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Prosody of Syntactically Complex Sentences in the Oral Reading of Young Children

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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 (a) the degree to which the prosody of syntactically complex sentences varied as a function of reading speed and accuracy and (b) the role that reading prosody might play in mediating individual differences in comprehension.

Spectrographic analysis of 80 third graders' and 29 adults' reading of a syntactically complex text was carried out. Oral reading skill was measured through standardized assessments. Pitch changes (changes in fundamental frequency) and pause duration were measured for sentence-final words of basic declarative sentences, basic declarative quotatives, *wh* questions, and yes–no questions; words preceding commas in complex adjectival phrases; and words preceding phrase-final commas.

Children who had quick and accurate oral reading had shorter and more adultlike pause structures, larger pitch declinations at the end of basic declarative sentences, and larger pitch rises at the end of yes–no questions. Furthermore, children who showed larger basic declarative sentence declinations and larger pitch rises following yes–no questions tended to demonstrate greater reading comprehension skills.

Keywords

prosody; comprehension; oral reading; fluency; punctuation

Over the past 3 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. Although differing definitions are available, there is general agreement as to the elements of fluent reading. Fluent reading is typically defined as reading text with speed, accuracy, and proper expression (National Reading Panel, 2000). Moreover, Rasinski (2004) referred to reading fluency as 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 is seen as a crucial bridge to comprehension (Fuchs, Fuchs, Hosp, & Jenkins, 2001; Prescott-Griffin & Witherell, 2004).

Although most would concur that the definition of fluent reading should include expressiveness as well as quick and accurate reading, expressiveness is rarely defined. Dowhower (1991) described the expressiveness aspect of fluency as synonymous with prosody (a term that refers to appropriate phrasing, pause structures, stress, and rise and fall patterns) and emphasized the syntactically linked nature of prosody. Cowie, Douglas-Cowie, and Wichmann (2002), however, made a distinction among prosody, fluency, and expressiveness. In their research,

only certain aspects of prosody were relevant to ratings of expressiveness, whereas others were relevant to ratings of fluency. One fluency rating system, by Allington (1983; see also Young & Bowers, 1995), added the idea of dramatic reading to the definition of fluent and expressive reading by defining a fluent reader as one who reads “in phrases, with fluency, using both terminal and internal punctuation, providing appropriate semantic and syntactic emphasis for the purposes of dramatization” as well as “expression approximating normal speech” (Young & Bowers, p. 435). Intuitively, it seems that the use of syntactically appropriate prosody may occur in the absence of a dramatic reading. The view we take in the current study is similar to that proposed by Dowhower, and we focus on the grammatical features of expressive reading.

The development of fluent reading has far-reaching implications for academic success. In the process of learning to read, children move from relying on slow, algorithmic, letter-by-letter (or unit-by-unit) processing to quickly rendering text (Logan, 1997). There is a recognized correlation between fluent reading and comprehension skill, although the nature of the relation is not clearly understood. However, because of the relation between fluency and comprehension, children's long-term academic performance is partly dependent on their ability to become fluent readers. According to Kuhn and Stahl (2003), there are two primary theories regarding fluency's contribution to comprehension, 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 the text, but he or she must also derive meaning from what is being read. According to LaBerge and Samuels (1974), this dual-task performance is an important indicator that lower level processes have become automatic. Given that individuals have limited processing capacity, devoting cognitive resources to lower order processes, such as decoding, leaves fewer resources available for higher order, non-automatic processes, such as comprehension. When less skilled readers are focused on decoding issues, they may not draw the appropriate connections with prior knowledge and inferences needed for understanding. Evidence for this theory is speed- and accuracy-linked improvement in higher level aspects of reading, such as comprehension (Gough, 1996; Nicholson, 1999; Perfetti & Hogaboam, 1975; Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004). However, this theory does not attend directly to the role of prosody as a contributor to comprehension.

Reading Comprehension and the Contribution of Prosody

According to Schwanenflugel et al. (2004), Kuhn and Stahl (2003), and Dowhower (1991), prosodic reading is widely considered to be a hallmark of the achievement of reading fluency. However, the link between prosody and other aspects of the reading process is unclear. Both Perfetti's (1985) verbal efficiency theory and, in particular, LaBerge and Samuels's (1974) automaticity theory suggest that once words are processed fluently and automatically, resources become available for children to engage in text-level aspects of reading. Presumably, this may include prosodic oral reading. Kuhn and Stahl (2003; see also National Reading Panel, 2000) argued that prosodic rendering of text is needed in addition to automatic individual word decoding for children to adequately comprehend. These authors theorized that the development of reading prosody may assist comprehension because prosodic reading indicates that the child has segmented text according to major syntactic and semantic elements. Indeed, evidence suggests that comprehension is improved when children 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). Prosody may provide the linguistic bracketing regarding key syntactic and semantic boundaries.

According to Dowhower (1991), scholars have identified at least six distinct speech indicators related to prosodic reading: (a) pausal intrusions, (b) length of phrases, (c) appropriateness of phrases, (d) phrase-final lengthening, (e) terminal intonation contours, and (f) stress. These features are classified as suprasegmental because they extend over more than one speech sound and contribute to meaning. Appropriate use of such markers signals a reader's ability to apply syntactic knowledge to text during reading while preserving accuracy and speed.

Prosody may provide an important linguistic link between fluency and comprehension. As Chafe (1988) suggested, 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) suggested that the explicit presence of prosodic cues might be one crucial difference between speech and reading and is 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 (Morgan, 1996), it follows that the absence of such cues in print may partially account for the difficulty many children have in parsing written text. However, Schreiber reported that evidence supporting a link between prosody and syntactic processing is weak, with some studies finding links between the use of prosodic features and syntactic comprehension and others failing to find such an effect.

Punctuation may serve as the visual cue to syntax-related prosody. Recently, Steinhauer (2003) suggested that overt prosody in spoken language and implicit prosody cued by punctuation during reading may have strong influences on sentence comprehension by guiding syntactic parsing. Steinhauer conducted experiments examining the processing of commas in silent reading to determine primarily whether commas served 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*. According to Steinhauer, this finding supports a direct correspondence between punctuation and implicit prosody, pointing to a common mechanism that allows punctuation in written communication to take on the functions that prosody does for speech.

In contrast, Chafe (1988) argued that, although punctuation is intended to capture major aspects of prosodic intent, prosodic features are not well dictated by text punctuation. For example, he noted that grammar rules that govern the placement of phrase-final commas between words in a series may dictate pauses in sentences such as "He came, he schmoozed, and he dazzled" but not in sentences such as "Arnie wanted the one with the red, white, and blue sprinkles." Question marks also exhibit prosodic uncertainty, seeming to dictate a final pitch rise for the end of yes-no questions (e.g., "Did Melanie go?"), but not for *wh* questions (e.g., "Where did Melanie go?"). Moreover, spoken language consists of shorter speech segments (about five or six words) before a pause than would be dictated by written punctuation, particularly for lengthy sentences. Consequently, oral readers introduce their own prosodic boundaries, which are not signaled in the text at all. Thus, because 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 limits of punctuation as a cue to the underlying prosodic structure of the text.

Besides learning the limits of punctuation, elementary school children are still developing their understanding of prosody. Bates (1976), for example, found that prosodic stress patterns were processed poorly by children as old as 8 years. Cutler and Swinney (1987) found that even 9- and 10- year-olds were not quite at adult levels in understanding the function of some contextual

prosodic features. Thus, it is possible that children who are just learning to read may not be able to make full use of the prosody engaged by oral reading.

Currently, the majority of available studies examining the development of oral reading prosody have focused on measures such as descriptive ratings of specific prosodic features (Bear, 1992; Clay & Imlach, 1971). Clay and Imlach (1971) used a rater to analyze separately the pausing, pitch, and stress found in the oral readings of 7-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, because statistical analyses were not carried out, it is unclear whether the skill differences were reliable across children. Furthermore, ratings can be unreliable across raters for some prosodic features, because it is difficult for listeners to disentangle prosodic from decoding issues (Bear, 1992).

Research using spectrographic analysis of oral reading prosody is surprisingly sparse. Herman (1985) counted the spectrographic presence of speech pauses of 8 children as they practiced reading a moderately difficult text and found that the number of pauses not dictated by punctuation dropped considerably with practice. As noted earlier, punctuation may be only a very rough indicator of where pauses are appropriate. Dowhower (1987) examined the effect of repeated reading on oral reading prosody in second grade children who read accurately but in a slow and word-by-word manner. After repeated practice, children showed significant improvements in prosodic reading in terms of decreased inappropriate pausing within words or major syntactic units, increased sentence-final vowel lengthening (a prosodic feature marking the end of a major syntactic unit; Cooper & Paccia-Cooper, 1980), and greater decline in pitch (or fundamental frequency [F_0] declination) occurring at the last syllable of a declarative sentence. Cowie et al. (2002) examined a wide range of prosodic variables in the oral readings of 24 children selected to be in the normal range of general reading skill. They found that pause and rate features were more related to fluency ratings, whereas pitch features (those related to F_0) were more related to expressiveness ratings. Although these studies provide good descriptive evidence for the idea that prosody is linked to fluent and expressive reading, they do not help us understand whether prosody is helpful for comprehension in young readers.

A study by Schwanenflugel et al. (2004) provided a direct assessment of the role of reading prosody in mediating the relation between decoding and comprehension skills. They carried out spectrographic analysis of the oral readings of a large sample of second and third grade children. Investigation focused on five prosodic features: (a) intersentential pause length, (b) intersentential pause length variability, (c) intrasentential pause length, (d) adult-child F_0 sentence profile match (based on adult comparison sample data), and (e) the sentence-final F_0 declination. Skilled readers (as determined by standardized assessment of word reading efficiency) 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. However, in terms of the role of reading prosody, the authors found a clear connection between prosodic reading and word reading efficiency, but reading prosody itself added little to the prediction of comprehension skills beyond that accounted for by word reading efficiency alone. The authors argued that reading prosody should be viewed as an indicator of the emergence of automatic word reading skills.

One reason that Schwanenflugel et al. (2004) failed to find a relation between reading prosody and reading comprehension skill is that the study focused on children's reading of a simple seven-sentence preprimer passage composed mainly of declarative sentences. Simple passages

may not encourage children to mark prosody in a way that relates to comprehension. It may be that as texts become more syntactically complex, children draw on their prosodic resources in a way that is more reflective of and helpful to comprehension skills.

Purpose of the Present Study

The purpose of this study is to determine the role of prosody in the overall reading process by examining the relation among the prosodic reading of syntactically complex sentences, reading speed and accuracy, and comprehension. This study directly addresses some of the limitations of the Schwanenflugel et al. (2004) study by focusing on the oral reading of a comparatively complex text directed at the children's grade level. The current study included a large sample of third grade children rather than the mixture of children at second and third grades found in the Schwanenflugel et al. study to avoid confounding individual differences with developmental change. Most important, however, the text included redundant observations of a more complete set of grammatical features than identified in previous research on reading prosody: basic declaratives, basic quotatives, *wh* questions, yes–no questions, complex adjectival phrases, and phrase-final commas. These sentence types were included because they allowed us to observe how children marked punctuation prosodically.

Intuitively, it seems that questions should be marked with a rising pitch, but Chafe (1988) indicated that this is true for some question types only. Similarly, intuition might dictate that commas should be marked with a pause, but Chafe suggested that not all commas need be marked. Some, such as phrase-final commas (e.g., “To avoid being run over, Paul jumped back”), might need to be marked, whereas others, such as commas in complex adjective phrases (e.g., “the large, striped, yellow bus”) might not. Finally, quotatives (e.g., “‘We oughta go,’ said Freddy”) are another type of sentence that might seem to call on prosodic marking. Thus, to answer the question of whether prosody is an indicator of good reading comprehension skills, it was important that we first discern which syntactic features are marked prosodically and which are not.

We asked a group of adults to read the text to determine whether they read targeted features of complex sentences in similar ways prosodically. From these readings, we identified a set of targeted features from six sentence types that were marked similarly among adults. We then determined how children who had quick and accurate reading skills marked these syntactically complex sentences compared with children whose decoding skills were comparatively slower and less accurate. Then we determined the degree to which these emergent prosodic features served as an additional contributor to reading comprehension skills beyond those accounted for by reading speed and accuracy.

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 to 10 years, 6 months) attending four public schools in northeast Georgia. The children were part of a larger study of the development of reading fluency. Only children not currently receiving special services for English language learners were included in the study. Furthermore, only children able to decode more than 90% of the words in the passage were included (3 additional children were excluded from the sample). Approximately 59% of the children were African American, 33% were European American, 5% were Hispanic American, and 4% were of unknown ethnicity. Children came from schools in which 79% of the students qualified for free and reduced lunch.

In addition, 29 undergraduates (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 psychology research participant pool and received credit toward 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 that incorporated three observations of six targeted linguistic features that 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 phrase commas (may not elicit pauses), and
6. phrase-final commas (may elicit pauses following phrase).

F_0 and pause length measurements were made for each of three examples for each type of structure in the text. 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 with the Flesch–Kincaid Grade Level Formula (Kincaid, Fishburne, Rogers, & Chissom, 1975), the Spache Readability Index (Spache, 1953), and the Dale–Chall Readability Index (Chall & Dale, 1995). Readability was computed and averaged across indexes, yielding an estimated grade level of 3.25. In addition, consideration was given to decodability, as decoding errors make the determination of reading prosody meaningless. The passage was as follows (the subscripted numbers are indexed to the sentence type in the list above but were not included in 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 via a Sound Devices (Reedsburg, WI) USBPre 1.5 microphone interface, a 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 (GoldWave, Inc., 2004) 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 with Praat Version 4.2.07 (Boersma & Weenink, 2004). Praat is a comprehensive speech software package designed to analyze, synthesize, and manipulate digital speech data. It 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—Before we analyzed children's oral readings, it was necessary to determine which sentence types were read similarly by adults. Basically, if there is wide variation in how adults read a particular sentence type, then it is unclear that there is a target prosody toward which children are striving. Thus, we used the sample of adult readers to determine which prosodic variables to target for investigation. We made the determination of whether a given sentence type was phrased in a similar prosodic manner in two phases: (a) capturing the prosodic features from key prosodic segments for each targeted sentence for each adult, and (b) determining whether the key prosodic segments were read similarly across adults for each sentence type.

In this initial phase, we determined the basic declarative pause length (the mean pause length between sentences) by isolating the target area on the spectrograph and visually creating a spectral slice containing only the pause interval. Pause durations, measured in milliseconds, were recorded and averaged across sentences. The targeted basic declarative sentence-final pauses included in the calculation are noted in the passage with the number 1.

We used similar procedures 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”), we made measurements for the pretag commas (the pause interval between the sentence-final word in the quote and the beginning of the tag). As in the case of simple declarative pauses, we determined pause lengths by visually demarcating the spectrograph at the limits of the pause interval and noting the duration in milliseconds. We obtained mean pretag pause lengths for each grammatical feature 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*. Phrase-final comma pauses (e.g., “One afternoon, near a pond”) were measured similarly, with the pause measurement occurring between the ending of the word preceding the comma and the start of the word following it (between *afternoon* and *near*). Again, in both instances we calculated means by averaging across sentences. The sentences used in calculating the means for complex adjectival phrases and phrase-final commas 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 (pretag). However, when 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 indexes of F_0 change for each structure type.

For phrase-final commas, F_0 was measured from the pitch peak to the declination preceding the comma (this often occurred over two words, e.g., “they waited,” but could occur over a single word if it was multisyllabic, e.g., “afternoon”). The mean F_0 declination was calculated and used as an index of phrase-final declination. For complex adjectival phrases, F_0 change was measured for each word included in the phrase (e.g., *happy*, *playful*, *curious*). We conducted single word measurement by measuring the F_0 from the natural break to the word end in multisyllable 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. The means, standard deviations, and ranges for each prosodic variable for adults can be found in Table 1.

After the targeted segments were captured from each sentence type, we determined which segments were marked reliably. We created histograms to graphically represent adult pause lengths and F_0 declination. These 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 Figures 1 and 2, respectively.

A perusal of these histograms indicates some interesting patterns in adults' use of prosody. As can be seen in Figure 1, 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. Figure 2 shows that there was more variability among adults in how they marked key segments prosodically with changes in pitch. For commas, for which no particular pitch patterns were anticipated, one pattern emerged. Most adults marked internal commas with declinations 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, whereas others marked them with a pitch rise.

Child prosody assessment—Because of this lack of consistency in pitch changes among adults with regard to *wh* questions, we did not target this sentence type for children's oral reading analysis. For each other feature, we measured the F_0 contour and associated pause lengths. Otherwise, equipment and prosody measurement 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. The children were not asked to read the passage under any pretend conditions (e.g., as if they were reading to a younger child), nor were they specifically instructed to read with expression. The interest was in measuring naturally elicited prosody, and we did not want to bias the findings by instructing the children to read in a manner that was uncharacteristic of their normal reading behavior. To ensure that children were reading the passage with comprehension, we asked the children five comprehension questions at the conclusion of the passage. All children were able to answer at least four questions correctly, and no child needed to be eliminated because he or she could not comprehend the passage. A list of these questions is available in Appendix A.

Reading Assessments and Procedures

To guard against order effects, we counterbalanced assessments such that half the children received reading prosody and reading speed and accuracy measures in the first half of the battery and half received the reading comprehension assessments first. Data collection assistants were trained on administration and scoring procedures to the standard of 100% agreement with the lead assistant on all reading assessments prior to collection.

Word reading efficiency assessment—To obtain an independent estimate of word reading efficiency, we administered children the Test of Word Reading Efficiency (Form B; Torgesen, Wagner, & Rashotte, 1999) Sight Word Efficiency and Phonemic Decoding Efficiency subtests. The Sight Word Efficiency subtest assesses the number of real words correctly read from a list within 45 s, whereas the Phonemic Decoding Efficiency subtest measures the number of pronounceable phonetically regular non-words that can be accurately decoded within 45 s. 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—We also administered the Gray Oral Reading Tests (Fourth Edition–Form B; Weiderholt & Bryant, 2001) to obtain an independent estimate of skill in reading connected text. Children were presented with a series of passages to read aloud and were scored on the rate and accuracy of their reading. Rate and accuracy scores were combined to yield a Standard Fluency score, which was then used as an indicator of connected text reading ability.

Reading comprehension assessment—We administered the Reading Comprehension subtest of the Wechsler Individual Achievement Test (WIAT; Psychological Corporation, 1992) to obtain an independent measure of reading comprehension skill. This subtest consists of a series of printed passages, each of which increases in complexity and is followed by an orally presented question. 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 provide an oral response in their own words. The test was discontinued once a child missed four consecutive items, as directed by the test manual. The WIAT 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 individual questions answered correctly, was converted to a standard score, which then served as an indicator of reading comprehension skill.

Results

The means, standard deviations, and ranges for the children on each variable can be found in Table 2. Statistical analyses were carried out in multiple steps, each addressing one of the major goals of the present research. The first was to determine the degree to which the prosody of syntactically complex sentences varied as a function of reading speed and accuracy. The second was to determine the role of prosody in oral reading skill by examining the relation among prosody of syntactically complex sentences, reading speed and accuracy, and reading comprehension.

Individual Differences in Reading Skill and the Prosody of Syntactically Complex Sentences

To assess how the prosody of syntactically complex sentences differed as a function of reading speed and accuracy, we created a composite score based on the Test of Word Reading Efficiency Total Word Reading Efficiency standard score and the Gray Oral Reading Tests Fluency standard score. This composite score was based on a factor score derived from an exploratory factor analysis on the test scores using principal-components extraction. This factor analysis yielded a good single factor fit, accounting for 85.33% of the variance (all factor loadings $> .92$). Henceforth, for simplicity, we refer to the composite score yielded by this analysis as *reading skill*. Then we carried out regression analyses treating reading skill as a predictor and each prosodic feature as the dependent variable. The correlations between the prosody variables can be found in Appendix B. However, for purposes of illustrating the relation between reading skill and these prosodic features, we present the mean scores for children in each reading skill quartile (low, low middle, high middle, and high) on the basis of these factor scores for each feature in Figures 3 and 4.

To ensure that reading skill did not interact with ethnicity for any prosodic variable, we carried out a regression analysis testing for the presence of an interaction between ethnicity (coded as African American vs. other) and reading skill on each prosodic feature. No statistically significant main effects or interactions were found (all $ps > .05$). Consequently, we ignored ethnicity in subsequent analyses and focused on the relation between reading skill and prosody.

To examine the relation between reading skill and children's prosodic reading of pause structures, we conducted a series of simple regressions using skill as the independent variable and the mean basic declarative, basic quotative, yes–no question, complex adjectival phrase, and phrase-final comma pause lengths as the dependent variables. Furthermore, because the graphic representations of reading skill–pause structure relations depicted in Figure 3 suggest potential nonlinear trends, regression analyses for all pause variables were computed with an additional quadratic component, and the significant findings are presented when appropriate. These analyses indicated that children made shorter pauses following basic declarative sentences with increasing skill ($R^2 = .251$), $F(1, 79) = 26.09$, $p = .001$. A significant quadratic relation was found between reading skill and basic declarative pause duration as well ($\Delta R^2 = .042$), $\Delta F(2, 77) = 4.57$, $p < .05$. Children also made shorter pauses following declarative quotatives as a function of increasing skill ($R^2 = .127$), $F(1, 79) = 12.53$, $p < .001$. Shorter pause durations following yes–no question types were also characteristic of better readers, with duration decreasing with higher skill level ($R^2 = .103$), $F(1, 79) = 8.97$, $p = .004$. For pauses at commas in complex adjectival phrases, we found that the presence of numerous decoding errors on the word *curious* following the comma made measurement of the second comma pause irrelevant. Thus, we targeted only the pause following the first adjective (at the first comma). Highly skilled readers made shorter pauses after the first adjective in the phrase compared with less skilled readers ($R^2 = .328$), $F(1, 79) = 37.09$, $p < .001$. Here again, a significant quadratic trend was found ($\Delta R^2 = .089$), $\Delta F(2, 77) = 11.40$, $p = .001$. Finally, pauses at phrase-final commas were shorter for more skilled readers as well ($R^2 = .144$), $F(1, 78) =$

13.52, $p < .001$. Overall, we found that more skilled readers made shorter pauses during text reading.

Chafe (1988) suggested that adult readers may not feel driven to mark every comma with a pause. Our own data with adults concur with those findings. It makes sense that more skilled readers might not pause at every comma as well. By analyzing the proportion of internal comma pauses marked by children that adults did not pause at (i.e., complex adjectival phrase commas, phrase-final commas, yes–no question commas, and basic quotatives commas), we were able to determine that more skilled readers were somewhat less likely to pause at commas than were less skilled readers ($R^2 = .123$), $F(1, 79) = 10.97$, $p = .001$, although, as can be seen from Figure 3F, most children paused on most of the commas.

In addition, we conducted a separate set of regression analyses (including tests for a quadratic component) to examine skill differences for the F_0 changes associated with each prosodic feature. Analyses indicated that children generally marked declarative sentences with falling pitch; however, larger declinations in pitch at the end of sentences were evident with increasing reading skill ($R^2 = .099$), $F(1, 79) = 8.54$, $p = .005$. Pitch differences in the treatment of basic declarative quotatives were not found ($R^2 = .003$), $F(1, 78) < 1$, $p = .612$, as children, across skill groups, tended to read this structure with a generally flat prosodic contour. Words prior to phrase-final commas 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 phrase-final commas ($R^2 = .006$), $F(1, 79) < 1$, $p = .506$. In addition, the treatment of complex adjectival phrase F_0 change was nonsignificant with respect to reading skill ($R^2 = .037$), $F(1, 79) = 3.03$, $p = .086$. However, further examination demonstrated a significant quadratic trend for the relation between reading skill and complex adjectival phrase F_0 change ($\Delta R^2 = .036$), $\Delta F(2, 77) = 5.29$, $p < .05$. Despite this significant finding, a review of Figure 4D indicates that the differences in the mean F_0 change for each skill group were generally not meaningful, as they all exhibited a relatively flat prosodic contour. Moreover, Dowhower (1987) suggested that pitch variations of less than 15 Hz are practically unnoticeable. Furthermore, we found a statistically significant relation between yes–no question pitch rise and reading skill ($R^2 = .117$), $F(1, 79) = 10.316$, $p = .002$. Thus, there was evidence of emerging skill differences in voice pitch for basic declarative pitch declination and yes–no question pitch rise, suggesting that better skilled readers were more likely to mark these sentence-final features with discernable changes in pitch.

The Role of Syntactically Complex Prosody in Oral Reading Skill

The second goal of the present research was to determine the association between reading speed and accuracy (defined by the factor scores for reading skill that we have noted) and prosody of syntactically complex sentences on reading comprehension (defined by the WIAT Reading Comprehension subtest). For this analysis, we only considered those prosody variables that were significantly related to reading skill in the previous section.

Preliminary analyses indicated considerable multicollinearity among prosody variables, as might be anticipated. This suggested a need to reduce the number of these variables under consideration for the subsequent model tests. We carried out exploratory factor analyses using principal-components analyses without rotation on the prosody variables with the intent of producing factor scores that could be used in subsequent regression analyses.

Our initial exploratory factor analysis of the prosody variables suggested a meaningful two-factor solution but also indicated that there was poor communality for the complex adjectival phrase commas with the other prosody variables (.362). This indicated the need to remove this prosody variable from consideration. Once it was removed, the prosody variables all displayed acceptable communalities (all greater than .43), and the two-factor solution remained evident

and meaningful with eigenvalues greater than 1.00. In particular, this analysis indicated a Pause factor consisting of basic quotative pause, basic declarative pause, phrase final comma pause, and yes–no question pause (accounting for 37.74% of the variance, with factor loadings all exceeding .62) and a Pitch factor consisting of basic declarative F_0 and yes–no question F_0 (accounting for 20.04% of the variance, with factor loadings each exceeding .62). Then, to obtain factor scores for pause and pitch, we ran independent exploratory factor analyses for each set of variables. The solution for pause variables accounted for 57.60% of the variance in scores and had factor loadings higher than .68, and the solution for pitch variables accounted for 70.98% of the variance in scores and had factor loadings of .84 each. Factor scores for reading skill, pause, and pitch were created for each participant for the subsequent hierarchical regression analyses. The correlations between these three factor scores can be found in Appendix C. Although we initially inspected for outliers at the individual prosody variable level, an inspection of these factor scores indicated one outlier whose Pause factor score was nearly five standard deviations from the mean. This participant's factor score was eliminated from subsequent analysis. Furthermore, we tested for potential quadratic relations between each of the factors and the reading comprehension measure prior to any further analyses. We found a significant quadratic trend for the relation between the Pause factor and reading comprehension ($\Delta R^2 = .065$), $\Delta F(2, 78) = 5.09$, $p < .05$. Consequently, model tests included the quadratic component of the Pause factor relation as an additional variable.

Schwanenflugel et al. (2004) found that prosody added little to reading skill in the prediction of reading comprehension and concluded that prosody played little role in the comprehension of text. In hierarchical regression terms, this view predicts that once reading skill variables are accounted for in the regression equation, there should be no additional variance accounted for by prosody variables on reading comprehension skill. Alternatively, Kuhn and Stahl (2003) predicted that prosody is important to reading comprehension beyond simple quick and accurate oral reading of text. If this is true, in hierarchical regression terms, we should find a significant association of prosody variables on reading comprehension skill beyond reading skill. To test these models, we included reading skill in the first step and then added the prosody variables, pause (along with the quadratic component) and pitch change, to the model.

Table 3 presents unstandardized coefficients, standard errors of the coefficient, and R , ΔR^2 , and F statistics for each model. As can be seen, at Step 1, reading skill accounted for substantial variance in reading comprehension skill, as predicted by both views. However, when prosody variables were added to the model at Step 2, at least one of these variables, pitch change, was a significant additional predictor to the model, $t(78) = 2.93$, $p = .005$, although pauses were not, linear trend $t(78) = 1.37$, $p = .176$ and quadratic $t(78) = 1.46$, $p = .149$. Moreover, when an additional hierarchical regression was carried out including only reading skill and pitch change, practically all of the additional variance accounted for by prosody could be attributed to pitch changes ($\Delta R^2 = 6.7\%$), $\Delta F(1, 76) = 8.70$, $p = .004$. Thus, it appears that there is support for the view of Kuhn and Stahl (2003) suggesting that prosody may assist readers in comprehension, but only for certain elements of it.

Discussion

The results of this study demonstrate the importance of quick and accurate reading as a contributor to prosodic reading and comprehension as well as the importance of prosody to comprehension. An association between reading speed and accuracy, on the one hand, and the prosody of syntactically complex sentences, on the other, was found for both pause structures and pitch changes. We found that children with quick and accurate oral reading made fewer and shorter pauses both at commas and at the end of sentences. Their pauses were brief both within sentences at comma markings and before quotative tags, resulting in reading that had a smooth and fluid quality. In contrast, children with emerging reading skill read with lengthy

and often inappropriate pausing both within and between sentences. Basic declarative sentence pauses were unusually long for these less skilled readers. Furthermore, these readers marked internal commas with long pauses that disrupted the flow of the sentence. They seemed to view commas as obligatory signals to pause.

Our analysis of sentence-final F_0 found two features that were linked with reading skill. Children with quick and accurate oral reading ended yes–no questions with a discernable pitch rise and ended declaratives with decided declinations in pitch. In contrast, children with slow and inaccurate reading skills ended these sentence types with F_0 changes that were comparatively flat. The combined effect of these pitch and pause features in less skilled readers was a rendering of text that sounded choppy, hesitant, and flat.

The findings we present regarding the prosody–reading skill relations show general similarity to those described in previous studies and add some new findings as well. Like Clay and Imlach (1971) and Schwanenflugel et al. (2004), we found that good readers made short pauses. In addition to this, we learned new information regarding children's treatment of internal punctuation. We found that good readers kept pauses short at internal commas across a variety of sentence types (i.e., basic declaratives, basic quotatives, and yes–no questions), but less skilled readers did not. Clay and Imlach (1971), Dowhower (1987), and Schwanenflugel et al. (2004) found that skilled readers ended declarative sentences with a marked declination in pitch. We, too, found that skilled readers ended declarative sentences with a decided declination in pitch. Beyond this, we learned that skilled readers showed large pitch rises following yes–no questions.

Our design targeted features that Chafe (1988) and Cooper and Paccia-Cooper (1980) suggested might require a distinct prosodic reading in adults. Through investigation, we were able to determine target prosody for how skilled adult readers generally treat these features. In agreement with previous studies, we found that adults marked basic declarative sentences reliably with a pitch decline. Although researchers have suggested that basic quotatives may require a pause following a quote (Cooper and Paccia-Cooper, 1980), our adult readers did not pause following basic quotatives, and our skilled child readers kept these short. According to Chafe (1988), *wh* question types may not require an upswing in pitch; in support of this, we found that adults did not show a uniform treatment of this structure, with many adults showing a moderate to large pitch rise and others electing to end these questions with a pitch decline. Furthermore, Chafe suggested that adults mark yes–no questions with an upswing in pitch. We, too, found this to be the case. 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 for phrase-final locations (e.g., “One afternoon, near a pond”). We found that adult readers generally did not pause at either structure. Overall, however, our findings concur with Chafe's basic point that punctuation does not seem to drive prosodic readings in adults. Moreover, skilled child readers seemed to be heading toward a prosodic rendering that was similar to that of adults.

The present research addresses 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 and engaging for children at this age but somewhat challenging because it contained long, syntactically complex sentences. Because we systematically examined a number of grammatical features, we are able to add to the literature some important observations regarding the development of reading prosody.

In addition, direct prosodic measurements were made over a large sample of children at the same grade level. Direct prosodic measurements have an advantage over the rating of prosody

because one can distinguish prosodic issues from decoding problems. In fact, segments with decoding problems were eliminated from consideration. Furthermore, the pauses and pitch changes could be directly quantified rather than impressionistically derived. This is not to say, however, that there is no potential value in ratings of prosody. Such ratings are much easier to carry out than spectrographic measurement. These ratings just need to be validated against actual spectrographic measurements to ensure that they are not confounded with other features of child readings (e.g., decoding problems, ethnicity). Still, overall ratings of prosody may be a simpler way to capture some elements of prosodic readings, such as reading in word groups. However, given the focus of the current study on syntax and punctuation, spectrographic measurements were the most precise way to capture that information.

The second major goal of this study was to determine the role of prosody in the reading process. We tested two possibilities for the potential role of reading prosody. Our first hypothesis was that reading prosody is a feature that emerges once children have quick, accurate, and automatic word- and text-level reading skills. This hypothesis was based on previous research by LaBerge and Samuels (1974) and Perfetti (1985) that suggests that once children are able to process words fluently and automatically, resources are then available for higher level processes to accrue. This part of our model showed strong support, as we found that reading skill was related to short and more adultlike pause structures, large declinations at the end of declaratives, and larger pitch rises following yes–no questions.

Our second hypothesis was that, once prosodic reading was established, this prosody might make a unique contribution to comprehension skill beyond that based on mere quick and accurate reading of text. This view was based on previous research that suggests that prosodic reading may provide important syntactic and semantic feedback to the reader, which may ultimately assist comprehension (Cromer, 1970; Kuhn & Stahl, 2003; O'Shea & Sindelar, 1983). This hypothesis was supported, but only for specific pitch features. That is, children who showed large declinations at the end of basic declarative sentences and larger pitch rises following yes–no questions tended to be those whose comprehension skills were greater. Pausing, however, was unrelated to comprehension skills beyond the relation accounted for by rapid and accurate text reading.

The current study has found better evidence for the relation between prosody and reading comprehension compared with previous research by Schwanenflugel et al. (2004). As in the current study, Schwanenflugel et al. found no independent effect of pause structures on reading comprehension once reading speed and accuracy were taken into account. However, their findings for pitch change were somewhat mixed. Unlike in the current study, they found no effect for sentence-final F_0 declinations for declarative sentences on reading comprehension. They did, however, note a small but significant effect of adult–child F_0 contour match. That is, children whose general pitch contour was similar to the averaged adult contour tended to have better reading comprehension skills. However, the authors concluded that, on the whole, prosody did not add much to the ability to predict children's reading comprehension beyond that accounted for by decoding skills. The current study has found a somewhat more general association between sentence-final pitch change and reading comprehension skill. We believe that this occurred because we focused on syntactically complex sentences and a passage that was a closer match to children's overall reading skill than the one used in the Schwanenflugel et al. study. Taken together with the findings of that earlier study, we think our current study highlights the role of pitch changes as an important variable in the prediction of reading comprehension skill. Consequently, we conclude that a focus should be placed on pitch changes rather than pause structures in thinking about the role of prosody in reading comprehension.

Thus, the current study suggests that different aspects of prosody may be distinctly related to different aspects of the reading process. Long pauses may signal that children are having

general difficulties with their decoding skills. By contrast, large pitch changes at end of sentences, where appropriate (i.e., where adults also change pitch), may indicate that children have good comprehension skills.

This information may have practical value for teachers who monitor their students' oral readings. First, we think our findings suggest that prosodic, or expressive, reading should receive some instructional emphasis in the classroom. Our research is clear in demonstrating that more advanced readers carry out prosodic readings that look very much like those carried out by adults. Furthermore, it seems reasonable to conclude that teachers might be able to use excessive pausing as an indicator that children are still having issues in decoding text. However, appropriate pitch contours may indicate that the children are fully fluent and automatic readers capable of understanding what they read. Once children have attained fluent, prosodic reading, it seems reasonable that they can move on to more difficult texts or that their teachers can focus to a greater extent on other topics, such as advanced reading comprehension strategies, which children will then have the cognitive resources to use.

Finally, we note that the prosodic renderings we obtained from children were based on instructions simply to read the story so that they could answer questions about it. We did not ask children to carry out dramatic readings. The associations between reading comprehension and prosody might have been stronger if such dramatic reading instructions were provided. Furthermore, it is likely that prosody will vary as a function of other contextual features, such as child motivation and text familiarity. The current study should be viewed as providing baseline information on a straightforward reading using texts at the children's grade level. Further studies should address the effects of these other variables on reading prosody and how reading prosody is related to other aspects of the reading process, such as reading motivation.

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Appendix

Appendix A: 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

Appendix B: Correlations Between Child Prosody Variables

Variable	1	2	3	4	5	6	7	8	9
1. Declarative p.	—								
2. Quotative p.	.407*	—							
3. Yes–no p.	.254*	.475*	—						
4. Adj. p.	.325*	.180	.277*	—					
5. Phrase-final p.	.455*	.516*	.481*	.353*	—				
6. Declarative F_0	.144	.225*	.002	.198	.126	—			
7. Quotative F_0	–.067	–.083	–.128	–.025	–.100	.064	—		
8. Yes–no F_0	.032	–.075	.047	–.060	.035	–.124	.067	—	
9. Adj. F_0	–.392*	–.116	.029	–.301*	–.100	–.220*	–.007	.010	—
10. Phrase-final F_0	–.256*	.065	.078	–.045	.079	–.161	–.327*	.024	.153

Note. p. = pause; Adj. = adjective; F_0 = fundamental frequency.

*
 $p < .05$.

Appendix C: Correlations Between Reading Skill and Child Prosody Factor Scores

Variable	1	2	3
1. Reading skill	—		
2. Pause factor	–.515**	—	

	Variable	1	2	3
3.	Pitch factor	.307**	-.104	—

**
 $p < .01$.

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Figure 1.

Histograms depicting the pattern of adult pause durations for each prosodic feature: basic declaratives (Figure 1A), declarative quotatives (Figure 1B), *wh* questions (Figure 1C), yes-no questions (Figure 1D), complex adjective phrase commas (Figure 1E), and phrase-final commas (Figure 1F).

Figure 2.

Histograms depicting the pattern of adult fundamental frequency (F_0) changes for each prosodic feature: basic declaratives (Figure 2A), declarative quotatives (Figure 2B), *wh* questions (Figure 2C), yes-no questions (Figure 2D), complex adjective phrase commas (Figure 2E), and phrase-final commas (Figure 2F).

Figure 3.

Children's mean pause lengths as a function of reading skill level for each prosodic feature: basic declaratives (Figure 3A), declarative quotatives (Figure 3B), yes-no question commas (Figure 3C), complex adjectival phrase (Figure 3D), phrase-final commas (Figure 3E), and proportion of internal commas (Figure 3F).

Figure 4.

Children's mean fundamental frequency (F_0) change as a function of reading skill level for each prosodic feature: basic declaratives (Figure 4A), declarative quotatives (Figure 4B), yes-no question commas (Figure 4C), complex adjectival phrase (Figure 4D), and phrase-final commas (Figure 4E).

Table 1
Descriptive Statistics for Adult Prosody Features

Prosody feature	Minimum	Maximum	<i>M</i>	<i>SD</i>
Basic declarative				
Pause (ms)	145	685	446	162
F_0 change (Hz)	-83	20	-20	23
Declarative quotative				
Pause (ms)	0	141	12	37
F_0 change (Hz)	-47	166	7	35
Wh question				
Pause (ms)	0	145	24	38
F_0 change (Hz)	-65	132	22	50
Yes-no question				
Pause (ms)	0	319	40	80
F_0 change (Hz)	6	309	48	57
Complex adjectival phrase commas				
Pause (ms)	0	337	53	105
F_0 change (Hz)	-229	48	-23	53
Phrase-final commas				
Pause (ms)	0	454	59	128
F_0 change (Hz)	-101	84	-19	42

Note. F_0 = fundamental frequency.

Table 2
Descriptive Statistics for Children's Oral Reading Assessments and Prosody Features

Variable	Minimum	Maximum	<i>M</i>	<i>SD</i>
Reading assessment				
TOWRE				
Sight Word Efficiency	81	136	101.8	11.7
Phonemic Decoding Efficiency	70	135	98.5	12.9
GORT-4 Oral Reading Fluency	2	18	9.5	3.2
WIAT Reading Comprehension	75	133	101.2	11.4
Prosody feature				
Basic declaratives				
Pause (ms)	37	2,542	598	392
F_0 change (Hz)	-168	33	-32	29
Declarative quotatives				
Pause (ms)	0	1,557	289	309
F_0 change (Hz)	-81	110	-6	28
Yes-no questions				
Pause (ms)	0	1,279	290	276
F change (Hz)	-18	207	44	35
Complex adjectival phrase commas				
Pause (ms)	0	1,474	318	328
F_0 change (Hz)	-188	76	-1	34
Phrase-final commas				
Pause (ms)	0	1,577	293	288
F_0 change (Hz)	-110	56	-30	27

Note. TOWRE = Test of Word Reading Efficiency; GORT-4 = Gray Oral Reading Tests (fourth edition- Form B); WIAT = Wechsler Individual Achievement Test; F_0 = fundamental frequency.

Table 3
Unstandardized Coefficient (B), Standard Error of Coefficient (SE), R, and ΔR^2 for Each Model

Model and Variable	B	SE	R	ΔR^2	Model F
Model 1					
Reading skill	6.839***	1.056	.594	.353	$F(1, 77) = 41.936$ ***
Model 2					
Reading skill	4.771***	1.315	.662	.085	$F(4, 74) = 14.420$ ***
Pitch change	3.232**	1.103			
Pause	-2.425	1.776			
Quadratic trend	1.310	0.901			

**
 $p < .01$.

 $p < .001$.