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# Reading Expressively and Understanding Thoroughly: An Examination of Prosody in Adults with Low Literacy Skills

**Katherine S. Binder**[*], **Elizabeth Tighe**[**], **Yue Jiang**[*], **Katharine Kaftanski**[*], **Cynthia Qi**[*], and **Scott P. Ardoin**[***]

[*]Mount Holyoke College

[**]Florida State University

[***]University of Georgia

## Abstract

The purpose of the current study was to explore the relationship between prosody, which is the expressive quality of reading out loud, and reading comprehension in adults with low literacy skills compared to skilled readers. All participants read a passage orally, and we extracted prosodic measures from the recordings. We examined pitch changes and how long readers paused at various points while reading. Finally, for the adults with low literacy skills, we collected information on decoding, word recognition, and reading comprehension. We found several interesting results. First, adults with low literacy skills paused longer than skilled readers and paused at a substantially greater number of punctuation marks. Second, while adults with low literacy skills do mark the end of declarative sentences with a pitch declination similar to skilled readers, their readings of questions lack a change in pitch. Third, decoding and word recognition skills were related to pauses while reading; readers with lower skills made longer and more frequent and inappropriate pauses. Finally, pausing measures explained a significant amount of variance in reading comprehension among the adults with low literacy skills.

### Keywords

Prosody; Adult Basic Education; Reading Comprehension; Decoding

In order for good reading comprehension to be achieved, a reader must learn to juggle a number of tasks, including being able to decode individual words and extract meaning from the text. Since individuals are only able to process a limited amount of information at a time, it is important for them to be able to decode and understand the text automatically to perform well in higher level processes such as reading comprehension. Thus, reading with fluency is an important skill readers must gain. Reading fluency has been defined as reading with speed, accuracy, and expression (National Reading Panel, 2000). This last aspect, expression or prosody, has captured researchers' attention in the last decade (e.g., Dowhower, 1991; Klauda & Guthrie, 2008; Miller & Schwanenflugel, 2006, 2008). Prosodic reading is the ability to read in expressive rhythmic and melodic patterns. Prosodic readers segment text into meaningful units marked by appropriate prosodic cues such as pauses, varied duration of those pauses, the raising and lowering of pitch, and lengthening of certain vowel sounds (Dowhower, 1991). Using narrative texts, researchers have generally found that better prosody is typically observed in students with greater reading achievement.

Katherine S. Binder, Department of Psychology and Education, Mount Holyoke College, 50 College St., South Hadley, MA 01075, kbinder@mtholyoke.edu.

Better readers pause less frequently while reading, decrease their pitch at the conclusion of sentences, and do not always stress words as heavily as do many poor readers (Klauda & Guthrie, 2008). In addition, variables assessing prosody explain significant variance in reading comprehension beyond reading accuracy and speed (e.g., Miller & Schwanenflugel, 2006). The purpose of the current study was to assess prosodic abilities in adults who are learning to read compared to skilled adult readers. Unfortunately, to date the existing literature examining the relationship between prosody and comprehension exclusively examines this relationship amongst children learning to read.

## How is prosody measured?

Prosody has primarily been measured using two approaches: subjective rating scales and spectrographic measures. In some research, and more commonly in the classroom, subjective rating scales are used for evaluation. Researchers often use the National Assessment of Educational Progress (NAEP) Oral Reading Fluency Scale (ORF) (Pinnell et al., 1995). This ORF Scale employs a four-point system for distinguishing between readers who primarily read word by word versus readers who string together larger chunks of text to create meaningful phrases. Another scale, the Multidimensional Fluency Scale (Rasinski, Rikli, & Johnston, 2009), was developed to capture a richer picture of prosodic reading, and is comprised of three subscales that are used to assess phrasing and expression, accuracy and smoothness, and pacing. Finally, Klauda and Guthrie (2008) developed a fluency rubric which assesses five dimensions of prosodic reading: passage expressiveness, phrasing, pace, smoothness, and word expressiveness. These rating scales are helpful in the classroom setting and useful for researchers who are collecting large data sets. Studies using these scales have consistently found expressive readers are fluent readers (Cowie, Douglas-Cowie, & Wichmann, 2002) and prosody is related to reading comprehension (Klauda & Guthrie, 2008; Rasinski et al., 2009).

Technological advances have made it possible to examine speech spectrographs using software (e.g., Praat; Boersma & Weenink, 2011) that can extract information from audio recordings of participants. This software thus provides a more direct and objective measure of prosodic reading data that allows better measurement of prosodic reading. For example, a researcher who is interested in examining appropriate and inappropriate phrasing can process a sound file to mark the beginnings and endings of words and examine the length of pauses between words. Consider the following sentence: After Lucy completed her homework, she ate peaches, bananas, and cherries. One would expect a reader to pause at a comma that indicates a clause boundary, such as the boundary between *homework* and *she*, but not pause at a comma that is used to separate words in a list, such as the boundary between *peaches* and *bananas* (e.g., Chafe, 1988). In addition, speech analysis software allows a researcher to extract information concerning changes in pitch. Several studies have shown that good readers mark the end of a declarative sentence with a decrease in pitch, while some questions elicit a raise in pitch at the end of the question (Miller & Schwanenflugel, 2006, 2008). Using software like Praat allows a researcher to measure the change in pitch made by readers on the last word of a sentence. In the current study, we used Praat to examine a number of characteristics (pause patterns and pitch changes) of oral reading related to prosody.

## The role of prosody in reading

Skilled readers are those who have mastered automaticity with words and phrases and are capable of performing text-level cognitive processes like comprehension. Less skilled readers struggle with basic components of reading, such as letter-sound recognition and word recognition. Many less skilled readers depend heavily on punctuation to identify

prosodic features. This method, when used for oral reading, often produces inappropriate prosody. As mentioned earlier, readers should pause at commas that separate clauses, but not commas that separate words in a list. One of the challenges that oral readers must face is learning when punctuation coincides with the appropriate prosodic feature and when it does not (Miller & Schwanenflugel, 2006). However, this means that less skilled readers must have a fundamental understanding of both the appropriate prosodic features and the underlying meaning of the text that supports them. This can be quite difficult to manage for a less skilled reader.

Cutler and Swinney (1987) examined the use of semantic and prosodic cues and found that children and adults exhibited differences in the type of cues they use to comprehend speech. Using an on-line target word monitoring task, their study revealed that in the early years, children focus primarily on semantic structure to process speech. Younger and older children, as well as the adults in their study, were sensitive to a semantic feature of the target words. That is, the participants took longer to detect closed class target words (i.e., articles and conjunctions) compared to open class target words (i.e., verbs and nouns). However, the youngest children in the study did not display any sensitivity to a prosodic cue, while the older children and adults were faster at detecting a target word that was accented compared to an unaccented target word. The accented words were spoken with longer durations, more pitch variability, and greater intensity. Cutler and Swinney (1987) concluded that between four and six years of age, children develop the ability to exploit both semantic and prosodic information during language processing.

Snow, Coots, and Smith (1982) demonstrated the importance of prosodic cues for less skilled readers. They concluded that poor readers improved their comprehension substantially when they were able to listen to the material aloud as they read silently. Schrieber (1987) inferred that since children use prosodic cues as an important tool for understanding several different levels of meaning for spoken sentences, the absence of these prosodic cues in text may account for the difficulty many less skilled readers have with reading comprehension.

Schwanenflugel, Hamilton, Wisenbaker, Kuhn, and Stahl (2004) studied prosodic skills among 120 second and third grade children. They characterized some of the prosodic features that change as a child develops fluent word decoding skills. As children become fluent decoders, they read with shorter pauses, steeper sentence-final declines in pitch, and with a more adult-like prosodic contour. Once a reader becomes a skilled decoder and reads fluently, he or she has more attention and resources available to engage in additional processing required for prosodic oral reading. Thus, children with faster decoding speeds are more likely to read prosodically than children who have slower decoding speeds.

Miller and Schwanenflugel (2006) established a relationship between prosody and reading comprehension. They tested 80 third graders, and found that children who were better readers made fewer and shorter pauses. In contrast, less skilled children paused often within and between sentences. Unlike their more skilled counterparts, less skilled readers made long pauses at every comma, regardless of whether the comma merely separated words in a list or if the comma separated phrases. Skilled readers also made more appropriate and larger pitch changes in oral reading. Miller and Schwanenflugel (2006) found that while variables related to pitch (i.e., declination in pitch for declarative sentences and a rise in pitch for yes/no questions) were linked to reading comprehension, pausing variables were not directly related to reading comprehension. Rather, pausing seemed to be more directly associated with decoding skills. Interestingly, when Miller and Schwanenflugel (2008) conducted a longitudinal study in which they tested 92 first grade students, they did find that both aspects of prosody, pausing, and pitch elements were related to reading comprehension.

Furthermore, Ravid and Mashraki (2007) found a relationship between prosody and reading comprehension among Hebrew-speaking children. In this study, 51 nine and ten-year-olds were asked to read a passage aloud, from which they extracted prosodic variables, and were tested on reading comprehension and morphology. Results of a multiple regression analysis suggested that variance in prosodic reading was explained by measures of reading comprehension and morphology. All three constructs were strongly correlated with each other such that the higher the reading comprehension score, the higher the prosodic score. Moreover, Ravid and Mashraki (2007) found that reading comprehension was more likely to occur when children read passages with fluency and expression.

The purpose of the current study was to further explore the relationship between prosody and reading comprehension in skilled and less skilled adult readers. This study differs from previous studies in that our less skilled population was comprised of low literate adult students who were enrolled in Adult Basic Education classes. Low literate adult reading populations are underrepresented in research even though approximately 90 million adults in the United States have limited or extremely limited reading skills (U.S. Department of Education, 2002). Since low literate adults' oral language skills may be slightly better than their reading skills, we wished to examine how their prosodic skills compared to skilled readers. In this study, adults with low literacy skills and skilled adult readers read a passage from which we extracted information on pauses and pitch changes using computer software. For pauses, we examined the length of time between words, commas that separated adjectives in a list, commas that separated phrases, pauses at the end of sentences, and pauses after quotations. We also measured the number of word and sentence intrusions during oral reading. That is, the number of times a reader either stumbled over a word, or made an inappropriate pause during the reading of a sentence. For pitch changes, we examined declinations at the end of declarative sentences, pitch increases at the end of yes/no and wh-questions, and pitch variability within declarative sentences. Finally, for the adults with low literacy skills, we collected information on decoding, word recognition, and reading comprehension skills.

Adults with low literacy skills have word decoding problems (Greenberg, Ehri, & Perin, 1997, 2002; Thompkins & Binder, 2003) and decoding problems might W – if adults with low literacy skills follow a similar developmental reading trajectory of children learning to read. Thus, we expected that adults with low literacy skills would have more lengthy pauses at all punctuation marks, not just ones that marked meaningful syntactic boundaries. In addition, we expected less variation in pitch across sentence final positions compared to skilled readers. If oral language experience compensates for poor decoding abilities then the less skilled adults' prosody patterns might mirror the skilled adults. Finally, we expected that the prosody variables would explain variance in reading comprehension ability for adults with low literacy skills.

## Method

### Participants

The participants included 57 adults from Adult Basic Education classes in Western Massachusetts. Of the 57 participants, only 52 completed both days of testing. There were 22 males and 35 females from a wide range of ages and diverse ethnic backgrounds. These participants received a monetary incentive.

Data were also collected from 28 female college students enrolled in a small liberal arts college in Western Massachusetts, who served as our skilled reader comparison group. For their participation, students received research credit.

## Materials

We decided to use a narrative text because nearly all other studies that have examined prosody have used narratives (e.g., Cowie et al., 2002; Miller & Schwanenflugel, 2006; Ravid & Mashraki, 2007; Schwanenflugel et al., 2006). We imagine this is because participants are more likely to read with expression when reading a narrative story as opposed to an expository text. The participants read a narrative fictional story consisting of three paragraphs (31 sentences and 357 words) detailing the relationship between two characters. The passage is provided in the Appendix. The passage was created to allow for various prosodic components to be extracted. Five types of pausal cues and three types of pitch cues were embedded in the passage. Pause types consisted of pauses after four pre-selected words, three complex adjectival commas, three phrase final commas, four sentence final pauses, and four basic quotatives. The passage also included four declarative sentences without commas. From these sentences, we counted the number of times the readers stumbled on a word, and the number of inappropriate pauses between words. For pitch cues, we examined three declarative sentences for sentence final pitch declinations, three wh-questions and three yes/no questions for sentence final pitch increases. We also examined pitch variability within four declarative sentences.

**Word Attack (WA) test—**The less skilled readers were administered a number of tasks that measured basic reading skills. The Word Attack subtest of the Woodcock Johnson assesses an individual's phonological decoding ability of non-words (Woodcock, 1987). The participant was presented with 45 non-words, such as *nat* or *ib*, and were asked to read them aloud. A correct response elicited a point only if the whole word was pronounced correctly. No response, incorrect syllable pronunciation, or reading the syllables disjointedly resulted in no points. The test was discontinued when the participant answered six items incorrectly.

**Phoneme Segmentation Fluency (PSF)—**This subtest of the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) measures phonological awareness by testing the ability to break real words into their subsequent phonemes. The examiner presented a word orally to the participant and asked the participant to say all the sounds in the word. For example, if given the word *mop*, the correct response would be */m/ /o/ /p/*. Participants were timed for one minute and told to sound out as many words as possible in that time. Participants needed to say each individual sound to receive full credit. The correct number of phonemes per minute determined the phoneme segmentation fluency rate (Good, & Kaminski, 2002). While this measure was designed to assess children's phonological awareness, a recent study (Binder, Snyder, Ardoin, & Morris, 2011) has demonstrated that this measure is reliable and valid for use with adults who have low literacy skills.

**Letter-Word Identification (LWI) and Passage Comprehension (PC)—**These subtests of the WJ-III were administered to measure general reading achievement (Woodcock, 1987). Letter-Word Identification assesses the participants' abilities to recognize and pronounce individual letters and words. Participants were shown pages with letters and groups of single words which progressed in difficulty and asked to identify specific letters/words. Testing was suspended when participants answered six words incorrectly.

For the Passage Comprehension subtest, participants were asked to read a series of sentences, each with a missing word, and supply the missing word. Testing was suspended when participants provided six incorrect responses.

### Procedure

The tasks were administered to the participants in two 30 minute sessions over a two-day span. The order of the sessions as well as the order of the tasks within the sessions was counterbalanced. All participants were audio-recorded during the testing sessions. Testing took place in a quiet classroom at the Adult Basic Education center for the adults with low literacy skills and in a research lab at the college for the skilled readers.

### Analysis Summary

We examined five types of pauses: pauses between words, after adjectival commas, after phrase final commas, after a sentence final period, and after a quotative. To establish the pause duration, we located the end of the word before the pause and found the beginning of the next word, and we marked each of those boundaries using Praat. We then extracted the pause duration, which was measured in milliseconds. We had several observations for each pause type (words – 4; adjectival commas – 3, phrase final comma – 3, sentence final position – 4, and quotatives – 4), and we averaged across those observations to get an average for each pause type for each participant.

We were also interested in examining word and sentence intrusions during reading. Four declarative sentences were selected from the passage that did not include any commas. First, we counted the number of words readers had difficulty reading. This was our measure of word intrusions. Second, we counted the number of times within those sentences that readers paused when there was no reason to pause (e.g., there was no comma present). This was our measure of sentence intrusions. We averaged across the four sentences to get an average word intrusion score and a sentence intrusion score.

Pitch changes were also measured in basic declarative sentences by subtracting the pitch at the end of the sentence from the last pitch peak of the final word of the sentence. We measured pitch changes in wh- questions and yes/no questions by subtracting the pitch at the end of the question from the last pitch valley of the final word of the sentence. There were three items for each of the three sentence types and for each sentence type the three respective pitch changes were averaged for each of the three conditions. In addition, to examine pitch variability, an additional four declarative sentences were selected. The pitch highs and lows were extracted from the sound files and then the lowest pitch in the sentence was subtracted from the highest pitch in the sentence. We then averaged across those four items to create pitch variability means for each participant.

## Results

We ran a 5 (pause type) × 2 (skill level) mixed ANOVA in which pause type was the repeated measure and skill level was the between groups variable. Less skilled readers ($M$ = 393 ms) had longer pauses compared to skilled readers ($M$ = 289 ms), $F(1, 78) = 15.16$, $MSe$ = 977,520, $p < .001$. Although there was no difference in the length of a pause between words ($M$ = 69 ms) and adjectival commas ($M$ = 109 ms), participants paused longer after phrase final commas ($M$ = 213 ms) compared to word and adjectival commas ($p$s < .001). Participants paused longer at the sentence final position ($M$ = 601 ms) compared to word, adjectival, and phrase final comma (all $p$s < .001), and finally participants paused for the longest amount of time after quotatives ($M$ = 712 ms) compared to all other pauses. This was supported by a significant main effect of pause type, $F(4,312) = 254.58$, $MSe$ = 24,995, $p < .001$. There was a significant interaction between pause type and skill level, $F(4, 312) = 2.43$, $MSe$ = 24,995, $p < .05$. Post-hoc tests revealed that adults with low literacy skills paused longer between words, after adjectival commas, and after phrase final commas compared to skilled readers ($t$s (79) = 3.3, 2.9, 4.4, $p$s < .001, respectively). However, there

were no differences between the skill levels for pauses after sentence final positions or quotatives (*p*s > .05). See Figure 1 for means and standard errors.

To examine inappropriate pausing within words and sentences, we subjected the intrusion measures to a 2 (intrusion type) × 2 (skill level) mixed ANOVA in which intrusion type was the repeated measure and skill level was the between groups variable. As predicted, adults with low literacy skills had more intrusions (*M* = .952) compared to skilled readers (*M* = .174), $F(1,78) = 35.35$, $MSe = .623$, $p < .001$. In addition, readers were more likely to have intrusions in sentences (*M* = .844) compared to words (*M* = .282), $F(1, 78) = 67.7$, $MSe = .170$, $p < .001$. Finally, adults with low literacy skills displayed more word and sentence intrusions compared to skilled readers, but the magnitude of that difference was much greater for sentence intrusions compared to word intrusions. This was supported by a significant interaction, $F(1, 78) = 19.71$, $MSe = .170$, $p < .001$. See Figure 2 for means and standard errors. Thus, much like children learning to read, adults with low literacy skills pause more frequently than skilled readers.

Next, we analyzed pitch changes at the end of sentences and questions. Those changes were subjected to a 3 (sentence type) × 2 (skill level) mixed ANOVA in which sentence type was the repeated measure, and skill level was the between groups variable. As expected, skilled readers had greater pitch changes (*M* = 32.91) compared to adults with low literacy skills (*M* = −0.77), $F(1,79) = 16.49$, $MSe = 3781$, $p < .001$. Also as predicted, a pitch decrease was associated with declarative sentence endings (*M* = –42.77), while there was a pitch increase associated with both wh- (*M* = 47.04) and yes/no questions (*M* = 43.93), $F(2,158) = 60.18$, $MSe = 3164$, $p < .001$. Inconsistent with past research (Chafe, 1988; Miller & Schwanenflugel, 2006), there were no differences in pitch increases between the two question types (*p*s > .05). Thus, our participants always had a rise in pitch at the end of both types of questions – not just yes/no questions. Sentence type and skill level produced a significant interaction, $F(2,158) = 10.35$, $MSe = 3164$, $p < .001$. Post hoc analyses revealed that while skilled (*M* = –50.19) and less skilled (*M* = –35.34) readers did not differ in terms of pitch decreases at the end of declarative sentences, $t(79) = –1.06$, $p > .05$, skilled readers had significantly higher pitch increases for both wh- (*M* = 78.31) and yes/no questions (*M* = 70.60) compared to adults with low literacy skills (*M* = 15.76; *M* = 17.26, $t(79) = 5.85$, $p < .001$; $t(79) = 3.43$, $p < .001$, respectively). See Figure 3 for means and standard errors. Thus, while both groups of readers had similar pitch profiles across declarative sentences, the pitch profiles of adults with low literacy skills were fairly flat for questions.

From the previous analysis, it appeared that adults with low literacy skills had less variation in their pitch. Thus, we wanted to examine pitch variability more closely across a set of declarative sentences. We subjected the mean difference between the high and low pitches within declarative sentences to a one-way ANOVA in which the pitch difference was the dependent variable and skill level was the between groups variable. As predicted, we found there was a greater difference for the skilled readers (*M* = 238.80) compared to the adults with low literacy skills (*M* = 182.91), $F(1, 78) = 10.60$, $MSe = 5366$, $p < .01$. Skilled readers do in fact display much more variable pitch profiles while reading compared to adults with low literacy skills.

For the adults with low literacy skills, we also conducted correlational analyses in which WA, DIBELS PSF, LWI, and PC were correlated with the prosody measures (pauses: words, adjectival commas, phrase-final commas, sentence final position, and quotatives; intrusions: word and sentence intrusions; pitch: declarative, wh-questions, yes/no question, and pitch variability). In addition, we calculated the words read correctly per minute (WCPM) for the passage in order to have another measure of reading ability. Table 1 contains the descriptive statistics for these measures, while Table 2 contains the correlation

coefficients. Consistent with the work of Schwanenflugel et al. (2004), the decoding/word recognition variables were all negatively correlated with both intrusion measures. Thus, the lower the participants' word decoding/recognition skills, the more inappropriate pauses they made both within words and within sentences. Additionally, both DIBELS PSF and LWI were negatively correlated with pauses at adjective comma boundaries, and DIBELS PSF was also negatively correlated with pauses at phrase-final boundaries. DIBELS PSF was also negatively correlated with two pitch variables: declarative sentences and overall pitch variability. LWI was also negatively correlated with overall pitch variability. PC was negatively correlated with adjectival and phrase-final pauses, and with both intrusion measures. WCPM was negatively correlated with both intrusions measures, too. Interestingly, no pitch measures were correlated with comprehension or WCPM.

Finally, we ran two hierarchical regression analyses in order to determine how much additional variance the prosody measures would contribute to the explanation of reading behavior above word decoding and recognition. For the first analysis, PC was our outcome measure, and WCPM was the outcome measure in the second analysis. In the first block, we entered WA, LWI, and DIBELS PSF, and the regression equation was significant, $F(3, 45) = 20.01$, $p < .001$, accounting for 57.2% of the variance in PC. In the second block, we added the two comma pause measures and the two intrusion measures. There was a significant increment in $R^2$, $F(4, 41) = 4.60$, $p < .01$. The prosody measures explained an additional 13.3% of the variance in PC, bringing the full model to 70.4%. In the second analysis in which we used WCPM as the outcome measure, the regression equation for the first step was significant, $F(3, 47) = 7.67$, $p < .001$, accounting for 32.9% of the variance in WCPM. In the second block, we added the two intrusion measures. There was a significant increment in $R^2$,$F(2, 45) = 4.98$, $p < .01$. The prosody measures explained an additional 12.2% of the variance in WCPM bringing the full model to 45.0%. Thus, prosody measures do explain variance in reading comprehension and rate for adults with low literacy skills.

## Discussion

The purpose of this study was to examine the prosodic characteristics of the oral reading behavior of adults with low literacy skills. We explored the relationships among prosody, decoding, word reading, reading comprehension, and reading rate and found four main findings. First, similar to less skilled children, adults with low literacy skills made long pauses and seemingly viewed nearly all punctuation as obligatory signals to pause. They stumbled on more words (i.e., word intrusions) and had more irrelevant pauses within sentences (i.e., sentence intrusions). Second, while adults with low literacy skills marked the end of declarative sentences with a pitch declination similar to skilled readers, their readings of questions was quite flat (i.e., lack of change in pitch). Overall, adults with low literacy skills displayed less pitch variability compared to skilled readers. Third, decoding and word recognition skills were related to pauses during reading; readers with lower skills made longer and more frequent and inappropriate pauses. Finally, pausing measures explained a significant amount of variance in reading comprehension and reading rate among the adults with low literacy skills.

Our pause data on adults with low literacy skills corresponds with pause data of less skilled children (Miller & Schwanenflugel, 2006, 2008; Schwanenflugel et al., 2004). Adults with low literacy skills used every punctuation mark as a cue to pause. The adults with low literacy skills in the current study paused significantly longer than the skilled readers at all commas, not just the commas that ended a clause. Pausing at clause boundaries allows a reader to wrap-up ideas and extract the gist of the text (Rayner, Kambe, & Duffy, 2000), whereas the same is not true for commas that separate adjectives in a list. Better readers recognize this distinction and allocate attention accordingly (Stine-Morrow et al., 2010).

Additionally, the adults with low literacy skills made more word and sentence intrusions compared to the skilled adult readers. Thus, these readers made a number of inappropriate pauses while reading. Our findings are quite similar to work conducted with children: studies have found greater prosody in children with better reading skills. Schwanenflugel and colleagues (Benjamin & Schwanenflugel, 2012; Miller & Schwanenflugel, 2006, 2008) argue that children with quick and accurate oral reading make fewer and shorter pauses in general, and children who have decoding difficulties pause longer. Intrusions are linked to decoding skills. Schwanenflugel et al. (2004) argue that fluent word decoding skills free up attentional resources so that they are available for prosodic reading. Prosodic reading would seem to serve mainly as evidence that children have automatic decoding skills.

Why do adults with low literacy skills and other poor readers pause so much while reading? According to the compensatory-encoding model (Walczyk, Marsiglia, Johns, & Bryan, 2004), readers will compensate for poor decoding and/or working memory skills by slowing the rate at which they read, pausing more often while reading, and re-reading prior text. These compensations allow readers to maintain certain levels of comprehension, even while their lower level skills are lacking. This means that poor readers will pause more often; however, such pausing serves the constructive purpose of allowing more time for cognitive processing. For instance, poor readers may use their pauses to a) allow extra time to activate the meaning of a low frequency word; b) to condense and integrate the ideas contained in the material before a punctuation mark; and c) to rehearse what was recently read.

The adults with low literacy skills in our study produced an interesting pattern of data for our pitch measures. First, the adults with low literacy skills performed similarly to the skilled adults in marking the end of declarative sentences with a pitch declination. This replicates findings by several researchers (Clay & Imlach, 1971; Dowhower, 1987; Miller & Schwanenflugel, 2006). However, their readings of questions were quite flat, while our skilled readers exhibited a pitch increase at the end of questions, which is a pattern that is replicated in other studies (Miller & Schwanenflugel, 2006, 2008; Schwanenflugel et al., 2004). Why would our adults with low literacy skills resemble skilled readers for declarative sentences, but not for questions? It may simply be a frequency effect: readers encounter more declarative sentences compared to questions, so they are quite familiar with hearing pitch decreases at the end of declarative sentences. Another possibility is that questions require more cognitive load. The higher the load, the fewer resources a reader has to devote to other skills, such as prosody. In addition, the overall pitch variability of the adults with low literacy skills was quite flat compared to the skilled readers. Thus, while adults with low literacy skills do display a decrease at the end of declarative sentences, the rest of their readings of those sentences do not vary much in terms of pitch. These readers have significant decoding problems, so they may be putting nearly all of their resources into recognizing individual words, and thus do not have enough remaining resources to vary their pitch across those sentences. In a longitudinal study, Miller and Schwanenflugel (2008) found that pitch variability increases across grade level. Thus, as the adults with low literacy skills gain better decoding and word recognition skills, we would expect their pitch variability to increase.

We had a range of abilities within our low literate adult sample for decoding, word recognition and comprehension abilities. We hypothesized that there would be relationships between pausal duration and other variables of reading skills. We expected that the difference between adjective pause length and clause pause length would correlate with other variables in reading skills, and this is indeed what we found. Readers with better decoding and word reading skills paused less frequently and for shorter durations than readers who had poorer decoding and word reading skills. Readers who experience fewer word and sentence intrusions had better comprehension abilities. In addition, these pause

measures explained variance in reading comprehension. Thus, similar to other studies (Miller & Schwanenflugel, 2006, 2008; Ravid & Mashraki, 2007), prosody seems to be related to reading comprehension for adults with low literacy skills.

Given the relationship between prosody and comprehension, future research needs to investigate an effective means to enable readers to read with fewer pauses and with greater expression (i.e., pitch) while reading. One intervention that has shown some promise is repeated readings. Dowhower (1987) examined how the use of repeated reading influenced the prosodic characteristics of reading. In a repeated reading method, typically, a student is given the same passage to read over and over until a certain level of fluency is obtained. Using this method, readers demonstrate gains in reading rate and word recognition ability (Ardoin, Eckert, & Cole, 2008; Therrien, 2004). Additionally, Dowhower (1987) found that this method also produced increases in prosodic reading: from the first to the final reading, readers made fewer inappropriate pauses and had greater decreases in pitch at the end of declarative sentences. Thus, this method might prove useful within an Adult Basic Education setting to help adults with low literacy skills become better, more expressive readers.

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## Appendix

Long before colonial times, [3] in the hilly region of France, [3] there was a young, silly, [2] rich prince in search of a lover. All his wealth did not make a difference because he was very lonely [1] in his cold, large, [2] empty palace. He wanted a lady to cook him dinner and clean his dirty home. [9] He needed to add flavor to his cookery and style to his dull house [6]. But first he had to make a confession. Before he was a prince, what did he do [8]? He was a beggar and a thief. [9] He entered the lottery [1] and became a winner. Despite his financial security, he was afraid, lonely, [2] and secretive. Wasn't it a fearsome worry that someone [1] would discover his past [7]?

One day a pretty woman [1] wearing a stylish dress with a flowery design walked by the castle. [4] What was she doing [8]? She was singing a beautiful melody. He looked at her with intensity and liked her sparkly earrings and blond hair. [4] He was drawn to her natural beauty. [9] What did he do then [8]? He went up to her with confidence and said, "I'd like to invite you to the annual music convention." [5] Realizing his sincerity and charming good looks, she said, "Yes, I'd like to go." [5] They sat on the grass beneath a shady tree to enjoy the serenity of the afternoon and discuss their mutual preference for classical music [6]. He took her to the opera and the ballet. [9]

The prince could not stop smiling because he felt so lucky. Did the couple begin spending every moment together [7]? Sure they did [6]. The prince's friends said, "Your dependence on her shows your stupidity and lack of maturity." [5] He was hurt by the severity of their opinions. [4] But didn't he hover and cling to her the majority of the time [7]? He gave her a hundred presents and asked her to marry him. She explained, "Since I am the youngest daughter, I have to stay home and take care of my mother. It's about my cultural beliefs." [5] He looked at her in puzzlement and his heart broke to pieces. [4] He was alone again, [3] still in search of his princess.

[1] = word pause

[2] = adjective pause

[3] = clause boundary pause

[4] = sentence boundary pause

[5] = quotative boundary pause

[6] = declarative pitch change

[7] = yes/no question pitch change

[8] = wh- question pitch change

[9] = declarative sentence for which pitch variability and word and sentence intrusions

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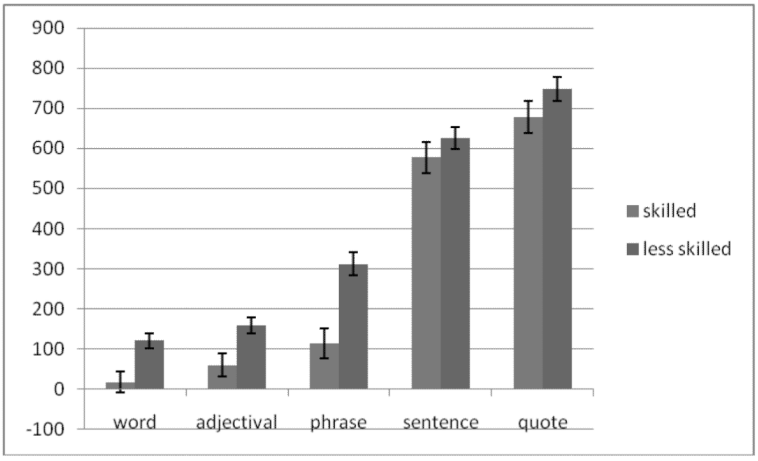


**Figure 1.**
Mean Pause Duration for Each Condition. Error bars show the Standard Error of the Mean.

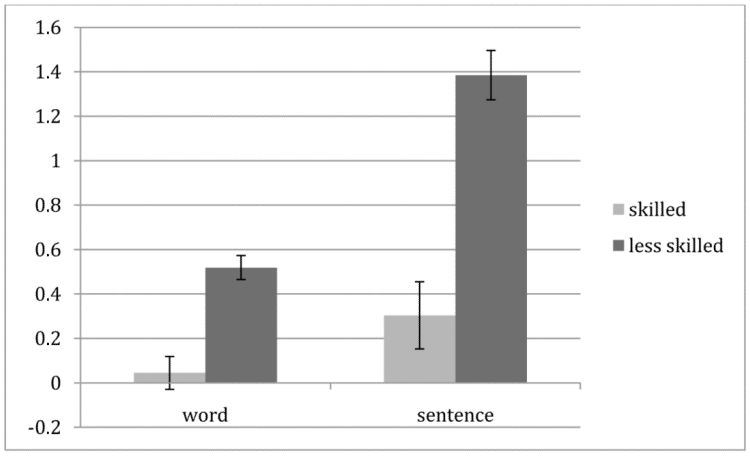


**Figure 2.**
Mean Number of Word and Sentence Intrusions across Conditions. Error bars show the Standard Error of the Mean.

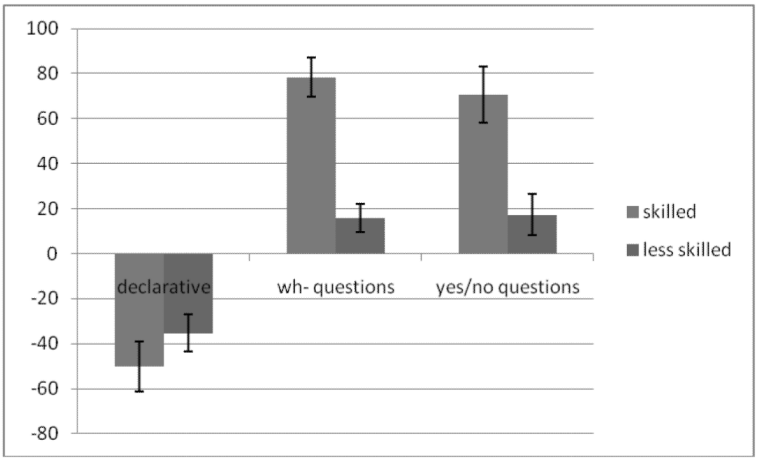


**Figure 3.**
Interaction between Pitch types and Skill levels.

**Table 1**

Descriptive Statistics for all Measures for the Adults with Low Literacy Skills

| Measure | Mean | Standard Deviation | Minimum Score | Maximum Score |
|---|---|---|---|---|
| DIBELS PSF | 25.08 | 11.05 | 1 | 46 |
| Letter Word Identification | 53.87 | 10.99 | 26 | 72 |
| Word Attack | 20.77 | 6.70 | 7 | 30 |
| Passage Comprehension | 27.60 | 5.35 | 16 | 37 |
| WCPM | 103.15 | 29.94 | 32.41 | 163.82 |
| *Pauses* | | | | |
| Words | 121 ms | 162 ms | 0 ms | 754 ms |
| Adj. Commas | 157 ms | 169 ms | 0 ms | 799 ms |
| Phrase Commas | 314 ms | 234 ms | 0 ms | 1136 ms |
| Sentences | 633 ms | 219 ms | 287 ms | 1194 ms |
| Quotatives | 747 ms | 250 ms | 287 ms | 1291 ms |
| *Intrusions* | | | | |
| Words | .519 | .480 | 0 | 2.25 |
| Sentences | 1.39 | .950 | 0 | 4.5 |
| *Pitch Changes* | | | | |
| Declarative | −35.38 Hz | 62.12 Hz | −250.64 Hz | 147.40 Hz |
| Wh- Questions | 15.76 Hz | 35.21 Hz | −127.05 Hz | 111.87 Hz |
| Yes/No Questions | 17.26 Hz | 37.09 Hz | −106.39 Hz | 91.91 Hz |
| Pitch Variation | 182.91 Hz | 78.42 Hz | 24.25 Hz | 394.44 Hz |

**Table 2**

Correlations between Decoding/Word Recognition and Comprehension Measures and Prosody Measures for Adults with Low Literacy Skills

| Prosody Types | Word Attack | DIBELS PSF | Letter Word Identification | Passage Comprehension | WRCM |
|---|---|---|---|---|---|
| *Pauses* | | | | | |
| Words | −0.201 | −0.100 | −0.255 | −0.046 | −.241 |
| Adj. Commas | −0.246 | −0.360** | −0.366* | −0.329* | −.173 |
| Phrase Commas | −0.120 | −0.271* | −0.120 | −0.388* | −.122 |
| Sentences | 0.062 | −0.151 | −0.023 | −0.131 | −.143 |
| Quotatives | −0.231 | −0.002 | −0.124 | −0.142 | −.223 |
| *Intrusions* | | | | | |
| Words | −0.507** | −0.280* | −0.640** | −0.536** | −.444** |
| Sentences | −0.540** | −0.467** | −0.679** | −0.602** | −.624** |
| *Pitch Changes* | | | | | |
| Declarative | −0.083 | −0.283* | −0.103 | −0.089 | −.050 |
| Wh- Questions | 0.117 | 0.142 | 0.098 | −0.118 | ..092 |
| Yes/No Questions | 0.250 | 0.056 | 0.123 | 0.036 | .176 |
| Pitch Variation | −0.237 | −0.305* | −0.288* | −0.261 | −.050 |

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