and not statistically significant. Listening to child was also negative and not statistically significant ($r = -.009, p = .90$). The correlation between self-regulation gains and listening to the teacher was positive, and was higher than the other verbal behaviors, but still was not statistically significant ($r = .114, p = .111$).

High-level play. Because of their basis in social learning, the two categories of behavior initially thought to be most closely associated with self-regulation gains were associative and cooperative interactions. However, the correlations between associative and cooperative interactions and self-regulation gains were low and non-significant.

Further analyses demonstrated a significant, positive correlation between sequential learning behaviors and self-regulation gains ($r=.213, p=.003$).

Involvement. The final learning behaviors of interest concerned children's level of involvement in the classroom. Both overall mean involvement throughout the day and mean involvement specifically during learning activities (i.e., not including transitions, meals) were examined. Only the involvement during learning activities was significantly correlated with gain ($r = .164, p = .02$), but the magnitude of the correlation was similar to that of children's overall involvement ($r = .139, p = .05$). However, the correlation between these two variables was quite high, as would be expected ($r = .814, p < .001$). Finally, there was also a significant, negative correlation between children's off-task behaviors (defined as being unoccupied, being disruptive, or being in time out during learning times) and self-regulation gain ($r=-.201, p=.005$).

Learning behavior variables summary. Learning behaviors were initially grouped into the three categories described previously (i.e., verbal behavior, high-level play, and involvement). Ultimately, after the correlations among the learning behaviors and self-regulation gains were examined, five different learning behavior categories were carried forward into the hypotheses testing. First, because of the non-significant, and slightly negative associations found between four of the five verbal behavior variables and self-regulation gains, these variables were dropped from the analysis. The only verbal behavior variable that was positively associated with self-regulation gains was "listening to teacher," but the correlation was not significant ($r=.114, p=.11$). Additional analyses

Table 10

Pearson Correlations among Child Learning Behaviors and Self-Regulation Gain Scores (Practice Sample; N=201)

	ST	TDT	CDT	LT	LC	A	C	S	OI	ILT	Off-task
SR Gain	-.041	-.007	-.019	.114	-.009	.074	.075	.213**	.139	.164*	-.201**
Self-talk (ST)		.084	.054	-.289**	-.262**	-.149*	.003	.206**	.147*	.121	.025
Teacher-directed talk (TDT)			.081	-.204**	-.122	.025	.204**	.119	.130	.177*	-.078
Child-directed talk (CDT)				-.388**	-.026	.333**	-.061	.210**	.267**	.225**	-.213**
Listening to teacher (LT)					.106	.083	.142*	-.131	-.085	-.074	-.024
Listening to child (LC)						.220**	.256**	-.117	-.055	-.022	-.016
Associative (A)							.121	.265**	.319**	.308**	-.147*
Cooperative (C)								.315**	.176*	.147*	-.127
Sequential (S)									.616**	.511**	-.421**
Overall Involvement (OI)										.814**	-.510**
Involvement during learning time (ILT)											-.663**

Note. **p<.01; *p<.05.

examined whether the setting mattered for talking and listening variables, but those analyses revealed no significant relationships between children's talking and listening and self-regulation gains. Thus, the only verbal interaction variable carried forward was listening to teacher. Although associative and cooperative interactions did not separately correlate with gains as anticipated, they were left in the analysis for conceptual and theoretical reasons. Additional distinctions were made to separate different categories within "high-level play." Associative and cooperative interactions were combined into one category called "social learning;" sequential learning formed its own category. Finally, "involvement" was divided into two separate components: involvement during learning times; and off-task behavior. The categories, along with the learning behaviors selected, and the descriptive statistics for the practice sample are shown in Table 11.

This section described the rationale and process for establishing this study's practice and cross-validation samples. This approach strengthens confidence in the study's potential findings with regards to the mediation model. The randomly-selected practice sample was shown to be statistically comparable to the remaining children in the cross-validation sample. Thus, the practice sample was used to develop necessary language and self-regulation composites, and the child learning behavior variables that will be employed in the mediation analysis using the cross-validation sample.

Table 11

Learning Behavior Variable Definitions and Descriptive Statistics (Practice Sample; N=201)

Category	Learning Behavior	Description	M	SD	Min.	Max.
Verbal Behavior	Listening to Teacher	Proportion of all sweeps in which children were coded as listening to the teacher	0.27	0.09	0.08	0.53
High-level Play	Social Learning Interactions	Proportion of all sweeps in which children were engaged in either an associative or a cooperative learning activity	0.10	0.06	0.00	0.36
	Sequential Learning Activities	Proportion of all sweeps in which children were engaged in sequential learning activities	0.23	0.08	0.02	0.52
Involvement	Involvement	Mean involvement rating for children across all sweeps, only during learning times	2.90	0.25	1.96	3.66
	Off-task Behavior	Proportion of all sweeps in which children were coded as being unoccupied, disruptive, or in time out	0.05	0.04	0.00	0.24

Hypotheses Testing

Once the process of composite development for the three key variables (language, self-regulation, and child learning behaviors) was completed using the practice sample of 201 children, the cross-validation sample of 348 children was used to test the study's primary research focus: Whether children's learning behaviors in the classroom would mediate the relationship between their entering language skills and their self-regulation gains. This overarching question consisted of three main hypotheses, which were tested using a mediation model to test the direct and indirect effects in the language – behavior – self-regulation relationship, including: 1) the association between children's entering language skills and their self-regulation gains in pre-kindergarten; 2) the association between children's language skills and their classroom learning behaviors; and, 3) the mediating effects of children's learning behaviors on the relationship between language and self-regulation. The following sections will discuss how the mediation model was tested using the cross-validation sample, and provide details regarding the results of the study's research hypotheses.

Analytical Strategy

The analyses involved testing mediation models using hierarchical data, as children in this study were nested within classrooms. Prior to testing the mediation, intra-class correlation coefficients (ICCs) were calculated in order to partition the child- and classroom-level variance components in children's language and self-regulation scores, as well as the learning behavior composites. The results indicated that, at Time 1, 12.1% of children's entering language skill was attributed to between- classroom differences. At

Time 2, 15.2% of the variance in self-regulation was accounted for by between-classroom differences. The variance accounted for at the classroom level for children's learning behaviors was higher than for language and self-regulation. The percentages of variance accounted for by between-classroom differences were: 53% for listening to teacher, 48% for social learning, 53% for sequential learning, 37% for involvement, and 15% for off-task behavior.

The current study's research hypotheses regarding the direct and indirect relationships between children's language and self-regulation skills and their learning behaviors necessitated models that would account for the between-classroom (Level 2) variance components. This was especially important given that as much as half of the variance was at the classroom-level for some of the child learning behavior composites. However, all of the variables of interest were measured at the individual child level, and the motivation for this study was to explore these relationships at the child level. The current study did not address the contextual effects of classroom-level differences, and there were no substantive hypotheses regarding Level 2 associations; thus, only the Level 1 effects were modeled. All of the variables were group-mean centered at the classroom level in order to isolate the effects for children within classrooms (i.e., separate the Level 1 effects from the Level 2 effects). Children's entering language, self-regulation gains, and learning behaviors were all centered on the classroom mean. Note that the centering was based on the overall classroom means from the total study sample of 549 children. Hereafter, references to low- or high-language or smaller/greater self-regulation gains are relative to other children in the classroom. The mediation models were analyzed in the Mplus software program (Muthén & Muthén, 1998-2011), using maximum likelihood

estimation with robust standard errors. Additionally, the mediation models were run using the Mplus complex models procedure to adjust the standard errors to account for the nesting of children within classrooms.

Prior to modeling the hypothesized direct and indirect effects between language, self-regulation, and classroom learning behaviors, the zero-order correlations among the classroom-mean-centered variables and observed variables were examined. These correlations are displayed in Table 12. Social learning, sequential learning, and involvement were all positively correlated with each other and with children's language composite scores at Time 1. There were significant, negative correlations between these variables and off-task behavior, which was also negatively related to children's language score. Social and sequential learning did not show a significant correlation with self-regulation gains, but there were statistically significant correlations between self-regulation gains and involvement ($r=.128, p<.05$) and off-task behavior ($r=-.119, p<.05$). There were no statistically significant correlations between ethnicity and any of the composite or observed variables. However, there were significant correlations for gender: females tended to have higher initial language scores, participate in more sequential learning activities, be more highly involved in learning activities, and engage in less off-task behavior. Age was also significantly, positively correlated with entering language skills, as well as social learning activities.

Table 12

Correlations among Composite and Observed Variables (Validation Sample; N=348)

	LT	Soc.	Seq.	Inv.	Off-task	SR Gain	Gender	Age	Eth.
Independent Variable									
Language (T1)	-.062	.261**	.165**	.159**	-.146**	.140**	-.123*	.274**	-.054
Child Learning Behaviors (Mediators)									
Listen to Teacher		-.094	-.094	.108*	-.204**	-.054	.004	-.078	-.014
Social Learning			.254**	.232**	-.171**	.056	-.079	.105*	.041
Sequential Learning				.340**	-.214**	-.009	-.186**	.103	.025
Involvement					-.678**	.128*	-.170**	.005	-.011
Off-task Behavior						-.119*	.200**	-.025	.005
Dependent Variable									
SR Gain							-.021	.074	-.050
Child Characteristics									
Gender (1=male)								.074	-.063
Age									.064
Ethnicity (1=non-white)									--

Note. ** $p < .01$. * $p < .05$. All variables centered at the classroom mean.

Path Analyses

To investigate the relationships between children's language skills at the beginning of pre-kindergarten, their learning behaviors in the classroom, and their self-regulation gains, path analyses were conducted in Mplus. These path models included both direct estimates and indirect estimates of effects. Following the MacKinnon (2008) approach, indirect effects were estimated to test if the relationship between children's initial language skills and their pre-kindergarten self-regulation gains was mediated by their learning behaviors in the classroom. Although the zero-order correlations showed associations between gender and age and some of the composite and observed variables, child-level covariates were not included in the mediation analyses. The rationale for excluding them was to be able to examine the overall effect of language ability on children's learning behaviors and self-regulation gains, irrespective of its source. (Additional analyses also tested mediation models that included child-level covariates. While some of the path coefficients were slightly different, the overall pattern of results was the same as the models without child covariates.)

Ultimately, five separate path models – one for each mediator – were analyzed. The current study had no hypotheses regarding the relationships between each of the learning behaviors, or how they might function as a group in relation to language and self-regulation. Thus, the rationale for analyzing each mediator separately was to get a better picture of how each was related individually to children's language and self-regulation. Figure 6 displays the standardized path coefficients of the direct effects among children's entering language skills, their learning behaviors, and their self-

regulation gains. The following sections discuss the results of the mediation models, and their implications for the current study's research hypotheses.

The relationship between children's entering language skills and their self-regulation gains. Each of the models in Figure 6 provides an estimate of the path coefficient between children's entering language skills and their residualized gains in self-regulation. However, these are mediation models, so the relationship between language and self-regulation gain in each model is influenced by the presence of the child learning behavior mediator(s). Because Hypothesis I specifically concerned the direct association between children's initial language skills and their self-regulation gains, a separate regression model was used to estimate this relationship. This model predicted children's self-regulation residualized gain score (T2 scores controlling for T1) from their fall language composite score. To parallel the mediation analyses, classroom-mean-centered self-regulation and language scores were used in this regression model. The results confirmed a significant, positive association between children's entering language scores and their self-regulation gains, $\beta = .14$, $t(336) = 2.60$, $p = .01$. This model demonstrated that children with stronger initial language scores at the beginning of pre-kindergarten had stronger self-regulation gains by the end of pre-kindergarten.

The relationship between children's entering language skills and their participation in learning behaviors in the classroom. Hypothesis II supposed that children with higher initial language skills at the beginning of pre-kindergarten would participate more frequently in the types of learning behaviors thought to be relevant for self-regulation growth. These relationships were tested as part of the mediation models,

and the path coefficients for language on each of the child learning behaviors are shown in Figure 6.

The results showed that children's initial language skills were associated with their participation in most of the learning behaviors of interest to this study. These results are represented in Figure 6 as the coefficients on the arrows pointing from "Language Skills Fall Pre-k" to the gray-shaded center boxes containing each of the five mediators. Solid lines represent a statistically significant path coefficient; dashed lines represent non-significant paths. These findings demonstrated that children who entered pre-kindergarten with stronger language skills participated more frequently in social learning interactions ($\beta = .26, p < .01$), and sequential learning activities ($\beta = .17, p < .01$), and they tended to exhibit higher levels of involvement ($\beta = .16, p < .01$) during learning time. In addition, they were less likely to engage in off-task behaviors ($\beta = -.15, p < .01$), like being unoccupied or disruptive, or being placed in time out. No association was found between children's entering language skills and the frequency with which they were coded as listening to the teacher.

While Hypothesis II did not specifically address the relationship between children's learning behaviors and their self-regulation gains, these paths are also estimated in the mediation model and were of interest. When controlling for children's entering language skills, the results revealed a non-significant relationship between children's participation in social learning activities and their self-regulation gains. The same was true for sequential learning activities as well. The relationship between children's involvement during learning time and their self-regulation gains was marginally significant ($\beta = .11, p = .07$). The relationship between children's off-task

behavior and their self-regulation gains also reached the level of marginal statistical significance ($\beta = -.10, p = .06$).

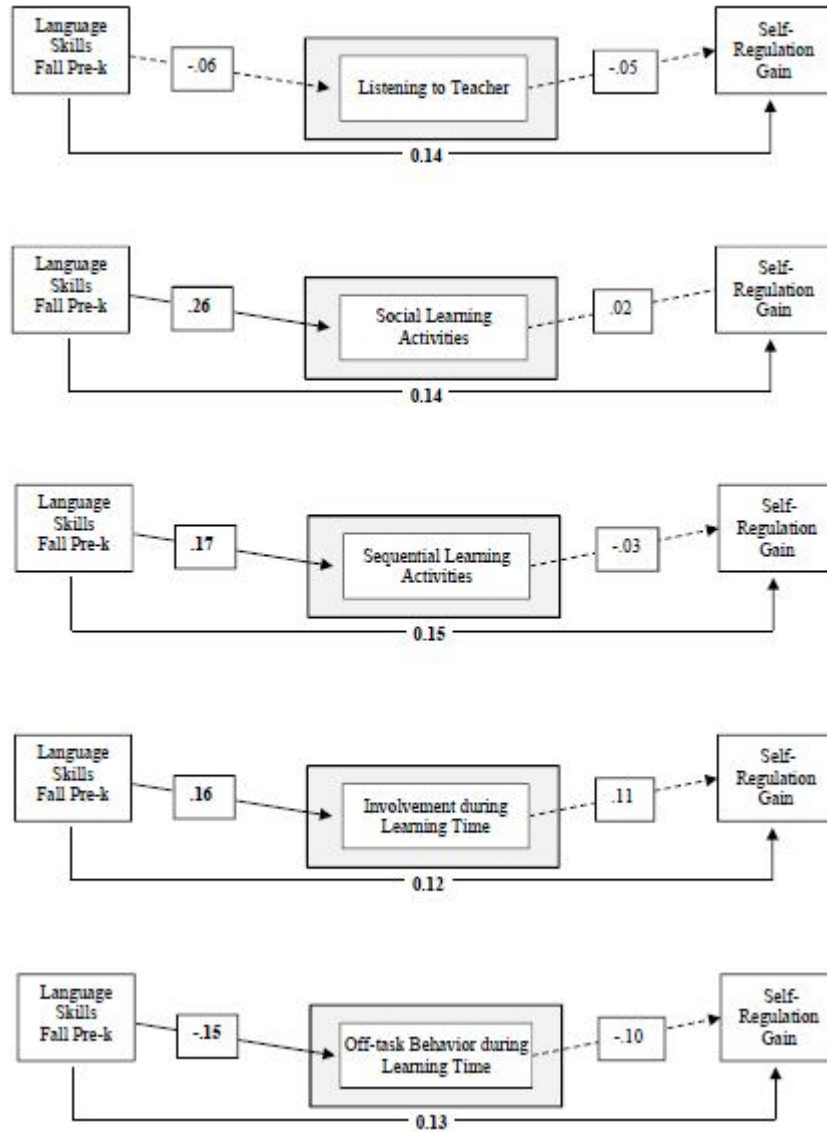


Figure 6. Path analysis models of direct effects among children's language skills, their learning behaviors, and their self-regulation gains during pre-kindergarten. Standardized path coefficients (interpretable as standardized regression coefficients) are provided on the straight, single-headed arrow. Boldface type and solid lines indicate coefficients significant at the .05 level. In the models for involvement during learning time and off-task behavior during learning time, the coefficients on self-regulation gain approached statistical significance ($p = .07, p = .06$, respectively).

Children’s learning behaviors as mediators between children’s entering language skills and self-regulation gains. The third and final research hypothesis was that children’s learning behaviors in the classroom would mediate the relationship between their initial language skills and their self-regulation growth, as depicted in Figure 7. In other words, the current study posited that children’s language skills affected their self-regulation growth because they influenced children’s participation in learning opportunities in the classroom that were meaningful for developing self-regulation. The results summarized thus far from the mediation analysis have concerned the direct effects, represented as paths *a* and *b* in Figure 7. In order to estimate the mediation effect (path *c'*), Mplus was used to estimate the indirect effects between language and self-regulation gains as mediated by children’s learning behaviors.

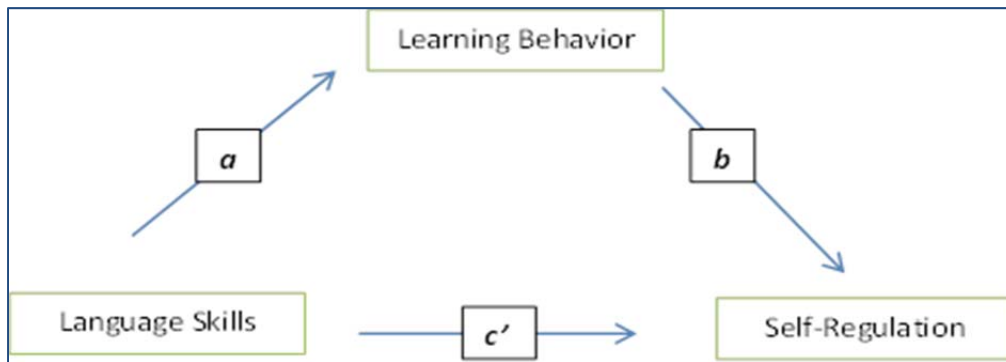


Figure 7. Hypothesized mediator model. (Adapted from Baron & Kenny, 1986; Zhao et al., 2010)

Table 13 displays the estimates of the indirect effects, standard errors, and confidence intervals for each mediator. As evidenced by the fact that each confidence interval crosses zero, the results of the mediation path analysis revealed no significant

Table 13

Estimates, Standard Errors, and Confidence Intervals for Tests of Indirect Effects

	Estimate	SE	95% Confidence Interval
Lang → Listening to Teacher → SR Gain	.003	.005	[-.007, .012]
Lang → Social Learning → SR Gain	.005	.019	[-.032, .043]
Lang → Sequential Learning → SR Gain	-.005	.012	[-.028, .017]
Lang → Involvement → SR Gain	.017	.011	[-.004, .039]
Lang → Off-task Beh. → SR Gain	.015	.009	[-.002, .032]

Note. N=348

mediation for any of the models. Thus, the hypothesis that children's learning behaviors would mediate the association between language and self-regulation gains was disconfirmed. It is notable, however, that the final two models (for children's involvement level and off-task behavior) approached, but did not reach statistically significant mediation ($p = .11$, and $p = .09$, respectively). Given the exploratory nature of this work, however, these relatively small relationships may be worth further consideration.

Follow-up analyses. Early evidence from the practice sample suggested a positive relationship between sequential learning activities and self-regulation gains that was not replicated in the validation sample. One possible explanation is that there were some classrooms that provided so little opportunity for these types of interactions that children's ability to choose to participate in those types of learning behaviors was severely constrained. This could be problematic, especially given the large amount of variation in these types of learning behaviors attributable to classroom-level factors. In

order to address this issue, the mean proportions of sweeps spent in social and sequential learning activities were examined at the classroom level. Classrooms with the lowest frequencies of these behaviors observed were examined further to determine if the low frequencies were typical for children in that class, or if one or two outlier children might be artificially suppressing the means. Both the social learning interactions and the sequential learning activities mediators were examined. After classrooms with very low instances of social and/or sequential learning opportunities were removed from the sample, the mediation models for these two child learning behavior mediators were re-analyzed. Ultimately, the results did not differ from the initial analyses.

Summary

This study explored three main research hypotheses regarding the associations between children's language, their learning behaviors, and their self-regulation gains in pre-kindergarten. Analyses testing Hypothesis I confirmed that children's fall language composite scores were significantly related to self-regulation gains during pre-kindergarten. Hypothesis II posited that children's entering language skills would be related to the kinds of learning behaviors they exhibited in the pre-kindergarten classroom. Results showed significant, positive associations between children's entering language and their participation in social learning interactions, and sequential learning activities. Further, children's language skills were positively related to their overall mean involvement during learning activities, and negatively related to off-task behavior. When the mediating effects of children's learning behaviors on the relationship between language and self-regulation gains were examined for Hypothesis III, no statistically

significant mediation was identified for any of the learning behavior mediators. However, it was noted that the models for children's involvement level and off-task behavior did approach the statistical criteria for mediation.

CHAPTER V

SUMMARY, DISCUSSION, AND CONCLUSIONS

The purpose of this study was to explore relationships between children's initial language skills, their self-regulation gains, and their learning behaviors in pre-kindergarten classrooms. First, the relationship between children's entering language skills and their self-regulation gains was examined. Then, the association between children's language and key learning behaviors in the classroom that were thought to be facilitative of self-regulation gains was analyzed. Finally, the mediating effects of these learning behaviors on the relationship between language and self-regulation growth were explored. This chapter summarizes the study's results, discusses the findings, and describes the strengths and weaknesses of the study.

Summary of Results

In the current study, children's language and self-regulation were assessed using a variety of measures, and their classroom learning behaviors were recorded through a series of observations during the pre-kindergarten year. This rich set of data provided an opportunity for a close examination of the effect of early language on self-regulation development. In addition, these data allowed for an exploration of the mechanisms behind the connection between children's language and their self-regulation, investigating the potential mediating effects of children's learning behaviors in the classroom. This study utilized a large data set to create two different samples of children: a practice sample used to explore relationships between classroom learning behaviors

and self-regulation gains, and a cross-validation sample used to test the resulting mediation models. Within these models, children's learning behaviors were centered on the classroom means to attempt to control for classroom-level differences and tap the experiences of the individual child.

The Association Between Children's Initial Language Skills and Their Self-Regulation Gains

Hypothesis I posited that children's initial language skills would be associated with their self-regulation growth over the course of the pre-kindergarten year. In other words, children who entered pre-kindergarten with strong language skills were predicted to make greater gains in self-regulation during pre-kindergarten. A residualized gain score was calculated to represent the growth in children's self-regulation between fall and spring that was not attributable to their initial fall performance, and children's fall language composite score was used to predict this gain. The results demonstrated that there was a significant positive relationship between children's initial language scores and their gains in self-regulation across the pre-kindergarten year.

The Association Between Children's Initial Language Skills and Their Learning Behaviors

Hypotheses II concerned whether children's initial language skills were associated with the types of learning behaviors in which they engaged in the classroom. After preliminary analyses using the practice sample identified the key classroom behaviors most likely related to self-regulation gains, Hypothesis II was tested on the cross-validation sample as part of the mediation model analyses. A composite of early language skills was shown to be positively associated with children's participation in

social and sequential learning activities. In addition, children with stronger language scores also tended to be more highly involved during classroom learning time. By contrast, there was a negative association between language and off-task behavior during learning time, indicating that children with lower language skills tended to engage in more off-task behaviors. No association was found between children's entering language and the proportion of sweeps in which they were coded as listening to the teacher.

The Mediating Effect of Children's Learning Behaviors on the Relationship Between Their Initial Language Skills and Their Self-Regulation Gains

The third and final hypothesis proposed that children's learning behaviors would mediate the relationship between language skills and self-regulation. This hypothesis was based on the idea that children who have stronger language skills are better able to engage in the kinds of enriching behaviors thought to be beneficial for self-regulation growth. While the results of Hypothesis II showed that children's language skills were related to their participation in social and sequential learning activities, these behaviors were not found to predict gains across the year in children's self-regulation. Thus, no significant mediation effects were found for social and sequential learning activities. Overall, Hypothesis III was not upheld, but the two mediation models for involvement and off-task behavior approached the statistical criteria for significant mediation.

In summary, the results of the present study suggested that children's entering language skills were related to their self-regulation gains. Language skills were positively associated with high-level play, including social learning interactions and sequential tasks, and children's entering language skills potentially facilitated greater involvement in the learning environment. Conversely, having lower language skills at the beginning of

pre-kindergarten was associated with higher rates of off-task behavior. Finally, children's level of involvement and their tendency to be off-task during learning time approached significance as mediators between language and self-regulation.

This study provided the opportunity to examine the relationships between children's language, their classroom learning behaviors, and their self-regulation development in a unique way. Although prior work has documented associations between early language and self-regulation, little has been done to explore the underlying mechanisms behind these complex and inter-related developmental processes. Not only does this study provide evidence of the nature of language as a foundational skill for self-regulation development, it also confirms language as a factor in how and to what extent children participate in the classroom learning environment. In addition, this study's results suggest potential pathways through which language affects self-regulation development.

Emerging Issues

This study's results led to several important points to consider further. First, the importance of being highly involved in learning, and its effects on self-regulation, will be explored. Then the role of early language skills in facilitating children's involvement in learning opportunities and interactions will be considered. Third, strategies and interventions designed to help vulnerable children develop self-regulation will be discussed. Finally, the benefits of large-sample research and cross-validation work will be described.

The Importance of Being Highly Involved in Learning

Based on the theoretical perspectives regarding the importance of high-level play for self-regulation development, the present study supposed that children's participation in social learning interactions and sequential activities would relate to their self-regulation gains. However, the current study did not find the anticipated links between self-regulation gains and children's participation in the selected learning behaviors. Consequently, the results did not support full mediation between language and the proposed learning behaviors (i.e., verbal, social, sequential), meaning that the relationship between early language skills and growth in self-regulation was not completely due to the types of behaviors high-language children were observed enacting in the classroom.

Despite the fact that the current study did not find significant associations between self-regulation gains and the kinds of verbal behavior, social learning interactions, and sequential learning activities in which children participated, the study demonstrated a marginally significant association between self-regulation and how highly engaged children were in the classroom overall. The results showed a trend that higher levels of involvement and lower levels of off-task behaviors were associated with greater gains in self-regulation, even after accounting for children's initial language skills in pre-kindergarten. These findings suggest that the specific types of activities in which children participate might not matter as much as the fact that they are highly involved.

There is little evidence at this point regarding specific aspects of classrooms that develop children's self-regulation. Some have suggested that teachers' classroom management – specifically keeping children engaged and on-task – is important to

children's development of self-regulation (Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009; Rimm-Kaufman, La Paro, Downer, & Pianta, 2005). This corresponds with the findings from the current study, which suggest a potential relationship between children's engagement in the classroom and their self-regulation gains.

In addition, research from the perspective of Self-Determination Theory (Ryan & Deci, 2000) suggests that motivation plays a pivotal role in developing self-regulated approaches to learning. Although most of this research has involved older elementary-aged children, there is a suggestion that how well the child is motivated to learn in the classroom affects his/her ability to self-regulate (Paris & Paris, 2001). Evidence from this study would correspond well to this suggestion, as the current study found a marginal association between children's engagement in learning (i.e., higher levels of involvement and lower amounts of off-task behavior) and their self-regulation gains during pre-kindergarten.

Children's level of involvement may be important for their self-regulation gains, but it seems to be slightly less dependent on the classroom-context, in contrast to the specific learning behaviors mediators. The ICCs for involvement and off-task behavior were 37% and 15%, respectively – both lower than the ICCs for listening to teacher (53%), social learning interactions (48%), and sequential activities (53%). This indicates that the specific learning opportunities provided in the classroom may be more dependent on the nature and structure of the classroom itself, but how engaged children are in the opportunities presented might actually be more individually determined by the child. Given that, it is even more important that teachers in classrooms serving children from

low-income backgrounds find ways to involve children that are not so dependent on individual interests.

Given that involvement and off-task behavior were associated with children's self-regulation gains, it is important to consider what influences children's level of engagement in the classroom environment. The current study addressed this question as well, and found that children's level of involvement in the classroom, as well as their ability to refrain from engaging in off-task behaviors, was significantly related to their entering language skills. In addition, the current study's findings suggest that language is also important for self-regulation growth.

Importance of Early Language Skills for Involvement in Learning Opportunities and Interactions

Prior work regarding children's self-regulation has treated it primarily as a school-entry predictor of academic success outcomes (e.g., Duncan et al., 2007; McClelland et al., 2000). Given the closely intertwined nature of the language and self-regulation developmental processes, however, it is important to consider what early skills might influence children's readiness to learn in the classroom and the effect that those skills and experiences might have on self-regulation. Some have suggested that language might, in fact, serve as the foundation for children's self-regulation development (Dickinson et al., 2006; Vygotsky, 1962; Winsler et al., 2003), but only a limited amount of empirical evidence has actually addressed this important question (Fuhs & Day, 2011; Vallotton & Ayoub, 2011).

Using a large sample of children and a wide variety of measures, the current study identified early language skills as being significantly related to children's self-regulation gains during pre-kindergarten. This finding indicates that children who began pre-kindergarten with initially stronger language skills made greater gains in self-regulation over the course of the year. While a concurrent association between skills like language and self-regulation may have been shown before, this study extends that prior work by demonstrating a link between children's initial language skills and the *gains* they made in developing self-regulation across the pre-kindergarten year.

In an attempt to disentangle and explain the process by which language skills may affect self-regulation growth, the current study also investigated how children's initial language skills affected their learning behaviors within the classroom context. A composite of children's language skills that included both vocabulary and comprehension was associated with children's participation in high-level learning opportunities in the classroom. Children's fall language scores predicted their frequency of associative, cooperative, and sequential learning behaviors across the year, as well as their level of involvement in learning activities – and were negatively related to off-task behavior.

As discussed in the preceding section, the current study found that higher levels of involvement and lower levels of off-task behavior mattered more for self-regulation gains than the specific types of learning behaviors children exhibited. Further, the results also showed that children's initial language skills were associated with these aspects of children's learning behavior in the classroom. These results suggest that language is a primary component of how deeply children become engaged in the learning opportunities offered in the classroom, regardless of what those specific opportunities are.

Because of their ability to become more highly involved in the classroom, children with higher language skills might benefit from a type of accumulated advantage. In other words, more highly skilled children may benefit more from the learning opportunities afforded to them, which in turn leads to even stronger cognitive development. Meanwhile, children with lower initial skills may derive less benefit from the opportunities afforded them, which has potentially short- and long-term negative consequences for their development.

Language skills might influence children's self-regulation in important, but less observable, ways as well. Children may, as Vygotsky suggested, use language as a tool for regulating thoughts and behaviors (1962). This idea corresponds with the findings of this study which suggest that perhaps children with better language skills were able to become more highly involved in their learning, and avoided more impulsive, or disruptive behaviors. It is possible that a stronger facility with language not only allowed children more opportunities for observable social interactions (as this study found), but also helps them focus their attention, tune out distractions, and inhibit off-task behavior better than children with lower language skills. This idea is supported by the fact that children have been found to use language (specifically, private speech) to control and direct their behavior and keep themselves on task in laboratory learning tasks (Azmitia et al., 1992; Berk & Garvin, 1984; Winsler et al., 2007). Maintaining attention and inhibiting inappropriate behavior are two of the main skills tapped by the current study's measures of self-regulation, on which children with better language skills showed more gains. As this advantage towards better self-regulation is given to children with better

language skills, it is important to consider how to help more vulnerable children develop these skills as well.

The current study provides evidence that children's use of language, broadly construed as their performance on language measures at the beginning of pre-kindergarten, helps them self-regulate. However, it was difficult to capture exactly how children use language to navigate the classroom environment. Initial hypotheses asserted that children's verbal behaviors in the classroom would be related to their self-regulation gains. These hypotheses were not upheld, but that may primarily be because children were listening to others far more than they were talking. In fact, children were only observed talking to themselves 6.6% of the time; they were talking to each other 9.3% of the time. Contrasted with the amount of time they were listening to the teacher (26.4%), they were only talking with the teacher 4.5% of the time. It may be that children's individual interactions with their teachers are important as well, but that information was not captured by the current study.

Helping Vulnerable Children Develop Self-Regulation

The pre-kindergarten classrooms included in the current study were all part of state-funded programs designed to provide early education to at-risk children. These programs are intended to intervene and make a meaningful difference to children's long-term success. In many cases, the classrooms placed a strong focus on children's academic readiness – specifically, the fundamental skills of early literacy and mathematics. However, given the mounting evidence concerning the importance of children's self-regulation (Duncan et al., 2007; Heckman & Rubinstein, 2001; McClelland et al., 2000),

there is a growing imperative to help bolster children's self-regulation development as well. Thus, it is important to consider how classrooms might foster these skills and behaviors in all of the young children they serve.

One question yet to be answered is what happens when lower-language children are provided rich learning opportunities – like those that higher-language children might seek out on their own. Likely, it is not enough to simply employ more social learning opportunities in the classroom because children with lower language skills will need additional supports if they are to fully participate in – and benefit from – those opportunities. In fact, classroom-based curricular approaches designed to foster self-regulation growth in early childhood have had mixed results (Farran, Lipsey, & Wilson, 2011; Bierman et al., 2008; Raver et al., 2011), possibly resulting from the difficulty in making meaningful learning opportunities available to the students who need it most. While the classroom activities provided for children might have been influenced by a particular curriculum, the skills necessary for engaging in those activities might not have been that different from typical classrooms. Thus, children who entered with lower language skills might have struggled to get involved in those potentially enriching activities. Not able to benefit from the opportunities available, and without sufficient support to become involved in those learning opportunities, these children could still show less self-regulation growth than their higher-language classmates. For instance, older but still relevant laboratory-based work has suggested that getting children with lower initial skills engaged in high-level play is difficult, and that those children tend to benefit less from the experience than their more academically prepared counterparts (Saltz et al., 1976).

By contrast, other more recent approaches have targeted children's self-regulation gains with very specific stand-alone activities that were neither part of a curriculum, nor integrated into the classroom environment. The activities investigated may provide a means for children with lower levels of language skills to participate in self-regulation-building activities. For example, in Tominey and McClelland's (2011) games intervention, children participated in a series of schoolyard-type games twice a week for six weeks. The results indicated that this simple 1-hour/week intervention showed promise for developing children's self-regulation – especially for those who scored in the bottom 50% on a test of self-regulation at school entry. These games involved, for instance, a version of “Red Light, Green Light” in which children either run or stop running in response to the teacher's commands. It may be that this direct, hands-on type practice utilizing working memory, attention, and inhibitory control skills is necessary for children with lower self-regulation and lower language skills.

Because of the inter-relatedness of language and self-regulation, interventions that are focused on one may benefit the other. For example, Tominey and McClelland (2011) also found that children who participated in their intervention showed better gains on the WJ-III Letter-Word Identification test. Although not a measure of children's oral language like those included in the current study, the Letter-Word subtest is a general indicator of early literacy skills, like letter and basic sight word knowledge. Similarly, an intervention designed to foster language skills may also benefit children's self-regulation.

Benefits of a Cross-Validation Approach

Because of the available large sample of children, the current study could employ a unique approach to teasing out the relationships between children's entering skills, their learning behaviors in the classroom, and their self-regulation outcomes. Not only does cross-validation lend credibility to the resulting models, but it also revealed some interesting patterns between the two samples.

The large number of children in the full sample allowed for stratified random sampling to assign children either to the "practice" sample or to the "validation" sample. Preliminary work investigating the relationships between classroom learning behaviors and self-regulation gains was conducted using the practice sample. Based largely on theory (and some limited empirical evidence), the analysis began with a set of behaviors thought to be particularly relevant to self-regulation growth – namely, those involving verbal and social interactions. One finding from the practice sample was that children who engaged more frequently in sequential learning activities also made larger gains in self-regulation during pre-kindergarten ($r = .22, p = .002$). Thus, sequential learning was carried forward as a potential mediator for the analyses conducted with the cross-validation sample. Also of note was that, within the verbal category, listening to teacher was the only positive (though not statistically significant) correlate of self-regulation gains in the practice sample, so it also was carried forward into the mediation analyses.

When the relationships between each of these variables and self-regulation gains were tested in the validation data set, however, a distinctly different pattern emerged. First, the correlation between sequential learning and self-regulation dropped virtually to

zero ($r = -.009, p = .86$). Second, although the correlation between listening to teacher and self-regulation gains appeared to be of similar magnitude in the validation data sample, within the context of the mediation model, it was related neither to children's entering language skills nor to their self-regulation gains.

These somewhat surprising findings underscore the importance of the cross-validation approach, particularly with respect to correlational research. Even though the current study employed a stratified random sampling methodology to ensure baseline equivalence, and even though the baseline demographics and test scores were comparable in the two samples, there were differences in the way the two samples behaved. Failure to replicate the findings for sequential learning in particular suggests one of two possible explanations. First, it is possible that the correlation detected was entirely spurious. Second, it is possible that the relative instability of individual child-level observational data makes it difficult to consistently detect effects even when they are there. These differences in the processes uncovered within two very similar samples highlight the complexity of trying to establish what works in classrooms, especially in correlational designs, and provide some understanding of the lack of replication across early childhood studies.

Despite the differences between the two samples in terms of some of the child learning behaviors, other results were quite consistent. Because the study utilized a cross-validation approach in which the learning behavior composites were developed on one sample, and then tested in the full mediation model on another sample, the likelihood of the associations being a result of capitalizing on chance is minimized. Thus, the methodology employed in the current study provides reasonable confidence that the

relationships detected in both samples are ones important to carry forward into future research.

Implications for Policy and Practice

This study explored the relationship between children's early language and their self-regulation gains, with a focus on providing information about the kinds of learning behaviors that may be related to each. Prior research has suggested that early self-regulation development is important for children's overall academic success. Further, theory and prior research suggest that language plays a key role in children's self-regulation processes. Results from the current study might encourage teachers to consider how language facilitates children's involvement and participation in the classroom, as well as the ways in which they might offer and support engaging learning opportunities for children.

As the current system of pre-kindergarten is primarily geared toward children from potentially at-risk backgrounds, it is important for practitioners and policy makers to recognize that children with low initial academic skills may also struggle in other areas. In fact, children with both low language and low self-regulation may be in particular jeopardy. Thus, the early childhood classroom itself offers a valuable opportunity for intervention, and early identification and intervention tailored toward these students may prove beneficial. One key component is placing importance on self-regulation as foundational skill – just as important as early numeracy and literacy. The research community is just beginning to test out ways of intervening with young children to facilitate self-regulation development.

Curricular approaches have had mixed results. Additional experimental work is needed to determine approaches that are most effective in facilitating children's self-regulation development, and the results of this study would suggest that those approaches should take language skills into account. Tominey and McClelland's (2011) intervention utilizing school-yard games to help children learn to self-regulate is a promising start, but it needs further research and refinement. Other researchers should be encouraged to develop new intervention ideas and try them out with children, paying specific attention to at-risk children with low language and low self-regulation at the beginning of school.

The current study's results showed that children with strong language skills were more highly involved in the available classroom learning opportunities, and this level of involvement was marginally related to their self-regulation gains. Further, lower initial language skills were associated with higher incidents of off-task behavior, which were marginally associated with lower self-regulation gains. One suggestion for teachers is that by being attuned to how engaged children are in the classroom, they might be able to detect which children are having difficulty. Teachers may be aware of children's tendencies toward being off-task or acting out, but they may not always correctly attribute these behavior problems to difficulties in engaging with the learning environment. Further, teachers may be less attuned to children's level of involvement – specifically whether they are highly involved – and they may not know how to improve the level of children's involvement. If the issue lies at least in part in their language competency, then teachers can focus their attention on providing language support that the child needs to become more involved the classroom. For instance, research has shown that children with lower language skills are not viewed by their peers as desirable play

partners (Gallagher, 1993). By scaffolding low-language children into the play scenario, teachers can model strong language usage, as well as giving the child an opportunity to become more highly involved in the classroom.

Strengths

The primary strength of the present study is its conceptual and statistical approach to exploring the mechanisms behind the language—self-regulation relationship. Though previous work has documented a link between self-regulation and academic success in early childhood, little research has explored whether initial language skills are a contributing factor in self-regulation development – despite the fact that theory suggests an important link between the two areas. Furthermore, the current study takes another step in disentangling these developmental processes by asking the question of whether children’s early language skills afford them a meaningful set of learning opportunities in the classroom, opportunities that are ultimately important for self-regulation growth. Using a mediation model, this study explored the potential underlying mechanisms linking language and self-regulation. The resulting analyses were enhanced by the study’s rich source of information regarding children’s learning behaviors in the classroom. These analyses extend prior work because they not only demonstrated that children’s language skills were related to their self-regulation gains, but they also explored how language skills facilitated self-regulation growth through children’s learning behaviors.

Because of the overall available sample size, this study could employ a cross-validation approach in testing whether the behaviors that were thought to be important for self-regulation growth actually met the criteria as mediators in the model predicting self-

regulation gains from early language skills. This is a strength of the current study because the relationships initially detected in the practice sample could be verified in the validation sample, mitigating the risk of capitalizing on chance. It is also important to note that this sample included children from ethnically diverse backgrounds, who represented a wide range of school entry skills in language and self-regulation.

In addition, unlike prior work that has often relied on a limited set of measures (or even just one measure) of children's language and/or self-regulation, the current study utilized a wide range of assessments, both standardized and non-standardized, to test children's early skills. Further, teacher ratings of children's language usage and self-regulation in the classroom were also included in the composite scores. Taken together as a composite, these assessments provide a robust measure of children's early language and self-regulation.

Limitations

While the strengths of this study make it an interesting and useful attempt to examine the relationship between children's language and self-regulation, there are some limitations that should be considered. One limitation concerns the statistical approach used to account for the hierarchical data structure. Other limitations primarily concern the number and nature of child observations.

Hierarchical Data Structure

The data used for this study were hierarchical – consisting of children nested within classrooms. These data, by definition, conflate child-level effects with classroom-

level effects. This was particularly problematic for the child learning behavior variables, because as much as half of the variation in those behaviors was actually attributable to classroom-level, as opposed to child-level, differences. Because the current study took a developmental perspective in investigating self-regulation growth at an individual child level, the decision was made to mean center all of the variables of interest at the classroom level, in order to disaggregate child-level effects from classroom-level effects. The current study chose not to investigate or model classroom contextual effects, and had no hypotheses about these types of relationships; only the child-level relationships between language, self-regulation, and learning behaviors were of interest.

Although using classroom-mean-centered data isolates child-level variance, it limits how the results can be interpreted. Because entering language, learning behaviors, and self-regulation gains were centered on the classroom mean, then these mean-centered variables represent children's entering language, learning behaviors, and self-regulation gains, *relative to the other children in the class*. By definition, then, a low-language skilled child from one classroom (of higher-language children) might be defined as a high-language skilled child in a different classroom (of lower-language children). Further, children's participation in the types of learning behaviors of interest was also relative to the other children in the classroom, with some classrooms providing overall more opportunity for these behaviors, and some providing less. However, given the current study's interest in investigating how language might facilitate how children utilize the opportunities afforded to them in the classroom, this was considered to be a necessary and unavoidable trade-off. Further, follow-up analyses were conducted with raw (non-mean-centered) data, and the results were similar to those reported in Chapter

IV. Nonetheless, the study's findings must be interpreted in terms of children's language skills, learning behaviors, and self-regulation gains relative to their peers in the same classrooms.

Number of Observations

The current study included three observations throughout the pre-kindergarten year. While children's learning behaviors were averaged over the course of all three observations, having additional observations from which to draw information about children's learning in their classrooms would provide a more stable measure. This stability would help insure that the types of behaviors coded for children really were indicative of how they spent their time in the classroom on a typical day, and decrease the influence of any one unrepresentative day. Further, if children were observed more frequently throughout the year, potential changes in their behaviors over time could be better documented.

Duration of Observations

The COP protocol is essentially a snapshot-based measure of children's learning behaviors in the classroom. The snapshot approach has its advantages (such as being able to code a distinct behavior very specifically and to observe all the children in similar learning situations in the classroom), but it also has a drawback in that the three-second observation window does not allow for coders to assess children's sustained attention. Although observers are trained to gauge children's involvement, involvement could still be fleeting. Sustained moderate- to high-level attention may be even more important that

bouts of high-level involvement that come and go. Because a major component of children's self-regulation involves the ability to sustain attention (and tune out distractions in the environment), this is possibly a very important aspect of children's learning behavior to capture, but would require a different sort of coding system from the COP.

Lack of Receptive Language Measure

Although the current study utilized three subtests of the Woodcock-Johnson III to assess children's language skills, it did not include a measure of receptive language. A measure of receptive language would have possibly been valuable as young children's receptive vocabulary tends to be deeper than their expressive vocabulary (Pinker, 1994). Including a measure of receptive vocabulary would have insured a more complete picture of children's early language skills. However, as the data were taken from a larger study with a pre-established protocol and assessment battery, it was not possible to add a test of receptive language.

Conclusions

The purpose of this dissertation was to examine the relationships between children's language skills, their learning behaviors, and their self-regulation gains in early childhood. This study used a cross-validation approach in which the full sample of children was split into two parts: a smaller practice sample, and a cross-validation sample. This approach allowed for preliminary analyses to identify potentially relevant

child learning behaviors that were then analyzed further using the cross-validation sample.

Using the cross-validation sample, analyses were conducted to test the association between children's language skills at pre-kindergarten entry and the gains in self-regulation they made over the course of the year. Next, the relationships between their language skills and the kinds of learning behaviors in which they engaged in the classroom were examined. Finally, the mediating effects of children's learning behaviors on the relationship between language and self-regulation gains were tested.

The results indicated that, overall, children's fall language skills were associated with their pre-kindergarten self-regulation gains. Children's language skills were also related to their participation in social learning interactions and sequential learning activities. However, their frequency of participation in these learning behaviors was not significantly related to their self-regulation gains in the cross-validation sample. Children's overall level of involvement during learning activities was associated with both children's entering language skills and their self-regulation gains. Language skills and self-regulation gains were also negatively correlated with children's display of off-task or disruptive behavior.

When the full mediation model was tested, the results showed that, because of their weak associations with self-regulation gains, children's participation in social learning interactions and sequential play did not significantly mediate the relationship between language and self-regulation gains. However, the models testing mediation with involvement and off-task behavior approached the level of statistical significance. These

findings suggested that language may affect self-regulation growth in unobservable ways, and point to a need for further exploration into the role that language, and resulting higher levels of classroom engagement, may play in facilitating children's self-regulation growth.

One particularly interesting finding of this study was the amount of variation among classrooms in terms of the different opportunities for social and sequential play. Preliminary analyses revealed that a large portion of the variation in children's learning behaviors was explained by the classroom. For some learning behaviors, more than 50% of the variance in children's participation was attributable to between-classroom differences. In other words, children's participation in the learning environment is a product both of what the individual child chooses, and what the classroom affords. This finding suggests the need to consider the classroom context effects regarding language and self-regulation development; however, this was beyond the scope of the current study.

Future research could build on the results of the current study in several key ways. First, classroom observations could be structured to allow for more frequent observations of children – and for longer periods of time – to give a more complete picture of children's participation and involvement in the classroom. Second, researchers could explore the reasons behind the low frequencies of children's verbal interactions in the classroom environment and determine if there are better ways to capture child-child interactions, as well as teacher-child interactions. Finally, the context effects of classrooms on children's language and self-regulation could be explored to take into

account the role that classrooms may play in shaping children's behavior, and how that might affect both language and self-regulation growth.

Appendix A

Test-Retest Reliability of Self-Regulation Measures (Lipsey et al., 2012)

	Test-Retest Reliability Two-Week Delay $M_{\text{day}} = 16.6, SD_{\text{day}} = 4.68$	Predictive Validity Performance at beginning of PreK predicting PreK gain in achievement	Predictive Validity Performance at beginning of PreK predicting end of PreK achievement
Backward Digit Span Time 1	0.72	0.06	0.42
Copy Design Time 1	0.71	0.12	0.41
DCCS Time 1	0.48	0.07	0.45
HTKS Time 1	0.80	0.11	0.54
Peg Tapping Time 1	0.80	0.09	0.56

Note. All correlations are significant at $p < .01$

Appendix B

Numbers of Children by Classroom in Practice and Cross-Validation Samples

	Number of Children	
	Practice Sample (N=201)	Cross-validation Sample (N=348)
1	6	7
2	6	9
3	7	6
4	6	6
5	4	1
6	2	2
7	2	5
8	0	3
9	1	1
10	1	1
11	3	3
12	1	4
13	1	3
14	0	3
15	3	3
16	6	5
17	5	5
18	4	9
19	5	7
20	5	7
21	4	8
22	2	9
23	2	8
24	2	6
25	2	2
26	1	4
27	2	6
28	3	5
29	5	7
30	3	9
31	3	4
32	0	5
33	0	5
34	5	1
35	1	6
36	6	6
37	3	3
38	2	2
39	0	7
40	6	7
41	2	3

Appendix B (cont.)

	Number of Children	
	Practice Sample (N=201)	Cross-validation Sample (N=348)
42	2	9
43	7	10
44	9	7
45	6	9
46	6	12
47	5	7
48	4	12
49	5	6
50	3	7
51	6	7
52	2	9
53	6	6
54	2	10
55	6	8
56	3	6
57	3	6
58	2	6
59	1	6
60	1	2
Total	201	348

REFERENCES

- Azmitia, M. (1992). Expertise, private speech, and the development of self-regulation. In R. M. Diaz & L. E. Berk (Eds.) *Private speech: From social interaction to self-regulation* (pp. 101-122). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Banfield, J. F., Wyland, C. L., Macrae, C. N., Munte, T. F., & Heatherton, T. F. (2004). The cognitive neuroscience of self-regulation. In R. F. Baumeister & K. D. Vohs (Eds.) *Handbook of self-regulation* (pp. 62-83). New York, NY: The Guilford Press.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 1173-1182.
- Berch, D. B., Krikorian, R., & Huha, E. M. (1998). The corsi block-tapping task: Methodological and theoretical considerations. *Brain and Cognition*, *38*, 317-338.
- Berk, L. E., & Garvin, R. A. (1984). Development of private speech among low-income Appalachian children. *Developmental Psychology*, *20*, 271-286.
- Bierman, K. L., Nix, R. L., Greenberg, M. T., Blair, C., & Domitrovich, C. E. (2008). Executive functions and school readiness intervention: Impact, moderation, and mediation in the Head Start REDI program. *Development and Psychopathology*, *20*, 821-843).
- Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist*, *57*(2), 111-127.
- Blair, C., Protzko, J., & Ursache, A. (2011). Self-regulation and early literacy. In S. B. Neuman & D. K. Dickinson (Eds.), *Handbook of early literacy research* (pp. 20-35). New York, NY: The Guilford Press.
- 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.
- Blair, C., Zelazo, P. D., & Greenberg, M. (2005). The measurement of executive function in early childhood. *Developmental Neuropsychology*, *28*, 561-571.
- Bodrova, E., & Leong, D. J. (2007). *Tools of the Mind: The Vygotskian approach to early childhood education* (2nd ed.). Upper Saddle River, NJ: Prentice-Hall.

- Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, switching, and working memory. *Developmental Neuropsychology, 19*(3), 273-293.
- Bialystok, E., & Martin, M. M. (2004). Attention and inhibition in bilingual children: Evidence from the dimensional change card sort task. *Developmental Science, 7*, 325-339.
- Campbell, F. A. & Ramey, C. T. (1994). Effects of early intervention on intellectual and academic achievement: A follow-up study of children from low-income families. *Child Development, 65*, 684-698.
- Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology, 28*, 595-616.
- Checa, P., Rodriguez-Bailon, R., & Rueda, M. R. (2008). Neurocognitive and temperamental systems of self-regulation and early adolescents' social and academic outcomes. *Mind, Brain, and Education, 2*, 177-187.
- Cohen, J. S., & Mendez, J. L. (2009). Emotion regulation, language ability, and the stability of preschool children's peer play behavior. *Early Education and Development, 20*, 1016-1037.
- Cohen, N. J., Vallance, D. D., Barwick, M., Im, N., Menna, R., Horodezky, N. B., & Isaacson, L. (2000). The interface between ADHD and language impairment: an examination of language, achievement, and cognitive processing. *Journal of Child Psychology and Psychiatry, 41*, 353-362.
- Cooper, D., & Farran, D. C. (1988). Behavioral risk in kindergarten. *Early Childhood Research Quarterly, 3*, 1-20.
- Cooper, D. H., & Farran, D. C. (1991). *The Cooper-Farran Behavioral Rating Scales*. Brandon, VT: Clinical Psychology Publishing.
- Davidson, M. C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia, 44*, 2037-2078.
- Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4-12 years old. *Science, 333*, 959-964.
- Diamond, A., & Taylor, C. (1996). Development of an aspect of executive control: Development of the abilities to remember what I said and to "do as I say, not as I do". *Developmental Psychobiology, 29*, 315-334.

- Dickinson, D. K., McCabe, A., & Essex, M. J. (2006). A window of opportunity we must open to all: The case for preschool with high-quality support for language and literacy. In David K. Dickinson & Susan B. Neuman (Eds.) *Handbook of early literacy research, Volume 2* (pp. 11-28). New York, NY: Guilford Publications.
- Dionne, G., Tremblay, R., Biovin, M., Laplante, D., & Perusse, D. (2003). Physical aggression and expressive vocabulary in 19-month old twins. *Developmental Psychology, 39*, 261-273.
- DiPerna, J., Lei, P., Reid, E. (2007). Kindergarten predictors of mathematical growth in the primary grades: An investigation using the Early Childhood Longitudinal Study—Kindergarten Cohort. *Journal of Educational Psychology, 99*(2), 369-379.
- Duncan, G., Dowsett, C., Claessens, A., Magnuson, K., Huston, A., Klebanov, P., ... Japel, C. (2007). School readiness and later achievement. *Developmental Psychology, 43*, 1428-1446.
- Elias, C. L. & Berk, L. E. (2002). Self-regulation in young children: Is there a role for sociodramatic play? *Early Childhood Research Quarterly, 17*, 216–238.
- Espy, K., McDiarmid, M. D., Cwik, M. F., Stalets, M. M., Hamby, A., & Senn, T. E. (2004). The contribution of executive functions to emergent mathematic skills in preschool children. *Developmental Neuropsychology, 26*(1), 465-486.
- Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience, 14*, 340-347.
- Fantuzzo, J., Bulotsky-Shearer, R., McDermott, P. A., McWayne, C., Frye, D., & Perlman, S. (2007). Investigation of dimensions of social-emotional classroom behavior and school readiness for low-income urban preschool children. *School Psychology Review, 36*, 44-62.
- Farran, D.C., Lipsey, M. W., & Wilson, S. J. (2011) Experimental evaluation of the Tools of the Mind pre-k curriculum: Technical report. Unpublished manuscript. Peabody Research Institute, Vanderbilt University, Nashville, TN.
- Farran, D. C., & Son-Yarborough, W. (2001). Title I funded preschools as a developmental context for children’s play and verbal behaviors. *Early Childhood Research Quarterly, 16*, 245-262.
- Farran, D. C. et al. (2006), Child Observation in Preschool (2008 revision). Tools of the Mind Adaptation, (2010). Peabody Research Institute.

- Feagans, L., Fendt, K. & Farran, D.C. (1995). The effects of day care intervention on teachers' ratings of the elementary school discourse skills in disadvantaged children. *International Journal of Behavioral Development*, 243-261.
- Floyd, F. J. & Widaman, K. F. (1995). Factor analysis in the development and refinement of clinical assessment instruments. *Psychological Assessment*, 7, 286-299.
- Fuhs, M. W., & Day, J. D. (2011). Verbal ability and executive functioning development in preschoolers at Head Start. *Developmental Psychology*, 47, 404-416.
- Gallagher, T. M. (1993). Language skill and the development of social competence in school-age children. *Language, Speech, and Hearing Services in Schools*, 24, 199-205.
- Garon, N., Bryson, S.E., & Smith, I.M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin*, 134, 31-60.
- Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action: Performance of children 3 ½ - 7 years old on a Stroop-like day-night test. *Cognition*, 53, 129-153.
- Heckman, J. J., & Rubinstein, Y. (2001). The importance of noncognitive skills: Lessons from the GED Testing Program. *The American Economic Review*, 91(2), 145-149.
- Hooper, S. R., Roberts, J. E., Zeisel, S. A., & Poe, M. (2003). Core language predictors of behavioral functioning in early elementary school children: Concurrent and longitudinal findings. *Behavioral Disorders*, 29, 10-24.
- Howse, R., Lange, G., Farran, D., Boyles, C. (2003). Motivation and self-regulation as predictors of achievement in economically disadvantaged young children. *The Journal of Experimental Education*, 71(2), 151-174.
- Hughes, C. (2011). Changes and challenges in 20 years of research into the development of executive functions. *Infant and Child Development*, 20, 251-271.
- Kochanska, G., Murray, K., & Harlan, E. (2000). Effortful Control in Early Childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology*, 36(2), 220-232.
- Krafft, K. C. and Berk, L. E. (1998). Private speech in two preschools: Significance of open-ended activities and make-believe play for verbal self-regulation. *Early Childhood Research Quarterly*, 13(4), 637-658.

- Lan, X., Legare, C. H., Ponitz, C. C., Li, S., & Morrison, F. J. (2011). Investigating the links between the subcomponents of executive function and academic achievement: A cross-cultural analysis of Chinese and American preschoolers. *Journal of Experimental Child Psychology, 108*, 677-692.
- LaParo, K., & Pianta, R. (2000). Predicting children's competence in the early school years: A meta-analytic review. *Review of Educational Research, 70*(4), 443-484.
- Li-Grining, C. P. (2007). Effortful control among low-income preschoolers in three cities: Stability, change, and individual differences. *Developmental Psychology, 43*(1), 208-221.
- Liew, J. (2012). Effortful control, executive functions, and education: Bringing self-regulatory and social-emotional competencies to the table. *Child Development Perspectives, 6*, 105-111.
- 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.L., Farran, D.C., Turner, K., & Dong, N. (2012). Self-regulation measurement study: Technical report. Available from M.W. Lipsey, Peabody Research Institute, Vanderbilt University, Box 0181 GPC, 230 Appleton Place, Nashville, TN 37203.
- MacKinnon, D. P. (2008). *Introduction to statistical mediation analysis*. Mahwah, NJ: Erlbaum.
- McClelland, M. M., Acock, A. C., Piccinin, A., Rhea, S. A., & Stallings, M. C. (in press). Relations between preschool attention span-persistence and age 25 educational outcomes. *Early Childhood Research Quarterly*.
- McClelland, M. M., & Cameron, C. (2011). Self-regulation and academic achievement in elementary school children. In R. M. Lerner, J. V. Lerner, E. P. Bowers, S. Lewin-Bizan, S. Gestsdottir, & J. B. Urban (Eds.), *Thriving in childhood and adolescence: The role of self-regulation processes*. New directions for child and adolescent development, 133, 29-44.
- McClelland, M. M., & Cameron, C. (2012). Self-regulation in early childhood: Improving conceptual clarity in developing ecologically valid measures. *Child Development Perspectives, 6*, 136-142.
- McClelland, M. M., Cameron, C., Connor, C., Farris, C., Jewkes, A., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology, 43*, 947-959.

- 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*, 307-329.
- McLoyd, V. C. (1998). Socioeconomic disadvantage and child development. *American Psychologist, 52*(2), 185-204.
- McWayne, C. M., Fantuzzo, J. W., & McDermott, P. A. (2004). Preschool competency in context: An investigation of the unique contribution of child competencies to early academic success. *Developmental Psychology, 40*, 633-645.
- McWayne, C., & Cheung, K. (2009). A picture of strength: Preschool competencies mediate the effects of early behavior problems on later academic and social adjustment for Head Start children. *Journal of Applied Developmental Psychology, 30*, 273-285.
- Mendez, J.L., Fantuzzo, J., & Cicchetti, D. (2002). Profiles of social competence among low-income African American preschool children. *Child Development, 73*, 1085-1100.
- Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H. ... Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences*. doi:10.1073/pnas.1010076108.
- Muthén, B. O., & Muthén, L. K. (1998-2011). Mplus user's guide. Sixth edition. Los Angeles, CA: Muthén & Muthén.
- Muthén, B. O. & Muthén, L. K. (2009). Mplus short courses topic 1: Exploratory factor analysis, confirmatory factor analysis, and structural equation modeling for continuous outcomes [PowerPoint slides]. Retrieved from www.statmodel.com.
- Nelson, K., Skwere, D. P., Goldman, S., Henseler, S., Presler, N., & Walkenfield, F. F. (2003). Entering a community of minds: An experiential approach to theory of mind. *Human Development, 46*(1), 24-46.
- NICHD Early Child Care Research and Network. (2004). Multiple pathways to early academic achievement. *Harvard Educational Review, 74*, 1-29.
- Osborn, A. F., Butler, N. R., & Morris, A. C. (1984). *The social life of Britain's five-year-olds: A report of the child health and education study*. London: Routledge & Kegan Paul.
- Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist, 36*(2), 89-101.

- Parten, M. B. (1932). Social participation among preschool children. *Journal of Abnormal and Social Psychology*, 27, 243-269.
- Pinker, S. (1994). *The language instinct: How the mind creates language*. New York: Morrow and Co.
- Pituch, K. A., Murphy, D. L., & Tate, R. L. (2010). Three-level models for indirect effects in school- and class-randomized experiments in education. *The Journal of Experimental Education*, 78, 60-95.
- Ponitz, C., McClelland, 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(2), 141-158.
- Ponitz, C., McClelland, M., Matthews, J., & Morrison, F. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. *Developmental Psychology*, 45, 605-619.
- Preacher, K. J. (2011). Multilevel SEM strategies for evaluating mediation in three-level data. *Multivariate Behavioral Research*, 46, 691-731.
- Qi, C. H., & Kaiser, A. P. (2004). Problem behaviors of low-income children with language delays: An observation study. *Journal of Speech, Language, and Hearing Research*, 47, 595-609.
- Rabiner, D., Coie, J. D., & The Conduct Problems Prevention Research Group. (2000). Early attention problems and children's reading achievement: A longitudinal investigation. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39, 859-867.
- Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F., Bub, K., & Pressler, E. (2011). CSRP's impact on low-income preschoolers' preacademic skills: Self-regulation as a mediating mechanism. *Child Development*, 82(1), 362-378.
- Rhoades, B. L., Greenberg, M. T., & Domitrovich, C. E. (2009). The contribution of inhibitory control to preschoolers' social-emotional competence. *Journal of Applied Developmental Psychology*, 30, 310-320.
- 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., La Paro, K. M., Downer, J. T., & Pianta, R. C. (2009). The contribution of classroom setting and quality of instruction to children's behavior in kindergarten classrooms. *The Elementary School Journal*, 105(4), 377-394.

- Rimm-Kaufman, S. E., Pianta, R., & Cox, M. (2000). Teachers' judgments of problems in the transition to kindergarten. *Early Childhood Research Quarterly, 15*(2), 147-166.
- Rohrkemper, M. M. (1989). Self-regulated learning and academic achievement: A Vygotskian view. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theory, research, and practice* (pp. 143-168). New York, NY: Springer-Verlag.
- Rosvold, H. E., Mirsky, A. F., Sarason, I., Bransome, E. D., & Beck, L. H. (1956). A Continuous Performance Test of brain damage. *Journal of Consulting Psychology, 20*, 343-350.
- Rothbart, M. K. (1981). Measurement of temperament in infancy. *Child Development, 52*, 569-578.
- 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.
- Rueda, M., Rothbart, M., McCandliss, B., Saccomanno, L., Posner, M. (2005). Training, maturation, and genetic influences on the development of executive attention. *Proceedings of the National Academy of Sciences, 102*(41), 14931-14936
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*, 68-68.
- Saltz, E., Dixon, D., & Johnson, J. (1977). Training disadvantaged preschoolers on various fantasy activities: Effects on cognitive functioning and impulse control. *Child Development, 48*(2), 367-380.
- Sektnan, M., McClelland, M. M., Acock, A., & Morrison, F. J. (2010). Relations between early family risk, children's behavioral regulation, and academic achievement. *Early Childhood Research Quarterly, 25*, 464-479.
- Singer, B. D., & Bashir, A. S. (1999). What are executive functions and self-regulation and what do they have to do with language-learning disorders? *Language, Speech, and Hearing Services in Schools, 30*, 265-273.
- Tannock, R., & Schachar, R. (1996). Executive dysfunction as an underlying mechanism of behavior and language problems in attention deficit hyperactivity disorder. In J. H. Beitchman, N. J. Cohen, M. M. Konstantarea, & R. Tannock (Eds.) *Language, learning, and behavior disorders: Developmental, biological, and clinical perspectives* (pp. 128-155). New York, NY: Cambridge University Press.

- Tominey, S. L., & McClelland, M. M. (2011). Red light, purple light: Findings from a randomized trial using circle time games to improve behavioral self-regulation in preschool. *Early Education & Development, 22*(3), 489-519
- Turner, K. A., Lipsey, M. W., Fuhs, M. W., Vorhaus, E., & Meador, D. N. (2012, March). *Academically relevant measures of executive function: Development and validation of assessments for preschool children*. Paper presented at the spring meeting of Society for Research on Educational Effectiveness, Washington, D.C.
- Vallotton, C., & Ayoub, C. (2011). Use your words: The role of language in the development of toddlers' self-regulation. *Early Childhood Research Quarterly, 26*(2), 169-181.
- Vohs, K. D., & Baumeister, R. F. (2004). Understanding self-regulation: An introduction. In R. F. Baumeister & K. D. Vohs (Eds.), *Handbook of self-regulation* (pp. 1-9). New York, NY: The Guilford Press.
- Vygotsky, L. S. (1963). *Thought and language*. Cambridge, MA: MIT Press.
- Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.
- Westby, C. E., & Cutler, S. K. (1994). Language and ADHD: Understanding the bases and treatment of self-regulatory deficits. *Topics in Language Disorders, 14*(4), 58-76.
- Wiebe, S. A., Espy, K., & Charak, D. (2008). Using confirmatory factor analysis to understand executive control in preschool children: I. Latent structure. *Developmental Psychology, 44*, 575-587.
- Winsler, A., de Leon, J. R., Wallace, B. A., Carlton, M. P., & Willson-Quayle, A. (2003). Private speech in preschool children: Developmental stability and change, across-task consistency, and relations with classroom behavior. *Journal of Child Language, 30*, 583-608.
- Winsler, A., Diaz, R. M., Atencio, D. J., McCarthy, E. M., & Chabay, L. A. (2000). Verbal self-regulation over time in preschool children at risk for attention and behavior problems. *Journal of Child Psychology and Psychiatry, 41*, 875-886.
- Winsler, A., Manfra, L., & Diaz, R. M. (2007). "Should I let them talk?": Private speech and task performance among preschool children with and without behavior problems. *Early Childhood Research Quarterly, 22*, 215-231.
- Woodcock, R. W., & Johnson, M. B. (1989). *Woodcock-Johnson Psychoeducational Battery – Revised*. Allen, TX: DLM Teaching Resources.

- Woodcock, R. W., & Mather, N. (2000). *Woodcock Johnson Psycho-Educational Battery—III*. Itasca, IL: Riverside.
- Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III*. Itasca, IL: Riverside Publishing.
- Young, D. (1970). *Group mathematics test*. Kent: Hodder and Stoughton.
- Zelazo, P. D. (2006). The dimensional change card sort (DCCS): A method of assessing executive function in children. *Nature Protocols*, *1*, 297-301.
- Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, *37*(2), 197-206.