Exploring the relationship between prosodic sensitivity and emergent literacy skills in a sample of pre-readers

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Abstract

A growing literature has demonstrated that prosodic sensitivity is related to reading development; however, research investigating the relationship between prosodic sensitivity and reading development in the period prior to reading instruction is sparse. Moreover, few measures of prosodic sensitivity are suitable for children of this age. In this study, four- to 5-year-old English-speaking children (*N* = 101) from Primary Schools in the West Midlands, UK who were identified as being pre-readers completed a new test of prosodic sensitivity (comprising four subtests) and were also assessed for their non-verbal IQ, vocabulary knowledge, morphological awareness, and phonological awareness (syllable segmentation, rhyme awareness, phoneme isolation, letter knowledge). The new measure was found to be sensitive to individual differences in prosodic sensitivity and participants' scores were significantly correlated with measures of vocabulary, phonological awareness, and morphological awareness. An exploratory factor analysis revealed that the prosodic sensitivity subtests loaded onto a single factor, and that prosodic sensitivity and phonological awareness loaded onto different factors. These findings suggest that prosodic sensitivity and phonological awareness are distinct, but related skills in the early stages of reading development.

Introduction

Prosodic sensitivity (sensitivity to speech rhythm) is a skill which develops in early infancy as part of a progressive attunement to one's first language (Jusczyk, 1999). Many recent studies have shown that prosodic sensitivity is implicated in successful reading acquisition (e.g., Goswami et al., 2009; Leong et al., 2011; Schwanenflugel et al., 2004), and in ways that are independent of segmental phonological awareness (e.g., Clin et al., 2009; Holliman et al., 2008, 2010a, 2010b, 2012; McBride-Chang, Lam et al., 2008; Whalley & Hansen, 2006; Wood, 2006). This represents a key theoretical development, as suprasegmental phonology is neglected in current models of reading acquisition (Wood et al., 2009; Zhang & McBride-Chang, 2010).

Wood et al. (2009) reviewed the available evidence and proposed a model that aims to explain the nature of the relationship between prosodic sensitivity and early literacy development via three possible contributory pathways. In the *first* pathway, it was suggested that children are born with a periodicity bias (Cutler & Mehler, 1993) which allows them to 'tune in' to the rhythmic properties of speech in their environment. This allows them to bootstrap their way into spoken word recognition, which facilitates the development of vocabulary and in turn, phonological awareness (Walley, 1993). In the second pathway, it was argued in accordance with Chiat (1983) and Kitzen (2001) that sensitivity to speech prosody (and stress in particular) may facilitate the identification of phonemes in words (which are easier in stressed rather than unstressed syllables) and may also promote the identification of onset-rime boundaries given that the peak of loudness in a syllable corresponds to vowel location (Scott, 1998), which may support decoding skill via analogical reasoning (Goswami, 2003; Goswami et al., 2002). In the third pathway, it was argued that the relationship between prosodic sensitivity and literacy may be explained via its link with morphological awareness in decoding multisyllabic words, which requires the additional skill of stress assignment (i.e., knowing to pronounce the word 'together' as toGEther, rather than TOgether, for example). While this final proposed pathway has been speculated on in the recent literature, few studies have assessed this.

In this study, a new assessment of prosodic sensitivity was developed and its relationship with measures of vocabulary, phonological awareness, and morphological awareness, was explored. There were two major research questions in this study:

Q1. *How does prosodic sensitivity relate to measures of vocabulary, phonological awareness, and morphological awareness?*

Q2. *To what extent are measures of prosodic sensitivity and phonological awareness assessing different components of the same skill?*

Method

Participants

All participating children in this study (*N* = 101) were recruited from three primary schools in the West Midlands, UK. The schools were comparable in terms of locality, proportion of males to females, and percentage of pupils with additional education requirements. Children were aged between 4 years 3 months and 5 years 2 months (mean age 4 years 8 months) and were in Reception year. All of the males (*n* = 64) and females (*n* = 37) who took part had English as their first language, and all were identified as 'pre-readers' in that they were unable to read a single word on the British Ability Scales III Word Reading subtest (Elliot & Smith, 2011).

Measures

- British Picture Vocabulary Scales III (Dunn, Dunn, Styles, & Sewell, 2009)
- Matrices subtest of the British Ability Scales III (Elliot & Smith, 2011)
- Primary Inventory of Phonological Awareness (Dodd et al., 2000)
    - *Syllable Segmentation*
    - *Rhyme Awareness*
    - *Phoneme Isolation*
    - *Letter Knowledge*
- Morphology Completion subtest of TLD: Primary (Newcomer & Hammill, 2008)
- Brenda's Animal Park (Holliman et al., in preparation, described below)

Brenda's Animal Park

During the task, children are introduced to the main character, Brenda, who works on an animal park. Brenda encounters four different kinds of problems on the animal park, which can be thought of as four subtests measuring slightly different aspects of prosodic sensitivity. A composite measure of prosodic sensitivity can be constructed by combining the scores on each individual subtest:

- Compound Nouns: Children had to decide whether an utterance took the form of a compound noun (e.g., 'butterfly') or a noun phrase (e.g., 'butter…fly'). Cronbach's α reliability coefficient was .6.
- Word Stress: Children had to decide whether a word was correctly stressed (e.g., 'CROcodile) or incorrectly stressed (e.g., croCOdile'). Cronbach's α reliability coefficient was .68.
- Intonation: Children had to decide whether an utterance sounded like a question (e.g., '/the farmer gets up early') or a statement (e.g., '\the farmer gets up early') implied by a rise or fall in intonation. Cronbach's α reliability coefficient was .75.
- Phrase Stress: Children had to decide which of two utterances (e.g., 'apple pie' [strong-weak-strong] and 'tomatoes' [weak-strong-weak]) matched the 'Ba-Ba' phrase (e.g., BA-ba-BA). Cronbach's α reliability coefficient was .68.

The task was administered on a laptop using a Microsoft PowerPoint Presentation with audio files. For each subtest there were six practice trials where corrective feedback was provided and 14 test trials. The task was administered in the order presented above to maintain a coherent story that would be understandable to children of this age. Test-retest reliability was found to be good (*r* = .786). The internal reliability (Cronbach's α) of the whole task was an impressive .91.

Results

Table 1 shows the mean and standard deviation scores on measures of general ability, morphology, phonological awareness (PA) and prosodic sensitivity (PS).

Task	Mean	Std. Deviation
Matrices (Max = 51)	6.02	2.05
Vocabulary (Max = 168)	52.3	8.69
Morphology (Max = 38)	7.96	5.12
PA: Syllable Segmentation (Max = 12)	1.13	2.2
PA: Rhyme Awareness (Max = 12)	3.52	2.72
PA: Phoneme Isolation (Max = 12)	7.46	3.88
PA: Letter Knowledge (Max = 32)	15.74	6.66
PS: Compound Nouns (Max = 14)	8.39	2.75
PS: Word Stress (Max = 14)	8.34	2.96
PS: Intonation (Max = 14)	8.72	3.28
PS: Phrase Stress (Max = 14)	7.65	3.03

Table 1. Summary statistics for children on all assessments in this study.

As the prosodic sensitivity measure involved a forced choice procedure, it was important to demonstrate that performance on this task was significantly above that expected by chance. A chi-square analysis indicated that a significant number of participants were performing above chance on all subtests: Compound Nouns, $\chi^2(1, N = 101) = 12.129$, $p < .001$; Word Stress, $\chi^2(1, N = 101) = 16.644$, $p < .001$, Intonation, $\chi^2(1, N = 101) = 13.554$, $p < .001$; and Phrase Stress, $\chi^2(1, N = 101) = 10.782$, $p = .001$.

Q1. How does prosodic sensitivity relate to measures of vocabulary, phonological awareness, and morphological awareness?

To investigate the relationship between prosodic sensitivity and the other assessments in this study, a correlation matrix was inspected (Table 2).

Variable	1	2	3	4	5	6	7	8	9	10	11
1: Age											
2: Matrices	-.03										
3: Vocabulary	.22*	.45***									
4: Morphology	.2*	.43***	.35***								
5: PA: Syllable Segmentation	.06	.15	.27**	-.01							
6: PA: Rhyme Awareness	.03	.08	.1	.21*	.36***						
7: PA: Phoneme Isolation	1	.24*	.33**	.31**	.07	.28**					
8: PA: Letter Knowledge	.07	.22*	.14	.24*	-.28**	-.01	.51***				
9: PS: Compound Nouns	.12	.18	.33**	.32**	.19	.33**	.27**	.22*			
10: PS: Word Stress	.16	.4***	.38***	.29**	.32**	.33**	.29**	.16	.89***		
11: PS: Intonation	.27**	.38***	.32**	.29**	.19	.21*	.29**	.28**	.83***	.85***	
12: PS: Phrase Stress	.16	.37***	.34**	.27**	.24*	.26**	.25*	.2*	.84***	.86***	.84***

Notes: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table 2: Correlation matrix between measures of age, general ability, morphological awareness, phonological awareness (PA), and prosodic sensitivity (PS).

It can be seen from Table 2 that subtests of the prosodic sensitivity measure correlated very strongly with each other, and generally correlated with measures of vocabulary, phonological awareness, and morphological awareness. This was expected given the growing literature demonstrating a link between these skills.

Q2. To what extent are measures of prosodic sensitivity and phonological awareness assessing different components of the same skill?

An exploratory factor analysis was conducted to see how the different prosodic (compound nouns, word stress, intonation, phrase stress) and phonological (syllable segmentation, phoneme isolation, rhyme awareness, and letter knowledge) measures load together. The sample size of 12 participants per variable was satisfactory, the Kaiser-Meyer-Olkin value was .809, and Bartlett's Test of Sphericity was highly significant, $\chi^2(28, N = 101) = 543.92$, $p < .001$. The correlation matrix contained a significant number of correlations, with no evidence of singularity or multicollinearity; thus, our data met the requirements for a factor analysis. The method used for factor extraction was principle component analysis and the rotation method was varimax with Kaiser Normalisation. Table 3 shows the results from the factor analysis, sorted by size.

Variables	Factor 1	Factor 2	Factor 3
PS: Word Stress	.926		
PS: Intonation	.925		
PS: Phrase Stress	.925		
PS: Compound Nouns	.918		
PA: Phoneme Isolation		.845	
PA: Letter Knowledge		.839	
PA: Rhyme Awareness			.797
PA: Syllable Segmentation			.788

Table 3: Rotated factor matrix showing factor loadings for the different prosodic sensitivity (PS) and phonological awareness (PA) measures.

Three factors with eigenvalues greater than 1 were identified and explained 49.7%, 18.9% and 14.2% of the variance respectively. Factor 1 comprised all four prosodic measures, with factor loadings ranging from .918 to .926; Factor 2 comprised phoneme isolation and letter knowledge from the phonological awareness battery, with factor loadings of .845 and .839 respectively; and Factor 3 comprised rhyme awareness and syllable segmentation from the phonological awareness battery, with factor loadings of .797 and .788 respectively.

Conclusion

These findings add to the growing literature demonstrating that prosodic sensitivity may support early reading development via its links with vocabulary, phonological awareness, and morphological awareness. The findings also suggest that prosodic sensitivity and phonological awareness are distinct, but related skills in the early stages of reading development.

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