THE CONTRIBUTION OF TEXT READING FLUENCY TO READING COMPREHENSION: NORMATIVE FINDINGS AND IMPLICATIONS FOR THE ASSESSMENT OF READING DISABILITIES

by

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ABSTRACT

The current investigation is comprised of two studies. Study 1 examined the theoretical and empirical relationships among word reading, text fluency, and reading comprehension. Third and fourth grade students (N=190) completed a series of standardized measures of word reading accuracy, word fluency, text fluency, and reading comprehension measures. Three models regarding how word reading accuracy, word reading fluency, and text reading fluency operate together to produce good comprehension were evaluated. The results supported a *text fluency model* which states that word reading accuracy, word fluency, and text fluency each make important contributions to comprehension in 3rd grade children. However, the influence of these basic reading skills declined in the 5th grade children, suggesting that other factors may be needed to explain reading comprehension in older students. Study 2 explored the diagnostic utility of text fluency measures in the identification of children with reading disabilities. Participants were 51 children referred to a university based clinic because of serious reading problems or a diagnosis of dyslexia, where children completed a battery of standardized intellectual, reading achievement, and processing measures. The results suggested that it is essential to assess text fluency in addition to word reading because failure to do so may result in the under-identification of children with reading disabilities. A group of children were identified within the clinical sample that exhibited specific deficits in their text fluency skills beyond those that could be accounted for by assessment of word reading skills. Together these results suggest that text fluency is an important reading skill for elementary school children and that this skill should not be overlooked when assessing children suspected of having a reading disability.

INDEX WORDS: text reading fluency, reading comprehension, learning disabilities

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

REVIEW OF THE LITERATURE

The development of fluent text reading skills is a primary educational goal for elementary school aged children. Although the definition of oral reading fluency is debated, one common definition is the ability to read text quickly, accurately, and with appropriate expression (National Reading Panel, 2000). Children are expected to develop proficient oral reading fluency skills during second and third grade, and by fourth grade children transition from learning to read to reading to learn (Chall, 1979, 1996). Those who do not possess fluent skills will likely experience difficulty learning content area knowledge from text in future grades, an effect which is difficult to remediate (Chall, Jacobs, & Baldwin, 1990). In sum, the development of fluent oral reading skills is essential for the academic success of children. For the sake of parsimony, the term *text fluency* will be used to refer strictly to the reading of connected text throughout this work.

In addition to the possible negative affects on content area learning, several other consequences have been associated with poor text fluency that stems from its being slow and laborious (Raskinski, 2001). Excessively slow reading leads to feelings of frustration on the part of the reader, which could further exacerbate reading difficulties (Raskinski, 2001) or undermine their motivation to read. Not only does it take dysfluent readers longer to read a given text, slow reading rate has been associated with children reading less text in general (Leinonen, Muller, Leppanen, Aro, Ahonen, & Lyytinen, 2001; NEAP, 1992; Pinnell, Pikulski, Wixon, Campbell, Gough, & Beatty, 1995; Raskinski, 2001). As reading lots of text is thought to promote the development of fluent reading

skills (Anderson, Wilson, & Fielding, 1988; Taylor, Frye, & Maruyama, 1990), children who read less due to reading dysfluency will not improve their reading skills at the same rate as their peers. On the other hand, children with fluent text reading skills may get more enjoyment from and thus spend more time reading, which in turn may promote the further development of fluent text reading skills.

Despite the importance of text fluency for children's academic development, text fluency is often overlooked in the assessment of reading disabilities. This omission may be due in part to the lack of available standardized and norm-referenced measures of text fluency (Fuchs, Fuchs, Hosp, & Jenkins, 2001). The majority of commonly used tests of broad reading achievement include word reading, decoding (sometimes called, pseudoword reading, phonemic decoding or word attack), and reading comprehension measures, but seldom include measures of text fluency (Fuchs et al., 2001). To my knowledge, the Gray Oral Reading Test -4 (GORT; Wiederholt & Bryant, 2001) is the only commonly used standardized, norm-referenced test of text fluency currently available for the assessment of children. Some reading measures are titled "reading fluency," but, in fact, do not fit standard definitions of fluency. For example, the reading fluency subtest in the Woodcock-Johnson Tests of Achievement – Third Edition assesses a child's ability to quickly read simple sentences and decide whether the statements (e.g., *The grass is green.*) are accurate (Mather & Woodcock, 2001). Standard definitions of reading fluency emphasize the fluent oral reading of large blocks of text (Kuhn & Stahl, 2004) as opposed to single sentences. Further, given the simplicity of the sentences, for older children this measure may represent general speed of processing or semantic verification processes rather than reading fluency skills.

The omission of appropriate measures of text fluency in the assessment of children's reading skills might have important implications for both diagnostic decision-making and in the evaluation of intervention outcomes. Although only a few studies on the identification of reading disabilities have included measures of text fluency, there is some suggestive evidence that these measures may be more sensitive to detecting reading difficulties than word reading measures (Breen & Drecktrah, 1990; Nation & Snowling, 1997). Moreover, some research suggests that deficits in text fluency are more difficult to remediate than deficits in word reading skills (Torgesen et al., 1999). If the evaluation of a child's response to intervention did not include a measure of text fluency, misleading conclusions may be drawn regarding the efficacy of the intervention.

Estimates of children's reading skills may differ between measures of text fluency and single word reading (Breen & Drecktrah, 1990; Nation & Snowling, 1997). If these differences are not due to the psychometric properties of the tests used, this might suggest that text fluency and word reading represent related but distinct reading skills. Some obvious differences in the task demands of word reading versus text fluency seem to exist. Whereas reading a list of words is a relatively short task, reading connected text often (although not always) involves a longer period of time engaged in sustained reading. Also, whereas "comprehension" when reading word lists involves accessing the individual word's meaning, children must simultaneously identify individual word meanings and construct meaning from the text as they read connected text (Sweet & Snow, 2003).

Differences exist across theorists regarding the extent to which text fluency and word reading skills represent distinct skills in relation to reading comprehension. Some

theorists view text fluency and the subsequent comprehension of text as being primarily the result of automatic (i.e., fast and accurate) word reading skills (LaBerge & Samuels, 1974; Perfetti, 1977, 1985; Torgesen, 2001). However, others perceive text fluency as making contributions to comprehension that go beyond those of word recognition. Some argue that features of the text such as the syntactic, morphological, and semantic cues in the text are used to identify phrasal boundaries and therefore facilitate comprehension (Schreiber, 1980; Young & Bowers, 1995). Text reading is also said to facilitate word reading and, thereby, improve comprehension either by triggering the automatic activation of semantic networks or though the conscious use of context (Posner & Synder, 1975). Still others conceptualize text fluency as representing the coordination of multiple or perhaps *all* reading processes (Fuchs et al., 2001; Wolf & Kadzir-Cohen, 2001).

The theoretical and empirical relationships among word reading, text fluency, and reading comprehension have diagnostic implications for the assessment of children with reading disabilities. Reading comprehension, or the construction of meaning from text, is the gold standard of reading skill and the desired outcome of reading for students. If text fluency makes contributions to comprehension beyond those accounted for by word reading, then a strong argument can be made for incorporating text fluency in the assessment of children's reading skills. However, if word reading is most primary to both text fluency and comprehension, then the comparatively "quick and easy" word reading measures would suffice, making the more time-consuming and complicated text fluency measures unnecessary when assessing children's reading skills.

Currently, educational researchers are calling for research examining several aspects of text fluency. Theoretical questions regarding the definition of text fluency need to be clarified (Wolf & Kadzir-Cohen, 2001), and a normative framework for the development of text fluency and its component structure is needed (Fuchs et al., 2001; Wolf & Kadzir-Cohen, 2001). The role of more specific variables such as text difficulty, naming speed, and prosody on text fluency requires further exploration (Fuchs et al., 2001). Implications for the incorporation of text fluency into the assessment of reading skills, especially with regard to fluency deficits in the identification of reading disability subtypes, need to be examined (Fuchs et al., 2001; Wolf & Kadzir-Cohen, 2001). Lastly, the application of fluency related knowledge to reading interventions requires further attention (Fuchs et. al., 2001; Lyon & Moats, 1997; National Reading Panel, 2000; Wolf & Kadzir-Cohen, 2001).

The purpose of this work is to explore the relationships among word reading, text fluency, and reading comprehension in 3rd and 5th grade children, and to determine the implications for incorporating measures of text fluency in the identification of children with reading disabilities. This study will provide needed research in two of the aforementioned areas requiring exploration, as this work will build upon the existing understanding of the development of text fluency and will examine the diagnostic utility of text fluency measures in the assessment of children's reading skills.

Definitions of Text Fluency

Text fluency has been defined most simply as rate and accuracy in oral reading (Torgesen, Rashotte, & Alexander, 2001; Hasbrouk & Tindal., 1992; Shinn, 1989). However, some definitions of text fluency include additional components. Reading

prosody, which is characterized by the ability to read text in an expressive, speech-like manner, is considered by many to be the hallmark of fluent reading (Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004). Therefore, prosody (or expressiveness) has also been included in some definitions of text fluency (Allington, 1983; Aulls, 1978; Wolf & Kadzir-Cohen, 2001). For example, the National Reading Panel (2000) described text fluency as the ability to read text quickly, accurately, and with appropriate expression. Several definitions of text fluency include reading comprehension processes (Fuchs et al., 2001; Kame'enui, Simmons, Good, & Harn, 2001; Harris and Hodges, 1995; Wolf & Kadzir-Cohen, 2001). Other definitions specify the levels of processing involved in text fluency, such as Kame'enui et al.'s (2001) description of text fluency as the development of proficiency in lower level skills (such as phonemic awareness) and as the outcome of proficiency in higher level skills (such as comprehension). Additionally, Wolf and Kadzir-Cohen's (2001) definition of text fluency described the development of fluency in terms of both its underlying component processes (i.e., perceptual, phonological, orthographic, morphological, semantic, and syntactic) and levels of subskills (e.g., letter, letter pattern, word, sentence, and passage). This work will borrow the simple definition of text fluency as rate and accuracy in oral reading (Torgesen, Rashotte, & Alexander, 2001; Hasbrouk & Tindal, 1992; Shinn, 1989), as these two components are the most readily observable and therefore reliably measured behaviors.

The focus of this work is on oral rather than silent reading. Beginning readers read aloud, but as children become skilled readers they transition to primarily silent reading. However, even with older elementary school children, the assessment of oral reading is generally preferred because it is an observable behavior and is therefore more

reliability and validly assessed. When text fluency is determined by the silent reading of text, the accuracy of what is read cannot be recorded and reading rate is determined by the child's self-report (e.g., circling the last word read), the accuracy of which may be questionable. Further, (oral) text fluency may be more closely associated to reading comprehension than silent text fluency. Fuchs, Fuchs, Eaton, and Hamlett (2000, as cited in Fuchs et al., 2001) found higher correlations between (oral) text fluency and two comprehension measures (.84, .80) than for silent text fluency (.38, .42) in 4th grade students. It was suggested that inaccurate report on the part of silent readers contributed to this rather unexpected finding. However, other possibilities exist. For example, perhaps oral reading allows the reader to use his or her listening skills to comprehend the text. More research is needed to replicate this finding and investigate the relationship between oral and silent reading across development. Unless otherwise specified, all references in this work to either text or word fluency refers to children's oral reading.

Assessment of Reading Fluency

Two primary components are most commonly represented in reading fluency measures: the ability to read quickly (reading rate) and accurately (accuracy). Reading fluency is typically measured at the word or text level.

Word Fluency

Reading fluency is sometimes conceptualized as *word fluency* rather than *text fluency*, or children's ability to quickly and accurately identify words or nonwords presented out of context in a word list rather than in text format. Although standardized measures of reading often include measures of children's ability to read untimed from lists of words or nonwords, to my knowledge the only standardized norm-referenced

measure of list fluency to date is the Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1997).

Text Fluency

Typically, tests of text fluency require children to read aloud from connected text while an examiner records the number and type of misread words as well as the time it takes the child to complete the text or passage. Thus, most measurement instruments employ the simplest definition of text fluency as rate and accuracy in the oral reading of text as these are the most readily measurable of all the indicators of the reading fluency construct (Torgesen et al., 2001). However, rate and accuracy are not measured in the same manner across all measurement instruments. Choice of instrumentation depends largely on the purpose of the assessment, as different types of text fluency measures provide varying types of information.

Standardized Measures of Text Fluency

Standardized and norm-referenced tests represent one approach to assessing children's text fluency skills. For example, the Gray Oral Reading Test-Fourth Edition (GORT-4; Weirdholt & Bryant, 2001) is one commonly used standardized, norm-referenced test of text fluency. Children are asked to read aloud from passages of increasing difficulty until the text becomes too challenging. Children's ultimate text fluency level is determined by the accuracy with which children read the text and the rate at which the child reads it. Standard scores allow comparisons to be made between an individual's reading skill and that of his or her same-aged peers. Assignment of children to standard scores on this assessment is done using a combination of rate indicators and accuracy indicators.

Curriculum-Based Measurement (CBM)

Curriculum-based measurement (CBM) is another commonly used method of assessing text fluency. CBM in reading uses a set of standardized procedures for assessing text fluency (see Shinn, 1989), but the text from which children read is not controlled. Rather, text is taken directly from the curriculum used in the child's classroom. Proponents of this form of CBM suggest that the use of local text in the measurement of fluency is essential, as text from the child's curriculum represents what is expected of the children within the classroom. Text fluency is measured as the number of words read correctly per minute or *cwpm*, which combines both the speed and accuracy of reading. The cwpm is commonly used by researchers outside of the CBM literature as an indicator of fluency (e.g., Torgesen et al., 2001). Given the child's grade, the time of year (fall, winter, spring), and cwpm, CBM norms provide information regarding a child's text fluency in the form of quartiles (e.g., Hasbrouk & Tindall, 1992, 2006; Madelaine & Wheldall, 2004; Marston & Magnusson, 1988; Shinn, 1989).

Some question the validity of the CBM approach precisely because of its dependency on the particular school's curriculum (Sofie & Riccio, 2002). Still, some teachers and reading specialists use CBM in text fluency to place children in instructional groups, provide them with appropriate reading materials, monitor progress, and set instructional goals (Hasbrouck & Tindall, 1992). Additionally, it has been suggested that this form of CBM can be used in the screening and eligibility determination of students for special education (Fewster & Macmillin, 2002; Hintze & Pettite, 2001; Sofie & Riccio, 2002).

Informal Reading Inventories

Whereas norm-referenced measures provide information about achievement in comparison to one's peers, criterion-referenced tests measure the extent to which absolute mastery in a specific skill area has been achieved (McCabe, Margolis, & Barenabum, 2001). Informal Reading Inventories (IRIs) are a type of criterion-referenced test that are often used to place children in instructional level reading material, assess reading progress, or place in reading groups. IRIs typically include a variety of items such as word lists, graded passages, reading comprehension questions, and story retells. Although IRIs often assess a variety of reading skills to place children in text of the appropriate difficulty level, they usually assess reading errors but not rate as a main indicator of text fluency (e.g., the *Qualitative Reading Inventory-3*, Leslie & Caldwell, 2001).

Miscue Analysis

With this method of assessing text fluency, types of oral reading errors (often called miscues) are frequently examined. It has been argued that the type of errors that children make while they are reading can provide important qualitative information regarding the individual's reading processes (Goodman & Goodman, 1994). Miscue analysis can be conducted from any oral reading of text, and is often done in conjunction with other assessments of text fluency. Different coding taxonomies may be used to code reading errors (i.e., Goodman & Burke, 1973; Weirdholt & Bryant, 1992, 2001), but a common breakdown includes a distinction between whether or not miscues preserve text meaning, grammatical function, morphological function, orthographic similarity (similar letter or letter patterns), or phonetic similarity (similar sounds). Miscue analysis can yield a variety of useful information, such as the types of word identification strategies

being employed. For example, it might be observed that the child is using initial letters to guess unknown words, even when the substituted word does not make sense in the sentence. In contrast, if a child self-corrects misread words, then this may indicate that the child is engaging in comprehension monitoring.

Reading Prosody

Reading prosody, or the ability to read with speech-like expression, is sometimes included in the assessment of fluent reading skills. Reading prosody is commonly evaluated using rating scales. For example, the National Assessment of Educational Progress used a 4-point fluency scale, where rating of 1 represented "word-by-word reading, with occasional 2-word or 3-word phrases that did not preserve meaningful syntax" to a rating of 4 which represented "primarily in larger, meaningful phrase groups, with regressions, repetitions, and deviations that did not detract from the overall structure of the story, and where most of the story was read with expressive interpretation" (Pinnell et al., 1995). Allington (1983) used a similar 6-point rating scale where a rating of 1 represented primarily "word-by-word reading" and a rating of 6 represented reading where 'phrases coinciding with punctuation, appropriate semantic and syntactic emphasis, and expression that approximated normal speech." More specific examinations of prosody might include direct measures of prosodic features such as the pitch, stress or intonation, and the duration of pauses within and between sentences (Cowie, Douglas-Cowie, & Wichman, 2002; Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004). However, few studies have examined in depth the role of prosody in text fluency probably due to the highly specialized equipment and technical skills needed to examine

specific prosodic features. Also, prosody is included in fewer definitions of text fluency than other aspects of fluency such as speed and accuracy.

Limitations and Considerations

Several possible limitations should be considered when using measures of text fluency. Reading rate may be limited by the individual's ability to quickly produce oral language (Goodman & Goodman, 1994). For example, if a child has an articulation problem, speech impediment, or merely just speaks slowly, then the child's oral reading rate may not accurately reflect the ability to read quickly. Moreover, younger children have a slower and more variable speaking rate than older children do, so measures that do not take into account the child's age may end up unduly penalizing younger children (Smith, 1992). When reading aloud individuals make superficial articulation errors as they might when participating in conversations (Goodman & Goodman, 1994), suggesting that counting such errors might misrepresent a child's fluency. Lastly, given that silent reading is the more dominant mode of reading for older, more experienced readers, it is unclear to what level our measurement of text fluency in older children is distorted by this change in reading modalities.

The difficulty level of text influences how quickly and accurately a child is able to read the text (Young & Bowers, 1995). For example, if a child with average skills reads from a grade level text and a much more difficult text, the reading rate and accuracy from the two texts may not be comparable. Further, the quality of the text could impact how readily a child is able to read a text. Despite the importance of the text quality and difficulty level, it is largely ignored when considering the appropriateness of both curriculum and assessment instruments (Hiebert, 2002). The question of how text

difficulty influences fluency may be complicated by the fact that disagreement exists regarding *what is* grade level material (Hiebert 2002). Several rubrics exist for categorizing the difficulty level of text, such as readability formulas (e.g. Fry, 1968), lexiles (MetaMetrics, 2000), critical word factor (Hiebert, 2000), and text leveling (Peterson, 1991). However, these systems often result in vastly different categorizations of the same text (Hiebert, 2002). More research is needed to examine the influence of the relative difficulty level of the text on text fluency (Fuchs et al., 2001).

Although overlap exists across measures of text fluency, fluency can be conceptualized and measured in several different ways. Therefore, when reading literature on text fluency, one must consider how text fluency was defined, measured, and the difficulty level of the text in any given study.

Reading Fluency and Definition of Reading Disability

A variety of terms are used to refer to children experiencing serious reading difficulties, and as such the terms used in this work need to be specified. The federal guidelines set forth in the Individuals with Disabilities Education Improvement Act (IDEA, 2004), P.L. 108-446 define a learning disability as a "disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations." Specifically, a learning disability can occur in the areas of oral expression, listening comprehension, written expression, basic reading skills, reading comprehension, mathematics calculation, and mathematical reasoning. The term reading disability can be used interchangeably with a specific learning disability in the area of reading, and is used throughout in this work. Until

recently, an IQ/achievement discrepancy was the primary criteria for identifying a child as having a learning disability. A minimum of discrepancy of 16 points between a child's reading achievement and intellectual functioning as measured by a norm-reference and standardized test, evidence of a processing deficit, at least average intellectual functioning, and several exclusionary criteria (i.e., not due to health, vision, hearing, social and emotional status, cultural and economic disadvantage, etc.) were required for the determination of a learning disability. One model proposed as an alternative to the discrepancy criteria is the low achievement or cut score model, where standard scores of 85 or lower are the primary criteria of a reading disability (Fletcher, 1985, Stanovich, 1999). Some proponents of the cut-score model some also endorse exclusionary criteria such as average intelligence (i.e., Dombroski et al., 2004; Siegel, 1999). When IDEA was reauthorized in 2004, this legislation was amended to allow for the consideration of the child's response to scientific, research-based interventions when determining eligibility for a learning disability. This modification was driven by consensus among experts and a wealth of literature criticizing the validity of the IQ/achievement discrepancy criteria.

Although the discrepancy criteria has been widely criticized for being atheoretical (Lyon, 1987), more damaging has been the overwhelming evidence that children identified as LD based on this criteria cannot be distinguished from other poor achieving readers on reading related cognitive tasks (Fletcher et al., 1994; Shankweiler et al., 1995; Stuebinger et al., 2002; Velluntino et al., 1996; Velluntino et al., 2000). Further, great variation exists across states on how the discrepancy is computed, which tests are used, and the size of the discrepancy, contributing to inconsistency in the definition and prevalence of LD across states (Fuchs & Fuchs, 2006). Variation across states in the

interpretation of the federal guidelines has always existed, and as state representatives reconsider their own state's definitions of learning disabilities many are likely to include response to intervention (RTI) criteria.

The federal guidelines set forth in IDEA are used to determine whether children are eligible for special education services in the school setting. However, practitioners who work in clinical settings frequently used the term "reading disorder" as defined by the Diagnostic and Statistical Manual of Mental Disorders- Fourth Edition (DSM-IV). The definition of a reading disorder essentially adheres to the IQ/achievement discrepancy criteria, although a minimum discrepancy is not specified. Another term, dyslexia, is frequently used by educators, researchers, and practitioners, and represents a subtype of learning disability. The International Dyslexic Association defines dyslexia as, "a specific learning disability that is neurological in origin. It is characterized by difficulties with accurate and / or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge."

Although the federal definition specifies that a reading disability can occur in two areas (basic reading and reading comprehension), three types of reading disabilities were reviewed by Lyon, Fletcher, and Barnes (2003) including word-level reading disability, reading comprehension disability, and reading fluency disability. However, the concept of a reading fluency disability is controversial, and more work is needed to explore this

potential form of reading disability (Lyon et al., 2003). Relative to the lack of research regarding text fluency problems as a disability, its importance in typically developing reading skill is comparatively well established (Chall, 1996; Kuhn & Stahl, 2004).

Etiology of Reading Disabilities

Consensus exists that phonological processing represents a core deficit in reading disabled as well as what Stanovich and Siegel (1994) termed "garden-variety poor readers" (Fletcher, Shaywitz, Shankweiler, Katz, Liberman, Stuebing, Francis, Fowler, & Shaywitz, 1994; Liberman & Shankweiler, 1991; Morris, Stuebing, Fletcher, Shaywitz, Lyon, Shankweiler, Katz, Francias, & Shaywitz, 1998; Shankweiler, Crain, Katz, Fowler, Liberman, Brady, Thornton, Lundquist, Dreyer, Fletcher, Stuebing, Shaywitz, & Shaywitz, 1995; Stanovich & Siegel, 1994). Mounting evidence suggests that a second core deficit in the processes that underlie naming speed may help to explain reading problems in many children (for a complete review see Wolf, Bowers, & Biddle, 2000). Although naming speed deficits have been documented in children with reading problems, the independence of the processes underlying naming speed from phonological processes is still debated (Vellutino et al., 2004). Evidence suggests that naming speed contributes more to word identification skills while phonological processing makes greater contributions to decoding skills (Wolf et al., 2002). Children with "double-deficits" in both phonological processing and naming speed are clearly more impaired than those having deficits in only one (Wolf & Bowers, 1999). Importantly, naming speed deficits have been shown to impact the rate with which individuals are able to read connected text (Bowers, 1993; Breznitz & Berman, 2003; Katzir, Shaul, & Breznitz,

2004; Stage, Sheppard, Davidson, & Browning, 2001; Young & Bowers, 1995), and so has particular implications for text fluency.

Automaticity theory (LaBerge & Samuels, 1974) offers one framework from which the impact of processing deficits on text fluency and comprehension may be discussed. Automaticity theory (LaBerge & Samuels, 1974) holds that as the micro-sublevel processes involved in decoding and reading words become automatic, resources are freed to use for higher-level processes such as comprehension. As children gain experience and practice reading, they develop proficiency in their word reading skills, allowing them to use their limited cognitive and attentional resources to making meaningful connections within the text. If deficits in phonological processing or naming speed impede the development of fast and accurate word reading skills, then reading is likely to be slow and dysfluent, leaving fewer cognitive resources available for comprehension. Therefore, problems in text fluency can be viewed as "downstream difficulties" (Lyon, Shaywitz, & Shaywitz, 2003, p. 9) caused by deficits in language-based processes that affect word reading.

Text Fluency Disability Subtype

Evidence from the reading disability subtype literature suggests that some children may exhibit specific deficits in text fluency, such that they are able to recognize and decode words, but read connected text at an excessively slow rate (Lovett, 1984, 1987; Morris, Stuebing, & Fletcher, 1998). Lovett (1984, 1987) argued that reading skills should be assessed in terms of two criteria, accuracy and automaticity. Lovett applied these criteria to identifying reading disabled children from within Ehri and Wilce's (1979, 1983) developmental model of word reading acquisition. From this framework

three stages were considered: First, children learn to accurately identify words (Stage 1); then they begin to automatically identify the word by sight (Stage 2); and lastly, children develop speed in recognizing words (Stage 3). Children were identified by Lovette as "accuracy-disabled" if they were unable to decode words with age-appropriate skill (i.e., demonstrated skills at least 1.5 years below their age expectancy). Accuracy-disabled children were characterized by slow and inaccurate reading, and were thought to fail at the first stage of word acquisition. Children who could recognize words accurately but who demonstrated deficiency in text reading speed (i.e., demonstrated skills at least 1.5 years below their age expectancy) were labeled as "rate-disabled" and were considered to be failing stage 3. When compared to fluent readers who were matched on isolated word recognition skills, the rate-disabled group recognized words more slowly, read connected text less accurately, exhibited deficits in performing visual naming speed tasks, and demonstrated poorer spelling skills on orthographic but not dictation tasks (Lovett, 1987). Further, the rate-disabled group showed no signs of the phonological processing deficits exhibited by the accuracy-disabled group and had better reading comprehension skills. These results suggest that the slow speed of word reading and the processing underlying visual naming speed may interfere with the rate-disabled children's ability to read connected text.

Morris et al. (1998) used cluster analysis to investigate subtypes of reading disabilities. Out of the seven reading disabled subtypes identified, six shared impairments in phonological processing, supporting the idea that phonological processing represents a core deficit in reading disabilities. Of particular interest is that 8% of children who qualified for a "rate-deficit" subtype. The rate-deficit subtype was characterized by poor

performance on measures of rapid serial naming, nonverbal memory, and production of speech. Importantly for our purposes here, these children demonstrated average decoding, word reading, and comprehension skills, but below average skills in text fluency. In contrast, another study was not able to identify any children who experienced difficulties with text fluency who did not experience concurrent difficulty on word fluency tasks (i.e., context-free) (Jenkins, Fuchs, van der Broek, Epsin, & Deno, 2003b). Jenkins et al. (2003b) examined a group of 4th grade students identified as reading disabled and used curriculum based measures to assess children's reading skills. Children's raw scores were converted to z-scores with a value of -1.00 or below indicating impaired skills. Perhaps Jenkins et al. results differed from Morris et al. and Lovette because they used measures of word fluency rather than word reading accuracy measures, which may be less distinct from text fluency. Alternately, differences across studies may be attributable to the use of standardized (Morris et al., 1998 and Lovette, 1984, 1987) versus curriculum based measures (Jenkins et al., 2003b), or to methodical differences of identifying children as impaired. Results from Morris et al. and Lovett suggest that some children experience specific problems in the area of text fluency, and that rapid serial naming may play role in mediating text reading rate.

Detecting Reading Problems Using Text Fluency

Difficulty with text fluency is increasingly acknowledged as a significant aspect of a reading disability. Until recently, dyslexia has been primarily assessed with measures of single word decoding. However, more recent conceptualizations by the British Psychological Society (1999) and the International Dyslexia Association (Lyon, Shaywitz, & Shaywitz, 2003) also include text fluency as an area of weakness for

individuals with dyslexia. One of the most important changes to the definition of dyslexia is the recognition that "what characterizes dyslexic individuals, particularly dyslexic adolescents and adults, is the inability to read fluently" (Lyon, Shaywitz, & Shaywitz, 2003, p. 6). Many adult dyslexics experience difficulties with text fluency even after becoming accurate word readers (Lefly & Pennington, 1991; Shaywitz, 2003) and improvements in text fluency from extensive interventions have been harder to attain than improvements in reading comprehension, decoding, and word reading skills (Lyon & Moats, 1997; Meyer & Felton, 1999; Torgesen et al., 2001).

To date, only a handful of studies have compared the assessment of reading problems using measures of text fluency rather than traditional measures of reading skills (i.e., word reading, decoding, reading comprehension). Breen and Drektah (1990) compared the performance of 32 learning disabled children on Kaufman Test of Educational Achievement (KTEA; Kaufman & Kaufman, 1998) and the Gray Oral Reading Test-Revised (GORT-R; Wiederhold & Bryant, 1986). The reading decoding and reading comprehension subtests of the KTEA produced significantly higher standard scores than did the GORT-R reading quotient, which combines both reading comprehension and fluency subscales, suggesting that the GORT-R might be more sensitive in detecting reading difficulties than the KTEA. However, because the scores they used conflated reading comprehension with text fluency (i.e., the GORT-R provides a score that combines reading fluency with reading comprehension which was used by these researchers) it is not clear which skill or skills were responsible for the lower estimates of reading skill observed on the GORT-R reading quotient as compared to the KTEA reading comprehension and decoding subscales.

McCabe, Margolis, and Barenbaum (2001) compared the performance of 34 fourth grade boys scoring below the 25th percentile on the Iowa Test of Basic Skills on a norm-referenced test of academic achievement, the Woodcock-Johnson Psychoeducational Battery-Revised (WJ-R; Woodcock & Mather, 1990), and a criterion-referenced informal reading inventory, the Qualitative Reading Inventory-Second Edition (QRI-II; Leslie & Caldwell, 1995). The QRI-II uses text reading accuracy to determine the grade level equivalent in reading skill and this was contrasted to grade equivalents generated by the WJ-R's Passage Comprehension, Reading Vocabulary, Letter-Word Identification, and Word Attack subtests. Of the 50% of cases in which the two tests provided different grade level estimates, the QRI provided a lower estimate of children's reading skills for 92% of these. Finally, Sofie and Riccio (2002) contrasted CBM measures of text fluency with the Passage Comprehension subtests of the Woodcock-Johnson Tests of Achievement-Revised in 40 first and second grade children. They too found support for the view that text fluency may differentiate struggling versus typically developing readers. In sum, the studies conducted to date are limited by generally small sample sizes and the use of different types of text fluency measures, but taken together they suggest that text fluency measures may be more sensitive to detecting reading problems in children than traditional word reading, decoding and reading comprehension measures.

Theoretical Overview

This theoretical overview will provide a backdrop from which to discuss the relative contributions of word reading and text fluency to reading comprehension. Proficient skills at the word level (i.e., word recognition and decoding) and the processes

that support these skills (orthographic, phonological, and semantic) have often been considered the most fundamental factors in the development of both fluent reading and comprehension skills. However, some argue that text fluency also makes significant contributions to reading comprehension above and beyond that which is accounted for by word fluency (Jenkins et al., 2003a). Theories were included in this section if they did one or more of the following: a) contributed to our understanding of why text fluency is important for children within the context of the development of general reading competency, b) focused on proficiency in lexical or sublexical processing as underlying the development of fluent reading skills and comprehension, or c) provided a rationale for the relationship between text fluency and reading comprehension.

Theories that Emphasize the Importance of Text Fluency for the Development of Reading Skill

Chall's (1983, 1996) stage model provides a broad, comprehensive review of the development of reading and also demonstrates the importance of text fluency within the context of normal reading development. Chall's five stage theory also provides a unique perspective in that the discussion of reading development is also embedded within the instructional demands placed on children across their elementary, middle, high school, and even college years. Stage 0, the pre-reading stage, involves the development of foundational reading skills that should be present prior to the onset of formal instruction (Chall, 1996). During this stage children develop a variety of emergent reading skills including phonemic awareness, the concepts of print such as understanding that the print conveys meaning and is composed of letters and words, and book handling knowledge (Kuhn & Stahl, 2004). The development of these skills is primarily related to the amount

of exposure children have to print. The first stage is referred to as the initial reading or decoding stage, which coincides with the beginning of formal instruction (Chall, 1996). During first and second grade, children develop an understanding of basic sound-letter correspondence and begin applying this knowledge to the decoding of words. During this stage accurate, but not yet automatic, word recognition skills are established.

The second stage in Chall's (1996) model of reading development is the confirmation and fluency, or "ungluing from print," (Chall p. 18) stage. During second and third grade children confirm what they already know through practice reading text, allowing their decoding skills to become fluent skills. As children's reading becomes more automatic and fluent, their reading begins to sound more like natural speech. This change is thought to occur when children begin to make use of prosodic features of the text such as phrasing, stress, and intonation (Kuhn & Stahl, 2004; Schwanenflugel et al., 2004). According to this model, fundamental decoding skills are a necessary condition for the development of fluent reading skills.

Once fluent reading skills are established, the remaining stages involve the continued development of reading comprehension and critical thinking skills. "Reading for the new" is the third stage in Chall's development of reading model. Beginning in fourth grade the task demands of reading begin to shift toward greater amounts of expository text for the purpose of learning content area material. It is this shift that Chall aptly described as moving from "learning to read" to "reading to learn" (Chall, 1996, p. 20). If children have not developed fluent reading skills by this stage, then they are likely to struggle with keeping up with their coursework, given the heavy reliance on reading as a means of accruing content area knowledge. Next, children begin to deal with a variety

of viewpoints within the text, and are expected to critically evaluate these viewpoints. This fourth stage is termed the multiple viewpoints stage and occurs during the high school years. Lastly, as children become adults they begin to synthesize a myriad of viewpoints and develop their own perspective through constructing and reconstructing information within the text.

In sum, Chall's (1996) stage model suggested that text fluency is an essential skill for children's academic success. Additionally, the mastery of fundamental decoding and word recognition skills are viewed as a prerequisite of fluency. Further, fluency is viewed as an important skill for constructing the meaning of and learning from text. Chall's theory is the only theory reviewed within this work that describes the developmental nature of text fluency. However, Chall's theory has been critiqued (perhaps unjustly) as implying that teachers should wait until children are fluent readers before embarking on comprehension instruction.

Theories that Emphasize Word Reading Proficiency in the Development of Text Fluency and Comprehension

Several prominent and influential theories of reading view word reading skills as primary to the development of text fluency and comprehension.

Automaticity Theory

LaBerge and Samuel's (1974) automaticity theory of reading is a classic paper that has influenced either directly or indirectly many subsequent theories of the development of reading skills. Automaticity theory has frequently been used to explain the relationship proposed between text fluency and reading comprehension (Fuchs et al., 2001; Kuhn & Stahl, 2004; Wolf et al., 2001). This theory is an information processing,

serial-stage model of the development of reading that emphasizes proficient word recognition and decoding skills as underlying fluent reading and adequate comprehension of text. According to this model, fluent readers are characterized by the ability to read quickly, without conscious effort, awareness, and even intent (Logan, 1997). Advertisers make use of the obligatory nature of reading, by placing signs along the highway, recognizing that like it or not, people read what they see. Although reading appears effortless for skilled readers, reading is in fact a complex skill, as evidenced by the halting efforts of beginning readers as they struggle to decipher unknown words. The development of automaticity allows for the completion of dual tasks, such as reading the words in a text while comprehending the meaning carried by the text. Automaticity theory offers a compelling explanation for how people are able the carry out a complex skill of reading without overloading their cognitive and attentional systems.

Several key concepts underscore LaBerge and Samuel's (1974) automatic information processing theory of reading. First, attention is conceptualized as selective and limited in its capacity. As such, the more attention that is required for a given process, the fewer attentional resources will be available for other processes. Conversely, when less attention is required to complete a task, unused attentional resources may be reallocated to other processes. Third, LaBerge and Samuels (1974) describe a process termed unitization, which explains how readers move from perceiving words as being comprised of small units (letters) to processing words as single units. Thus, through practice the micro-subskills involved in decoding words become automatic, allowing for proficiency in word recognition. This process frees up attentional resources that can then be reallocated to higher level processing skills such as reading comprehension. Lastly, the

progression towards automatic processing was purported to be sequential such that the development of higher-level skills must await the automatization of lower level skills. In sum, automaticity theory viewed word recognition as being the most fundamental factor in the development of both fluency and comprehension.

Surprising little research has examined the key aspects of automaticity theory. However, automaticity theory's view that as reading skills become fast and accurate, more resources become available for comprehension is supported by the finding that fast and accurate word reading is an important predictor of reading comprehension in early elementary school children (Gough et al., 1996; Juel et al., 1986; Shankweiler et al., 1999; Schwanenflugel et al., 2004; Schwanenflugel et al., in press). Also, as would be predicted by automaticity theory, the development of autonomous word reading (i.e., the ability to read without awareness or intent) early in the acquisition of reading skill indicates increasing skills (Schwanenflugel et al., in press).

Although automaticity theory significantly impacted subsequent theories of the development of reading skills, several key aspects of this theory have been criticized. For example, automaticity theory specified that the use of higher-level skills such as comprehension must await the development of lower level skills such as word recognition and decoding. However, Stanovich's (1980) interactive-compensatory model posited that deficits at any level of processing could be compensated for by relying more heavily on the other processes. Therefore, lower level process such as word recognition could be facilitated by a higher-level process such as context facilitation. If less skilled readers were able to use context to facilitate word recognition, then the premise that higher-level processes must await the development of lower level processes would be

dispelled. Through a series of experiments (see Stanovich, 1980, 1984) it was demonstrated that when less skilled readers were provided with text at their relative reading level, they were able to use context as well if not better than skilled readers. Further, automaticity theory has been criticized by equating obligatory processes with capacity-free processes, and for conflating processing resources with the concept of conscious attention (Stanovich, 2000).

Verbal Efficiency Theory

Verbal efficiency theory (Perfetti, 1977, 1985) is another influential information processing theory that emphasized the efficient lexical processing as essential for reading skills, especially comprehension. Verbal efficiency theory posits that individual differences in reading comprehension are explained by the efficient operation of several local processes operating in parallel, including orthographic, phonological, and semantic processes. Similar to LaBerge and Samuel's automaticity theory, Perfetti posited that when these local systems are efficient, resources are freed and may be reallocated to higher-level processes such as reading comprehension. However, inefficient system operations impede reading comprehension by slowing the rate at which the text is read. Slower reading rate interferes with the reader's ability to hold large units of texts in working memory, thereby limiting the reader's ability to work on, manipulate, organize the information from the text, resulting in poorer reading comprehension and recall.

Ehri's Sight Word Reading Theory

Ehri (1983, 1992, 1995) described a series of phases involved in the development of automatic sight word reading. As several prominent theories of text fluency focus on the development of automatic word reading skills, Ehri's work is of particular importance

to this review because it offers a compelling explanation for how such proficiency may develop. Sight word reading can be defined as the "process of reading words by accessing them in memory," (Ehri, 1995, p. 11). More specifically, sight word reading occurs after the reader has read the word several times, at which point the visual sight of the word triggers information about the spelling, pronunciation, and meaning of that word in the reader's word memory bank or lexicon (Ehri, 1995). Ehri (1995) suggested that a connection is formed between the visual cue (the written form of the word) and its pronunciation and meaning. Further, it was postulated that the type of connections formed varies in terms of the degree of involvement in the alphabetic system across development of sight word reading skills. The alphabetic system refers to the connections between written letters and the sounds they represent.

According to Ehri, the first phase in the development of sight word reading is the pre-alphabetic phase, termed as such because the letter-sound relationships are not involved in the connections formed between the visual cue and the word meaning (Ehri, 1995). Rather, these beginning readers remember sight words by forming a connection between a visual attribute of the word and its pronunciation. For example, a child in this phase may recognize a word based on a salient cue such as a thumbprint next to the word or by remembering the round looking eyes in "look." Next, during the partial alphabetic phase, readers begin to make connections between some letters and sounds, and are able to segment initial and final sounds of words (Ehri, 1995). Children in this phase do not yet posses a complete knowledge of the spelling system, especially vowels. As such, phonetic cue reading is typically observed in this phase, meaning that children are able to use the first and last sounds of words as salient cues to identify words.

As readers form complete connections between letters and their sounds, they move into the full alphabetic phase (Ehri, 1995). Full alphabetic readers are able to remember sight words by forming connections between the letters and sounds in the word. Reading becomes much more accurate during this phase, as the reader now posses the skills to decode words, even novel or pseudowords they have never seen. Typically readers in this phase are able to retain the word's information in their lexicon after about four successful encounters with the word (Reitsma, 1983). Sight word reading allows irregular words that do not follow typical sound-letter associations to be learned. Word reading also becomes faster, as sight word reading is much faster than decoding. Good readers are able to read sight words as quickly as single digits, suggesting that words are processed as whole units rather than as group of letters (Ehri & Wilce, 1983). During the full alphabetic phase, readers' lexicons increase greatly and readers begin to recognize letter patterns across words. During the consolidated alphabetic phase children become able to process multiple rather than single letter units such as syllables, morphemes, or rimes units (Ehri, 1995). These letter patterns become part of children's spelling system, and the larger units reduce the load on memory. For example, the ending "alk" can be processed as a single unit making the words "walk", "chalk", and "talk" two rather than four unit words.

Ehri's (1995) model offered a compelling explanation for how sight word reading skills develop. However, the relationship between the development of sight word reading and other reading skills such as text fluency and comprehension was not discussed. Torgesen's (2001) model of text fluency more explicitly depicts the relationships between word identification, text fluency, and reading comprehension skills.

Torgesen's Model of Text Fluency

It has been suggested that the fundamental "bottleneck" for disabled readers occurs at the word level (Lyon, 1995), and that these difficulties stem from problems in the ability to fluently (i.e., fast and accurately) identify individual words rather than stemming from other problems such as appropriately utilizing text level features or the accessing of semantic information (Torgesen et al., 2001). A model of text fluency was proposed detailing five primary components or factors that might underlie individual differences in reading rate (Torgesen et al., 2001). Text fluency within this model was defined simply as rate and accuracy in the oral reading of text (Hasbrouk & Tindal, 1992; Shinn, 1989), and a strong relationship between oral reading rate and reading comprehension was supposed. This model describes how word identification factors affect oral reading rate, and, by extension, reading comprehension.

First, the proportion of words within the text that the reader is able to recognize as sight words, or words that the readers can immediately recognize from memory (Ehri, 1992; 1995) is thought to contribute to reading rate (Torgesen et al., 2001). Reading rate will be limited when the reader is unable to read a high proportion of the words by sight, as this would require the reader to use more time and resource demanding strategies to identify the word. Second, the speed with which it takes individuals to identify sight words also may affect reading rate. Differences in the speed of sight word recognition might be attributed to the number of times the individual has read the word, general speed of processing, or in the case of oral reading, the individual's articulation rate (Torgesen et al., 2001). Third, when novel words are encountered, the speed with which individuals are able to employ processes such as phonetic decoding or using the context to identify

the word may also affect reading rate. In a similar vein, word identification may be speeded by the use of contextual information. The degree to which an individual is able to utilize information from the text to facilitate word recognition may depend in part on their breadth of general background knowledge and vocabulary (Torgesen et al., 2001). However, as children become fluent readers and develop more reliable word reading strategies, context clues are used less frequently to decipher unknown words (Stanovich & Stanovich, 1995). Lastly, the speed with which individuals are able to identify word meanings may also affect reading rate, such that if meanings are accessed slowly then readers may need to slow down their reading rate in order to comprehend the text.

According to Torgesen's model of text fluency, the ability to read words by sight is the most important factor in text fluency. It is only when a novel word is encountered that has not yet become part of the reader's sight word lexicon that three out of the four factors posited by this model become important. General processing speed also plays an important role in this model.

Thus far, theories that view text fluency and reading comprehension as being primarily the result of automatic word recognition have been discussed. Indeed, a wealth of research has demonstrated that word reading is strongly related to reading comprehension (Gough, Hoover, & Peterson, 1996; Juel, Griffith, & Gough, 1986; Shankweiler, Lundquist, Katz, Stuebing, & Fletcher, 1999; Stanovich, 1980) and fluency (Jenkins, Fuchs, Van Der Broek, Epsin, & Deno, 2003a; Torgesen et al., 2001; Schwanenflugel et al., in press; Shinn et al., 1992). However, research has also demonstrated that text fluency is related to reading comprehension (Fuchs et al., 2001; Fuchs, Fuchs, & Maxwell, 1988; Jenkins et al., 2003a; Pinnell et al., 1995; Shinn, Good,

Knutson, Tilly, & Collins, 1992). Some argue that text fluency has a relationship to reading comprehension that cannot be explained by word reading skills alone (Fuchs et al., 2001; Schreiber, 1980; Young & Bowers, 1995; Wolf & Kadzir-Cohen, 2001). Inherent to the latter viewpoint is the assumption that there is something specific about reading text that contributes to comprehension, such that readers get more information by reading text than by what is represented just by the meanings of the words comprising the text.

Theories that Address the Relationship between Text fluency and Comprehension

Several theoretical rationales can be used to explain how text fluency may be related to reading comprehension. The first rationale suggests that reading words in context facilitates word recognition and, in turn, comprehension by causing the automatic spreading of activation among related semantic memory networks (Posner & Synder, 1975). An alternative explanation suggests that readers use features of the text such as syntactic, semantic, and morphological cues to identify phrasal boundaries and these features, in turn, allow the reader to comprehend what is read (Schreiber, 1980; Young & Bowers, 1995). Lastly, text fluency has been conceptualized as involving the integration of multiple higher (comprehension) and lower (word recognition) processes (Fuchs et al., 2001; Wolf & Kadzir-Cohen, 2001). These rationales provide theoretical frameworks representative of the current literature from which the possible contributions of text fluency to reading comprehension may be discussed.

Context Facilitation

Posner and Synder's (1975) two-process expectancy theory may explain how connected text or context reading facilitates word recognition and by extension reading

comprehension. Although Posner and Synder's theory is not a reading theory per se, it has been applied to the process of reading as a means of conceptualizing the relationship between word and text reading (e.g., Stanovich, 1980; Jenkins et al., 2003a). Research has demonstrated that words are read faster in context than when the same words are presented out of context (i.e., in a word list) (e.g., Doehring, 1976; Stanovich, 1980). Additionally, context reading has been found to make significant unique contributions to comprehension in older elementary school children, even after context-free word reading skills were taken into account (Jenkins et al., 2003a). Text fluency may facilitate word recognition by causing the spread of activation among semantic networks, which is thought to occur while individuals read text.

Two context-based expectancy processes are thought to occur concurrently and independently of one another as individuals read text (Posner & Snyder, 1975). The first process is thought to be automatic and fast in spreading activation among semantic networks. Information within the text activates related semantic memory locations (i.e., word meanings or concepts), which in turn spreads the activation to other related or neighboring semantic memory locations. The thresholds for the retrieval of words or concepts from memory that have already been activated are lowered, thus facilitating word recognition. Whereas the first process operates without using attentional resources, the second process is slow acting and attentionally demanding, as individuals consciously use the information within the text to recognize words (Posner & Synder, 1975). If the two expectancy-based processes facilitate word recognition, then comprehension may also be enhanced freeing cognitive and attentional resources to be reallocated from lower level word recognition process to higher-level comprehension processes.

Stanovich's (1980) interactive-compensatory model explains how processes such as those posited by Posner and Synder (1975) might apply to word recognition in readers with varying skill. Stanovich posited that deficits at any level of processing could be compensated by relying more heavily on the other processes. Posner and Synder's (1975) processes were posited to work concurrently, with the automatic spreading of activation being fast and the conscious use of context slow and attentionally demanding. Skilled readers who can identify words before the conscious processes have been completed would rarely rely on using context to identify words. However, less skilled children whose word reading skills are still slow and inefficient would be more likely to rely on the conscious use of context, as the slow acting conscious processes may be completed before the word is identified. The conscious use of context is an attentionally demanding process, and might limit the amount of resources available for further comprehension. This suggests that as word reading skills become automatic, the automatic process rather than the conscious processes primarily work to facilitate word recognition when reading text.

In sum, when applied to reading Posner and Synder's (1975) theory lends support to the idea that text fluency facilitates comprehension. However, it does so by suggesting that word reading within text triggers the spreading of activation among semantic networks rather than by some particular features or characteristics of the text itself. To some degree, Posner and Synder's theory supports both the idea that word reading is most primary to comprehension and that text fluency also makes contributions to comprehension**.**

Other Text Features that may Benefit Comprehension

An alternative theoretical rationale for how text fluency may benefit reading comprehension suggests that readers use text features such as syntactic and semantic cues to recognize words and construct meaning from the text. Syntax refers to "a set of rules through which the relationships among words is determined" (Cooper & Stewart, 1987, p. 159) and generally refers to the grammatical structure of the sentence. There is some evidence to suggest that a relationship exists between syntactic awareness and the syntactic complexity of the text and reading comprehension. For example, syntactically complex texts are more difficult for children to understand (Distefano & Valencia, 1980) and oral disruptions (or miscues) occur more often during syntactically complex phrases (Cooper & Stewart, 1987). Also, when children were matched on decoding, age, and nonverbal ability, the semantic ambiguity of the text and syntactic awareness of the reader differentiated between groups identified as either poor or average comprehenders (Nation & Snowling, 2000). Fluent text readers verbally segment word strings into larger syntactic groupings which may serve to support comprehension (Rasinski, 1990; Young & Bowers, 1995).

Reading prosody, which is characterized by the ability to read text in an expressive, speech-like manner, is considered by many to be the hallmark of fluent reading (Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004). Theories that focus on the role of prosody in the reading process may shed some light in how the text features may facilitate word comprehension. Individuals use prosodic cues such as the pitch or intonation, stress or loudness, and duration or timing (Kuhn & Stahl, 2004) present in oral language to mark phrasal boundaries and to understand the meaning being

conveyed (Schreiber, 1980). The identification of phrasal boundaries is thought to facilitate comprehension of the text by breaking language into smaller, more readily processable units for the working memory system. However, the prosodic cues present in natural speech that would facilitate recognition of phrasal boundaries are not embedded in the text (e.g. Carroll & Slowiaczek, 1987). Rather, is has been suggested that children learn to compensate for the lack of prosodic cues in the text by using morphological, semantic, and syntactic cues found in the text to identify phrasal boundaries (Schreiber, 1980). For example, Chafe (1988) suggested that the assignment of words to syntactic roles is necessary for one prosodic feature, intonation, to occur. Thus, in order for children to read with expression and to facilitate the construct meaning from the text, readers may integrate processes from the word, phrase, and sentence levels.

Although the role of reading prosody is commonly believed to be an important marker of fluency, the relationship between reading prosody, reading comprehension, and reading skill is unclear. Repeated reading of text has been shown to improve oral reading prosody in second grade students (Dowhower, 1987). Also, some evidence is available to suggest that syntactic phrasing ability is somewhat related to comprehension in average but not poor readers (Young & Bowers, 1995).

Schwanenflugel et al. (2004) explored two models to describe the relationship that reading prosody might play in mediating the relation between word decoding skills and reading comprehension skills. One model posited that reading prosody emerges once efficient decoding skills have developed, after which prosody facilitates comprehension. The second model posited that both decoding skills and reading comprehension make unique contributions to reading prosody. Findings suggested that, in early elementary

school children, prosody should be considered an indicator of efficient decoding skills, and that a strong relationship also exists between reading comprehension and decoding skills. However, only minimal support was found for a relationship between reading comprehension and reading prosody. This study suggested that the for early elementary school children the most important aspect of text fluency for enhancing reading comprehension, then, is not that children's reading sounds more like speech, but that they can decode quickly and accurately. On the other hand, the study focused on very simple texts, which may not require prosody to be understood. More research is needed to clarify these relationships as children's skills continue to develop into later elementary school, especially given the sparseness of the current literature on this topic.

Text Fluency: An Interactive Process

Fuchs et al. (2001) proposed that text fluency involves a "complex orchestration," of sublexical, lexical, and comprehension processes (Fuchs et al., 2001). Text fluency is thought to involve sublexical processes such as automatically translating letters to their corresponding sound representations and lexical processes including the unitization of multiple sounds units into single word units and accessing lexical representations. Several higher level comprehension or semantic processes are thought to be involved, such as creation of meaningful connections within and between the sentences, making inferences, and linking the information within the text to the reader's prior information (Fuchs et al., 2001). A basic premise of automaticity theory, that the development of automatic processing in lower level skills frees resources so that they may be used for comprehension, is essential to this conceptualization of fluency. Without the automatization of lower level processes, the coordination and integration of reading

processes required to read fluently would not be possible. Further, because text fluency is thought to reflect the complex integration of word reading and comprehension processes, it is suggested that this skill represents an indicator of overall reading competence (Fuchs et al., 2001).

Similarly, Wolf and Katzir-Cohen (2001) described a developmental, component-based model of text fluency. According to this model, text fluency involves the coordination of *all* reading processes and subskills. Wolf and Kadzir-Cohen posited this coordination involves several major systems including the orthographic, phonological, morphological, semantic, and syntactical systems across several levels including the letter, letter-pattern, word, and text level. Beringer, Abbott, Billingsley, and Nagy (2001) were cited as emphasizing the role of executive functioning in enabling the coordination of these internal systems. Further, a number of more specific component processes were outlined including: "lower level attention and visual perception, orthographic (letter pattern) representation and identification, auditory perception, phonological representation and phoneme awareness, short-term and long-term memory, lexical access and retrieval, semantic representation, decoding and word identification, morpho/syntactic and prosodic knowledge, connected text knowledge, and comprehension" (Wolf et al., 2001, p. 220).

Both Fuchs et al. (2001) and Wolf and Kadzir-Cohen (2001) described text fluency as involving the integration or coordination of multiple reading processes. It is notable that neither conceptualizations of text fluency provided enough detail for how these processes might be coordinated to allow for hypothesis testing and empirical validation. Wolf and Kadzir admitted that their developmental and component-based

model possessed a “difficult challenge for empirical validation,” and instead suggested that this model be used as a framework to guide future research. Be that as it may, both models lack direct empirical evidence for the processes that were proposed to be involved in text fluency. Therefore, although the conceptualization of text fluency as representing the integration of both word and reading comprehension may be intriguing, it does not provide support for the idea that text fluency makes contributions to reading comprehension beyond those accounted for by word recognition.

Several possible theoretical rationales were explored to elucidate the relationship between text fluency and reading comprehension. Across this review, little evidence exists to suggest that there is something unique about text that facilitates reading comprehension. Posner and Synder’s (1975) two expectancy-based processes may facilitate comprehension indirectly by aiding in word recognition. There is some evidence that syntactic awareness and the syntactic complexity of text affects reading comprehension (Cooper & Stewart, 1987; Distefano & Valencia, 1980; Nation & Snowling, 2000). However, the current literature on reading prosody does not provide strong support for the idea that text features are used by the reader to comprehend text (e.g., Schwanenflugel et al., 2004). Lastly, although some researchers have proposed that oral reading involves the coordination of multiple reading processes (Fuchs et al, 2001; Wolf & Kadzir-Cohen, 2001), detailed descriptions of how these processes may be coordinated were lacking and empirical evidence was not presented.

Empirical Relationships among Word Reading, Text fluency, and Comprehension

It was established in the theoretical overview that a wealth of evidence exists to suggest that word reading is strongly related to both reading comprehension and fluency,

and that fluency and comprehension are also related to one another. It could be argued that the relationship between fluency and comprehension can be explained by context-free word reading skills, which are thought to be essential to both reading and comprehension skills. However, evidence from a few studies examining the relationship among text fluency, word reading skills, and reading comprehension suggest that text fluency makes unique contributions to comprehension beyond those accounted for by word reading skills.

One investigation by Jenkins, Fuchs, van den Broek, Espin, and Deno (2003a) compared 4th grade children's ability to fluently read a 3rd grade level passage and a list of single words taken from that passage. Fluency in this study was measured by speed (the number of word read correctly per minute) and time (the seconds per correctly read word). Reading comprehension was assessed using the Iowa Test of Basic Skills, which requires children to read passages and then answer several multiple choice questions regarding what they read. Text fluency and reading comprehension shared unique variance even after word fluency skills had been controlled for both speed and time (42% and 29%, respectively); whereas, after accounting for text fluency, word fluency explained a negligible amount of variance in reading comprehension (1% and 4%, respectively). Additionally, both word fluency and reading comprehension made significant unique contributions to predicting text fluency (Jenkins et al., 2003a). These findings suggest that the ability to quickly and accurately identify words out of context is an essential skill for fluent reading *and* that the ability to quickly and accurately read words in text is important for reading comprehension.

Similar results were obtained in a factor analytic study that examined text reading accuracy, single word reading, listening comprehension, and reading comprehension skills in 7-9 year-old children using standardized measures (Nation & Snowling, 1997). Two factors, decoding and comprehension, were extracted and listening comprehension loaded equally on both factors. As the reading skill indices went from lower level to higher level processes (decoding, word reading, and text reading accuracy), greater loadings on the comprehension factor were observed (.16, .29, & .40, respectively), whereas both text reading accuracy and single word reading skills loaded highly on the decoding factor. Reading skill was not examined as a function of age or grade in this study.

Conversely, a study examining the development of text fluency in younger children (1st, 2nd, and 3rd grade) did not find that text fluency made significant unique contributions to reading comprehension after word recognition skills were taken into account (Schwanenflugel, Meisinger, Wisenbaker, Kuhn, Strauss, & Morris, in press). Text fluency was measured by the GORT-3 reading rate score. Using confirmatory factors analysis, Shinn et al. (1992) observed differences in the factor structure of reading in 3rd and 5th grade students. Measures of decoding (regular and nonsense word reading), reading comprehension (written retell, cloze task, literal and inferential questions), and text fluency using curriculum-based measurement (CBM) was administered to all participants. Children read aloud from two grade level texts pulled from their basal reader and the number of word read correctly per minute was used as the measures of text fluency. The following four models were tested: a) a one factor model where all measures represented general reading competence construct, b) a two factor model consisting of

decoding and reading comprehension, where fluency is represented under the decoding construct, c) a two factor model consisting of decoding and reading comprehension, where fluency is represented under the reading comprehension construct, and d) a three factor model where decoding, reading comprehension, and oral reading comprehension each represent a separate construct. For 3rd grade students, the one factor model was found to best fit the model, whereas the two factor model where text fluency was represented as decoding was found to best fit the 5th grade data (Shinn et al., 1992).

Although Shinn et al. (1992) results may suggest that text fluency is more closely related to decoding skills than to comprehension in 5th grade students, several possible limitations exist to this interpretation. First, text fluency correlated highly on *both* the comprehension and decoding factors (.89-.90 and .74-.75, respectively), and the fluency measures correlated as high or higher on all the measures loading on the comprehension factor with the exception of the cloze task. This suggests that text fluency is related to both decoding and comprehension, but this study did not address the relative unique contributions made among these skills to one another. Also, Shinn et al. suggested that the format of the assessment also limits the conclusions that can be drawn from this study. All the measures that loaded on the decoding factor involved oral reading and responding, whereas all the measures loading on the comprehension factor involved silent reading and written responses. It was suggested that "Oral Reading/Verbal Responses" and "Silent Reading/Written Responses" might be more appropriate labels for the two factors identified by that analysis. Still, Shinn et al. (1992) demonstrated that the factor structure of reading may vary across development, and that text fluency may be closely related to both word reading and comprehension.

Conclusions on the Empirical Findings

The literature examining the relationships among word reading, text fluency, and comprehension is sparse and results varied across studies. There is some evidence to suggest that text fluency makes unique contributions to comprehension beyond those made by word reading skills in 4th grade students (Jenkins et al., 2003a) and that text fluency may be more related to comprehension than word reading (Nation & Snowling, 1997). However, there is also evidence that in early elementary school children, proficiency in word reading skills is most important for both text fluency and comprehension (Schwanenflugel et al., in press). Further, the results of the Shinn et al. (1992) study have several possible limitations and the unique contributions of text fluency to comprehension were not examined. It is unclear whether the differences across studies are due to the type of measures used, the difficulty levels of the text, the age of the children, or some other variable. To date, no study has examined the relative contributions of word reading and text fluency to reading comprehension in both early and later elementary school children. This study seeks to fill this gap in the literature by clarifying the relationships among word reading, text fluency, and reading comprehension skills in 3rd and 5th grade students.

Statement of Purpose

The purpose of this work is to explore the theoretical and empirical relationships among word reading, text fluency, and reading comprehension in 3rd and 5th grade children, and to determine the implications for incorporating measures of text fluency in the identification of children with reading disabilities. This study will fill two important gaps in the current literature by: (a) building upon the existing understanding of the

development of text fluency and (b) examining the diagnostic utility of text fluency measures in the assessment of children's suspected of having a reading disability.

The present research consists of two studies, one being a normative study of the relationships among word reading, text fluency, and reading comprehension, while the other examines the utility of text fluency in diagnosing children with reading disabilities in a clinical sample. In study 1, the viability of three theoretical models depicting the relationships among word reading, text fluency, and reading comprehension will be examined: (a) the *word reading proficiency model*, (b) the *context facilitation model*, and (c) the *text reading model*. These models differ with regard to whether text fluency is predicted to make unique contributions to reading comprehension after accounting for word reading skills (i.e., word accuracy and word fluency). Study 2 will examine whether the omission of text fluency measures results in the under identification of children with reading disabilities, whether a subgroup of children with specific deficits in text fluency can be identified, and, if such a group exists, what characterizes readers with specific fluency deficits as compared to other readers. Study 1 has direct implications for Study 2, because if text fluency is found to benefit reading comprehension then a strong rationale for the importance of assessing text fluency when diagnosing children with reading disabilities can be made.

CHAPTER 2

STUDY 1

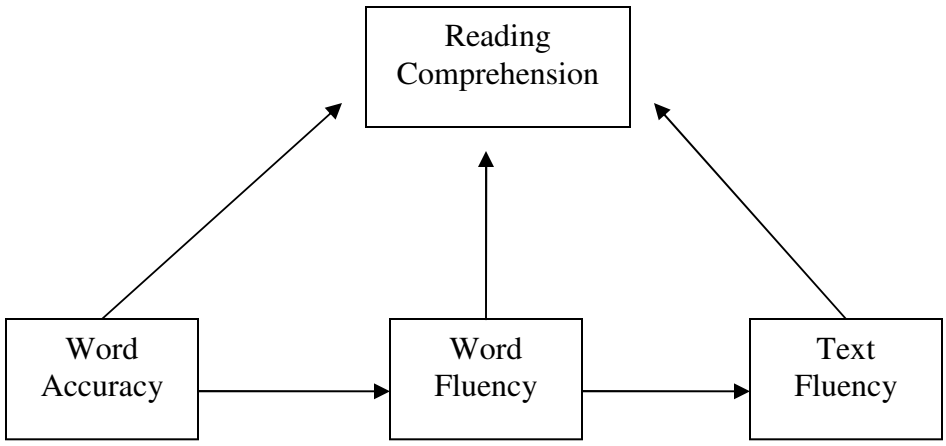
The purpose of Study 1 was to examine the role of word accuracy, word fluency, and text fluency in benefiting reading comprehension skills. Across the review of the literature, little theoretical and empirical support was found for the notion that text fluency facilitates reading comprehension. Some theorists have described processes by which text fluency contributes to reading comprehension beyond that which is explained by word reading (e.g., Fuchs et al., 2001; Schreiber, 1980; Wolf and Katzir-Cohen 2001; Young & Bowers, 1995), but a well developed theoretical framework has not yet been put forth. Further, little empirical evidence currently exists to support these claims (Jenkins et al., 2003a; Nation & Snowling, 1997), and some evidence may contradict this claim for children in early elementary school (Schwanenflugel et al., in press). Importantly, it is possible that text fluency does make independent contributions to comprehension, but that a strong theoretical and empirical rationale has not yet been put forth.

Path analysis was used to examine the viability of three theoretical models depicting how word reading, text fluency, and reading comprehension relate to each other: (a) Text Fluency Model; (b) Simple Fluency Model; and (c) Context Facilitation Model. These models are described briefly below.

(a) *Text fluency model*. The *text fluency model* assumes that word accuracy and word fluency skills are essential for text fluency and comprehension. Therefore, this model predicts that word reading skills (i.e., both timed and untimed measures of

decoding and single word reading) would explain a substantial amount of the variance in both text fluency and comprehension. Additionally, the text fluency model posits that text fluency involves processes that go beyond that of word reading and, as such, predicts that text fluency *will* make a unique contribution to reading comprehension because children who are fluent text readers as well as word readers are those who read prosodically and impose a syntactic organization on their reading.

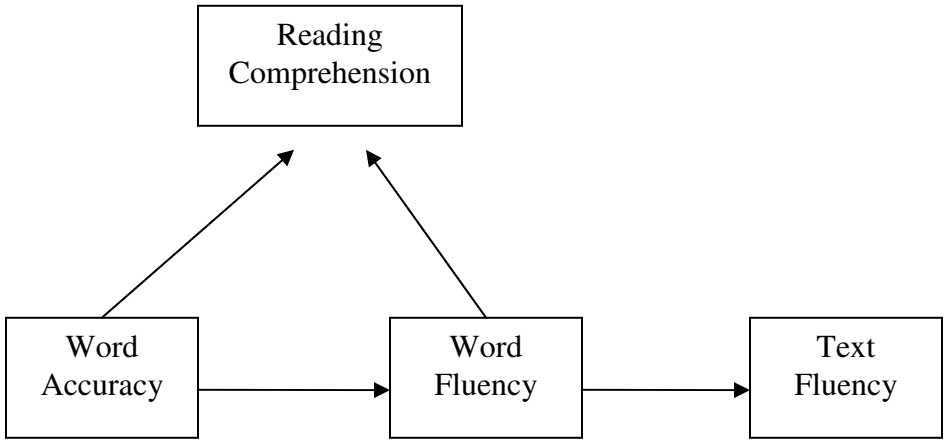
Figure 2.1
Recursive Path Model: Text Fluency Model



(b) *Simple fluency model.* The *simple fluency model* as proposed by Schwanenflugel et al. (in press) posits that both text fluency and reading comprehension are primarily the result of automatic word readings skills (e.g., LaBerge & Samuels, 1974; Perfetti, 1977, 1985; Torgesen, 2001). According to this model, as word reading skills become automatic, reading moves from being halting, effortful, and slow to being fluent, which frees cognitive and attentional resources from lower level processes and reallocates them for comprehension tasks (LaBerge & Samuels, 1974; Perfetti, 1977). Similar to the text fluency model, this model predicts that word accuracy and word fluency variables will

make important contributions to both text fluency and reading comprehension. Further, this model would suggest that text fluency and word fluency are largely measures of the same construct (speed and accuracy of words read). Thus, it is expected that text fluency will *not* make a significant positive contribution to reading comprehension after taking into account the word accuracy and word fluency variables. Text fluency is viewed as a byproduct of proficient word reading skills, with word reading skills facilitating comprehension. In sum, the crux of the difference between the simple fluency model and the text fluency model is whether text fluency is predicted to make a unique contribution to reading comprehension after accounting for word accuracy and word fluency.

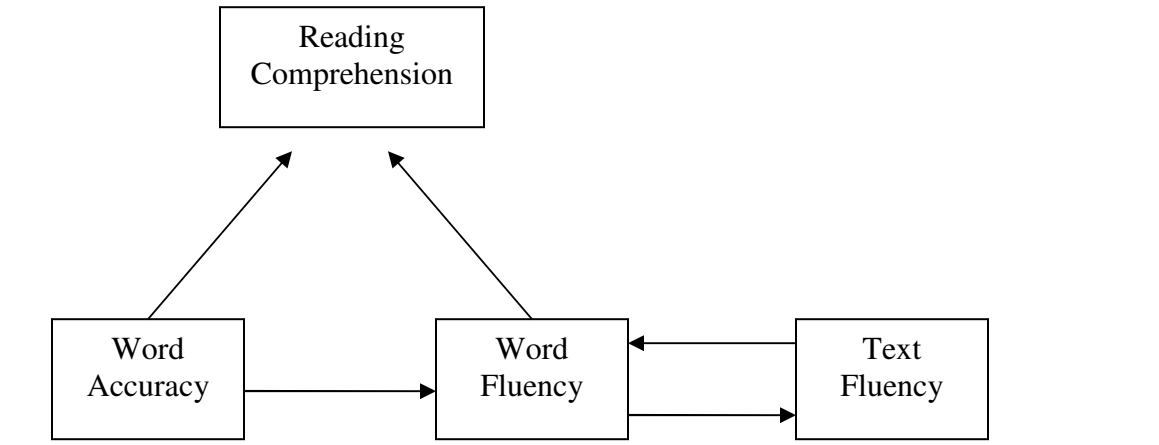
Figure 2.2
Recursive Path Model: Simple Fluency Model



(c) *Context facilitation model.* Like the other two models, the context facilitation model assumes that strong word level skills are essential for text fluency and comprehension. This facilitation of word reading skills via text fluency is thought to occur through the spreading of activation in semantic networks and the use of context for word identification (Posner & Synder, 1975). Context reading may facilitate reading

comprehension *indirectly*, in that, by facilitating word recognition, cognitive and attentional resources are freed that can be devoted to reading comprehension (LaBerge & Samuels, 1974). Therefore, this model predicts that text fluency would make some contributions to reading comprehension, but only indirectly by facilitating efficient word reading skills. Children who can identify words by sight are thought to benefit from reading connected text as information within the text activates related semantic memory locations (i.e., word meanings or concepts). This activation then spreads to other related or neighboring semantic memory locations lowering the thresholds for the retrieval of words or concepts from memory, thus facilitating word recognition. In contrast, less skilled readers with inefficient word reading skills may be more likely to consciously use context, as the slow acting conscious process may be completed before the word is identified (Stanovich, 1980). Relying on conscious process requires cognitive resources that are then unavailable for comprehension.

Figure 2.3
Nonrecursive Path Model: Context Facilitation Model



Method

Participants

Participants were 98 3rd and 92 5th (N = 190) grade students from five elementary schools located in the southeastern and northeastern parts of the United States. 76 3rd and 73 5th grade students participated were from southeastern schools, whereas 22 3rd graders and 19 5th graders were from the northeastern schools. Based on the 2003-2004 state school report cards for participating schools, between 48% - 92% of children were eligible for free or reduced lunch. The demographic make-up of the schools was as follows: 51.0% were African American, 33.7% Caucasian, 13.2% Hispanic, and 2.1% other. Of the participants, 55% were female. Participating students ranged from 8.5 to 12.2 years of age (M = 10.2, SD = 1.13). Data collection occurred during the spring of 2004 (March through May),

Measures

The following standardized measures of word accuracy, word fluency, text fluency, and reading comprehension were individually administered to all participants:

Word Accuracy

To access children's ability to accurately identify and decode words in isolation (i.e., context-free word reading), the Word Identification and Word Attack subtests of the Woodcock Reading Mastery Tests- Revised (WRMT-R; Woodcock, 1986) was administered. On the Word Identification subtest, children are presented with a list of real words and are asked to read them aloud. On the Word Attack subtest, children are asked to read from a list of nonwords they have never before seen; therefore, they must use their understanding of sound letter associations to decode these novel words. The reading

of nonwords is an indicator of children's phonological processing skills (Siegel, 1993). On each subtest, the number of real words and nonwords children are able to read are recorded. The two subtests are combined to produce the Basic Reading Skills Composite, whose standard score has a mean of 100 and a standard deviation of 15. The Basic Reading Skills Composite was used as the indicator of word accuracy in the data analysis. Untimed word reading measures are commonly used by both clinicians and researchers to assess children's reading skills. The WRMT-R reports internal consistency coefficients ranging from .91 to .97 on the Word Identification subtest and between .89 and .90 on the Word Attack subsets for third and fifth grade children. Validity estimates for the Word Identification subtest ranged from .82 to .74, and for the Word Attack subtest ranged from .83 to .90 with similar reading measures for 3rd and 5th grade students, respectively.

Word Fluency

The Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1997) measures children's ability to fluently (i.e., quickly *and* accurately) read real words and nonwords. The TOWRE is comprised of the Sight Word Reading Efficiency and Phonemic Decoding Efficiency subtests, and the Total Reading Efficiency composite standard scores which combines the two subtests. The Sight Word Efficiency subset consists of a list of words for which children are asked to read aloud as many words as they can in 45 seconds. On the Phonemic Decoding Efficiency subtest children are asked to read aloud as many nonwords as they can in 45 seconds. The number of words and nonwords read correctly in 45 seconds is recorded. The TOWRE reports test-retest reliabilities between .90 and .97, and validity estimates with other word reading measures

of between .91 and .94. The standard score for the Total Reading Efficiency composite has a mean of 100 and a standard deviation of 15.

Text Fluency

Text fluency was assessed using the Gray Oral Reading Test-Fourth Edition (GORT-4) and the Dynamic Indicators of Basic Early Literacy Skills- Sixth Edition (DIBELS):

(a) The Gray Oral Reading Test- Fourth Edition (GORT-4; Weirdholt & Bryant, 2001) is designed to assess text fluency and consists of a series of increasingly difficult passages. This test produces several subscales, but the Reading Rate scale was used for the purpose of this study. The examiner records the time in seconds it takes for the child to complete each passage and any oral reading errors that are made. Oral reading errors include misread words, substitutions, insertions, omissions, repetitions, and self-corrections. Children continue reading passages of increasing difficulty until the reading becomes too slow and inaccurate based on the discontinue rule (i.e., a combination of reading speed and the number of misread words) set by the test developer. A Reading Rate rating is assigned for each passage based on how long it took the child to read the passage, and these ratings are then summed to form a cumulative reading rate score. The GORT-4 provides scaled scores for the Reading Rate subtest, which have a mean of 10 and a standard deviation of 3. The GORT-4 manual reported strong reliability evidence, with internal consistency coefficients between .89 and .96, test re-test reliability of .95, and inner-rater reliability of .97 for the Reading Rate scale (GORT-4; Weirdholt & Bryant, 2001). Concurrent validity estimates with other measures of reading skills (i.e., reading comprehension, word reading, and decoding measures) for the Reading Rate

scales had a median of .64. However, the GORT-4 was not compared with other measures of text fluency by its test developers. Given that the GORT-4 is one of the few fluency measures available, it is important to examine whether it is comparable to other measures of text fluency. A second more recently developed measure of text fluency, the DIBELS Oral Reading Fluency, will be administered to all participants so that the concurrent validity of the GORT-4 can be examined.

(b) The DIBELS Oral Reading Fluency is a standardized, criterion referenced test of text fluency. The DIBELS fluency passages and procedures are based on Curriculum Based Measurement (CBM) in oral reading, a method of assessing text fluency skills developed by Shinn (1989) and Deno (1989). The DIBELS tests are available from their website (http://dibls.uoregon.edu), including the reading passages and all materials needed for test administration. Children are asked to read aloud from three grade level reading passages of similar difficulty level for one minute. The examiner records all the oral reading errors including words omitted and substituted as well as hesitations of more than three seconds. Misread words that are self-corrected within three seconds, repeated words, and inserted words are scored as accurate. The number of words read correctly per minute (cwpm) for each passage is calculated by counting the number words correctly read by the child. The median cwpm of the three passages is used to identify children's benchmark level. For example, in the spring of their third grade year, children who read 110 cwpm or higher are classified as "low risk", children reading 80 to 109 per minute are classified as at "some risk", and those who are reading less than 80 words correctly per minute are classified as at "high risk" for demonstrating below grade level reading comprehension skills on end of the year high stakes testing. The DIBELS Oral Reading

Fluency is used by schools to identify children who are at-risk of failing end of the year high stakes testing and to monitor students reading progress throughout the year. The DIBELS fluency reports test-retest reliabilities between .92 and .97, and alternative form reliability between .89 and .94. Criterion-related validity estimates range from .52 to .92 (Shaw & Shaw, 2002).

Reading Comprehension

The *Wechsler Individual Achievement Test- Reading Comprehension subtest* (WIAT; The Psychological Corporation, 1992) was used to assess children's reading comprehension level. Children read sentences or passages and then are asked questions about what they read. The number of questions answered correctly is recorded. The reading comprehension subtest of the WIAT generates a standard score with a mean of 100 and a standard deviation of 15. The WIAT manual reports internal consistency estimates ranging between .85 to .88, test-retest reliabilities between .84 and .88, and inter-rater reliabilities between .89 and .99 for third and fifth grade children. Validity estimates with other similar reading measures ranged between .78 and .86 (WIAT; The Psychological Corporation, 1992).

Procedure

Written parental consent was required for participation in the study. In addition, the purpose of the study was explained to the participating children in understandable terms and child assent was obtained prior to testing. All measures were individually administered by testers in a quiet area of the school to minimize distractions. Measures were counterbalanced to control for order effects.

Total testing time took between 1 hour and 1 hour and 15 minutes, depending on the particular child. The testing was sometimes broken into two sessions due to classroom schedules (i.e., lunch, recess, tests, assemblies) or if the child became fatigued. Occasionally testing was not completed in the same day, but no more than a few days elapsed between testing sessions. Children received a small token of thanks at the end of each testing session, such as a sticker or pencil. A small teacher honorarium was provided for the teachers in the form of books donated to the classroom or school library.

All testers were trained by a school psychology doctoral student who had substantial experience of reading fluency assessment. These testers were trained to have at least 95% agreement with the trainer and the trainer observed the testers for the first week of testing to ensure procedural adherence.

Statistical Analyses

Path analysis was used to test the viability of three theoretical models of reading (see Figure 2.4-Figure 2.6). Path analysis allows the researcher to build a theoretical model that provides a rationale for why the variables are correlated, and then assesses whether the proposed model "fits" or provides a good explanation for the observed correlations. Real relationships can be masked by inter-correlations among variables, and path analysis is valuable because it decomposes these correlations into their constitute parts (Kline, 1998). Path analysis is one statistical technique in the structural equation modeling (SEM) family. Its use is appropriate when there are a priori hypotheses regarding the relationships among the variables and when there is a single indicator for each variable of interest.

Several statistical assumptions are required when using path analysis including multivariate normality and linear relationship among the variables; therefore, the data was screened for violations of these assumptions. Values for univariate skewness and kurtosis for all measures used in the path analysis fell within acceptable limits for both the 3rd and 5th grade data using *z*-score cutoffs suggested by Kline (1998) (see Table 2.1). The relative multivariate kurtosis statistic was 1.04 for the 3rd grade and 0.95 for the 5th grade, indicating that the requirement of multivariate normality was met for the variables used in this analysis (a cut-off of < 2.0 was used). Visual inspection of the scatter plots suggested generally linear relationships among the variables.

Table 2.1
Univariate Normality Statistics for all Variables

Variable	Skew	Kurtosis
	3rd Grade (*N* = 98)	
Comprehension (WIAT)	2.50	.62
Word Accuracy (WRMT-R)	2.33	-.67
Word Fluency (TOWRE)	1.54	.38
Text Fluency (GORT-4)	.29	-.18
	5th Grade (*N* = 92)	
Comprehension (WIAT)	.46	.05
Word Accuracy (WRMT-R)	1.14	.19
Word Fluency (TOWRE)	-.81	-.87
Text Fluency (GORT-4)	-.03	-1.70

Note: Cut-off values for skewness < $\left|3.0\right|$ and kurtosis < $\left|8.0\right|$ were used (Kline, 1998).

Before any analyses were conducted, the data was screened for missing data points, outliers, and multicollinearity (Kline, 1998). No subjects were found to have missing data. Scatter plots were examined for the presence of univariate outliers (i.e., data point exceeding 3 *SD* from the mean) and Mahalanobis distance was used to screen for multivariate outliers. Multicollinearity occurs when variables that appear to be

separate actually measure the same construct, and correlations exceeding $r = .85$ indicate potential problems in this area (Kline, 1998). An examination of the correlations matrix (see Table 2.2) did not suggest the presence of multicollinearity in either the 3rd or 5th grade data.

Model fit was determined using maximum likelihood estimation method. Maximum likelihood estimation was used for three reasons: (a) it is the most commonly used estimation method, (b) it is most accurate when using normally distributed data, and (c) it is most appropriate when using a small sample size ($N \leq 250$). Several indicators of model fit were used in this analysis, each measuring different aspects of model fit. Hu and Bentler (1998, 1999) suggest using a two-index strategy that includes presenting the Standardized Root Mean Square (SRMR) and supplementing it with one of several other indicators (TLI, BL89, CFI, Gamma hat, Mc, or RMSEA). Several of the supplemental indices are not recommended to use with a small sample size ($N \leq 250$), so the Bentler Comparative Fit Index (CFI) was chosen. The SRMR is the standardized summary of the average difference between the observed and model-implied covariances (i.e., the covariance residuals) (Kline, 1998). The SRMR is quite sensitive to simple model misspecification and a SRMR <.08 indicates reasonable fit (Hu & Bentler, 1999). The CFI is an incremental fit index that represents the proportion of increased fit of the hypothesized model relative to a null baseline model (a model with all of the parameters forced to equal zero) (Kline, 1998). CFI values close to .90 are commonly used to indicate adequate fit, but a more stringent criteria is CFI > .95 (Hu & Bentler, 1998, 1999).

Kline (1998) recommends reporting two other types of fit indices, the χ^2 fit index that tests "the difference in fit between a given overidentified model and a just-identified version of it" (Kline, 1998, p. 128) and one index that adjusts for model complexity such as the Tucker-Lewis Index. Although it is tradition to present the χ^2 fit index, it is generally not the preferable index for various reasons (see Hu & Bentler, 1998 for a review) and needs to be supplemented with other indicators of fit. Generally, a nonsignificant χ^2 indicates reasonable fit; however many researchers consider values close to $\chi^2/df < 3$ to be a more appropriate cut-off value (Kline, 1998). Lastly, the Tucker-Lewis Index (TLI) is similar to the CFI but is parsimony adjusted, and the same cut off values are used for both indices. Model fit can be improved simply by adding paths; therefore a parsimony adjusted index considers the fit relative to the degrees of freedom.

Results

Concurrent Validity of the GORT-4

The GORT-4 was used in this study to assess children's text fluency skills, yet the developers of this test did not compare its results with that of other measures of text fluency. To rule out the possibility that our results were due to poor instrumentation, the concurrent validity of the GORT-4 was investigated by comparing it to a commonly used standardized and criterion referenced measure, the DIBELS Oral Reading Fluency. The GORT-4 rate scaled score was correlated with the number correct words per minute (cwpm) from the DIBELS Oral Reading Fluency. Results suggested that the GORT-4 and the DIBELS Oral Reading Fluency provide similar estimates of text fluency skills in 3rd grade ($r = .91$, $p < .001$) and 5th grade children ($r = .92$, $p < .001$). Consequently, the

GORT-4 was deemed a valid indicator of reading fluency and age-based standard scores from the instrument were used as the indicator of text fluency.

Table 2.2
Means, Standard Deviations, and Correlations for all Variables

Variables	1	2	3	4
		3rd Grade (*N* = 98)		
1. Comprehension (WIAT)	--	--	--	--
2. Word Accuracy (WRMT-R)	.58**	--	--	--
3. Word Fluency (TOWRE)	.51**	.81**	--	--
4. Text Fluency (GORT-4)	.63**	.74**	.82**	--
M	99.8	106.2	101.8	9.9
SD	13.1	15.1	15.3	3.4
		5th Grade (*N* = 92)		
1. Comprehension (WIAT)	--	--	--	--
2. Word Accuracy (WRMT-R)	.29**	--	--	--
3. Word Fluency (TOWRE)	.14	.66**	--	--
4. Text Fluency (GORT-4)	.28**	.60**	.78**	--
M	91.7	102.8	98.8	9.4
SD	13.1	13.9	13.3	3.1

Note: *$p<.05$, **$p<.01$

Tests of the Theoretical Models

Path Analysis of the Theoretical Models

The covariance matrix from each grade was used separately as input to LISREL 8.72 (Joreskog & Sorborm, 2005) and parameter estimates were obtained using the maximum likelihood estimation method. The covariance matrices used in the analyses can be found in Table 2.3. Means, standard deviations, and correlations for each grade are presented in Table 2.2 and suggest that, on average, children in these two samples demonstrated age-appropriate reading skills as would be expected in a normative sample. Standard scores were used for all measures except for the GORT-4 Reading Rate scale, which provided a scaled score.

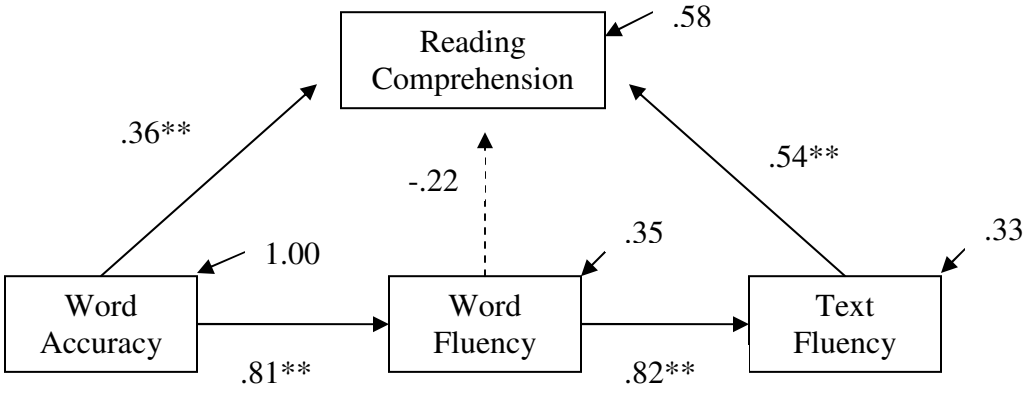
Table 2.3
Variances and Covariances for all Variables

Variable	1	2	3	4
		3rd Grade (N = 98)		
1. Word Fluency (TOWRE)	234.7			
2. Word Accuracy (WRMT-R)	186.0	227.1		
3. Comprehension (WIAT)	102.5	114.8	170.8	
4. Text Fluency (GORT-4)	43.0	38.4	28.1	11.8
		5th Grade (N = 92)		
1. Word Fluency (TOWRE)	176.2			
2. Word Accuracy (WRMT-R)	121.3	192.3		
3. Comprehension (WIAT)	25.1	52.6	172.6	
4. Text Reading (GORT-4)	31.7	25.4	11.5	9.5

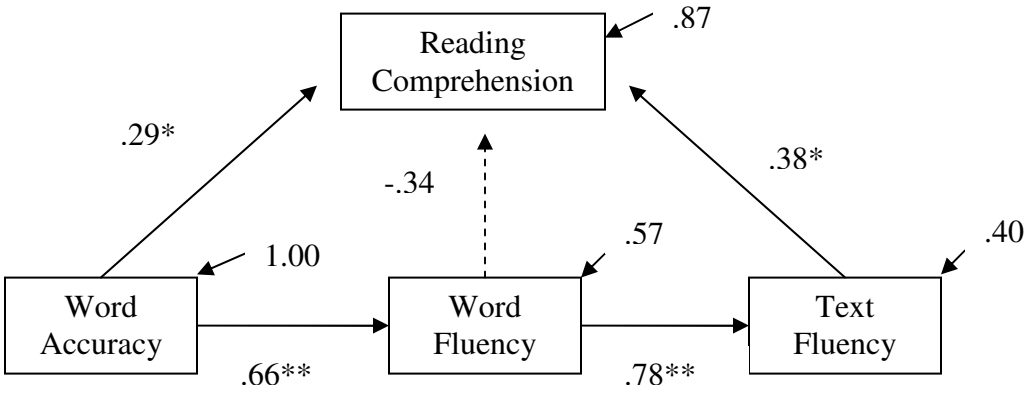
Text fluency model. The overall text fluency model provided a reasonable fit for the 5th grade data (SRMR = .03, CFI = .99, TLI = .92, χ^2 (1) = 2.84, ns) and provided an acceptable fit according to most indices for the 3rd grade data (SRMR = .03, CFI = .98, TLI = .89, χ^2 (1) = 5.73, $p < .05$). Standardized parameter estimates for the 3rd and 5th grade models are presented in Figure 2.4. Solid lines represent significant paths and dashed lines represent nonsignificant paths.

Figure 2.4
Standardized Parameter Estimates for the Text Fluency Model

3rd Grade Model



5th Grade Model



Examination of the direct paths leading to reading comprehension as an outcome measure indicated the importance of text fluency in reading comprehension. The direct path from text fluency to reading comprehension was significant for 3rd grade ($p < .01$) and 5th grade ($p < .05$), as was the direct path from word accuracy to reading comprehension for 3rd ($p < .01$) and 5th grades ($p < .05$) (see Table 2.4). In contrast, the direct path from word fluency to reading comprehension was not significant for either grade and was even opposite the direction predicted by the model. However, an examination of the indirect effects revealed a significant mediating effect for word fluency on reading comprehension via text fluency for 3rd grade ($p < .01$) and 5th grade ($p < .05$). In other words, some of the effects of word fluency on reading comprehension were transmitted through text fluency. Examination of the paths to text fluency as an outcome measure indicates the importance of word reading skills for text fluency in both grades. The direct path from word fluency to text fluency was significant for both grades ($p < .01$). Similarly, an indirect effect was found for word accuracy on text fluency via word fluency ($p < .01$).

Table 2.4
Path Weights, Standard Errors, & t Values for the Text Fluency Model

Path	Weight	SE	t
Third Grade			
		Direct Paths	
Word Accuracy to:			
Word Fluency	.81	.06	13.33**
Reading Comprehension	.36	.11	2.77**
Word Fluency to:			
Text Fluency	.82	.01	13.92**
Reading Comprehension	-.22	.14	-1.27
Text Fluency to:			
Reading Comprehension	.54	.51	4.01**
		Indirect Paths	
Word Accuracy to:			
Text Fluency	.66	.02	9.63**
Reading Comprehension	.18	.09	1.66
Word Fluency to:			
Reading Comprehension	.44	.10	3.86**
Fifth Grade			
Path	Weight	SE	t
		Direct Paths	
Word Accuracy to:			
Word Fluency	.66	.08	8.31**
Reading Comprehension	.29	.12	2.21*
Word Fluency to:			
Text Fluency	.78	.02	11.70**
Reading Comprehension	-.34	.18	-1.89
Text Fluency to:			
Reading Comprehension	.38	.66	2.41*
		Indirect Paths	
Word Accuracy to:			
Text Fluency	.51	.02	6.78**
Reading Comprehension	-.03	.08	-.34

Word Fluency to:			
Reading Comprehension	.29	.12	2.36*

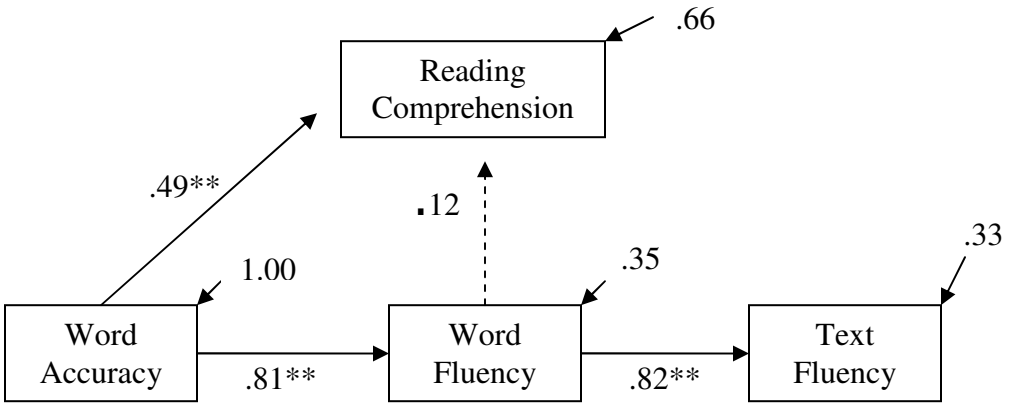
Note: * $p < .05$; ** $p<.01$.

In sum, results of the path analysis generally supported the text fluency model Text fluency made significant contributions to comprehension in both grades after accounting for word accuracy and word fluency skills. Still, it is apparent that word level skills are closely related to text fluency and are important for comprehension, even though word fluency's contribution to comprehension was made indirectly through text fluency rather than directly as predicted by the model. Taken together, the structural equations for this model accounted for a large portion of the variance in word fluency in 3rd and 5th grade (65% and 43%, respectively) and in text fluency (67% and 60%, respectively). Importantly, the amount of variance explained in reading comprehension by the model decreased from 42% in 3rd grade to only 13% in 5th grade. This finding indicates a declining influence of basic reading skills on reading comprehension, and suggests that other factors need to be examined to account for reading comprehension in older children.

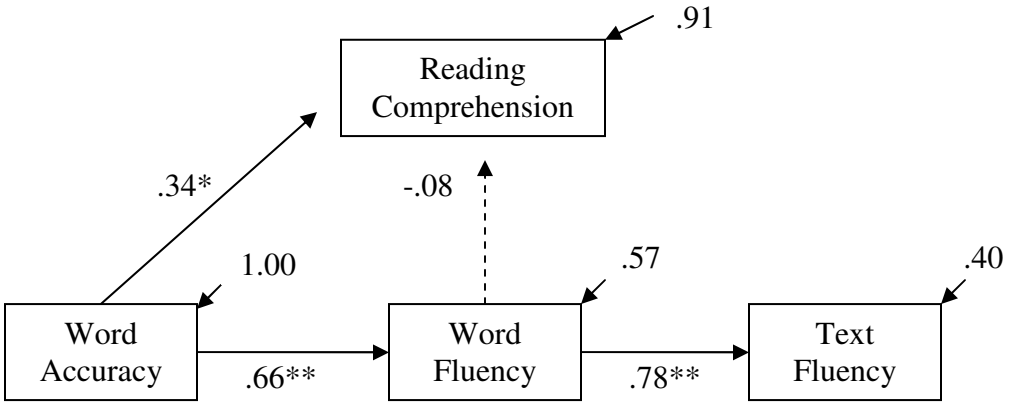
Simple fluency model. The simple fluency model did not provide an acceptable fit for the 3rd grade data (SRMR = .07, CFI = .93, TLI = .80, χ^2 (2) = 18.19, $p < .001$), but this model provided a more acceptable fit for the 5th grade data (SRMR = .06, CFI = .95, TLI = .86, χ^2 (2) = 8.02, $p < .05$). Standardized parameter estimates for the 3rd and 5th grade models are presented in Figure 2.5. Solid lines represent significant paths and dashed lines represent nonsignificant paths.

Figure 2.5
Standardized Parameter Estimates for the Simple Fluency Model

3rd Grade Model



5th Grade Model



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

Similar to the text fluency model, the results indicated that word accuracy and word fluency are important skills for text fluency. The direct path from word fluency to text fluency was significant for both the 3rd and 5th grade models ($p < .01$), and an examination of the indirect effects revealed a significant mediating effect for word accuracy on text fluency via word fluency ($p < .01$) (see Table 2.5). An examination of the direct paths leading to reading comprehension revealed a significant path from word accuracy for both 3rd grade ($p < .01$) and 5th grade ($p < .05$), but not from word fluency (ns). Given the finding that the effect of word fluency on reading comprehension was

mediated by text fluency in the text fluency model, it is not surprising that the path from word fluency to reading comprehension was nonsignificant in this model where the path from text fluency to reading comprehension was eliminated. Taken together, the model accounted for a large portion of variance in word fluency in 3rd and 5th grade (65% and 43%, respectively) and in text fluency (67% and 60%, respectively). Again, a decline in the influence of basic reading skills on comprehension was observed, with 34% of the variance in reading comprehension explained by the model in 3rd grade but only 8.7% in 5th grade. In conclusion, results of the path analysis did not support the simple fluency model.

Table 2.5
Path Weights, Standard Errors, & t Values for the Simple Fluency Model

Path	Weight	SE	t
	Third Grade		
	Direct Paths		
Word Accuracy to:			
Word Fluency	.81	.06	13.33**
Reading Comprehension	.49	.12	3.48**
Word Fluency to:			
Text Fluency	.82	.01	13.92**
Reading Comprehension	.12	.12	.87
	Indirect Paths		
Word Accuracy to:			
Text Fluency	.66	.02	9.63**
Reading Comprehension	.10	.10	.86
	Fifth Grade		
Path	Weight	SE	t
	Direct Paths		
Word Accuracy to:			
Word Fluency	.66	.08	8.31**

Reading Comprehension	.34	.13	2.56*
Word Fluency to:			
Text Fluency	.78	.02	11.70**
Reading Comprehension	-.08	.13	-.61
	Indirect Paths		
Word Accuracy to:			
Text Fluency	.51	.02	6.78**
Reading Comprehension	-.05	.08	-.61

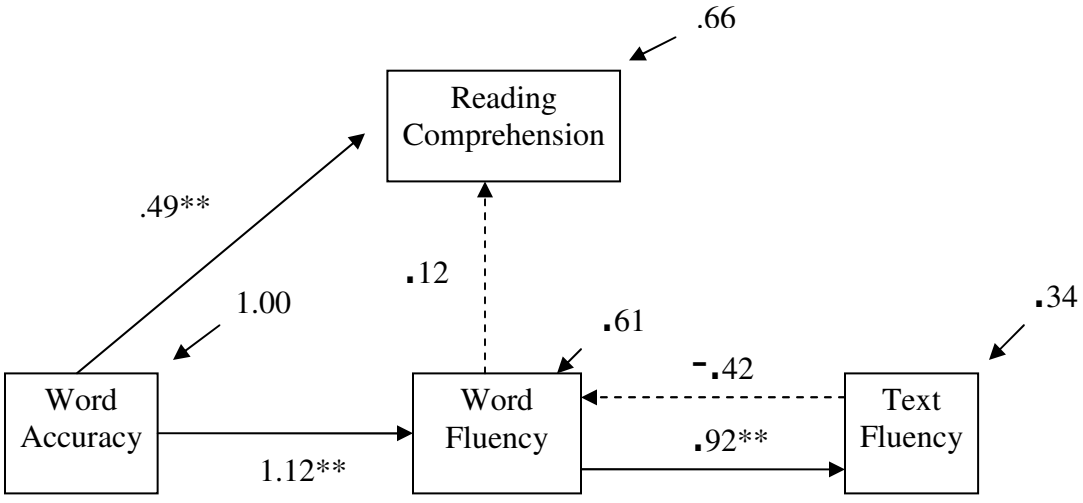
Note: * p < .05; ** p<.01.

Context facilitation model. The context facilitation model posits that reading connected text benefits reading comprehension by facilitating fast and accurate word identification. To evaluate the context facilitation model a direct path from text fluency to word fluency was added creating a feedback loop. Of primary interest in the evaluation of this nonrecursive model is whether the path added from text fluency to word fluency is significant. Nonrecursive models have either feedback loops or correlated disturbances, whereas recursive model such as the simple fluency model and the text fluency model have unidirectional paths and uncorrelated disturbances (Kline, 1998).

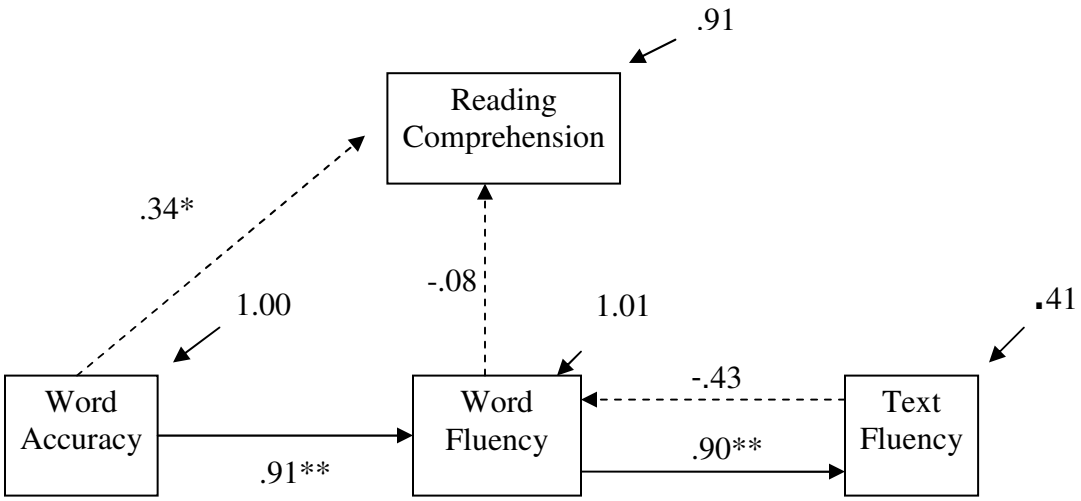
Figure 2.6

Standardized Parameter Estimates for the Context Facilitation Model

3rd Grade Model



5th Grade Model



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

The context facilitation model did not provide an acceptable fit for the 3rd grade data (SRMR = .09, CFI = .95, TLI = .71, χ^2 (1) = 13.23, p<.001) and provided a more acceptable fit for the 5th grade data (SRMR = .045, CFI = .97, TLI = .80, χ^2 (1) = 5.35, *p* = .02). Standardized parameter estimates for the 3rd and 5th grade models are presented in Figure 2.6. The direct path from text fluency to word fluency was not significant for either grade. The 3rd grade context facilitation model was similar to the 3rd grade text fluency model in terms of the relationships among the variables. However, the addition of a nonsignificant path from text fluency to word fluency resulted in additional nonsignificant paths from word accuracy and text fluency to reading comprehension in the 5th grade model. The 5th grade model generally makes little sense for 5th graders since it would suggest that there is no relationship between word or text reading skill and reading comprehension. Taken together, the structural equations for this model accounted for a large portion of the variance in word fluency, text fluency, and reading comprehension in 3rd grade (39%, 66 %, & 34%, respectively). The structural equations

for this model in 5th grade accounted for very little variance in word fluency and reading comprehension (1% & 9%, respectively), but a greater amount in text fluency (59%). In sum, the results of this analysis do not support the context facilitation model.

Table 2.6
Path Weights, Standard Errors, & t Values for the Context Facilitation Model

Third Grade			
Path	Weight	SE	t
	Direct Paths		
Word Accuracy to:			
Word Fluency	1.12	.19	5.90**
Reading Comprehension	.49	.12	3.48**
Word Fluency to:			
Text Fluency	.92	.02	12.43**
Reading Comprehension	.12	.12	.87
Text Fluency to:			
Word Fluency	-.42	1.03	-1.81
	Indirect Paths		
Word Accuracy to:			
Word Fluency	-.31	.19	-1.69
Text Fluency	.74	.02	10.84**
Reading Comprehension	.10	.10	.86
Word Fluency to:			
Word Fluency	-.28	.12	-2.29*
Text Fluency	-.26	.03	-2.03*
Reading Comprehension	.03	.04	-.81
Text Fluency to:			
Word Fluency	.12	.51	1.01
Text Fluency	-.28	.12	-2.29*
Reading Comprehension	-.04	.17	-.82
Fifth Grade			
Path	Weight	SE	t
	Direct Paths		

Word Accuracy to:			
Word Fluency	.91	.22	4.00**
Reading Comprehension	.34	.13	2.56*
Word Fluency to:			
Text Fluency	.90	.02	8.79**
Reading Comprehension	-.08	.13	-.61
Text Fluency to:			
Word Fluency	-.43	1.47	-1.25
		Indirect Paths	
Word Accuracy to:			
Word Fluency	-.25	.21	-1.15
Text Fluency	.60	.02	7.03**
Reading Comprehension	-.05	.08	-.61
Word Fluency to:			
Word Fluency	-.28	.18	-1.57
Text Fluency	-.25	.04	-1.37
Reading Comprehension	-.02	.04	.57
Text Fluency to:			
Word Fluency	.12	.73	.70
Text Fluency	-.28	.18	-1.57
Reading Comprehension	.03	.19	.58

Discussion

Results from the path analysis clearly support the *text fluency model,* where word accuracy, word fluency, and text fluency each make important contributions to reading comprehension. Further, as predicted by the *text fluency model,* word accuracy and word fluency were found to be essential for text fluency. However, the degree to which these skills influence reading comprehension appears to diminish as children grow older, and other factors may need to be considered to explain comprehension in older students. As children encounter more complex text it may be that the ability to utilize prior knowledge, to draw inferences, and to demonstrate abstraction skills become increasingly

essential for comprehension. Other studies have pointed to possible developmental changes in the relationships among reading skills (Shinn et al., 1992), and this work suggests a divergence of reading comprehension from the basic word and text fluency skills by the end of 5th grade. Results from this study are consistent with that of several studies whose findings pointed to the importance of text fluency for reading comprehension (i.e., Jenkins et al., 2003a; Nation & Snowling, 1997).

The findings of the current study directly contradict those of Schwanenflugel et al. (in press) who found no additional benefit from text fluency on reading comprehension once word fluency was controlled for in first, second, and third grade children. The differences between their study and the current study deserve careful consideration because the current study used similar diagnostic instruments and a very similar population. There are a number of differences between their study and this one that might account for these differences in findings. First, their study included a measure of Stroop interference in the model to address the autonomy aspect of reading. The current study lacked such a measure. The Stroop interference measure in that study displayed a minimal relationship to other aspects of the model such as word fluency, text fluency, and reading comprehension, so this is unlikely to be the source of the discrepancy between the studies. Second, that study focused on early reading (1st through 3rd grade) rather than reading in the middle grades (3rd and 5th grade). It may be that the model for older children is different than that for younger children. I doubt that this explanation is the likely one, however, because their study included a third grade sample similar in demographic composition and absolute reading skills to the current one. Third, Schwanenflugel and colleagues included measures of rapid naming speed, which may be

an important contributor to text fluency, whereas the current study did not. Some of the variance in text fluency may have been accounted for by the rapid naming speed in their model, leaving less unique variance available to contribute to reading comprehension. On the other hand, rapid naming speed seemed to account for little variance in their model, so it is unclear whether that is the difference between their study and the current study. Fourth, the current study included both timed and untimed measures of word reading skills, whereas Schwanenflugel and colleagues included only timed word (word fluency) reading measures. Their use of word fluency measures alone may have combined sources of variance, as word fluency may be more closely related to text fluency than word reading accuracy. In contrast, in the current study word accuracy and word fluency were represented as distinct skills within the model. I think this is the most likely source for the discrepancy between their findings and that of the present study. The current study, because of its use of timed and untimed measures of word reading skill, allowed me to distinguish between the two. Thus, I conclude that it's likely that once children have accurate word reading skills, it is the contribution of text fluency which, because it is a downstream measure, captures all the important variation related to reading fluency.

For children in early elementary school, fluent text reading skills seems to benefit reading comprehension. This finding provides a strong rational for the inclusion of text fluency in the assessment of children's reading skills. Given that little variance in reading comprehension was explained by the model in the 5th grade sample, the importance of assessing text fluency in older children with normal reading skills may be debatable. It may be that by 5th grade children's basic reading skills, or the ability to quickly and accurately read words and connected text, have largely developed, and consequently

these skills become of little relevance to comprehension (Chall, 1979, 1996). This finding is supported by the literature which suggests that the relationship between reading comprehension and text fluency is stronger in elementary school than in older students (Gray, 1925; Jenkins & Jewel, 1993; Sassenrath, 1972). However, failure to develop proficient basic reading skills at this age could still impede reading comprehension as well as the learning of content area knowledge. Therefore, with regards to the assessment of children's reading skills, text fluency may be less relevant for older normal readers than for children younger children or for those who are experiencing significant difficulties in their basic reading skills. Study 2 will explore the utility of text fluency versus word reading measures in identifying children as reading disabled.

CHAPTER 3

STUDY 2

The primary aim of Study 2 was to investigate the utility of a standardized, norm-referenced measure of text fluency, the Gray Oral Reading Test, Third Edition (GORT-3) for identifying children with reading disabilities. Specifically, the Reading Rate subscale of the GORT-3 was compared to commonly used standardized measures of word reading and decoding. The results of Study 1 suggested that fluent text reading facilitates comprehension in elementary school children. Given that reading comprehension is the primary goal of reading, Study 1 provided support for the idea that text fluency is an important reading skill. Previous research also suggests that text fluency may be more sensitive to detecting reading problems than traditional measures of word reading, decoding, and reading comprehension (e.g., Breen & Decorah, 1990; McCabe, Margolis, & Barenbaum, 2001, Sofie & Riccio, 2002), yet text fluency is often overlooked in the assessment of children's reading skills. It follows that the omission of text fluency may result in the under-identification of children with reading disabilities. However, studies of text fluency with Reading Disabled (RD) populations have been limited by generally sample small sizes and the use of different types of text fluency measures (i.e., curriculum-based measurement, informal reading inventories, or standardized measures). In general, more research is needed to establish the utility of text fluency in detecting reading problems.

There are several reasons why children with reading disabilities may show particular problems with text fluency. Evidence from the reading disability subtype

literature (e.g., Lovett, 1984, 1987; Morris et al., 1998) suggests that some children with reading disabilities exhibit specific deficits in text fluency, and that, for these children, rapid serial naming plays a role in mediating text reading rate. Consensus exists that phonological processing represents a core deficit for children who experience problems with reading. However, neither Lovett (1984, 1987) nor Morris et al. (1998) found phonological processing deficits in reading disabled children with specific problems in text fluency, suggesting that phonological processing may not differentiate text fluency deficit readers from other struggling readers. Interestingly, Lovette (1984, 1987) and Morris et al. (1998) also found that readers with specific deficits in their text fluency skills did not experience significant problems with reading comprehension. This directly contrasts what would be expected given the results of Study 1, which found that text fluency facilitates comprehension, and deserves further exploration. Although not examined by either Lovett or Morris and colleagues, age may also play an important role in understanding children who struggle with reading connected text, as word reading skills may need to become consolidated before text reading becomes fluent (Chall, 1979, 1996). Rapid naming speed, phonological processing, and children's age may be important factors in explaining why some children experience difficulties specifically with text fluency.

Three specific research questions were addressed in Study 2. First, does a distinct group of children with specific deficits in text fluency exist? Second, if so, what cognitive features differentiate children with specific text fluency deficits from struggling and normal readers? Finally, does the omission of text fluency in the assessment of children

referred due to reading difficulties result in the under identification of children with reading disabilities?

The current study examined these issues using a clinical sample of children referred to a university clinic for dyslexia. Children were assessed on intelligence, word reading, text fluency, reading comprehension, rapid naming, and phonological processing. If there is a distinct text fluency dyslexia subtype, we would expect that there will be some children who show typical word reading abilities psychometrically with distinctly low text fluency abilities. Children with specific deficits in text fluency would be expected to show deficits in their rapid naming speed but not phonological processing skills (Lovette, 1984, 1987; Morris et al., 1998), and may be older than students who are struggling with both word and text reading. Further, on the basis of Study 1's findings, it was also expected that children with distinct deficits in text fluency would experience reduced reading comprehension compared to their more fluent peers. Children were identified as either normal, globally impaired, or text fluency deficit readers. These groupings allowed for comparisons to be made between children with average reading skills (normal readers), those with poor word and text reading skills (globally impaired readers), and those who struggle specifically when reading connected text (text fluency deficit readers) on measures of phonological processing, rapid naming speed, reading comprehension, and age.

The omission of text fluency was hypothesized to result in the under identification of children with reading disabilities. To explore this possibility, two models were used to identify children as reading disabled, the discrepancy and low achievement models. Traditionally, the IQ/achievement *discrepancy model* has been most often used to

identify children as having a reading disability, although its validity was been rigorously questioned in the literature (Fletcher et al., 1999; Stuebinger et al., 2002; Velluntino et al., 2000). Another competing model is the *low achievement* or cut score model, where standard scores of 85 or lower are the primary criteria or a reading disability (Fletcher, 1985, Stanovich, 1999), although some also propose exclusionary criteria such as average intelligence (i.e., Dombroski et al., 2004; Siegel, 1999). Lastly, the *response to intervention model (RTI)* (i.e., Gresham, 2001) proposes that students who do not respond to appropriate reading interventions be categorized as reading disabled. As discussed in the introduction, the most recent reauthorization of IDEA modified the federal definition to allow for the use of a student's response to intervention in the determination of a specific learning disability. Improvements in text fluency from extensive interventions have been harder to attain than improvements in reading comprehension, decoding, and word reading skills (Lyon & Moats, 1997; Meyer & Felton, 1999; Torgesen et al., 2001), suggesting that text fluency may be especially important for assessing children's response to intervention (RTI). Unfortunately, it was not possible to assess response to treatment in this study as information regarding intervention history was not available.

Method

Participants

Participants were children between the ages of 8 and 12 years of age referred to the Center for Clinical and Developmental Neuropsychology at the University of Georgia to participate in a larger study of familial and neurological features of dyslexia. Families with at least one child who was experiencing serious reading problems or who had been previously diagnosed with developmental dyslexia were referred to the study through

schools, local organizations, and advertisements. Siblings of the referred students were not included in this study. Selected participants were children without a history of psychiatric disorders, neurological disorders, severe pre- or perinatal complications, or traumatic brain injury. Previous diagnoses of Attention-Deficit/Hyperactivity Disorder (ADHD) were permitted because prior research had demonstrated that the cognitive deficits found for those diagnosed with ADHD and RD are distinct (August & Garfinkel, 1990; Shaywitz et al., 1995). Children received a full neuropsychological evaluation, an assessment to screen for Speech-Language Impairment (SLI), and an intelligence assessment. To qualify for this study, a full scale intelligence quotient within the average range or above (i.e., standard scores > 80) and language skills within the normal range (i.e., no diagnosed speech and language impairments) were required.

Of the 51 participants, 63% were male. The demographic make-up of the sample was as follows: 94.1% was Caucasian-American and 5.9% was African-American. Participants ranged from 8.0 to 16.25 years of age, with a mean of 10.38 (*SD* = 1.60). Although no children in our sample met criteria for ADHD-Hyperactive Impulsive Subtype, 15.7% were diagnosed with ADHD-Primarily Inattentive Subtype and 31.4% of the subjects were diagnosed with ADHD-Combined Subtype. Graduate students in a School Psychology program diagnosed children with ADHD using the criteria outlined in the Diagnostic and Statistical Manual (DSM-IV; The American Psychological Association, 1994) under the supervision of a licensed Psychologist.

Procedure

Families came to the University of Georgia's Center for Clinical and Developmental Neuropsychology to participate in the research. The parents provided

informed, written consent for their own and their child's participation. In addition, the child provided written assent witnessed by their parents. Assessments were completed during the day, with a one-hour lunch break and additional breaks as needed. In exchange for their participation, parents received a comprehensive neuropsychological report on their child with results reported in a manner useful to school systems for making special education eligibility determinations. All children received a free t-shirt.

Measures

A comprehensive neuropsychological test battery consisting of measures designed to assess intelligence, academic achievement, receptive and expressive language, phonological processing, memory, visual-spatial ability, orthographic skills, executive functioning, handedness, exposure to print, and social-emotional functioning was administered. Measures included in the present study include the Wechsler Abbreviated Scale of Intelligence, and selected subtests from the Gray Oral Reading Test – Third Edition, the Comprehensive Test of Phonological Processing, and the Woodcock Reading Mastery Test – Revised.

Intellectual Ability

The Wechsler Abbreviated Scale of Intelligence (WASI; The Psychological Corporation, 1999) is a brief, norm-referenced, individually administered test of intellectual ability. The WASI is composed of four subtests: Vocabulary and Similarities create a Verbal Intelligence Quotient (VIQ), and Block Design and Matrices create a Performance (nonverbal) Intelligence Quotient (PIQ). Together, the four subtests form the Full Scale Intelligence Quotient (FSIQ), which was used in this study as an indicator of general intellectual functioning. The text manual reports reliabilities between .95 and

.97 for the FSIQ, and concurrent validity estimates with the WSIC-IV of .87 for children between the ages of 8 and 16.

Word Reading Accuracy

The Word Identification and Word Attack subtests from the Woodcock Reading Mastery Test - Revised (WRMT-R; Woodcock, 1986) were used as measures of word reading accuracy and decoding skills, and were the same as reported for Study 1.

Reading Comprehension

The Passage Comprehension subtest from the Woodcock Reading Mastery Test - Revised (WRMT-R; Woodcock, 1998) was used as measure of reading comprehension. Children silently read short passages and then were asked to identify the key word missing from the passage. Initially, the passages consist of short sentence with a picture but progress to more complicated text. The test manual reports internal consistency coefficients ranging from .68 to .92 on the Passage Comprehension subtest, and concurrent validity estimates with similar measures between .55 and .71 (WRMT-R; Woodcock, 1998).

Text Fluency

The Reading Rate scale from the Gray Oral Reading Test – Third Edition (Pro-Ed, 1995) was used to assess children's skills in fluently reading connected text. Test administration, procedures, and interpretation were identical to those of the GORT-4 reported in Study 1. A linear transformation was used to convert the GORT-3 Reading Rate scaled scores to standard scores having a mean of 100 (SD=15) to facilitate comparisons across measures. According to the GORT-3 manual, validity estimates for the Reading Rate scale ranged from .34 to .82, with a median validity of .65, and

reliability estimates ranged from .82 to .92, with a median reliability of .90 (Pro-Ed, 1995).

Rapid Naming Speed

The Rapid Naming composite from the Comprehensive Test of Phonological Processing *(*CTOPP; Wagner, Torgesen, & Rashotte, 1999) is a measure of the efficient retrieval of visual and phonological information from long-term memory. The Rapid Naming Composite Score is composed of Rapid Letter Naming and Rapid Digit Naming subtests and provides standard scores with a mean of 100 and a standard deviation of 15. Children are presented with a list of 72 randomly ordered letters and digits, and the time is takes to name these stimuli is recorded for each list separately. The test manual reports reliabilities of between .86-.92 for children ages 7 and older, and concurrent validity with various reading measures of between .44-.70 (Wagner, Torgesen, & Rashotte, 1999).

Phonological Processing

The Elision and Phoneme Reversal subtests from the Comprehensive Test of Phonological Processing *(*CTOPP; Wagner, Torgesen, & Rashotte, 1999) were averaged together to create a composite used as a measure of phonological processing. These subtests were selected as previous research had demonstrated that they discriminate between individuals with reading disabilities such as dyslexia from normal readers (Lombardino, Riccio, Hynd, & Pinheiro, 1997). The elision subtest requires children to listen to a string of phonemes such as “m” “o” “p” and blend them together to create a word “mop”. On the phoneme reversal subtest children listen to a real word “mop” and then are asked to reserve the order of the phonemes “pom”. The manual reports reliabilities of between .82-.89 for the elision subtest and .79-.89 for the phoneme

reversal subtest. The manual reports concurrent validity with various reading measures of .39-.75 for the elision subtest and .45-.61 for the phoneme reversal subtest.

Results

Descriptive Statistics

Means for the reading achievement measures fell in the low average to below average range, as would be expected in a clinical sample of children referred due to suspected reading difficulties. Children performed best on reading comprehension as measured by the WRMT-R (*M* =93.20, *SD* = 9.99), followed by decoding as measured by the WRMT-R Word Attack subtest (*M* = 92.49, *SD* = 11.02), then word reading as measured by the WRMT-R Word Identification subtest (*M* = 90.25, *SD* = 10.13), whereas the lowest score was observed on text fluency as measured by the GORT-3 (*M* = 79.41, *SD* = 13.77). Processing measures followed a similar pattern. An average score of 78.25 was found for the phonological processing composite (*SD* = 12.48), and an average score of 91.27 was found for the rapid naming composite (*SD* = 15.43). Full Scale IQ as measured by the WASI ranged from 82 to 141 standard score points and with a mean of 101.25 (*SD* = 11.46). Table 3.1 shows correlations among the various measures.

Table 3.1
Correlations among the Variables (*N*= 51)

	1	2	3	4	5	6	7
1. Text Fluency (GORT-3)	--	--	--	--	--	--	--
2. Word Reading (WRMT-R)	.71**	--	--	--	--	--	--
3. Decoding (WRMT-R)	.58**	.86**	--	--	--	--	--
4. Comprehension (WRMT-R)	.56**	.76**	.61**	--	--	--	--
5. Naming Speed (CTOPP)	.71**	.54**	.45**	.47**	--	--	--
6. Age -.20	-.27	-.29*	-.01	-.19	--	--	
7. Phonological Processing .34* (CTOPP)	.63**	.67**	.48**	.32*	-.10	--	

Note: *p<.05, **p<.01

Text Fluency Deficit

Children were identified as having a specific deficit in text fluency (i.e., poor text fluency but otherwise adequate basic reading skills) if the following criteria were met: (a) at least average word reading accuracy and decoding skills (i.e., standard score of greater than 85), (b) below average text fluency skills (i.e., standard score below 85), and (c) a minimum difference of 10 standard scores points (or 2/3 one standard deviation) between text fluency and their other basic reading skills (i.e., word reading accuracy and decoding). The use of a buffer zone is thought to "mitigate some of the arbitrariness of a cut score" approach (Shankweiler et al., 1999, p.75) and has been used by other researchers when dividing children into groups based on their reading profile (e.g., Jenkins et al., 2003b). The use of a 10 standard score point difference in criteria (c) was chosen as it was judged by the researcher to be clinically meaningful. The Federal definition of a learning disability in reading makes a distinction between basic reading skills and reading comprehension, such that an individual may be identified as having a specific reading disability in either area. Text fluency may be viewed as a basic reading skill and was therefore compared to word reading and decoding rather than reading comprehension as noted in the criteria (above). Further, these criteria were not meant to mimic federal guidelines, but were instead aimed at identifying children with specific deficits in their text fluency skills. The Federal guidelines were applied to this data later in the results section.

Using these criteria, 12 out of 51 children (23.5%) were identified as having a specific deficit in text fluency. For these 12 children a mean difference of 18.50 standard

score points (SD = 7.42) was found between word reading accuracy and text fluency skills, and a mean difference of 20.42 (SD = 9.29) was observed between decoding and text fluency skills.

It has been shown that children with specific deficits in text fluency exist in this sample; however what differentiates these children who are experiencing problems reading connected text from those that struggle with word level reading or have normal reading skills is unclear. The review of the literature suggested that rapid naming speed, phonological processing, and age may play a role in mediating text reading rate, and consequently that these skills may differentiate text fluency deficit readers from children with normal reading skills. In light of Study 1 and the importance of comprehension as a reading skill, children's comprehension skills were also examined. To better understand the profile of the text fluency deficit group, 20 normal readers (children with standard scores greater than 85 on word reading, decoding, and text fluency measures), and 14 readers with globally impaired reading skill (children with standard score below 85 on text fluency and word reading or decoding measures) were identified, leaving 5 students who were not identified as fitting into any group. Means for each reading groups are displayed in Table 3.2.

Table 3.2

Means and Standard Deviations for All Reading Groups

	TFD	GI	NO
Text Fluency (GORT-3)	72.08 (9.16)	68.21 (8.90)	92.00 (9.38)
Word Reading (WRMT-R)	91.42 (3.20)	78.71 (6.79)	98.10 (8.23)
Decoding (WRMT-R)	93.33 (4.01)	81.43 (7.54)	99.95 (10.85)

Comprehension (WRMT-R)	94.50 (10.73)	83.79 (7.44)	99.84 (6.15)
Rapid Naming (CTOPP)	86.75 (15.11)	83.00 (12.25)	100.00 (15.07)
PP (CTOPP)	79.55 (9.93)	69.64 (9.45)	83.00 (14.04)
Age	10.66 (1.69)	11.05 (1.98)	9.94 (1.12)
N	12	14	20

Note. TFD = Text fluency deficit, GI = globally impaired, NO = normal readers, PP = Phonological Processing, values in parentheses represent standard deviations

To determine whether the text fluency deficit group could be identified in ways other than unusually low text fluency, a series of one-way ANOVAs was conducted to examine the effects of reading group (i.e., text fluency deficit, globally impaired, and normal reader) on rapid naming speed, phonological processing, age, and reading comprehension. Children's age was not found to vary across reading groups, F (2, 42) = 2.17, $p > .05$, partial $\eta^2 = .091$. However, a main effect was found for reading groups on rapid naming speed, F (2, 42) = 6.68, $p = .003$, partial $\eta^2 = .24$. Tukey post hoc comparisons indicated that both the text fluency deficit ($p = .039$) and globally impaired reader group ($p = .004$) demonstrated slower rapid naming speed compared to normal readers; however, text fluency deficit and globally impaired readers did not differ from one another on this measure ($p > .05$). A main effect was also found for reading groups on phonological processing, F (2, 42) = 5.36, $p = .008$, partial $\eta^2 = .203$. Although Tukey post hoc comparisons revealed that the globally impaired readers had significantly lower phonological processing skills than normal readers ($p = .007$), no difference was observed between the text fluency deficit and either the globally impaired ($p > .05$) or normal readers ($p > .05$) in this area. However, the phonological processing skills of the normal

readers was quite low (M = 83.0), possibly to due the fact that this was a clinical sample. It could be reasonably argued that a mean score of 79.55 on phonological processing represents a skill deficit for the text fluency deficit group as well. With regard to reading comprehension, a main effect was found for reading group, F (2, 42) = 16.51, p = .000, partial η^2 = .44. Tukey post hoc comparisons revealed that globally impaired readers comprehended significantly less of what they read as compared to the text fluency deficit (p = .004) and normal reader (p = .000), but no differences were observed between the latter two groups (p > .05). Despite the lack of a statistical difference in reading comprehension between the text fluency deficit and normal reader group, it is important to point out that the reading comprehension scores of the text fluency deficit group was 5.3 standard scores below (or 14 percentile ranks lower) those of the normal reader group and fell between the normal reader (50th percentile) and globally impaired reading groups (14th percentile rank).

In sum, approximately 23.5% of the children in this sample showed skill deficits when asked to read aloud from connected text but did not experience difficulty accurately reading single words presented in isolation or in decoding unknown words. In comparison to normal readers, children with text fluency deficits demonstrated slower rapid naming speed, but this did not distinguish them from other reading disabled children. In contrast, the globally impaired readers exhibited deficits in both rapid naming speed and phonological processing as compared to normal readers, and comprehended less of what was read. Lastly, although rapid naming speed may be an important variable for explaining differences between the text fluency deficit children and normal readers, the moderate effect size (partial η^2 = .24) for rapid naming speed suggests that a large

amount of variance was not explained by this variable. Other variables may be at work here that were not examined in this study.

Diagnostic Implications

The primary aim of study 2 was to investigate the utility of text fluency in the identification of children with reading disabilities. Specifically, it was hypothesized that the omission of text fluency may result in the under identification of children with reading disabilities. To investigate this possibility, two criteria were used to identify children as reading disabled: a) the *discrepancy model* which required a difference of greater than 15 standard score points between the child's FSIQ as measured by the WASI and reading achievement, and b) the *low achievement model* that required below average reading achievement (standard scores < 85). These criteria were applied separately using the word reading accuracy, decoding, text fluency measures, and frequencies of reading disability diagnosis are displayed in Table 3.3. A Pearson chi square analysis revealed that when the discrepancy model was applied, more children were identified as reading disabled when text fluency measures were used as compared to both word reading accuracy, χ^2 (1) = 11.59, p = .001, and decoding measures, χ^2 (1) = 10.53, p = .001. Similarly, when the low achievement model was used, children were more frequently identified as reading disabled when using text fluency measures as compared to either word reading, χ^2 (1) = 10.85, p = .001, or decoding measures, χ^2 (1) = 5.67, p = .017. Regardless of the model used, nearly twice as many children were identified as reading disabled when using the text fluency standard scores as compared to either the decoding or word reading accuracy scores (see Table 3.3).

Table 3.3

Low Achievement and Discrepancy Models Applied to Clinical Sample

	Text Fluency (GORT-3)	Word Reading (WRMT-R)	Decoding (WRMT-R)
		Discrepancy	
Reading Disabled	33	15	14
Not Reading Disabled	18	36	37
		Low Achievement	
Reading Disabled	27	13	9
Not Reading Disabled	24	38	42

Text Fluency Problems in a Non-Clinical Sample

One difficulty with the current study is that it reflected the size of the problem in a clinical, largely white sample with children referred on the basis of having a reading problem. It is reasonable to assume that children being referred to University of Georgia's Center for Clinical and Developmental Neuropsychology may have experienced particularly difficult problems with reading. While such a sample has its advantages, it also has disadvantages in terms of learning the relative incidence of text fluency issues. In the previous study, I used similar instruments to explore the relationship between word reading, text fluency, and reading comprehension in a nonclinical sample in 3rd and 5th grade children. Because children's intellectual functioning was not assessed in Study 1, only the *low achievement model* could be applied to the 3rd and 5th grade data. The distribution of students across the low achievement groups was equal across 3rd and 5th graders, and therefore the combined

percentages for both grades are presented. Using the text fluency scores and cut-offs similar to that above, 17.9% of the children were identified as reading disabled, whereas fewer children were identified as having below average word fluency (11.19%) or word accuracy (5.8%) skills. Similar to the clinical sample, text fluency measures appear to be more sensitive to detecting reading problems in the normative sample.

Table 3.4

Low Achievement Model Applied to Normative Sample of 3rd & 5th Graders

	Text Fluency (GORT-4)	Word Fluency (TOWRE)	Word Accuracy (WRMT-R)
	Low Achievement		
Reading Disabled	34	21	11
Not Reading Disabled	156	169	179

Discussion

Results of Study 2 suggest that it is essential to evaluate text fluency when assessing children referred for reading difficulties, as failure to do so may result in the under-identification of children with reading disabilities. The results of this study were generally consistent with that of previous research (Lovett, 1984, 1987; Morris et al., 1998) in finding that a subgroup of children exist who exhibit specific deficits in text fluency, and that rapid naming speed may play a role determining the rate at which children read connected text.

Results from this study should be viewed as preliminary, as it is limited by a small sample size and several potentially important factors for text fluency were not examined. For example, the age variable was not found to differ across reading groups; however, it

is not clear whether age is indeed irrelevant or if insufficient variation in the age of the participants contributed to this finding. Also, the extent to which children received intervention prior to their assessment and the quality of that intervention is unknown. The "normal" reader group exhibited somewhat poor phonological processing skills, perhaps that group represents children who received and benefited from high quality reading interventions. Given that improvements in text fluency have been harder to attain than improvements in reading comprehension, decoding, and word reading skills (Lyon & Moats, 1997; Meyer & Felton, 1999; Torgesen et al., 2001), it may be that the text fluency deficit group represents children who did not respond well to treatment. Text fluency may be particularly important as many states move towards a response to treatment approach to identifying children as reading disabled in the school setting.

CHAPTER 4

GENERAL DISCUSSION

The purpose of this work was twofold. First, it explored the theoretical and empirical relationships among word reading, text fluency, and reading comprehension in 3rd and 5th grade children to determine how reading fluency operates to produce better comprehension in older elementary school children. The viability of three theoretical models was examined including the *simple fluency model*, the *text fluency model*, and the *context facilitation model,* and results generally supported the *text fluency model*. Text fluency, word accuracy, and word fluency were each found to make important contributions to reading comprehension. Interestingly, the results pointed to a decline in the influence of children's reading fluency (as defined by text fluency, word fluency & word accuracy) on reading comprehension by the end of 5th grade. Second, the diagnostic utility of text fluency measures in the identification of children as reading disabled was examined. Importantly, Study 1 provided support for the inclusion of text fluency in the assessment of children's reading skills, as text fluency was found to benefit children's comprehension. Results from Study 2 suggested that it is essential to assess text fluency as failure to do so may result in the under identification of children with reading disabilities. Consistent with previous research, a group of children in the clinical sample was identified as exhibiting specific deficits in their ability to fluently read connected text.

Results from the normative study were generally consistent with previous research. Strong positive relationships among word reading, text fluency, and

comprehension had been clearly established within the literature (Gough et al., 1996; Jenkins et al., 2003a, 2003b; Juel et al., 1986; Schwanenflugel et al., in press; Shankweiler et al., 1999; Shinn et al., 1992; Stanovich, 1980; Torgesen et al., 2001); however the question remained as to whether the relationship between text fluency and reading comprehension was spurious (i.e., caused by the intercorrelations between word reading and text fluency alone) or because of the unique features of text fluency to reading comprehension. Results from the path analysis clearly supported the *text fluency model*, where word accuracy, word fluency, and text fluency each made important contributions to reading comprehension. Therefore, these findings are consistent with research that suggests proficient word reading skills are essential for reading comprehension (Gough, Hoover, & Peterson, 1996; Juel, Griffith, & Gough, 1986; Shankweiler, Lundquist, Katz, Stuebing, & Fletcher, 1999; Stanovich, 1980), as well as those which point to the direct benefits of text fluency for comprehension (Jenkins et al., 2003a; Nation & Snowling, 1997).

This work is in direct contrast with work reported by Schwanenflugel et al. (in press) who found that text fluency does not make unique contributions to comprehension in 1st through 3rd grade students. However, this discrepancy may be attributable to the identification of the model used in these two studies. The current study used both timed and untimed measures of word reading, whereas Schwanenflugel and colleagues only included timed measures of word reading.

Results from the normative study (Study 1) also pointed to a divergence of reading comprehension from the basic reading skills (word fluency, word accuracy, and text fluency) in older readers. This trend is consistent with Schwanenflugel and

colleagues (in press) finding that the proportion of variance explained in reading comprehension declined across 1st grade, 2nd grade, and 3rd grade. In that study, the variance accounted for by the model decreased from 75% in first grade to 39% in third. This continued trend was observed in Study 1 with 42% of the variance in reading comprehension explained in the 3rd grade text fluency model whereas only 13 % was explained in the 5th grade text fluency model. Other research has pointed to a decline in the relationship between text fluency and reading comprehension in older children (Gray, 1925; Jenkins & Jewel, 1993; Sassenrath, 1972).

Interestingly, these results are consistent with that of another ongoing investigation on the prevalence of word callers, or children who efficiently read or "call out" words when reading text, but do so without comprehension taking place (Meisinger, Schwanenflugel, Woo, Kuhn, & Bradley, in preparation). Word callers are in essence children who demonstrate a discrepancy between their comprehension and text fluency skills. In that study, many more 5th graders were found to be word callers (15%) than 3rd graders (3%) or 2nd graders (< 1%), indicating that reading comprehension may be diverging from other basic reading skills by 5th grade. Given this developmental trend, other factors may need to be considered to explain comprehension in older students.

There are a number of likely reasons why reading fluency becomes increasingly less important to reading comprehension as children get older. First, as children get older, the types of texts that they read demand skills other than that which can be accounted for by reading fluency. Skills such as the utilization of prior knowledge, the drawing of inferences from the text, and the ability to abstract become more important once children have mastered the basic skills of quickly and accurately identifying the words in text and

they begin to encounter more complex materials (Chall, 1983, 1996; Sweet & Snow, 2003) . Such a divergence is consistent with Chall's (1983, 1996) developmental stage model of reading, which posits that once fluency reading skills are established, the remaining stages focus on the continued development of more complex comprehension and critical thinking skills.

Second, silent reading skills may be more relevant for comprehension in older students, as children have typically transitioned to this mode of reading by fourth or fifth grade. Oral reading is generally supportive for comprehension in low skilled and young readers only (Holmes & Allison, 1985; Miller & Smith, 1990). Once children are fluent, they generally transition to silent reading effectively. However, remarkably little research has targeted the relationship between oral and silent reading in older students and work in this area is needed.

How does the fluent reading of text benefit comprehension beyond that accounted for by mere accurate word reading? Earlier, I had suggested that fluent text reading requires readers to identify phrasal boundaries during the reading of text through their prosody. This prosody breaks up continuous language into smaller more readily processable units for working memory by inserting pauses and pitch declinations at various syntactic junctures. While listening, individuals use prosodic cues such as the pitch or intonation, stress (loudness), and duration (timing) to identify phrasal boundaries and to understand nuances in the meaning being conveyed (Fon & Johnson, 2004; Kraljic & Brennan, 2005; Kuhn & Stahl, 2004; Schreiber, 1980). In reading, readers are thought to use features of the text such as punctuation and syntactic cues such as "the" to identify phrasal boundaries (Chafe, 1988; Schreiber, 1980; Young & Bowers, 1995), although

oral readers must abstract prosodic features to a great extent while reading aloud (Miller & Schwanenflugel, 2006). Most primarily, the identification of phrasal boundaries signaled by prosodic readings are thought to promote comprehension by breaking text into manageable and meaningful chunks for processing in the working memory. To some extent, oral reading combines the benefits of both reading and listening by combining punctuation and prosodic features to use for syntactic parsing. Presumably, younger readers may not gain the same benefits from the joint sources of information because they are generally less fluent. This may explain some of the differences between the findings of Schwanenflugel et al. (in press) who focused on younger children and those of the current study.

Logan's instance theory of automaticity (1988, 1990) as applied to reading (Logan, 1997) also described a process which may be useful in thinking about the distinction between simple word decoding benefits for comprehension and text level benefits. According to Logan (1997), the encoding of text into memory may occur, not only at the sublexical and lexical level, but also at the phrasal and sentence level. According to this view, each time a reader encounters a letter, word, phrase, or sentence, an instance representation or trace is encoded and stored. As these instances build up they become easier to retrieve and their retrieval becomes quicker and more accurate. Logan (1997) suggested that in some instances as little as a single trial is sufficient for automaticity to develop, although other researchers suggest 3 to 5 trials as more typical (O'Shea, Sindelar, & O'Shea, 1985, 1987; Reutzel, 2003). As readers gain skill and are exposed to more texts, automaticity may develop not just at the word level, but also at the phrasal and perhaps even the sentence level, freeing additional cognitive and attentional

resources for comprehension (LaBerge & Samuels, 1974). For example, phrases such as *in the*, *in the car,* and even *riding in the car* are fairly common and are likely to be on encountered regularly. As words, phrases, and possibly sentences are encountered regularly, they are likely to be processed as a unit rather than as discrete letter strings, thus, freeing up space in working memory for comprehension.

At some point, however, automaticity at these higher levels is not enough to produce good comprehension because the issue ceases to be one of freed resources and becomes an issue of whether the child has the knowledge necessary to use those resources effectively. Thus, as children get older, their texts become more complex and the requirements of reading them (say, for learning rather than entertainment) involve other processes such as the utilization of relevant prior knowledge, drawing inferences from implicit features in the text, and understanding abstract language. Therefore, the benefits of automaticity would be after a certain point limited, as the freeing of resources does not necessarily translate into the appropriate utilization of those resources. It is important to note that, because text fluency seems to have a declining influence on reading comprehension with development, it is clear that much of the improvement in reading comprehension (in absolute terms) that occurs with development belongs outside the purview of text fluency processes. Thus, fluent text reading processes will only get children so far in helping them comprehend what they are reading.

In contrast, the integrative models proposed by some theorists (e.g., Fuchs et al., 2001; Wolf & Kadzir-Cohen, 2001) purport that text fluency is involved in the integration of these higher level comprehension processes. Therefore, according to the integrative models the benefits of text fluency for comprehension should continue

through the middle school and high school years. The findings of the current study suggest that this is not the case. My study finds a limited role for fluency by fifth grade.

In sum, the instance theory of automaticity provides a reasonable framework from which to conceptualize the benefits of text fluency for comprehension in early elementary school aged children, and that these benefits decline as children grown older and encounter more complicated text. To elucidate the mechanism behind this empirical finding, specific examinations of parsing, prosody, and working memory need to be specifically addressed. Therefore, Study 1 represents an important first step in understanding the relationship between reading comprehension and text fluency as it provides empirical support for the role of text fluency for comprehension, but more work will be needed to fully understand how these contributions are made.

Results from Study 2 confirms the unique role of text fluency by adding to the growing body of evidence that text fluency measures are more sensitive in detecting reading problems than word reading measures are (e.g., Breen & Drektah, 1990; McCabe, Margolis, & Barenbaum, 2001; Sofie & Riccio, 2002). Text fluency may have particular implications for the assessment of children's response to intervention (RTI). Indeed, a growing literature supports the use of CBM of text fluency for monitoring reading progress and assessing children's response to intervention (i.e., Fewster & MacMillan, 2002; Hintze & Petitte, 2001; Marston, 1989). Given the national trend toward using failure to response to appropriate intervention as a means of identifying children as reading disabled in the public schools, text fluency should not be overlooked in the assessment of children's reading skills, especially since there are a number of effective interventions on reading fluency that might be effective in improving

comprehension in early elementary school children (Kuhn, Schwanenflugel, Morris, Morrow, Meisinger, Sevcik, & Woo, in press). My study also found that some children exhibit specific deficits in text fluency (Lovett, 1984, 1987; Morris et al., 1998). To my knowledge this is the first study to directly compare the diagnostic outcomes of using text fluency versus word reading measures to identify children as reading disabled. The omission of text fluency resulted in the under identification of children with reading disabilities in this sample. The results of Study 2 suggest that the assessment of children's text fluency is essential when a reading disability is suspected.

Three reading groups were identified in Study 2, a normal reader group, a globally impaired reader group, and a text fluency deficit group. The normal readers had average skills in word reading, decoding, text fluency, reading comprehension, and rapid naming speed, but below average skills in phonological processing, whereas the globally impaired readers had deficits across all areas of reading skill. Interestingly, similar to Lovett (1984, 1987) and Morris et al. (1998), I found that children with specific deficits in text fluency did not experience difficulty with comprehension and differed significantly from the normal readers only in their rapid naming speed. These results were largely unanticipated based on the results of study 1. The normative study found that text fluency benefited reading comprehension in elementary school children; therefore, it was expected that dysfluent readers in the clinical sample would experience some concurrent difficulties in reading comprehension. Surprisingly, this was not found to be the case. However, the identification of dysfluent children with accurate word reading does support study 1's finding that word reading and text fluency represent separate reading skills.

Several possible explanations exist for why some children with specific deficits in their text fluency skills did not also experience difficulties with comprehension. First, the age of the participants in study 2 may have contributed to this unexpected finding. Study 1 revealed that by 5th grade (i.e., age 10 or greater) very little of the variance in reading comprehension was explained by children's basic reading skills, suggesting that other factors become more important as children grow older and text becomes more complicated. Fifty-one percent of the children in study 2 were 10 years of age or older. It may be that children's difficulty with text did not translate into difficulty with comprehension because by age 10 being a fluent reader had limited benefits for comprehension.

Second, the small size of the clinical sample may have adversely affected statistical power, making it difficult to detect differences in reading comprehension across the reading groups. The average a reading comprehension standard score for the normal reader group was 5 points higher than the text fluency deficit group, a difference that was not statistically significant. However, when considered in terms of skills at the 34th as compared to the 50th percentile, such as difference may be reasonably argued as potentially meaningful. Further, although age was not found to vary significantly across reading groups, it is not clear whether age is indeed irrelevant or whether insufficient variation in children's age contributed to this finding.

Third, the children's educational history (i.e., whether they received intervention and the quality of that intervention) may play a role in explaining why some dysfluent readers adequately comprehended what they read. All children who participated in the study were referred due to concerns of serious reading problems or a previous diagnosis

of dyslexia. However, information related to the children's educational history of was not available. It may be that the "normal" reader group consisted of children who received and/or responded well to intervention; therefore, these children may not represent normal readers. This notion is supported by the presence of below average phonological processing skills in an otherwise normal reading profile for that group. It may be that the globally impaired and text fluency deficit children had not yet received high quality intervention or did not respond well to intervention. Some research has found that improvements in text fluency are harder to obtain than improvements in reading comprehension, decoding, and word reading accuracy skills (Lyon & Moats, 1997; Meyer & Felton, 1999; Torgesen et al., 2001). Alternately, the text fluency deficit group may have contained children who benefited from interventions focused on the development of accurate word reading and comprehension skills, but have not yet developed fluent skills. This might explain why these readers did not experience significant difficulties comprehending what they read. From a developmental perspective, children are thought to first develop accurate word recognition skills which then become fluent (fast and accurate) as they confirm what they know and gain practice with text (Chall, 1983, 1996).

Given that children with specific deficits in their text fluency skills have now been identified in three independent studies (Lovett, 1984, 1987; Morris et al., 1998), it can be argued that a subgroup of these children exist in clinical populations. However, it has not been established that dysfluency alone results in impairments in children's academic functioning. Specifically, if children can comprehend what they read, then does simply being a slow reader impede them academically? Yet being a dysfluent reader may

also have practical implications that represent impairments in children's academic or social functioning. For example, being a slow reader could make it difficult to keep up with the pace of materials presented in class and could therefore interfere with the learning of content area knowledge. Being a slow reader may also have implications for children's performance on high stakes tests such as the SAT, which requires adolescents to read and answer many questions within a limited period of time. Further, if it takes a child longer to read their homework assignments, less free time is available to complete typical childhood activities such as playing recreational sports. Additionally, slow and laborious reading may result in feelings of frustration (Raskinski, 2001), which could contribute to a negative view of academics or even feelings of low self worth. However, little research has been conducted in this area, and the practical significance of specific deficits in text fluency is unknown.

In light of Study 1, it is not clear why some readers in the clinical sample had specific deficits in text fluency which did not interfere significantly with their ability to understand what they read. Results from study 2 need to be replicated and expanded upon in order to better understand the relationship between text fluency and reading comprehension in children with reading disabilities. In addition to exploring the participant's age, other potentially important variables should be explored in a larger clinical sample. Working memory, or the ability to manipulate and hold information in short term memory, may be an important factor for text fluency (Perfetti, 1977, 1985). Additionally, rapid naming speed may be a part of a general slow speed of processing. Speed of processing should be investigated as a potentially rate limiting factor. Further, although the text fluency deficit group did not differ from the normal readers in terms of

their phonological processing, the relatively poor skills across all referred groups suggest that phonological processing problems should not be overlooked as another potentially important skill for text fluency.

Several limitations exist that should be considered when generalizing the results of this work to that of other studies. First, the results of Study 1 should be considered most applicable to later elementary school students. Future research is needed to explore the predictors of reading comprehension in middle and high school students. Further research is needed to explore the development of oral versus silent reading text fluency as children mature as readers. Second, reading prosody, which is considered the hallmark of fluency reading by many researchers, was not assessed in this study. The implications of prosody among children with specific text fluency deficits need to be explored. Third, additional work is needed to elucidate the mechanisms behind text fluency's contributions to reading comprehension. Future work should address parsing, reading prosody, working memory, and processing speed as potential mediating factors between text fluency and reading comprehension in both typical and atypical readers. Also, the practical significance of being a dysfluent reader needs to be explored to determine whether being a dysfluent reader with adequate comprehension skills results in functional impairments for the reader. Further, text fluency should be further investigated to explore its utility in assessing children's response to intervention. Given the dearth of standardized, norm-references measures of text fluency, test developers should include text fluency measures in batteries whose aim is to assess children's reading skills.

In sum, text fluency should be viewed as an important skill for children in elementary school and for children who are experiencing reading difficulties. Text

fluency should be included in the assessment of children suspected having a reading disability, and also when assessing children's response to reading interventions.

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