# Sensitivity to Lexical and Metrical Stress in Phonological Awareness and Early Reading Development

Ilana Goodman, Lesly Wade-Woolley, and Amanda Libenson

Queen's University at Kingston, Ontario, Canada

## Introduction

Although there is a research consensus that phonological awareness strongly contributes to reading development (Rayner, Foorman, Perfetti, Psetsky, & Seidenberg, 2001), it cannot account for all of the variance in reading achievement. Because oral language competency is connected with reading aptitude, reading researchers have begun to consider that the cognitive mechanisms involved in oral language competency might also be important for the development of phonological awareness and reading.

Prosodic sensitivity, the awareness of the underlying rhythmic patterns of spoken language based on stress and tone, is considered important by language researchers for segmenting continuous speech into words, and may also play a meaningful role in reading and phonological awareness development. There are two components of linguistic stress; metrical stress is the rhythmic pattern that occurs across a phrase or several syllables and lexical stress is the linguistic stress that occurs within a word (e.g., desert vs. dessert). Recent research has provided some evidence for a relationship between linguistic stress sensitivity, phonological awareness and reading; however, the nature of this relationship requires further investigation (Wade-Woolley & Wood, 2006). Holliman, Wood and Sheehy (2005) found that the variance in children's sensitivity to lexical stress was significantly related to high and low levels of phonological awareness and reading. As well, Wood and Terrell (1998) found that poor readers have poorer sensitivity to metrical stress. However, these previous studies did not examine whether prosodic sensitivity could explain variance in reading after controlling for phonological awareness. The previous studies also did not examine lexical and metrical stress within the same study.

## Objectives

1. Does prosodic sensitivity explain variability in phonological awareness?
2. Does prosodic sensitivity explain individual differences in reading that are not explained by phonological awareness?
3. Do lexical and metrical stress sensitivity make differential contributions to phonological awareness and reading?

## Methods

**Participants and Procedure**

Forty-five children in senior kindergarten ($M$ = 67.22 months, $SD$ = 3.48) were used in these study's sample. All of the participants attended one of 4 elementary schools or 2 daycares in Eastern Ontario. Each child participated in four separate test sessions lasting approximately 20 minutes.

**Control Measures:**

*Matrix Analogies Task (MAT) (Naglieri, 1985).* To test their non-verbal intelligence, children must select the missing piece or part of a pattern from 5 or 6 alternatives.

**PA Measures:**

*Peabody Picture Vocabulary Test (PPVT-III) (Dunn & Dunn, 1997).* To measure their receptive vocabulary, children are shown a set of four pictures and asked to choose the one that best illustrates the word stated by the experimenter (e.g., *show me 'ball'*).

*Phoneme Deletion (Wood & Terrell, 1998).* The child is required to either delete the initial or final phoneme from an uttered word. For example, the child would hear the word 'told' and the correct answer would be 'old'.

*Phoneme Blending (Comprehensive Test of Phonological Processing: CTOPP; Wagner, R. K., Torgesen, J. K., & Rashotte, C. A., 1999).* The child hears separate phonemes or syllables and must combine them into one word. For example, the child must combine /i/ and /t/ into the word 'it'.

*Sound Matching Task (CTOPP).* The child is required to identify the word in a series of three that bests matches a target word. For example, the experimenter asks 'which word starts with the same sound as *pan*? *Pig*, *hat* or *cone*?'

**Linguistic Stress Measures:**

*The Mispronunciation Task* (*Wood, 2006).* This task measures lexical stress and requires the child to recognize disyllabic words when they are presented with inversed syllabic stress. For example, the word CLOset is heard as cloSET and the word RaCOON is heard as RAcoon. The children must identify the correct object in a cross-section of a house.

*Compound Nouns Task (Wells & Peppe, 2003).* The children are shown two sets of drawings that contain a different number of pictures that depict compound nouns or non-phrases that differ by prosodic features (intonation, stress and pause) (e.g., *foot, ball, and socks* = three items vs *football and socks* = two items). Children are told to select the set of drawings that best illustrates what they have heard on a recording.

**Reading Measures:**

Reading accuracy was measured by the *Word Identification* subtest of the *Woodcock Reading Mastery Test Revised (Woodcock, 1998)* and the *Reading Subtest* of the *Wide Range Achievement Test 3 (Wilkinson, 1993)*. Both require the children to read words of increasing difficulty.

*Letter-Sound Identification.* Children are presented with the letters of the alphabet in random order and required to provide at least one of the corresponding sounds

## Results

**Question 1: Do lexical and metrical stress make independent contributions to phonological awareness?**

All three measures of phonological awareness were significantly correlated and were thus combined into a composite variable. A hierarchical linear regression was conducted to test whether lexical and metrical stress sensitivity could explain unique variance in phoneme awareness over and above the variance explained by verbal and non-verbal intelligence. Together, lexical stress sensitivity and metrical stress sensitivity accounted for an additional 29.0% of the variance in phoneme awareness, $F$ (2, 40) = 10.42, $p$ < .01 beyond the variance explained by verbal and non-verbal intelligence. When entered separately into different steps of the regression, lexical stress sensitivity accounted for an additional 19.4% of the variance after controlling for metrical stress sensitivity and intelligence, $F$ (1, 40) = 13.92, $p$ < .01 (See Table 1).

**Table 1.**
***Hierarchical Regression Analysis for Variables Explaining Phonological Awareness* (N = 45)**

| Step | ¶§$^2$ | Variable | Final $\beta$ | $t$ | $p$ |
|---|---|---|---|---|---|
| 1. | .16 | Verbal Intelligence | .20 | 1.47 | .15 |
| | | Non Verbal Intelligence | .02 | .151 | .88 |
| 2. | .09 | Metrical Stress | .22 | 1.79 | .08 |
| 3. | .19 | Lexical Stress | .51 | 3.73 | .001 |

* p < .05

**Table 2**
***Hierarchical Regression Analysis for Variables Explaining Reading* (N = 45)**

| Step | ¶§$^2$ | Variable | Final $\beta$ | $t$ | $p$ |
|---|---|---|---|---|---|
| 1. | .05 | Verbal Intelligence | .16 | 1.00 | .32 |
| | | Non Verbal Intelligence | -.08 | -.47 | .64 |
| 2. | .03 | Metrical Stress | .09 | .62 | .54 |
| 3. | . 15 | Lexical Stress | .45 | 2.81 | .01 |

* p < .05

**Table 3.**
***Hierarchical Regression Analysis for Variables Explaining Reading Controlling for Phonological Awareness (PA)* (N = 45)**

| Step | ¶§$^2$ | Variable | Final $\beta$ | $t$ | $p$ |
|---|---|---|---|---|---|
| 1. | .05 | Verbal Intelligence | -.03 | -.32 | .75 |
| | | Non Verbal Intelligence | -.10 | -1.00 | .33 |
| 2. | .03 | Metrical Stress | -.12 | - 1.35 | .19 |
| 3. | .66 | PA | .95 | 8.65 | .001 |
| 4. | .001 | Lexical Stress | - .04 | -.32 | .75 |

* p < .05

However, metrical stress sensitivity did not account for unique variance in phonological awareness after controlling for intelligence and lexical stress sensitivity, F (1, 40) = 3.21, $p$ >.05.

**Question 2: Do lexical and metrical stress explain unique variance in reading beyond phonological awareness?**

Because the three reading measures were found to be significantly they were standardized and averaged into a composite score representing reading ability. A hierarchical linear regression analysis was conducted to test whether lexical and metrical stress sensitivity could explain differential amounts of the variance in reading. Verbal and non-verbal intelligence were controlled for.

When lexical and metrical stress sensitivity were entered independently, lexical stress accounted for a significant 15.2% of the variance in reading after controlling for metrical stress, $F$ (1, 40) = 7.88, $p$ < .05. Metrical stress sensitivity did not account for significant variance in reading once lexical stress was controlled for, $F$ (1, 40) = .388, $p$ > .05 (See Table 2).

In a separate regression, we investigated whether lexical stress sensitivity would account for additional variance in reading beyond phonological awareness. Once phonological awareness was controlled for, lexical stress sensitivity was no longer a significant explanatory variable, $F$ (1, 39) = .100, $p$ < .05 (See Table 3).

## Discussion

The present study sought to determine the roles of lexical and metrical stress sensitivity in the development of reading and phonological awareness development. Our results suggest that lexical stress sensitivity is important in the development of phonological awareness which facilitates greater reading ability. These results are in line with the findings of Holliman, Wood and Sheehy (2005) who also found a relationship between lexical stress and phonological awareness. Better sensitivity to lexical stress may help focus children's attention on the stressed syllable, making it easier to identify the phonemes within a stressed syllable and develop phonological representations (Wood & Terrell, 1998).

In addition, we found that metrical stress did not explain significant variance in reading or phonological awareness. These results differ from the findings of Wood & Terrell (1998) who found that poor readers have poorer sensitivity to metrical stress than typical readers. One major difference between these two studies is the age of the sample used. Wood and Terrell examined 9 year old children who are more advanced readers. As children age and their reading progresses they learn to read polysyllabic words that require the alternation between strong and weak syllables. Therefore, metrical stress sensitivity might be more important for advanced reading. This speculation is supported by a study conducted by David, Wade-Woolley, Kirby, and Smithrin (2007) who demonstrated that non-speech rhythmic sensitivity in kindergarten significantly predicted reading in grade 5, but not in grades 1 through 4.

In sum, the findings of the present study suggest that lexical stress sensitivity might be important for the development of phonological awareness. In contrast, metrical stress sensitivity might become more important during the advanced stages of reading once the role of phonological awareness diminishes. The young sample used in the current design did not allow a relationship to be detected. Future investigations that measure advanced reading are needed in order to adequately examine this possibility.

## References

David D., Wade-Woolley, L., Kirby, J.R., Smithrim, K. (2007), Rhythm and Reading Development in School-Age Children: A Longitudinal Study. *Journal of Research in Reading, 29*, 169-183.

Holliman, A., Wood, C., and Sheehy, K. (2005, June). *Metrical stress sensitivity in beginning readers and its relationship to phonological awareness*. Paper presented at the annual meeting of the Society for the Scientific Study of Reading, Toronto.

Rayner, K., Foorman, B. R., Perfetti, C. A., Pesetsky, D. & Seidenberg, M.S. (2001).

Wade-Woolley, L., & Wood, C. (2006). Editorial: Prosodic sensitivity and reading development. J*ournal of Research in Reading, 29*(3),253-257.

Wood, C. & Terrell, C. (1998). Poor readers' ability to detect speech rhythm and perceive rapid speech. *British Journal of Developmental Psychology, 16,* 397-413.