Investigating the role of prosody in the development of fluent reading

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Abstract:

For nearly thirty years, research has shown that strong sensitivity to phonemic and phonological awareness is an invaluable part of developing strong reading ability. Until recently, however, research in this field has largely ignored the role of prosody, an important phonological component to many languages, in its demonstration of the predictive powers of phonological processing on reading skill. This study presents an analysis of individual differences in children at different levels of reading development and their sensitivity to metrical stress in relation to reading ability. Children with stronger prosodic sensitivity are shown to be more fluent readers, stronger comprehenders, and more accurate decoders. We argue that prosodic sensitivity is related to reading through the development of morphological awareness.

Introduction:

While the importance of phonological awareness is undeniable, it does not account for all of the variance in reading achievement. Most investigations into phonological awareness are limited by their dependence on sub-syllabic elements (phoneme, onset, rime) and therefore do not incorporate supra-segmental information such as linguistic stress. Thus, while existing measures of phonological sensitivity can provide a good insight into simple reading tasks, we may want to look elsewhere for additional sources of variance in more complex reading phenomena, including multi-syllabic word reading and comprehension.

Prosody is composed of the stress and intonation patterns of a language. Metrical stress can be defined as the overall stress pattern across an entire phrase or sentence, while lexical stress is concerned only with the stress pattern of a particular word. Here, we focus on metrical stress, or the alternation of strong and weak syllables across an utterance.

Previous studies have provided strong evidence for the existence of a relationship between prosody and reading and pre-reading ability (e.g. Ashby, J., 2006; Miller, J., & Schwanenflugel, P. J., 2006; Whalley, K., & Hansen, J., 2006; Wood, C., 2006). A few of these studies have found the predictive ability of prosodic skills above and beyond that of phonological awareness on reading ability. For example, Whalley and Hansen found that after controlling for phonological awareness, children with greater prosodic skill had both superior word reading accuracy and reading comprehension than their peers. Through our investigation of children at different stages in reading development, we sought to find evidence of how this relationship between prosody and reading may work.

One possible connection between stress and reading is through morphological awareness. In English, certain affixes drive a lexical stress shift (e.g. -ic; *pho*tograph, photo*gra*phic), while others are stress-neutral; (e.g. -ive; ex*press*, ex*pres*sive). Furthermore, as the majority of multi-syllabic words in English are morphologically complex, and metrical stress assignment is sensitive to the number of syllables in each of the phrase's words, morphologically complex words can alter the metrical pronunciation of a passage while reading. As morphological awareness has been found to be highly predictive of reading ability in later development, past the predictive powers of phonological awareness (e.g. Deacon, S. H., & Kirby, J. R., 2004), it is quite plausible that this relationship between prosody and morphological awareness could carry over to the relationship between prosody and reading.

This study examined how individual differences in metrical stress sensitivity in grade school children related to morphological awareness and reading ability.

Central Questions:

1. Do individual differences in metrical stress sensitivity predict morphological awareness?

2. Do individual differences in metrical stress sensitivity predict reading ability? If so, which part(s): fluency, comprehension, and/or decoding?

Method:

Participants

Sixty-nine students from four different schools in Eastern Ontario, Canada took part in our study: 19 students in grade 3, 25 students in grade 5, and 25 students in grade 7.

Participation was determined entirely by parental consent and student assent; no preliminary screenings for reading ability or other skills were given. All the students who participated in the study were included for analysis here.

Materials

Measures testing cognitive-linguistic skills of the children included:

Matrix Analogies Test (MAT; Naglieri, J. A., 1985): To test their ability in nonverbal analogical reasoning, children were asked to choose which one of five or six options best belonged in a missing section of the picture they were shown. Age-referenced standard scores are used in the analyses.

Peabody Picture Vocabulary Test (PPVT; Dunn, L., & Dunn, L., 1997): As a test of receptive vocabulary, children were asked to choose which one of four pictures best represented a word provided to them by naming the picture by corresponding number (ex. "What number is *dilapidated*?"). Age-referenced standard scores are used in the analyses.

Digits Backwards (Comprehensive Test of Phonological Processing: CTOPP; Wagner, R. K., Torgesen, J. K., & Rashotte, C. A., 1999): As a test of verbal working memory, children were asked to listen carefully to a string of numbers (increasing from 2 to 7 digits in length) and repeat them back in the opposite order.

Measures testing reading foundation skills of the children included:

Phoneme Elision (CTOPP): Children were asked to repeat a word and then to again repeat the word without saying one of the syllables or phonemes (ex. "Say *popcorn*. Now say *popcorn* without the *corn*." "Say *split*. Now say *split* without the /p/.") Age-referenced standard scores are used in the analyses.

Morphological Awareness: This task was adapted from Carlisle (1988). Children were given a stem followed by a sentence that they were asked to complete with a word that was related to the stem (ex. "The word is *remark*. The speed of the car was… [remarkable].")

Prosodic Sensitivity:

Stress Contour Matching: To test their sensitivity to metrical stress, children were asked to wear a pair of headphones and to listen carefully to two sentences. The first sentence played to them was normally recorded and had no distortions (ex. "This is my little brother's favourite toy.") The second sentence played to them was low-pass filtered and was either the same sentence played to them initially, or a sentence matched on the number of syllables which carried a different prosodic contour (ex. "This is my little brother's favourite toy" or "This is Vivian's red apron and shoes."). Low-pass filtering removes the phonemic information and leaves only the intonation contour. Children were asked to judge whether the two sentences were the same or different.

Measures testing reading ability included:

Gray Oral Reading Test (GORT; Weiderhold, J. L., & Bryant, B. R., 2001): To test children's ability in passage reading and comprehension, children read a series of passages of increasing difficulty. Reading was scored by measuring the length of time it took to read the passage and the number of errors made while reading. After each passage, children answered 5 multiple-choice comprehension questions about the passage they had just read.

Sight Word Efficiency (Test of Word Reading Efficiency: TOWRE; Torgesen, J. K., Wagner, R. K., & Rashotte, C. A., 1999): To test word reading accuracy, children were asked to read as many words as possible from a list of words of increasing difficulty in 45 seconds.

Phonetic Decoding Efficiency (TOWRE): As a test of non-word decoding, children were asked to read as many non-words as possible from a list of non-words of increasing difficulty in 45 seconds.

Word Identification (WID; Woodcock, R. W., 1998): As a test of word reading accuracy, children were asked to read a list of words, beginning at a level appropriate for their age group, of increasing difficulty. Reading was not timed, but testing stopped after 6 consecutive errors.

Three composite scores of these reading measures were created for further analysis; a decoding score was created from the scores of TOWRE and WID, a fluency score from the rate and accuracy scores of the GORT, and a comprehension score from the comprehension questions of the GORT.

Procedure

These tasks and others were divided into four batteries of tests, with tasks administered in a fixed order designed to minimize boredom in the children and to keep each session within the timeframe of one half hour or less.

Children were removed from class on different days for a total of 4 or 5 sessions. In each session, children were brought to a quiet, semi-private area within the school to complete the tasks by a trained research assistant.

Results:

1. Do individual differences in metrical stress sensitivity predict morphological awareness?

To answer this question, we first examined a series of zero-order correlations between the cognitive-linguistic abilities, phonemic awareness, morphological awareness and the prosodic sensitivity measure. We found significant correlations between our measures of phonemic awareness, morphological awareness and prosodic sensitivity (see Table 1).

Table 1. **Pearson correlations and significance levels between cognitive-linguistic, reading foundation, and prosodic sensitivity measures.**

	MAT	PPVT	Digits Backwards	Phoneme Elision	Morphological Awareness	Stress Contour Matching
MAT	1	.47**	.09	.38**	.15	.04
PPVT		1	.11	.45**	.48**	.22
Digits Backwards			1	.19	.45**	.23
Phoneme Elision				1	.29**	**.29***
Morphological Awareness					1	**.57****
Stress Contour Matching						1

Note: * denotes significance at the p<.05 level; ** denotes significance at the p<.01 level.

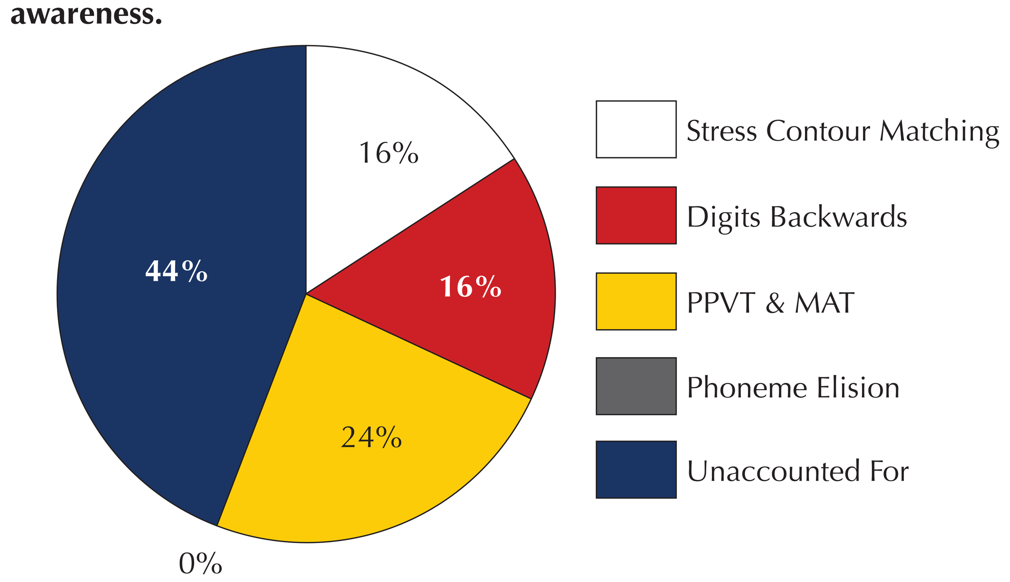
In order to determine whether prosodic sensitivity is a unique predictor of morphological awareness, we carried out a multiple regression analysis with morphological awareness as the dependent variable. We found that metrical stress sensitivity is a significant predictor of morphological awareness, even after controlling for cognitive-linguistic abilities and phonemic awareness (see Table 2 and Figure 1).

Table 2. **Multiple regression showing predictors of Morphological Awareness.**

Step/Variable	R	R^2 Change	F Change	Final β
1. MAT	0.49	0.24	10.39**	-0.06
PPVT				0.41**
2. Digits Backwards	0.63	0.16	16.93**	0.32**
3. Phoneme Elision	0.63	0.002	0.18	-0.06
4. Stress Contour Matching	0.75	0.16	22.80**	0.43**

Note: * denotes significance at the p<.05 level; ** denotes significance at the p<.01 level.

Figure 1. **Distribution of variance contributed by the predictors of morphological awareness.**



2. Do individual differences in metrical stress sensitivity predict reading ability? If so, which part(s): fluency, comprehension, or decoding?

To answer this question, we first examined a series of zero-order correlations between the cognitive-linguistic measures, phonemic awareness, morphological awareness, prosodic sensitivity, and our three reading composite scores. Significant correlations were observed between prosodic sensitivity and reading measures (see Table 3).

Table 3. **Pearson correlations among reading constructs and predictor measures.**

	Fluency	Comprehension	Decoding
MAT	.09	.28**	.14
PPVT	.38**	.54**	.43**
Digits Backwards	.42**	.49**	.41**
Phoneme Elision	.31**	.38**	.38**
Morphological Awareness	.74**	.70**	.78**
Stress Contour Matching	**.40****	**.39****	**.46****

Note: * denotes significance at the p<.05 level; ** denotes significance at the p<.01 level.

In order to determine the relationship between prosodic sensitivity and reading, we carried out three multiple regression analyses with each of the reading composite scores as a dependent variable. We found that metrical stress sensitivity is a significant predictor of all of the reading skills (fluency, comprehension, and decoding), before controlling for morphological awareness (see Table 4).

Table 4. **Multiple regression showing predictors of Fluency, Comprehension and Decoding.**

Fluency				
Step/Variable	R	R^2 Change	F Change	Final β
1. MAT	0.39	0.16	5.98**	-0.08
PPVT				0.04
2. Digits Backwards	0.55	0.15	13.27**	0.11
3. Phoneme Elision	0.56	0.02	1.48	0.12
4. Stress Contour Matching	0.61	0.06	5.46*	-0.04
5. Morphological Awareness	0.75	0.20	27.67**	0.67**
Comprehension				
Step/Variable	R	R^2 Change	F Change	Final β
1. MAT	0.54	0.29	13.27**	0.04
PPVT				0.23*
2. Digits Backwards	0.69	0.18	22.37**	0.24*
3. Phoneme Elision	0.70	0.01	1.12	0.09
4. Stress Contour Matching	0.72	0.03	4.16*	-0.002
5. Morphological Awareness	0.78	0.09	13.94**	0.45**
Decoding				
Step/Variable	R	R^2 Change	F Change	Final β
1. MAT	0.44	0.19	7.68**	-0.06
PPVT				0.03
2. Digits Backwards	0.57	0.13	12.50**	0.06
3. Phoneme Elision	0.60	0.03	3.09	0.18
4. Stress Contour Matching	0.65	0.07	7.46**	-0.02
5. Morphological Awareness	0.80	0.22	38.22**	0.71**

Note: * denotes significance at the p<.05 level; ** denotes significance at the p<.01 level.

Discussion:

In this study, we argue that prosodic sensitivity is related to reading through morphological awareness. The results of the regression analysis show that prosodic sensitivity is a significant unique predictor of morphological awareness beyond the controls of age-adjusted verbal and nonverbal cognitive ability, working memory and phonological awareness. It is likely that this relationship is due to the fact that morpho-syntactic complexity in English is intimately connected to stress computation and stress assignment rules (Jarmulowicz, 2002). Affixation in morphologically complex words may drive semi-obligatory stress shifts, and individual differences in prosodic sensitivity may be related to the facility with which these derivational changes are made in spoken language. Simple correlations show relationships in the moderate range (r = .39 - .46) between prosody and all three components of reading, but these relationships do not survive in regression analyses once morphological awareness is controlled. This is a predicted result if prosodic sensitivity is related to reading through morphological awareness.

References:

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