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Examining Relationships Between the WaKIDS GOLD Social-Emotional and Cognitive Subtests of Executive Function and Kindergarten Reading Readiness

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By

AMY WRIGHT

A dissertation submitted in partial fulfillment

Of the requirements for the degree of

Doctor of Education

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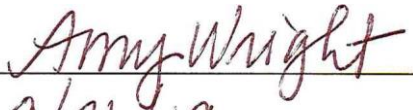
Signature 

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Abstract

Executive function skills, which are defined as a person's ability to regulate behaviors such as attention, working memory, and inhibitory control, play a role in a child's successful transition from preschool to kindergarten. The purpose of this study was to review and analyze the relationship between executive function in early childhood, as measured by the WaKIDS GOLD™ social-emotional and cognitive subtests, and early reading readiness. The research design was both correlational and predictive (Gall, Gall, & Borg, 2006). The target population is kindergarteners in a suburban Washington State school district. The study is based on data collected at the beginning of the kindergarten year and at the end of the year using the social emotional and cognitive subtests of the WaKIDS GOLD™ assessment. WaKIDS GOLD™ cognitive and social emotional subtests. WaKIDS GOLD™ subtests were found to have a low to moderate correlation to early reading skills, specifically phonemic awareness and were also found to be a moderate predictor of growth in reading skills over the kindergarten year.

Keywords: executive function, kindergarten readiness, working memory, inhibitory control, self-regulation, attention

CHAPTER 1: Introduction

Statement of the Problem

The transition from preschool to kindergarten is a major milestone in the life of a young child. Most children successfully navigate the move from a relatively unstructured preschool setting to the more formal learning environment of kindergarten without too much struggle (Ponitz et al., 2008). The typical kindergarten learning environment requires self-control and other skills to regulate behavior such as paying attention, following directions, and inhibiting inappropriate actions (McClelland, Acock, & Morrison, 2006; Ponitz et al., 2008). All these skills are called *executive function* and are necessary at all age levels for daily life and success at work and school, and begin to develop early in life (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009). In the current standards-driven, high-stakes testing environment of education beginning in early childhood, practitioners are seeking information and instructional strategies to facilitate and improve student achievement. As a child transitions from preschool to kindergarten, it is quite plausible that the level of acquired executive function skills will predict and impact his or her academic, and more specifically, reading readiness (Isquith, Crawford, Espy, & Gioia, 2005).

Executive function is a set of skills that help people control their behavior and direct it toward carrying out tasks and goals. The ability to regulate behaviors such as attention, working memory, and inhibitory control play a role in a child's successful transition from preschool to kindergarten as they are expected to listen, engage in activities, and work with others. Children who are emotionally prepared with these behavior regulation skills exhibit classroom behavior that facilitates learning (Brock et

al., 2009). Students who possess strong executive function have a better ability to pay attention, follow along, and construct meaning from information.

Executive function skills that enable children to control impulses, make plans, and stay focused are not set at birth. The prefrontal cortex at the front of the brain handles most executive function skills and develops steadily from birth. The rudimentary signs of executive function emerge toward the end of the first year of life (Diamond, 2002; Posner & Rothbart, 2000; Zelazo, 2004). Children are born with the potential to develop these capacities, or not, depending on experiences during infancy, through childhood and into adolescence (Center on the Developing Child, 2011). Executive function skills are primarily built through relationships with adults and within the context of a child's home environment. If that environment is growth-promoting, it provides children with scaffolding that helps them practice necessary skills before they must perform them alone. This scaffolding takes the form of routines, modeled social behaviors, supportive reliable relationships, play, strategies for coping with stress and exercise. On the contrary, if the child's environment provides adverse experiences, then skill development can be delayed or impaired (Duncan et al., 2007).

Children who do not have opportunities to use and strengthen these skills and therefore fail to become proficient, or children who lack the capacity for proficiency due to disability, or even adults who lose executive function skills due to brain injury or old age have a difficult time managing the routines of daily life, studying, sustaining friendships, holding down a job or managing crisis (Center for the Developing Child, 2011).

The process of development is one in which children gradually manage more and more aspects of their environments and lives on their own. As toddlers and young preschoolers learn to stop going after a ball as it rolls into the street, learn to brush teeth, get dressed or clean up toys without reminders, the adults in their lives set the framework, or scaffolding, that helps them to use the executive function skills that they are developing (Posner & Rothbart, 2000). While adaptive executive function skills are developing, working memory and attention control undergo rapid development during the preschool years and have substantial impact on children's developing "approaches to learning" and corresponding academic readiness (Blair, 2002; Diamond, Barnett, Thomas, & Munro, 2007; Welsh, Nix, Blair, Bierman, & Nelson, 2010). By age three most children can organize themselves to complete tasks that involve two rules (If it is red, put it here. If it is blue, put it there). They can also demonstrate inhibitory control by maintaining focus in the face of distractions for short periods and hold rules mentally as they figure things out, demonstrating working memory. As children prepare to make the transition from preschool to kindergarten, the five-year-old mind, in contrast to the three-year-old mind, is remarkably complex (Blair, 2006). Older preschoolers can demonstrate conscious problem solving by shifting from one rule in a game to another, inhibiting responses that are inappropriate even if highly desirable, like waiting for a piece of candy knowing there is a chance for more later (Center for the Developing Child, 2011). They can also follow multi-step directions in games such as Simon Says. While these skills are still emerging, they enable children to acquire knowledge and to participate in the elementary school experience as they enter kindergarten.

In general, most kindergarten teachers regard children's executive function and behavioral regulation as more important than children's academic knowledge in predicting adjustment to kindergarten (Brock et al., 2009; Lin, Lawrence, & Gorrell, 2003; Rimm-Kaufman, Pianta, & Cox, 2000). Scientists argue that strong working memory, cognitive self-control, and attentional skill provide the basis upon which children's abilities to learn to read, write and do math can be built (Barkley, 2001; Blair, 2002). In practice, these skills support the processes such as focusing, remembering, and planning that enable children to effectively and efficiently master the content of learning. Children with stronger working memory, inhibition and attentional skills have also been found to make larger gains on tests of early math, language and literacy developing during the preschool and kindergarten years than their peers with weaker executive function skills (Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Blair & Razza, 2007; Epsy et al., 2004; Fuchs et al., 2006; McClelland et al., 2007). The challenge faced by teachers of kindergarten to determine and understand these foundational executive function skills is where kindergarten entry assessments come in (Lonigan, Allan, & Lerner, 2011; West, Denton, & Germino-Hausken, 2000). According to Scott-Little, Bruner, and Schultz (2011), "data collected at kindergarten entry serve both as a cumulative glimpse into how children's early experiences have (or have not) supported their development and learning and offer a baseline for kindergarten instruction and for measuring future progress" (p.1).

During the 2016-17 school year, the state of Washington implemented state-funded full day kindergarten for all students to ensure that all children in Washington get a great start in kindergarten (Washington State Office of the Superintendent of Public

Instruction [WA OSPI], 2015). As part of this initiative, Washington State has adopted Teaching Strategies GOLD™ for their kindergarten assessment process known as Washington Kindergarten Inventory of Developing Skills (WaKIDS). This assessment is presently being used by all state-funded full-day kindergarten classrooms across the State for the purpose of providing kindergarten teachers with valuable information about their students across six development areas representing the "whole child" (social-emotional, physical, cognitive, language, literacy, and mathematics) (Teaching Strategies, 2011). This is an observation-based assessment, and according to Teaching Strategies GOLD™, the assessment "blends ongoing, authentic assessment of all areas of developmental and learning with intentional, focused performance assessment tasks for selected predictors of school readiness in the areas of literacy and numeracy" (Teaching Strategies, 2010, p.1). The GOLD™ Cognitive and Social-Emotional subtests of the WaKIDS assessment measure the executive function skills students demonstrate at the beginning and end of kindergarten and may have a relationship with their literacy development (Scott-Little et al., 2011).

Purpose of the Study

The primary focus of this doctoral dissertation is to explore relationships between the social-emotional and cognitive subtests of the WaKIDS and measures of kindergarten reading readiness based on the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) Assessment. The objectives are twofold: (a) to determine the strength of relationship between the WaKIDS GOLD™ subtests for executive function skills and the DIBELS assessment, and (b) to determine the power of WaKIDS GOLD™ subtests to predict reading readiness in kindergarten.

Research Questions

Question 1. Do Fall WaKIDS GOLD™ social-emotional and cognitive subtests of executive function scores significantly correlate with the DIBELS Beginning of Year (BOY) scores after controlling for age and gender?

a. Do Fall WaKIDS GOLD™ social-emotional subtest of executive function scores significantly correlate with the (BOY) First Sound Fluency (FSF) subtest of DIBELS Assessment, after controlling for age and gender?

b. Do Fall WaKIDS GOLD™ social emotional subset of executive function scores significantly correlate with the BOY Letter Naming Fluency (LNF) subtest of DIBELS Assessment, after controlling for age and gender?

c. Do Fall WaKIDS GOLD™ cognitive subtest of executive function scores significantly correlate with the BOY First Sound Fluency (FSF) subtest of DIBELS Assessment, after controlling for age and gender?

d. Do Fall WaKIDS GOLD™ cognitive subtest of executive function scores significantly correlate with the BOY Letter Naming Fluency (LNF) subtest of DIBELS Assessment after controlling for age and gender?

Question 2: Do Fall WaKIDS GOLD™ social-emotional and cognitive subtests of executive function scores significantly correlate with the DIBELS End of Year (EOY) scores after controlling for age and gender?

a. Do Fall WaKIDS GOLD™ social-emotional subtest of executive function scores significantly correlate with the EOY Nonsense Word Fluency (NWF) subtest of DIBELS Assessment, after controlling for age and gender?

b. Do Fall WaKIDS GOLD™ social emotional subset of executive function scores significantly correlate with the EOY Phoneme Segmentation Fluency (PSF) subtest of DIBELS Assessment, after controlling for age and gender?

c. Do Fall WaKIDS GOLD™ cognitive subtest of executive function scores significantly correlate with the EOY Nonsense Word Fluency (NWF) subtest of DIBELS Assessment, after controlling for age and gender?

d. Do Fall WaKIDS GOLD cognitive subtest of executive function scores significantly correlate with the EOY Phoneme Segmentation Fluency (PSF) test of DIBELS Assessment, after controlling for age and gender?

Question 3: Do the Spring WaKIDS GOLD™ social-emotional and cognitive subtests of executive function significantly correlate with DIBELS EOY Assessments?

a. Do Spring WaKIDS GOLD™ social emotional subtests of executive function significantly correlate with the NWF subtest of the DIBELS EOY Assessment?

b. Do Spring WaKIDS GOLD™ social emotional subtests of executive function significantly correlate to the PSF subtest of the DIBELS EOY Assessment?

c. Do Spring WaKIDS GOLD™ cognitive subtests of executive function significantly correlate with the NWF subtest of the DIBELS EOY Assessment?

d. Do Spring WaKIDS GOLD™ cognitive subtests of executive function significantly correlate to the PSF subtest of the DIBELS EOY Assessment?

Question 4: Do the Fall WaKIDS GOLD™ social-emotional and cognitive subtests of executive function scores predict growth in literacy skills over the kindergarten year after controlling for age, gender, and beginning of the year literacy skills as measured by DIBELS EOY Assessments?

a. Do Fall WaKIDS GOLD™ social emotional and cognitive subtests of executive function scores predict growth in literacy skills over the kindergarten year after controlling for age, gender, and beginning of the year literacy skills, as measured by the NWF subtest of the DIBELS Assessment?

b. Do Fall WaKIDS GOLD™ social emotional and cognitive subtests of executive function scores predict growth in literacy skills over the kindergarten year after controlling for age, gender, and beginning of the year literacy skills, as measured by the PSF subtest of the DIBELS Assessment?

The null hypothesis in this study is that executive function skills have no impact on reading readiness scores.

CHAPTER 2: Literature Review

Introduction

The purpose of this section is to provide a framework for evaluating the relationship between subtests of the WaKIDS GOLD™ assessment that screens executive function skills and the DIBELS assessments. It is important to establish the key elements of early childhood executive function and early literacy assessment. Past theoretical and empirical research will be reviewed in this chapter to establish the important elements of executive function as it relates to kindergarten students.

To be successful in life, adults must possess the ability to multitask, display self-control, follow multi-step directions even when interrupted, and to stay focused on what one is doing (Center for the Developing Child at Harvard University, 2011). Without these skills, it is a challenge to solve problems and make decisions while persisting at tedious yet important tasks. All of these abilities fall under the umbrella of executive function, which includes the set of skills that help a person focus on multiple streams of information at the same time, make plans, monitor errors, and revise plans.

Acquisition of these skills is one of the more important tasks of childhood, and a key to academic success, beginning in early childhood, through elementary school and adolescence. Young children rely on their developing executive function skills to help them as they learn to read and write and participate in all social and academic aspects of the classroom. Among researchers who study executive function, three dimensions of self-regulation are frequently highlighted for young children: working memory, inhibitory control, and attention (Center on the Developing Child at Harvard University, 2011).

Historical Context

Post-World War II instruction in American schools was heavily influenced by mental ability conceptions of student functioning (Zimmerman, 1990). Thurstone's development of the Primary Mental Abilities Test in 1938 was widely hailed as the measure to provide the "definitive factorial description" of the full range of student abilities (Zimmerman, 1990). Once tested, students were classified and placed in optimal learning environments such as reading groups in elementary school settings. Teachers were encouraged to focus lessons and curriculum to each child's unique ability.

During the 1960s, education reform was informed by the work of Hunt (1961) and Bloom (1968) and their influential books on the importance of early learning experiences on children's development and also by Lyndon B. Johnson's *War on Poverty* (Zimmerman, 1990). The emphasis was on "disadvantage" and the intellectual environment of the home of poor children. Reforms were designed by humanistic psychologists to make schools more relevant and less threatening to children in the hope of helping them be more ready to learn (Zimmerman & Shunk, 2001). Less reliance on grading, more flexible curricular requirements, and more concern about students' social adjustment to school were the recommendations (Zimmerman, 1990). At this time, Head Start began in an effort to "catch children up" and counteract the lack of exposure to the "hidden curriculum" that was provided in the homes of middle-class children and missing from the homes of children of poverty (Raver & Zigler, 1997; Schumacher, Greenberg, & Mezey, 2003). The goal of this reform was to compensate for the differences of disadvantaged children through the use of innovative teaching methods and curriculum.

The 1970s brought disillusionment with the results of the reform efforts to eliminate the effects of poverty, so a new wave of reforms was launched (Glasser & Center, 1975). Reformers attributed the decline in student success in schools to a decline in educational standards during the 1960s. A "Back to Basics" approach was established. Then in 1983, the National Commission on Excellence in Education released *A Nation at Risk: The Imperative for Educational Reform*, which recognized academic underachievement in the American education system and made recommendations for the future (Gardner, Larson, & Baker, 1983). This landmark publication began a new wave of reforms that set the stage for No Child Left Behind Legislation (U.S. Department of Education, 2001), and the current adoption of the Common Core State Standards for College and Career Readiness (Common Core State Standards Initiative, 2014).

Throughout most of these changes in education, kindergarten was viewed as "a child's garden, where faithful gardeners supported children's healthy growth and prepared them for school and a lifelong love of learning" (Miller & Almon, 2009). For many years this philosophical view of Friedrich Fröebel's Kindergarten Pedagogy (1899) served public education well as kindergarten was viewed as a transition, and as a place to develop readiness for the more formal setting of first grade. The standards movement and No Child Left Behind Legislation shifted that view. Now "the bar for kindergarten achievement has been raised so that it is essentially at the level of first grade achievement 20 years ago" (Miller & Almon, 2009). The study of kindergarten readiness, specifically the skills necessary for students to develop literacy and math ability, has followed the trajectory of the implementation of standards and high stakes testing. Many tools have been developed to assess executive function and its relation to school success.

As changes were coming to kindergarten, the concept of executive function was first defined in the 1970s. Based on studies of the role of the prefrontal cortex in behavior and learning process from the 1950s, Michael Posner coined the term "cognitive control" in 1975 and proposed that there is a separate executive branch of the attentional system responsible for focusing attention on selected aspects of the environment (Goldstein, Naglieri, Princiotta, & Otero, 2014; Posner & Petersen, 1989). Alan Baddeley proposed a similar system as part of his model of working memory, stating that there must be a component which he referred to as the central executive: allowing information to be manipulated in short term memory (Baddeley, 2003). Shallice (1988) also suggested that attention is regulated by a supervisory system, which can override automatic responses in favor of scheduling behavior on based on intentions. Consensus slowly emerged that this control system is housed in the prefrontal cortex. While other researchers used the term "executive" when discussing this work performed by the prefrontal cortex, more than thirty or more constructs have been included under the umbrella term executive function, making the concept difficult to operationally define (Goldstein et al., 2014). Goldstein, Naglieri, Princiotta & Otero (2014) conducted a large national study of children and suggested that executive function was best defined as a single phenomenon, conceptualized as the efficiency with which individuals go about acquiring knowledge, as well as solving problems.

Glossary of Terms

Executive function: An umbrella term for the management of cognitive processes including working memory, inhibitory control and attention (Zelazo, Carter, Reznick, & Frye, 1997).

Self-Regulation: A child's ability to gain control of bodily functions, manage powerful emotions, and maintain focus and attention (Rueda, Posner, & Rothbart, 2005; Zimmerman, 1990).

Working Memory: The theoretical framework that refers to structures and processes used for temporarily storing and manipulating information (Baddeley, 1996, 2003).

Inhibitory Control: The ability to resist distractions, give a more considered response, avoid one's first reactions, and taking turns (Brock et al., 2009; Mischel, Shoda, & Rodriguez, 1989; Raver et al., 2011)

Theoretical Framework of the Study

Self-Regulation Theory and Function

Self-regulation is the key to executive function as it relates to learning. In the 1980's Zimmerman developed Self-Regulation Theory (1990), which explores the construct of self-regulation in children. In the past fifteen years, researchers have been studying the skills of self-regulation that develop earliest in children and affect reading readiness and school success. These researchers looked to Vygotsky, Piaget, Montessori, and Skinner for insight on how children develop as learners (Zimmermann & Schunk, 2001). Self-Regulation Theory (SRT) is grounded in constructivist (Pascual-Leone & Goodman, 1979; Piaget, 1969), social or observation (Bandura, 1991; Vygotsky, 1980), motivation (Brooks, 2008; Dweck, 1986), and operant (Skinner, 1953) theories. SRT is described as the regulation of three aspects of learning— behavior, motivation, and cognition—which helps to promote reading and writing achievement (Zimmerman, 1990). The three aspects are also identified as components of executive function, a term

first used by neuroscientists and educational psychologists in the 1980s. Although the theoretical framework for executive function is not new, the term has become more prevalent in education since researchers Lyon and Krasnegor "coined" the phrase in a 1996 publication. Many definitions of executive function have been formulated, but Brown's (2006) description of executive function as "the management system of the brain" (p.12) or the wide range of central control processes used to direct conscious thought has been widely agreed upon as a working definition. Brown (2006) continues to note, "although the definition of executive function is still evolving, most researchers agree that the term should be used to refer to brain circuits that prioritize, integrate, and regulate cognitive function" (p.36). The management of the brain's executive function then provides the mechanism for self-regulation.

Zimmerman and current theorists continue to build on the work of others who examined the cognitive components of executive functioning such as attention, working memory and inhibitory control. In the late 1970s, Shiffrin and Schneider (1984) studied selective attention by developing a theory of automatic and controlled processing (Shiffrin & Schneider, 1977). They postulated that automatic processing was generally a fast, effortless process. Controlled processing is often slow and effortful and is used with novel or inconsistent information. They saw automatic and controlled processing working in parallel ways as children develop the attention skills needed as readers and students (Shiffrin & Schneider, 1984). To read effectively, children need to exhibit automaticity in identifying letter-sound associations and use controlled processing in word attack activities (Blair, 2002). To learn, retain, and use those skills, children must possess

effective attention, working memory, and self-regulation with inhibitory control (Ponitz, McClelland, Matthews, & Morrison, 2009)

Attention

Building on the research on attention regulation, Posner and Petersen (1989) added to the work of Shiffrin and Schneider (1984) to identify which part of the brain would perform attention tasks. To illustrate, he divided the attention "system" into subsystems that perform different, but related functions. Those functions are (a) orienting to sensory events, (b) detecting signals for focus (conscious) processing, and (c) maintaining a vigilant or alert state (Posner & Petersen, 1989, p.2). This construct of cognitive control over the attention regulation system became one of the building blocks of executive function research. In kindergarten, "attention includes selecting and attending to relevant information, such as listening to the teacher and focusing on a task" (Ponitz et al., 2009, p. 606). As a child learns to read, attention is key to the development of letter-sound association, sequence of events in a story, and independent practice to solidify skills (Cooper & Kiger, 2006)

Inhibitory Control

British neuropsychologists Norman and Shallice (1986) posited, "the primary role of attention is in the control of action" (p. 26) and is regulated by "a supervisory attentional system" (1981, p. 26). Baddeley (1996) called it the "Supervisory Activating System." This system manages the controlled and automatic processing which leads to attention and behavioral control. Inhibitory control is a cognitive process of executive function exhibited when a child controls or inhibits impulses and responses to stimuli. Inhibitory control often shows up in kindergarten as the ability to sit still, take turns, and

modify or correct incorrect responses (Allan, Hume, Allan, Farrington, & Lonigan, 2014). It can be as simple as a child remembering to raise their hand to answer a question or talk (Ponitz et al., 2009, p.606). While it seems intuitive that these abilities to control behavior would help a child engage in learning more effectively, there is a body of research that has found that children who arrive at school with well-established inhibitory control skills may learn more easily, to be more positive about school and have better relationships with peers and teachers (Benson, Sabbagh, Carlson, & Zelazo, 2013; Welsh, et al., 2010). More specifically, the ability to listen and engage in teacher-led instruction in a small or large group setting is key to the acquisition of reading skills (Cooper & Kiger, 2006.

Working Memory

Baddeley developed a model of working memory that includes automatic and controlled responses and the connection of these responses to attention and memory (Baddeley & Hitch, 1974). He called the management system for these processes "the central executive" (Baddeley, 1996, p.5), which he referred to as the most important component in terms of its general impact on cognition. Baddeley also points out that in recent years, there have been at least two dominant approaches in attempting to understand the process underlying self-regulation, both pointing to evidence that executive control, or later called executive function, is housed in the frontal lobe of the brain. For a kindergartener, working memory entails cognitively remembering and then carrying out teacher instructions as well as recognizing letters and sounds, and then mentally manipulating those letters and sounds to create words that have meaning (Center on the Developing Child at Harvard University, 2011).

Empirical Studies of Executive Function and School Readiness

Hot and Cool Executive Function Skills in Kindergarten

Brock, Rimm-Kaufman, Nathanson, and Grim (2009) explored the role of executive function in determining children's successful transition to kindergarten. The researchers based their study on the conceptualization of two components of executive function; labeled as "hot" and "cool," both based in an emotional component of executive self-regulating skills. In a classroom, some tasks are less emotionally laden, such as thinking abstractly, while others involve regulation of potentially intense emotions, such as deciding whether to hit the child who has taken one's toy (Brock et al., 2009). Cognitive problem solving that is less emotionally laden is called "cool" executive function and includes abstract concepts and symbols like numbers and letters (Blair & Razza, 2007). Attention, working memory, and inhibitory control are all considered cool executive function skills (Brock et al., 2009). Children can also encounter problems in the classroom that have an emotional component, referred to as "hot" executive function. Hot executive function skills involve the ability to delay gratification and regulate emotional responses (Brock et al., 2009). In the typical kindergarten classroom, success relies on the ability to remember instructions (working memory), attend to important features, and stay on task, suggesting that cool executive function plays a key role in kindergarten readiness and achievement (Brock et al., 2009).

This study, Brock et al., 2009 involved 173 kindergarteners from 36 classrooms in seven elementary schools and 36 kindergarten teachers, with teaching experience ranging from 1 to 37 years (M = 18 years). Researchers received parental consent for 333 students and 173 were randomly selected, from the 36 classrooms. Parents completed a

demographic questionnaire to determine levels of demographic risk. In the fall and spring, students were administered executive function and achievement tasks as well as a cognitive abilities test. Cool and hot executive function was measured with specific tasks. Hierarchical linear model results predicting outcomes by hot and cool executive function were presented. Children with well-developed cool executive function ($t = 2.52$, $p < .05$, $d = .22$), children who scored higher on a test of cognitive ability ($t = 3.45$, $p < 0.001$, $d = .28$), children who attended preschool ($t = 3.32$, $p < 0.001$, $d = .19$), and girls ($t = -2.78$, $p < .01$, $d < 0.15$), were all rated by their teachers in the spring on a learning behaviors questionnaire as displaying more learning related positive behaviors (Brock, et al., 2009). These same groups displayed more classroom engagement. Effect sizes suggested small associations between cool executive function and classroom behaviors (.18 to .22) after controlling for other child attributes and demographics. Cool executive function emerged as a significant predictor of both behavioral outcomes, whereas hot EF did not predict either outcome when analyzed concurrently with cool executive function (Brock et al., 2009).

One explanation for the overall lack of hot executive function association may lie in the nature of kindergarten classrooms and may prompt further exploration (Brock et al., 2009). Teachers anticipate many children will enter kindergarten lacking the capacity to regulate their emotional responses. Kindergarten teachers may structure the learning environment to support and compensate for students with poor hot executive function skills. In this more teacher-managed environment, the students may have the same opportunities for learning despite lacking hot executive function skills (Rimm-Kaufman et al., 2000). Beyond kindergarten, classroom contexts may not be as well aligned with

children's developmental needs and teachers may expect children to regulate their own emotions in order to attend to academic tasks. Bembenutty and Karabenick (2004) suggest that hot executive function skills may play a more important role in academic achievement later in schooling when adolescents are expected to delay immediate gratification (e.g. playing video games), in lieu of less tangible rewards (e.g. completing homework). Bembenutty and Karabenick's (2004) study makes a case for a significant connection between executive function skills of self-regulation, specifically the "cool" executive function skills of attention and working memory and readiness for kindergarten.

There are additional limitations to this study. Brock et al. (2009) reported the population sample to be 173 children from four rural school districts. In addition, 35% of the families reported an annual income of less than $30,000 and 61% of the families reported no formal preschool. The authors did take family risk factors into account, but only 39% of the children experienced some form of preschool experience, which included Head Start, private preschool, or daycare. Finally, 72.5% reported children's ethnicity as Caucasian American. As a result, participant demographics may not be representative of the general population of children entering kindergarten. The WaKIDS assessment subtests, like most kindergarten readiness screening tools, for the cognitive and social emotional domains screen for executive function skills that the authors of this study would consider "cool."

Executive Function's Contribution to Success in Kindergarten and Beyond

Most educators would assume that success in kindergarten provides the foundation for success throughout a student's school career (McClelland et al., 2006).

Investigating the questions about the impact of executive function skills on kindergarten readiness and the transfer to the rest of a child's academic career is the focus of many empirical studies. McClelland, Acock, and Morrison, (2006) investigated the relationship of kindergarten executive function skills to reading and math growth between kindergarten and sixth grade. In other words, do early gains due to developed executive function continue to contribute to school success throughout the elementary school years? The study sought to (a) examine if kindergarten learning-related, or "cool" executive function skills predicted initial levels and continued growth in reading and math skills between kindergarten and sixth grade, and (b) compare the reading and math skills of children rated as having low levels of executive function skills with their higher rated peers from kindergarten through sixth grade. The goal was to determine the extent to which self-regulating executive function skills could be used as an indicator of future academic success (McClelland et al., 2006). The study consisted of data collected on 538 children in North Carolina. The sample of children consisted of 51% Caucasian, 49% African American, and 51% male and 49% female. Children entered the study at the beginning of kindergarten and ranged in age from 48 to 71 months (M = 65 months, SD = 4.22 months). The challenge for this longitudinal study was a decrease in sample size (538 to 260) from kindergarten to sixth grade, due to attrition. The researchers addressed the missing data by using Full Information Maximum Likelihood (FIML) estimation and conducted a series (18) of logistic regressions. The assumption was made that the data in the analyses were missing at random, which is an assumption of FIML (Enders & Bandalos, 2001).

Between kindergarten and second grade, mathematics and reading were assessed in the fall and the spring with the Peabody Individual Achievement Test. The North Carolina End-of-Grade Tests were administered in grades three through six in the spring. Initial analyses indicated that children's kindergarten executive function skills were significantly related to their reading and math scores between kindergarten and sixth grade. Correlations between executive function skills and reading ranged from .38 to .50 ($p < .05$), and the correlation between learning-related skills and math ranged from .41 to .49 ($p < .05$) (McClelland et al., 2006). Between kindergarten and second grade, latent growth curve analysis demonstrated that children's kindergarten learning related skills, or "cool" executive function skills, were significantly correlated to reading scores (McClelland et al., 2006). Learning-related skills were significantly related to initial reading level at kindergarten ($B = .17$, $p < .001$) and growth in reading ($B = .35$, $p < .001$) between kindergarten and second grade, after controlling for the child's IQ, age, ethnicity, and maternal education level (McClelland et al., 2006). The results of this study seem to suggest that executive function skill development is related to reading readiness in kindergarten and into the primary grades. However, due to the large amount of attrition in this study, the results about executive function's effect on academic performance beyond second grade have limitations and the authors advise that they should be used with caution (McClelland et al., 2006). In addition, the assessments used changed as students progressed through elementary school, which could potentially result in separate growth curve data. Also, children's self-regulation executive function skills were based on teacher ratings at the beginning of kindergarten and the researchers noted that the majority of students rated with low executive function skills were African American,

which may have influenced how teachers rated them. Research suggests that teachers rate children from minority groups lower on components of kindergarten readiness than their non-minority group peers (Rimm-Kaufman et al., 2000). Even with the limitations, this study confirms the importance of self-regulation, or "cool" executive function skills for academic success in kindergarten through second grade. It suggests the need further study of the impact of the level of executive function skills as students enter kindergarten as a predictor of success, not only for kindergarten readiness, but also beyond the kindergarten year.

In addition to the use of different assessment measures, perhaps the most impactful limitation to this study is the missing data due to attrition. In reviewing the data, the relationship between executive function skills and reading and math performance weakened in third grade when the sample size also decreased (from $n = 538$ to $n = 260$). However, while inconclusive about reading development through sixth grade, the study's findings were consistent between kindergarten and second grade. During this period, the same tests were used, and the sample size was relatively stable. The conclusions of the authors' analysis of the kindergarten through second grade data show that kindergarten executive function skills relate to second grade reading achievement. This finding aligns with common conclusions throughout the field of kindergarten reading readiness research that there are specific skills that contribute to a more successful transition to formal school. According to the Annenberg Institute for School Reform (2010) on early reading proficiency, "Reading improvement changes most dramatically in the early years and slower in later years. By third grade students are expected to know the fundamentals of reading and be able to apply their reading skills

across the curriculum“(Musen, 2010, p.1). There may be value in the findings of the first three years of this study as it relates to kindergarten readiness.

Executive Function's Relationship to Mathematics and Literacy Development

Blair and Razza (2007) studied executive function's relationship to math and literacy abilities in kindergarten. They defined executive function as control of the cognitive self-regulation processes of attention, working memory, and inhibitory control (Blair & Razza, 2007, p. 648). The researchers also made a distinction between "hot" and "cool" executive function skills in their study of 170 children who attended Head Start programs serving predominantly white families in rural and non-urban locations. The mean age of the children at the time of testing in preschool was five years one month (range three years nine months to five years eight months), the mean age of testing in kindergarten was six years two months (range five years seven months to six years eleven months). All children were from households in which family income fell below the poverty line.

The children were seen individually in two 45-minute sessions during the preschool year and once in the spring of the kindergarten year. In preschool, the children were administered a measure of receptive vocabulary and an attention measure of executive function along with a peg-tapping measure (inhibitory control). In kindergarten, the same measures were given along with a nonverbal intelligence test. For the peg-tapping measure, children were instructed to tap twice with a wooden dowel when the experimenter tapped once and once when the experimenter tapped twice. This activity requires children to inhibit a natural tendency to mimic the action of the assessor while remembering the rule for the correct response. A proportion score or the number of

correct responses divided by the total number of trials (16) was used to measure performance on this task (Blair & Razza, 2007).

To assess reading readiness, phonemic awareness was measured using the Elison Subtest of the Preschool Comprehensive Test of Phonological and Print Processing. This task requires children to segment words into phonemic components. A scoring algorithm was utilized to derive standard scores from the raw assessment data. Of the sample of 170 children, data from academic measures in kindergarten were available for 141 children. Of those children, several were missing data for the executive function measures. The reason for all missing data was primarily related to child refusal to participate in that aspect of the assessment and reflects the difficulty, according to the researchers, of collecting data with young children (Blair & Razza, 2007). To address the missing data, Full Information Likelihood (FIML) estimation was used to derive estimates of relations among variables in all analyses.

Multiple regression was used to examine the unique relation of the measures of each aspect of executive self-regulation to each of the academic outcomes, controlling for verbal and fluid intelligence. In these regression equations, all possible predictors were entered simultaneously, and coefficients associated with the Type II sums of squares were interpreted to estimate the unique effect of each independent variable on the academic ability measures. Relations were significant at $p < .05$. Results indicated that the inhibitory control aspect of executive function measured both in preschool ($B = .17$, $p < .05$) and kindergarten ($B = .20$, $p < 0.01$) made an independent contribution to early mathematics knowledge. In addition, only the inhibitory control aspect of executive function measured in kindergarten was related to phonemic awareness ($B = .27$, $p <$

0.01*)*. Examination of executive function self-regulation behaviors to letter knowledge indicated that the inhibitory control aspect of executive function was related to letter knowledge ($B = .17$, $p < .05$) as well. Blair and Razza (2007) state that the study "indicates the inhibitory control aspect of executive function to be a consistent correlate of early academic ability" (p. 656). Among the three aspects of self-regulation executive function examined; attention, working memory, and inhibitory control, it was inhibitory control that was the only one to be independently related to all three measures of kindergarten academic ability. Based on this study, it seems that the ability to inhibit response tendencies in the face of irrelevant or distracting information, such as in the context of solving a math problem or when discriminating letters of phonemes is a contributor to developing academic ability.

One of the benefits of Blair and Razza's study (2007) is the quality and reliability of the assessments used to academically assess very young children. The Early Childhood Longitudinal Study Measure for kindergarten was designed especially for prekindergarten students to assess mathematics knowledge ($\alpha = 0.92$**)**. Phonemic awareness ($\alpha = 0.84$**)** and letter knowledge ($\alpha = 0.96$**)** were measured with the Elision subtests of the Comprehensive Test of Phonological Processing (Blair & Razza, 2007). These assessments have been tested with Head Start children in hundreds of settings, so not only are they statistically reliable, but the results are aligned and transfer to early childhood classroom curriculum and skills (Hintze, Ryan, & Stoner, 2003).

Self-regulation and Kindergarten Outcomes

Ponitz, McClelland, and Morrison (2009) examined an assessment of self-regulation and the contributions of executive function behaviors to achievement and to

teacher-rated classroom functioning in a sample of 343 kindergarteners from two geographic sites in the United States. Self-regulation was measured with the Head Toes Knees Shoulders (HTKS) task, as a structured observation requiring children to perform the opposite of a dominant response to four different oral commands. The researchers defined self-regulation as "multiple components of executive function including attention, working memory, and inhibitory control" (Ponitz et al., 2009, p.605).

The researchers based their work around three research questions that align in many ways to the purpose of this paper. First, what is the extent of variability and gains in kindergarteners' scores on the HTKS task and how does the HTKS task performance correlate with parent and teacher ratings of kindergarten readiness skills? Second, does self-regulation at kindergarten entry show predictive validity for end of kindergarten mathematics, literacy and vocabulary achievement and teacher ratings of classroom functioning? Finally, does initial self-regulation predict kindergarten gains in achievement? (Ponitz et al., 2009, p.605).

Children in the study were recruited from two sites, one middle- to upper-middle socioeconomic status (SES) urban area in Michigan and a mixed-SES rural site in Oregon. In total, 281 children participated in Michigan and 93 children took part in Oregon. Data were collected from three sources: parents, teachers, and children. Parents rated children's temperament, specifically attention and inhibitory control, on the attentional focusing and inhibitory control scales of the Child Behavior Questionnaire in spring and summer before kindergarten. Teachers reported on children's classroom self-regulation and interpersonal skills in the spring of kindergarten. The teacher ratings were obtained using a 5-point Likert-type scale. An exploratory factor analysis was then

conducted, and the two largest factors tapped were classroom behavior regulation and interpersonal skills. Scale composites were created using the average of the item ratings (Ponitz et al., 2009).

To assess achievement in mathematics, literacy, and expressive vocabulary, three subtests from the Woodcock-Johnson Psychoeducational Battery II Tests of Achievement were used. To assess self-regulation executive function, the Head Toes Knees Shoulders (HTKS) task was given in the fall and again in the spring. This test measures self-regulation with children's responses to 10 trial commands and was designed for early elementary students. After practicing two oral commands (e.g., "touch your head" and "touch your toes"), children are asked to respond in an unnatural way to two types on the first 10 trials, and then four types on the second 10 trials of paired commands. For example, if the teacher said, "Touch your toes," the correct response would be for the child to touch his or her head. In a similar way, the correct response to a "Touch your knees" command would be for the child to touch his or her shoulders. Correct responses earn two points; incorrect responses earn zero points, and one point was given if the child self corrects a response. Higher scores indicate a higher level of self-regulation (Ponitz et al., 2009).

Once all the data was collected, the researchers then assessed predictive validity of the initial self-regulation for markers of kindergarten success. Hierarchical Linear Modeling (HLM) was used to model the unique contributions of fall HTKS self-regulation to spring levels of achievement and teacher-rated classroom functioning as well as interpersonal skills. For mathematics level in the spring, fall HTKS was reported as a significant predictor (d = .56). For spring literacy level, fall HTKS scores were

reported as significant predictors (d = .27). For vocabulary level in the spring, increased fall HTKS was reported as a significant positive predictor (d = .19). According to this study, the authors claim that there seems to be a relationship between higher levels of beginning of kindergarten executive function self-regulation skills and performance on a standardized test of kindergarten reading and mathematics ability (Ponitz et al., 2009).

This study had several positive aspects, including the use of teacher ratings, completed in the spring of kindergarten, which were compared with the scores on the executive function assessment. The assessment, Head Toes Knees Shoulders (HTKS), was then tested to determine if a relationship existed with achievement test scores. Children who were rated higher in the spring by their kindergarten teacher on a behavior regulation scale earned higher HTKS scores in the spring (r = .20, p < .01) (Ponitz et al., 2009). Other studies reviewed for this paper collected teacher input, but it was typically only used as a baseline measure, so using teacher data at the end of the study to compare with executive function scores was unique and provided a way to explore construct validity for the HTKS. Knowing that the tool measures the skills that teachers consider appropriate executive function skills for kindergarten may be useful in designing further studies. However, one recommendation would be to repeat this investigation with a larger and more diverse sample. The children were predominantly from upper middle-class families with the mean parent education level at almost a college degree (M = 15.68 years), potentially limiting its transferability to other populations. Another recommendation would be to obtain longitudinal data to determine how these students progress through first grade.

Ponitz, McClelland, Matthews, and Morrison (2009) claim many significant findings that predict kindergarten literacy but fall HTKS results seem to show small effects on literacy (d = .27) and vocabulary (d = .19). Spring mathematics level showed medium effects when compared to fall HTKS scores (d = .56), so this study may have value in exploring the role of executive function and mathematics achievement. These findings are interesting for this study as it aligns with the executive function skills that teachers believe to be the most useful predictors of kindergarten readiness and was also a teacher rating system or authentic performance assessment like WaKIDS GOLD (Teaching Strategies, 2011).

Prekindergarten Executive Function's Contribution to Kindergarten Achievement

Welsh, Nix, Blair, Bierman, and Nelson (2010) examined developmental connections between the cognitive processes of working memory, inhibitory control, and growth in emergent literacy and numeracy across the pre-kindergarten year and their relative contribution to kindergarten reading and math achievement. Their sample consisted of 164 Head Start children who were followed longitudinally. The authors claim that many studies suggest working memory and attention control play a key role in supporting early literacy and mathematical skills in elementary school students, but educational research has rarely examined these skills in a longitudinal context during early childhood. The researchers isolated the cognitive executive function skills of working memory and attention from the behavior executive function skill of inhibitory control.

The goal of this study was to examine the precursors of reading and math achievement in kindergarten, specifically the association between executive function

skills, particularly working memory and attention, and the acquisition of academic skill in kindergarten. This study also sought to assess the degree to which executive function skills during prekindergarten made unique contributions to kindergarten achievement. Students in the sample were measured three times, at the beginning and at the end of prekindergarten and at the end of the kindergarten year. Three measures were used from the Test of Preschool Early Literacy during the prekindergarten year, assessing print knowledge, blending of sounds, and decomposing words. A composite score, which averaged the scores on the three tests, was computed to represent emergent literacy skills during the prekindergarten year. Four measures were used to assess reading achievement at the end of kindergarten from the Woodcock Johnson III: Test of Achievement. These tests measured sight word reading, fluency, decoding, and story recall. Again, all four scores were standardized and averaged into a composite score representing reading achievement at the end of kindergarten.

Executive function was measured with the Peg Tapping Task (Diamond & Taylor, 1996) and the Dimensional Change Card Sort (Frye, Zelazo, & Palfai, 1995). Correlations among the executive function measures ranged from .26 ($p < .001$) to .35 ($p < .001$). Exploratory factor analysis revealed a single factor, suggesting that, at this age, working memory and attention control share considerable variance and have not been well differentiated, so the researchers created one composite measure of executive function for each assessment period by standardizing and averaging scores on the executive function tasks. To determine whether the cognitive skills composites from prekindergarten predicted reading and math achievement at the end of kindergarten, zero-order correlation coefficients were computed. Prekindergarten executive function showed

a significant relationship to kindergarten reading achievement (r = .32 to .52) and to kindergarten math achievement (r = .39 to .58) (Welsh et al., 2010).

To test the hypothesis that growth in the executive function cognitive skills of working memory and attention control during the prekindergarten year would make unique contributions to growth in emergent literacy in kindergarten, a series of path models were estimated. In a saturated path model, all independent variables (initial and end-of-year prekindergarten emergent literacy, numeracy, executive function, and language skills) were allowed to affect one another and the outcome. The results showed that initial levels of executive function are related to growth in emergent literacy skills between the beginning and the end of the prekindergarten year (B = .29) and had a unique influence on kindergarten reading achievement (B = .36). This focus on the cognitive executive function skills allowed specific data to be collected around these skills which are connected to the retrieval of information from long-term memory, sustain mental representation and allow for focused manipulation of key information which are all building blocks to early reading (Welsh et al., 2010)

The advantage of studies like the one conducted by Welsh, Nix, Blair, Bierman, and Nelson (2010), is a broader definition and assessment of literacy skills. The researchers claim that these measures from the Elision scales of the Test of Preschool Early Literacy and Woodcock Johnson II: Test of Achievement were chosen based upon prior research reporting correlations in the range of .43 to .88 between these subscales and the acquisition of early reading skills (Welsh, et al., 2010). Across the prekindergarten and kindergarten years in which this study took place, students were tested in print knowledge, blending, compound words, letter-word identification, story

recall, sight words and reading fluency (pp. 5-6). All assessments were standardized and averaged into a composite score representing reading achievement at the end of kindergarten, creating a very robust measure (Welsh et al., 2010).

This study also used a series of path models to test the hypothesis that growth in working memory and attention during pre-kindergarten would make unique contributions to growth in emergent literacy and math skills. This longitudinal model demonstrated the relationships among several variables and how those relationships travel. This was a useful way to show the direct and indirect relationships of the independent variables (Welsh et al., 2010).

In contrast to the robust battery of reading assessments, this study only used three tasks combined to form a composite to assess working memory and attention control skills of executive function. A factor analysis revealed a single factor, so working memory and attention control shared variance and were not well differentiated. Due to this, the researchers did not isolate the specific executive function skills to determine which is most closely related to gains in reading achievement. Working memory and attention control skills are both cognitive executive functions but have different purposes as a child develops as a reader (Cartwright, 2012). This information could be useful in addressing skills aligned to Common Core State Standards for kindergarten. Further research to explore the relationship each of these skills to the detailed data around the discrete reading skills collected from the academic measures used would inform interventions and additional research in this area.

There are additional limitations to Welsh et al.'s (2010) study. First, the researchers were working with a relatively small sample (n = 164) of Head Start students

with many risk factors ranging from parent education level, (33% of mothers hadn't finished high school and 68% of families had incomes below the poverty level). Also, while this research did report improved student growth, the results were limited in terms of data analysis and overall significance as both were nearly nonexistent. In addition, child assessments were conducted three times over two years (beginning and end of prekindergarten and end of kindergarten), yet other variables that may have contributed to growth over time were not identified. Specifically, student age and the impact of growth and developmental changes beyond the mean age at the beginning of prekindergarten (M = 4.49) were not addressed as a variable.

Researchers seem to agree that self-regulation executive function plays a role in kindergarten readiness (Blair & Razza, 2007; Ponitz et al., 2009; Welsh et al., 2010). Agreement on the role of each individual aspect of cognitive and behavioral executive function in relation to academic achievement is not as easy to find. First, researchers must differentiate cognitive from behavioral executive function. This is reflected in conceptualizations that suggest that one aspect of executive function, for example, inhibitory control, has a greater impact on school readiness than the cognitive functions of working memory or attention. Some researchers have examined the relationship of "hot" executive function skills that have an emotional base to the unique classroom structure of kindergarten classrooms and "cool" executive function skills that seem to be more learning related (Brock et al., 2009). Regardless, it seems clear that executive function may be a potential predictor of kindergarten readiness, both for the behavior regulation and cognitive processing required in standard-based kindergarten classrooms. The collection of research shows an evolution from primarily a behavior-focused

construct to one that connects behavior to cognitive processes of learning. This change in focus has occurred not only in research, but in practice as well, because in the past, early childhood educators believed that if a child were able to control his or her behavior and inhibit reactions, then they would be ready and able to be successful in the more play-based, exploratory model of kindergarten prior to the standards movement. Current practitioners would agree that is no longer a valid or useful belief (Miller & Almon, 2009). As the academic rigor of kindergarten has increased since No Child Left Behind (2001), the focus of research has shifted to the cognitive regulation skills necessary to attend, hold, and manipulate information in the brain (Center on the Developing Child at Harvard University, 2011).

The most recent of the studies reviewed about executive function as it relates to kindergarten for this review was published in 2010. At that time the requirements for No Child Left Behind were in full swing and high stakes testing and reading intervention models had made it to kindergarten, changing the landscape of kindergarten that many believed to be a place of exploration and play in preparation for the more formal setting of first grade (Miller & Almon, 2009). Fast forwarding to 2019 and full-implementation of the Common Core State Standards and the expectations that kindergarteners are to be reading, writing, and performing mathematics tasks once reserved for first grade, researchers are seeking answers to questions about what it looks like to be ready for kindergarten.

In the context of this problem of practice, Miller and Almon (2009) and Ponitz, McClelland, Matthews, and Morrison (2009) sought to investigate the common variables, classified as executive function, which contributed to pre-reading skill development in

kindergarten. It was consistently confirmed by the studies reviewed that a significant relationship exists between the self-regulation skills of inhibitory control, working memory, attention, and kindergarten readiness. This relationship confirms the importance for further research in reading development in young children to go hand-in-hand with research around the self-regulation skills necessary to learn, process, and apply those skills. Early childhood educators everywhere have many early reading assessments at their disposal, and some are a mandated component of their program, like WaKIDS GOLD™, and are usually to be administered at key points throughout the school year (Teaching Strategies, 2010). Few prekindergarten and kindergarten teachers have access to, or knowledge of, assessments of executive function skills, making the WaKIDS initiative unique in that it does assess for self-regulation and other "cool" executive function abilities. In a typical school setting, executive function skills are usually assessed by a school psychologist as part of a larger battery of tests and performed only when a child is struggling or failing. This formal assessment typically occurs several years after kindergarten when a student is not making adequate progress toward mastery of grade level standards.

Assessing students in executive function skills, in tandem with reading assessments, has the potential to inform interventions early and support the development of successful students as they enter elementary school. Further research is needed into the relationship of self-regulation skills to the specific reading and math skills assessed in kindergarten, along with additional studies to test the construct validity of executive function assessments for young children in order to increase their use and acceptance as reliable measures of student achievement to be more broadly used.

Early Literacy

Emergent Literacy

Whitehurst and Lonigan's (1998) theory of emergent literacy developed the definition of emergent literacy which built on the work of others (Clay, 1966; Fitzgerald, Schuele, & Roberts, 1992, as "the skills, knowledge and attitudes that are presumed to be developmental precursors to conventional forms of reading and writing and environments that support these developments" (p.849). In their theory, the acquisition of literacy is considered a developmental continuum beginning at the start of a child's life, before formal schooling begins. Whitehurst and Lonigan specified that the skills and knowledge highlighted in their definition of emergent literacy can be categorized into one of two interdependent domains: *outside-in* and *inside-out* processes. Outside-in processes involve "children's understanding of the context in which the text they are trying to read occurs" (Whitehurst & Lonigan, 1998, p. 854). Skills under this domain include vocabulary, narrative construction, and conceptual and semantic knowledge that can support comprehension (Whitehurst & Lonigan, 1998). Inside-out processes involve, "children's knowledge of the rules for translating the particular writing they are trying to read into sounds" (Whitehurst & Lonigan, 1998). Skills under this domain include phonological and syntactic awareness, as well as print awareness (Whitehurst & Lonigan, 2001). The researchers claim that both outside-in and inside-out processes work together and are essential for successful reading development. Another component to Whitehurst and Lonigan's (1998) definition of emergent literacy involves the environments that support both outside-in and inside-out skills before a child enters school. Just as executive function skill development is affected by home environments, it is inevitable

that there will be wide-ranging variability in emerging literacy skills children bring to kindergarten, with some more prepared for literacy practices than others (Whitehurst & Lonigan, 1998; Snow, Burns, & Griffin, 1998). This work highlights the importance that environmental and executive function skill factors be considered alongside reading skills and knowledge when assessing early literacy development as environment plays a role in the development of executive function skills like attention and inhibitory control, both critical for reading development.

Kindergarten Entry Assessment

The importance of early childhood assessment for early literacy to inform instruction in a Common Core Kindergarten classroom is an area of greater awareness and scrutiny (Ed.gov, 2011). The challenge lies in identifying and understanding children's literacy levels as they enter kindergarten. Early literacy assessment has more value than ever before. High quality literacy instruction is the goal to help early childhood students develop the foundational reading skills necessary to be successful as they progress through elementary school (Rupley, Blair, & Nichols, 2009; Snow et al., 1998). Assessment, when used appropriately, can be a powerful tool to inform instruction and intervention (Coyne & Harn, 2006; Lonigan et al., 2011).

Lonigan et al. (2011) state that assessments providing data on "children's developmental achievements in key areas of early literacy can provide teachers with the information they need to provide optimal learning experiences for children" (p. 499). A variety of assessment tools for screening young readers and their environments have become available in recent years (Snow & Van Hemel, 2008). One of the assessment types that has become more widely used is a kindergarten entry assessment program. This

type of entry assessment can provide "data collected at kindergarten entry which serves both as a cumulative glimpse into how children's early experiences have or have not supported their development and learning and offer a baseline for kindergarten instruction and for measuring future progress" Scott, Little et al., 2011, p. 1).

Development of a kindergarten entry assessment (KEA) program has been encouraged by the U.S. Department of Education through the *Race to the Top Early Learning Challenge* launched in 2011 to motivate states to develop plans for improving the quality of their early education systems (ED.gov, 2011). Washington State is a leader among the states without a *Race to the Top* application that developed and implemented a KEA. Washington State has adopted Teaching Strategies GOLD™ for its kindergarten assessment program known as the *Washington Kindergarten Inventory of Developing Skills* (WaKIDS), which is being used in all state-funded full day kindergarten classrooms throughout the state. The assessment provides information to teachers about incoming kindergartners across six developmental domains, representing the "whole child" (social emotional, physical, cognitive, language, literacy, and mathematics) (Teaching Strategies, 2011).

WaKIDS GOLD™ is an observation-based teacher rating system, or authentic performance assessment, that "blends ongoing, authentic assessment in all areas of development and learning with intentional, focused performance assessment tasks for selected predictors of school readiness in the areas of literacy and numeracy" (Teaching Strategies, 2010, p. 1). Soderberg, Stull, Cummings, Nolen, McCutchen, and Joseph (2013) investigated inter-rater reliability and concurrent validity of the WaKIDS assessment, specifically with regard to diverse populations of students attending

kindergarten in the state of Washington. In order to determine the concurrent validity of the WaKIDS assessment results with established standardized assessments, a psychometric design was implemented. Children's scores (*n* = 333) from the WaKIDS assessment, administered by their teachers were compared to scores from norm-referenced assessments, administered by researchers. Both assessments were given in the fall of the same school year. The study found WaKIDS assessment accurately predicts performance on the norm-referenced achievement battery on most domains, with low correlations for the social emotional and physical domains (Soderberg et al., 2013) Statistically significant relationships were demonstrated between children's WaKIDS ratings and their performance on standardized measures of mathematics, language, and literacy (Soderberg et al., 2013)

Overview of the WaKIDS Assessment System using Teaching Strategies GOLD™

To motivate states to develop plans for improving the quality of their early education systems, development of a kindergarten entry assessment program (KEA) was encouraged by the US department of Education through the *Race to the Top Early Learning Challenge* in 2011 (ED.gov, 2011). Scott-Little et al. (2011) presented four general goals that states incorporating KEAs tend to incorporate in their plans: 1) to assess the degree to which children in the state are starting school "ready"; 2) to identify schools and populations of children for which additional efforts are most needed to ensure educational success; 3) to provide additional direction to kindergarten teachers in helping their students develop and learn; and 4) to inform parents about their child's learning and development and provide an opportunity to engage parents in supporting their child's learning.

Washington State is one of the leaders among the states in the development and implementation of a KEA. In 2011, the state adopted a modified version of Teaching Strategies GOLD® as the assessment tool in their new kindergarten assessment process known as WaKIDS. Beginning in the 2016-2017 school year, WaKIDS is an initiative being implemented in all of Washington state-funded full day kindergarten classrooms that seeks to ensure every child is adequately prepared for kindergarten. The three main components of the WaKIDS initiative are: 1) strengthening the family's connection to the child's education environment; 2) delivering a comprehensive assessment of the whole child for teachers to gather information on the skills, abilities, and areas for growth as the child enters kindergarten; and 3) a collaboration between early learning providers and kindergarten teachers to improve information-sharing and the transition of students from early learning environments to kindergarten (Joseph, Cevasco, Lee, & Stull, 2011).

All kindergarten teachers participating in WaKIDS are required to attend an Office of the Superintendent of Public Instruction (OSPI)-sponsored training prior to administering the assessment. During the two-day training, teachers are given an overview of the instrument purpose, background and research basis, overview of the assessment kit and materials, video administration of the assessment, practice sessions, and time for questions. The assessment is designed so that a teacher can observe a child's skill level in each of six domains (social-emotional, physical, cognitive, language, literacy, and mathematics) during normal classroom routines and activities. WaKIDS required only one assessment administration at the beginning of the school year. Teachers and districts may choose to administer the assessment up to two additional times throughout the school year to document student progress.

The primary purpose of Teaching Strategies GOLD™ is to document children's development over time, to inform instruction and to facilitate and communication with families and other stakeholders. The developers of the assessment claim that Teaching Strategies GOLD™ can be used to assess all children, including English-language learners, children with disabilities, and children who demonstrate competencies beyond typical developmental expectations (Lambert, Kim, & Burts, 2014). Students are assessed through a teacher-completed survey of the child's skills on a color-coded progression of development. The progressions are based on standard development and learning expectations and a rating scale is used to assign a value to the child's level on a particular progression. The color-coded bands of progression are underscored by a nine-point rating scale, which indicate the child's score for a given item (Joseph, Cevasco, Lee, & Stull, 2011). According to the developers, studies have been conducted to determine reliability and validity for the complete version of GOLD™. An interrater reliability study examined the correlation between the ratings of a Teaching Strategies GOLD™ trainer and the rating of teachers new to the system. The researchers found the resulting correlations to be strong, with all but one being above .90 and the lowest correlation at .80. (Soderberg et al., 2013). However, it is important to note that these findings report reliability of the full measure of the Teaching Strategies GOLD™ assessment and cannot necessarily be generalized to the abbreviated version of the assessment used for WaKIDS. The developers also stress the importance of remembering that GOLD™ is "not intended as a screening or diagnostic measure, an achievement test, or a program evaluation tool." (Teaching Strategies, 2011). It "blends ongoing, authentic assessment in all areas of development and learning with intentional, focused performance assessment

tasks for selected predictors of school readiness in the areas of literacy and numeracy. (Teaching Strategies, 2010).

There are two domains in Teaching Strategies GOLD™ that specifically address executive function skills; the Cognitive and the Social Emotional Domains. In the Social Emotional Domain, Objective 1: *Regulates own emotions and behaviors* measures a student's self-regulation and inhibitory control ability. This objective is further broken down into: (a) manages feelings, (b) follows limits and expectations, and (c) takes care of own needs appropriately. In the Cognitive domain, Objective 1 measures the executive function skill of working memory and attention by measuring if a student displays positive approaches to learning by attending and engaging, along with persisting and solving problems. The observational assessment also records inhibitory control factors of flexibility and inventiveness in thinking. Similarly, in the Cognitive Domain, Objective 12 is focused primarily on working memory. It measures how a child remembers and connects experiences.

GOLD™ uses color bands to describe overlapping developmental progressions. In GOLD™, the purple band represents the widely held expectations for kindergartners. These widely held expectations are criterion-referenced ranges of expected development and learning for each age or class/grade in GOLD™. Widely held expectations may be demonstrated at any time during the kindergarten year—not necessarily at the beginning. We expect entering kindergarteners (those being assessed by WaKIDS) to score one level below the purple band—or where the purple and blue bands meet but do not overlap. The expected Fall scale score for kindergarten for the Cognitive Domain is 679 and the expected Fall Scale Score for Social Emotional Domain is 653. The Comparative Report

defines GOLD™ Readiness as any student demonstrating one level below purple or higher. Because developmental stages overlap, one level below the purple band may fall into several color bands of GOLD™, not just blue (Teaching Strategies, 2010).

Overview of DIBELS assessment system

DIBELS is an acronym for the Dynamic Indicators of Basic Early Literacy Skills; a collection of standardized, individually administered, short fluency measures that can be used to systematically monitor the development of pre- and early reading skills. The DIBELS assessment is used to gauge a student's progress, as well as identify children in need of reading intervention (Kaminski, 2002)

DIBELS measures students' ability to identify letter names and initial sounds, to segment phonemes, to decode nonsense words, to demonstrate word use fluency, as well as their retell fluency, and their oral reading fluency, based on the five big ideas of literacy presented by the National Reading Panel in 2000. Those big ideas are phonological awareness, systematic phonics instruction, fluency, vocabulary, and comprehension. The DIBELS became the standard for literacy assessment when it was tied to Reading First grants adopted under the No Child Left Behind Act in 2002. In the years since the institution of No Child Left Behind, DIBELS has become a standard in many school districts (University of Oregon Center on Teaching and Learning, 2008)

DIBELS is iterative in nature, with the battery of subtests administered at three times during the school year from kindergarten to sixth grade. A trained adult administers the subtests. There are seven subtests, but not all are administered at all grade levels. In kindergarten, there are five recommended subtests: Letter Naming Fluency (LNF), First Sounds Fluency (FSF), Phoneme Segmentation (PSF), Nonsense Word Fluency (NWF),

and Oral Reading Fluency (ORF). Skills are measured in three areas: phonemic awareness, alphabetic principle, and fluency. (Good, Simmons, & Kame'emui, 2001). DIBELS Next is the most recent version of the assessment.

DIBELS First Sounds Fluency (FSF) is a measure of early phonemic awareness. Phonemic awareness is the ability to recognize and manipulate sounds or phonemes in spoken words; to realize that words are made of sounds (Cooper & Kiger, 2006). During administration, students are provided a page of random pictures, the test administrator reads from the testing manual, telling the child to point to the picture of the word that starts with a particular sound such as /t/ (tuh). The score is the correct number of initial sounds identified in one minute. This assessment is given in kindergarten at the beginning and middle of the year (University of Oregon Center on Teaching and Learning, 2008).

Letter Naming Fluency (LNF) is a measure of a child's ability to rapidly name the letters of the alphabet. The student is given a sheet of paper with upper and lower-case letters of the alphabet listed in random order. They are given one minute to name each letter they can identify. The score is the correct number of letters identified in one minute. This subtest is administered at three points in kindergarten and through the fall of grade one (University of Oregon Center on Teaching and Learning, 2008).

Phoneme Segmentation Fluency (PSF) measures phonemic awareness. In this subtest, students listen to words spoken by the test administrator. For each word spoken, children are asked to identify all the sounds, or phonemes, they hear in the word. The total number of phonemes correctly identified in one minute is recorded.

Nonsense Word Fluency (NWF) measures the alphabetic principle. The test uses pseudo words such as toj, mim, and lut. The students are asked to read a list of two or

three letter pseudo words that generally follow a consonant-vowel-consonant pattern. Students may read the entire word or just say the sounds the letters make. The total number of letters sounds correctly identified in one minute is recorded (University of Oregon Center on Teaching and Learning, 2008).

Once a student has been assessed on all subtests appropriate for their grade level, student scores are calculated and used to determine a student's level of risk. Student data are entered into the DIBELS database, which calculates the student's risk level. Students are identified as at risk, some risk, or low risk in each of the constructs assessed. Student scores are also used to identify students who need intensive intervention, strategic intervention or who are performing at grade level benchmark.

Research on the Validity of the DIBELS

Inquiry into the validity and reliability of the DIBELS assessment has been consistent since its inception. Researchers continue to call for extended research on the assessment (Roehrig et al., 2008). Hintze, Ryan, & Stoner (2003) examined the concurrent validity of the DIBELS subtest and the Comprehensive Test of Phonological Processing (CTOPP). The CTOPP is a measure of phonological processing. There are seven subtests with three composite scores: phonological awareness, phonological memory, and rapid naming. The results suggested that DIBELS subtest are moderately correlated with CTOPP composite scores (r = .60).

In a study conducted by Riedel in 2007, it was found that the beginning of the year Nonsense Word Fluency (NWF) subtest was a strong predictor of end-of-the-year reading achievement for first graders *(r* = .74). Riedel also explored the power of the DIBELS Oral Reading Fluency (DORF) in first grade and found it to be the strongest

predictor of year end reading achievement (r = .87). While the examination of the suite of first grade assessments validated the use of NWF and DORF as indicators of reading achievement, Riedel (2007) came to the conclusion based on results of his study that only the NWF and DORF subtests were necessary at the middle of first grade to determine those students at risk for reading failure (p. 559).

Conclusion and Summary of Literature Review

Empirical evidence on early literacy acquisition in kindergarten has demonstrated that the executive function skills of working memory, attention, and inhibitory control are predictors of reading achievement at the end of kindergarten. It would stand to reason that the strength of a child's executive function skills at the beginning of kindergarten would be accurate predictors of reading achievement at the end of kindergarten. This reasoning is based on the assumption that the assessments of executive function at the beginning of kindergarten exist and are valid and reliable measures that are correlated with widely-used early literacy assessments.

These assumptions are the basis for this study which examines the relationships between the WaKIDS GOLD™ Social-Emotional and Cognitive Subtests of Executive Function and kindergarten reading readiness. Detailed information on the methodology is presented in chapter three.

CHAPTER 3: Methodology

This chapter describes methodological elements of the study, how the participants were selected, and the instruments used to measure executive function skills and reading achievement in kindergarten. Details about how the study was conducted, and an outline of the statistical analysis is also provided.

Research Design

The purpose of this study was to investigate the utility of the WaKIDS subtests that highlight executive function to predict reading ability at the beginning and end of kindergarten. This is a non-experimental research study using ex post facto data. The type of design selected is both correlational and predictive (Gall, Borg & Gall,1996). It is a correlational research design because the variables were not manipulated making the study non experimental. It is predictive in design as the goal is to explore how beginning of the year executive function ability predicts reading achievement (Gall et al., 2007). The target population is full day kindergarten students in a single school district in Western Washington. The data was collected in the 2016-2017 school year.

The results of this study may address concerns about readiness differences and may provide topics for further research regarding specific executive function skills that can be taught and assessed in early childhood to improve and predict reading readiness success. This study is significant for several reasons. First, the study examined the strength of relationships between the WaKIDS GOLD^{TM} assessment and the DIBELS subtests. WaKIDS is an initiative currently being implemented in all Washington state-funded full-day kindergarten classrooms that seeks to ensure every child is adequately prepared for kindergarten (Soderberg et al., 2013).

The results of this study may fill a gap in the literature related to the WaKIDS predictive validity and the DIBELS performance measures. This is especially important to all school districts in the Washington State who have adopted the WaKIDS GOLD™ assessment as part of the full implementation of state-funded full-day kindergarten. In the 2015-16 school year, WaKIDS reached 59,000 kindergarteners (OSPI, 2015) Most of these students were in state-funded, full-day kindergartens. Second, the data were collected over a school year, which allows for a full exploration of potential relationship between WaKIDS and STAR. Lastly, this study has ecological validity. The assessments administered are part of a yearly routine in schools throughout Washington State, increasing the likelihood that results from this study represent typical schools in Washington.

Research Questions

The purpose of this study is to investigate the effects of executive function skills on reading readiness skill development in kindergarten students. The broader aim is to provide additional support to the growing body of evidence pertaining to the effects of executive function skill development on early childhood education. The following research questions will be explored:

Question 1. Do Fall WaKIDS GOLD™ social-emotional and cognitive subtests of executive function scores significantly correlate with the DIBELS Beginning of Year (BOY) scores after controlling for age and gender?

a. Do Fall WaKIDS GOLD™ social-emotional subtest of executive function scores significantly correlate with the (BOY) First Sound Fluency (FSF) subtest of DIBELS Assessment, after controlling for age and gender?

b. Do Fall WaKIDS GOLD™ social emotional subset of executive function scores significantly correlate with the BOY Letter Naming Fluency (LNF) subtest of DIBELS Assessment, after controlling for age and gender?

c. Do Fall WaKIDS GOLD™ cognitive subtest of executive function scores significantly correlate with the BOY First Sound Fluency (FSF) subtest of DIBELS Assessment, after controlling for age and gender?

d. Do Fall WaKIDS GOLD™ cognitive subtest of executive function scores significantly correlate with the BOY Letter Naming Fluency (LNF) subtest of DIBELS Assessment after controlling for age and gender?

Question 2: Do Fall WaKIDS GOLD™ social-emotional and cognitive subtests of executive function scores significantly correlate with the DIBELS End of Year (EOY) scores after controlling for age and gender?

a. Do Fall WaKIDS GOLD™ social-emotional subtest of executive function scores significantly correlate with the EOY Nonsense Word Fluency (NWF) subtest of DIBELS Assessment, after controlling for age and gender?

b. Do Fall WaKIDS GOLD™ social emotional subset of executive function scores significantly correlate with the EOY Phoneme Segmentation Fluency (PSF) subtest of DIBELS Assessment, after controlling for age and gender?

c. Do Fall WaKIDS GOLD™ cognitive subtest of executive function scores significantly correlate with the EOY Nonsense Word Fluency (NWF) subtest of DIBELS Assessment, after controlling for age and gender?

d. Do Fall WaKIDS GOLD™ cognitive subtest of executive function scores significantly correlate with the EOY Phoneme Segmentation Fluency (PSF) test of DIBELS Assessment, after controlling for age and gender?

Question 3: Do the Spring WaKIDS GOLD™ social-emotional and cognitive subtests of executive function significantly correlate with DIBELS EOY Assessments?

a. Do Spring WaKIDS GOLD™ social emotional subtests of executive function significantly correlate with the NWF subtest of the DIBELS EOY Assessment?

b. Do Spring WaKIDS GOLD™ social emotional subtests of executive function significantly correlate with the PSF subtest of the DIBELS EOY Assessment?

c. Do Spring WaKIDS GOLD™ cognitive subtests of executive function significantly correlate with the NWF subtest of the DIBELS EOY Assessment?

d. Do Spring WaKIDS GOLD™ cognitive subtests of executive function significantly correlate with the PSF subtest of the DIBELS EOY Assessment?

Question 4: Do the Fall WaKIDS GOLD™ social-emotional and cognitive subtests of executive function scores predict growth in literacy skills over the kindergarten year after controlling for age, gender, and beginning of the year literacy skills as measured by DIBELS EOY Assessments?

a. Do Fall WaKIDS GOLD™ social emotional and cognitive subtests of executive function scores predict growth in literacy skills over the kindergarten year after controlling for age, gender, and beginning of the year literacy skills, as measured by the NWF subtest of the DIBELS Assessment?

b. Do Fall WaKIDS GOLD™ social emotional and cognitive subtests of executive function scores predict growth in literacy skills over the kindergarten

year after controlling for age, gender, and beginning of the year literacy skills, as measured by the PSF subtest of the DIBELS Assessment?

The null hypothesis in this study is that executive function skills have no impact on reading readiness scores.

Participants

The participants for the students were chosen from a school district located in three suburban cities east of Seattle in Washington State. Some of the schools in the district are in unincorporated King County and are considered rural. The student population is 6.8% Hispanic, 0.5% American Indian/Alaskan Native, 4.8% Asian, 0.8% African American, 0.2% Native Hawaiian/Other Pacific Islander, and 82.5% White. Additionally, 11.7% of the population qualifies for free- or reduced-price lunch. Special Education services were provided to 12.2% of the students. The district selected for this study has a low mobility rate, so the 468 students tested in the fall, were also tested in the spring, showing no attrition. See Table 1.

Table 1

School District Demographic Information

	% of School District Population
Total Enrollment	6,910
Male	52.7%
Female	48.6%
African American	0.8%
Asian American	4.8%
Hispanic	6.8%
Native American (American Indian/Native Alaskan)	0.5%
White	82.5%
Free or reduced-price meals	11.7%
Transitional Bilingual	2.3%
Special Education	12.2%
Passing third grade ELA SBAC	71.0%

Sampling Procedure

To obtain an adequate sample for the study, the principal investigator followed all research protocols required by the participating district. The principal investigator

completed a proposal and formal request for approval to conduct research studies in the participating district. These documents are included in the appendices.

Individual participants selected for the study were enrolled as kindergarteners in the 2016-17 academic school year. The sample consisted of 470 students. The sampling procedure was convenience and used an intact group of students.

All student data were provided from the participating district after proper research permission protocols were completed. The data for this study are housed in district databases and were delivered in one extensive Microsoft Excel spreadsheet. Each student was assigned a student identification number in place of first and last names. The principal investigator has no access to students' personal information. The data consisted of reports from all intact kindergarten classrooms in the district's six elementary schools, consisting of 470 students during the 2016-2017 school year.

To begin, the data were screened for duplicate cases and participants with significant amounts of missing data. Only two cases were removed because the data were formatted incorrectly and incomplete. Some of the non-essential data were hidden for all participants on the excel spreadsheet and then the data were merged into one data file using Statistical Package for the Social Sciences (SPSS). Preliminary descriptive statistics were run and each of the variables was examined. The overall sample of students with Fall and Spring WaKIDS scores and Spring DIBELS scores equaled N = 470. Statistical tests were conducted on the sample.

The purpose of this non-experimental prediction research is to examine relationships between variables. In this study, the strength of relationships between WaKIDS Cognitive and Social Emotional subtests and DIBELS kindergarten reading

assessment is explored. The students were administered the WaKIDS assessment on the district assessment calendar schedule by trained teachers. Teachers administered the WaKIDS assessment to their own students two times during the year. The DIBELS Reading Assessment was administered according to district calendar schedule and specific subtests were given in the fall and in the spring.

Data Analysis and Statistical Procedures

First, descriptive statistics were generated for all variables. Means, standard deviations, frequency tables, scatter plots, and histograms were computed on each variable as appropriate for continuous or categorical variables. This provided an understanding of the relationship of each variable in the dataset. After descriptive statistics were generated and reviewed, a correlation matrix was created to explore the strength of the relationships between the criterion and predictor variables.

Fall and Spring scores for the WaKIDS GOLD^{TM} assessment Cognitive and Social Emotional subtests are included as predictor variables. In addition, demographic information such as gender and age were reviewed as predictor variables. The criterion variables are the Spring DIBELS measures of PSF, NWF, and DIBELS NEXT EOY composite scores.

The predictor variable WaKIDS GOLD^{TM} subtest is reported as a scaled score. The Cognitive subtest is divided into four dimensions of attention and memory that together result in the scaled score: (1) attending and engaging, (2) remembering and recalling, (3) organizing, and (4) symbolic thinking. Similarly, the Social Emotional subtest scaled score is divided into three dimensions of inhibitory control: (1) behavior

and emotional regulation, (2) positive peer interaction, and (3) balancing needs and rights of self and others.

Multiple measures of reading ability are assessed during the Spring DIBELS assessment. For this study, the criterion-reference scores for two subtests were reviewed. Descriptive statistics are included in the following chapter.

After descriptive statistics were generated and reviewed, a correlation matrix was created to explore the strength of the relationship between the criterion and predictor variables. Statistical significance was assessed at both the $p < .05$ and $p < .01$ levels. Since multicollinearity is a problem for multiple regression (Field, 2009), a series of analyses was conducted to determine the level of collinearity among the predictors and the criterion variable. A visual scan of the correlation matrix (see Table 4) showed that all of the predictor variables were correlated at less than $r = .80$. After examining the data for multicollinearity, a series of preliminary multiple regression analyses was conducted to determine the relationship between executive function skills and reading achievement.

In summary, this chapter reviewed the study's design and method. The rationale behind the methodological elements, research design, and statistical procedures was presented in the intent to increase internal validity and possible replication of research. The next chapter reports the results of the statistical analyses as they related to each of the research questions.

CHAPTER 4: Results

Chapter 4 articulates the results of the statistical analyses conducted on the data. The focus of this study was to examine the relationship between the WaKIDS subtests of executive function and kindergarten reading skills as measured by DIBELS. As detailed in Chapter 3, the primary statistical procedures conducted were descriptive, correlation, and regression. Findings are organized herein by preliminary descriptive statistics, followed by the research questions outlined in the study. The results of the research questions begin with a broad review of the relationships between the variables and continue to a narrow focus on a specific subset of the sample.

Preliminary Descriptive Statistics

As mentioned in the previous chapter, descriptive statistics were computed for each of the variables and the study sample. Descriptive statistics, including means and standard deviations, are included to provide a framework for understanding the present data set. Table 2 lists the descriptive statistics for this study. Table 3 lists the correlations among WaKIDS and DIBELS subtests.

Table 2

Descriptive Statistics for all Variables

Variables	*N*	*Min*	*Max*	*Mean*	*SD*
Gender	470	-	-	-	-
Male	225				
Female	205				
Missing	60				
Age in months	470	76.30	100.22	86.35	4.19
Valid	410				
Missing	60				
WaKIDS Cognitive Fall	470	377	800	679.22	55.25
WaKIDS Soc-Emo Fall	470	369	795	636.57	50.27
WaKIDS Cognitive Spring	470	413	800	750.38	40.48
WaKIDS Soc-Emo Spring	470	404	800	697.57	54.99
DIBELS LNF Fall	470	0	77	25.76	16.81
DIBELS FSF Fall	470	0	52	21.65	12.20
DIBELS PSF Spring	470	0	80	53.61	14.12
DIBELS NWF Spring	470	0	143	48.02	31.37

Table 3

Correlations among the WaKIDS Subtests and DIBELS Subtests Controlling for Age in Months and Gender (n = 388)

Variables	WaKIDS Cognitive Fall	WaKIDS Soc-Emo Fall	WaKIDS Cognitive Spring	WaKIDS Soc-Emo Spring
WaKIDS Cognitive Fall	1	.600**	.646**	.464**
WaKIDS Soc-Emo Fall	.600**	1	.485**	.739**
WaKIDS Cognitive Spring	.646**	.485**	1	.618**
WaKIDS Soc-Emo Spring	.464**	.739**	.618**	1
DIBELS LNF Fall	.296**	.218**	.381**	.280**
DIBELS FSF Fall	.326**	.138**	.366**	.223**
DIBELS PSF EOY	.267**	.202**	.306**	.269**
DIBELS NWF - EOY	.178**	.120**	.299**	.225**

**Statistical significance was assessed at $p < .01$ level.

*Statistical significance was assessed at $p < .05$ level.

LNF= Letter Name Fluency

FSF= First Sound Fluency

PSF= Phoneme Segmentation Fluency

NWF= Nonsense Word Fluency

Research Question 1

Do Fall WaKIDS GOLD social-emotional and cognitive subtests of executive function scores significantly correlate with the DIBELS Beginning of Year (BOY) scores after controlling for age and gender? This question was broken into four sub questions that looked specifically at the correlations between the WaKIDS measures and DIBELS subtests. A correlation matrix was created to show the strength of the relationships between each WaKIDS subtest and the individual DIBELS subtests. Significant correlations were flagged at the .01 and .05 levels. All of the correlations shown in Table 3 were significant at the $p < .01$ level. Results for individual research questions follow.

Question 1a: Do Fall WaKIDS GOLD social-emotional subtest of executive function scores significantly correlate with the (BOY) First Sound Fluency (FSF) subtest of DIBELS Assessment, after controlling for age and gender? There was a small positive correlation between Fall WaKIDS social emotional subtest and DIBELS BOY FSF, $r = .22$ $p < .001$ with Fall WaKIDS social emotional scores associated with beginning of the year First Sound Fluency (FSF).

Question 1b: Do Fall WaKIDS GOLD social emotional subset of executive function scores significantly correlate with the BOY Letter Naming Fluency (LNF) subtest of DIBELS Assessment, after controlling for age and gender? There was a small positive correlation between the Fall WaKIDS social emotional subtest and the DIBELS BOY LNF, $r = .138$, $p < .001$ with Fall WaKIDS social emotional scores associated with beginning of the year Letter Naming Fluency.

Question 1c: Do Fall WaKIDS GOLD cognitive subtest of executive function scores significantly correlate with the BOY First Sound Fluency (FSF) subtest of DIBELS

Assessment, after controlling for age and gender? There was a moderate positive correlation between the Fall WaKIDS cognitive subtest and the DIBELS BOY FSF, r = .296, p < .001 with Fall WaKIDS cognitive scores associated with beginning of the year First Sound Fluency.

Question 1d: Do Fall WaKIDS GOLD cognitive subtest of executive function scores significantly correlate with the BOY Letter Naming Fluency (LNF) subtest of DIBELS Assessment after controlling for age and gender? There was a moderate positive correlation between the Fall WaKIDS cognitive subtest and the DIBELS BOY LNF, r = .326, p < .001 with Fall WaKIDS cognitive scores associate with beginning of the year Letter Naming Fluency.

Research Question 2

Do Fall WaKIDS GOLD social-emotional and cognitive subtests of executive function scores significantly correlate with the DIBELS End of Year (EOY) scores after controlling for age and gender? This question was broken into four sub questions that looked specifically at the correlations between the WaKIDS and DIBELS subtests.

Question 2a: Do Fall WaKIDS GOLD social-emotional subtest of executive function scores significantly correlate with the EOY Nonsense Word Fluency (NWF) subtest of DIBELS Assessment, after controlling for age and gender? There was a small positive correlation between Fall WaKIDS social emotional subtest and DIBELS EOY NWF, r = .120, p < .001 with Fall WaKIDS social emotional scores associated with end of the year Nonsense Word Fluency.

Question 2b: Do Fall WaKIDS GOLD™ social emotional subset of executive function scores significantly correlate with the EOY Phoneme Segmentation Fluency

(PSF) subtest of DIBELS Assessment, after controlling for age and gender? There was a small positive correlation between the Fall WaKIDS social emotional subtest and the DIBELS EOY PSF, r =.202, p < .001 with Fall WaKIDS social emotional scores associated with end of the year Phoneme Segmentation Fluency.

Question 2c: Do Fall WaKIDS GOLD™ cognitive subtest of executive function scores significantly correlate with the EOY Nonsense Word Fluency (NWF) subtest of DIBELS Assessment, after controlling for age and gender? There was a small positive correlation between the Fall WaKIDS cognitive subtest and the DIBELS EOY NWF, r = .178, p < .001 with Fall WaKIDS cognitive scores associated with end of the year Nonsense Word Fluency.

Question 2d: Do Fall WaKIDS GOLD™ cognitive subtest of executive function scores significantly correlate with the EOY Phoneme Segmentation Fluency (PSF) test of DIBELS Assessment, after controlling for age and gender? There was a small positive correlation between the Fall WaKIDS cognitive subtest and the DIBELS EOY PSF, r =.267, p < .001 with Fall WaKIDS cognitive scores associated with end of the year Phoneme Segmentation Fluency.

Research Question 3

Do the Spring WaKIDS GOLD social-emotional and cognitive subtests of executive function significantly correlate with DIBELS EOY Assessments? This question was broken into two sub questions that looked specifically at the relationship between the WaKIDS and DIBELS subtests.

Question 3a: Do Spring WaKIDS GOLD social emotional and cognitive subtests of executive function significantly correlate with the NWF subtest of the DIBELS EOY

Assessment? There was a small positive correlation between Spring WaKIDS social emotional subtest and DIBELS EOY NWF, $r = .225$, $p < .001$. The Spring WaKIDS cognitive subtest demonstrated a small positive correlation with DIBELS EOY NWF, $r = .299$, $p < .001$.

Question 3b: Do Spring WaKIDS GOLD™ social emotional and cognitive subtests of executive function significantly correlate with the PSF subtest of the DIBELS EOY Assessment? There was a small positive correlation between Spring WaKIDS social emotional subtest and DIBELS EOY PSF, $r = .269$, $p < .001$. The Spring WaKIDS cognitive subtest demonstrated a moderately positive correlation with DIBELS EOY PSF, $r = .306$, $p < .001$.

Research Question 4

Do the Fall WaKIDS GOLD™ social-emotional and cognitive subtests of executive function scores predict growth in literacy skills over the kindergarten year after controlling for age, gender, and beginning of the year literacy skills as measured by DIBELS EOY Assessments? This question was broken into two sub questions that looked specifically at the relationship between the Fall WaKIDS and EOY DIBELS subtests.

Question 4a: Do Fall WaKIDS GOLD™ social emotional and cognitive subtests of executive function scores predict growth in literacy skills over the kindergarten year after controlling for age, gender, and beginning of the year literacy skills, as measured by the NWF subtest of the DIBELS Assessment? Hierarchical multiple regression was used to assess the ability of two WaKIDS subtests (social emotional and cognitive) to predict growth in literacy skills over the kindergarten year, after controlling for age, gender, and beginning of the year literacy skills as measured by the NWF subtest of

DIBELS. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity. Age and gender were entered at Step 1, explaining only .03% of the variance in EOY reading skills. After entering the Fall WaKIDS social emotional and cognitive scores at Step 2, the total variance explained by the model as a whole was 36.1%, $F(2, 388) = 20.549$, $p < .001$. WAKIDS social emotional and cognitive scores explained an additional .5% of the variance in reading skills, after controlling for age and gender, R^2 change = .003, $F_{change}(2, 386) = 20.549$, $p < .001$. In the final model, neither of the two WAKIDS measures were statistically significant, with the WaKIDS cognitive subtest recording a higher beta value ($\beta = -.070$, $p > .05$) than the WaKIDS social emotional subtest ($\beta = .053$, $p > .05$). See Table 4.

Table 4

Dependent Variable DIBELS NWF EOY

Step	Variables entered	R^2 *change*	Sig. R^2 *change*	Final β	Sig. final beta
1	Gender			-.070	.091
	Age in Months	.003	.563	-.083	.044
2	DIBELS FSF Fall			.176	.000
	DIBELS LNF Fall	.118	.000	.507	.000
3	WaKIDS Cog Fall			-.070	.194
	WaKIDS Soc-Emo Fall	.032	.001	.053	.313

FSF = DIBELS First Sound Fluency

LNF = DIBELS Letter Name Fluency

Question 4b: Do Fall WaKIDS GOLD social emotional and cognitive subtests of executive function scores predict growth in literacy skills over the kindergarten year after controlling for age, gender, and beginning of the year literacy skills, as measured by the EOY PSF subtest of the DIBELS Assessment? Hierarchical multiple regression was used to assess the ability of two WaKIDS subtests (social emotional and cognitive) to predict growth in literacy skills over the kindergarten year, after controlling for age, gender, and

beginning of the year literacy skills as measured by the PSF subtest of DIBELS. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity. Age and gender were entered at Step 1, explaining only .8% of the variance in EOY reading skills. After entering the Fall and Spring WaKIDS social emotional and cognitive scores at Steps 2 and 3, the total variance explained by the model as a whole was 13.9% of the variance in reading skills, after controlling for age and gender, R^2 change = .032, $F_{change}(2, 386) = 13.142$, $p < .001$. In the final model, only the Fall WaKIDS cognitive measure was statistically significant, with the WaKIDS cognitive subtest recording a higher beta value ($\beta = .167$, $p < .05$) than the WaKIDS social emotional subtest ($\beta = .042$, $p > .05$). See Table 5.

Table 5

Dependent Variable DIBELS PSF EOY

Step	Variables entered	R^2 change	Sig. R^2 change	Final beta	Sig. final beta
1	Gender			.026	.583
	Age in Months	.008	.216	-.022	.673
2	DIBELS FSF Fall			.311	.000
	DIBELS LNF Fall	.118	.000	-.044	.439
3	WaKIDS Cog Fall			.167	.008
	WaKIDS Soc-Emo Fall	.032	.001	.042	.487

FSF = DIBELS First Sound Fluency

LNF = DIBELS Letter Name Fluency

Chapter 5: Discussion

Summary of Research Purposes and Methodology

This study sought to examine the utility of two subtests of the WaKIDS GOLD™ assessment that identify a student's level of executive function skill in predicting reading readiness as measured by the DIBELS assessment. WaKIDS GOLD™ is administered to every kindergartener in Washington State at least once per year in the fall, requiring substantial efforts by already-busy teachers. Many school districts administer the assessment more than once. This assessment serves as a universal screener for teachers and schools to identify student strengths and areas of needed intervention as part of a Response to Intervention (RTI) framework (Fuchs & Fuchs, 2006). This study examined the predictive power of the WaKIDS GOLD™ cognitive and social emotional subtest score at the beginning of the year and the reading skills of phonemic awareness and phonics as measured by DIBELS at the beginning and end of the kindergarten year. In addition, demographic data was explored to evaluate how reading readiness might differ for different genders or by birthdate. Correlation and regression analysis were used to explore how well WaKIDS subtests predicted reading readiness the DIBELS assessment. The findings of the investigation, the theoretical and practical implications of these findings, and limitations of the study are presented along with recommendations for future research. Results for each research question are discussed.

Both WaKIDS GOLD™ and DIBELS assessments were given in the fall of kindergarten approximately a month into the school year. The WaKIDS GOLD™ assessment data is obtained through teacher observation of student demonstration of specific skills as indicated in each subtest. The skills assessed in the WaKIDS GOLD™

social emotional subtest measure if a child demonstrates the executive function skills to regulate their own emotions and behaviors, manage feelings, follow limits and expectations, balance needs and rights of self and others, and solve social problems. All of these skills fall under the executive function of inhibitory control. The cognitive subtest of WaKIDS GOLD^{TM} measures the child's demonstration of the attention and working memory executive function skills of attending and engagement, persistence, and the ability to remember and connects experiences (Teaching Strategies, 2010).

At the beginning of the kindergarten year, students were assessed on the First Sound Fluency (FSF) and the Letter Naming Fluency (LNF) subtests of the DIBELS assessment. The DIBELS assessment is used by many school districts nationwide as a tool to provide specific reading support in a Response to Intervention (RTI) model in the school district. The information obtained through the FSF and LNF subtests give teachers and reading specialist specific information about each child's strengths and weakness in pre-reading skills. FSF is a measure of phonemic awareness, the ability to recognize and manipulate phonemes in spoken words (Ehri & Nunes, 2002). FSF assesses the child's ability to identify the initial sound of a spoken word. The teacher asks the student to point to the picture of the word that starts with a specific sound. For example, the teacher may ask the student to point to the picture of the word that starts with the sound /t/ (tuh). The score is the correct number of initial sounds identified in one minute. The Letter Naming Fluency (LNF) subtest measures a student's ability to name letters from a page of the lower- and upper-case alphabet. The score is the correct number of letters identified in one minute.

In the Spring, kindergarteners are assessed with the Phoneme Segmentation Fluency (PSF) and Nonsense Word Fluency (NWF) subtests. The PSF also measures phonemic awareness. In this assessment, the student listens to words spoken by the teacher. Students are asked to identify all of the sounds or phonemes that they hear in the word (Good & Kaminski, 2002, p.329). The number of correct phoneme segments identified in one minute is recorded. In the NWF subtest, the student is measured on their ability to map sounds into letters. This subtest measures alphabetic principle, or the idea that letters in words have a relationship to specific sounds (Stahl, Duff-Hester, & Dougherty Stahl, 2006). This tests a student's ability to generate letter sounds out of context using pseudowords such as poj, dut, and fim. Any correct sounds are recorded and full pseudowords are given a score of two or three based on the number of letters in the made-up word. The total number of letter sounds correctly identified in one minute is recorded.

Research Questions

Research question 1 sought to discover if Fall WaKIDS subtests of executive function significantly correlate to Beginning of Year (BOY) DIBELS scores of early literacy. There was a small correlation between the social emotional subtest and First Sound Fluency (FSF), $r = .218$, $p < .001$, and between Letter Name Fluency (LNF), $r = .138$, $p < .001$. The cognitive subtest of WAKIDS showed a stronger correlation with Beginning of Year FSF, $r = .296$, , $p < .001$ and with LNF, $r = .326$, , $p < .001$ The FSF and LNF subtests assess phonemic awareness and phonics skills, so a higher correlation to the WaKIDS subtest that assesses "cool" executive function skills like attention and working memory might be expected. Brock et al. (2009) stated:

> Children engage in cognitive problem solving or cool executive function (EF) when they encounter and manipulate abstract concepts and symbols (e.g. number and letters). The extent to which children successfully navigate higher order thinking (abstraction) is dictated, in part, by their attention, working memory, and inhibitory control (p 337).

The findings of this study indicated that students who brought higher "cool" executive function skills like attention and working memory, scored higher on the subtests of DIBELS that measured the more abstract reading abilities such as naming the letters of the alphabet (LNF) and phonemic awareness (FSF).

Research question 2 looked at the relationship between the Fall WaKIDS subtests of executive function and End of Year (EOY) DIBELS subtests of early literacy. In the spring, DIBELS assesses a student's ability to use phonics skills to decode nonsense words through the Nonsense Word Fluency (NWF) subtest. Kindergarten students are also assessed on the phonemic awareness skill of breaking apart words through the Phoneme Segmentation Fluency (PSF) subtest. In this study, there was a small positive correlation found between Fall WaKIDS social emotional subtest and DIBELS EOY NWF, $r = .120$, $p < .001$. There was also a small positive correlation between the Fall WaKIDS social emotional subtest and the EOY PSF subtest, $r = .202$, $p < .001$. The WaKIDS cognitive subtest and the EOY DIBELS NWF subtest also showed a small positive correlation, $r = .224$, $n = 470$, $p < .001$. The WaKIDS Fall cognitive subtest showed moderately positive correlation to the EOY PSF subtest, $r = .267$, $p < .001$. These findings are consistent with other research reviewed for this study. Brock et al. (2009) found that the "cool" executive function skills of attention, working memory, and

inhibitory control were not only correlated to beginning of the year transition to kindergarten, but were also predictors of kindergarten readiness (p. 345). The same study also found that the executive function skills that children brought to kindergarten did not correlate or predict gains in standardized reading scores during the kindergarten year (Brock et al., 2009). One of the potential reasons for the lack of finding may be attributed to the intensely scaffolded focus on the development of reading skills in kindergarten. In the typical kindergarten classroom, children spend a large proportion of their time in teacher-direct literacy instruction (Pianta, La Paro, Payne, Cox, & Bradley 2002). Also, in a typical kindergarten classroom, literacy instruction is the subject on which the largest amount of time is spent, ensuring that the majority of children show gains regardless of the executive function skills they possess at kindergarten entry (Brock et al., 2009). In practical terms, in most kindergarten settings, teachers pace instruction to account for any potential lack in a kindergarten student's ability to attend and provide direct instruction and practice with the frequency to develop students' working memory, not rely upon it. Teachers anticipate that many children will come to kindergarten with not-yet-developed executive function skills, specifically attention and self-regulation and provide the structure for students to not only engage in learning regardless of their executive function skills, but also in that structure, to develop their emerging executive function skills as well (Rimm-Kaufman et al., 2000). Therefore, taking into account the intentional structure of a kindergarten classroom, the small correlation found in this study between the beginning of year executive function skills and the end of year achievement is not a surprising result.

Research question 3 investigated the relationship between Spring WaKIDS social emotional and cognitive subtests and the EOY DIBELS subtests of Nonsense Word Fluency (NWF) and Phoneme Segmentation Fluency (PSF). There was a small positive correlation between Spring WaKIDS social emotional subtest and DIBELS EOY NWF, $r = .225$, $p < .001$, and the DIBELS EOY PSF, $r = .269$, $p < .001$. The Spring WaKIDS cognitive subtest demonstrated a small positive correlation to DIBELS EOY NWF, $r = .299$, $p < .001$, and a moderate correlation to DIBELS EOY PSF, $r = .306$, $p < .001$. NWF measures a child's ability to generate letter sounds out of context. The correlation between WaKIDS subtests and Phoneme Segmentation Fluency was moderate for both WAKIDS subtests. The other three DIBELS subtests, LNF, FSF, and NWF all require children to exhibit the understanding of "whole word" representation, or the construction of meaning by putting sounds together. PSF requires a child to deconstruct words by thinking about a spoken word in terms of syllables, onsets and rimes, and individual phonemes, and then manipulating the elements to break them into individual pieces. This linguistic task requires the application of Baddeley's model of verbal working memory (Baddeley & Hitch, 1974). This central cognitive regulatory process is critical for children as they approach challenging situations (Welsh et al., 2010). Valiente, Lemery-Chalfant, Swanson, and Reiser (2008) found that early working memory was key in the development of problem-solving abilities in young children. The PSF assessment is presented as a deconstruction of a word, to isolate its individual parts, relying on working memory to hear the word and then manipulate it in the brain to identify the onset and rime along with individual phonemes. The moderate correlation between the WaKIDS subtests of executive function, specifically the cognitive subtest in both Fall and Spring,

and the social emotional subtest in the Spring, with the PSF subtest of DIBELS supports the claims of previous researchers who found that the executive function skills of attention, and more so working memory, "enable children to organize their thinking and behavior with increasing flexibility, decrease their reactive responding to contextual cues and contingencies, and engage in self-regulated and rule governed behavior"(Blair, 2002; Welsh et al., 2010). It appears that the cognitive, or "cool" executive function skills like working memory and attention that a child brings to kindergarten and the development that takes place over the kindergarten year play a role in the ability to engage in more complex early reading tasks.

Research question 4 examined the predictive relationship between Fall and Spring WaKIDS GOLD social emotional and cognitive subtests of executive function scores and the EOY subtest of the DIBELS assessments. With the EOY DIBELS assessment as the dependent variable, the study sought to discover if the information obtained from the WaKIDS subtests in the fall and spring would be a predictor of how a child might score on the EOY reading assessment. This is potentially useful information for classroom teachers and intervention specialists. Just as with reading skills, if it is determined that a kindergarten student scores low on the subtests of executive function in the beginning of the year, then a teacher can focus on intervention support for the child to develop those skills. Providing the necessary support for the development of executive function skills to the targeted reading instruction that occurs in the typical kindergarten classroom may improve reading outcomes at the end of the year.

The total variance explained by the model as a whole was 12.6%, $F(2, 388) = 13{,}358$, $p < .001$. The two WaKIDS measures explained an additional 15.8% of the

variance in reading skills, after controlling for age and gender, R^2 change = .032, $F_{change}(2, 386) = 13.984$, $p < .001$. In the final model, only the WaKIDS cognitive measure was statistically significant, with the WaKIDS cognitive subtest recording a beta value (*beta* = .167, $p < .05$) higher than the WaKIDS social emotional subtest (*beta* = .019, $p < .05$) when the dependent variable was the EOY PSF subtest. The beta values for the WaKIDS subtests when the dependent variable was the EOY NWF subtest were WaKIDS cognitive subtest beta value ($\beta = -.070$, $p < .05$) and WaKIDS social-emotional subtest beta ($\beta = .053$, $p < .05$). The WaKIDS cognitive subtest of "cool" executive function skills was a better predictor of end of the year reading ability. These findings encourage an intentional focus on teaching and supporting executive function skills in kindergarten and supporting students who do not develop those skills at the rate needed to affect reading development. Providing targeted executive function intervention, just as intervention is typically provided for children who show deficits in foundational reading abilities, may contribute to more successful skill development outcomes at the end of the kindergarten year. These findings also raise questions about the emerging executive function skills of younger children, and how early learning programs might foster growth in these skills.

Theoretical Implications

The theoretical aspect of this study is based on Zimmerman's Self-Regulation Theory (1989), which explores the construct of self-regulation, and executive function in children. Specifically, the notion that the cognitive components of executive functioning such as attention, working memory and inhibitory control have influence on a child's development as a reader and learner. This study was an exploration of the executive

function skills that students bring to kindergarten and the relationship of those skills to early reading skills. Findings of this study indicated that the subtests that measured executive function on the WaKIDS GOLD™ assessment, administered to all kindergarteners in Washington State positively correlated to early kindergarten reading skills as measured by the DIBELS assessment.

Cognitive and Social Emotional Subtests

The WaKIDS subtests of cognitive and social-emotional skills are observation-based assessments designed to be used in the day-to-day instruction of the classroom as teachers collect observational records on each student over the course of the school year. For the purpose of this study, the two subtests were found to be highly correlated.

Table 6

Correlations Among the WaKIDS Subtests

Variables	WaKIDS Cognitive Fall	WaKIDS Soc-Emo Fall	WaKIDS Cognitive Spring	WaKIDS Soc-Emo Spring
WaKIDS Cognitive Fall	1	.691**	.684**	.535**
WaKIDS Soc-Emo Fall	.691**	1	.575**	.770**
WaKIDS Cognitive Spring	.684**	.575**	1	.671**
WaKIDS Soc-Emo Spring	.535**	.770**	.671**	1

Cognitive vs Social Emotional Scores (or "hot" vs "cool" EF)

Executive function refers in a general sense to the coordination of higher order thinking process and skills, including working memory, inhibitory control, attention (Zelazo et al., 2003). This broad definition can make it challenging to observe individual skills in young children and connect them to the presence of EF skills or, or lack of those skills. Researchers have divided the umbrella of EF skills into two interrelated but distinct constructs (Blair & Razza, 2007). The label "hot" EF is used to describe emotional problem solving and "cool" EF is used to describe cognitive problem solving (Zelazo & Muller, 2002, Brock et al., 2009). As kindergarten has become more focused on academic achievement, the importance of emotional and behavior regulation's relationship to the development of those skills has never been more important. In this study, the WaKIDS GOLD™ subtests of social-emotional and cognitive skills were used to examine the executive function skills that students bring to school and the skills that are developed over the kindergarten year. The social-emotional components of the WaKIDS subtest looks at the inhibitory control or "hot" skills, while the cognitive subtest of WaKIDS measures the "cool" skills of attention and working memory. In this study it was discovered that the cognitive or "cool EF" skills had a stronger correlation with end of year reading skills as measured by DIBELS subtests. These findings were consistent with many of the research studies reviewed for this project. Brock et al. (2009), found that:

> In the classroom, children's achievement relies on the ability to remember instructions, and represent the goal of the lesson (working memory), attend to the important features of the lesson (executive attention), and stay on task (inhibitory

control), suggesting cool EF may play a role in kindergarteners' achievement. (p. 338)

Similarly, Blair and Razza (2007) explained that cool or cognitive executive function "places emphasis on the role of knowledge of problem elements and relations among these elements as central to executive function and its ability to academic ability" (p. 658). As discussed earlier in this chapter, the stronger relationship between the cool or cognitive skills and how students perform on tests, may be related to the structure of a typical kindergarten classroom in which teachers predict, support, manage, and scaffold classroom activities, to make up for any lacking hot executive function skills (Brock et al., 2009).

Gender

Low positive correlations were found between gender and scores on all subtests used, with the exception of the DIBELS EOY NWF test, which showed a low negative correlation. See Table 7.

Table 7

Correlations between Gender and WaKIDS and DIBELS Subtests

	WaKIDS Cognitive Fall	WaKIDS Soc-Emo Fall	WaKIDS Cognitive Spring	WaKIDS Soc-Emo Spring	DIBELS EOY NWF
Gender	.121	.196	.188	.202	-0.33

At first glance, this low correlation with gender in this study was surprising, given the widely accepted assumption that girls demonstrate kindergarten readiness prior to

their male counterparts. A 2018 study by Grissom and Reyes found, in general, little support for significant gender or sex differences in executive function. They discovered that, "while individual factors may show a tendency towards a sex bias (e.g. increased impulsive action in males, reduced reaction time in males, improved working memory in females), sex difference in executive function are not overwhelming" (p. 92). When running the hierarchical multiple regression models, gender made a very small contribution to the model, $R^2 = .008$, $p < .001$.

Practical Implications

This study provided evidence that executive function skills play a role in reading development in young children. As observational tools like the WAKIDS GOLD™ are being used to assess the skills that students bring to kindergarten and to track development of skills throughout the school year, most school districts have intervention programs for reading and math skill deficits that are found through the use of these observational assessments. The challenge is providing teachers with an easy-to-use intervention tool to more intentionally support and teach the skills of attention, working memory and inhibitory control as part of a whole-child program. Determining students who might benefit from early intervention to develop self-regulation and cognitive executive function skills and helping to build these learning-related skills may prevent social and academic problems as a child progresses through elementary school and beyond (McClelland et al.,2006). The results of this study present the need for educators and policy makers to examine executive function skills along with academic skills and take into account how to explicitly teach or intentionally provide opportunities for

students to refine the skills of attention, working memory, and inhibitory control in the same way that reading skills are taught in kindergarten.

Limitations of the Research

Consistent with any research in education there are limitations to this study that must be considered. This section addressed the issues related to design, methods, sample, and specifically to internal and external validity.

Design. The design of this study is a considerable limitation. This study was non-experimental using post facto data. As with all ex post facto studies, it is impossible to control for extraneous variables. Also, the data were collected by teachers in schools and the WaKIDS GOLD™ is an assessment of observational data collection. Teachers are trained to account for interrater reliability, but the testing conditions mirror real life situations, so they are subject to extraneous variables. This limits the internal validity of the study.

Methods. The methods selected for this study are multiple regression and correlation. This was an appropriate choice for this study based upon the research questions, but methods using regression and correlation are limited. This was a robust data set, so hierarchical linear modeling may have been another suitable statistical method. While multiple regression was appropriate for the research questions of this study, it does limit external validity.

Sample. While the sample size of this group was robust, it was limited to kindergarten students during one year in a suburban setting. The results, therefore, can only be compared to school districts with similar demographics. In addition, WaKIDS GOLD™ is a new assessment used in every school in Washington State. While based on

the Teaching Strategies GOLD™ assessment that has a wider and more historical use throughout the country, the unique adaptation of the test for use in Washington State's state-funded full day kindergarten classrooms has undergone slight changes every year since it started being used statewide in 2016. These changes limit generalizability and external validity.

Suggestions for Future Research

Executive function skills, which are defined as a person's ability to regulate behaviors such as attention, working memory, and inhibitory control, play a role in a child's successful transition from preschool to kindergarten. The purpose of this study was to review and analyze the relationship between executive function in early childhood, as measured by the WaKIDS GOLD™ social-emotional and cognitive subtests, and early reading readiness. The research design was both correlational and predictive (Gall, Borg, & Gall, 1996). The target population is kindergarteners in a suburban Washington State school district. The study is based on data collected at the beginning of the kindergarten year and at the end of the year using the social emotional and cognitive subtests of the WaKIDS GOLD™ assessment. WaKIDS GOLD™ cognitive and social emotional subtests were hypothesized to be a moderate predictor of reading achievement as measured by the DIBELS Literacy Assessment

This study provides evidence of the relationship between a child's ability to attend, hold and manipulate items in working memory, and inhibit responses as a key component to development as a reader early in their school experience. This topic was robustly researched in the first ten years of the 21st century (Blair & Razza, 2007; Brock et al., 2009; Cartwright, 2012; McClelland et al., 2006; Ponitz et al., 2008, Rimm-

Kaufman, Curby, Grimm, Nathanson, & Brock, 2009; Zelazo, 2004). While the topic has gone out of vogue, the academic rigor and expectations on kindergarteners to attend, use working memory, and inhibit emotional responses has significantly increased. The task for educators and policy makers to provide developmentally appropriate practices while meeting rigorous academic curriculum standards as found in the Common Core State Standards is a formidable one. Further research using measures geared to measure executive function skills with more precision is needed. The goal would be to provide an assessment of executive function in young children that highly correlates to early reading inventory assessments to further explore the relationships between these skills. The hopeful outcome of further research is to find an assessment tool that is reliable and easily accessible for teachers of young children.

The findings of this study offer evidence that lead to some potential next steps for future research. Some are discussed below:

1. *An examination of the WaKIDS GOLD™ Social Emotional subtest.* This study suggests that the WaKIDS GOLD™ subtest shows a small correlation to reading readiness skills as measured by EOY subtests in the DIBELS suite. An examination of this subtest in comparison to other measures of executive function in young children may provide information on the power of this assessment to measure executive function. A full examination in a controlled environment is needed.
2. *An examination of the WaKIDS GOLD™ Cognitive Subtest.* This study suggests that the WaKIDS GOLD™ subtest is moderately correlated to reading readiness. An examination of this subtest in comparison to other

measures of executive function in young children may provide information on the power of this assessment to measure executive function. A full examination in a controlled environment is needed.

3. *An examination of other classroom-based measures of executive function in kindergarten students.* The catalog of tools that can be used in a classroom setting to assess executive function in five-year-old children is limited. An examination of available tools, their function, and validity could add to the development of appropriate assessments or broader use of executive function screening as a predictor of academic readiness in kindergarten.
4. *An examination of the connection between play and academic learning and how purposeful play in the school setting can facilitate the growth of executive function skills (Pyle & Alaca, 2018).* Play was taken for granted for much of the history of education. Children played with siblings and neighbors, and much that play was spontaneous, and child initiated. In school, play was a significant component of a kindergarten classroom, which often had puppet stages, building blocks, and play kitchens. As kindergarten has become more academic, direct instruction and academic-focused activities have limited play to reschedule recess times. While child development experts have called for child-initiated play to be restored to kindergarten, the push for children to master the basic elements of reading earlier and earlier has prevailed. As challenges with behavior and emotional-regulation are still the topic of pedagogy among educators, further research into how the critical school stills

of executive function can be built in natural through play is an important question to investigate.

5. *A qualitative study examining teacher attitudes toward the WaKIDS GOLD™ assessment and its ability to provide useful data on developing executive function skills.* The usefulness of any tool by the practitioners who use them should also be a pursuit of research. The current assessments of executive function presented in the research review of this study like the HTKS, peg-tapping, or other tests used by school psychologists, do not lend themselves for use in a classroom setting. WaKIDS GOLD™ is designed as an observational tool that doesn't require the teacher to meet one-on-one with a child or set up any specific materials for the child to use. Collecting data on how teachers implement the assessment as well on how they use the data could add to the body of research around effective measurement tools for executive function.
6. *An intervention study testing approaches to develop executive function skills in kindergarten.* Given the varying levels of social-emotional and cognitive executive function skills found in this study, there is a clear need for further research into how executive function skills can be developed in a kindergarten classroom setting once an assessment of EF shows that a child is lacking specific skills like working memory or inhibitory control.

Conclusion

This study found significant results for the four stated research questions regarding the role that executive function skills play in when a child builds the skills to

learn to read. Acquisition of executive function skills is one of the more important tasks of childhood, and a key to academic success, beginning before a student enters kindergarten. Results of this study highlighted that while the executive function skills that students bring to kindergarten have a small to moderate correlation to the reading skills that they bring with them, the relationship grows stronger over the course of the year as cognitive executive function skills of attention and memory are developed and raises the question about whether executive function skills should be able to be built through the curriculum and structure of kindergarten, or would students benefit from a more intentional focus on teaching these important skills. Several researchers have looked at the relationship between a child's level of executive function skills and the impact on their development as readers. Young children rely on their developing executive function skills to help them as they learn to read and participate in all social and academic aspects of the classroom. Among researchers who have studied executive function in recent years, three dimensions of self-regulation are frequently highlighted for young children and were the areas of focus for this study; working memory and attention which are considered "cool" or more cognitive regulation skills, and inhibitory control, a "hot" or emotional regulation skill (Blair & Razza, 2007; Brock et al., 2009). Many prominent researchers have added to the discussion, connecting executive function skills and kindergarten reading readiness (Blair & Razza, 2007, Brock et al., 2009, McClelland et al., 2006; Morrison, Ponitz, & McClelland, 2010; Ponitz et al., 2009).

There is much more to be investigated on the topic of the relationship between executive function in young children and reading development. This study is an attempt to expand the knowledge on the use of a classroom-based executive function assessment

in kindergarten children, specifically the utility of the WaKIDS GOLD™ cognitive and social-emotional subtests. Despite the limitations of the study, the results are compelling and provide support for ongoing research on this topic. Further research is needed to confirm the results found here and to continue to explore the use and validity of assessments of executive function in young children and the relationship to kindergarten reading readiness. The tools for classroom teachers to use to measure executive function are limited, but the acknowledgement of the necessity for these types of assessments is growing. The overarching goal is helping children develop necessary reading readiness skills and grow as readers. Additional research in the role of executive function in this process can equip educators to better meet this goal.

References

Allan, N. P., Hume, L. E., Allan, D. M., Farrington, A. L., & Lonigan, C. J. (2014). Relations between inhibitory control and the development of academic skills in preschool and kindergarten: A meta-analysis. *Developmental Psychology*, *50*(10), 2368.

Baddeley, A. (1996). Exploring the central executive. *The Quarterly Journal of Experimental Psychology: Section A*, *49*(1), 5-28.

Baddeley, A. (2003). Working memory: Looking back and looking forward. *Nature Reviews Neuroscience*, *4*(10), 829-839.

Baddeley, A. D., & Hitch, G. (1974). Working memory. *Psychology of Learning and Motivation*, *8*, 47-89.

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes*, *50*(2), 248-287.

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

Bembenutty, H., & Karabenick, S. A. (2004). Inherent association between academic delay of gratification, future time perspective, and self-regulated learning. *Educational Psychology Review*, *16*(1), 35-57.

Benson, J. E., Sabbagh, M. A., Carlson, S. M., & Zelazo, P. D. (2013). Individual differences in executive functioning predict preschoolers' improvement from theory-of-mind training. *Developmental Psychology*, *49*(9), 1615.

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*(3), 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.

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

Brock, L. L., Rimm-Kaufman, S. E., Nathanson, L., & Grimm, K. J. (2009). The contributions of 'hot' and 'cool' executive function to children's academic achievement, learning-related behaviors, and engagement in kindergarten. *Early Childhood Research Quarterly, 24*(3), 337-349.

Brooks, I. (2008). *Organizational behavior: Individuals, groups and organization.* Boston, MA: Pearson Education.

Brown, T. E. (2006). Executive functions and attention deficit hyperactivity disorder: Implications of two conflicting views. *International Journal of Disability, Development and Education, 53*(1), 35-46.

Cartwright, K. B. (2012). Insights from cognitive neuroscience: The importance of executive function for early reading development and education. *Early Education & Development, 23*(1), 24-36.

Center on the Developing Child at Harvard University. (2011). *Building the brain's "air traffic control" system: How early experiences shape the development of*

executive function: Working paper no. 11. Retrieved from http://www.developingchild.harvard.edu

Clay, M. M. (1966). *Emergent reading behavior* (Unpublished doctoral dissertation). University of Auckland, New Zealand.

Cooper, J. D., Chard, D., & Kiger, N. D. (2006). The Struggling Reader: Interventions That Work. *Education Review//Reseñas Educativas*.

Coyne, M. D., & Harn, B. A. (2006). Promoting beginning reading success through meaningful assessment of early literacy skills. *Psychology in the Schools, 43*(1), 33-43.

Diamond, A. (2002). Normal development of prefrontal cortex from birth to young adulthood: Cognitive functions, anatomy, and biochemistry. *Principles of frontal lobe function*, 466-503.

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*(4), 315-334.

Diamond, A., Barnett, W. S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science (New York, NY), 318*(5855), 1387.

Duncan, G.J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A.C., Klebanov, P. Japel, C. (2007). School readiness and later achievements. *Developmental Psychology, 43*(6), *1428-1446.*

Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040.

ED.gov. (2011). *We can't wait: Nine states awarded Race to the Top-Early Learning Challenge grants awards will help build statewide systems of high quality early education programs*. Retrieved from: http://www.ed.gov/news/press=releases/we-cant-wait-nine-states-awarded-race-top-early-learning-challenge-grants-awards.

Ehri, L. C., & Nunes, S. R. (2002). The role of phonemic awareness in learning to read. In A. E. Farnstrup & S. J. Samuels (Eds.), *What research has to say about reading instruction* (*3rd ed.*) (pp. 87-109). Newark, DE: International Reading Association.

Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling*, *8*(3), 430-457.

Espy, K. A., McDiarmid, M. M., 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.

Field, A. (2009). *Discovering statistics using SPSS*. Sage publications.

Fitzgerald, J., Schuele, C. M., & Roberts, J. E. (1992). Emergent literacy: What is it and what does the teacher of children with learning disabilities need to know about it? *Reading and Writing Quarterly*, v8, 71-85.

Froebel, F. (1899). *Pedagogics of the kindergarten.* Translated by Josephine Jarvis. Retrieved from www.books.google.com

Frye, D., Zelazo, P. D., & Palfai, T. (1995). Theory of mind and rule-based reasoning. *Cognitive Development*, *10*(4), 483-527.

Fuchs, D., & Fuchs, L. S. (2006). Introduction to response to intervention: What, why, and how valid is it?. *Reading Research Quarterly*, *41*(1), 93-99.

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction.* Boston, MA. Pearson.

Gardner, D. P., Larsen, Y.W., & Baker, W. (1983). A nation at risk: The imperative for educational reform. *Washington, DC: US Government Printing Office,*

Glasser, W., & Center, E. T. (1975). *Schools without failure.* New York, NY: HarperCollins.

Goldstein, S., Naglieri, J. A., Princiotta, D., & Otero, T. M. (2014). Introduction: a history of executive functioning as a theoretical and clinical construct. In *Handbook of executive functioning* (pp. 3-12). Springer New York.

Good, R. H. & Kaminski, R. A. (Eds). (2002). *Dynamic Indicators of Basic Early Literacy Skills (6th ed.). Eugene, OR: Institute for the Development of Educational Achievement.* Retrieved from http://dibels.uoregon.edu/

Good, R. H., Simmons, D.C., & Kame'enui, E., (2001). The importance and decision-making utility of a continuum of fluency-based indicators foundational reading skills for third-grade high stakes outcomes. *Scientific Studies of Reading, 5*(3), 257-288.

Grissom, N. M., & Reyes, T. M. (2018). Let's call the whole thing off: Evaluating gender and sex differences in executive function. *Neuropsychopharmacology*, *44*, 86-96.

Hintze, J. M., Ryan, A. L., & Stoner, G. (2003). Concurrent validity and diagnostic accuracy of the dynamic indicators of basic early literacy skills and the

comprehensive test of phonological processing. *School Psychology Review*,*32*(4), 541-556.

Hunt, J.M. (1961). *Intelligence and experience.* Oxford, England: Ronald.

Isquith, P. K., Crawford, J. S., Espy, K. A., & Gioia, G. A. (2005). Assessment of executive function in preschool-aged children. *Mental Retardation and Developmental Disabilities Research Reviews, 11*(3), 209-215.

Joseph, G. E., Cevasco, M., Lee, T., & Stull, S. (2010). WaKIDS pilot: Preliminary report.

Kaminski, R. A. (2002). *Dynamic indicators of basic early literacy skills: DIBELS*. R. H. Good (Ed.). Dynamic Measurement Group.

Lambert, R. G., Kim, D.H., & Burts, D.C. (2014). Using teacher ratings to track the growth and development of young children using the Teaching Strategies GOLD(R) assessment system. *Journal of Psychoeducational Assessment*, *32*(1), 27-39.

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

Lonigan, C. J., Allan, N. P., & Lerner, M. D. (2011). Assessment of preschool early literacy skills: Linking children's educational needs with empirically supported instructional activities. *Psychology in the Schools*, *48*(5), 488-501.

Lonigan, C. J., Burgess, S. R., & Anthony, J. L. (2000). Development of emergent literacy and early reading skills in preschool children: Evidence from a latent-variable longitudinal study. *Developmental Psychology*, *36*(5), 596-613.

Lyon, G., & Krasnegor, N. A. (1996). *Attention, memory, and executive function.* Baltimore, MD: Paul H Brookes.

McClelland, M. M., Acock, A. C., & Morrison, F. J. (2006). The impact of kindergarten learning-related skills on academic trajectories at the end of elementary school. *Early Childhood Research Quarterly, 21*(4), 471-490.

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

Miller, E., & Almon, J. (2009). Crisis in the kindergarten: Why children need to play in school. *Alliance for Childhood (NJ3a),*

Mischel, W., Shoda, Y., & Rodriguez, M. I. (1989). Delay of gratification in children. *Science (New York, N.Y.), 244*(4907), 933-938.

Morrison, F. J., Ponitz, C. C., & McClelland, M. M. (2010). Self-regulation and academic achievement in the transition to school. *Child Development at the Intersection of Emotion and Cognition,* 203-224.

Musen, L. (2010). Early reading proficiency. Leading indicator spotlight. *Annenberg Institute for School Reform at Brown University (NJ1).*

Norman, D. A., & Shallice, T. (1986). *Attention to action.* Springer.

Office of the Superintendent of Public Instruction Washington (2006). *Bulletin No. 082-06 Curriculum and Instruction*. Retrieved from http://www.k12.wa.us/bulletinsmemos/Bulletins2006/B082-06.doc

Pascual-Leone, J., & Goodman, D. (1979). Intelligence and experience: A Neopiagetian approach. *Instructional Science, 8*(4), 301-367.

Piaget, J. (1969). *The psychology of the child*. New York, NY: Basic Books.

Pianta, R. C., La Paro, K. M., Payne, C., Cox, M. J., & Bradley, R. (2002). The relation of kindergarten classroom environment to teacher, family, and school characteristics and child outcomes. *The elementary school journal*, *102*(3), 225-238.

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

Ponitz, C. E. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly, 23*(2), 141-158.

Posner, M. I., & Petersen, S. E. (1989). *The attention system of the human brain* (No. TR-89-1). Washington University Department of Neurology.

Posner, M. I., & Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Development and Psychopathology*, *12*(3), 427-441.

Pyle, A., & Alaca, B. (2018). Kindergarten children's perspectives on play and learning. *Early Child Development and Care*, *188*(8), 1063-1075.

Raver, C. C., & Zigler, E. F. (1997). Social competence: An untapped dimension in evaluating head start's success. *Early Childhood Research Quarterly, 12*(4), 363-385.

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.

Raver, C., & Blair, C. (2016). Neuroscientific insights: Attention, working memory, and inhibitory control. *The Future of Children,26*(2), 95-118.

Rennie, D. A., Bull, R., & Diamond, A. (2004). Executive functioning in preschoolers: Reducing the inhibitory demands of the dimensional change card sort task. *Developmental Neuropsychology, 26*(1), 423-443.

Riedel, B.W. (2007). The relation between DIBELS, reading comprehension, and vocabulary in urban first-grade students. *Reading Research Quarterly, 42*(4), 546-547.

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.

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

Roehrig, A. D., Petscher, Y., Nettles, S. M., Hudson, R. F., & Torgesen, J. K. (2008). Accuracy of the DIBELS oral reading fluency measure for predicting third grade reading comprehension outcomes. *Journal of School Psychology, 46*(3), 343-366.

Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2005). The development of executive attention: Contributions to the emergence of self-regulation. *Developmental Neuropsychology, 28*(2), 573-594.

Rupley, W.H., Blair, T. R., & Nichols, W. D. (2009). Effective reading instruction for struggling readers: The role of direct/explicit teaching. *Reading & Writing Quarterly*, 25(2-3), 125-138.

Schumacher, R., Greenberg, M., & Mezey, J. (2003). *Head Start reauthorization: A preliminary analysis of HR 2210, the School Readiness Act of 2003*. Washington, D.C.: Center for Law and Social Policy.

Scott-Little, C., Bruner, C., & Schultz, T. (2011). *Discussion guide to responding to focused investment area (E) (1) and competitive priority 3: Kindergarten entry assessment*. Retrieved from http://www.elccollaborative.org/illinois/doc_view/17-kindergarten-entry-assessment-discussion-guide-html

Shallice, T. (1988). *From neuropsychology to mental structure*. Cambridge University Press.

Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychological Review*, *84*(2), 127.

Shiffrin, R. M., & Schneider, W. (1984). Automatic and controlled processing revisited. *Psychological Review*, *91*(2), 269-276.

Skinner, B. F. (1953). *Science and human behavior*. New York, NY: Simon and Schuster

Snow, C. F., Burns, M. S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. Washington, D.C.: National Academy Press.

Snow, C. E., Van Hemel, S. B., National Research Council of the National Academies, National Research Council, & National Academies. (2008). *Early childhood assessment: Why, what, and how* (Vol. 1). Washington, DC: National Academies Press.

Soderberg, J. S., Stull, S., Cummings, K., Nolen, E., McCutchen, D., & Joseph, G. (2013). Inter-rater reliability and concurrent validity study of the Washington Kindergarten Inventory of Developing Skills (WaKIDS). *Unpublished report prepared for the State of Washington Office of Superintendent of Public Instruction*.

Stahl, S. A., Duff-Hester, A. M., & Dougherty Stahl, K. A. (2006). Everything you wanted to know about phonics (but were afraid to ask). In K. A. Dougherty Stahl & M. C. McKenna (Eds.), *Reading research at work: Foundations of effective practice* (pp. 126-154). New York: Guilford.

Teaching Strategies. (2010). *Research Foundation: Teaching Strategies GOLD ® assessment system.* Retrieved from http://www.teachingstrategies.com/content/pageDocs/Research-Foundation-GOLD-2010.pdf

Teaching Strategies. (2011). *Press release: Teaching Strategies GOLD(R) assessment system selected for use in the Washington Kindergarten Inventory of Developing Skills program.* Retrieved from

http://www/teachingstrategies.com/content/pageDocs/teaching-Strategies-WaKIDS-Press-Release-10-2011.pdf

U.S. Department of Education. (2001). *No child left behind executive summary.* Retrieved from http://www2.ed.gov/nclb/landing.jhtml

U.S. Department of Education. (2002). *Early reading first program archive*. Retrieved from http://www2.ed.gov/programs/earlyreading/index.html

University of Oregon Center on Teaching and Learning. (2008). *Description of the DIBELS data system.* Retrieved from http://dibels.uoregon.edu/docs/data_sys_desc.pdf

Valiente, C., Lemery-Chalfant, K., Swanson, J., & Reiser, M. (2008). Prediction of participation. *Journal of Educational Psychology*, *100*(1), 67.

Vygotsky, L. S. (1980). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Washington State Office of the Superintendent of Public Instruction. (2015). *What is WAKids program summary*. Retrieved from http://www.k12.wa.us/WaKIDS/pubdocs/WhatIsWaKIDS.pdf

Welsh, J. A., Nix, R. L., Blair, C., Bierman, K. L., & Nelson, K. E. (2010). The development of cognitive skills and gains in academic school readiness for children from low-income families. *Journal of Educational Psychology*, *102*(1), 43.

West, J., Germino-Hausken, E., & Denton, K. (2000). *America's Kindergartners: Findings from the Early Childhood Longitudinal Study*. DIANE Publishing.

Whitehurst, G. J., & Lonigan, C. J. (1998). Emergent literacy: Development from prereaders to readers. In S. B. Neuman & D. K. Dickinson (Eds.), *Handbook of early literacy research*. New York: Gilford Press.

Zelazo, P. D. (2004). The development of conscious control in childhood. *Trends in Cognitive Sciences, 8*(1), 12-17.

Zelazo, P. D., Carter, A., Reznick, J. S., & Frye, D. (1997). Early development of executive function: A problem-solving framework. *Review of General Psychology, 1*(2), 198.

Zelazo, P. D., Müller, U., Frye, D., Marcovitch, S., Argitis, G., Boseovski, J. Sutherland, A. (2003). The development of executive function in early childhood. *Monographs of the Society for Research in Child Development, 68*(3), vii-137.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25*(1), 3-17.

Zimmerman, B. J., & Schunk, D. H. (2001). *Self-regulated learning and academic achievement: Theoretical perspectives.* New York, NY: Routledge.