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The Contribution of Self-Regulation to Reading Comprehension in Adolescent Learners

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THE CONTRIBUTION OF SELF-REGULATION TO READING COMPREHENSION IN ADOLESCENT LEARNERS

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in The Department of Communication Sciences and Disorders

by

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August 2016
This work is dedicated to my daughters, Anna Katherine and Allison Parker. It is my hope that this journey will strengthen your faith in God and increase your personal resolve in facing what seem to be impossible tasks.

In loving memory of my mother, Bobbie S. Clouatre
“You can and you will.”
1938-2016
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“In this world you will have trouble, but take heart, I have overcome the world.”

John 16:33
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ABSTRACT

The purpose of this study was to examine the dually implicated processes of language and self-regulation in reading comprehension and to determine if self-regulation contributes unique variance to reading comprehension beyond word recognition/decoding and oral language comprehension. The study also sought to determine if the unique contribution of self-regulation to reading comprehension differs for students with language/learning difficulties and students with typical language/learning histories.

Thirty-two 6th, 7th, and 8th graders participated in this study. Of these participants, 17 students had language/learning difficulties and 15 students had typical language/learning histories. All participants attended a low performing public middle school located in a rural school district. Each participant was administered a battery of assessments that elicited measures of reading comprehension, oral language comprehension, word recognition/decoding, and self-regulation. The dependent variable in the analyses was the performance score on the reading comprehension measure.

Independent variables included the measures of oral language ability, word recognition/decoding, and self-regulation. Hierarchical multiple regression and correlation analyses were used to explore the relationship among these variables and to determine their contribution to reading comprehension.

The results of this investigation indicated that self-regulation contributed significant variance to reading comprehension in addition to the variance accounted for by oral language comprehension and word recognition/decoding in adolescent learners. Further, the investigation found that self-regulation was moderately correlated with word recognition/decoding and highly correlated with oral language comprehension. Findings
also revealed that self-regulation contributed a greater proportion of variance to reading comprehension for students with typical language/learning histories than for students with language/learning difficulties, supporting earlier research showing poor readers fail to use active comprehension strategies when reading.
INTRODUCTION

Reading comprehension deficits are a critical problem for students, beginning early and persisting into adulthood (Catts, Adlof, & Ellis Weismer, 2006; Hickman, Bartholomew, Mathwig & Heinrich, 2008; Sparks, 2013). Retrospective studies of high school dropouts revealed that problems, such as knowledge of language, differed between dropouts and graduates as early as kindergarten (Hickman, Bartholomew, Mathwig & Heinrich, 2008). Further, children with language impairments in kindergarten are at high-risk for reading impairment in later grades (Gosse, Hoffman & Invernizzi, 2012). Few students who show reading comprehension delays at third grade overcome these deficits, with a widening gap between good and poor comprehenders with increasing grade level. By high school, 91% continue to display comprehension deficits, with 78% of these showing significant impairments (Catts, Adlof, & Ellis Weismer, 2006). While researchers have identified many social, economic, and instructional factors contributing to poor achievement and failure to complete high school, poor reading comprehension is a critical variable because it affects performance in all academic areas (Hickman, Bartholomew, Mathwig & Heinrich, 2008; Sparks & Reese, 2012). Understanding the factors that contribute to poor reading comprehension is important to understanding, preventing, and remediating these deficits.

Since it was first proposed by Gough and Tunmer in 1986, the Simple View of Reading has been a widely accepted conceptualization of reading comprehension. The Simple View proposed that reading comprehension is the product of a student’s ability to decode words and comprehend oral language. In other words, reading comprehension can be predicted by multiplying the scores on measures of a student’s decoding and oral language comprehension abilities. Research has shown that other skills known to be
important to reading, such as vocabulary, phonemic awareness, and grapheme knowledge, were subskills of decoding and oral language comprehension, because they did not contribute any additional predictive power to reading comprehension outcomes (Gough & Tunmer, 1986; Juel, Griffin, & Gough, 1986; Neuhaus, Roldan, Boulware-Goode, & Swank, 2006; Vellutino, Tunmer, Jaccard, & Chen, 2007). However, depending on the study, the combination of decoding and oral language comprehension only accounted for between 45 to 85% of the variance in reading comprehension (Byrne & Fielding-Barnsley, 1995; Catts, Hogan, & Adolf, 2005; Chen & Vellutino, 1997; Conners & Olson, 1990; Cutting & Scarborough, 2006; Dreyer & Katz, 1992; Hoover & Gough, 1990; Johnston & Kirby, 2006; Joshi & Aaron, 2000; Megherbi, Seigneur, & Ehrlich, 2006). This incomplete accounting of the factors involved in reading comprehension led many to propose that some third ability was also critical, suggesting that this factor may involve the ability to coordinate the processes of decoding and oral language comprehension (Conners, 2009; Walczyk, 2000; Walczyk, Marsiglia, Johns, & Bryan, 2004). The factors they proposed have in common the property of being active strategies used to monitor and correct comprehension failures, or strategies recognized as executive functions.

The purpose of this study was to further explore this argument by examining the cognitive process used to guide, monitor, and direct executive functions, self-regulation (Singer & Bashir, 1999). Specifically, this study sought to determine whether self-regulation would account for a greater amount of the variance in reading comprehension than decoding and oral language comprehension alone. Further, it sought to determine if the unique contribution of self-regulation to reading comprehension differed for students with language/learning difficulties and students with typical language/learning histories.
LITERATURE REVIEW

To support the claim that self-regulation contributes to reading comprehension, a comprehensive discussion of the reciprocal nature of self-regulation and both oral and written language is warranted. The forthcoming chapter seeks to accomplish this end by providing theoretical and research perspectives on the interrelatedness of these processes. The first of four sections provides a developmental prospective on the association among language, learning, and self-regulation and presents supporting research. Initially, self-regulation and executive functioning are defined. Then, two prominent developmental theories are presented that describe and explain how self-regulatory self-talk may be used as a tool to build cognition. Next, the role of language in the development of self-regulatory processes is examined. And then, the association among language impairment, poor self-regulation, and learning problems is explored.

The second section explores the long-term relationship between oral and written language comprehension and discusses relevant research. It examines reading difficulties associated with language impairment in children across various grade levels, with an emphasis on specific reading comprehension deficits. In the third section, the cognitive aspects of reading comprehension and the situational model are discussed. The role of self-regulation in the engagement of verbal working memory, prior knowledge, and inferencing in the development of mental models of meaning is explored. The fourth section explores reading comprehension strategies that have been effective for students with language/learning difficulties with an emphasis on metacognitive strategies. The chapter concludes with the introduction of a research study that aspires to inform the current literature on the importance of self-regulation in reading comprehension.
A Developmental Prospective: Language, Learning, and Self-Regulation

Executive Functioning and Self-Regulation. The terms executive functioning and self-regulation describe cognitive processes that are related to the prefrontal cortex of the human brain. In reviewing recent literature on these cognitive processes, various descriptions and terms were found that described them. This section will add clarification to the concept of executive functioning and self-regulation by reviewing terminology presented in recent literature and offering a working definition of executive functioning and self-regulation that is relevant to the current study.

Executive function, self-regulation, self-monitoring, cognitive control, behavior regulation, behavioral inhibition, metacognition, and emotional regulation are all terms that can be found in research literature to describe higher cognitive functions. Although the terms are different, they are consistently used to refer to metacognitive tasks and self-regulatory concepts that control thoughts, actions, and emotions. For example, the terms self-regulation and executive functioning are sometimes used interchangeably and are defined as cognitive processes that include thoughtful planning and initiation of tasks (Westby, 2004). Singer and colleagues (1999) make a distinction between them. They define executive functions as “components that include inhibiting actions, restraining and delaying responses, attending selectively, setting goals, planning and organizing, maintaining and shifting sets, attention, and working memory,” and self-regulation as “a set of behaviors that are used flexibly to guide, monitor, and direct the success of one’s performance” (p. 266). In other words, self-regulatory behaviors include the application of executive processes within specific contexts to accomplish a desired task.
Terms used in this paper are in alignment with those outlined by Singer and colleagues. Here, *self-regulation* is defined as the cognitive process used to guide, monitor, and direct one’s own performance by engaging all other executive processes. *Executive functioning* is the functional or behavioral outcome of the executive processes. For example, self-regulation enables a student to recognize that he or she did not understand a previously read paragraph and then to engage executive or purposeful remediation processes (i.e., rereading with greater attention, self-questioning, reflecting on prior knowledge, or purposefully holding information in working memory through self-talk or verbal rehearsal).

Further, executive functioning (EF) skills include a wide range of cognitive and self-regulatory concepts (Denckla, 2007; Kaufman, 2010). To clarify these concepts, Kaufman divided EF into two strands of cognitive skills. First, the metacognitive strand, which embodies academic elements that play a fundamental role in comprehension, planning, task initiation, and task completion (goal setting, planning, sequencing, organizing, time management, task initiation, task persistence, goal-directed attention, working memory, and set shifting), and second, the social/emotional regulation strand, which is associated with behavioral, social, and emotional regulation (impulse control, emotional control, and adaptability). Collectively, both strands function to engage purposeful thinking or behavior to achieve some desired outcome, and both are controlled by self-regulation (See Figure 1.0: Executive Processes and Functions).
Developmental Theories of Self-Regulation. In the mid-1920s Piaget reported observational research that detailed his account of children using “egocentric speech,” or more simply, talking to themselves. Piaget speculated that this occurrence was a reflection of immature cognitive development that would eventually be replaced by efficient social communication that develops from within the child (Piaget, 1923/1962). First Lev Vygotsky, then later his student, Alexander Luria, opposed Piaget’s theory of inside-out development of private speech. They speculated that private speech was developed through the interaction of the child in the environment (Vygotsky & Luria, 1930/1993). That is, private speech develops from the environment of the child through socially interacting with others.
Vygotsky argued that a child’s behavior and attention are initially directed by the symbol systems of adults in their environment, usually the spoken word. Later, the child begins to internalize the adult’s social speech and starts to talk out loud to direct his own thinking, problem solving, and behavior (Vygotsky & Luria, 1930/1993). Therefore, language is first used to communicate with others and then it is also used for communication and guidance of self. The internalization of language then changes the child’s cognitive processes through the use of words as mental tools (Shaffer, et al., 2002). “Preintellectual language and prelinguistic cognition fuse to create verbally mediated thought” (Winsler, 2009, p. 4). The convergence of these processes goes on to build neurological connections that increase functional cognition, such as self-reflection and self-regulated behavior. From this perspective, it is verbally mediated thought that acts as a tool to build cognition and self-regulation. Vallotton and Ayoub (2011) contend that the larger the symbolic repertoire one has, the greater capacity one has for self-regulation. Likewise, it is probable that a reciprocal relationship exists. Greater capacity for self-regulation may support language growth, as more complex symbol systems are needed to plan, monitor, and guide more sophisticated self-regulatory processes.

**Language and the Development of Self-Regulatory Processes.** Verbally mediated thought, or the marriage of thought and language, allows the child to self-regulate. Vygotsky theorized that there are two main lines of development that support this higher level of cognitive functioning: the *natural line of development* and the *cultural line of improvement* (Muller, Jacques, Brocki, & Zelazo, 2009; Vygotsky & Luria, 1994). Accordingly, the *natural line of development* supports basic mental processes and is related to physical growth and maturation. In other words, this line of development is expressed
through nature. It embodies rudimentary mental processes that act as the foundation for the development of more advanced mental processes.

The cultural line of improvement is responsible for the development of these more advanced mental processes. This line of development is the result of social interactions and orientation to the world. Through social input, the rudimentary mental processes of the natural line of development are built upon to develop higher levels of functioning as new methods of reasoning are learned. For example, typically developing humans have the basic ability to remember things. Through social interaction, the ability to intellectualize or learn to voluntarily control memory emerges. A tool, like language or even the act of tying a knot in a handkerchief as a reminder, transforms the basic ability to remember into the voluntary act of remembering. Thus, Vygotsky argues that external stimuli mediate the transformation of mental processes from rudimentary to higher level (Vygotsky, 1978). That is “semiotic mediation, the regulation and control of behavior through the use of sign systems (particularly language), frees the child from the immediate perceptual field, allowing the child to plan solutions in advance” (Muller, Jacques, Brocki, & Zelazo, 2009, p. 54).

From this perspective, it is within the convergence of these lines through language that self-regulatory control develops. Here, language allows a child to be free of the here-and-now and enables him to plan solutions using past, present, and future circumstances (Muller, Jacques, Brocki, & Zelazo, 2009). Thus, language with self, or inner speech, is a tool that supports self-regulation through verbal self-guidance that directs the other executive processes, such as goal setting, planning, sequencing, organizing, time management, task initiation, task persistence, goal-directed attention, working memory, set shifting, impulse
control, emotional control, and adaptability (Kaufman, 2010). For academic and social functioning, inner speech provides a means for the child to denote and use rules that guide appropriate ways to respond to particular tasks. Inner speech may also be used to keep track of task sequence and direct attention to information that is relevant to the task at hand (Cragg & Nation, 2010). The development of rules and rule systems, or “auxiliary instruments” (Vygotsky & Luria, 1994, p. 110), is paramount in the development of self-regulatory processes that mediate all other executive functioning skills. Language, with its two-class system of lexicon and syntax (Buher, 1934/1990), provides the tools that serve as the building blocks for these rules and rules systems. Models of executive functioning, self-talk, and language have been established that seek to explain this relationship.

Zelazo and colleagues (Zelazo, 1999; Zelazo, 2004; Zelazo, Carter, Reznick, & Frye, 1997; Zelazo & Frye, 1997; Zelazo & Jacques, 1996; Zelazo & Muller, 2002; Zelazo, Muller, Frye, & Marcovitch, 2003; Muller, Jacques, Brocki, & Zelazo, 2009) developed one such model through the integration of two of their earlier models that described theories of cognitive control and levels of consciousness, Cognitive Complexity and Control Theory-Revised (CCC-r) and the Levels of Consciousness (LOC) model. Respectively, these early models emphasize the development of cognitive rules and the ability of the child to reflect on their use to increase capacity for more complex rules over the course of development. More specifically, CCC-r considers that maturation related changes in executive functioning are due to the increase in the child’s capacity to formulate rules and use these rules for problem solving. The LOC model emphasizes how the child’s age related increases in consciousness allow him to reflect more fully on the more complex rules. The integration
of these two models provides a framework for the intentional foundation, or self-regulation, of executive functioning (Muller, Jacques, Brocki, & Zelazo, 2009).

Müller and colleagues (2009) summarized the fundamental claims to this framework. Their framework asserts that executive function is a functional outcome of cognitive processes and not an explanatory concept (Zelazo, Carter, Reznick, & Frye, 1997). In other words, EF is the manifestation of the ability to regulate cognitive processes (i.e., planning, organizing, and thinking flexibly). The central premise is that rules are formulated in silent self-directed speech and help children plan behavior. Children use these formulated rules to solve problems as they arise by helping them to regulate inferences and actions and also to select important information to manipulate in working memory. Rule systems vary in complexity and increase as the child ages. The increase in rule capacity can be seen across many domains of behavior (such as academic performance, social/emotional regulations, and self-control behaviors) through the manifestation of executive functioning. Their framework further explains that the complexity of rule systems is based on the number of embedded rule levels the child is able to employ. As the child matures, he is able to reflect more on his own personal experiences through increased levels of consciousness that are “dependent on the experience-dependent maturation of hierarchical neural networks involving prefrontal cortex” (Muller, Jacques, Brocki, & Zelazo, 2009, p.55).

Zelazo and colleagues’ model asserts that self-talk supports the formulation of rules and rule systems that allow children to plan behavior and solve problems by directing them to regulate information in working memory, make inferences, and initiate action.
They surmise that the complexity of these rule systems is a function of the child’s ability to embed more and more rules into his or her repertoire that, in turn, builds greater capacity.

**Language, Working Memory, and Verbal Self-Regulation.** Given the aforementioned model, the role of working memory is an important process in the application of self-regulatory skills and language. Recall that self-regulation through verbal self-talk acts as a director for other executive processes. Verbal working memory is one such process and has been shown to correlate with language processes in vocabulary acquisition (Gathercole & Baddeley, 1989), language comprehension (Just & Carpenter, 1992), syntactic processing (King & Just, 1991), and reading comprehension (Daneman & Carpenter, 1980; Gathercole & Baddeley, 1993; Marton & Schwartz, 2003). Different models of working memory focus on various processes, but all emphasize the common threads of capacity, capacity limits, and the role of rehearsal for holding things in the mind to allow for thought integration (such as attending to important details, engaging prior knowledge, and making predictions).

Baddeley (1986) developed one model of working memory that is widely used in research. His model describes a multicomponent system of capacity that is regulated by the “central executive.” According to Baddeley, the central executive supervises, controls, and organizes communication within working memory and other cognitive components, such as long-term memory systems, attention, and vocabulary (Baddeley, 1986). It is unclear if Baddeley’s functional description of the central executive is synonymous with the process of self-regulation, but studies have shown that verbal rehearsal, like private speech, improves the functional outcomes of capacity limits (Gathercole & Baddeley, 1990; Montgomery, 1995; van der Ley & Howard, 1993). The forthcoming description of the
process of verbal rehearsal makes this assumption plausible; nevertheless, more research is needed to explore this possibility.

Baddeley describes three components of working memory: the central executive, the phonological loop, and the visuo-spatial scratchpad. The phonological loop is the temporary storage area for verbal material, sound based information, and articulatory control functions. It plays an important role in vocabulary acquisition and learning to read and can be measured in terms of memory span for digits and serial recall tests (Gathercole & Baddeley, 1993). The visuo-spatial scratchpad processes spatial and visual information (or nonverbal working memory) and can be measured in terms of pattern span memory, and the central executive that coordinates and integrates information of both (Baddeley, 1986; Zelazo, Muller, Frye, & Marcovitch, 2003).

Although the phonological loop plays an important role in learning to read, its function becomes less important for higher-level language skills like reading comprehension. Thus, for older children and adults another model of working memory that considers more complex language comprehension and production is relevant. Just and Carpenter (1992) developed a model of working memory that describes the relationship between working memory and language comprehension. Their model is more closely aligned with the function of Baddeley’s central executive component, and thus also requires self-regulatory control and rehearsal to inhibit the decay of information. Here, working memory capacity is influence by the semantic and syntactic complexity of language. Therefore, to process larger linguistic units (for example, more words, morphemes, and sentences) greater resources must be allocated. These resources include attention, task switching, encoding constructs, and rehearsal (Marton & Schwartz, 2003).
Based on conceptual models of language development and private speech, and the role of these processes in self-regulation and other executive processes (i.e., working memory, attention, and cognitive flexibility), the importance of language in the development of cognitive processes cannot be overstated. Nelson (1996) identified three functions of language that add support to this premise. She describes language as a tool for thinking, self-guidance and evaluation, as well as communicating with others. She further argued that conceptual knowledge in general, and linguistically encoded concept knowledge in particular, develops through emerging understanding of the function of linguistic symbols through social engagement. Thus greater linguistic proficiency leads to greater understanding of conceptual knowledge that positively impacts self-talk that will in turn guide the processing of relevant sensory input. From the perspective of theoretical models of language and cognition, linguistic symbol systems are tools used to develop more complex rule systems that drive self-direction. These tools act in accordance with each other to impact academic, social, and behavioral outcomes.

**Reciprocal Support: Language and Self-Regulation.** In support of Vygotsky’s theory of self-regulatory self-talk, there is a body of research that provides empirical evidence that the social speech of adults helps to build lexical and grammatical representations in children and, in turn, builds cognitive capacity and impulse control behaviors. In other words, the social speech of adults in the child’s environment serves to build conceptual and lexical knowledge that serves, not only to communicate more effectively with others, but also to engage in more effective communication with self. Further, greater proficiency in communication with self greatly improves abilities in attention, processing speed, information storage, rehearsal, and retrieval. A few studies
from a large body of research are presented here to provide evidence of this relationship. As will be shown in forthcoming sections of this paper, these processes subsequently support later reading comprehension ability.

Hart and Risley (1995) examined the vocabularies of young children as related to the amount and quality of parental interaction. They observed and recorded the verbal interactions of 42 children and their families over the course of two years and measured their accomplishments in vocabulary use and growth. The results of their study indicated that the number of different words used by the children was highly correlated with amount and quality of parental interactions and input. Similarly, Landry and colleagues (2002) examined the role of maternal verbal scaffolding (providing information to children about the association between objects and actions) of their children’s language at 3 and 4 years of age. They measured the influence it had on the executive skills of these children at six years. Mothers’ interactions were monitored and coded during home visits and were later correlated to coded measures of executive functioning skills used by the children when they reached six years. Researchers observed that verbal scaffolding supported the development of language skills and fostered later self-regulatory skills at six. That is, children who received higher quality maternal input through verbal scaffolding showed more mature attentional skills and independence in cognitive and social problem solving abilities.

Additionally, research shows that as a child’s vocabulary increases, the ability to sort and categorize objects becomes more refined. Gopnik and Meltzoff (1987) conducted a longitudinal study that investigated the development of categorization behavior in twelve 15-18 month old children in relation to their vocabulary development. Their results
suggest that a period of rapid vocabulary learning coincides with rapid gains in the ability to sort sets of objects. These findings offer evidence that there is a specific relationship between lexical knowledge and cognitive development during this age period.

Lexical knowledge has also been shown to support the development of spatial concepts. Bowerman (1996) studied the mastery of the concept of space in children as young as 18 months. She found that at around 18 months of age children begin to use spatial concept words such as in, out, up and down after hearing adults use them in their environment. Initially, they do not fully understand the concepts, but as adults provide feedback across a range of situations, they begin to gain mastery. Here again, rapid gains in vocabulary development correspond to conceptual growth.

Other studies have investigated how language and private speech influence the attentional capacity and task performance of school age children (Berk, 1986; Bivens & Berk, 1990). Berk and colleagues investigated the role of private speech in the development of task performance, attention, and motor behaviors that interfere with task performance. First through third graders were observed while engaged in an independent math activity. They noted that as children progressed through grade levels, they used more task relevant private speech that progressed from more overt word play and repetitions through less audible muttering or lip and tongue movements with no audible signal. Further, the use of more task-relevant private speech predicted greater attentional focus on task and fewer extraneous motor behaviors.

Bono (2003) investigated parenting and language ability in relation to self-regulation and school readiness. She conducted two short-term longitudinal studies of children beginning when they were six months old and ending at 36 months. She found
positive associations between parenting and school readiness. She further found that language ability was associated with cognitive school readiness and with prosocial behavior.

Another longitudinal study was conducted that further extended investigations for children up to 48 months of age. Roben and colleagues (2013) investigated the observable expression of anger and regulatory strategy use of 120 children from 18 to 48 months of age. Regulatory strategies included support seeking and distraction used during a delay task. Their findings suggested that young children with typically developing language skills are less angry than children whose language skills are delayed. They noted that over time the expression of anger decreased as language skills improved.

This research presents evidence that children acquire language through exposure to the social speech of adults in their environment. Children subsequently develop categorical knowledge, conceptual knowledge, social/emotional regulation, impulse control, and other cognitive processes. As language provides symbolic tools (i.e., semantics and syntax) to develop cognitive rules and rule systems, children with typically developing language and cognition acquire them through mere exposure to quality models. However, children with language impairment have difficulty mastering the patterns and networks of language that are necessary to support the rules and rule systems of cognition.

In sum, the development of language and cognition are interrelated processes. Children and adolescents with language impairment have inherent problems with self-regulation secondary to this relationship. Shortcomings in executive processes are manifested in deficits in executive functions such as goal setting, planning, sequencing, organizing, time management, task initiation, task persistence, goal-directed attention,
working memory, and set shifting. Communication with self is needed to purposefully manage behaviors that guide the processes responsible for executive functioning. Children with language impairment (LI) are at-risk for poor academic and social outcomes because, in addition to core language deficits, they often lack proficiency self-regulation.

**The Long-term Relationship Between Oral and Written Language**

Children entering kindergarten bring with them a lifetime of spoken language learning. From birth, the concurrent development of conceptual, semantic, and syntactic knowledge has shaped their language repertoire. Children with typically developing language and early emergent literacy skills are better equipped for learning to read than their cohorts with language impairment because reading takes advantage of established oral language abilities by layering written language demands onto already established oral language (Catts & Kamhi, 2005). For example, children with rich vocabularies more readily attach meaning to decoded words that are already established in their spoken language repertoire. That is, children use the blueprint of familiar phonological structures of words to aid in decoding and simultaneously use their established lexicon to extract meaning. More complexly, readers must overlay decoded text onto existing linguistic knowledge (such as knowledge of semantics and syntax) to extract meaning from higher-level text structure (Catts & Kamhi, 2005). From this perspective, it appears that reading is overlaid onto the foundation of oral language comprehension. Hence, it is not surprising that children with impaired language often become struggling readers who fail to meet grade-level standards in school (Catts & Kamhi, 2005).

**The Simple View of Reading.** The Simple View of Reading (Gough & Tunmer, 1986) divides reading into two components: decoding or word identification and oral language
comprehension. According to this model, decoding or word identification is the process of transforming print into words. It includes the visual perception of orthographic symbols and sound-symbol correspondence. The oral language comprehension component includes the understanding and interpretation of language (i.e., constructing meaning from word, sentence and discourse levels). Considering this framework, the foundational role of language in reading development is critical. In fact, research that spans over 25 years shows that word recognition/decoding and oral language comprehension account for large amounts of variance in reading comprehension (Bryne & Fielding-Barnsley, 1995; Catts, Hogan, & Adolf, 2005; Chen & Vellutino, 1997; Conners & Olson, 1990; Cutting & Scarborough, 2006; Dreyer & Katz, 1992; Hoover & Gough, 1990; Johnston & Kirby, 2006; Joshi & Aaron, 2000; Megherbi, Seigneuric, & Ehrlich, 2006; Savage, 2001; Storch & Whitehurst, 2002; Tiu & Lewis, 2003). Further, there is evidence that the contributions of word recognition/decoding and oral language comprehension to reading comprehension shift throughout the trajectory of reading development. That is, word recognition/decoding has a greater influence on reading comprehension during the early stages of reading, and oral language comprehension contributes to a greater degree in more advanced reading stages (Carver, 1998; Catts, Hogan, & Adolf, 2005; Chen & Vellutino, 1997; Hogan, Adlof, & Alonzo, 2014). Figure 1.1 provides a visual to illustrate the theoretical components of the Simple View of Reading.

**Deficits in Language and Literacy.** It has been well documented that preschool children with language/learning problems are at-risk for long-term difficulties in reading as a result of deficits in the acquisition and use of language, first in spoken modalities and then in written ones (Catts, Adolf, & Weismer, 2006; Snowling, Bishop, & Stothard, 2000).
Figure 1.1. Theoretical Components of the Simple View of Reading

While typically developing students readily acquire reading skills with exposure to language and literacy, students with language impairment often do not. Of the six percent of students in kindergarten and first grade found to receive speech and language services, 25% had articulation deficits with comorbid reading problems. Sixty-six percent of children receiving speech-language services for language impairment also had reading deficits (Catts, Fey, & Tomblin, 2002; Gosse, Hoffman, & Invernizzi, 2012). Researchers have found that, even with clinically remediated language, 75% of preschool children identified as language impaired at 2 to 5 years of age have reading problems in second grade (Scarborough & Dobrich, 1990). Further, there is evidence of long-term reading problems for children with LI through late primary and secondary school (Bishop & Adams, 1990; Catts H, 1993).

Although phonological awareness and decoding skills deficits have been identified as barriers to their success (Ball & Blackhman, 1991; O’Conner & Jenkins, 1995; Vaughn & Klingner, 2004), many students with LI have significant and lasting difficulties
understanding what they have read even when they are able to decode adequately (Vaughn & Klingner, 2004; Williams, 1998). For example, Catts and colleagues (2006) found that children with oral language deficits in kindergarten had persistent reading comprehension deficits in eighth grade. The amount of research in support of the notion that language impairment impacts reading outcomes is vast. However, the scope of research in this area has been limited.

According to the National Center for Family Literacy (2008), studies seldom investigate reading in children younger than 4 years or older than second grade. Moreover, most research in reading has focused primarily on the reading of single words or the comprehension of sentences (Durand, Loe, Yeatman, & Feldman, 2013). This is concerning because the reading comprehension deficits of children with LI reach far beyond second grade. Students in first through twelfth grades are expected to read on-level text with purpose and understanding and then demonstrate understanding through critical analysis and interpretation, a difficult task for students who struggle to derive meaning from text.

To offer insight into the relationship of weak language to long-term difficulties in reading, studies are presented that investigate factors that have been established as contributors to reading outcomes. Investigations have examined this relationship using longitudinal studies in which children with LI were monitored from preschool or kindergarten through late primary or secondary school. Studies revealed that the prevalence of reading problems in children with LI was significantly elevated from children with typical language histories (Bishop & Adams, 1990; Catts, Fey, Tomblin, & Zang, 2002). Furthermore, studies have found that children with LI have persistent low academic
achievement, greater grade retention, and lower rates of post-secondary school attendance than their peers with typically developing language (Nation & Aram, 1980; Hall & Tomblin, 1978).

Reading disorders can be broadly classified as deficits in word recognition, poor comprehension, or both. A specific insufficiency, dyslexia, is characterized by problems with poor word recognition abilities, poor spelling, and limited decoding ability. Although a secondary consequence of this disorder often includes poor comprehension of text related to additional language deficits, some researchers believe that deficits in the phonological components of language are typically to blame for poor reading outcomes (Lyon, Shaywitz, & Shaywitz, 2003). Other children have deficits in reading comprehension caused by more general language impairment, termed garden variety reading deficits (Gough & Tunmer, 1986) or language learning disabilities (Catts & Kamhi, 2005). Consequently, there is evidence that contributions of word recognition/decoding and oral language comprehension may shift for typical versus poor readers (Cain & Oakhill, 2006; Catts, Adolf, & Weismer, 2006; Catts & Kamhi, 2005; Georgiou, Das, & Hayward, 2009; Gough & Tunner, 1986; Lyon, Shaywitz, & Shaywitz, 2003; Nation, Clarke, Marshall, & Durand, 2004; Nation, Cocksey, Taylor, & Bishop, 2010; Ricketts, Sperring, & Nation, 2014; Vervaeke, McNamara, & Scissons, 2007). There is a sizeable body of research investigating these well-established components of reading comprehension in individuals with reading problems. A collection of studies is forthcoming to shed light on the nature and extent of reading problems in children with language impairment across grade levels.

Some researchers looked at specific early reading skills like phonological awareness and letter identification. Both skills are considered to be indicators of later reading
abilities. For example, an early study by Catts (1990) suggested that phonological awareness and rapid naming ability in kindergarten predicted reading achievement in first and second grade. Much later, Vervaeke, McNamara, and Scissons (2007) conducted a longitudinal study that followed children (n=650) from kindergarten through third grade and found that letter identification and phonological awareness in kindergarten predicted reading problems in third grade. Similarly, Catts, Fey, Zhang, and Tomblin (2001) measured language, nonverbal cognition, rapid naming, phonological awareness, and letter identification in 604 kindergarten children and compared their performance to reading comprehension ability in the second grade. They found that letter identification and phonological awareness skills in kindergarten were the best predictors of reading comprehension performance in the second grade.

The good news is that research shows that improvements in phonological awareness can be achieved through interventions targeting specific phonological awareness skills (Gillon, 2000; van Kleeck, Gillam, & McFadden, 1998). The bad news, however, is that reading comprehension in early grades depends more on the ability to decode accurately; but as the complexity of texts increases in higher grade levels, reading comprehension depends more on overall language ability to gain meaning from print.

So while research shows that measures of phonological awareness are predictive of word reading, measures of language ability are predictive of reading comprehension (Catts, 1993). From the perspective of the Simple View of Reading (Gough & Tunmer, 1986), reading comprehension is the product of decoding or word recognition and oral language. Thus, it is evident that oral language is related to both word reading and reading comprehension. However, beyond word reading, reading comprehension requires more
complex language, like developmentally appropriate command of semantics, syntax, and morphosyntax. Subsequently, some children have problems understanding what they have read even when they are able to decode adequately (Vaughn & Klingner, 2004; Williams, 1998).

Seeking clarity on this problem, researchers have shown interest in examining reading comprehension problems in children with relatively intact decoding ability (Catts, Adolf, & Weismer, 2006; Cain & Oakhill, 2006; Georgiou, Das, & Hayward, 2009; Nation, Clarke, Marshall, & Durand, 2004; Nation, Cocksey, Taylor, & Bishop, 2010; Ricketts, Sperring, & Nation, 2014). Organized chronologically, the following selections profile studies from a growing body of research on specific reading comprehension deficits over the past decade.

Nation, Clarke, Marshall, and Durand (2004) looked at the language capabilities of eight-year-old children with poor reading comprehension ability. Two hundred and thirty-six primary school children were screen for reading accuracy, reading comprehension, and the decoding of nonwords. Of these, 25 poor comprehenders and 23 control children were selected and matched for decoding skills and chronological age. Study participants were administered language tests that examined the following: phonological skills, semantic skills, morphosyntax, and broader language skills. They found that compared to controls, poor comprehenders were impaired across all measures of language with the exception of measures that focus on phonological skills. In particular, weaknesses in vocabulary and grammatical understanding were noted. These findings highlight the proposition that
children with serious deficits in oral language and reading comprehension may be able to read fluently and accurately, leading to under identification of children in need of remedial services in schools.

Catts, Adolf, and Weismer (2006) investigated the language abilities of 8th grade children with specific reading comprehension deficits (n=57) and compared them to typical readers (n=98) and children with specific decoding deficits (n=27) in a concurrent and retrospective study. The participants in their study originally took part in an epidemiologic study on the prevalence of language impairment in kindergarten (Tomblin, Records, Buckwalter, Zhang, Smith, & O'Brian, 1997). Subgroups of children were selected to participate in a longitudinal study in which they were administered language and reading assessments in kindergarten, second, fourth, and eighth grades. Groups were selected based on their word recognition and reading comprehension composite scores in 8th grade. First, investigators looked at the language comprehension and phonological processing performance in 8th grade across all three subgroups. They found that poor comprehenders had deficits in language comprehension and normal abilities in phonological processing; poor decoders were found to have the opposite pattern of language abilities (good language comprehension and poor phonological processing).

Second, investigators looked retrospectively at the language comprehension and phonological processing of the three subgroups of children in kindergarten, 2nd, and 4th grades. Additionally, they looked at word recognition and reading comprehension in 2nd and 4th grades. They found that all subgroups maintained language and word recognition profiles across grade levels. Poor comprehenders in grade 8 had a history of language comprehension problems in kindergarten, 2nd, and 4th grades. Investigators found that the
observed language problems in grade 8 were more apparent in vocabulary and discourse, and less apparent in grammar. These findings were of great concern, as these researchers point out, because the “subclinical” nature of these deficits often results in the under identification of language impairment in children with reading comprehension problems. Notably, the finding that deficits in grammar are “less apparent” in 8th graders differs from the Nation and colleagues (2004) finding that weakness in grammatical understanding was a salient characteristic of 8 year-old children identified as poor comprehenders. These findings possibly point to an increased capacity for linguistic and cognitive rules and rule systems in children through physical maturity and greater exposure to the language of adults in their environment.

Cain and Oakhill (2006) were interested in determining if a consistent pattern of skill impairment could be pinpointed in children with poor reading comprehension and poor overall educational attainment. Students were drawn from 17 classrooms across six elementary schools and included a group (n=102) of 7 and 8 year-old students who had initially participated in a longitudinal study. These students were assessed for word reading and reading comprehension ability and were further divided into two groups based on assessment performance. Students were excluded from participation if word reading scores were either six months below or 12 months above expected performance levels for their age. Based on reading comprehension performance, the remaining students were divided into groups of either good or poor comprehenders. Therefore, participants in both groups had age-appropriate word reading skills and either good comprehension (n=23) or poor comprehension (n=23). Children in both groups were administered an assessment battery, first at age 8 years and then again at age 11 years. At age 8 years, the
following skills were assessed: word reading, text comprehension, vocabulary, syntax, general cognitive ability, working memory, and comprehension subskills. At age 11 years, the following skills were assessed: listening comprehension, Standard Assessment Test (SAT), and reasoning scores.

Findings suggest that although weak language skills were evident across poor comprehenders, no overt pattern of skill weakness emerged for the group during the initial assessment phase at age eight years. However, consistent with well-established research (Chall & Jacobs, 2003; National Institute of Child Health and Human Development, 2000; RAND Reading Study Group, 2002; Biancarosa & Snow, 2004), they found that poor vocabulary skills correlated with impaired growth in word reading ability; and poor general cognitive ability correlated with impaired growth in comprehension. Further, they found that children with poor reading comprehension performed significantly below the group of good comprehenders on academic outcomes as measured by the SAT. One notable finding was that problems in reading comprehension could not be determined by performance on measures of isolated skills. Further, verbal skills and cognitive skills appear to impact educational outcomes in children with poor reading comprehension.

Nation, Cocksey, Taylor, and Bishop (2010) set out to investigate the early reading and language skills of children who go on to become poor reading comprehenders in mid-childhood. Similar to the design of a study by Catts and colleagues (2006), these researchers also used a longitudinal study design to examine this association. Initially, study participants included 242 five-year-old students attending 17 primary schools in the United Kingdom. Language and reading skills were thoroughly assessed on five occasions: within three months of entering school (n=242), six months later (n=234), one year later
(n=215), two years later (n=202), and three years later (n=172). Participants’ ages were approximately 5, 5.5, 6, 7, and 8 years respectively. Reading comprehension, phonological processing, and language skills were assessed across testing occasions. During the final testing occasion at age 8, a group of poor comprehenders (n=15) and a group of control children (n=15) were selected. Performance scores for both groups were examined retrospectively at each testing point. Reading over time revealed no group differences in letter knowledge, early word reading, and reading fluency.

At 6 and 7 years of age, reading accuracy was equivalent across both groups but reading comprehension was consistently deficient for the group of poor comprehenders. Likewise, children with good reading comprehension showed adequate reading comprehension at all points in time. Further, poor comprehenders made very few raw score gains across time as compared to controls. Language and phonological skills over time revealed that poor comprehenders scored less well on all non-phonological language measures across all testing occasions. One exception was reported at 5 years of age. Poor comprehenders did not differ from controls on two different measure of expressive vocabulary during the first testing occasion. For phonological measures, groups generally did not differ across testing occasions. However, a sound-matching task at age five showed low average performance for the group of poor comprehenders as opposed to high average for controls.

Overall, results of Nation and colleagues’ 2010 study suggest that 8 year-old children with poor reading comprehension presented with the same profile throughout early reading development. That is, non-phonological aspect of oral language influenced early reading and resulted in consistent profiles for both groups across time. Their findings
also show that oral language weaknesses in mid-childhood are not merely a consequence of poor reading comprehension, as investigations began prior to formal training in reading.

Ricketts, Sperring, and Nation (2014) conducted a longitudinal study that investigated educational attainment in children with specific reading comprehension problems. Reportedly only the second study of its kind (the first being Cain and Oakhill’s 2006 study), researchers investigated whether educational weaknesses, as measured by national assessments, might become more prominent across grade levels with increases in reading comprehension complexity. Fifteen poor comprehenders and 15 controls were selected from a sample of 81 children attending mainstream schools in the UK. Groups were matched for chronological age, nonverbal reasoning, and decoding ability. Participants were assessed at three different points in time: Time 1 at age 9 years, Time 2 at age 11 years, and Time 3 at age 16 years. Performance scores on measures of nonverbal reasoning, decoding, and reading comprehension were obtained at Time 1; at Time 2, these plus a measure of vocabulary knowledge were obtained and data on standardized measures of educational attainment were collected; and at Time 3, standardized measures of educational attainment were collected for the second time.

Researchers found that poor comprehenders first assessed at 9 years of age show poor educational outcomes at the end of primary school at 11 years compared to children with good comprehension skills. Further, poor comprehenders also perform less well than controls at the end of compulsory school (equivalent to U.S. secondary school) at 16 years of age. These findings highlight the link between reading comprehension and educational attainment. Furthermore, educational attainment in poor comprehenders is impacted across grade levels.
These studies clearly show that a strong relationship exists between oral language and reading comprehension across grade levels and that the association impacts educational outcomes. Overall non-phonological language weaknesses are apparent in poor reading comprehenders. Although a pattern of oral language deficits did not emerge, significant weaknesses in vocabulary, grammar, and discourse were noted most often. Further, research suggests that poor vocabulary often leads to weak word reading ability, and poor general cognitive ability leads to impaired growth in reading comprehension. Of particular interest, is the finding that children with poor reading comprehension skills in higher-grade levels show the same profile of language weaknesses throughout early development, even before instruction in reading began. This is important because it reveals that while deficits in language are implicated in poor reading comprehension, unidentified variables also contribute.

**Beyond Decoding and Oral Language Comprehension.** Researchers have made attempts to identify some of the sources of variance to reading comprehension that have not been accounted for by the Simple View. Tiu and colleagues (2003) looked at the contribution of visual processing speed and IQ to reading comprehension. They found that both contributed uniquely to reading comprehension variance. Specifically, processing speed accounted for unique variance above word recognition and oral language, and IQ contributed above those components and processing speed. Other researchers investigated the contribution of context-free and context reading fluency on reading comprehension (Jenkins, Fuchs, van den Brock, & Deno, 2003). They found that context fluency accounts for more variance in reading comprehension than does list, or context-free, reading fluency. Yet, other researchers looked at reading fluency and found that no unique variance in
reading comprehension could be accounted for beyond word recognition and oral language comprehension (Adolf, Catts, & Little, 2006). Johnson and Kirby (2006) and Joshi and Aaron (2000) found that naming speed accounted for small but significant amounts of unique variance. Still others have looked more closely at vocabulary and grammatical understanding to determine how abilities in these areas contribute and found no unique contributions (Catts, Adolf, & Weismer, 2006; Oakhill, Cain, & Bryant, 2003).

One study sought to find unique variance to reading comprehension and to challenge Gough and Tunmer’s Simple View regarding its central premise. Georgiou, Das, and Hayward (2009) hypothesized that reading comprehension would not be the product of decoding and listening comprehension, and proposed that naming speed and phonological awareness could explain unique variance in reading comprehension outside of decoding and listening comprehension contributions. They looked at 50 English speaking Canadian First Nation children in 3rd and 4th grades. Participants lived on a reservation and had no diagnosed impairments. However, researchers reported that special education services were not available in their school district, so it is unlikely that attempts had been made to diagnose any type of impairment. Measures of phonological awareness, rapid naming speed, decoding, listening comprehension and reading comprehension were administered. According to investigators, their findings discredit the Simple View of Reading. They found that children had average levels of decoding and listening comprehension skills, yet they presented with poor reading comprehension. They looked more closely at decoding and listening comprehension and reported that, combined, they only accounted for 45-47% of the unique variance in reading comprehension. With respect to naming speed and phonological awareness, neither contributed unique variance
beyond the initial finding for decoding and listening comprehension (which were considered together). While researchers failed to account for the source of unique variance, their findings suggest that other variables must be considered.

One notable study has particular relevance to the current investigation. Conners (2008), looked at the contribution of attentional control on reading comprehension beyond decoding and language comprehension in an unselected sample of 67 eight-year-olds. To measure reading comprehension, the Peabody Individual Achievement Test-Revised (PIAT-R) Reading Comprehension subtest (Markwardt, 1989) was used. The PIAT-4 uses single-sentences that require participants to identify a picture from a group of pictures that best depicts the intended meaning of the sentence. The Word Recognition subtest of the same instrument was used to measure word recognition. The Test of Auditory Comprehension of Language-Revised (TACL-R; Carrow-Woolfolk, 1985) was used as the measure of language comprehension and employed subtests that measured receptive vocabulary, comprehension of grammatical morphemes, and the comprehension of complex syntax. Finally, the variable of interest, attentional control, was examined using the Star Counting Test (SCT) (de Jong & Das-Smaal, 1990). The SCT presents rows of stars, pluses, and minuses on 24 task pages. Participants are required to count stars while following plus/minus prompts that indicate changes in the direction of the counting sequence. According to test authors, the SCT requires the activation of automatic forward counting, the inhibition of forward counting, and the more controlled activation of backward counting.

A hierarchical regression analysis using the performance scores on the aforementioned measures revealed that attentional controlled contributed significant
variance to reading comprehension. Moreover, attentional control was similar to language comprehension in the amount of unique variance contributed. Specifically, the analysis revealed that oral language, word recognition/decoding, and attentional control accounted for 63% of the variance in reading comprehension. The proportions of variance accounted for in reading comprehension included: 27% shared among all three components, 23% from word recognition/decoding, 8% oral language, and 5% attentional control. In short, Conners’s findings point to attentional control as a significant contributor to reading comprehension (Conners, 2008).

These studies clearly show that factors beyond word recognition and oral language comprehension contribute to reading comprehension. Further, what we know about the reciprocal nature of language and self-regulation and the identified contribution of attentional control to reading comprehension inspires interest in learning more about how improved self-regulatory processes support reading comprehension. The following section discusses the role of self-regulation in the development of mental models of meaning.

Cognitive Aspects of Reading Comprehension and Situational Models

Perfetti (1999) supports the notion that reading comprehension is supported by oral language comprehension but offers two additional considerations that imply weakness in the simplicity of this view. The first consideration is that “the written language comprehension processes can take advantage of general language processing only to the extent that the visual-to-linguistic transcoding processes are effective.” The second consideration is that “the typical forms of written texts may place demands on comprehension that are not shared by spoken language” (pp. 167). It has been shown through reading comprehension research that meaning does not exist in text (Sweet &
Snow, 2003) but through the construction of mental representations of the message within a text (Perfetti, Landi, & Oakhill, 2005). In other words, to gain meaning from more complex text, additional reading comprehension strategies that employ higher-level processing of information must be employed.

Thus, reading comprehension requires purposeful thinking during which meaning is constructed through engagement between the text and reader (Durkin, 1993). Because it involves the simultaneous extracting and constructing of meaning, the process is a highly demanding cognitive task (Snow & Sweet, 2003). Reading comprehension is a reader-controlled process that requires self-regulation for proficiency (Brown, 1980). Thus in reading, the same language-distancing strategies that make it possible for the reader to self-regulate (Sigel, 1982) also make it possible for the reader to construct and reconstruct mental models that allow for inferencing and predicting (Westby, 2004). Self-regulatory skills in reading comprehension involve: using planning skills to read with specific questions and purpose; using organizational skills to follow text cohesion; engaging working memory to hold things in the mind while looking for new information; shifting patterns of thought processes through the organizational parameters of text; processing linguistic information at the word through passage comprehension levels; formulating concepts for depth of text understanding; inhibiting responses like jumping ahead or focusing on irrelevant information; and sustaining attention to focus on text for a prolonged period of time (Kaufman, 2010).

Examples of the manifestation of self-regulatory processes in reading comprehension involve identifying key elements in text, monitoring one’s own comprehension, using corrective strategies when gaps in comprehension occur, selecting
retrieval cues, and self-assessing overall comprehension and test readiness (Westby, 2004). Of note is that the Simple View of Reading does not account for these processes. Given that self-regulation is necessary for purposeful engagement with text across different levels of text complexity, it is plausible that self-regulation is a critical component of the literacy puzzle and may contribute a large degree of unique variance in reading comprehension. See Figure 1.2 for Beyond the Simple View: Another Piece of the Literacy Puzzle.

**The Situational Model of Reading Comprehension.** To examine the notion of reading and the processes involved in reading for meaning, van Dijk and Kintsch (1983; Kintsch, 1992) presented an influential model of text comprehension referred to as the *situational model*. This model considers reading comprehension at different levels of increasing complexity. Its components include *surface-level* representation, *text-based* representation, and *situational level* representation.

First, *surface-structure* representation involves the reading and interpretation of particular words and phrases. It includes the comprehension of information contained explicitly in the text and is considered the microstructure of the text. At a higher level, *text-based* representation involves the interpretation of overall syntax. This level considers the relationship among propositions or idea units that are explicitly expressed within text but are present in whole sections of texts that are related semantically. The derivation of meaning here, although less explicit than surface-structure comprehension, is possible through text-only interpretation of larger idea units. These are microstructure units that are collectively organized into more global chunks of meaning called macrostructure units (Kintsch, 1998). Macrostructures of meaning are embedded within text and require higher
order processing to extract meaning. But even within this level of comprehension, the reader’s level of understanding would only be sufficient for reproducing/retelling what was read. For a deeper level of comprehension, *situational* representation is needed. The *situational level* represents the mental model of the situation described in the text. The development of this level of representation involves “the integration of information given in the text with applicable prior knowledge and the goals of the comprehender” (Kintsch & Rawson, 2005, p. 211).

Thus, in the situational model, the reader must integrate prior knowledge with information provided in the text by using inferencing to fill gaps in comprehension. Recall that self-regulation plays a vital role in reading comprehension. It is used in reading comprehension as the reader uses self-talk to plan, organize, engage working memory, and shift perspectives to make sense of what is being read. Further, self-regulation helps the reader to self-monitor reading performance and to integrate prior knowledge with
information found in text to make inferences. Hence, verbal working memory, prior knowledge, and inferencing are important processes coordinated by self-regulation and are vital for effective reading comprehension. A brief discussion follows to explore these concepts.

**Verbal Working Memory.** Researchers have found evidence that verbal working memory is the most salient cognitive process associated with reading comprehension (Alloway, Gathercole, Willis, & Adams, 2005; Baddeley, 1986; Daneman & Carpenter, 1980; Georgiou, Das, & Hayward, 2008). Initially, the visuo-spatial component and phonological loop of working memory processes print and retrieves labels from long-term memory stores, respectively. The central executive then processes and integrates the information through self-regulation. Working memory capacity is influenced by the semantic and syntactic complexity of language. Therefore, to process larger linguistic units (for example, more words, morphemes, and sentences) greater resources must be allocated. Self-regulation helps the reader to integrate information provided in text with prior knowledge, to regulate inferences and actions, and to select important information to manipulate in working memory. Self-regulation serves to employ resources like allocating attention, task switching (cognitive flexibility), encoding constructs, and rehearsal.

Studies show that working memory, language ability, and cognitive resource allocation work together to impact comprehension. For example, Marten and Schwarts (2003) were interested in examining components of working memory along with other executive functions. They looked at non-word repetition ability and sentence comprehension skills using various sentence complexity and length. Participants included 26 children ranging in age from 7 to 10 years. Thirteen children presented with LI and 13
children had typically developing language. Their findings revealed significant group differences for both tasks. Children with LI showed lower processing and attentional capacity than children with typical language on non-word repetition tasks that included non-words of increasing length. This conclusion was reached because these children showed no difference in their ability to discriminate non-words of varying length. This suggested that limitations in simultaneous processing of information was responsible for poor performance on this task due to inadequate use of encoding and rehearsal rather than difficulty in encoding and analyzing the phonological structure of the non-words. By adding sentence comprehension tasks with varying sentence lengths and including embedded non-words, these researchers were able to explore aspects of working memory, language comprehension, and cognitive resource allocation. Again, researchers found that children with LI performed less well than children with normal language functioning. Specifically, they found that children with LI were less able to simultaneously process non-words along with semantic and syntactic information. They noted that if the child focused on the sentence, they often neglected to rehearse the non-word; and if the child focused on the non-word, they were unable to accurately answer the comprehension questions. In other words, there is a reciprocal relationship between working memory, language and executive functioning. Greater working memory capacity is needed to process increasingly complex language and greater cognitive resources must be employed to make up differences.

Montgomery (2000) looked at the role of verbal working memory in sentence level comprehension in contrast to semantic and syntactic understanding. The researcher investigated nonsense word repetition tasks and sentence comprehension tasks. The sentence comprehension task included two conditions, short sentence with no linguistic
redundancy and longer sentences that included linguistic redundancy (e.g., “The girl smiling is pushing the boy,” versus “The girl who is smiling is pushing the boy”). Fourteen children with language impairment and 13 children with normal language were included in the study. Montgomery’s findings suggested children with LI are less able to comprehend longer sentences, even when those sentences contain redundant information. He also noted that children with LI did less well than controls on nonsense word repetition task, leading to his conclusion that children with LI have less functional verbal working memory capacity than children with normal language. He postulates that due to limitations in verbal working memory, children with LI have greater difficulty managing cognitive resources because they are unable to efficiently self-regulate executive processes.

To show that children with reading deficits present with problems in the executive processes of verbal self-regulation and working memory, Snowling (1981) presented a reading task using nonsense words of increasing complexity (e.g., one-syllable, two-syllable, and the inclusion of consonant clusters) to children with reading deficits and age-matched peers with normal abilities in reading. She found no significant difference in groups for single syllable nonsense words. However, as nonsense words increased in complexity (more syllables and consonant clusters), the group of poor readers performed less well than age-matched peers with normal abilities in reading. Likewise, children with developmental language disorders perform as poorly on this task as children with severe deficits in reading (Kamhi & Catts, 1986).

These research findings point to working memory limitations resulting from mismanagement or poor regulation of cognitive resources, such as deficits in attention, speed of processing, storage, retrieval, strategy use and rehearsal (Leonard, Deevey, Fey, &
Bredin-Oia, 2013). Further, children with LI have comprehension difficulty because of their inability to efficiently maintain stimulus items that have been encoded through verbal rehearsal. That is, children with LI are less able to formulate coherent internal dialogue to support working memory and other executive processes, like comprehension, planning, task initiation, task completion, and behavior/social/emotional regulation.

**Prior knowledge.** The extant research that points to prior knowledge as a key element in reading comprehension is vast. The premise is that prior knowledge of text content facilitates the development of situational models by reducing processing demands. Some researchers even consider prior knowledge to be the best predictor of reading comprehension ability (Hirsch, 2006; Willingham, 2006). For example, Fincher-Kiefer and colleagues (1988) looked at the processing of sentence content using sentences that included neutral topics and sentences about baseball. Their findings suggest that high versus low topic knowledge positively influences the development of situational models as evidenced by greater degrees of sentence content recall. Similarly, Schneider and Korkel (1989) found that after verbal skills have been accounted for, prior knowledge of a topic contributes significantly to comprehension performance. They looked at 3rd, 5th, and 7th grade students with varying degrees of soccer expertise and found that third grade soccer experts outperformed seventh grade novices in recalling more idea units from a soccer-themed passage. These findings suggest that less effort is needed to construct a situational model when greater prior knowledge can be engaged from long-term memory. Quite possibly though, these findings may also point to motivational factors that influence the development of situational models by improving the level of engagement that is required to efficiently use inferencing.
In contrast to these studies, Clark and Kamhi (2014) looked at the influence of prior knowledge and interest on fourth- and fifth-grade students’ passage comprehension performance scores and found no association. Two experiments were conducted that led to this conclusion. First, an experiment was conducted that assessed prior knowledge using key concept questions on grade level passages and measurements of interest using a 5-point rating scale. Participants included 10 boys and 8 girls from general education classrooms. Then a second experiment assessed comprehension performance on grade-leveled passages using one general question of prior knowledge and three measures of topic interest (least interesting, most interesting, and forced selection). Participants included 10 boys and 15 girls, also from general education classrooms. Results of both experiments revealed that prior knowledge and interest of a topic did not improve comprehension performance. Further, comprehension performance was actually better when students did not report prior knowledge of the topic; possibly because the topic “experts” believed that reliance on past experience alone was enough to accurately answer comprehension questions, and thus they consulted the text less often.

Obviously, decades of research in support of prior knowledge as a catalyst for improved reading comprehension is not negated by this study, but it does bring forth questions about what other factors deserve more consideration. For example, is existence of prior knowledge the best predictor of reading comprehension ability or is the self-regulated engagement of prior knowledge equally important?

Jenkins, Barksdale and Clinton (1978) investigated the effects of motivation on reading comprehension scores in two academic settings, a remedial and regular classroom. The aim was to determine if engagement, increased with external motivation, could
improve reading comprehension as measured by the accuracy of answers to comprehension questions. These researchers looked at the effect of monetary contingent reinforcement on the accuracy of answers to comprehension questions with no reading comprehension strategy training whatsoever. Examiners used a combination across-setting, multiple-baseline with reversal design to assess the effects of contingent reinforcement on the reading comprehension performance of three male poor reading comprehenders in fourth and fifth grades. They found that contingency reinforcement in the absence of reading comprehension skills training resulted in sudden and immediate improvements in reading comprehension as measured by the accuracy of answers to comprehension questions. This study points to active and intentional (or self-regulated) reading comprehension motivated by the desire to earn a monetary reward.

Prior knowledge is very important for comprehending what has been read. Reduced cognitive demands while reading familiar material will most certainly allow the reader to use cognitive resources for other aspects of reading, like processing more complex text or reading and comprehending text more quickly. However, mixed findings in the studies above lead one to consider other processes involved. The aforementioned studies highlight the need for more emphasis on the role of self-regulation to engage inferencing in reading comprehension.

**Inferencing.** A defining characteristic of poor comprehenders is the failure to use inferencing while reading (Yuill & Oakhill, 1991). In reading comprehension, an *inference* can be defined as “a cognitive process the reader goes through to obtain the implicit meaning of a written text on the basis of two sources of information: the propositional content of the text (i.e., idea units that are stated) and prior knowledge of the reader”
(Chikalanga, 1992, p. 697). In other words, inferencing in reading is necessary for the reader to go beyond the literal content of the text and develop mental representation of what is read. Self-regulation makes inferencing possible by actively engaging the cognitive processes needed to make sense of what is read.

An early taxonomy, termed question taxonomy, put forth by Pearson and Johnson (1978) was designed to add clarity to the idea of inferencing and how we use it to fill gaps in the comprehension of written language. This taxonomy uses the relationship between questions and responses to explore this relationship. It focuses on where the information used by the reader to formulate a response can be found. For example, the information was found within the text, within the reader’s prior knowledge, or both. From this view, there are three types of responses: textually explicit, textually implicit, and scriptally implicit.

A textually explicit response is present overtly within the text. This category does not require inferencing. It is akin to the surface-structure representation as outlined by van Dijk and Kintsch (1983; Kintsch, 1992) and requires linguistic interpretation to gain meaning. A textually implicit response is present within the text but is embedded within the text-based macrostructure. That is, an appropriate response can be found within larger chunks of meaning within the text, but inferencing is required to make logical jumps between prior knowledge and information presented within the text itself. Finally, a scriptally implicit response requires the reader to use prior knowledge through mental scripts to formulate an appropriate response. Here, the text leads the reader to a situational or mental representation through the integration of prior knowledge. The appropriate scriptally implicit response is found within this juncture, the space between the text and the prior knowledge of the reader (e.g., upon reading *The Three Bears*, a question with a
scriptally implicit response may be “What is porridge?”). While the question taxonomy is a classification system that is useful in measuring a student's inferencing ability according to an explicit or implicit message found in text, it could also be used as a self-regulatory tool to assist the reader in guiding and monitoring his/her own inferencing ability.

From this perspective, it is easy to see the value of self-regulatory and oral language processes in reading comprehension. The proposition that reading comprehension is a reader controlled process that requires adequate language ability is not new. The reader must engage verbal working memory and integrate prior knowledge to generate inferences toward fully developed mental representations of the text to be comprehended. Engage, integrate and generate, action words that indicate intention and responsibility on the part of the reader. Thus, self-regulation and language comprehension (along with adequate decoding skills) are necessary to gain meaning from print.

Children who fail to develop adequate reading comprehension skills through exposure to language and literacy need more specialized support. Instruction in reading comprehension strategies and self-regulatory skills may improve literacy outcomes. Intimations from empirically supported reading comprehension strategies give credence to the proposition that self-regulation contributes significantly to reading comprehension. The following section on the effectiveness of reading comprehension strategy instruction supports this premise.

Evidence from Reading Comprehension Strategy Research

According to Duke and Pearson (2002), reading comprehension processes and strategies are most often studied by looking at what good comprehenders do before, during, and after reading. Hence, good comprehenders read actively, set goals for reading,
and constantly evaluate whether or not reading goals are being met. They make note of text structure and frequently make predictions about what is to come. Good readers read selectively by making decisions about what to read carefully, quickly, or not at all. They construct meaning and question the meaning of what is read. Good readers attempt to gain meaning from unfamiliar words and concepts and are able to identify inconsistencies while reading. They can integrate prior knowledge and can consider the perspective of the author of the text. Good readers monitor their understanding and make adjustments in their reading if necessary. They approach different types of text differently, attending to story grammar while reading narrative text and construct summaries while reading expository text. Good readers process text during reading and after reading. Finally, good readers find satisfaction from productively reading and comprehending what is read.

Good readers spontaneously use reading comprehension strategies or readily acquire strategies modeled by their teachers. A reading comprehension strategy is a “cognitive or behavioral action that is employed under specific contextual conditions with the goal of improving some aspect of comprehension” (Graesser, 2012, p. 7). Some cognitive processes in reading comprehension involve processing information, drawing on conceptual and linguistic knowledge, inferencing, making predictions, using prior knowledge, problem solving, and learning. Under “specific contextual” conditions, reading comprehension strategies are useful to improve text understanding. In other words, knowing when to use what strategy is what good comprehenders do. There is a large body of research investigating reading comprehension strategies in children both with and without language and learning problems.
For children without learning disabilities, the National Reading Panel (2000) identified 16 reading comprehension strategies that have been extensively researched. Seven of these have firm empirical support: comprehension monitoring, cooperative learning, graphic and semantic organizers including story maps, question answering, question generation, summarization, and multiple or combined strategy use. A brief description of each follows along with relevant studies that point to the effectiveness of each.

*Comprehension monitoring* has been shown to improve reading comprehension outcomes in children (Baumann, Seifert-Kessell, & Jones, 1992; Elliot-Faust & Pressley, 1986). Instruction of this strategy includes teaching the reader to become aware of his or her understanding and to use other strategies when breakdowns occur. Studies have also revealed that *cooperative learning*, or collaboration among readers to learn strategies during reading, has improved reading outcomes (Klingner, Vaugh, & Schmunn, 1998; Pickens & McNaughton, 1988). The use of *graphic or semantic organizers* helps the reader to graphically organize relationships among ideas presented within the text (Berkowitz, 1986). *Story structure or story grammar* strategies allow the reader to ask wh-questions about plots, characters, timelines, and story events. Studies show that story grammar is effective in the comprehension of narrative text (Carnine & Kinder, 1985; Newby, Caldwell, & Recht, 1989). *Question answering* is when the reader answer questions about the text and receives instructional feedback regarding correctness (Ezell, Hunsicker, & Quinque, 1997; Raphael, 1982; Raphael & McKinney, 1983). *Question generation* is when the reader asks wh-questions to himself to achieve comprehension (Davey & McBride, 1986; Linden & Wittrock, 1981). *Summarization* strategy is when the reader recognizes the main ideas
and is able to organize them into a meaningful whole. The use of summarization has been shown to be an effective comprehension strategy (Afflerbach & Walker, 1992; Baumann, 1984). Lastly, *multiple-strategy use*, when the reader is taught to use more than one strategy during a text interaction, is vastly supported (National Reading Panel, 2000). Good comprehenders use many of these and apply them according to their needs (Pressley, 2002).

For good readers, reading comprehension strategies are generally learned informally. That is, explicit instruction is often not necessary. In contrast to what good comprehender do, children with learning disabilities (LD) often fail to spontaneously engage in the processes necessary for successful comprehension. For example, children with LD often fail to strategically process information and appropriately use background knowledge to gain meaning from print. In addition to having a limited vocabulary, they frequently lack metacognitive awareness and are largely unaware of common text structures (Gerten, Fuchs, Williams, & Baker, 2001; Mastropieri, Scruggs, & Graetz, 2003). In other words, children with LD frequently lack the conscious knowledge of what is expected during reading and the strategies needed for reading efficiently. (Westby, 2004).

For children with learning disabilities, a body of research exists that explores strategy effectiveness in this population. A review of the literature revealed several examinations and meta-analyses of reading comprehension interventions. An early meta-analysis by Talbott, Loyd, and Tankersley (1994) looked at 48 studies published between 1978 and 1992. Researchers found that self-questioning, self-monitoring, and self-recording were associated with the greatest gains in reading comprehension ability.
In 1996, Mastropieri, Scruggs, Bakken, and Whedon looked at 68 studies published between 1976 and 1995, an overlapping timeframe of Talbot and colleagues (1994) analysis, and found similar results. They found that the greatest gains in reading comprehension were associated with strategies that involved activating background knowledge, summarizing, self-monitoring, and self-questioning. Swanson and colleague (Swanson, 1999; Swanson & Hoskyn, 1998) looked at 58 studies published between 1972 and 1997 and found that the reading comprehension of students with LD improved most when multiple strategies were taught using direct instruction. Further, they looked at 20 different instructional variables and found that three could account for most of the variance in outcomes: controlling task complexity, small group instruction, and instruction in guided questioning strategies.

Gersten, Fuchs, Williams, and Baker (2001) reviewed 20 years of intervention research. These researchers reviewed two bodies of research. One body of research investigated strategy instruction in narrative text and the other included instruction in expository text. The findings for narrative text comprehension points to the usefulness of instruction in self-regulated learning and strategies that incorporate question-guided story grammar (e.g., “Who was the story about?” and “What are they trying to do?”) (Carnine & Kinder, 1985). The body of work on expository text points to multiple strategy instruction (i.e., predicting, summarizing, etc.) in conjunction with self-regulation strategies (i.e., explicitly selecting strategies, monitoring comprehension and self-questioning before, during, and after reading) as the most effective avenue for improved text comprehension.
In studies of both narrative and expository text comprehension, the addition of the aforementioned self-regulatory learning techniques improved task persistence and overall reading comprehension ability.

Mastropieri, Scruggs, and Graetz (2003) described reading comprehension research specifically for secondary students. Their review revealed that comprehension strategy instruction using peer tutors and domain specific elaborative strategies were effective in facilitating comprehension gains. Later, Kim, Vaughn, Wanzek, and Wei (2004) investigated the effectiveness of graphic organizers for improved comprehension through a meta-analysis of studies conducted between 1963 and 2001. Twenty-one studies that included graphic organizers like semantic organizers, framed outlines, and cognitive maps were considered. Their findings indicate that overall comprehension improved for students with learning disabilities with strategy instruction using graphic organizers.

Gajria, Jitendra, Sood, and Sacks (2007) reviewed 29 studies investigating the comprehension of expository text in students with learning disabilities. Findings reveal that strategies using self-monitoring, identifying the main idea, using inferences, graphic organizers, and reciprocal teaching were the most effective in improving reading comprehension. More recently, Berkeley, Scruggs, and Mastropieri (2010) integrated findings from reading comprehension instruction research published between 1995 and 2006. The aim of this study was to determine if reading comprehension strategies identified as effective during their previous meta-analysis (Mastropieri, Scruggs, Bakken, & Whedon, 1996) emerge as effective a decade later. Their results indicated that a wide variety of reading comprehension interventions (i.e., fundamental reading instruction, text enhancement, and question strategy instruction) continued to show effectiveness.
While other meta-analyses looked at reading comprehension strategy instruction across varying age groups, a recent investigation looked at the critical factors in reading comprehension instruction for children with learning disabilities in middle school. Kim, Linan-Thompson, and Misquitta (2012) identified and investigated five critical factors in 14 different studies published between 1990 and 2010. The aim of their analysis was to guide practitioners in the application of reading comprehension instruction to produce better reading outcomes. Kim and colleagues’ critical factors included: 1) type of instructional method, 2) self-monitoring, 3) components of reading incorporated, 4) fidelity of instructions (scripted/non-scripted, researcher/teacher), and 5) group size. Their results revealed that main idea and summarization strategy were the most effective in producing reading comprehension gains. Adding self-monitoring to main idea instruction yielded further gains. They also found that targeting comprehension alone or along with vocabulary skills instruction improved comprehension. In terms of instructional delivery, it was noted that interventions presented by researchers, as opposed to teachers, resulted in greater gains across intervention types.

As researchers sought to determine the best instructional practices to support comprehension in students with learning disabilities, a common theme emerged. Reading comprehension strategy instruction with explicit metacognitive training improved comprehension performance in this population of students. While single strategies used in conjunction with metacognitive training yielded improvements, multiple strategies used with metacognitive training was more effective in achieving greater gains and generalization of skills. Further, studies revealed that longer intervention durations produce longer treatment effects. Specifically, all of the aforementioned meta-analyses and
reviews point to the effectiveness of self-monitoring and self-questioning in reading. Scattered throughout the eight syntheses, the following strategies were revealed to be most effective for expository text: self-monitoring, self-questioning, identifying the main idea, engaging prior knowledge, summarizing, making predictions, text enhancement (i.e., graphic organizers), fundamental reading instruction (i.e., vocabulary instruction), peer tutoring and reciprocal teaching (i.e., questioning, clarifying, summarizing, and predicting). For narrative text comprehension, strategies that focus story grammar elements were found to be the most effective. Further, controlling for task complexity, using small group instruction, and using guided question strategies were the best predictors of reading comprehension success (Swanson & Hoskyn, 1998).

As described above, there is a large body of research investigating reading comprehension strategy instruction for children with disabilities. Adding evidence, a relatively small selection of effective individual studies that focus on the addition of self-regulatory skills alongside other strategies includes Johnson and colleagues’ (1997) work with story grammar, Manset-Williamson and Nelson’s (2005) work with multiple strategies, and Jitendra and colleagues’ (2000) work with main idea strategy.

Parker (2015) conducted a pilot study investigating the extent to which a self-regulatory reading technique (question-answer-relationship strategy with think questions) used in specific narrative (social stories) and expository (topics relevant to adolescence) contexts improved the language functioning and reading comprehension abilities of high school students with language impairment. Fourteen 9th and 10th grade students from a rural high school were assigned to an intervention or comparison condition. Participants in both groups received seven 30-minute sessions across four weeks. The experimental group
received intervention while the comparison group engaged in independent passage reading. Both groups participated in pre- and post testing, and both groups participated in progress monitoring at the conclusion of each session. Results indicated that students in the intervention group made greater gains on all language measures than students in the comparison group. Further, students in the intervention group outperformed the comparison group for reading comprehension across time. The results of this pilot study indicate that the explicit instruction of self-regulatory reading techniques improves the language functioning and reading comprehension abilities of high school students with language impairment.

From this perspective, it is easy to see the value of self-regulatory skills in reading. Further, it is reasonable to consider self-regulation as a possible source of the unexplained variance in reading comprehension that has not been accounted for by models of reading comprehension, like the Simple View (Gough & Tunmer, 1986). The purpose of this study was to investigate the contribution of self-regulation to reading comprehension in adolescents and to determine if that contribution varied significantly for students with language/learning difficulties versus students with typical language/learning histories. The questions of this study included:

1) Does self-regulation make a significant contribution to reading comprehension in addition to decoding and oral language comprehension?

2) What is the strength of the relationship between decoding and self-regulation?

3) What is the strength of the relationship between overall oral language functioning and self-regulation?
4) Is the contribution of self-regulation to reading comprehension the same for students with language/learning difficulties and students with typical language/learning histories?
METHODS

Research Design

An exploratory research design was used to investigate whether self-regulation makes a significant contribution to reading comprehension. Three components deemed to be important for reading comprehension were measured for 32 middle school students (i.e., oral language comprehension, word recognition/decoding, and self-regulation) and compared for their relative contribution to reading comprehension. Self-regulation to reading comprehension was further compared for students with language/learning difficulties and students with typical language/learning abilities. Finally, the strength of the relationship between self-regulation and decoding and between self-regulation and overall language functioning was examined to determine if self-regulation made a significant contribution to known contributors to reading comprehension in isolated contexts.

Setting

Participants were recruited from a small rural middle school in South Louisiana. The school has a population of 196 students. Of the 196 students, 172 were considered economically disadvantaged. Students receiving special education services accounted for 8% of the school's population. The School's Performance Score (SPS) ranking of “D” indicated that, based on state standardized test measures and the number of high school credits earned by the completion of the freshman year, the middle school was state-rated as below average. Statewide accountability testing further revealed that 50% of the school’s population earned “non-proficient” scores in English-Language Arts/literacy (Louisiana Department of Education, 2015).
Participants

Student Participants. Participants included students enrolled in 6th, 7th, and 8th grades. All participants spoke English as their primary language and had visual and hearing acuity within normal limits as indicated by school-wide screening measures. Consent forms approved by the LSU Institutional Review Board (See Appendix A) were sent home by the school’s principal to seek parental authorization for students to participate in the study. All students meeting the aforementioned criteria and receiving parental consent were included in the study.

Participants (n=32) included 3 students who received special education services in accord with Individualized Education Programs (IEPs), 17 students who performed below proficient levels in reading comprehension as indicated by Scholastic Reading Inventory (SRI) scores, and 15 students who achieved reading comprehension proficiency as indicated by the same measure. For students who received services in accord with IEPs, areas of exceptionality included: Specific Learning Disability with Specific Language Impairment (SLI), n=1; Other Health Impairment with SLI, n=1; and Intellectual Disability/mild with SLI, n=1. Students ranged in age from 11;10 to 14;7 years (M=13.2) and included 14 male and 18 female students. Participants included: 27 African American students, 3 Caucasian students, and 2 Hispanic students. See Table 2.0 for characteristics of 6th, 7th, and 8th grade participants including demographic data and academic status.

Students were considered at-risk for language and learning difficulties if one or more of the following criteria were met: 1) the student was identified as a non-proficient reader as indicated by SRI performance scores; 2) the school district’s pupil appraisal system identified the student as having a language/learning impairment as indicated by
### Table 2.0 Characteristics of 6th, 7th and 8th Grade Participants including Demographic Data and Academic Status

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IEP or 504 plan participation; and 3) language assessment performance measures administered within the study indicated that language functioning was -1.5 standard deviations or more below the test mean of 100. Based on these criteria, 17 students presented with language/learning difficulties and 15 students were determined to have typical language/learning histories.

**Assessment Team.** The primary investigator was a master’s level clinician and doctoral candidate with 16 years of experience in schools and certification from the American Speech-Language and Hearing Association. The primary investigator had extensive experience in test administration, scoring, and interpretation. The assessment team also included seven trained lab assistants. All parties completed the National Institutes of Health training course *Protecting Human Research Participants.*

**Measures**

**Oral Language.** The *Test of Language Development-Intermediate 4th-Edition* (TOLD-I4) (Hammill & Newcomer, Test of Language Development-Intermediate fourth Edition, 2008) was used to measure oral language abilities. The TOLD-I4 is appropriate for children and adolescents ranging in age from 8-0 to 17-11 with a testing time ranging from 30-60 minutes. The assessment contains six subtests that measure semantic and grammatical skills. Subtests are further divided into three target areas: listening abilities, organizing abilities, and speaking abilities. Subtests include: *Sentence Combining, Picture Vocabulary, Word Ordering, Relational Vocabulary, Morphological Comprehension,* and *Multiple Meanings.*

The *Sentence Combining* subtest requires students to form a compound or complex sentence from two or more simple sentences presented orally by the examiner. This
subtest measures grammatical understanding and speaking abilities. The *Picture Vocabulary* subtest requires students to listen to a two-word phrase (i.e., *monkey see*) and point to a picture that best represents the phrase from a selection of six pictures. This subtest measures semantic skills and listening abilities. The *Word Ordering* subtest requires students to construct sentences from a series of randomly presented words. This subtest measures grammatical and organizational skills. The *Relational Vocabulary* subtest requires students to describe the relationship among three words presented orally by the examiner. This subtest measures semantic abilities and organizational skills. The *Morphological Comprehension* subtest requires students to distinguish grammatically correct from incorrect sentences. This subtest assesses grammatical skills and listening ability. Finally, the *Multiple Meanings* subtest requires students to generate multiple meanings of words presented orally by the examiner. This subtest assesses semantic knowledge and speaking abilities.

While individual subtest scores indicate specific areas of strength and weakness, the combination of subtest performance scores reveals an overall *Spoken Language Quotient*. The Spoken Language score has a test mean of 100 with a standard deviation of 15. Subtests scores have a subtest mean of 10 with a standard deviation of 3. Standard scores for the overall *Spoken Language Quotient* were used in the present analysis.

**Reading Comprehension.** The Scholastic Reading Inventory (SRI) is an interactive reading comprehension assessment that uses Lexile® measures derived from raw scores. The Lexile Framework measures the reading ability of the student and the semantic and syntactic complexity of the text being read and is criterion referenced (Scholastic, 2006). The criterion-referenced measure provides the reading level of the student. This reading
level measure may be used to monitor change in reading performance over time and to match readers with appropriately leveled text. SRI raw scores may also be converted to norm-referenced scores. The norm-referenced test results provide grade-level ranges and performance standards that include national percentile ranks, stanines, and normal curve equivalents. Norm-referenced test results were used in the present analysis.

The SRI test consists of short fiction and nonfiction reading passages followed by multiple choice or fill-in-the-blank questions. Initially, students are taught to log in to the SRI computerized system and are presented with written and audio-recorded test directions. To ensure that students understand the test directions, a brief practice test is presented consisting of three simple passages and questions. If a student is unable to answer the simple practice questions correctly, a help window will appear instructing the student to ask the teacher for assistance. This process is repeated until the student is able to answer all simple practice questions correctly. Following the practice test section, 2 to 5 additional questions are presented to establish an appropriate starting point and level of difficulty. Once this is established, the actual test begins. Passages and questions are adapted to the performance of the student. In other words, the test uses the accuracy of student responses to adjust the level of difficulty up or down. Generally, the test presents between 20 to 25 questions. To answer questions accurately, students are required to use higher-level thinking skills (i.e., inferencing, drawing conclusions, using vocabulary knowledge in context).

**Word Recognition/Decoding.** The *Word Reading subtest of the Wide Range Achievement Test 4* (WRAT:4) (Wilkinson & Robertson, 2006) was administered as a measure of word recognition/decoding with a testing time of approximately 10 minutes.
The WRAT:4 is a norm-referenced measure of educational attainment, with the full battery comprised of word reading, sentence comprehension, spelling, and math computation subtests. Test norms are available for individuals from 5-94 years.

The Word Reading subtest is comprised of 55 printed words presented in isolation. The reader is required to recognize and accurately pronounce words aloud. A standard score is derived with a test mean of 100 and standard deviation of 15. The standard score was used in the present analysis.

**Self-Regulation.** A stroop task was used to measure self-regulatory skills. Originally developed by J.R. Stroop (1935), the stroop task measures the individual's ability to selectively attend to a task, inhibit competing stimuli while attending, and to shift between task requirements. Stroop tasks include the presentation of color words presented as congruent (i.e., blue with blue ink) or incongruent (i.e., blue with red ink) colors. The participant is required to name the color of the printed word (or ink) and inhibit the reading of the actual printed word. The current study used the iStroop Test (Khaliq, 2014). The iStroop Test is a digital application of this task presented on a mobile application using an Apple iPad. The iStroop Test generates the number of accurate responses completed within one minute. The sum of three 60-second trials was used as the measure of self-regulatory control.

Prior to the administration of the iStroop Test, subjects were screened for color blindness and automatic word recognition of color words. The materials included two 8.5x11 inch sheets of cardstock paper, the first containing color names “red,” “blue,” “green,” “orange,” “purple,” “black,” “purple,” “brown,” “gray,” and “yellow,” presented in a row printed in 60 point black font to ensure accuracy and automaticity of color name
reading ability (see Appendix B for Stroop Task Word Reading Screening Pretest). The second contained a randomly arranged series of red, blue, green, orange, purple, and yellow colored squares, with each color occurring twice (see Appendix C for Stroop Task Color Blindness Screening Pretest).

**Procedure**

Three assessments were administered to participants by the primary investigator and/or trained assistants. These instruments assessed overall language functioning, word recognition, and self-regulatory skills, respectively. Assessments were individually administered to students in a quiet, unoccupied classroom designated by the school’s principal. Testing sessions included two meetings that lasted approximately 45-minutes each. Per school administrator request, students participated in testing during their scheduled physical education period. The six subtests of the Test of Language Development-Intermediate-Fourth Edition (TOLD-I:4) were administered according to standardized procedures in either one or two testing sessions depending on time required to reach ceilings. This was followed by the word recognition subtest of the Wide-Range Achievement Testing-Fourth Edition (WRAT4).

The iStroop Test was preceded by the word recognition for color words screening and color blindness assessments. Word recognition of color names was assessed by presenting the color name sheet to the student and directing him/her to orally read the list of color words. If a student was unable to automatically read color words, the examiner intended to give the correct answer and present the task again. The task was to be repeated until the student was able to read all color words accurately and automatically. All students were able to automatically read the color words with 100% accuracy on the first attempt.
Presenting the sheet of colored squares to the student and directing him/her to name the color of each square assessed color blindness. Again, all students performed with 100% accuracy on the first attempt. Based on screening results, all students were able to proceed to the iStroop Test.

SRI reading comprehension performance scores were garnered from school-wide testing data. The school-based reading specialist administered the reading comprehension assessment to whole classes in the school’s computer lab approximately five weeks prior to the study initiation. Oral language comprehension, word recognition/decoding, and self-regulation scores for 6th, 7th, and 8th grade participants are profiled in Table 2.1.

**Assessor Training.** The primary investigator provided two one-hour training sessions to the research assistants. During session one, the assistants received copies of assessment instrument materials and an overview of each. Sessions two included the modeling of tests administration by the primary investigator followed by an observation of an actual testing session at the school site. Once participant testing was initiated, the primary investigator observed the first testing session of each assistant to assure fidelity. Feedback was provided following the session. One subsequent observation was conducted randomly to monitor assessment fidelity. The school’s reading specialist received training on the administration of the reading comprehension assessment through district-wide professional development.

**Data Reliability.** Two undergraduate lab assistants scored and rechecked all assessments for accuracy. One hundred percent inter-rater reliability was required. If one hundred percent inter-rater agreement was not achieved, the primary investigator rescored the instrument in question. The score was accepted when two reliability checks
Table 2.1 Oral Language Comprehension, Word Recognition/Decoding, and Self-Regulation Scores for 6th, 7th, and 8th Grade Participants

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<th>Student</th>
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<td>103.9</td>
<td>91.2</td>
<td>59.8</td>
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</table>

Notes. NCE=Normal curve equivalent. SS=Standard score
revealed identical scores. Data was entered into Statistical Package for the Social Sciences (SPSS) by a lab assistant and was rechecked for accuracy by a second lab assistant. The primary investigator conducted a third check to ensure accuracy.

**Data Analysis**

SPSS was used to analyze data. An analysis of standardized residuals was carried out to identify potential outliers. No outliers were noted. The standardized residual values ranged from -2.2 to +2.2. Variance Inflation Factors (VIFs) and Tolerance levels were calculated to see if multicollinearity between predictors was a concern. Variance Inflation Factors greater than 10 and Tolerance less than 0.1 are cause for concern (Field, 2013). The results indicated that multicollinearity was not a concern. See Table 2.2 for collinearity statistics. The data met the assumption of independence of errors (Durban-Watson value = 2.2). Durban-Watson values may range between 0 and 4. To meet the assumption of independence of error, a value approximating 2 is desirable, values less than 1 or greater than 3 are cause for concern (Field, 2013). Further, the histogram and the P-P plot of standardized residuals showed that the data contained approximately normally distributed errors. The assumption of non-zero variance was also met (Reading Comprehension, Variance = 556.2; Oral Language Comprehension, Variance = 258.3; Word Recognition/Decoding, Variance = 125.8; and Self-Regulation, Variance = 140.2). Hence, all assumptions of multiple regression were met.

<table>
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<tr>
<th>Table 2.2 Collinearity Statistics</th>
<th>VIF</th>
<th>Tolerance</th>
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<tr>
<td>Oral Language Comprehension</td>
<td>3.186</td>
<td>.314</td>
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<tr>
<td>Word Recognition/Decoding</td>
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<td>Self-Regulation</td>
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Note. VIF=Variance Inflation Factor
The first question, “Does self-regulation make a significant contribution to reading comprehension in addition to word recognition/decoding and oral language comprehension?” was addressed using a hierarchical multiple regression analysis. It was hypothesized that self-regulation would contribute a significant prediction of reading comprehension scores above and beyond the effects of general language and word recognition/decoding scores.

The second and third questions, “What is the strength of the relationship between decoding and self-regulation?” and “What is the strength of the relationship between overall oral language functioning and self-regulation?” were addressed using Pearson's correlation coefficients. It was hypothesized that self-regulation would have a weak positive relationship to decoding and a moderate to strong positive relationship to general language.

The fourth question, “Is the contribution of self-regulation to reading comprehension the same for students with language/learning difficulties and students with typical language/learning abilities?” was addressed by using two hierarchical multiple regression analyses to capture group differences for self-regulation. One analysis used a dummy variable for students with language/learning difficulties and students with typical language/learning histories and included an interaction term for group status and self-regulation. The second analysis was conducted upon splitting the data by group status to capture the proportion of variance accounted for by each variable in the model. It was hypothesized that the proportion of variance of self-regulation to reading comprehension would be similar for students with language/learning difficulties and students with typical language/learning histories.
RESULTS

The purpose of this study was to investigate the contribution of self-regulation to reading comprehension above and beyond the contributions of word recognition/decoding and oral language comprehension and to determine if that contribution varied significantly for students with language/learning difficulties and those with typical language/learning histories. Further, it aimed to determine the strength of the relationship of self-regulation to the known contributors to reading comprehension variance, word recognition/decoding and oral language comprehension. Specifically, research questions addressed the following: 1) Does self-regulation make a significant contribution to reading comprehension in addition to word recognition/decoding and oral language comprehension? 2) What is the strength of the relationship between decoding and self-regulation? 3) What is the strength of the relationship between overall oral language functioning and self-regulation? and 4) Is the contribution of self-regulation to reading comprehension the same for students with language/learning difficulties and students with typical language/learning histories?

Reading Comprehension

The Scholastic Reading Inventory (SRI) generates raw scores that can be converted to Lexile® measures or may be reported in percentile rank, stanine, normal curve equivalent (NCE), or grade-level standard scores (Scholastic, 2006). Normal curve equivalent scores were used in the present analysis. The NCE scores of all participants (n=32) for reading comprehension ranged from 1.0 to 93.0, with an average of 44.4 ($SD = 23.58$). Table 3.0 profiles Scholastic Reading Inventory (SRI) NCE scores.
Table 3.0 Scholastic Reading Inventory (SRI) Performance Scores

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<tr>
<th>Student</th>
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<th>NCE</th>
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Note. NCE=Normal Curve Equivalent

**Word Recognition/Decoding**

The *Word Reading* subtest of the *Wide Range Achievement Test 4* (WRAT:4) (Wilkinson & Robertson, 2006) generates raw scores that may also be converted to NCE scores or standard scores. Standard scores have a subtest mean of 100 and standard deviation of 15. This study used standard scores for this measure to maintain consistency within measures for the independent variables when available. For example, oral language comprehension measures are reported using standard scores. The standard scores for word recognition/decoding (n=32) ranged from 79.0 to 119.0, with an average of 98.4 (SD = 11.2). Table 3.1 reports WRAT:4 Word Reading Subtest standard scores.

**Oral Language Comprehension**

The *Test of Language Development-Intermediate 4th-Edition* (TOLD-I4) (Hammill & Newcomer, Test of Language Development-Intermediate fourth Edition, 2008) results in subtest scores as well as composite scores. The scaled scores from six subtests combine to generate a *Spoken Language Quotient*. The subtests include measures of semantic and
grammatical skills that target listening abilities, organizing abilities, and speaking abilities.

The *Spoken Language Quotient* has a test mean of 100 with a standard deviation of 15.

Subtest scores have a mean of 10 with a standard deviation of 3. Standard scores for the overall *Spoken Language Quotient* were used in the present analysis as the measure of oral language comprehension. The observations for oral language comprehension (n=32) ranged from 54.0 to 123.0, with an average of 89.8 ($SD = 16.1$). Table 3.2 profiles the Spoken Language Composite scores for the *TOLDI4*.

**Table 3.1 WRAT:4 Word Reading Subtest Performance Scores**

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Note. SS=Subtest Standard Score

**Table 3.2 Spoken Language Composite for TOLDI4**

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<td>11</td>
<td>97</td>
<td>22</td>
<td>123</td>
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</tr>
</tbody>
</table>

Note. SS=Subtest Standard Score
Self-Regulation

Measures of self-regulation were derived from performance scores on the iStroop Test (Khaliq, 2014). The iStroop Test generates the number of accurate responses completed within one minute. The sum of three 60-second trials was used as the measure of self-regulatory control. The observations for self-regulation (n=32) ranged from 18.0 to 73.0, with an average of 53.5 (SD = 11.8). Table 3.3 profiles performance scores for the iStroop Test.

Table 3.3 Performances Profiles for the iStroop Test

<table>
<thead>
<tr>
<th>Student</th>
<th>Score</th>
<th>Student</th>
<th>Score</th>
<th>Student</th>
<th>Score</th>
</tr>
</thead>
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<td>1</td>
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<td>12</td>
<td>52</td>
<td>23</td>
<td>55</td>
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<td>31</td>
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<tr>
<td>3</td>
<td>45</td>
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<td>42</td>
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<td>54</td>
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<tr>
<td>4</td>
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<td>15</td>
<td>55</td>
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<td>11</td>
<td>51</td>
<td>22</td>
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</table>

Descriptive statistics for reading comprehension, oral language comprehension, word recognition/decoding, and self-regulation measures are presented in Table 3.4. No outliers were detected. Skewness and kurtosis values were within +/-1.0 with the exception of self-regulation, which was slightly larger, but still within acceptable limits (skewness = -.92, kurtosis = 1.2). Correlations among variables are presented in Table 3.5.

Question 1

The first question, "Does self-regulation make a significant contribution to reading comprehension in addition to word recognition/decoding and oral language comprehension?" was addressed using a hierarchical multiple regression analysis.
Table 3.4 Descriptive Statistics for Reading Comprehension, Oral Language Comprehension, Word Recognition/Decoding, and Self-Regulation Measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
<th>Skew</th>
<th>Kurtosis</th>
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<tr>
<td>Reading Comprehension</td>
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<td>23.6</td>
<td>92</td>
<td>.176</td>
<td>-.330</td>
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<tr>
<td>Oral Language Comprehension</td>
<td>32</td>
<td>89.8</td>
<td>16.1</td>
<td>69</td>
<td>.172</td>
<td>-.002</td>
</tr>
<tr>
<td>Word Recognition/Decoding</td>
<td>32</td>
<td>98.4</td>
<td>11.2</td>
<td>40</td>
<td>.461</td>
<td>-.713</td>
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<td>Self-Regulation</td>
<td>32</td>
<td>53.3</td>
<td>11.8</td>
<td>55</td>
<td>-.923</td>
<td>1.293</td>
</tr>
</tbody>
</table>


Table 3.5 Correlations Among Variables

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<th>4</th>
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</thead>
<tbody>
<tr>
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<td>.841**</td>
<td>1</td>
<td></td>
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<td>2. Oral Language Comprehension</td>
<td>.685**</td>
<td>.767**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3. Word Recognition/Decoding</td>
<td>.764**</td>
<td>.700**</td>
<td>.582**</td>
<td>1</td>
</tr>
</tbody>
</table>


Hierarchical multiple regression analyses allow researchers to enter variables into an equation model according to logical and theoretical considerations. Generally, known predictors are entered into the model first in the order of their known predictive value. Then, new predictors may be added to determine what value is added at the point of entry for each (Field, 2013).

Accordingly, a three-step hierarchical multiple regression was conducted with reading comprehension as the dependent variable. Oral language comprehension was entered in step 1, as oral language comprehension is a well-established contributor to reading comprehension and has been shown to influence reading outcomes prior to the
initiation of formal instruction in reading (Nation, Cocksey, Taylor, & Bishop, 2010). Word recognition/decoding was entered in step 2, as this skill is addressed during the early stages of reading instruction. In step 3, self-regulation was entered into the model as the variable of interest. As noted above, all assumptions for hierarchical multiple regression were met prior to the analysis.

The hierarchical multiple regression analysis for the contributions of oral language comprehension, word recognition/decoding, and self-regulation to reading comprehension is summarized in Table 3.6 and visually profiled in Figure 3.0. Step 1 revealed that oral language comprehension contributed a significant amount of variance to reading comprehension, $F(1,30)=72.5, p<.00, R^2 = 0.71$, indicating that approximately 71% of the variance in reading comprehension can be accounted for by oral language comprehension. Introducing word recognition/decoding into the model in step 2 explained less than 1% of unique variance to reading comprehension and this change in $R^2$ (.004) was not significant, $F(1,29) = .393, p = .54$, indicating that word recognition/decoding did not account for a significant amount of unique variance above and beyond oral language comprehension. In step 3, adding self-regulation to the model resulted in a statistically significant change in $R^2$ (.06), indicating that self-regulation explains nearly 6% of unique variance to reading comprehension $F(1,28) = 6.98, p = .01$.

The hierarchical multiple regression analysis was repeated using dummy variables for the grade levels of participants to determine if a significant contribution would be made to the model. Dummy variables included designations for 6th, 7th, and 8th grades and were included in a fourth step. The analysis revealed that the grade level of participants was not a significant predictor of reading comprehension abilities, ($F(2,26)=.363, p = .70$).
Table 3.6 Hierarchical Multiple Regression Analysis Summary for the Contributions of Oral Language, Word Recognition/Decoding, and Self-Regulation to Reading Comprehension

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Unstan. β</th>
<th>S.E.</th>
<th>Stan. β</th>
<th>t</th>
<th>Sig.</th>
<th>Adj R²</th>
<th>R²</th>
<th>ΔR²</th>
<th>Sig.ΔR²</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 (Constant)</td>
<td>-66.35</td>
<td>13.22</td>
<td>-5.02</td>
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<td>.71</td>
<td>.71</td>
<td>.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral Language</td>
<td>1.23</td>
<td>.15</td>
<td>.84</td>
<td>8.51</td>
<td>.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2 (Constant)</td>
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<td>-3.62</td>
<td>.00</td>
<td>.69</td>
<td>.71</td>
<td>.04</td>
<td>.54</td>
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<td></td>
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<td>.00</td>
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<td></td>
</tr>
<tr>
<td>Word/Recognition Decoding</td>
<td>.21</td>
<td>.33</td>
<td>.10</td>
<td>.63</td>
<td>.54</td>
<td></td>
<td></td>
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<tr>
<td>Step 3 (Constant)</td>
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<td>19.31</td>
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<td>.77</td>
<td>.06</td>
<td>.01</td>
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<td>.56</td>
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<tr>
<td>Word Decoding</td>
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<td>.06</td>
<td>.43</td>
<td>.67</td>
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<tr>
<td>Self-Regulation</td>
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<td>.34</td>
<td>2.64</td>
<td>.01</td>
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</tr>
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<td>32</td>
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<td>32</td>
</tr>
</tbody>
</table>

Note. Unstan.= Unstandardized; S.E.= Standard Error; Stan.= Standardized; Sig. = Significance; Adj =Adjusted.

Figure 3.0. Proportions of Reading Comprehension Variance Accounted for by Oral Language Comprehension, Word Recognition/Decoding and Self-Regulation for the Unselected Sample of Participants

Questions 2 and 3

The second and third questions, “What is the strength of the relationship between decoding and self-regulation?” and “What is the strength of the relationship between overall oral language functioning and self-regulation?” were addressed using Pearson’s correlation
coefficients for word recognition/decoding and self-regulation, then oral language comprehension and self-regulation. Results revealed the following respectively: \( r = .582, \ r^2 = .33 \ n=32, \ p < .001. \) and \( r = .700, \ r^2 = .49 \ n=32, \ p < .001. \) Hence, there is a moderate positive relationship between self-regulation and word recognition/decoding \( (r^2 = .33, \ or \ 33\%) \) and a strong positive relationship between self-regulation and oral language comprehension \( (r^2 = .49, \ or \ 49\%). \)

**Question 4**

The fourth question, “Is the contribution of self-regulation to reading comprehension the same for students with language/learning difficulties and students with typical language/learning histories?” was addressed using two hierarchical multiple regression analyses. The first analysis used a dummy variable for participants’ language/learning status: students with language/learning difficulties \( (n=17) \) and students with typical language/learning histories \( (n=15) \) and included a product term for self-regulation and group status to capture the contribution of the interaction to the model. Table 3.7 presents descriptive statistics for reading comprehension, oral language comprehension, word recognition/decoding, and self-regulation for students according to group status.

<table>
<thead>
<tr>
<th>Overall Language Learning (LL) Status</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>Oral Language Comprehension</td>
<td>101.73</td>
<td>12.139</td>
<td>15</td>
</tr>
<tr>
<td>Word Recognition/Decoding</td>
<td>104.47</td>
<td>11.319</td>
<td>15</td>
</tr>
<tr>
<td>Self-Regulation</td>
<td>59.27</td>
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<td>15</td>
</tr>
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<td><strong>LLD History</strong></td>
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</tr>
<tr>
<td>Reading Comprehension</td>
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<td>12.521</td>
<td>17</td>
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<tr>
<td>Oral Language Comprehension</td>
<td>79.24</td>
<td>10.929</td>
<td>17</td>
</tr>
<tr>
<td>Word Recognition/Decoding</td>
<td>93.00</td>
<td>8.132</td>
<td>17</td>
</tr>
<tr>
<td>Self-Regulation</td>
<td>48.47</td>
<td>12.047</td>
<td>17</td>
</tr>
</tbody>
</table>

Note. LLD=Language/Learning Difficulties
Because the variable lacked significance in prior hierarchical multiple regression analyses, word recognition/decoding was removed from this model to improve the overall fit of the data. The independent variables, oral language comprehension and self-regulation, were centered for ease of interpretation.

The second hierarchical multiple regression analysis used to address this question was completed upon splitting the data into two groups: students with language/learning difficulties and students with typical language/learning histories. All variables were included in the analyses, oral language comprehension, word recognition/decoding, and self-regulation. This method was selected to capture the change in $R^2$ for each variable at its point of entry into the model so that a direct comparison could be made for proportions of variance accounted for between groups.

The first hierarchical multiple regression analysis included the following steps and results. Step 1 revealed that oral language comprehension contributed a significant amount of variance to reading comprehension, $F(1,30)=72.45, p<.00, R^2 = 0.71$, indicating that approximately 71% of the variance in reading comprehension can be accounted for by oral language comprehension in this model. In step 2, adding self-regulation to the model resulted in a statistically significant change in $R^2$ (.06), indicating that self-regulation explains nearly 6% of unique variance to reading comprehension, $F(1,29)=7.47, p < .01$.

Adding language/learning group status to the model in step 3 did not result in a significant change in $R^2$ (.02), $F(1,28)=2.60, p=.12, R^2 = 0.79$, indicating that language/learning status insignificantly accounted for only 2% of additional variance to reading comprehension. However, adding the interaction between self-regulation and group language/learning status into the model in step 4, resulted in a significant change in $R^2$ (.05), $F(1,27)=8.30, p=$
.01, \( R^2 = 0.84 \), indicating that 5% of additional variance could be explained by the interaction between self-regulation and group status. Table 3.8 summarizes the results of the hierarchical multiple regression analysis investigating the contributions of oral language comprehension, self-regulation, language/learning status, and the interaction term for self-regulation and group status to reading comprehension.

Next, hierarchical multiple regression analyses were performed to explore the proportion of variance in reading comprehension accounted for by oral language comprehension, word recognition/decoding, and self-regulation for students with and without histories of language/learning difficulties.

For students with no history of language/learning difficulty the following results were revealed. Oral language comprehension significantly predicted reading comprehension scores, \( B=1.26, \beta=.70, t(13)=3.60, p<.004 \). Oral language comprehension also explained a significant proportion of variance in reading comprehension \( F(1,13)=12.644, p<.00, R^2 = 0.49 \), indicating that approximately 49% of the variance in reading comprehension can be accounted for by oral language comprehension for this population of students. Word recognition/decoding did not significantly predict reading comprehension scores, \( B=.19, \beta=.10, t(12)=.38, p=.71 \). Further, word recognition/decoding explained less than 1% of unique variance to reading comprehension and this change in \( R^2 (.006) \) was not significant, \( F(1,12) = .146, p = .71 \). Self-regulation significantly predicted reading comprehension scores, \( B=1.52, \beta=.61, t(11)=3.10, p<.01 \). Self-regulation also explained a significant proportion of variance in reading comprehension, \( F(1,11)= 9.301, p < .01 \). Self-regulation resulted in a significant change in \( R^2 (.23) \), indicating that self-regulation explains approximately 23% of unique variance to reading comprehension for
participants with typical language/learning histories. Figure 3.1 presents the proportions of variance in reading comprehension accounted for by these components for students with typical language/learning histories.

For students with language/learning difficulties the following results were revealed. Oral language comprehension significantly predicted reading comprehension scores, B=.82, β=.72, t(15)=4.00, p<.00. Oral language comprehension also explained a significant proportion of variance in reading comprehension F(1,15)= 16.04, p< .00, R² = 0.52, indicating that approximately 52% of the variance in reading comprehension can be accounted for by oral language comprehension for this population of students. Word

Table 3.8 Hierarchical Multiple Regression Analysis Summary for the Contributions of Oral Language Comprehension, Self-Regulation, and Language/Learning Status to Reading Comprehension

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Unstan. β</th>
<th>S.E.</th>
<th>Stan. β</th>
<th>t</th>
<th>Sig.</th>
<th>Adj R²</th>
<th>R²</th>
<th>ΔR²</th>
<th>Sig.ΔR² Change</th>
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<td>.00</td>
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<td>.77</td>
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<tr>
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<td>.81</td>
<td>.84</td>
<td>.05</td>
<td>.01</td>
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<td>-.418</td>
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</tbody>
</table>

Note. Unstan.= Unstandardized; S.E.= Standard Error; Stan.= Standardized; Sig. = Significance; Adj =Adjusted; LL= Language Learning Group
Figure 3.1. Proportions of Reading Comprehension Variance Accounted for By Oral Language Comprehension, Word Recognition/Decoding and Self-Regulation for Students with Typical Language/Learning Histories

recognition/decoding did not significantly predict reading comprehension scores, B=.28, β=.18, t(14)=.69, p=.50. The model shows a change in $R^2 (.02)$ that was not significant, F (1,14) = .47, p = .50, but explains 2% of unique variance to reading comprehension. Self-regulation approached significance in the prediction of reading comprehension scores, B=.42, β=.41, t(13)=1.87, p=.08. Self-regulation resulted in a change in $R^2 (.10)$, F (1,13) = 3.5, p = .08, that suggests that 10% of unique variance to reading comprehension can be accounted for by self-regulation. Figure 3.2 shows the proportion of variance in reading comprehension that is associated with oral language comprehension, word recognition/decoding, and self-regulation for participants with language/learning difficulties.
Figure 3.2. Proportions of Reading Comprehension Variance Accounted for By Oral Language Comprehension, Word Recognition/Decoding and Self-Regulation for Students with Language/Learning Difficulties
DISCUSSION

The purpose of this study was to examine the dually implicated processes of language and self-regulation in reading comprehension and to determine if self-regulation contributes unique variance to reading comprehension beyond word recognition/decoding and oral language comprehension. The study also sought to determine if the unique contribution of self-regulation to reading comprehension differs for students with language/learning difficulties and students with typical language/learning histories.

This study uniquely contributes to the body of work on reading comprehension by:
1) revealing self-regulation as a source of reading comprehension variance; 2) expanding the limited body of existing research on reading comprehension for adolescent learners; and 3) providing insight into how the influence of oral language comprehension, word recognition/decoding, and self-regulation differs for students with and without typical language/learning histories.

Self-Regulation and Reading Comprehension Variance

The first question in this study addressed self-regulation as a source of previously unexplained variance to reading comprehension. It was hypothesized that since self-regulation is neither a mental ability (i.e., oral language) or an academic skill (i.e., decoding) but rather a self-directive process, it would contribute unique variance to the prediction of reading comprehension, after decoding and language comprehension had been considered. A hierarchical multiple regression analysis revealed that self-regulation did significantly contribute to reading comprehension variance. Specifically, the regression model revealed the following variable contributions to reading comprehension for the unselected sample of participants: oral language comprehension, 71%; word recognition/decoding, less than
1%; and self-regulation, 6%. Thus, the hypothesis that self-regulation is a third component of reading comprehension in the Simple View was supported statistically. The hierarchical multiple regression analysis was then repeated using dummy variables for the grade levels of participants to determine if a significant contribution would be made to the model. The analysis revealed that the grade level of participants was not a significant predictor.

The finding that oral language comprehension contributed such a high percentage of variance was not surprising. Studies have shown that oral language comprehension and decoding skills contribute greatly to reading comprehension ability (Bryne & Fielding-Barnsley, 1995; Catts, Hogan, & Adolf, 2005; Chen & Vellutino, 1997; Conners & Olson, 1990; Cutting & Scarborough, 2006; Dreyer & Katz, 1992; Hoover & Gough, 1990; Johnston & Kirby, 2006; Joshi & Aaron, 2000; Megherbi, Seigneuric, & Ehrlich, 2006; Savage, 2001; Storch & Whitehurst, 2002; Tiu & Lewis, 2003). Although previous research on the contribution of oral language to reading comprehension revealed lower percentage values, this study differed in that participants were adolescent learners as opposed to students in earlier stages of reading. Students in higher grades are challenged with the task of reading and comprehending more complex text that relies more on advanced language abilities to gain meaning from print (Catts, 1993). Hence, the contribution of oral language to reading comprehension is less notable for students in earlier grades and more pronounced for student in more advanced stages of reading. Recall that Georgiou and colleagues (2009) found that oral language comprehension and decoding combined only accounted for 45-47% of reading comprehension variance in third and fourth graders and Conners (2008) found that oral language contributed only 8% of unique variance for 8-year-olds.
Likewise, the finding that word recognition/decoding did not contribute a significant amount of variance to reading comprehension for adolescent learners was not unexpected given previous research on earlier versus later predictors to reading comprehension achievement. That is, word recognition/decoding has a greater influence on reading comprehension during the early stages of reading, and oral language comprehension contributes to a greater degree in more advanced reading stages (Carver, 1998; Catts, Hogan, & Adolf, 2005; Chen & Vellutino, 1997; Hogan, Adlof, & Alonzo, 2014). For example, several researchers have found that specific skills like phonological awareness and letter identification in kindergarteners are the best predictors of reading achievement for students in grades three and four (Catts, 1990; Catts, Fey, Zhang, & Tomblin, 2001; Vervaeke, McNamara, & Scissons, 2007). However, the degree to which the present findings lacked significance was greater than expected given that Conners (2008) reported that word recognition/decoding accounted for 23% of unique variance to reading comprehension for 8-year-old students; and the current study revealed that word recognition/decoding accounted for less than 1% for students with an average age of 13 years.

Although caution should be used in comparing these data given different study participants and measures, the data suggest a shift occurs from word recognition/decoding accounting for approximately one-fourth of the variance at third grade to almost none of the variance in the more advanced readers of this study. Although not the primary aim of this study, this finding adds to the body of research investigating the contribution of decoding to reading comprehension across age and grade levels and supports previous findings that decoding is a less important variable with increasing grade levels.
Finally, the finding that self-regulation contributed 6% of unique variance to reading comprehension was in line with the aforementioned study by Conners (2008). She found that attentional control accounted for 5% of unique variance to reading comprehension. Interestingly, in contrast to the shift in oral language comprehension and word recognition/decoding variance that was noted for students at different stages of reading, the contribution of variance for this similar construct did not shift for Conners’s younger population of students and the population of older students included in this study.

Due to the limited amount of empirical research available on self-regulation and reading comprehension, the hypothesis that self-regulation would contribute significantly to reading comprehension was largely based on a synthesis of related theoretical and empirical research, as detailed in the paper. Adding to this limited body of research, this study provides evidence that self-regulation contributes unique variance to reading comprehension after controlling for oral language comprehension and word recognition/decoding.

**Self-Regulation and Known Contributors to Reading Comprehension Variance**

The second and third questions in this study addressed the relationship of self-regulation to oral language comprehension and the relationship of self-regulation to word recognition/decoding. It was hypothesized that self-regulation would have a weak positive relationship to decoding and a moderate to strong positive relationship to general language.

As shown by the correlation analysis, self-regulation was revealed to have a moderate positive relationship to word recognition/decoding ($r = .582$). Specifically, 33% of the variance in word recognition/decoding was shared with self-regulatory ability in this
population of students. That is, greater self-regulatory ability was shown to correlate with greater word recognition/decoding ability. In this study, stronger word recognition skills were measured by the recognition of more polysyllabic vocabulary words on the word-reading subtest. Recognizing written words is part being able to decode the printed syllable structures, but also in part recognizing a word once pronounced. This implies that those with better word recognition also have larger vocabularies. This is consistent with the well-established finding that better readers have much larger vocabularies (Chall & Jacobs, 2003; National Institute of Child Health and Human Development, 2000; RAND Reading Study Group, 2002; Biancarosa & Snow, 2004) and poor readers have weak vocabulary skills (Cain & Oakhill; 2006). Given that verbal working memory, a process directed by self-regulation, has been shown to correlate with vocabulary acquisition (Gathercole & Baddeley, 1989), it was not surprising that a positive relationship would exist.

The relationship between self-regulation and overall oral language functioning showed a strong positive relationship ($r = .700$). It was revealed that 49% of the variance in language functioning was shared with self-regulatory ability in this population of students. That is, as self-regulatory ability increased, oral language functioning also increased, and vice versa.

These findings were not unexpected given theoretical considerations and empirical research that support the idea that a relationship between language and self-regulatory processes exists. From a theoretical standpoint, for example, there is a large body of work that describes and explains the trajectory of the concurrent development of language and self-regulation (Cragg & Nation, 2010; Muller, Jacques, Brocki, & Zelazo, 2009; Nelson;
The common theme of this body of work is that a child’s behavior and attention are initially directed by the symbol systems of adults in his environment, such as giving the child verbal directives and corrections. Gradually, the child begins to internalize adults’ social speech and starts to talk aloud to direct his own thinking, problem solving, and self-direction. Eventually, rules are formulated in silent self-directed speech and this allows the child to plan and regulate his own behavior. In turn, greater capacity for self-regulation supports language growth, as more sophisticated self-regulatory processes are needed to process more complex language.

Likewise, the finding that self-regulation and oral language comprehension are highly correlated is in line with previous empirical research that points to this relationship in studies involving young children. For example, Berk and colleagues (1986; 1990) found that more task relevant private speech (as observed through the progression from more overt word play and repetitions through less audible muttering or lip and tongue movement with no audible signal) predicted greater attentional focus on tasks and fewer extraneous motor behaviors. Roben and colleagues (2013) also found this relationship as they compared the expression of anger and self-regulatory strategy use in children with and without impaired language. They found that children with typically developing language displayed fewer expressions of anger and more self-regulatory behaviors (i.e., self-distracting while engaged in delayed gratification exercises) than children with impaired language abilities.
Bono (2003) found that language ability was associated with cognitive school readiness and prosocial behavior. And similarly, Landry and colleagues (2002) found that verbal scaffolding supported the development of language skills and fostered later self-regulatory skills. That is, children with typical language abilities showed more mature attentional skills and independence in cognitive and social problem solving abilities. The current study supports and extends this body of research by showing that a strong relationship of language functioning and self-regulation exists for adolescent learners.

**Self-Regulation and Group Differences**

The final question of the study addressed the contribution of self-regulation to reading comprehension variance for students with language/learning difficulties (n=17) and students with typical language/learning histories (n=15). Because of the reciprocal nature of language and self-regulation, it was hypothesized that the contribution of self-regulation to reading comprehension would be similar for both groups. Two hierarchical multiple regression analyses were used to address this question comprehensively.

The first analysis was conducted to capture group differences as related to self-regulation by including an interaction term for these variables, while controlling for oral language, self-regulation alone, and group status alone. Since word recognition/decoding lacked significance in prior analyses, it was removed from this analysis to improve the overall fit of the data to the model to provide a more robust prediction.

The result of this analysis revealed that the interaction of group and self-regulation made a significant contribution to the model. In other words, the relationship of self-regulation to reading comprehension varied by group. Students with language/learning difficulties performed less well on measures of self-regulation than the group of typically
developing students, but the contribution of self-regulation to reading comprehension was greater for students with typical language/learning histories. Further, the interaction of group status and self-regulation in the model resulted in the identification of 5% of variance to reading comprehension.

The second hierarchical multiple regression analysis was performed upon splitting the data into groups according to language/learning status. All variables (oral language comprehension, word recognition/decoding, and self-regulation) were included in the analysis. This method of data analysis was used to capture the proportion of variance accounted for by each variable according to language/learning group status. Caution should be used when interpreting these results due to the further reduction of an already small sample size that was required to make this comparison. Nevertheless, these findings provide important information regarding the different contributions of self-regulation to reading comprehension for students with different language/learning histories.

The regression model revealed the following variable contributions to reading comprehension for the group of students with typical language/learning histories: oral language comprehension, 49%; word recognition/decoding, less than 1%; and self-regulation, 23%. Of these variable contributions to reading comprehension, oral language comprehension and self-regulation were significant ($p < .00$ and $p < .01$, respectively). Word recognition/decoding, as in earlier analyses, was not significant ($p = .71$). For students with language/learning difficulties the following variable contributions were observed: oral language comprehension, 52%; word recognition/decoding, 2%; and self-regulation, 10%. Of these contributions to reading comprehension, oral language was
significant ($p < .00$); word recognition/decoding lacked significance ($p = .50$); and self-regulation approached significance ($p = .08$).

It was not surprising that the proportions of reading comprehension variance accounted for by oral language comprehension was similar for both groups of students. Research clearly shows that a relationship exists between oral and written language comprehension (Catts, Adolf, & Weismer, 2006; Catts & Kamhi, 2005; Snowling, Bishop, & Stothard, 2000). Longitudinal studies have found that the prevalence of reading problems in students with low language abilities is elevated as compared to students with typical language abilities and further show that impact of low language ability on reading outcomes is lasting (Bishop & Adams, 1990; Catts, Fey, Tomblin, & Zang, 2002).

Although the proportion of variance of word recognition/decoding to reading comprehension was minimal for both groups, the proportion was slightly higher for students with language/learning difficulties. That is, students with language/learning difficulties showed slightly more reliance on the skill of word recognition/decoding while reading than typically developing peers. One possible explanation for this difference may be related to the theory proposed by the Simple View (Gough & Tunmer, 1986).

Recall that reading comprehension has been theorized to be the product of oral language comprehension and decoding. Therefore, reading comprehension ability is impacted by weakness in one or both components. In other words, poor reading comprehension can be a consequence of poor word recognition/decoding, poor oral language comprehension, or both (Catts & Kamhi, 2005; Gough & Tunmer, 1986; Lyon, Shaywitz, & Shaywitz, 2003). In this study, students with language/learning difficulties were known to have low oral language abilities. Thus, it is plausible that the greater
proportion of variance for word recognition/decoding for this group over the group of students with typical language/learning histories may have been influenced by greater reliance on the skill of word recognition/decoding.

Finally, the proportion of variance contributed to reading comprehension by self-regulation was examined for both groups of students. It was hypothesized that the proportion of variance would be similar for each group, given the relationship of self-regulation to language and language to reading comprehension outcomes. While the study did reveal lower self-regulation scores for the group of students with language/learning difficulties (m=48.47, SD=12.05) than the group of students with typical language/learning histories (m=59.27, SD=8.84), the proportions of variance contributed to reading comprehension differed.

The study revealed the proportion of variance contributed to reading comprehension by self-regulation was greater for students with typical language/learning histories (23%) than for students with language/learning difficulties (10%). This difference was not predicted in the hypothesis. These findings support that self-regulatory abilities make a significant contribution to reading comprehension in both good and poor readers. However, the findings also suggest that students with stronger language/learning abilities draw on self-regulatory competencies more than students with low language/learning abilities.

This finding is in line with related research that shows the relationship of language functioning to cognitive resource allocation necessary for adequate reading comprehension. For example, Marten and Schwarts (2003) found that children with impaired language were less able than typically developing children to manage cognitive
resources like working memory and other executive processes while reading. Montgomery (2000) looked at reading comprehension ability in children with impaired language and children with typical language functioning and found that children with impaired language have less functional verbal working memory capacity. Montgomery proposed that children with impaired language have difficulty managing cognitive resources because they are unable to efficiently self-regulate executive processes.

Similarly, Snowling (1981) showed that children with reading deficits present with problems in the executive processes of verbal self-regulation and working memory. Subsequent to these findings, it is probable that the greater contribution of self-regulation to reading comprehension for students with typical language/learning histories could be related to more efficient abilities in cognitive resource allocation, like engaging working memory, accessing prior knowledge, and inferencing, than their peers with language/learning difficulties.

**Conclusion**

The results of this investigation indicated that self-regulation contributes significant variance to reading comprehension in addition to the variance accounted for by oral language comprehension and word recognition/decoding in adolescent learners. Further, the investigation found that self-regulation, although not a linguistic or academic skill, was moderately correlated with word recognition/decoding and highly correlated with oral language comprehension. Lastly, findings revealed that self-regulation contributed a greater proportion of variance to reading comprehension for students with typical language/learning histories than for students with language/learning difficulties.
The findings of this study have important theoretical and clinical implications. First, the identification of self-regulation as a factor that significantly contributes to reading comprehension may support early identification efforts and drive the development of interventions that effectively target reading comprehension for children in early stages of reading. It is foreseeable that self-regulatory intervention techniques practiced in the context of language and literacy could support all three areas concurrently. Second, as reading comprehension problems are prevalent in higher-grade levels, this study offers direction for educational stakeholders to explore additional support for struggling students using self-regulatory reading techniques that can be implemented across content areas. And third, the identification of an additional contributor to reading comprehension variance in the context of Gough and Tunmer’s (1986) influential Simple View of Reading may encourage discussions that lead to further research on the contribution of self-regulation to reading comprehension.

Limitations and Future Research

Although the current exploratory study provides insights into the contribution of self-regulation to reading comprehension for adolescent learners and explores these contributions for students with language/learning difficulties and students with typical language/learning histories, several limitations must be addressed in future research. Some of the limitations of the study included: sample size, the lack of student diversity, the number of methods used to measure each variable, the use of real words for the word recognition/decoding measure, not accounting for gender and disability differences, and the lack of longitudinal data.
First, the current study included 32 participants. This number of participants is relatively small for making robust predictions. Future studies should attempt to replicate these findings using a larger sample size. Second, many of the participants in the study had similar demographic characteristics. Participants with varied demographic characteristics would make future research more generalizable. Third, the current study used measures for the variables reading comprehension, oral language comprehension, word recognition/decoding, and self-regulation. Future studies should use multiple measures to address each predictor to produce stronger results.

Fourth, the word recognition/decoding score used in this study was a measure of word reading ability only. While measures of word reading have been shown to be effective in measuring this skill (Johnston & Kirby, 2006), future research should combine this measure with a measure of nonsense word reading to provide a more comprehensive assessment of this ability. Fifth, the current study did not seek to determine if the relationship of self-regulation to reading comprehension varied based on gender or disability classification of the student. Future research investigating the relationship of self-regulation to reading comprehension specific to these populations of students would be useful in developing programs that address reading comprehension problems in these targeted populations. Finally, future research should include longitudinal studies that examine the effects and stability of self-regulatory performance across time.
REFERENCES


RAND Reading Study Group. (2002). *Reading for understanding: Toward an RD program in reading comprehension.* Santa Monica: RAND.


APPENDIX A
IRB INFORMATION

ACTION ON EXEMPTION APPROVAL REQUEST

TO: Rebecca Parker
Communication Sciences and Disorders

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: February 2, 2016

RE: IRB# E9728

TITLE: The Contribution of Self-Regulation to Reading Comprehension in Adolescents At-Risk for Language and Learning Difficulties


Review Date: 1/25/2016

Approved X Disapproved

Approval Date: 2/1/2016 Approval Expiration Date: 1/31/2019

Exemption Category/Paragraph: 1. 2a. 4a

Signed Consent Waived?: No

Re-review frequency: (three years unless otherwise stated)

LSU Proposal Number (if applicable): 

Protocol Matches Scope of Work in Grant proposal: (if applicable)

By: Dennis Landin, Chairman

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING – Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU’s Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
8. SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc. Approvals will automatically be closed by the IRB on the expiration date unless the PI requests a continuation.

*All investigators and support staff have access to copies of the Belmont Report, LSU’s Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb
**Project Description**

The goal of this project is to improve the literacy skills and educational outcomes of adolescents at risk of academic difficulties through the exploration of self-regulation as a factor contributing to reading comprehension outcomes. Self-regulation is typically used in reading comprehension as the reader uses self-talk to plan, organize, engage working memory, and shift perspectives to make sense of what is being read. Further, self-regulation helps the reader to self-monitor reading performance and to integrate prior knowledge with information found in text to make inferences. When breakdowns in comprehension occur, self-regulation guides the reader to make decisions about rereading, slowing down, or using other comprehension strategies.

**Participants**

*Three hundred* academically at-risk students attending Louisiana universities, colleges, and middle/high schools will be selected to participate in this study. This population typically has poor academic and social outcomes related to deficits in reading comprehension and self-regulatory skills.

**Procedure**

Students will be given four assessments across two 1-hour testing sessions. Assessments will include measures of reading comprehension, decoding, oral language, and self-regulation. Performance data gathered from these measures will serve as dependent measures for the study.

No known risks are associated with participation in this study. Materials and procedures are similar to those typically used in the educational setting. There is no risk of physical, mental, or emotional harm related to the materials or procedures presented. Study participants will be informed that they may withdraw from the study at any time with no penalty.

A unique code consisting of numbers and letters will be assigned to each student. Therefore, there is minimal risk that individual participants will be identified. Participants’ names will not be used in any publications or presentations. If a reference must be made regarding a study participant, a pseudonym will be used.
Child Assent for Participation

Project Title: The Contribution of Self-Regulation to Reading Comprehension in Adolescents At-Risk for Language and Learning Difficulties

Performance Sites: Louisiana Universities, Community Colleges, and Public Middle/High Schools

I, _____________________________, agree to participate in a study to find ways to help students improve learning. I understand that I will have to do work with my learning specialists and a speech-language pathologist and allow them to share my assignments and test scores with researchers from Louisiana State University. I understand that my name will not be used. I realize that I must follow learning session rules and complete assignments. I can decide to stop participating in the study at any time.

Student Signature: __________________________________________

Student’s Age: _______ Date: __________________

Witness* ___________________________ Date: __________________

* (N.B. Witness must be present for the assent process, not just the signature by the minor.)

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu | lsu.edu/irb
Consent for Participation

Project Title: The Contribution of Self-Regulation to Reading Comprehension in Adolescents At-Risk for Language and Learning Difficulties

Performance Site: Louisiana Universities, Community Colleges, and Public Middle/High Schools

Investigators: The following investigators are available for questions, M-F, 8:00 a.m. – 4:30 p.m. Dr. Jan Norris COMD, Louisiana State University (LSU), (225) 578-3936 Rebecca Parker COMD, LSU, rpark33@lsu.edu, (225) 578-2992

Purpose of the Project: College and university centers for academic success, area middle/high schools, and LSU are working together to improve reading comprehension and educational outcomes of adolescents at risk of academic difficulties through the exploration of self-regulation as a factor contributing to reading comprehension outcomes. Self-regulation is typically used in reading comprehension as the reader uses self-talk to plan, organize, engage working memory, and shift perspectives to make sense of what is being read. Further, self-regulation helps the reader to self-monitor reading performance and to integrate prior knowledge with information found in text to make inferences. When breakdowns in comprehension occur, self-regulation guides the reader to make decisions about rereading, slowing down, or using other comprehension strategies.

Number of Subjects: 300

Inclusion Criteria: Participants must be enrolled in a Louisiana college, university, or area middle/high school. Participants must speak English as their primary language and must have visual/hearing acuity within normal limits.

Exclusion Criteria: Participants not enrolled in a college, university or middle/high school will be excluded. Students who do not speak English as a primary language will not be included in the study. Students with impaired visual/hearing acuity will not be included in the study.

Description of the study: This study will explore self-regulation as a contributing factor in reading comprehension, beyond the well-established contributions of decoding and oral language functioning. It is hypothesized that self-regulation will significantly contribute to reading comprehension.

Procedure
Students will be given four assessments across two 1-hour testing sessions. Assessments will include measures of reading comprehension, decoding, oral language, and self-regulation. Performance data gathered from these measures will serve as dependent measures for the study. Each student’s academic history will be reviewed, including middle/high school GPA, SAT or ACT scores, and college GPA (when applicable).
**Benefits:** This information would provide valuable information to the participant regarding his/her unique reading comprehension strengths and weaknesses. Further, identifying the factors that significantly contribute to reading comprehension would impact academic programming that may result in better literacy outcomes.

**Risks:** There is a minimal risk of the participants being identified. Codes will be assigned to each student and all records will be stored in a locked filing cabinet. Only the investigator will have access to student records. No other risks are associated with study participation.

**Right to Refuse:** Participation is voluntary. At any time, the subject may withdraw from the study without penalty or loss of any benefit to which they might otherwise be entitled.

**Privacy:** We will use these data to influence academic programming that will improve the reading comprehension ability and overall academic progress of students at risk for learning difficulties. Investigators may review the school records of participants in this study. The name of the student will not be shared with anyone. All test scores and other performance data will be anonymously entered into a file for statistical analysis. The results of this study may be published, but no names or identifying information will be included for publication. Subject identity will remain confidential unless law requires disclosure.

**Financial Information:** There is no cost for participation in the study, nor is there any compensation to the subjects for participation.

The study has been discussed with me and all of my questions have been answered. I may direct additional questions regarding study specifics to the investigator. If I have questions about subjects' rights or other concerns, I can contact Dennis Landin, Chairman, Institutional Review Board, (225) 578-8692, irb@lsu.edu, www.lsu.edu/irb.

My child, ________________________, may participate in the study described above, and I acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

**Parent's Signature:** __________________________ Date: __________________

The parent has indicated to me that he/she is unable to read. I certify that I have read this consent form to the parent and explained that by completing the signature line above he/she has given permission for his/her child to be included in the study.

**Signature of Reader:** ________________________ Date: __________________

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APPENDIX B
STROOP TASK COLOR BLINDNESS SCREENING PRETEST

Stroop Task Screening: Color Blindness
APPENDIX C
STROOP TASK COLOR WORD READING
SCREENING PRETEST

RED
BLUE
GREEN
ORANGE
PURPLE
BLACK
BROWN
GRAY
YELLOW
VITA

Rebecca Parker completed her Bachelor of Arts degree in Communication Sciences and Disorders in 1997 at Louisiana State University. She continued at Louisiana State University to complete a Master of Arts degree in Communication Sciences and Disorders in 1999. Following the completion of her master’s degree, Rebecca worked in a variety of clinical and academic settings, including schools, rehabilitation centers, nursing homes, early childhood centers, and private practice. Rebecca earned her certificate of clinical competence from the American Speech-Language Hearing Association in 2000. After fourteen years of clinical practice, Rebecca returned to Louisiana State University to pursue her PhD under the direction of Dr. Janet Norris. During her matriculation, Rebecca focused her studies on adolescent learners and the executive processes that impact reading comprehension. While teaching at LSU as a graduate assistant and instructor of record, Rebecca was awarded the LSU Tiger Athletic Foundation Teaching Award for 2015 in recognition of her “commitment to teaching, serving the Baton Rouge community, and furthering the civic engagement of LSU students.” Rebecca is currently self-employed as a private practice speech-language pathologist.