

THE PREDICTIVE VALUE OF PROSODY: DIFFERENCES BETWEEN SIMPLE AND
DIFFICULT TEXTS IN THE ORAL READING OF SECOND GRADERS

by

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(Under the Direction of Paula J. Schwanenflugel)

ABSTRACT

Fluency in reading is ideally determined by measuring rate, accuracy, and prosodic qualities in the oral reading of a child. However, prosodic measures vary widely among researchers, and the contribution of reading prosody to both reading fluency and reading comprehension is still undetermined. The present study examines three prosodic variables—sentence-final F_0 change, intrasentential pausing, and intonation contour—in the oral readings of second grade children ($N=90$) from two texts, one simple and one difficult. While variables were not all equal in their relationship to fluency and comprehension, prosody from the more difficult text was found to be a better predictor of both fluency and comprehension.

INDEX WORDS: Fluency, Prosody, Oral reading, Text difficulty, Second grade, Comprehension, Prosody measurement

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DEDICATION

To my loving husband, Nate. You are my sunshine.

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Chapter 1

Introduction and Literature Review

Since Clay and Imlach's (1971) groundbreaking look at the development of reading prosody in the oral reading of seven-year-old children, research into the interaction among prosody, fluency, and comprehension has been fruitful, yet uneven. The concern over word-by-word and generally dysfluent reading in emergent readers has fostered some consensus in defining fluent reading. In 2000, the National Reading Panel (NRP) defined fluent readers as those who "are able to read orally with speed, accuracy, and proper expression" (p. 11). While the first two components of this definition, speed and accuracy, require simple measures for assessment, defining and measuring "proper expression" has proven a more difficult task and has received less empirical attention. Proper expression is a general term that may be viewed as synonymous with appropriate reading prosody—simply understood as the musical quality of language. Prosody is common to all languages with each language possessing a unique set of prosodic features. While linguists have systematically studied prosodic features for decades—and even centuries—they tend to limit their domain to natural, or spontaneous, speech. But, prosody has been found to differ in spontaneous and read speech (Howell & Kadi-Hanifi, 1991), and prosodic units for measurement in oral reading research have not yet been definitively determined (Smith, 2004). The lack of solid ground in oral reading research presents problems as well as obvious opportunities. While prosody is a quality that most listeners can easily use to distinguish one reader's skill from another's, its actual function in children's literacy development is somewhat mysterious.

Recently, positive strides have been made in attempting to determine the relationships between prosody and fluency, and prosody and comprehension (Miller & Schwanenflugel, 2006, 2008; Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004; Schwanenflugel et al., 2006). A strong connection between prosody and fluency has been demonstrated, though the exact relationship is still unknown. That prosody is important, however, is becoming widely recognized. Some association has even been made between prosody and comprehension. Kuhn and Stahl (2003) identified two theories that attempt to explain the now well-known correlation between fluency and comprehension; one focuses on the contribution of automaticity to fluency, and the other focuses on the contribution of prosody. Implied in the second theory, is an indirect relationship between prosody and comprehension. The goal of the present research is to further illuminate the relationship between prosody and comprehension by examining prosody, fluency, and comprehension using quantitative measures of all three constructs.

Fluency and its Contribution to Reading Skill

Fluency is an important facet in the development of reading proficiency. Such proficiency is comprised of numerous components and exists on multiple levels. The benefit of being a fluent reader is obvious: as a pathway to comprehension, fluent and automatic reading allows the reader to focus attention on the meaning of texts rather than simply the mechanics of decoding the text (LaBerge & Samuels, 1974). There is considerable agreement that fluent readers are those who can read quickly, accurately, with comprehension, and with appropriate expression (Schwanenflugel & Ruston, 2008). However, because fluency is a skill comprised of these multiple sub-skills, a workable definition of fluency requires some precision in defining the individual components. Schwanenflugel and Ruston (2008) claim most researchers would agree

that in order for a child to be considered a fluent reader, he or she must be able to identify orthographic units and convert these symbols into the seamlessly connected sounds of speech. Additionally, children must be able to quickly and accurately identify words, a key skill to develop during the early elementary years. A step beyond fast and accurate identification of words is the automatic processing of words—a child should reach a point at which he or she cannot help but process print seen on street signs, television, newspaper headlines, etc. Finally, it is well established that in order to achieve a level of fluency in reading, a child must be able to process connected text, quickly and accurately.

However, two components of fluency—reading with expression and reading with comprehension—remain controversial in their specific contribution to reading skill (Schwanenflugel & Ruston, 2008). For example, can a reader be considered fluent while reading quickly and accurately but without much expression? Some research has suggested that fluency can exist without expression, but expression rarely exists without fluency (Koriat, Greenberg, & Kreiner, 2002). Also, reading with expression tends to demonstrate that a child is also reading with a basic level of comprehension, but results have been mixed when researchers have attempted to link the two (e.g., Miller & Schwanenflugel, 2006; Young & Bowers, 1995). Finally, although it is well known that a strong relationship exists between fluency and comprehension, the exact nature of that relationship is yet to be determined. Because of the difficulty in pinpointing the nature of expressiveness and comprehension within the definition of fluency, many measures of fluency simply incorporate word identification and rate and accuracy of reading connected texts.

Not only is fluency comprised of multiple components, but it is also thought to exist on multiple levels. Schwanenflugel et al. (2004) used word-level fluency measures in a study

looking at the relationship between fluency and comprehension, and found that word-level fluency skills work together with text fluency to promote comprehension in early elementary school students. Since then, however, studies have shown that syntactic- and passage-level fluency skills account for significant variance in comprehension measures as well (Cain, Oakhill, & Bryant, 2004; Klauda & Guthrie, 2008; Miller & Schwanenflugel, 2006, 2008). Syntactic-level fluency may be understood as fluency at the phrasal level, with the reader being able to read chunks of text fluently rather than simply reading words fluently. Because phrases and larger syntactic groupings tend to follow specific patterns, fluency at this level may also be associated with comprehension. When readers are presented with syntactic groups that pattern unpredictably, fluency is interrupted (Hirose, 2003). In most cases, though, fluency at the syntactic-level benefits the reader, and probably serves as a scaffold to reading lengthier segments of text. Fluency skills have been found to increase when longer texts are broken up into smaller syntactic clusters (LeVasseur, Macaruso, & Shankweiler, 2008; O'Shea & Sindelar, 1983). The English language does not use visible accents or other prosodic markings to guide readers, and most phrase boundaries and even some clause boundaries are not marked with punctuation. Thus, achieving fluency at the level of syntactic grouping is likely a key component in understanding text.

Examining passage-level fluency, Smith (2004) found that skilled adult readers pause longer at more significant semantic boundaries and lower their pitch more at the end of a discourse (a conversation between individuals). These effects are the most pronounced during topic transitions. Thus, there are levels of fluency that affect how a person reads word lists, syntactic units, and semantically connected passages. These findings highlight the value in using connected texts to both foster and measure fluency skills in young readers (Kuhn, 2005; Kuhn &

Stahl, 2003; LeVasseur et al., 2008; Miller & Schwanenflugel, 2006). While quick and accurate reading of word lists may demonstrate that a child has appropriate phonemic decoding skills and automatic word processing ability, listening to a child read a text aloud allows the observer to get a sense of the child's timing, intonation, stress, and even understanding of the semantic structure of the text. The presence of these qualities may indicate that the child has reached a certain level of automaticity in his or her reading ability (LaBerge & Samuels, 1974). These multi-level skills, however, are more difficult to measure objectively than simple rate and accuracy assessments and tend to be neglected or measured via subjective rating scales or holistic rubrics.

Because educators are finding that good speed and accuracy alone do not equal good reading, many methods used to increase fluency in emergent readers have come into question. If expression, rate, accuracy, and comprehension are linked, then instructional methods should work to improve all these elements of fluent reading (Corn, 2006; Rasinski, 2006), and word-list drills alone cannot develop these skills. Repeated reading interventions have proven effective in improving the automaticity of children's reading of connected texts with skills transferring to novel texts (Dowhower, 1987; Herman, 1985; Kuhn, 2005; LeVasseur et al., 2008). This method is based on the premise that repeated exposure to a text will aide in the child's development of automaticity. One form of repeated reading—reading along with a skilled reader—was found to especially improve expressiveness in children's reading (Dowhower, 1987). This type of training provides an opportunity for the child to hear fluent word-reading skills as well as phrasing, intonation, and pausing appropriate to the structure of the text. Other methods for improving fluency exist as well, and some recent research has indicated that effective fluency instruction may involve either repeated or wide reading of texts, as long as focus is placed on prosody in addition to rate and accuracy (Kuhn, 2005; Kuhn & Stahl, 2003). The most effective methods for

improving fluency, then, seem to involve prosody at some level. This connection between prosody and fluency begs the question, what is prosody? In order to examine the role of prosody in fluent reading, the role of prosody in language must be briefly examined.

What is Prosody?

Prosody is the music of language. Many languages require specific tones or other prosodic pronunciation cues in order to communicate meaning effectively. English, though, is not a tone language but one in which meaning is typically communicated via structure and stress. While the grammar of English includes word-level stress, tone, and timing, English speakers tend to use prosody at the phrase, sentence, and even entire discourse level. Some sentences would simply not be interpreted the same if spoken in different ways. Consider the impact that intonation and pausing can have on the interpretation of the following sentence:

- a. I don't play with her because she's ill. [Her being ill is not the reason I play with her]
- b. I don't play with her | because she's ill. [I don't play with her and her being ill is the reason]

The use of phrasing and intonation in the sentence above has an obvious impact on how accurately the speaker communicates his or her idea. In spoken language this tool may often compensate for what might otherwise result in a lack of clarity (Hirschberg, 2002). Numerous studies have examined speech prosody and several features that are typically subsumed by prosody are loudness, duration, pitch, and pause (Couper-Kuhlen, 1986). Loudness is often modified to place stress on a particular word, phrase, or exclamation; duration can involve rhythm, vowel length, and even the lengthening of an entire word for emphasis; pitch is measured in Hertz (Hz) and is also called intonation or fundamental frequency (F_0); pause is also

used for emphasis, to divide an utterance into its major syntactic components and also to signal turn taking in dialogue. Lexical stress—the stress pattern within a word itself—does not fall into the category of prosody, as the denotative meanings of words are often differentiated by lexical stress and, thus, it is not always variable like the above-mentioned prosodic features (Couper-Kuhlen, 1986). The segmental phonological characteristics of a word are, likewise, outside of the domain of prosody, as these attributes—the defining sound of a particular consonant cluster, for example—are non-variable and will typically change the word itself if modified.

A native-speaker of English hardly pays attention to the prosodic qualities of his or her casual dialogue. However, as demonstrated in the example sentences above, native-speakers can automatically adjust the prosody of their speech to communicate specific meaning effectively. The listener simply has to correctly interpret those cues. Hirschberg (2002), however, warned that there is no single method of conveying a particular meaning that is employed by a given speaker, and there is no method of conveying meaning that has been found common to all speakers within a language. Context, body language, and other factors also assist listeners in interpreting speech, but when a speaker and a listener are not face-to-face, prosody likely takes the major role in supplying interpretive cues.

As prosodic variation in speech seems to be largely connected with interpreting meaning, it seems natural to assume that prosody is based on the meaning of an utterance or text. Smith's (2004) finding that both adult readers and speakers mark significant semantic boundaries with longer pauses and lowered pitch demonstrate this effect of meaning on macro-level prosody. However, experiments by Koriat, Greenburg, and Kreiner (2002) demonstrate that prosodic rendering of a text is largely based on its structure rather than semantic content. Their results suggest pause pattern consistency in reading is based on the structure of the sentence, not the

meaning. They conclude that structure is extracted prior to meaning, and that this extraction facilitates comprehension of the text. This finding is consistent with Chomsky's theory of syntax in spoken language, which demonstrates that the grammatical structure of a sentence exists prior to the insertion of phonological, morphological, and semantic information (Chomsky, 1965, 1981, 1995). However, the experiments of Koriat and associates, as well as the theories propagated by Chomsky, were concerned with the reading of isolated sentences, not paragraphs or lengthier texts. So the conclusion that readers behave similarly based on the structure of a sentence rather than the meaning is consistent with previous (Blaauw, 1994; Esser & Polomski, 1988; Wichmann, 1994) findings that within topics, prosodic behavior reflects the syntactic structure of sentences while being sensitive to semantic structure at the discourse or passage level. Regardless, whether prosody is largely reflective of semantic structure or syntactic structure of language remains controversial, but probably both aspects of language are reflected in prosody. Further, whether both aspects are represented similarly in children's prosody is unclear.

What is Reading Prosody?

While an individual simply has to correctly interpret the body language and prosodic cues of a speaker in order to engage in dialogue, effective communication via written language tends to require more precision and standardization in word order, punctuation, and sentence structure to communicate effectively. Additionally, a reader has to possess a certain level of phonological awareness on the suprasegmental level to correctly comprehend and interpret text. Thus, read speech differs from spontaneous speech, and the prosody—especially intonation—differs among these two linguistic domains as well.

When comparing adult spontaneous speech with oral reading, Esser (1988) did not find any guaranteed predictability between particular syntactic units and intonation in either spontaneous or read speech. Simple observation, however, demonstrated that some prosodic cues are typically employed to convey particular types of meaning. Esser found, for example, that readers tended to end sentences with a falling tone when reading both simple and difficult texts. However, falling tones did not necessarily signify finality, as most sentences contained multiple instances of this within the sentence itself. These sentence-internal falls tended to reflect syntactic units, and Esser noted that once both syntactic structure and semantic factors were taken into account, intonation within read text was fairly predictable. Wichmann's (1994) work also suggested that sentence-internal falls tended to reflect the syntactic structure of the text when examining the relationship between pitch peaks and baselines in oral readers, and as a reader approached the end of a topic, pitch troughs more closely approached the speaker's baseline. Both researchers, then, found connections between syntax and semantics in research on intonation. Both Esser and Wichmann concluded that spontaneous speech is not less 'syntactic' than read speech (and some similarities do exist between the two), it simply allows for more variation. Less restrictive structural planning is permissible in spontaneous speech because other methods are available for communicating meaning (e.g., body language). Blaauw (1994) observed that listeners could differentiate between spontaneous and read speech with 77% accuracy, largely based on the increase in pitch fluctuations at minor syntactic boundaries present in spontaneous speech.

Other studies have also noted salient differences between read and spontaneous speech. Howell and Kadi-Hanifi (1991) revealed that speech rate tended to increase in read speech, and readers tended to uniformly drop many of the pauses that were present in spontaneous speech.

This finding not only agrees with Esser's (1988) observation that there was less prosodic variation in read speech versus spontaneous speech, but also provides evidence against recommending phrasal pausing in assessing reading prosody (see Hudson, Lane, & Pullen, 2005). Penalizing children for failing to pause at phrasal boundaries is a practice that is not consistent with research demonstrating that skilled readers tend to avoid pausing at such boundaries.

Prosody—in both spontaneous speech and oral reading—serves the function of conveying meaning beyond that accounted for by the collective denotative meanings of words within sentences. Prosody's function is an important one, and the recent interest by psychologists, educators, linguists, and computer scientists highlights the numerous and widespread applications for a better understanding of this aspect of language.

The Development of Reading Prosody

How prosody develops in readers is still relatively not understood. Traditionally, there have been two ways of examining prosody and how it develops. This work has centered on looking at prosody either as a measure of expression or in relationship to structure. These two approaches are not as different as they seem, but their distinction is presented by Kuhn and Stahl (2003), who divided prosody into two parts: expression and chunking. While expression consists of suprasegmental linguistic features such as pitch, stress, and length of vowels and consonants, chunking is defined as the grouping of words into appropriate units or phrases. Both expression and chunking seem to be intertwined, though, as an appropriate prosodic reading of a text requires not only that pitch vary appropriately, but that words be grouped appropriately into their syntactic units.

Because written English does not provide many prosodic cues, function words and other morphological markers might serve as the necessary cues for chunking, requiring readers to have the requisite morphological skills necessary to recognize those structural cues at the sentence level (Koriat et al., 2002; see Ravid & Mashraki, 2007 for similar evidence in Hebrew; Schreiber, 1991). Weber (2006), for instance, highlights the importance of paying special attention to function words—often used at phrase boundaries—and their role in prosody and fluent reading. Because research has demonstrated that skilled readers are less likely to pause at commas and minor phrase boundaries than less skilled readers or spontaneous speakers (Chafe, 1988; Howell & Kadi-Hanifi, 1991; Miller & Schwanenflugel, 2006), the appropriate prosodic rendering of function words might very well serve as indicators of a child's fluency and comprehension. Weber (2006) reports that function words generally take a weak stress and sound different depending on how they work in the sentence—that is, they serve the structure of the sentence. One might, then, be able to measure a child's development of prosodic skills, then, by examining their use of function words, though evidence is sparse at present.

The case of function words demonstrates how prosody interacts with grammar at the word, phrase, and sentence level. While each word in the English language has its own prosodic pattern, the expressive reader is able to seamlessly re-distribute prosody appropriately to convey a particular meaning for groups of words. The less skilled reader, on the other hand, might be able to fluently read each word in a text, but might do so in a way that conveys no intended meaning beyond that of the words in isolation. This failure to align prosody with phrase, sentence, and passage structure is commonly known as 'word-calling'. Linguistically, this is an apt term, as these readers are calling out words using prosody based solely on lexical stress patterns and are not properly chunking syntactic units. If it is true that the structure of a text is

extracted prior to analysis of meaning (Koriat et al., 2002) then ‘word callers’ might benefit more from practice reading connected texts than simply practice reading word lists.

Most poor readers, though, are not word callers, and so this phenomenon does not explain all failure in reading with expression. Young and Bowers (1995) established that when texts of various difficulty were used to test the fluency and expressiveness of fifth graders, average readers were more fluent and expressive with texts at their reading level (fifth grade level) than poor readers with texts at their level (second grade reading level). A text parsing test was also given, and both groups of students performed well in parsing the most difficult text into appropriate syntactic chunks. These findings suggest that poor readers simply might not possess the fundamental skills necessary to read with expression even when the text is simple enough for fast and accurate reading and even when parsing tests suggest that they possess some phrasal knowledge. Any speaker of a language has some phrasal knowledge of that language, but to appropriately apply that knowledge to reading it appears that some level of proficiency may need to be achieved.

The connection between the development of chunking, expression, and basic reading proficiency in children is reflected in the prosody-measuring methods used in many studies. Several studies have attempted to measure children’s oral reading prosody in a rather holistic fashion, but few have used objective measures. Most have tended to use rating systems either for measuring prosody itself, or including prosody in a fluency rating system. Koriat et al. (2002), for example, had judges rate readers on “prosodic naturalness”, from 1—very low—to 10—very high. Young and Bowers (1995) assigned children a fluency score from 1—word by word reading—to 6—“read in phrases, with fluency, using both terminal and internal punctuation; provides appropriate semantic and syntactic emphasis for purposes of dramatization; expression

approximates normal speech” (p. 435)—as a measure of fluency and expression. The National Assessment of Educational Progress (NAEP) study (Pinnell et al., 1995) incorporated expressiveness in a fluency scale of four levels, with Level 1 describing reading as “primarily word-by-word. Occasional two-word or three-word phrases may occur—but these are infrequent and/or they do not preserve meaningful syntax” (p. 15), while reading at Level 4 involved reading as follows:

...primarily in larger, meaningful phrase groups. Although some regressions, repetitions, and deviations from text may be present in Level 4, these do not appear to detract from the overall structure of the story. Preservation of the author’s syntax is consistent. Some or most of the story is read with expressive interpretation. (p. 15)

The assumption—consistent with simple observation—was that prosodic development in the oral reading of children seemed to rest upon the foundation of automatic and accurate fluency skills. One rarely observes a dysfluent reader reading with expression.

The Relationship between Prosody and Fluency

In the past, many educators simply viewed fluent reading as the result of skillfulness in word recognition rather than a skill that contributes to the competent reading of connected texts and is improved by reading connected texts (Zutell & Rasinski, 1991). As the National Reading Panel (2000) report highlighting the importance of fluency instruction in the classroom was released, reading researchers and school systems adopted reading fluency as a key skill in reading instruction. Unfortunately, some educators have found that the pressure to produce fast and accurate reading in their students has resulted in a frenzied instructional approach, especially in high-risk schools that are under pressure to get results, quickly (Corn, 2006). But these approaches focus only on a partial definition of fluency: rate and accuracy. In her critique of the

push for speed in children's reading, an experienced elementary school teacher (Corn, 2006) argued that fluency is not simply defined as fast reading; rather, expression and appropriate phrasing are important as well if comprehension is the end goal. Kuhn and Stahl (2003) also highlighted the need for a more thorough understanding of prosody if fluency was to be fully understood.

Current research on prosody and fluency owes much to two relatively early works which highlighted the question of prosody in fluent reading by focusing on specific indicators that show a person is a prosodic reader. Clay and Imlach (1971) found that better readers tended to behave differently than poor readers in their pausing, pitch, and stress placement. Dowhower's (1991) review of the literature suggested that prosodic indicators related to fluent reading include limited and appropriate pauses, appropriate phrase length, the number of phrases read appropriately vs. inappropriately, length of final words at syntactic boundaries, pitch change at terminal markers, and stress.

As interest in oral fluency has continued to increase, researchers and educators alike have aimed to discover how to measure prosody and determine its impact on the reading process. As evidenced in the rating scales discussed in the previous section, though, methods and results have varied with the relationship between prosody and fluency remaining vaguely understood. One method researchers have used to try and isolate prosodic awareness in children and determine which instructional methods might be most effective in promoting it has been to administer parsing tests, in which children manually segment written text into syntactic clusters. An early study (Snow, Coots, & Smith, 1982) examined the effect of auditorily presented prosodic cues on parsing ability in fifth graders, and measured parsing skill as an outcome variable. Their data indicated that children parsed text most accurately when they heard it presented with exaggerated

prosody; the next best condition for children was a ‘normal’ reading of the text, and the least effective condition was no audio at all. This method of measuring prosodic ability in children, though, only measures the child’s chunking skills on paper and might not provide any further insight into how prosody relates to fluency.

Another more typical method of assessing prosodic ability has been to use a rating scale, in which fluency and prosody are often combined. The later NAEP study included “expressive interpretation” as a factor in scoring oral reading fluency skill in fourth graders (Pinnell et al., 1995), but fluency was rated on a holistic rubric, and expression was simply one factor among several required for a student to earn a particular score. It is likely that expressiveness measured in this way would be affected by oral reading in which there are many oral miscues, leaving it unclear whether low ratings represent poor decoding or true word-by-word reading.

Recent studies have examined the specific relationship between prosody and fluency by using more objective measures of prosody at the phoneme and word level (Ashby, 2006; Ashby & Clifton, 2005), phrase level (Whalley & Hansen, 2006), and sentence or passage level (Cowie, Douglas-Cowie, & Wichmann, 2002; Miller & Schwanenflugel, 2006, 2008; Schwanenflugel et al., 2004). The present study examines prosody at the sentence level, and will look more closely at those studies which have done likewise. Cowie and associates (2002) sought to examine prosody, fluency, and the relationship between the two. While they used a scale to rate prosody, they attempted to measure prosody alone while using another measure for fluency. They found an interaction between fluency and prosody in readers: children who scored high on the expression scale tended to be highly fluent, while children who scored low on expression varied widely regarding fluency. Thus, they concluded that fast and accurate readers can be expressive in their reading (though they might not be), but a child who is not fast or accurate will have a

very difficult time reading with expression because she does not have the foundational skills necessary to properly chunk words into phrases and meaningful units. Kuhn & Stahl (2003) agreed, pointing out that as children become more comfortable with a text, they are able to begin to imitate the natural rhythms and intonations of conversation in their reading. Prosodic reading, then, is made possible by fluency.

Schwanenflugel and colleagues (Miller & Schwanenflugel, 2006, 2008; Schwanenflugel et al., 2004) also examined the role of prosody in fluency by conducting a three-year longitudinal study (including several sub-studies) of first through third graders. Using a much larger sample than Cowie et al. (2002), they had fairly similar findings in their first sub-study with second- and third-grade children: children who read with good speed were more likely to read with prosody than children who read slowly, even if they were all at least 90% accurate. They found that good readers made fewer and shorter intersentential pauses, declined more in pitch at the ends of sentences, and were more adult-like in their intonation contour than children with poorer decoding skills.

The studies conducted by Cowie et al. (2002) and Schwanenflugel and colleagues (2008; 2004), however, utilized fairly simple texts (grade level averages at 2.0 and 1.97, respectively) with vastly different grammatical structure—Cowie et al. had children read a text that was comprised largely of quotatives with some questions, while children in the Schwanenflugel et al. study read a text comprised solely of declaratives. To observe the effect of a relatively challenging and grammatically varied text on prosody in children's oral reading, Miller and Schwanenflugel (2006) created a passage containing quotatives, questions, and simple declaratives at an estimated grade level of 3.25. With third graders as participants, this text was at the reading level of most children. Interestingly, and in accord with Chafe (1988), they found

that skilled readers were less likely to pause at commas than less skilled readers. This finding directly contradicts suggestions (Hudson et al., 2005) that teachers should assess students' prosody by observing whether or not they pause at phrase boundaries marked with punctuation. Miller and Schwanenflugel (2006) also found, consistent with Schwanenflugel et al. (2004), that skilled readers used larger pitch declinations to mark the ends of declarative sentences than less skilled readers. In the final segment of their three-year longitudinal study with third-grade fluency as the outcome variable (Miller & Schwanenflugel, 2008), researchers found that intonation contour (matching pitch curves with those of adults) in both first- and second-graders significantly predicted fluency in third grade. Pausal intrusions, however, did not, though pauses did play a significant role in predicting comprehension, discussed below.

There does not yet seem to be agreement as to whether pause frequency is a measure of fluency or a measure of expressiveness. Cowie et al. (2002) classified pause frequency and intersentence pause duration as measures of fluency and found them both to be significant predictors of listeners' perception of fluency. However, other research has used pause patterns as a measure of prosody, based on the syntactic relationship between pauses and oral reading (Koriat et al., 2002). Thus, there appears to be at least two distinct functions of pausing in oral reading: 1) pausing may serve as a prosodic cue to the listener, used skillfully by the reader to convey meaning via chunking—a prosody issue; 2) pausing may be used when the reader needs time to decode the next word in a text—a fluency issue. More research is needed to further investigate the categorization of pausing, though it is evident that pausing might serve as a connector between prosody and fluency.

The Relationship between Prosody and Comprehension

The question of whether fluency contributes to comprehension invites an intuitive response. If fluent reading involves reading at a good rate, with accuracy, and with expression, then one could say that anyone who does not have these qualities is probably not someone who comprehends the text. But when reading instruction focuses primarily on mastery of word lists, ‘expression’ is extracted from the definition and something gets lost. LaBerge and Samuels (1974) criticized the educational establishment for simply using word lists to develop the reading skills of students. They argued that rather than simply engaging in word-level rate and accuracy exercises, students needed to develop automatic skills with connected text if they were to comprehend that text. Thus, they presented a distinction between word-reading fluency and text-reading fluency with word-reading fluency looked at as a prerequisite to text-reading fluency. It is believed that once a child has the ability to automatically decode text, he or she will be able to focus on meaning, supporting the idea that fast readers also tend to be those who comprehend text well (Pinnell et al., 1995).

The NRP (2000) determined that fluency (defined as rate, accuracy, and expression) was a critical factor in comprehension. Following this claim, several studies have found a significant connection between word decoding speed and comprehension (Klauda & Guthrie, 2008; Schwanenflugel et al., 2004), connected text-reading skill and comprehension (Klauda & Guthrie, 2008; Miller & Schwanenflugel, 2006), and word reading skill as a predictor of later comprehension skill (Miller & Schwanenflugel, 2008). As already demonstrated, fluency and prosody are connected in some way, and if prosodic reading demonstrates at least a grasp of structure at the phrasal level and meaning at the passage level, then prosody’s role in comprehension is likely significant as well. Dowhower (1987) noted that as children improve in

rate, accuracy, and comprehension, they also tend to read with greater prosody. Alternatively, those who cannot appropriately chunk words into their syntactic groupings—often used as a measure of prosodic skill—fail at comprehending text (1991). Prosody, then, seems to either serve to promote comprehension or act as an indicator of comprehension.

The interaction between fluency and prosody in studying comprehension—and the difficulty of separating these reading skills—is evident in recent research. Whalley and Hansen (2006) noted that after controlling for related factors such as rhythmic sensitivity and phonological awareness, prosody (defined as sensitivity to stress patterns in words) accounted for variance in both word-reading accuracy and reading comprehension, with comprehension being linked most closely with phrase-level prosody. In light of evidence that appropriate chunking is based on syntactic structure, and that structure is extracted prior to meaning, it makes sense that students who are skilled in prosody at the phrase level (i.e., students who “chunk” appropriately) are also students who comprehend what they are reading (Blaauw, 1994; Koriat et al., 2002). Prosody, though, involves much more than just chunking of text. Definitions also include intonation, stress, and appropriate pausing.

While prosody and fluency are easily connected, some research has failed to find a significant connection between prosody and comprehension (Cowie et al., 2002; Schwanenflugel et al., 2004; Snow et al., 1982). Schwanenflugel et al. (2004) highlighted the possibility that the study of prosody in reading might be irrelevant for children of very young ages due to the necessity of possessing some understanding of syntactic roles. The authors used second and third grade readers in their study—using a 90% accuracy level as a cut-off for eligibility—because these children could safely be assumed to have developed some degree of fluency in their reading. Their goal was to determine where prosody fit into discussions on reading development.

Results suggested little direct relationship between prosody and comprehension, but (like Koriat et al., 2002) found that fluent decoding skills seem to permit the use of prosody in reading.

Using more specific syntactic criteria to explore the relationships between fluency, prosody, and comprehension, Miller and Schwanenflugel (2006) were able to find a significant relationship between pitch changes and comprehension. Children who had the greatest pitch declination at the end of declarative sentences and the greatest pitch rises at the end of yes-no questions also had the highest reading comprehension scores. A later longitudinal study by Miller and Schwanenflugel (2008) found that fewer pausal intrusions between first and second grade successfully predicted comprehension skill in third grade, and an adult-like intonation contour accounted for significant variance in reading comprehension in third grade. Thus, as one of the few longitudinal studies of prosody available, this research demonstrates the possibility of certain prosodic features (like pausal intrusions, sentence-final pitch changes, and intonation contours) serving as predictors of comprehension both immediately and in later years.

While Schwanenflugel and colleagues examined fluency and prosody at the word, phrase, and sentence level, Klauda and Guthrie (2008) built upon these findings to include passage-level fluency and prosody. They found that fifth grade students who comprehended the text tended also to score high on a measure of passage-level expressiveness. Though Klauda and Guthrie used a rating scale to judge prosody (which might be influenced by child miscues) rather than spectrographic measurements, their finding is consistent with our understanding of prosody in English: prosody interacts with both syntax at the phrase level and semantics at the passage level (Esser & Polonski, 1988). Still, fifth graders are fundamentally more fluent than the first-though third-graders studied by Schwanenflugel and her colleagues, so it is unclear whether younger readers would be as influenced by passage level prosody characteristics than older

children may be. Moreover, because rating scales would likely be influenced by child miscues whereas they can be explicitly controlled for or eliminated when using spectrographic measurements means that it is difficult to interpret whether effects determined by ratings are truly attributable to expressiveness and not other factors.

While these studies have begun to find connections between prosody, fluency, and comprehension, many questions still remain. In each of the previous studies mentioned, a single text was used to obtain the prosody score or measurements. However, Young and Bowers' (1995) work examining the role of text difficulty in prosody demonstrated the possible significance of the interaction between text difficulty and fluency. Additionally, the varied results by Schwanenflugel and colleagues in prosody's predictive value for comprehension solicit further inquiry into this relationship.

The Impact of Text Difficulty

There is little evidence in the literature on the effect that text complexity or difficulty has on reading fluency, comprehension, or prosody. Studies tend to examine these variables in relationship to one another using a single text. As early as the Clay and Imlach (1971) study, though, some attention was paid to the effect that text complexity might have on decoding and other reading skill variables. In their study of the oral reading of seven-year-old children, Clay and Imlach used four stories of increasing structural complexity and sentence length, but they did not incorporate a breakdown of results per story into their discussion. Based on the overall findings of their study, though, they did conclude that skilled readers have the ability to be guided by larger segments of text, while poorer readers tend to function best with two- or three-word phrases at most. These results imply that fluency and comprehension could be significantly hampered when low-skilled readers are given difficult or complex texts to read.

It may be assumed that text complexity plays a significant role in children's reading fluency by examining automaticity theory (LaBerge & Samuels, 1974) and applying it to this potential relationship. Some methods for measuring the reading level of a text include crosschecking words in the text with words on a list of frequently encountered words for children (Spache, 1953) while others simply use a formula that accounts for characters per word and words per sentence (Flesch, 1948). Regardless of the method used to determine the grade-level equivalent of a text's readability, it is likely that children, in general, will read texts rated at a high grade level less fluently and with less comprehension than texts rated at a low grade level. This is because longer or unfamiliar words will slow a reader down and, according to automaticity theory, take up cognitive space for decoding that might otherwise be used to focus on understanding meaning. Of course, a child who is already reading with age-appropriate fluency will probably find it easier to quickly incorporate a few unfamiliar words into his or her repertoire than a child who has not yet become a fluent reader.

In a study examining the relationship between fluency and text difficulty, fifth graders with generally poor reading skill declined in rate and accuracy more rapidly from grade two to grade three to grade five level texts than readers with average skill. Additionally, the poor readers declined significantly in overall fluency (incorporating expressiveness) from text to text while the fluency ratings of average readers did not change at all across the three texts (Young & Bowers, 1995). This study showing sharp decreases in performance by poor readers in the fifth grade as text difficulty approached grade level provides evidence that struggling readers might benefit from a reading program which matches them with texts at their reading level as opposed to simply their grade level. Research by O'Connor and associates (2002) supported this approach. These authors studied the influence of text difficulty on various reading skills in poor

readers in the third through fifth grades and found that using texts at a student's reading level versus grade level resulted in significant improvements in oral reading fluency over the course of an 18-week intervention. They, like many others, found that fluency was the most influential contributor to reading comprehension.

There is little research on the effects of text difficulty in reading outcomes like fluency and comprehension, but there is even less research examining text difficulty in relationship to prosody. Many studies have been conducted in linguistics and speech communication sciences to provide insight into how features like intonation and pausing distinguish speakers from one another and communicate meaning in different ways. The language medium of interest, however, is spontaneous speech in most cases. Young and Bowers (1995) looked at parsing skill as a measure of prosody awareness in texts of differing complexity using poor and average fifth grade readers as participants. They found that the parsing ability of children from both skill groups increased as a function of increasing text difficulty even though the rate, accuracy, and overall fluency skills of the poor readers decreased markedly across texts. This result sets prosody apart from fluency when looking at the influence of text difficulty. The increased sentence complexity characteristic of a fifth grade text as opposed to a second grade text appears to have assisted readers in recognizing phrasal boundaries. In turn, the ability to parse text might assist in children's fluency development—likely resulting in better comprehension as well. A recent study found greater expressive fluency gains after repeated readings of syntactically cued text than text presented in a traditional layout (LeVasseur et al., 2008). It appears that simplifying the text by chunking it into its component parts served as a scaffold for development of prosodic skill.

While parsing seems to be enhanced by providing children with fairly difficult texts, parsing skill is not measured by oral reading but by segmenting text with a pencil, and measures

metalinguistic knowledge about parsing rather than actual parsing itself. Segmenting text into component phrases and clauses is part of what characterizes prosodic readers, but the effect of text difficulty on measured prosody variables is still unknown. Measuring different treatments of minor syntactic boundaries in oral reading might prove difficult; while minor syntactic boundaries are marked with salient prosody in spontaneous speech, they are less noticeable in read speech (Blaauw, 1994). So, syntactic variation within major boundaries (clauses and sentences, for example) might not have much of an effect on reading prosody in children, though this is still unknown.

Overall, the effect that text difficulty or complexity exerts upon children's prosody is very much open for speculation. Prosody's close relationship to fluency and its potentially significant relationship to comprehension make it a prime target for further research. Prosody is that musical quality that is so easy to recognize, yet it is so difficult to trace its development and its effects. However, if—as some of the aforementioned research suggests—prosody is made possible by fluent reading skills (Cowie et al., 2002), and fluency is the key to comprehension (LaBerge & Samuels, 1974), then it might follow that when a text is of sufficient difficulty to use all the fluency resources in a reader, then his or her prosodic skills could provide additional assistance in comprehending the text.

The Purpose of the Present Study

The present study has been designed to both replicate and build upon the findings of Schwanenflugel and colleagues (2006, 2008; 2004) by examining the role of text difficulty in the prosody of children's oral reading, as suggested by Young and Bowers (1995). Because not all measures of prosody in spontaneous speech might be relevant to a study of read speech, only variables that have been shown potentially useful are of interest for this study. The prosodic

measures of interest are those which have been found to be possibly predictive of comprehension by Schwanenflugel et al (2004) and Miller and Schwanenflugel (2006, 2008)—i.e., sentence-final pitch change, adult-like intonation contour, and number of intersentential pauses. Until the technology of the 20th century, precise measurements of these factors were practically impossible to obtain. However, spectrographic software is now readily available for measuring amplitude, timing, and frequency as well as other linguistic and paralinguistic vocal effects (e.g., Boersma & Weenink, 2008). Thus, this study will utilize current spectrographic technology to measure prosodic variables rather than judge prosody based on a rating scale. It is unclear at this point how reading prosody changes as texts grow more complex, how prosody impacts comprehension, and which prosodic variables serve as predictors of comprehension. The goal of the present study is to provide insight into these questions.

Chapter 2

Method

Participants

Participants were 90 second grade children (57% female, 43% male; mean age = 8 years, 2 months, $SD = 4$ months; 32% African American, 50% European American, 10% Hispanic American, 4% Asian American, 2% other, and 1% of unknown ethnicity) who were part of a larger study on the development of reading fluency and participated in a broader intervention study that was unrelated to the present research. The children attended one of five schools (four in Georgia or 83% of the sample and one in New Jersey or 17%). While students from multiple ethnic backgrounds and two different geographical areas of the United States participated in the study, previous research which included these participants found that no significant prosodic differences existed between the groups for purposes of the present study (Schwanenflugel et al., 2004). Only children not receiving special services for dual language learners and who were able to reach a “difficult” targeted passage were included in the study so that neither primary language nor decoding errors would be confounds and comparisons between a simple and difficult passage could be made. All children had received parental consent for participating in the study and assented to their own participation.

Twenty adult participants (70% female, 30% male; 30% African American, 70% European American) were also recruited for this study to develop an adult fundamental frequency intonation contour baseline to which children’s intonation contour could be compared. The adult sample was matched as closely as possible to the second grade sample in general

demographics to control for possible regional differences in reading styles, and the sample was balanced among working- and middle-class participants. Of the adults, 85% had been raised in and currently lived in northeast Georgia, while 15% of adults were from New Jersey. All had been raised within shopping distance of one of the groups of child participants and were recruited through University ties or simply by door-to-door solicitation among area businesses. Adults received a children's book as an incentive for participating in the study.

General Assessments and Procedures

For children, formal reading assessments were administered during the spring term of second grade. Children were administered a test of reading fluency, word reading efficiency, and reading comprehension, counterbalanced so that half the participants received oral reading fluency and word reading efficiency measures in the first half of the battery, and half received the reading comprehension assessment first. All assessments were carried out by testers trained to a standard of 100% agreement with a trained school psychologist. All were tested in a quiet location in their school.

Word reading efficiency assessment

To obtain an independent estimate of word reading efficiency, we administered children the Test of Word Reading Efficiency (TOWRE) Sight Word Efficiency subtest (Torgesen, Wagner, & Rashotte, 1999). This subtest assesses the number of real words correctly read from a list within 45 seconds. Children were assessed using TOWRE-Form A; the subtest raw score was converted to a standard score based on age as directed by the test manual. Test-retest reliability calculated for children ages 6-9 years is reported as 0.97 in the test manual. Furthermore, concurrent validity estimates reported in the test manual have a coefficient of 0.94 for second grade students (Torgesen et al., 1999).

Oral reading fluency assessment

To measure children's oral reading fluency, children were assessed with the Gray Oral Reading Test (J. L. Wiederholt, & Bryant, B. R., 2001; J. L. Wiederholt, & Bryant, B.R., 1992) to assess students' skill in reading connected text. The discontinue rule for the assessment was consistent with that specified in the test manuals. The test presents children a series of passages of increasing difficulty to read aloud. As these children were participants in a larger longitudinal study, 36% of children were administered the Gray Oral Reading Test, 3rd edition (Form A, GORT-3) and 64% of children were administered the 4th edition of the test (Form A, GORT-4). Passages were presented as formatted in the student booklet. Raw scores for rate were converted to standard scores based on age as directed by the respective test manuals. The authors of the test report an internal consistency reliability of 0.90 and test-retest reliability of 0.95 for children in this age range for rate scores. Validity estimates—compared with other reading skills tests—are reported as ranging from 0.39 to 0.89 (J. L. Wiederholt, & Bryant, B. R., 2001).

Reading comprehension assessment

The Reading Comprehension subtest of the Wechsler Individual Achievement Test (WIAT; The Psychological Corporation, 1992) was administered to obtain an independent measure of the students' reading comprehension skill. This subtest consists of a series of printed passages, each of which increases in difficulty, followed by a question presented and responded to orally. The subtest contains both literal and inferential comprehension question types. The children were instructed to read a passage, listen to the question presented by the examiner, and then respond orally, in their own words. Once a child missed four consecutive questions, the test was discontinued. This test measures reading comprehension as children's ability to answer questions about the text, a skill that many teachers consider a key indicator of reading

comprehension (Richardson, Anders, Tidwell, & Lloyd, 1991). The raw score—determined by the number of questions answered correctly—was converted to a standard score, based on age, which then served as an indicator of reading comprehension skill, henceforth referred to as WIAT-RC. The split-half reliability coefficient for this age range has a mean of 0.92, and the validity estimates fall between 0.73 and 0.78 (The Psychological Corporation, 1992).

Reading Prosody Assessment and Procedures

Prosodic measurements were carried out on the two selected target passages from the GORT (passage 1 from GORT-3 or passage 3—the same passage—from GORT-4, henceforth, “easy” passage; passage 3 of the GORT-3 or passage 6, the same passage, from the GORT-4 henceforth, “difficult” passage). The easy passage was selected because it was highly decodable and allowed for prosodic measurement in a context with few decoding errors. This story was introduced with the following instructions: “This story is about two people in a family. Read the story to find out what happens to them.” Our own readability analyses using the Flesch-Kincaid Grade-Level Formula (Flesch, 1948) and the Spache Readability index (Spache, 1953) yielded an average estimated grade level of 1.97, somewhat below the grade level of children in the study. The passage was 52 words long and consisted of seven sentences: three simple declaratives, a salutation quotative, a yes-no question quotative, and then two declarative quotatives.

The difficult passage was selected because the test manuals indicated that its readability was above grade level for the participants and, thus, would allow for a comparison of prosodic measurements with a more difficult text. Our own readability analyses using the Flesch-Kincaid Grade-Level Formula and the Spache Readability Index yielded an average estimated grade level of 3.79. The passage was 100 words long and consisted of nine sentences: seven simple

declaratives and two complex declaratives. The second passage was introduced as follows: “This story is about people doing something together. Read the story to find out what they are doing.” For both passages, examiners directed students to read the passages as quickly and as well as they could.

Readings from the children were obtained using either a Sony TCD-D100 digital audio-tape cassette recorder or Sound Devices USBPre 1.5 microphone computer interface. A Sony ECM-717 Stereo Unidirectional Microphone was used with both recording devices.

Additionally, a shareware version of GoldWave Digital Audio Editor (GoldWave Inc., 2004) and Audacity v. 1.2.6 ("Audacity," 2008), an open source digital audio editor, were used to create individual .wav files for prosody analysis. Background interference was reduced using noise reduction procedures, and prosodic analysis was carried out using Praat v.5.0.38. Praat is a free software program that is used to analyze, synthesize, and manipulate digital speech data (Boersma & Weenink, 2008).

For the adults, only the two targeted passages from the study were provided for recording. Adults were instructed to read the story aloud, and this reading was recorded in a quiet area of their home or work using an Olympus WS-110 digital voice recorder. They read the easy passage prior to the difficult passage.

Measurement of Prosodic Features

Based on recent studies examining reading prosody (Miller & Schwanenflugel, 2006, 2008; Schwanenflugel et al., 2004), we examined prosodic features that were expected to be predictive of reading comprehension. Among these features, we analyzed for the number of pausal intrusions within a passage (intra-sentential pausing) and the fundamental frequency (F_0) change at the ends of sentences. We also analyzed for children’s similarity to an averaged adult

intonation contour for each of the two stories. The twenty adult participants had similar linguistically regional and demographic backgrounds as the children in the study.

The first three sentences of each passage were chosen for prosodic measurement. In both passages, the first three sentences were declarative and free of internal punctuation such as commas or quotatives, which might direct intra-sentential pausing. This method allowed us to target text that was fairly uniform linguistically. Additionally, all prosodic measurements were taken using PRAAT (Boersma & Weenink, 2008), a software program developed for linguistic analysis of sound and speech.

Sentence final F_0 change was measured by isolating the target area on the spectrograph and measuring the pitch change, in Hertz (Hz), from the final pitch peak to the end of the sentence. Magnitude of F_0 declination was determined by subtracting the final from the peak fundamental frequency. Measurements were taken on the three basic declarative sentences at the beginning of each of the texts, and the mean difference in F_0 was used as an indicator of sentence-final F_0 declination for each passage. In some cases, “creaky voice” was observed in recording. Creaky voice is a result of irregular vocal fold vibration, and can occur at any pitch. However, the result is that the pitch drops approximately two octaves below normal frequency. Thus, end-of-sentence prosody indicating creaky voice was not included as data (i.e., scored as missing) as this is generally not considered a valid indicator of F_0 . Henceforth, averaged sentence-final pitch change measurement from the simpler text is referred to as *simple sentence-final F_0* and from the more difficult text as *difficult sentence-final F_0* .

Intra-sentential pausal intrusions were counted by isolating the temporal space between the end of a word and the start of the following word. Pauses exceeding 100ms were counted as pausal intrusions (Miller & Schwanenflugel, 2006, 2008). Because the number of words

contained in the first three sentences of each passage differed, the raw number of pausal intrusions per passage was divided by the total number of intra-sentential pausal intrusion opportunities per passage, resulting in a pause proportion per passage for each participant. Henceforth, pausal intrusion measurement from the simpler text is referred to as *simple pause ratio* and from the more difficult text as *difficult pause ratio*.

To determine the intonation contour for each child and adult, each word in the first three sentences of each story was isolated, and its vocalic nucleus (the voiced portion of the word, which produces F_0) measured. So that comparisons between the children and adults could be determined, an average F_0 was obtained for each word by averaging over the 20 adult participants. This method is consistent with previous studies (Miller & Schwanenflugel, 2006, 2008; Schwanenflugel et al., 2004) and was verified as suitable by obtaining a Cronbach-alpha reliability score across adults for each story ($\alpha = 0.904$ for the simple story; $\alpha = 0.945$ for the difficult story), suggesting that adults shared a similar intonation contour while reading the stories. The same vocalic nucleus measurement was carried out on the oral readings of the child participants, and each child's intonation contour was correlated (Pearson r) with the averaged adult contour, resulting in an adult-like prosody score for each child. Henceforth, this index of adult-like prosody measurement from the simpler text is referred to as *simple F_0 contour* and from the more difficult text as *difficult F_0 contour*.

Chapter 3

Results

Prior to analysis, the data were inspected graphically for prosodic outliers. Box plots (Figure 1) showed evidence of two outlier measurements (denoted by asterisks) among the children's adult-like prosody match scores for the first story. However, when further tests were performed, it was determined that including these outliers did not demonstrate any marked effect on statistical outcomes, and the data had been accurately measured and recorded. Thus, the outliers were retained. Additionally, the scale scores from the GORT were converted to standard scores so that all standardized test scores were on the same scale. The standardized scores reflect a mean of 100 and a standard deviation of 15 (The Psychological Corporation, 1992; Torgesen et al., 1999). As evident in Table 1, however, the children in this sample scored higher, on average, than their peers. This result was expected, as only children who had reached the pre-determined benchmark (the difficult text chosen from the GORT) were included in the present study. The means, SD, and ranges for each variable can be found in Table 1.

Analyses were carried out in multiple steps, each addressing one of the major goals of the present research. The first goal was to determine whether text difficulty impacted children's prosodic renderings of the text. The second was to discern whether children's fluency level played a role in their prosodic reading of simple and difficult texts. The third goal was to determine if prosodic measurements from a more difficult text were more predictive of both fluency and reading comprehension than prosody as measured from a simple text.

The Impact of Text Difficulty on Reading Prosody

To answer the first two research questions, a single score was developed that would serve as a general indicator of fluency—operationally defined as rate and accuracy for the present study—based on children’s standardized test performance using their GORT and TOWRE scores. The children’s GORT and TOWRE scores were averaged for the purpose of obtaining a single fluency score for each child, henceforth known as the *fluency skill* score (Schwanenflugel et al., 2004). The resulting scores were used to divide the children into three fluency groups (low, middle, and high); since two children received identical scores bordering the middle and high groups, they were both placed in the middle group rather than placing one in the middle and one in the high fluency group. The fluency group descriptive statistics can be found in Table 2. A one-way ANOVA revealed significant differences between fluency groups, $F(2, 87) = 151.307$, $p < 0.001$, and a Fisher’s LSD test revealed significant differences between all three groups ($p < 0.001$ for all mean differences).

We then ran a 3 Fluency Skill X 2 Text Difficulty split plot repeated measures ANOVA for each of the three prosody variables. The means for each group on each passage can be found in Figures 1, 2, and 3. The sentence-final F_0 change omnibus test revealed a significantly large effect of fluency group, $F(2, 80) = 12.569$, $p < 0.001$, partial $\eta^2 = 0.239$, as expected¹. There was also a significant medium-sized effect of text difficulty, with children dropping their pitch less at the ends of sentences in the more difficult text, $F(1, 80) = 5.454$, $p = 0.022$, partial $\eta^2 = 0.064$. There was not, however a significant Text Difficulty X Fluency Group interaction, $F(2, 80) = 0.012$, $p = 0.988$, indicating that children generally tend to make less salient drops in pitch at the ends of sentences in more difficult texts than simple texts, regardless of fluency level.

¹ η^2 is a measure of effect size that is equivalent to R^2 in a regression context. Large effects of fluency group are expected as children were separated into groups based on their standardized fluency scores.

When testing for main effects of fluency group, we ran a Fisher's LSD test and found that the low fluency group decreased F_0 significantly less at the ends of sentences than both the middle and high groups (mean difference = -19.12 and -27.49, respectively²; $p < 0.01$). However, the middle and high groups did not differ significantly from each other. Thus, it is evident that children with fluency approximating grade level do not make as significant drops in sentence-final F_0 as children with greater fluency skills (see Figure 1).

The pause ratio omnibus test revealed somewhat different results. A very large and significant effect of fluency group was again found, $F(2, 87) = 50.906$, $p < 0.001$, partial $\eta^2 = 0.539$, with more fluent children having a lower ratio of pauses than less fluent children. A quite large and significant effect of text difficulty was also found, with children making more pauses in the more difficult text, $F(1, 87) = 202.367$, $p < 0.001$, partial $\eta^2 = 0.699$. However, in contrast to the sentence-final F_0 change tests, the pause ratio omnibus test revealed a large and significant Fluency Group X Text Difficulty interaction, $F(2, 87) = 24.954$, $p < 0.001$, partial $\eta^2 = 0.365$. Thus, in pausing while reading aloud, children in different fluency groups did not behave alike when a more difficult text was introduced. To test for simple effects of text difficulty we performed three dependent-samples t-tests—one test for each fluency group. T-tests comparing text difficulty differences within each group revealed significant differences for all fluency groups at $p < 0.01$. In all fluency groups, children paused significantly more when reading the more difficult text. However, as demonstrated in Figure 2, the mean difference in irrelevant pausing between texts increased as a function of decreasing fluency. Thus, the pause ratio of grade-level (low fluency, in this context) readers increased sharply in the more difficult text, while the pause ratio of high fluency readers increased significantly, but not as dramatically. A

² Dowhower (1987) suggested that pitch variations less than 15 Hz are likely unnoticeable. Thus, the differences between the low and middle groups and the low and high groups could be considered of practical importance.

Fisher's LSD test confirmed this. The difference between the easy and difficult text was significantly greater among the low-fluency readers than among the middle-fluency readers ($p < 0.001$), and the difference between the easy and difficult text was significantly greater among middle-fluency readers than high-fluency readers ($p < 0.001$). Thus, as text difficulty increases, the number of pauses children make multiplies as a function of decreased fluency skill (see Figure 2).

Finally, the adult-like prosody score omnibus test revealed a significant effect of fluency group, $F(2, 87) = 8.880$, $p < 0.001$, partial $\eta^2 = 0.170$, and a significant effect of text difficulty, $F(1, 87) = 17.468$, $p < 0.001$, partial $\eta^2 = 0.167$, with children becoming more adult-like in their prosody as text difficulty increased. However, there was not a significant Text Difficulty X Fluency Group interaction, $F(2, 87) = 0.076$, $p = 0.927$. To test for main effects of fluency group, we ran a Fisher's LSD test, and found that the middle and high fluency groups were significantly more adult-like in their prosody than the low fluency group ($p < 0.01$ for both comparisons), but the middle and high fluency groups did not differ from one another ($p = 0.209$). Group means for each text are represented in Figure 3.

Thus, text difficulty does influence children's prosodic reading. As text difficulty increases, children make less-salient changes in sentence-final pitch and they tend to pause more. However, their intonation-contour becomes more adult-like. Fluency level does influence children's prosody when reading simple and difficult texts. Children with approximately grade-level fluency (low group) have less of a sentence-final pitch change than readers above grade level; children at grade-level also pause more, and their pausing increases significantly more as texts get harder, compared to children with above grade-level fluency. Finally, all children develop a more adult-like intonation contour as text difficulty increases.

Prosodic Reading as a Predictor of Fluency and Comprehension

A third goal of the present study was to determine the predictive value of reading prosody: 1) whether prosody in a difficult text served as a better predictor of reading fluency than prosody in a simple text, and 2) whether reading prosody can serve as a predictor of comprehension beyond that accounted for by reading rate type measures such as the TOWRE and GORT.

To look at reading prosody as a predictor of fluency, each variable was individually entered into a regression analysis with fluency skill (the GORT and TOWRE average for each child) as the dependent variable. As is evident in Table 3, each prosody variable, individually correlated significantly with fluency skill, and the variables—individually—accounted for six to sixty-six percent of fluency skill variance. However, the intonation contour variable for the easy story only correlated with fluency skill at $r = 0.265$, suggesting that there is a tenuous relationship between intonation contour and fluency skill in simple texts.

To determine whether the three prosody variables from the more difficult text were more or less predictive of fluency than the three prosody variables from the simple text, we carried out a two-block hierarchical regression using the fluency skill score as the dependent variable. As individual variables from the more complex text were more predictive of fluency (see Table 3), a significant R^2 change was expected. The results confirmed this expectation, as prosody from the more difficult text was found to be a better predictor of fluency than prosody from the simple text (R^2 change = 0.116, $p < 0.001$).

To look at the issue of whether reading prosody as a predictor of reading comprehension beyond that accounted for by simple rate fluency measures, we carried out a hierarchical regression holding fluency skill scores constant to see if prosody measurements from the first

story had any independent predictive value of WIAT scores. As expected, the fluency accounted for a significant amount of variance in the reading comprehension scores of the WIAT, $R^2 = 0.535$, $F(1, 84) = 96.736$, $p < 0.001$. When the prosody variables from the easy story were added in a second step, they were found to have no significant predictive value beyond that of fluency, $R^2 = 0.554$, R^2 change = 0.019, $F(3, 81) = 1.151$, $p = 0.334$.

Finally, to determine whether prosody from a more difficult text has independent predictive value beyond that of fluency, we carried out a second hierarchical regression. Again, fluency accounted for a significant amount of variance in WIAT scores, $R^2 = 0.509$, $F(1, 84) = 87.050$, $p < 0.001$. However, when prosody variables from the more difficult story were entered into the equation, they were found to have significant predictive value beyond that of fluency, $R^2 = 0.591$, R^2 change = 0.082, $F(3, 81) = 5.437$, $p = 0.002$. When individual prosodic variables were entered into the regression equation one at a time, sentence-final F_0 change in the difficult text was found to account for a small but significant amount of variance in comprehension beyond what can be explained by fluency scores, R^2 change = 0.051, $F(1, 83) = 9.724$, $p = 0.003$. Pause ratio in the difficult text also accounted for a small but significant amount of variance in comprehension scores, R^2 change = 0.024, $F(1, 87) = 4.990$, $p = 0.028$. Adult-like prosody score from the difficult text, however, did not account for any significant variance in reading comprehension scores, R^2 change = 0.002, $F(1, 87) = 0.453$, $p = 0.503$. While prosody from the difficult text was found to account for significant variance in comprehension scores beyond what can be explained by fluency, only sentence-final F_0 change and pause ratio contributed to this finding.

Thus, in response to the third research question, 1) reading prosody in both simple and difficult texts can serve as a predictor of fluency, but prosody from a more difficult text is

approximately 12% more predictive of reading fluency than prosody from a simple text; 2) prosody does work somewhat independently of fluency in predicting reading comprehension, but only when the prosody is measured from a relatively difficult text given children's fluency level. Additionally, only sentence-final F_0 change and pause ratio can be demonstrated to have a significant predictive relationship with reading comprehension.

Table 1
Descriptive Statistics

Variable	Minimum	Maximum	<i>M</i>	<i>SD</i>
GORT	75	150	109.33	13.537
WIAT-RC	81	154	111.59	15.241
TOWRE	89	145	112.79	11.706
Simple sentence-final F_0	-24.22	106.15	41.5977	26.67837
Difficult sentence-final F_0	-46.21	107.87	34.7100	31.09564
Simple Pause Ratio	.000	.773	.18131	.159436
Difficult Pause Ratio	.000	.967	.36037	.253362
Simple F_0 Contour	-.044	.884	.62367	.177167
Difficult F_0 Contour	.270	.911	.70678	.149671

Note. GORT = Gray Oral Reading Test; WIAT-RC = Wechsler Individual Achievement Test, Reading Comprehension subtest; TOWRE = Test of Word Reading Efficiency, sight-word subtest; Simple = Simple text from the GORT; Difficult = Difficult text from the GORT; sentence-final F_0 = Average sentence-final F_0 change; F_0 contour = adult-like prosody score based on intonation contour

Table 2
Averaged GORT and TOWRE scores for each fluency group

	N	Minimum	Maximum	<i>M</i>	<i>SD</i>
Low Fluency Group	30	82.50	106.50	98.20	6.08
Middle Fluency Group	31	107.00	116.50	111.56	3.26
High Fluency Group	29	117.00	147.50	123.83	6.97

Table 3
Correlations between prosody variables and fluency skill

Variable	1	2	3	4	5	6	7
1. Fluency Skill	—	.463**	.453**	-.706**	-.817**	.265*	.421**
2. Simple sentence-final F ₀		—	.381**	-.316**	-.416**	.303**	.080
3. Difficult sentence-final F ₀			—	-.317**	-.438**	.369**	.286**
4. Simple pause ratio				—	.842**	-.466**	-.457**
5. Difficult pause ratio					—	-.380**	-.516**
6. Simple F ₀ contour						—	.355**
7. Difficult F ₀ contour							—

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

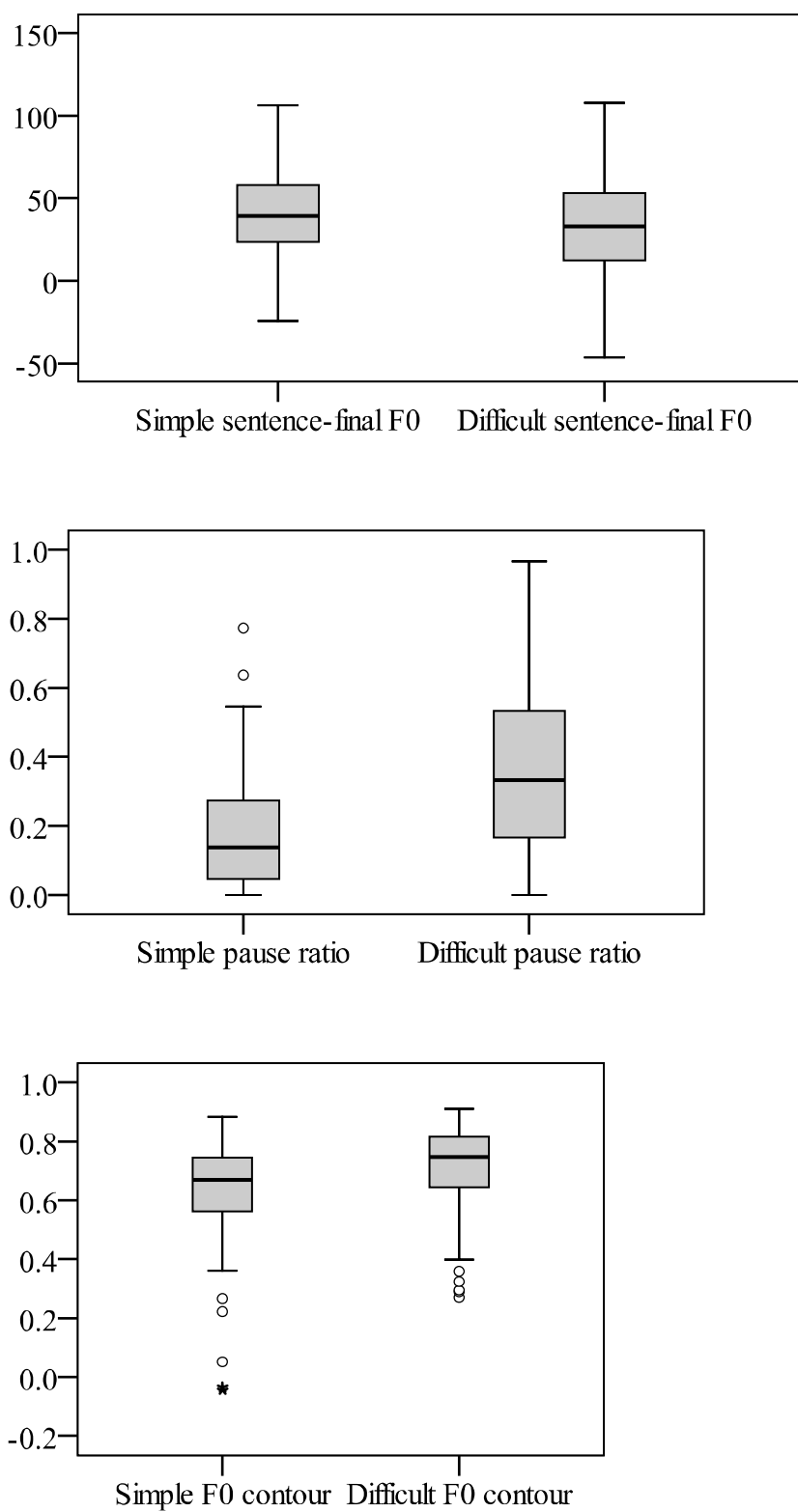


Figure 1
Box plots of prosodic variable measurements among child participants.

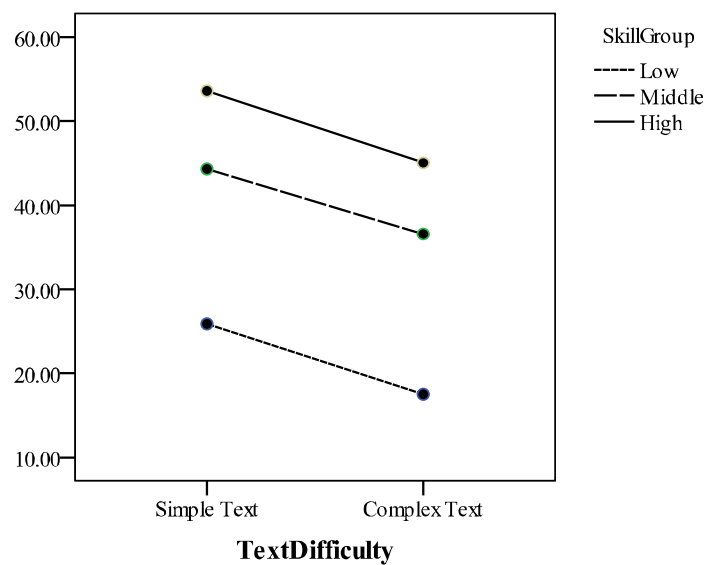


Figure 2
Sentence-final F_0 change as a function of text difficulty and fluency level

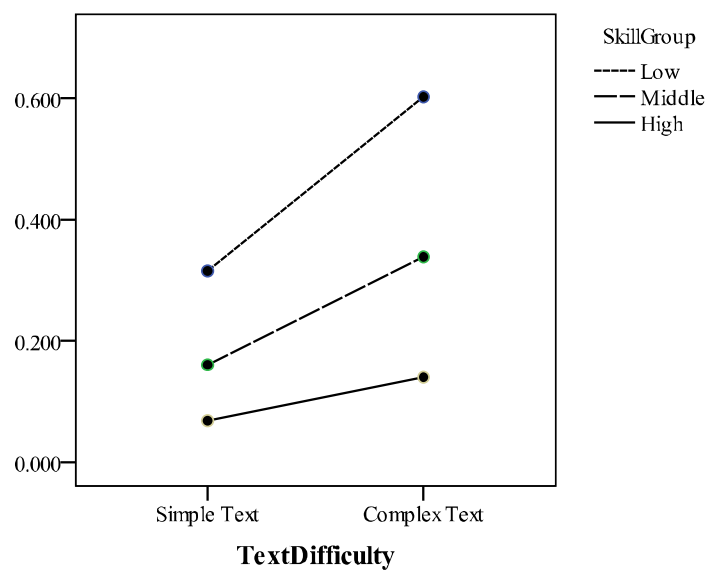


Figure 3
Pause ratio as a function of text difficulty and fluency level

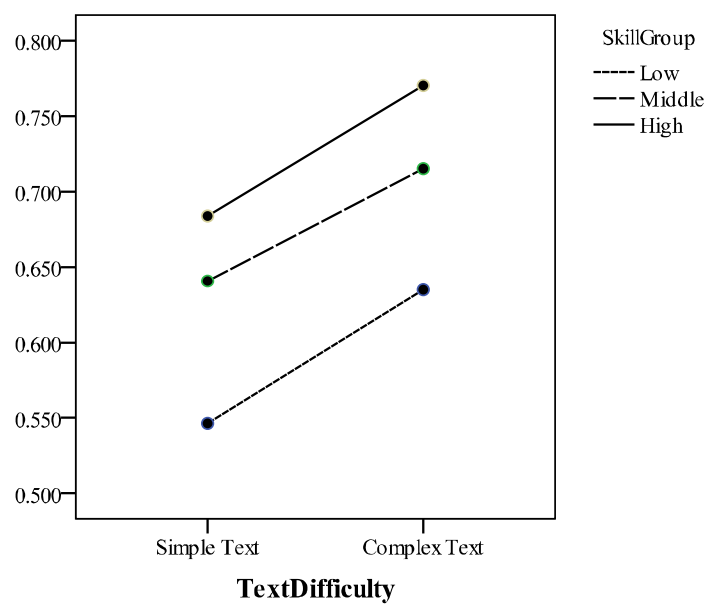


Figure 4
Adult-like prosody scores as a function of text difficulty and fluency level

Chapter 4

Discussion

Summary of Results

Findings demonstrate that text difficulty impacts prosodic performance. When reading a more difficult text aloud children paused more between words within the sentence and decreased their pitch less at the end of a sentence. However, their intonation contour was more adult-like with the more difficult text. These trends hold among all fluency levels.

Overall, there was consistency in the behavior of children of different fluency groups. Among all fluency groups, children changed their pitch less at the ends of sentences in the more difficult text. This makes sense for purely physiological reasons given that some research shows that speakers produce shallower pitch declinations toward the ends of longer sentences as they start to run out of air (Ladd, 1984). However, since more fluent readers consistently maintained sharper declines in sentence-final pitch, non-physiological factors are likely at work as well. By definition, fluent readers read with greater speed than dysfluent readers, so they were probably able to incorporate more words—an entire sentence, for instance—within one breath. Further, all fluency groups became more adult-like in their prosody as text difficulty increased, and all groups exhibited a greater number of intrasentential pauses in the more difficult text. However, change in pause increase was different among groups. Analysis showed an interaction between fluency group and pause ratio; children at the lowest fluency level had the sharpest increase in pausing as a function of text difficulty whereas children at the highest level only increased modestly. Additionally, pause ratio was the only variable for which significant differences were

found to exist between the middle and high fluency groups. The low fluency group read with shallower sentence-final pitch change, a greater number of pauses within sentences, and less adult-like intonation contour than both the middle and high group. While the means of the high fluency group demonstrated consistently greater skill among all prosody variables than the middle fluency group, these differences were only significant with the pause ratio measurements. It is possible that some of the increase in pausing across fluency groups is a result of pausing for breath due to longer sentences in the difficult passage. The interaction might be explained by an increased number of decoding uncertainties in less fluent readers as text difficulty increased. Thus, reading more slowly would require students to pause for breath more often in the difficult passage, with the least fluent readers being affected the most. An examination into the causes of pausal intrusions within sentences could be beneficial in exploring these possibilities.

As expected, prosodic variables for both the simple and difficult text correlated significantly with fluency score. However, prosody from the more difficult text was found to be 12% more predictive of fluency than prosody from the simple text. Likewise, regression analyses demonstrated that prosody from the more difficult text was more predictive of comprehension than prosody from the simple text. Prosody from the simple text did not account for any significant variance beyond what could be explained by fluency scores. Prosody from the difficult text, however, did account for a moderate percentage of variance in comprehension scores beyond what could be explained by fluency scores.

Comparison with Previous Research

Like Young and Bowers (1995), we found that text difficulty played a significant role in children's prosodic reading. Young and Bowers found parsing on the easiest story to be the worst for both below-grade-level and grade-level readers. Similarly, the current study indicated that

children of all fluency levels became more adult-like in their prosodic reading as text difficulty increased. Likely, this was a result of the greater opportunity for prosodic interpretation in a text composed of longer sentences with more phrasal variation. Also, just as the present study demonstrated that prosody and fluency are more highly correlated using data from the more difficult text, Young and Bowers found that parsing and fluency were more strongly correlated in the most difficult text and parsing and rate were most highly related in the most difficult text.

Previous studies (Clay & Imlach, 1971; Dowhower, 1987; Miller & Schwanenflugel, 2006, 2008; Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004) have found that children who were more fluent in their reading paused less within sentences and made greater intonation declines at the ends of declarative sentences. Results from the present study confirm these findings and further solidify the belief that fluency is inextricably connected to oral reading prosody. Present findings are consistent with Miller and Schwanenflugel (2008), whose longitudinal findings suggested that a decrease in pausal intrusions is a gateway for development of proper pitch variation in oral reading. Data from the present study demonstrate significant negative correlations between pause ratio and adult-like prosody score as well as between pause ratio and sentence-final F_0 change; this holds for both the simple and difficult texts. Also, consistent with previous studies (Miller & Schwanenflugel, 2006, 2008; Schwanenflugel et al., 2004) we found that as children increase in fluency, their intonation contours become more adult-like.

The present study was also consistent with numerous previous studies finding a significant relationship between fluency and comprehension (e.g., Klauda & Guthrie, 2008; LaBerge & Samuels, 1974; Pinnell et al., 1995; Schwanenflugel et al., 2004; Schwanenflugel et al., 2006). It appears that children who can read text with ease have an easier time understanding

what they are reading, probably due to the cognitive resources that become available once automaticity is achieved in reading. Additionally, regression analyses were consistent with previous research in demonstrating that at least some prosodic variables may serve as predictors of fluency (Miller & Schwanenflugel, 2006; Schwanenflugel et al., 2004; Whalley & Hansen, 2006; Young & Bowers, 1995) as well as comprehension (Klauda & Guthrie, 2008; Miller & Schwanenflugel, 2006, 2008; Ravid & Mashraki, 2007; Schwanenflugel et al., 2004; Whalley & Hansen, 2006). Also, like Miller & Schwanenflugel (2006), most of the variance in reading comprehension accounted for by prosody, could be attributed to pitch change. In sum, the present results are consistent in many ways with previous findings, namely, 1) text difficulty has an impact on children's oral reading prosody; 2) children with greater fluency tend to read more prosodically than children with low fluency; and 3) prosody contributes in some way to both fluency and comprehension.

The present results also conflict in some ways with previous research. Unlike Miller and Schwanenflugel (2006), pause ratio from the more difficult text accounted for small but significant variance in reading comprehension, though results from the simple text were consistent with Miller and Schwanenflugel, as pause ratio made no unique contribution. The present study demonstrates the potential insight that could be gained by looking at texts of variable difficulty when making prosody determinations in children. Perhaps our findings differ from Miller and Schwanenflugel because the difficult text used in the current study had an even higher readability than that study and our children were younger. It may be that as texts become more difficult, more or different prosodic variables are recruited to support comprehension as a means of amplifying the segmenting and communicative effects of prosody for short-term memory.

Snow and Coots (1981) stated that “a number of linguists have regarded intonation contour as a prominent prosodic marker of the natural units of language” (p. 26), and Schwanenflugel et al. (2004) found a small but significant amount of variation in comprehension scores explained by adult-like prosodic profile score. In the present study, intonation contour did not account for any significant variance in comprehension beyond that accounted for by measures of rate and accuracy. Interestingly, the text that was used in Schwanenflugel et al. is the same text that was used as the simple text in the present study. The studies were not completely aligned, however, as the nature of the present study only allowed the participation of students who had reached a particularly advanced level of fluency on the GORT. Although the adult-like prosody scores were similar in the two studies on this passage (.58 on the Schwanenflugel et al. study and .62 on this one), children in the present study were necessarily more adult-like in their oral reading fluency overall than children in previous studies, pausing less with fewer miscues. Because adult-like prosody was more common in general among the present sample of students, this variable simply might not have played as large a role in variance among reading comprehension scores for these more fluent readers. As children became more adult-like across fluency groups as text difficulty increased, it makes sense that adult-like intonation from the difficult text also played an insignificant role in accounting for variance in reading comprehension. The inconsistency revealed between these two similar studies demonstrates the need for further research in this area.

The present study expands upon previous research in this area with some findings that have not been widely explored: 1) text difficulty impacts children’s reading prosody; 2) children become more adult-like in their reading as text difficulty increases; 3) there is a significant interaction between text difficulty and fluency level when intrasentential pausing is measured;

4) difficult texts are better predictors of rate and accuracy than simple texts; 5) prosody from a relatively difficult text serves as a better predictor of comprehension than from a simple text.

First, the present study used objective measurements of prosody to show that text difficulty significantly impacts children's oral reading. Based on the complexity of the text, children behave differently in their sentence-final F_0 behavior, their intrasentential pausing, and their sentence-level intonation contour. Second, while Young and Bowers (1995) found that children of all skill levels performed better on parsing tests using texts at grade level versus easier texts, the present study demonstrates that children also use more natural and adult-like intonation when reading from texts at or even slightly above their level. Third, Cowie et al. (2002) found that inexpressive readers tended to make more inappropriate pauses as they progressed through texts. Similarly, the present study shows that children with low fluency skill—who were also the least expressive—increased intrasentential pausing at a significantly greater rate than children with high fluency skill. While this finding is not identical to that of Cowie et al., it is consistent in showing that pausing seems to be closely connected to both fluency skills, in general, and prosody, specifically.

Fourth, in addition to earlier findings demonstrating a connection between fluency skill and prosody (Dowhower, 1987; Kuhn, 2005; Miller & Schwanenflugel, 2006, 2008; Schwanenflugel et al., 2004; Whalley & Hansen, 2006; Young & Bowers, 1995), the present study suggests not only that prosody is a significant predictor of fluency, but that prosody measured from a more difficult text is a better predictor of fluency than prosody measured from a relatively simple text. This finding makes sense in light of the consistently distinct differences in prosodic measurements that was observed between fluency groups in the present study. Fifth, the present study presents new evidence that text difficulty matters when prosody is used to predict

comprehension. The simpler text was simply not complex enough for prosodic differences in these children to play a role in predicting comprehension.

Implications of the Present Study

The initial hypothesis and motivation for pursuing the present study was that text difficulty played a role in both the prosody of young readers and the predictive value of prosody. This overarching hypothesis was confirmed and support shown for prosody's significant, if minor, role in the development of reading competence in children. In average and above-average second-grade readers, prosody measurements taken from an above-grade-level text were significantly different from measurements taken from a grade-level text. As suspected, children with superior fluency skills had more pronounced sentence-final pitch declinations, fewer intrasentential pauses, and more adult-like sentence-level intonation than less fluent children—and these findings held for both the simple and difficult texts. Finally, while no simple-text prosody measurements from these average and above-average readers were found to be independently predictive of comprehension, both sentence-final F_0 change and pause ratio measurements accounted for significant variance in children's reading comprehension scores. Likewise, prosody measurements from the more difficult text were more predictive of fluency than from the simple text. All research questions for the present study were answered in the affirmative, leading to several implications for both reading assessment and educational practice.

Because not all prosodic features were shown to contribute equally to predictions of reading comprehension, results from the present study can be used to suggest improvements or alternatives to holistic oral reading rubrics (Pinnell et al., 1995; Rasinski, 2006). Specifically, pausing—often included in measures of general fluency—and sentence-final pitch decrease might be used as indicators of prosodic skill. Additionally, texts that are slightly challenging for

individual students are likely better than texts below a child's level for assessing general reading skill and using prosody to predict both fluency and comprehension. Fluency skill with simple texts, not prosody, was shown to predict reading comprehension in the present study. For prosody to play a role in predicting comprehension alongside fluency, assessments must be difficult enough to require the student's use of prosody as a possible scaffold to comprehension.

The NAEP study (Pinnell et al., 1995) found that "oral reading experience can be important in developing reading fluency; however, not all oral reading activities may be equally successful with all students" (p. 59). In examining the differences between the low, middle, and highly fluent readers in the present study, it is apparent that one text cannot match the scaffolding needs of all children in a classroom. Cowie et al. (2002) suggested that the relationship between fluency and expressiveness might be characterized by interactions as well as other independent effects. This is most clearly represented by the Text Difficulty x Fluency Group interaction found when looking at the pause ratio variable. The low fluency group which, on average, was comprised of children fluent at grade level, experienced a sharp increase in pausing within sentences when the difficult text (at a nearly fourth grade reading level) was introduced. Thus, if these children were left alone to read the text without any form of modeling, they would probably experience sufficient difficulty to prevent their comprehension of the text (LaBerge & Samuels, 1974). Research suggests that some children may need coaching in the form of re-reading or read-along practice to promote fluency (Dowhower, 1987; Pinnell et al., 1995; Zutell & Rasinski, 1991). On the other hand, children in the high fluency group experienced a relatively slight increase in intrasentential pausing from the simple to the difficult text. Educators might find that these children would benefit from exposure to somewhat challenging texts rather than simply grade level texts (Zutell & Rasinski, 1991). Educators might

also take into account the predictive value that pausing and sentence-final pitch changes have for reading comprehension. These variables only seemed to have any significant value when a fairly challenging text was used.

Limitations of the Present Study & Directions for Future Research

The present study was conducted for the simple purpose of examining the effect of text difficulty on oral reading prosody, fluency, and comprehension. However, conclusions about prosody, especially, are limited since prosody was examined only at the sentence level. Recent research has found significant effects of prosody at the word (Ashby, 2006; Ashby & Clifton, 2005; Weber, 2006; Whalley & Hansen, 2006), syntactic unit (Hirose, 2003; Miller & Schwanenflugel, 2006; Smith, 2004; Whalley & Hansen, 2006), and discourse or passage level (Klauda & Guthrie, 2008; Smith, 2004). Conclusions made by examining prosodic behavior at the sentence level—i.e., sentence-final F_0 change, number of intrasentential pauses, intonation contour—might not necessarily reflect a reader's prosodic awareness at the passage level. However, the above-mentioned studies have consistently found that appropriate expression tends to coincide with fluency.

The moderate connection found in the present study between prosody and comprehension might have been stronger had phrasal and passage-level prosody been examined. If reading with expression involves segmenting text into meaningful units (Dowhower, 1991) and demonstrating an awareness of story or passage grammar (Klauda & Guthrie, 2008), then work needs to continue in examining prosody and chunking at the syntactic unit level and the passage level as opposed to simply the word or sentence level. Further, having passages with greater topic development would allow us to determine whether there are discourse prosody features that

could indicate comprehension and would potentially engage more prosodic features (Wennerstrom, 2001).

Additionally, the prosodic characteristics of oral reading in the present sample may have been more salient had the instructions for the GORT been modified. Instructing a child to read quickly could easily result in the child's discarding normal use of prosody in order to simply race through the text. The instructions on the test were not designed for assessment other than rate and accuracy. This could have especially affected the present sample of children, who had higher average test scores in fluency and comprehension than their peers. While there was enough heterogeneity in the sample to find significant results, some variables—such as adult-like intonation contour—might have been shown to have more effect on comprehension had a greater number of children with average and below-average fluency been able to be included.

Some limitations also might exist in the specific prosodic units chosen for measurement. Schreiber (1991) suggested an emphasis in examining syntactically appropriate pauses rather than simply the more holistic intrasentential pausing that was examined in the present study. Pause ratio at the sentence level might be better considered a measure of fluency, not prosody. Koriath et al. (2002) used phrasal pausing as a measure of fluency, and this method of measuring prosodic pausing is more consistent with what we know about chunking. Students who chunk text appropriately are both more fluent and have better comprehension than students who do not. Pausing—even slightly—at appropriate syntactic boundaries might be a sign that the student is utilizing short term memory strategy to improve comprehension. Some research in the fields of linguistics and speech communications suggest that sentence-final F_0 declination might not be the best measure of appropriate prosody. Couper-Kuhlen (1986), for example, argued that vowel quality can affect F_0 as high vowels (like /i/) have intrinsically higher pitch than lower vowels

(like /u/, for instance). Additionally, pitch might best be measured as an overall pattern of relative variation rather than simply a sentence-final drop (Couper-Kuhlen, 1986, p. 9). Finally, some sentence-final pitch declination is likely explained simply by physiological phenomena (reduction in sub-glottal pressure as a result of continued breathing out) rather than intentional control (Ladd, 1984). Of course, if this were the only factor at work in sentence-final pitch declination, one would expect both low and highly fluent readers to behave similarly for this variable, which was not the case in the present study. These other factors, however, limit the use of sentence-final F_0 change as an absolute measure of prosodic skill in reading aloud.

Recent studies examining the role of intonation contour as a measure of prosody in children's reading have found promising results (Miller & Schwanenflugel, 2006, 2008; Schwanenflugel et al., 2004). However, the present study did not find the adult-likeness of a child's intonation contour to have any significant predictive value for comprehension. These mixed results raise questions about this method of measuring prosody. However, the idea that skilled readers share similar prosodic profiles is supported by research examining prosody as a function of syntactic structure (Koriat et al., 2002). Limitations in using this variable might simply have arisen from the method in which intonation contour has been measured. Linguists suggest measuring not only pitch peaks but pitch troughs as well, and it is likely that better profile matching would occur if several F_0 measurements were taken at regular intervals throughout an utterance (including multiple measurements within words themselves) rather than simply at high and/or low points of the utterance or word (Hermes, 2006; Ladd, 1984; Wichmann, 1994). With greater precision in measuring intonation contours, more accurate generalizations might be made regarding the transition of children from emergent to mature oral readers.

Several useful results from the present study and from past research may be used to inform future research. First, with the apparent affect of text difficulty on prosody found in the present study, future studies should examine data from both syntactic-level processing measures and measures of macrostructure awareness (Klauda & Guthrie, 2008) at different levels of text complexity. Second, the role of text genre should be explored as well regarding the impact that prosody has on comprehension, with comprehension of some genres (e.g., narrative) relating to prosody more than others (e.g., technical/instructional). Third, fluency and prosody are closely related, but some prosodic variables might be more closely linked to fluency than others. Cowie et al. (2002) concluded that fluency involves basic skills which permit expressiveness. A closer look into the common features of fluency and prosody, and those features which differentiate the two, should be taken to better account for variance in reading skills assessments. Fourth, Ravid and Mashraki (2007) found that children did better with using appropriate pausing than intonation, supporting the belief that prosodic reading reflects online processing, more sensitive to structure than content (Koriat et al., 2002). Ravid and Mashraki (2007) concluded that social maturation might be affecting children's ability to understand and vocally interpret the relational factors at work in narratives. Because the present study found pausing also to be a more stable and salient indicator of comprehension in text, future research should examine 1) pause patterns from a larger sample of children than that studied by Koriat et al. (2002) to determine whether these patterns are informed by structure or meaning, and 2) the prosodic capabilities of children in interpreting relationships in text. Finally, future research should involve continued study into the prosodic implications of function words and the role they might play as a link between prosody and comprehension. Because they sound different base on their role in a sentence, these

multipurpose words might be able to provide educators with insight into how children are comprehending a particular text as they read orally (Weber, 2006).

After decades of research in the discipline of reading each new answer seems to present more questions, all leading to the more expansive questions of, “what makes one child’s reading development so different from another child in the same classroom?” and “what is the best method for teaching and assessing reading skills?” Every engineer knows that a single major structural flaw or environmental anomaly can cause the collapse of a building or a bridge. In education, however, isolating a single factor rarely—if ever—provides a satisfactory answer to a question regarding a child’s performance. Rather, research seems to continually point to the need to bring other disciplines into the mix. A child’s reading can be influenced by family dynamics, linguistic development, cognitive functioning, socio-economic status, cultural norms, and numerous other broad factors. Prosody, specifically, functions at the earliest stages of an infant’s perceptive language development and it is possible that since a child’s vocabulary development is largely a function of his or her SES, prosodic skill could be related along these lines as well. Future studies in reading education and educational psychology can continue to draw from these diverse sources of knowledge and experience.

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