THE ROLE OF COMPLEX PROSODY IN THE ORAL READING OF YOUNG CHILDREN

by

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(Under the Direction of Paula Schwanenflugel)

ABSTRACT

Prosodic, or expressive, reading is considered to be one of the essential features of the achievement of reading fluency. The purpose of this study was to determine the degree to which complex prosody varied as a function of reading skill and what role prosody might play in mediating individual differences in comprehension. Direct prosodic measurement was used and reading skill was determined through standardized assessments. Spectrographic analysis of 80 3rd graders and 29 adults' reading of a complex 3rd grade text was employed. Fundamental frequency (F_0) and pause duration measurements were made for each of the following grammatical structures: basic declarative sentences; basic quotatives; yes-no questions; complex adjectival phrases; and frontal movement phrases. Efficient readers had shorter and more adult-like pause structures. Structural equation modeling found evidence that decoding and oral reading abilities predict prosodic reading and comprehension skill, but failed to find an indirect effect of prosody for comprehension.

INDEX WORDS: Prosody, Comprehension, Oral reading, Fluency, Punctuation

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CHAPTER 1

INTRODUCTION

Over the past three decades our understanding of what constitutes fluent reading has expanded considerably. What once was characterized solely by fast and accurate word recognition has grown to include a number of component skills. Though differing definitions are available there is general agreement as to the elements of fluent reading. Fluent reading is often defined as reading text with speed, accuracy, and proper expression (National Reading Panel, 2000). Moreover, according to Rasinski (2004), reading fluency refers to the reader's ability to develop control over surface-level text processing, so that he or she can focus on understanding the deeper levels of meaning embedded in the text. Thus, fluency is not considered an end in itself, but rather a crucial pathway to comprehension. If fluency involves not only speed and accuracy, but also appropriate phrasing, intonation, and expression (prosodic features) to convey meaning and demonstrate understanding, then it seems evident that fluency ties together the sum total of skills necessary for comprehension (Prescott-Griffin & Witherell, 2004). But why exactly is the achievement of fluent reading important and what is the nature of the relationship between fluency and comprehension?

The development of fluent reading is a critical milestone in the early education of children, carrying far reaching implications for academic success. Given the relationship between fluency and comprehension explained above, it seems clear that children's academic performance is largely dependent upon their ability to become fluent readers. Children who do not develop fluency early on in the schooling process, by the second and third grades, are at an extreme disadvantage. As a result of being unprepared to meet the necessary skill demands, they

will likely experience difficulty learning important material from texts introduced in later grades (Chall, Jacobs, & Baldwin, 1990). For example, by the fourth grade school curriculum begins to shift and instructional emphasis in reading that was once based upon text information generally known to children is replaced by text information that is new. At this point, children are not only expected to learn independently from text, but face significant risk of educational underachievement or failure should they lack the required skills to do so (Chall, 1996b). In short, the need for effective fluency instruction in the early elementary grades is imperative given that fluent reading is vital for children to be able to read and learn from content area texts in the intermediate grades.

Despite general consensus regarding the primary components of fluent reading, the relationship between fluency and comprehension is somewhat contentious. Though there is a recognized correlation between developed expertise in fluent reading and comprehension skill, the nature of the relationship is not clearly understood. Given that the ultimate goal of reading is the construction of meaning (Anderson, Hiebert, Wilkinson, & Scott, 1985), it is important to assess fluency's role in comprehension. According to Kuhn and Stahl (2003), there are two primary theories regarding fluency's contribution to a reader's understanding of text, each of which emphasizes one of fluency's component parts. The first, and better known of the two theories, stresses the contribution of automaticity to fluent reading, whereas the second focuses on the role of prosody.

Reading Comprehension as Cognitive-Based Processing: Automaticity Theory

Reading is a complex performance, one that requires simultaneous execution of multiple interdependent tasks. Not only must a reader determine what words are present in text, but he or she must also make sense of them. In other words, a reader must derive meaning from what is

being read. According to LaBerge and Samuels (1974) this dual-task performance is an important indicator of whether lower-level processes have become automatic. Given that individuals have limited processing capacity, devoting cognitive resources to lower-order processes, such as decoding, leaves less resources available for higher-order non-automatic processes, such as comprehension. With the acquisition of automatic processes, performance is speeded, effortless, and autonomous (Logan, 1997). As a result, skilled readers are not only able to read with accuracy, but are able to achieve instantaneous, or automatic, word recognition without conscious awareness. This automaticity permits higher-order processes to take place. There is general agreement among researchers and educators that effective word recognition is necessary for reading comprehension (e.g., Stanovich, 2000). Research has consistently shown that accurate and automatic word readers are better comprehenders, as proficient readers rely on automated skills to conserve their attentional resources. Theory suggests that children who have developed automaticity rapidly process high-frequency words and decode new words quickly, allowing attention to be shifted to reading for meaning. Effortful decoding places greater demands on cognitive abilities. As a result, the reader expends more energy struggling to recognize words and has less attentional capacity available for comprehension. Stanovich (2000) suggests that for less skilled readers this creates a barrier to understanding. Because the reader must compensate for difficulty in word recognition, they may fail to connect one idea to another within the text. In order for children to comprehend text they need to recognize words automatically so that the effort involved in recognizing words does not draw attentional capacity away from resources needed for comprehension. In this way, the automaticity theory accounts for two of the components of fluent reading, accuracy and speed. Moreover, it

further offers an explanation for automaticity's role in reading comprehension. However, there is an important aspect of fluency that this theory does not attend to, that of prosody.

Reading Comprehension and the Contribution of Prosody

According to Schwanenflugel, Hamilton, Kuhn, Wisenbaker, and Stahl (2004), prosodic reading is widely considered to be a hallmark of the achievement of reading fluency. When a child is reading prosodically, their oral reading sounds much like speech, with appropriate phrasing, pause structures, stress, rise and fall patterns, and general expressiveness. However, the link between prosody and other aspects of the reading process is unclear. Though automatic decoding is recognized as an essential element of fluent reading, reading comprehension may involve other aspects of reading skill beyond automatic single word decoding. Both Perfetti's (1985) verbal efficiency theory and, in particular, LaBerge and Samuels' (1974) automaticity theory suggest that once words are processed fluently and automatically, resources become available for children to engage in the additional processing required for prosodic oral reading. However, Kuhn and Stahl (2003), argue that fluent reading consists of more than simply reading words quickly and accurately. When an individual reads fluently he or she is also reading with expression, incorporating a series of speech features in order to produce the tonal and rhythmic aspects of language (Dowhower, 1991). Kuhn and Stahl, (2003; see also National Reading Panel, 2000) suggest that prosodic, or expressive, rendering of text is needed in addition to automatic individual word decoding in order for children to adequately comprehend. They theorize that the development of reading prosody may assist comprehension because prosodic reading indicates that the child has segmented text according to major syntactic/semantic elements. Indeed, evidence suggests that comprehension is improved in children when they are provided with information about syntactic and semantic boundaries (Cromer, 1970; O'Shea & Sindelar, 1983).

Additionally, comprehension in older children may be related to skill in syntactic phrasing (Young & Bowers, 1995). Nevertheless, appropriate phrasing, intonation, and stress are all considered to be indicators of fluent reading. Moreover, the ability to group text into meaningful phrase units indicates that the reader has an understanding of what is being read.

According to Dowhower (1991), scholars have identified at least six distinct prosodic indicators related to expressive reading: (a) pausal intrusions; (b) length of phrases; (c) appropriateness of phrases; (d) phrase-final lengthening; (e) terminal intonation contours; and (f) stress. Taken together, these features are classified as suprasegmental because they extend over more than one speech sound and contribute to meaning. Appropriate use of such markers signifies a reader's ability to apply syntactic knowledge to text and further demonstrates the ability to produce the essential features of expressive oral language during reading, while preserving accuracy and speed. Given this understanding of what constitutes prosody, it is necessary to determine the role prosody plays in the development of fluency and the ways in which prosodic features contribute to the construction of meaning from a text.

Prosody may provide a link between fluency and comprehension. As Chafe (1988) suggested that, to read a sentence with intonation, one must assign syntactic roles to the words in the sentence. The assignment of syntactic roles is a key component of microprocessing, or the mental parsing of a text into hierarchically ordered propositions (Kintsch, 1998). Schreiber (1987) also suggested that the explicit presence of prosodic cues might be one crucial difference between speech and reading and one of the reasons that speech is easier to understand. Assuming that prosodic cues serve an important signaling function for children in their processing of spoken language, it follows that the absence of consistent corresponding cues in print may partially account for the difficulty many children have in acquiring fluent reading skills.

However, Schreiber (1987) reported that the evidence supporting a link between prosody and microprocessing is weak, with some studies finding links between the use of prosodic features and syntactic comprehension and others failing to find such an effect.

Steinhauer (2003) suggests that overt prosody in spoken language and both punctuation and implicit prosody during reading may have strong influence on sentence comprehension—indicating that this type of non-lexical information may guide syntactic parsing. Experiments were conducted examining the processing of commas in silent reading, primarily whether commas could be viewed as orthographic triggers for covert, or subvocal, prosodic phrasing. In these event-related brain potential studies, speech boundaries and commas reliably elicited a similar online brain response, termed the *Closure Positive Shift* (CPS). According to Steinhauer (2003), this finding supports a direct correspondence between punctuation and implicit prosody, pointing to a common mechanism that shows commas are likely to produce subvocal prosodic phrasing.

According to Chafe (1988), punctuation is intended to capture major aspects of prosodic intent but often fails to account for the full range of prosodic phenomena, as prosodic features are not well dictated by text punctuation. For example, grammar rules that govern the placement of commas between items in a series may dictate prosodic breaks, or pause structures, for sentences such as *He came, he saw, he conquered,* but not for sentences such as *He wanted the one with the red, white, and blue sprinkles*. Question marks also exhibit prosodic ambiguity, dictating a final pitch rise for the end of yes-no questions *(e.g., Did Susan go?),* but not usually for wh-questions, which typically result in a final pitch declination *(e.g. Where did Susan go?).* Moreover, spoken language consists of shorter intonation units (about 5 or 6 words) and usually contains more pauses than would be dictated by written punctuation. This is particularly so for

lengthy sentences that place greater demands on short-term memory. Consequently, oral readers will introduce their own prosodic boundaries that were not signaled by punctuation marks in text (Chafe, 1988). Since oral readers must abstract prosodic features to a great extent while reading aloud, one of the tasks children have in learning how to read aloud is to learn the limitations of punctuation as a cue to the underlying prosodic structure of the text.

One point to consider regarding reading prosody is that children may be learning to read prosodically at an age when their conception of prosodic features in spoken language is not fully developed. Bates (1976), for example, found that prosodic stress patterns are processed poorly by children as old as 8 years of age. For example, they may not understand differences in meaning between sentences such as *Beth is already **at** the party* and *Beth is **already** at the party.* Evidence demonstrating that even 9- and 10- year-olds are not quite at adult levels in understanding the function of some contextual prosodic features conclusively supports developmental considerations as well; showing that comprehension of sentence-level prosody is acquired relatively late (Cruttenden, 1974; 1985; see Cutler & Swinney, 1987). Consequently, it is possible that prosody is an irrelevant feature of fluent reading fundamentally unrelated to reading skill at this age.

Currently, the majority of available studies examining the development of oral reading prosody have used mainly indirect measures of prosodic reading such as descriptive rating scales. The reasons for this have mostly to do with the technical difficulty and time commitment associated with direct prosodic measurement. Thus, for practical reasons, fluency rating scales have often been used in lieu of direct measurements of prosody. The National Assessment of Educational Progress (NAEP), for example, used a 4-point oral reading fluency scale to categorize reading skill. The NAEP fluency scale made the following skill designations: (1)

"Reads 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." (2) "Reads primarily in two-word phrases with some three- or four-word groupings. Some word by word reading may be present. Word groupings may seem awkward and unrelated to larger context of sentence or passage." (3) "Reads primarily in three- or four-word phrase groups. Some smaller groupings may be present. However, the majority of phrasing seems appropriate and preserves the syntax of the author. Little or no expressive interpretation is present." (4) "Reads primarily in larger, meaningful phrase groups. Although some regressions, repetitions, and deviations from text may be present, 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."

Similarly, Allington (1983) used a 6-point scale that distinguished "word-by-word reading" (1) from reading that occurred with "phrases coinciding with punctuation, appropriate semantic and syntactic emphasis, and expression that approximated normal speech" (6). Zutell and Rasinski (1991) recommended using a multidimensional fluency scale, suggesting that separate ratings on three distinct aspects of reading (phrasing, smoothness, and pace) provides a more detailed evaluation of fluency than single dimension scales and is better able to capture the strengths and weaknesses of individual readers. Each dimension consists of a 4-point rating system that reads as follows:

a. Phrasing (1) "Monotonic with little sense of phrase boundaries; frequent word-by-word reading." (2) "Frequent two- and three-word phrases giving the impression of choppy reading; improper stress and intonation that fails to mark ends of sentences and run-ons." (3) "Mixture of run-ons, mid-sentence pauses for breath,

and possibly some choppiness; reasonable stress/intonation." (4) "Generally well-phrased, mostly in clause and sentence units, with adequate attention to expression."

b. Smoothness (1) "Frequent extended pauses, hesitations, false starts, sound outs, repetitions, and/or multiple attempts." (2) "Several "rough spots" in text where extended pauses, hesitations, etc., are more frequent and disruptive." (3) Occasional breaks in smoothness caused by difficulties with specific words and/or structures." (4) "Generally smooth reading with some breaks, but word and structure difficulties are resolved quickly, usually through self-correction."

c. Pace (1) "Slow and laborious." (2) "Moderately slow." (3) "Uneven mixture of fast and slow reading." (4) "Consistently conversational." Though these scales may be useful from a practical standpoint, particularly in providing a qualitative evaluation of reading fluency in general, and certain aspects of prosody in specific, they are not direct measurements of the prosodic aspects of reading and consequently offer little explanation or clarification regarding the relationships between decoding speed, accuracy, and prosody.

Research examining direct measurement of oral reading prosody is surprisingly sparse. The landmark study of reading prosody by Clay and Imlach (1971) used a rater to analyze pausing, pitch, and stress using oral reading recordings taken from a large sample of seven-year-old children. Children who made few and short pauses were found to be the best readers according to objective assessments of skill. In addition, the best readers completed declarative sentences with a fall in pitch. However, there were a number of issues that limit the utility of the Clay and Imlach (1971) study for establishing basic findings regarding the development of

reading prosody in the transition to fluent reading. First, because the technology needed to conduct prosodic analyses was not yet widely available, Clay and Imlach did not directly measure sound features, and, instead, relied on the impressions of a single rater. Second, neither reliability nor statistical analyses were conducted on the ratings of prosody performed. Consequently, it is unclear whether the changes noted were general across children and whether other issues, such as decoding problems, were of influence. Finally, a large percentage of the children Clay and Imlach studied had decoding error rates exceeding 30% and reading rates below 25 correct words per minute. This last point raises two separate issues: (1) many of the children in the sample might not even be characterized as readers transitioning to fluency, and (2) the level of decoding errors makes it difficult to distinguish decoding issues from prosodic ones.

Several studies have attempted to examine prosody directly through spectrographic analysis. For example, Herman (1985) used a voice-activated microprocessing computer component to electronically count the presence of speech pauses in the oral reading of eight remedial 4^{th} to 6^{th} grade children. The children were recorded reading passages of moderate difficulty, and the computer counted pauses exceeding 166 ms. The students total number of pauses made while reading the story were compared to the standard number of pauses for each story (defined by using punctuation marks that signal speech pauses in text). Herman found that the number of pausal intrusions (in this case, pauses not dictated by punctuation) within stories dropped considerably as a result of repeated reading until a rate of 85 correct words per minute was reached. Though punctuation is only a very rough indicator of where pauses are appropriate and the number of participants used in this study was quite small, findings nevertheless suggest

that students develop a sense of syntactic phrasing and note prosodic cues with greater reading fluency.

In perhaps the best study concerning the development of prosodic features in children's oral reading (Dowhower, 1987); the effect of repeated reading on oral reading prosody was examined in 2nd grade children. Subjects were 2nd grade children who met dual criteria of having adequate word decoding skills, but whose reading was characteristically slow and word-by-word in manner. Students' audiotaped oral reading samples were analyzed on a microprocessor-controlled machine to determine the duration of each word, the length of pauses between words, and the fundamental frequencies (F_0) for subject-final and sentence final words. The mean number of pausal intrusions was calculated (defined as inappropriate pauses that occur within words or syntactic units) along with the mean phrase length (the number of words between pauses). Intonation was determined by measuring the F_0 change (the difference between the peak and final F_0 for each word) with a fall in pitch defined as a decrease of more than 15 Hz from the peak to the final pitch. In addition, the percentage of instances in which students marked the sentence-final word with falling pitch was determined. Findings after repeated practice showed significant improvements in prosodic reading, mainly a reduction in the mean number of pausal intrusions (approximately 23% at pretest and 9% at posttest), increased sentence-final vowel lengthening (a prosodic feature marking the end of a major syntactic unit; Cooper & Paccia-Cooper, 1980), and a greater F_0 declination occurring at the last syllable of a declarative sentence.

Schwanenflugel et al. (2004) examined the role of reading prosody with respect to decoding and comprehension skills. From spectrographic analysis of digital oral reading recordings collected from a large sample of second and third grade readers, Schwanenflugel et al.

(2004) suggested that prosodic reading is an indicator of developing word reading automaticity, but that it added little to predicting comprehension skills beyond word reading alone. Investigation concerned the following five prosodic structures which have been implicated in the development of oral reading and/or prosody: (1) inter-sentential pause length means; (2) inter-sentential pause length variances; (3) intra-sentential pause length means; (4) adult-child F_0 sentence profile match (based upon adult comparison sample data); (5) the sentence-final F_0 declination. Skilled readers (as determined by objective word reading assessment) were found to make shorter pauses both within sentences and between them with minimal variability. Furthermore, good oral readers ended declarative sentences with discernable and relatively large pitch declinations, as noted in Clay and Imlach (1971) and Dowhower (1987). Skilled oral readers also matched adults in their overall prosodic contours, indicating the presence of a clear prosodic target to which children strive. Still, the models tested suggested that there is a relationship between decoding skills and prosodic reading, but that there is minimal relationship between prosodic reading and reading comprehension skills.

One possibility for the findings of Schwanenflugel et al. (2004) is that, although co-occurring, reading prosody is an epiphenomenon unrelated to other important aspects of reading such as reading comprehension. Karlin (1985), for example, analyzed pitch, stress, and pauses in a sample of 54 Black West Indian College Students and found no relationship between prosody and comprehension skill. As such, prosodic reading would seem to serve mainly as evidence that children have acquired automatic decoding skills. In fact, Schwanenflugel et al. did find a relationship between prosody and word decoding skills, but none between prosody and reading comprehension. However, another possibility for the findings of Schwanenflugel et al. is that their analysis was carried out on children's reading of a simple text and focused mainly on

declarative sentences which offered limited opportunity to observe prosodic reading. Simple passages may not encourage children to mark prosody in a way that relates to comprehension. The lack of challenging content, structure, and comprehension demands may account for the failure to find much of a relationship between reading prosody and comprehension.

The purpose of this study is to further examine the role of prosody in the overall reading process, with primary emphasis on the relationship between the prosodic reading of complex sentences and comprehension. The present research concerned both the development of prosodic reading as a function of reading skill and an understanding of how prosody may be related to decoding, fluency, and comprehension skill. Direct prosodic measurement was employed and reading skill was determined through use of standardized assessments.

As a follow-up to Schwanenflugel et al. (2004), this study directly addresses some of the limitations discussed in previous research. The current study focuses on the spectrographic analysis of the oral reading of a comparatively complex text rather than the simple text used in that study. The current study included a large sample of 3rd grade children rather than the mixture of children at second and third grade found in the Schwanenflugel et al. study. By using children at a single grade level, we avoided confounding individual differences with developmental change. Further, because it is unclear whether adults read complex sentences in similar ways prosodically, we asked a comparison group of adults to read the text. Most importantly, however, the text included redundant observations of a more complete set of grammatical features than were identified in previous research on prosody. Such features included: basic declaratives, basic quotatives, wh-questions, yes-no questions, complex adjectival phrases, and frontal movement phrases. These sentence types were included because they allow us to make direct observations of how and whether adults and children marked punctuation prosodically. For example, intuition

tells us that individuals might mark questions with a rising pitch, but Chafe (1988) indicated that this might be true for only some question types. Similarly, intuition might indicate that commas should be marked with pausing, but Chafe suggested that not all commas need be marked. Some, like frontal movement commas (where a phrase whose canonical place in the sentence is in the object position such as in *On top of the roof, he sat dejectedly*), might be marked while others such as complex adjective phrases (such as the *large, striped, yellow bus)* might not be. Finally, quotatives are another type of sentence which might seem to call on prosodic marking. Thus, for us to be able to examine the question of whether prosody is an indicator of good reading comprehension skills, it was important that we first discerned which syntactic features are marked prosodically and which are not. Once a set of reliably marked sentence types were identified, we could determine the degree to which children used these features prosodically as a function of reading fluency and what role that prosody might play in mediating individual differences in reading comprehension.

CHAPTER 2

METHOD

Participants

Participants were 80 third-grade children (33% male, 66% female; mean age = 9 years, 3 months; SD = 4 months; range = 8 years, 7 months – 10 years, 6 months) attending four public schools located in urban northeast Georgia. The children were part of a larger unpublished study of the development of reading fluency. Only those children who were native speakers of English and who were able to decode most of the words (>90%) in the targeted oral reading passage were included in the study. Another three children were excluded a priori because they did not read the passage at a 90% accuracy level. Approximately 59% of the children were African-American, 33% European-American, 5% Hispanic-American. Four percent were of unknown ethnicity. The children came from schools in which 79% of the students qualified for free and reduced lunch.

In addition, twenty-nine undergraduate students (15 male and 14 female; 21 European-American, 7 African-American, and 1 Asian-American) at the University of Georgia formed the adult comparison sample. Participants were recruited through the Research Participant Pool and received credit towards the completion of a course requirement for their involvement. Participation was restricted to native speakers of English. Another participant was removed a priori because of technical difficulties during recording.

Stimuli and Procedure

A passage was created which incorporated three observations of six targeted linguistic features which Chafe (1988) and Cooper and Paccia-Cooper (1980) suggested might require a distinct prosodic reading in adults:

(1) basic declarative sentences (may elicit pitch decline at the end of the sentence);

(2) basic quotatives (may elicit pause following quote);

(3) wh-questions (may not elicit upswing in pitch);

(4) yes-no questions (may elicit pitch rise);

(5) complex adjectival phrases (may not elicit pauses); and

(6) frontal movement comma phrases (may elicit pauses following phrase).

Three examples of each type of prosodic feature were included in the passage. F_0 and pause length measurements were made for each of three examples for each type of structure within the text. To ensure that children would be able to read the constructed passage, we aimed at creating a passage that would be decodable by most of the children with a targeted readability at, or slightly below, the children's current grade level. Readability analysis was carried out using the Flesch-Kincaid Grade Level formula from WordPerfect 10, the Spache Readability Index, and the Dale-Chall Readability Index. Readability was computed and averaged across indices, yielding an estimated grade level of 3.25. In addition, consideration was given to decodability, since decoding errors make the determination of reading prosody irrelevant and indicate a pre-prosodic stage of reading development. The passage is presented below (the numbers serve as an index to indicate its sentence type above, but were not included on the passage that the participants read):

Frog and Toad were [happy, playful, curious][5] animal friends. One [afternoon, near][6] a pond in the forest, Frog and Toad played together. They spotted a trail in the distance.

"Where do you think it goes?"[3] asked Frog.

"Let's find out,"[2] said Toad.

They started down the path.[1] They came upon a cabin with a [pretty, colorful, tidy][5] garden hidden behind a fence.

"Do you see anyone inside?"[4] asked Toad.

"No, I can't see anything," said Frog.

The house looked empty.

"Should we go over there and look?"[4] asked Frog.

"I don't know. How do we get in?"[3] asked Toad.

Frog and Toad wanted to look around.[1] Nobody [was home, but][6] it seemed that someone might live there.

"Let's wait to see if anyone comes home,"[2] said Toad.

"Good idea," replied Frog.

As [they waited, they][6] could hear the other animals at play. Then, a [tall, thin, and smiling][5] man came walking toward the house. Frog and Toad went to meet him. [1]

"What's your name?"[3] asked Frog.

"John," said the man. He could see them looking at his garden.

"Would you like to see my garden?"[4] asked John.

"We would like that very much,"[2] said Toad.

The man led Frog and Toad inside the garden fence.

The garden had many beautiful flowers.

The passage was presented to each participant on a laminated sheet of paper.

Oral reading recordings were collected using a Sound Devices USBPre 1.5 Microphone Interface, Dell Inspiron 5100 notebook computer, and a Sony ECM-717 Stereo Unidirectional Microphone. USBPre 1.5 is a complete, portable hardware interface for computer-based digital recording. A shareware version of GoldWave digital audio editor was used to create individual digital *.wav* files. Adult recordings were taken in a laboratory setting. Children's recordings were carried out in a quiet location in their school as part of their general assessment for this study.

Prosodic analysis of each recording of the oral reading passage was conducted using *Praat v*4.2.07. *Praat* is a comprehensive speech software package designed to analyze, synthesize, and manipulate digital speech data (Boersma & Weenink, 2004). *Praat* allows for basic measurement of F_0 contour and pause duration. Only pause lengths exceeding 100 ms were included because they could be reliably measured.

Adult Prosody Assessment. Prior to analyzing children's oral readings it was necessary to determine which sentence types were read similarly by adults. Basically, if there is a wide variation in how adults read a particular sentence type, then it is unclear that there is a target prosody towards which children are striving. Thus, the sample of adult readers was used to determine which prosodic variables to target for investigation. Determining whether a given sentence type was phrased in a similar prosodic manner occurred in two phases: (a) capturing the prosodic features from key prosodic segments for each targeted sentence for each adult; (b) determining whether the key prosodic segments were read similarly across adults for each sentence type.

In this initial phase, the basic declarative pause length (the mean pause length between sentences) was determined by isolating the target area on the spectrograph and visually creating a

spectral slice containing only the pause interval. Pause durations, measured in milliseconds (ms), were recorded and averaged across sentences. The targeted basic declarative sentence-final pauses included in the calculation are noted on the passage with the number "1."

Similar procedures were used to determine pause length measurements for declarative quotatives, wh-questions, and yes-no questions. However, because each of these was a quotative and carried a tag indicating the speaker (e.g. said Frog), measurements were made for the pre-tag pause (the pause interval between the sentence-final word within the quote and the beginning of the tag). As in the case of simple declarative pauses, pause lengths were determined by visually demarcating the spectrograph at the limits of the pause interval and noting the duration in milliseconds. Mean pre-tag pause lengths for each grammatical feature were obtained by averaging across sentences. The sentences used in calculating the means are indicated by the numbers "2" for declarative quotatives, "3" for wh-questions, and "4" for yes-no questions.

Pause lengths for sentence-internal commas were also measured through spectral slicing. For complex adjectival phrases (e.g. *Frog and Toad were happy, playful, curious animal friends.*) pause duration was measured for each comma in the series. Pauses were measured between *happy* and *playful,* and also between *playful* and *curious*. Frontal movement comma phrase pauses (e.g., *One afternoon, near a pond*…) were measured similarly, with the pause measurement occurring at the comma (between *afternoon* and *near*). Again, in both instances means were calculated by averaging across sentences. The sentences used in calculating the means for complex adjectival phrases and frontal movement comma phrases are indicated by the numbers "5" and "6" respectively.

The basic declarative sentence-final F_0 declination was measured in Hertz from the final pitch peak to the end of the sentence. This was viewed as preferable to simply measuring the fall

in pitch on just the final word in the sentence because that measure of declination often fails to describe the fall in pitch heard at the end of a sentence when the final word is one syllable long (e.g., The sentence, “They started down the path,” illustrates this issue. The F_0 structure is rather flat for “path” and the meaningful F_0 change is between “the” and “path.”) The F_0 declination was measured on the three basic declarative example sentences and the mean difference in F_0 was used as an index of sentence-final declination.

Similar F_0 measurements were made for declarative quotatives, wh-questions, and yes-no questions. In each case, measurements were made to examine the sentence-final F_0 change for the structure (pre-tag). However, where the structure ended with a rise in pitch, measurements were made from the preceding pitch valley to the final peak. Mean differences were calculated for each feature and were used as indices of F_0 change for each structure type.

For frontal movement comma phrases, F_0 was measured from the pitch peak to the declination preceding the comma (often occurring over two words, e.g. *they waited,*…but could occur over a single word if multisyllabic, e.g. *afternoon,*…). The mean F_0 declination was calculated and used as an index of frontal movement phrase declination. For complex adjectival phrases, F_0 change was measured for each word included in the phrase (e.g., *happy, playful, curious*). Single word measurement was conducted by measuring the F_0 from the natural break to the word end in multisyllabe words (e.g., *ha-ppy, play-ful, cur-ious*) or by following the F_0 contour in the case of single syllable words (e.g. *tall, thin*). Means were calculated for each word included in the phrase.

After the targeted segments were captured from each sentence type, we determined which segments were marked reliably. Histograms were created in order to graphically represent adult pause lengths and F_0 declination. Histograms allowed us to determine whether adults generally

paused, generally declined in pitch, or generally rose in pitch at important segments. Histograms for pause length and F_0 change can be seen in Appendices A and B, respectively.

A perusal of these histograms indicates some interesting patterns in adults' use of prosody. As can be seen in Appendix A, long pauses seemed to be relegated to the ends of basic declarative sentences only. All other pauses (in our case, all sentence-internal features) seemed to be quite short for these skilled adult readers. Appendix B shows that there was more variability among adults in how they marked key segments prosodically with changes in pitch. For commas, where no particular pitch patterns were anticipated, several emerged. Most adults marked internal commas (with the exception of frontal movement commas) with rises in pitch. Most adults marked basic declarative sentences with pitch declinations. However, for questions, pitch changes are an issue. Chafe (1988) noted that not all question types are marked with rises in pitch and we concur. Only yes-no questions were consistently marked with rises in pitch. A distinct segment of adults marked wh-questions with a declination while others marked them with a pitch rise. Because of this lack of consistency in pitch among adults with regards to wh-questions, we did not target this sentence type for children's oral reading analysis.

Child Prosody Assessment. Based on information gathered from the adult comparison data we chose to measure five prosodic structures in children's oral reading: (1) basic declarative sentences; (2) basic quotatives; (3) yes-no questions; (4) complex adjectival phrases; and (5) frontal movement comma phrases. For each feature we measured the F_0 contour and associated pause lengths. Equipment and procedures were identical to those discussed for the adult sample. The children were given the following directions: "I would like you to read a short story about friends playing together. Then I am going to ask you some questions about what you have read." Then, each child read the passage aloud. To ensure that children were reading the passage with

comprehension, a set of five comprehension questions was included at the end of the passage. All children in our sample were able to answer at least four questions correctly and no child needed to be eliminated because they could not comprehend the passage. A list of these questions is available in Appendix E.

Reading Assessments and Procedures

As previously noted, this study was part of a larger study on the development of reading fluency and thus the measures discussed here represented a smaller component of an extensive overall test battery. To guard against order effects, appropriate counterbalancing procedures for the order of assessments were used. Assessments were divided into two groups (with the reading prosody and oral reading fluency measures in one group and the decoding and comprehension assessments in the other) such that half the children received the reading prosody measure in the first half of the battery and half received it in the second half. Furthermore, the order of assessments was counterbalanced within the two groups.

Decoding speed assessment. To obtain an independent estimate of word reading speed, children were administered the Test of Word Reading Efficiency (TOWRE), Form B (Torgesen, Wagner, & Rashotte, 1999). The TOWRE contains two subtests. The Sight Word Efficiency (SWE) subtest assesses the number of real words correctly read from a list within 45 seconds, whereas the Phonemic Decoding Efficiency (PDE) subtest measures the number of pronounceable phonetically regular nonwords that can be accurately decoded within 45 seconds. Concurrent validity estimates reported in the test manual have a median of .91 in Grades 1 through 3. Alternate form reliabilities have a median score of .97 in Grades 1 through 3. The subtest standard scores were summed and converted to a Total Word Reading Efficiency Standard Score as directed by the test manual.

Oral reading fluency assessment. The Gray Oral Reading Tests-4th Edition (GORT-4), Form B was administered in order to obtain an independent estimate of oral reading fluency. Children were given a series of passages to read aloud and were scored on the rate and accuracy of their reading. Rate and Accuracy scores are combined to yield a Fluency score. The standard Fluency score was used as an index of oral reading ability. Wiederholt and Bryant (2001) report that the GORT has average internal consistency coefficients of between .87 and .98, with the majority over .90.

Reading comprehension assessment. The Reading Comprehension subtest of the Wechsler Individual Achievement Test (WIAT) was administered in order to obtain an independent measure of the children's reading comprehension skill. This subtest consists of printed passages of increasing complexity, each followed by an orally presented question. The child read each passage, listened to the question, and responded orally in his or her own words. The test was discontinued once the child missed 4 consecutive items. The test manual reports validity estimates with a median of .74 and reliability estimates of .91 in Grades 1 through 3 (WIAT, 1992). Raw scores, determined by the number of questions answered correctly, were converted to standard scores which were then used as an index of reading comprehension skill.

CHAPTER 3

RESULTS

Statistical analyses were carried out in multiple steps, each addressing one of the major goals of the present research. The first of such goals was to determine the degree to which the prosody of complex sentences varied as a function of reading skill. The second was to determine the role of complex prosody in reading skill by examining the relationship between complex prosody, reading fluency, and reading comprehension. I will describe each of these in turn.

Individual Differences in Reading Skill and Complex Sentence Prosody

To assess how the prosody of complex sentences differed as a function of reading skill, children were divided into skill group quartiles based on their TOWRE Total Word Reading Efficiency Standard Score and their standard GORT Fluency score (Skill designations were: Low, Low-Middle, High-Middle, and High). To ensure that decoding skill and oral reading fluency did not interact with ethnicity for any prosodic variable, a 4 Skill X 4 Ethnicity (African-American, European-American, Hispanic-American, Other) ANOVA was conducted with each of the prosodic features serving as the dependent variable. No statistically significant interactions were found from these analyses, indicating that children's prosodic reading was rather similar across skill level, regardless of ethnic background. Given this finding, and that one of the major purposes of this study was to characterize prosodic reading as a function of reading skill, we did not consider ethnicity in subsequent analyses.

To examine the relationship between reading skill and children's prosodic reading of pause structures, we conducted a series of One Way ANOVAs using skill level as the

independent variable and the mean basic declarative pause, basic quotative pause, yes-no question pause, complex adjectival phrase pause, and frontal movement comma phrase pause as the dependent variables. Children made shorter basic declarative pauses with increasing skill, F (3, 76) = 9.551, $p < .001$, partial eta^2 = .274. Follow-up Tukey tests revealed that the differences in basic declarative pause length came between Low skill readers and Low-Middle readers, $p < .05$ and also between Low skill and both High-Middle and High skill readers, $p < .001$. Readers also made shorter declarative quotative pauses as a function of increasing skill, F (3, 76) = 5.646, $p = .002$, partial eta^2 = .182. Follow-up Tukey tests revealed that the major changes occurred between Low skill readers and High-Middle readers, $p < .05$, and also between Low and High skill readers, $p < .01$. Shorter pause durations following yes-no question types were also characteristic of better readers, with duration decreasing with higher skill level F (3, 76) = 6.507, $p = .001$, partial eta^2 = .204. Tukey tests showed that the differences were found between Low skill and Low-Middle readers, $p < .05$, and also between Low skill and both High-Middle and High skill readers, $p < .01$. For complex adjectival phrase pauses we found that the presence of numerous decoding errors following the comma made measurement of the second comma pause unfeasible. Thus, we targeted only the pause following the first adjective (at the first comma). High skill readers made shorter pauses after the first adjective in the phrase compared to lower skill readers F (3, 74) = 11.464, $p < .001$, partial eta^2 = .317. Follow-up Tukey tests showed pause differences between Low and Low-Middle readers, $p < .05$, and between Low skill and both High-Middle and High skill readers, $p < .001$. There was also a difference between Low-Middle readers and High skill readers, $p < .05$. Finally, frontal movement comma pauses were shorter for High skill readers as well, F (3, 76) = 4.321, $p = .007$, partial eta^2 = .146. Follow-up Tukey tests showed major differences between Low skill and High-Middle readers, $p < .05$, and

also between Low and High skill readers, $p < .01$. Overall, we found that High skill readers made fewer and shorter pauses during text reading.

Chafe (1988) suggested that skilled readers may not feel "driven" to mark every comma with a pause. By analyzing the percentage of internal comma structure pauses marked by each skill group, we were able to determine that High skill readers were less obligated to mark each comma prosodically compared to Low skill readers. On average, High skill readers marked 50% of complex adjectival phrase commas compared to 85% of Low skill readers. Similarly, High skill readers paused at 43% of frontal movement commas compared to 67% for Low skill readers. These figures can be seen in Table 3. Generally, pause differences are most prominent at the extremes between Low skill and High skill readers. High-Middle and High skill readers tend to mark pause structures similarly.

In addition, a separate set of ANOVAs was conducted to examine skill differences for the F_0 changes associated with each prosodic feature. Analyses indicated that the expressive oral reading of complex prosody as measured by pitch contour did not differ with respect to reading skill level. Although the children in our study generally marked declarative sentences with falling pitch, we did not find that children's reading of basic declarative pitch declination differed statistically with respect to reading skill, F (3, 76) = 2.356, p = .078, partial eta^2 = .085. Pitch differences in the treatment of basic quotatives were not found, F (3, 76) = .638, p = .593, partial eta^2 = .025, as children, across skill groups, tended to read this structure with a generally flat prosodic contour. Frontal movement phrase structures appeared to be read with a declination in pitch; however, there was no statistically significant skill-related pattern for the F_0 change associated with frontal movement phrases, F (3, 76) = .875, p = .455, partial eta^2 = .033. In addition, we did not find that the treatment of complex adjectival phrase F_0 change differed with

respect to reading skill, F (3, 76) = .893, p = .449, partial eta^2 = .034. However, we found a statistically significant difference in yes-no question pitch rise with increased reading skill, F (3, 76) = 4.205, p = .008, partial eta^2 = .142. Follow-up Tukey tests revealed that the differences were found between High skill and both Low and Low-Middle readers, $p > .05$. There was some evidence of emerging skill differences as revealed by significant findings for yes-no question F_0 change and the near significant basic declarative pitch declination.

The Role of Complex Prosody in Reading Skill

The second goal of the present research was to examine the relationship between reading skill (defined by decoding speed skill and oral reading fluency), prosody, and reading comprehension. Schwanenflugel et al. (2004) found that, once decoding skills were accounted for, the prosody of simple sentences was not a significant predictor of reading comprehension skill. However, in that study, decoding skill was a significant predictor of prosody, suggesting that children who had quick and accurate word decoding skills tended to read prosodically. In the present study, we attempted to assess whether the model supported by Schwanenfugel et al. could be extended to the prosodic reading of more complex sentence types than that focused on in that study. As noted earlier, it might be argued that prosody is primarily for comprehension when the prosody is reflective of the processing of complex syntactic structures. To that end, structural equation modeling was carried out using Mplus Version 3.11 (Muthen & Muthen, 2004). Because reading fluency is generally deemed to consist of quick, accurate word decoding, and good reading of connected text, the Sight Word Efficiency and Phonemic Decoding Efficiency age-based standard scores from the TOWRE and GORT Fluency standard score (a measure of oral reading ability) served as indicators of a latent variable which we called *Oral Reading Fluency*. Because only pause lengths discriminated between skilled and less skilled

readers in our earlier analyses, with the exception of only yes-no question pitch rise, only pauses were considered relevant indicators of skill-related complex prosody. Thus, mean sentence-final declarative sentence pause length, sentence-final declarative quotative pause length, yes-no question pause length, complex adjective pause length, and frontal movement pause length served as indicators of a latent variable which we called *Prosody*. We used children's age-based standard scores on the WIAT reading comprehension subtest to serve as the indicator of children's reading comprehension skill. To test the prediction that reading prosody is one outcome of fluent reading, Oral Reading Fluency served as a direct predictor of Prosody. To reflect the belief that skilled comprehension is another outcome of reading fluency, Oral Reading Fluency was used as a direct predictor of WIAT-Reading Comprehension. Finally, to test the view that prosodic reading has emergent features that enable better reading comprehension beyond those accounted for by fluent reading, we assessed the indirect path between Prosody and WIAT-Reading Comprehension.

A picture of the resulting model can be found in Figure 1, with statistically significant paths represented with solid lines and statistically nonsignificant paths represented by dashed lines. Although not all the indices indicated that the model was well-fitting, most of the fit indices did indicate that the model was well-fitting, $X^2(25) = 43.522$, $p = .0123$; RMSEA = .096; CFI = .942; Tucker-Lewis = .916. Path weights and standard errors are shown in Table 4.

The model shows that children with better oral reading fluency were more likely to read prosodically. That is, efficient readers had shorter and more adult-like pause structures. In fact, the model accounted for 46.2 % of the variance in reading prosody. Furthermore, they were also more likely to have better comprehension skills. The model accounted for 39.7 % of the variance in reading comprehension skills. However, it seems as though there are no significant emergent

benefits (indirect effects) of prosody for skilled reading comprehension. These findings replicate the findings of Schwanenflugel et al. (2004).

CHAPTER 4

DISCUSSION

The results of this study demonstrate the importance of oral reading fluency as a contributor to prosodic reading. Through examination of several prosodic structures, we found that as children develop more skilled word decoding and oral reading abilities they made fewer and shorter pauses. Such treatment of pause structures occurred both within sentences at comma markings and before quotative tags, resulting in reading that had a smooth and fluid quality. In most respects, their pausing looked like that of skilled adult readers. In contrast, young readers with emerging decoding and oral reading fluency read with lengthy and often inappropriate pausing both within and between sentences. Internal comma pauses were marked with considerable duration and disrupted the flow of the sentence. Each and every comma was marked with a distinct pause. This is something that both adults and more fluent readers did not do. Similarly, basic declarative sentence pauses were unusually long for less fluent readers as well. This resulted in a rendering of text which sounded choppy and seemed to preserve proper syntax at times.

Our characterization of prosody looking specifically at F_0 changes in children's reading of grammatical structures did not provide any clear indication of expressive differences related to reading fluency with the exception of yes-no questions. Although comparison of means and graphical trends show differences in expressive treatment as measured by F_0, particularly for yes-no question pitch rise, for the most part pitch changes did not seem an important indicator of skill. However, there was more variability among adults with this prosodic feature also. This

suggests that, for complex sentences, there are considerable idiosyncratic differences among adults and children regarding how they render pitch for different sentence types.

The findings presented here show some general similarities to those discussed in previous studies. For example, like Clay and Imlach (1971) and Schwanenflugel et al. (2004), we found that good readers made short pauses. These short pauses occurred both within sentences (at internal commas) and between sentences of different type, including basic declaratives, basic quotatives, and yes-no questions. Moreover, Clay and Imlach, Dowhower (1987), and Schwanenflugel et al. found that skilled readers ended declarative sentences with a marked declination in pitch. Overall, we found that children in our study generally ended declarative sentences with a declination in pitch; however, there were no statistically significant differences as a function of reading skill.

We selected features which Chafe (1988) and Cooper and Paccia-Cooper (1980) suggested might require a distinct prosodic reading in adults and through investigation we were able to determine a target prosody for how skilled adult readers treat these features. In agreement with previous studies, we found that basic declarative sentences are reliably marked with a pitch decline. Though it was suggested that basic quotatives require a pause following a quote (Cooper and Paccia-Cooper, 1980), adult readers apparently do not pause following a basic quotative. According to Chafe (1988), wh-question types do not require an upswing in pitch; however, we found that proper treatment of this structure by adults is rather ambiguous with many adults showing a moderate to large pitch rise. On the other hand, as found by Chafe, adult readers do mark yes-no question types with an upswing in pitch. Chafe suggested differentiated reading of internal comma structures, specifying that pauses are not marked at commas in a series (e.g.,

happy, playful, curious), but may be marked in frontal movement phrases (e.g., *One afternoon, near a pond.…*). We found that adult readers did not pause at either structure.

The present research addressed some of the limitations of previous studies. We constructed a passage that expanded the complexity of observable structures to include a variety of grammatical features relevant to oral reading and/or speech prosody. The passage was designed to be both decodable for children at this age and engaging. In addition, direct prosodic measurements were made over a large sample of children at the same grade level, avoiding the issue of confounding individual differences with developmental change. Finally, because we systematically examined a number of grammatical features we are able to add some important observations regarding reading prosody to the literature.

The second major goal of this study was to determine the role of prosody in view of the total reading process, with emphasis on the relationship between prosodic reading and comprehension. To that end, we conducted structural equation modeling to further our understanding of how these processes might be related to each other. Our findings suggested that once children automatize low-level processes, resources become available for both prosodic reading and reading for meaning. This hypothesis was based on previous research by LaBerge and Samuels (1974) and Perfetti (1985) which suggested that once children are able to process words fluently and automatically, resources are then available for prosodic reading. Furthermore, we assumed that if some of these available resources were transferred to prosodic reading, then prosody may have a mediating role for increased comprehension. This view was based on previous research that suggested prosodic reading may provide important syntactic and semantic information to the reader which may ultimately assist comprehension (Cromer, 1970; O'Shea and Sindelar, 1983).

From this, it is apparent that our model is guided by two separate hypotheses. First, once children develop the ability to read quickly, accurately, and fluently, resources become available for prosodic reading. This part of our model showed strong support, as we found that fluent word decoding and oral reading ability were related to short and more adult-like pause structures. This relationship can be seen in Figure 1.

The second hypothesis was that prosody may provide a reader with necessary information so that prosody alone contributes something to comprehension beyond that of fluent reading. This hypothesis was not supported. We found no indirect effect of prosodic reading for enhanced comprehension. As such, it appears as if there is no emergent benefit of prosody, but that decoding ability and oral reading fluency predict prosodic reading and comprehension skill.

The lack of support for prosody's contribution to comprehension, however, is not to say that it is an unimportant aspect of the reading process. Rather, it simply indicates that the nature of prosody's role in reading remains unclear. At this point, findings from both the Schwanenflugel et al. study and the current study suggest that prosody does not serve an independent function for increased comprehension skill, but that prosody does seem to signal that children have acquired automaticity and reading fluency. Our inability to uncover the role of prosody in reading development may be due to a number of factors.

Two main possibilities exist as reasons for our failure to find a relationship between prosody and comprehension. First, it is possible that the passage we created may be flawed in the sense that we did not create suitable examples for the prosodic structures under investigation. Given that this was largely an experimental measure, it is possible that we overlooked some important structural elements. Our data, however, does not support this conclusion. Considering that we were able to show large differences in the treatment of pause structures as a function of

reading skill, differences that were unrelated to decoding errors, it seems that the passage we used was successful in eliciting prosodic text reading.

Second, we considered the possibility that our outcome measure of reading comprehension, the WIAT-Reading Comprehension subtest, may have been poorly suited in helping us find a relationship between prosody and comprehension. This measure was selected because its design was based upon a broad definition that captured many elements of reading comprehension and because of its sound psychometric properties. Given that we failed to find even a modest relationship between prosodic reading and comprehension, it seems unlikely that another measure would have resulted in significant findings.

As a cautionary note, these findings should not be used to suggest that prosodic, or expressive, reading should no longer receive instructional emphasis in the classroom. Such action would be premature, especially considering the lack of research available in the area of reading prosody and the observation that highly skilled readers do display appropriately prosodic reading. On the other hand, it does suggest that an overemphasis on prosodic reading is unwarranted as well once children display quick and accurate rendering of text. Even in the absence of finding a direct benefit of prosodic reading for reading comprehension, the current findings do support the idea that prosody can serve as an indicator that children have mastered fluent oral reading and as a result may help teachers gauge reading progress. Once children have attained fluent, prosodic reading, it seems reasonable that they can move to either more difficult text or that they can focus on other topics such as reading comprehension.

In sum, the current study supports the view that once children are able to read text quickly and accurately, they are able to use freed up resources to read text expressively. On the

other hand, the current study finds no support for the hypothesis that this prosodic rendering of text assists in reading comprehension beyond that accounted for by oral reading fluency alone.

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APPENDIX A

Histograms Depicting the Pattern of Adult Pause Durations for Each Prosodic Feature

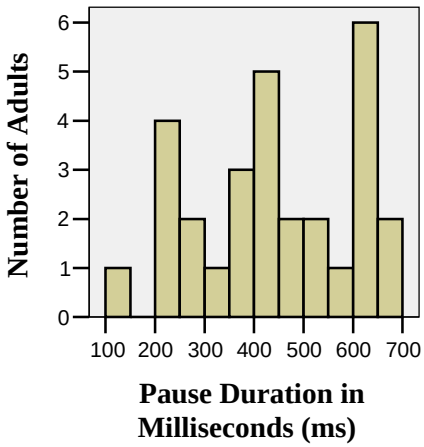


Figure A1. Basic Declarative

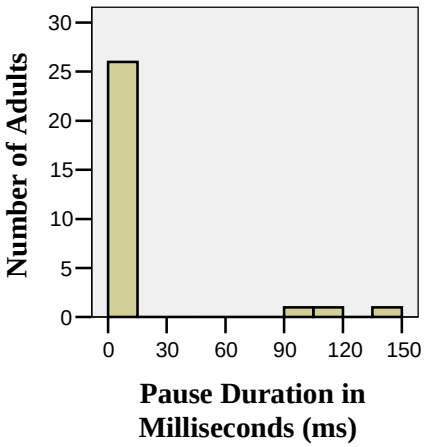


Figure A2. Declarative Quotative

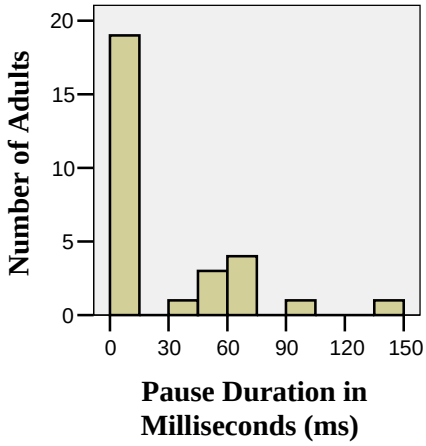


Figure A3. Wh-Question

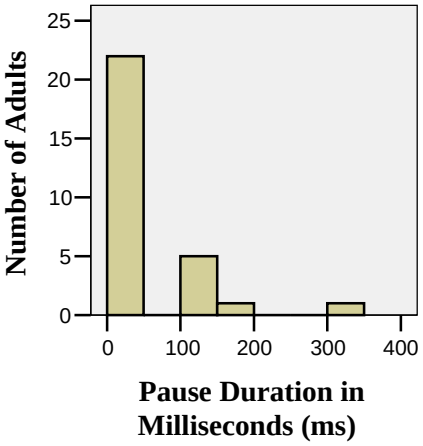


Figure A4. Yes-No Question

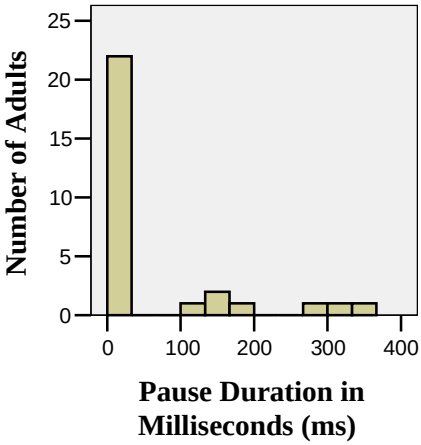


Figure A5. Complex Adjectival Phrase

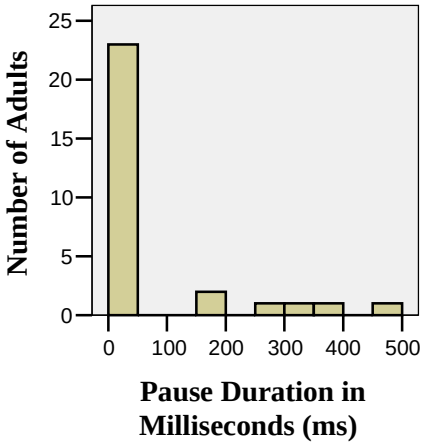


Figure A6. Frontal Movement Phrase

APPENDIX B

Histograms Depicting the Pattern of Adult F_0 Changes for Each Prosodic Feature

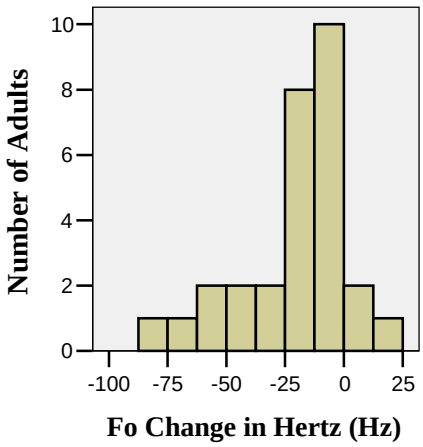


Figure B1. Basic Declarative

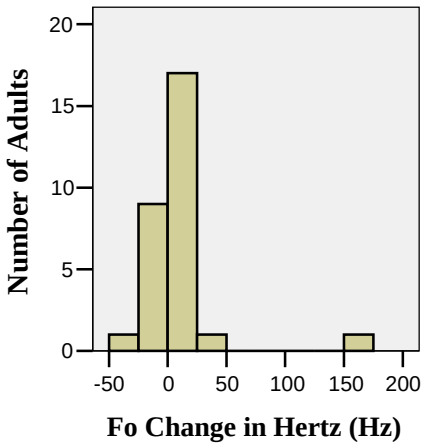


Figure B2. Declarative Quotative

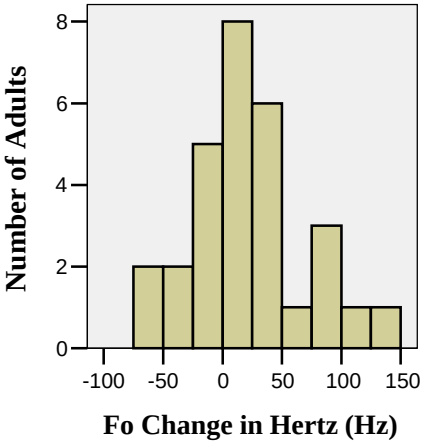


Figure B3. Wh-Question

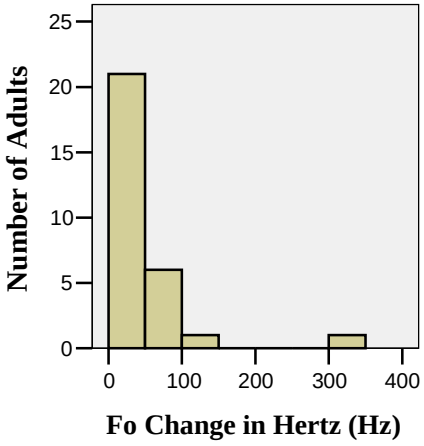


Figure B4. Yes-No Question

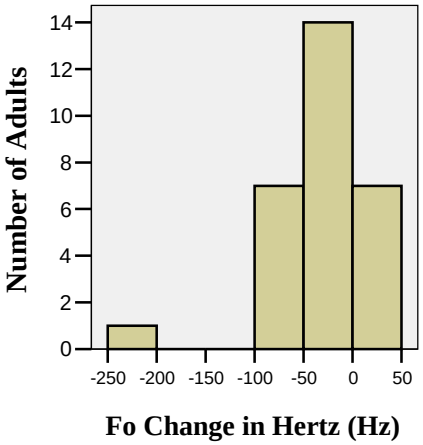


Figure B5. Complex Adjectival Phrase

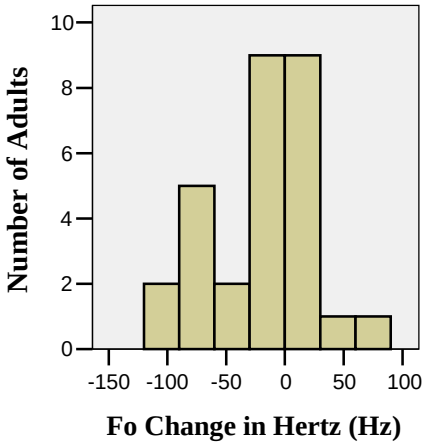


Figure B6. Frontal Movement Phrase

APPENDIX C

Children's Mean Pause Lengths as a Function of Reading Skill Level for Each Prosodic Feature

Figure C1. Basic Declarative

Figure C2. Declarative Quotative

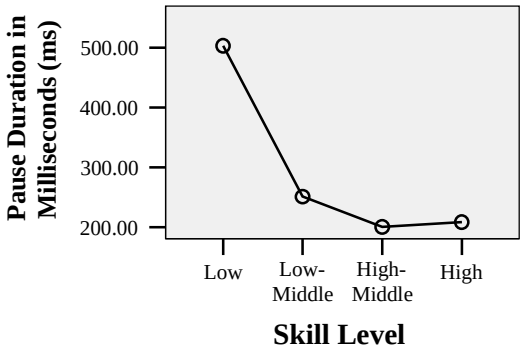


Figure C3. Yes-No Question

Figure C4. Complex Adjectival Phrase

Figure C5. Frontal Movement Phrase

APPENDIX D

Children's Mean F_0 Change as a Function of Reading Skill Level for Each Prosodic Feature

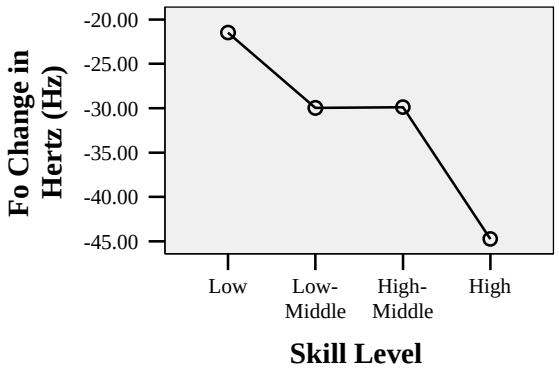


Figure D1. Basic Declarative

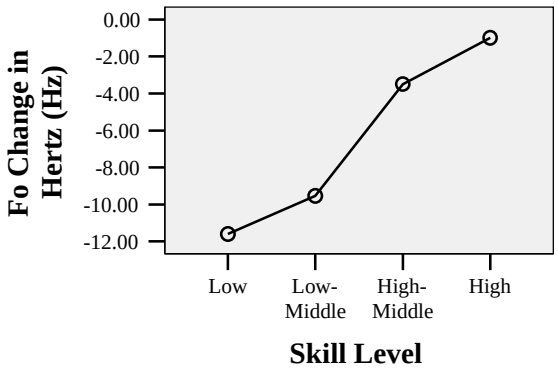


Figure D2. Declarative Quotative

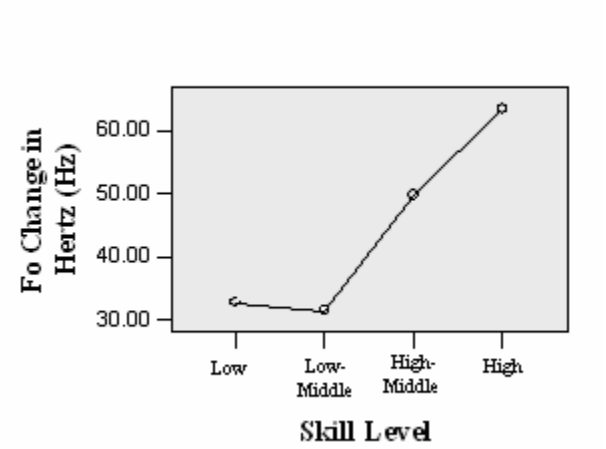


Figure D3. Yes-No Question

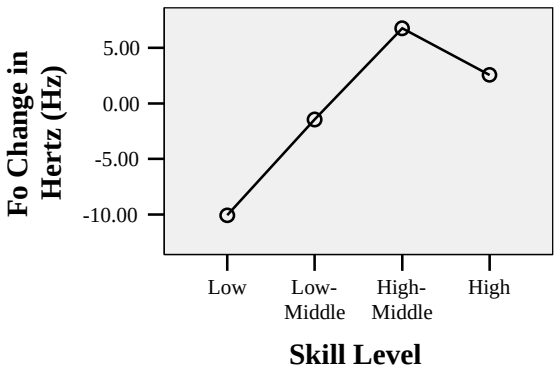


Figure D4. Complex Adjectival Phrase

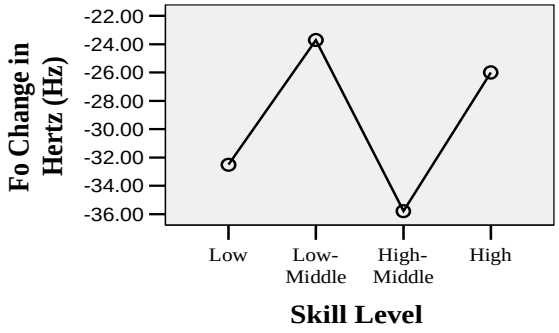


Figure D5. Frontal Movement Phrase

APPENDIX E

Comprehension Questions for Reading Prosody Passage

1. What were Frog and Toad doing in the story?
    A. Sleeping
    B. Playing
    C. Fighting
    D. Swimming

2. Where did the trail lead?
    A. A pond
    B. Tall trees
    C. A cabin
    D. Some rocks

3. Who lived in the house?
    A. Frog
    B. Toad
    C. A short man named Jim
    D. A tall man named John

4. How do you think the man felt at the end of the story?
    A. Happy
    B. Sad
    C. Angry
    D. Tired

5. Why do you think Frog and Toad wanted to see who lived in the house?
    A. They wanted to play in the forest
    B. They wanted to look at the garden
    C. They wanted to eat lunch
    D. They wanted to take a nap

Table 1

Descriptive Statistics for Adult Prosody Variables

Prosody Variables	N	Min.	Max.	Mean (SD)
Basic Declarative Pause (ms)	29	145	685	446 (162)
Basic Declarative F_0 Change	29	-83	20	-19.80 (23.33)
Declarative Quotative Pause (ms)	29	0	141	12 (37)
Declarative Quotative F_0 Change	29	-47	166	7.48 (34.76)
Wh-Question Pause (ms)	29	0	145	24 (38)
Wh-Question F_0 Change	29	-65	132	21.58 (49.75)
Yes-No Question Pause (ms)	29	0	319	40 (80)
Yes-No Question F_0 Change	29	6	309	47.98 (56.77)
Complex Adjectival Pause (ms)	29	0	337	53 (105)
Complex Adjectival F_0 Change	29	-229	48	-23.37 (52.68)
Frontal Movement Pause (ms)	29	0	454	59 (128)
Frontal Movement F_0 Change	29	-101	84	-19.30 (42.18)

Table 2

Means (and Standard Deviations) for Reading Assessments and Prosody Variables

	Decoding Skill Group			
Variable	Low	Low-Middle	High-Middle	High
TOWRE				
Sight Word Efficiency				
Raw Score	47.25 (6.19)	55.50 (6.23)	62.10 (4.70)	71.00 (6.91)
Standard Score	89 (6)	97 (5)	106 (7)	115 (9)
Phonemic Decoding				
Raw Score	14.75 (6.53)	20.80 (6.13)	27.80 (6.74)	39.80 (6.77)
Standard Score	86 (7)	93 (5)	101 (7)	114 (9)
TOWRE Total Standard Score	86 (11)	94 (8)	104 (9)	118 (15)
N	20	20	20	20
GORT Oral Reading Fluency				
Fluency Standard Score	5.75 (1.65)	8.40 (1.23)	10.35 (.93)	13.45 (2.16)
N	20	20	20	20
WIAT Reading Comprehension				
Raw Score	16.80 (3.55)	18.40 (3.35)	20.70 (4.19)	22.35 (4.25)
Standard Score	94 (8)	98 (8)	105 (11)	108 (13)
N	20	20	20	20
Prosody Variables				
Basic Declarative Pause (ms)	921 (532)	621 (285)	455 (242)	397 (200)
Basic Declarative F_0 Change	-21.48 (17.20)	-29.97 (19.88)	-29.88 (21.96)	-44.73 (44.72)
Declarative Quotative Pause (ms)	468 (411)	353 (332)	210 (175)	126 (123)
Declarative Quotative F_0 Change	-11.60 (18.37)	-9.54 (14.05)	-3.49 (38.03)	-1.00 (33.75)
Yes-No Question Pause (ms)	503 (398)	251 (181)	200 (181)	208 (169)
Yes-No Question F_0 Change	32.78 (18.99)	31.51 (26.39)	49.77 (33.87)	63.38 (46.60)
Complex Adjectival Pause (ms)	614 (386)	356 (341)	216 (196)	116 (100)
Complex Adjectival F_0 Change	-10.09 (49.98)	-1.45 (22.45)	6.77 (26.56)	2.57 (30.34)
Frontal Movement Pause (ms)	463 (440)	308 (206)	231 (191)	171 (147)
Frontal Movement F_0 Change	-32.52 (28.57)	-23.70 (18.35)	-35.79 (24.64)	-25.99 (33.50)

Table 3

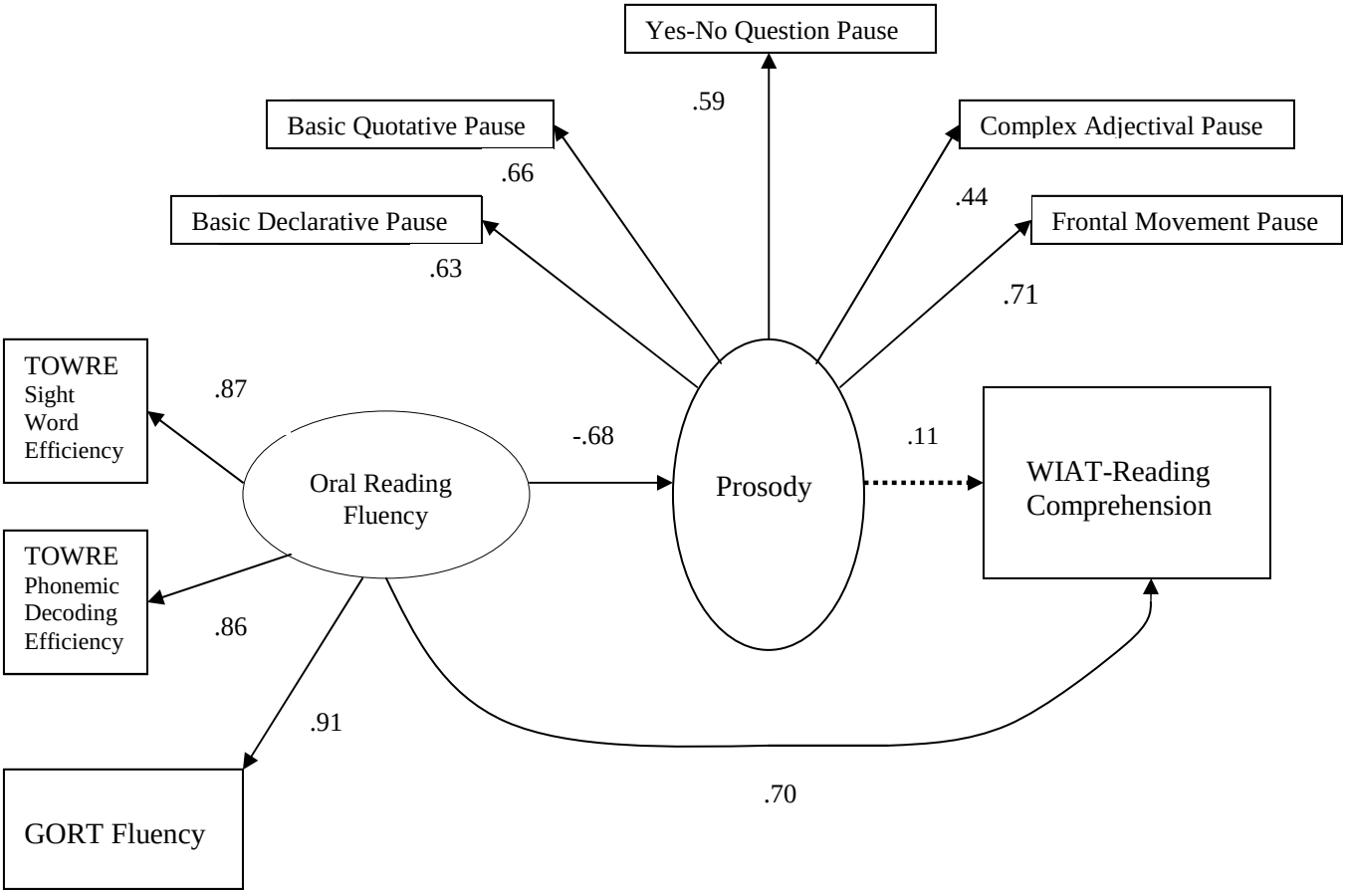
Percentage of Internal Comma Structure Pauses Marked by Skill Group

Skill Group	Complex Adjectival Phrase	Frontal Movement Phrase
Low	85	67
Low-Middle	63	48
High-Middle	45	43
High	50	43

Table 4

Model Results

Path	Estimates	S.E.	Est./S.E.	Std	StdYX
Fluency by					
Sight Word Efficiency	1.000	0.000	0.000	10.170	0.873
Phonemic Decoding	1.081	0.106	10.181	10.989	0.860
GORT Fluency	0.286	0.026	11.167	2.912	0.911
Prosody by					
Basic Declarative Pause	1.699	0.516	3.291	245.080	0.629
Basic Quotative Pause	1.407	0.420	3.355	203.033	0.661
Yes-No Question Pause	1.116	0.350	3.193	161.024	0.587
Complex Adjectival Pause	1.000	0.000	0.000	144.260	0.443
Frontal Movement Pause	1.410	0.410	3.440	203.375	0.711
Prosody On					
Oral Reading Fluency	-9.646	2.913	-3.311	-0.680	-0.680
Reading Comprehension On					
Oral Reading Fluency	0.779	0.172	4.519	7.922	0.698
Prosody	0.008	0.013	0.659	1.210	0.107



$X^2(25) = 43.522$, $p = .0123$
RMSEA = .096; CFI = .942;
Tucker-Lewis = .916

Figure 1. The Role of Prosody in Mediating Individual Differences in Comprehension