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 five-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 vocabulary, phonological awareness, and morphological 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 attainment related to one’s first language (Jusczyk, 1988). Many recent studies have shown that prosodic sensitivity is implicated in successful reading acquisition (e.g., Goswami et al., 2006; Levelt et al., 2006; Sénécal et al., 2006), with deficits that are associated with later reading difficulties (e.g., Brandeau-Chang, Lam et al., 2009; Whalley & Hansen, 2006; Wood, 2006). This represents a key theoretical development, as speech prosodic phonology is neglected in current models of reading acquisition (Wood et al., 2007; Zhang & McRitchie-Cheng, 2010).

Wood et al. (2008) reviewed the available evidence and proposed a model that aims to explain the nature of the relationship between prosodic sensitivity and early literacy development through three possible contributory pathways. In the first pathway, it was suggested that children are born with a predisposed bias (Culler & Mather, 1990) 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 (McInerney, 1995). 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 as opposed to unaccented syllables) and may also provide the identification of onset-rime boundaries given that the peak of stress in syllables corresponds to coda position (Scotitt, 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 morphological awareness is 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 explored. There were two main hypotheses in the pathway.

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 these primary schools in the West Midlands, UK. The sample was comparable in terms of sex, 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 = 52) and females (N = 49) 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 II: Word Reading subtest (Bram et al., 2011).

Measures
• British Picture Vocabulary Scales III (Ehren, Dunn, Styles, & Sewell, 2000)
• MATRICS subsitute of the British Ability Scales III (Bram et al., 2011)
• Primary Inventory of Phonological Awareness (Dodd et al., 2002)
• Syllable Segmentation
• Rhyme Awareness
• Phoneme Isolation
• Phoneme Knowledge
• Morphology Completion subtest of T.D.: Primary (Newcarrow & Hammill, 2008)
• Brenda’s Animal Park (Fieldman 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 in individual subtests.

• Compound Nouns: Children had to decide whether an utterance looks like the form of a compound noun (e.g., “buffalo”) or a noun phrase (e.g., “buffalo’s”).
• Word Stress: Children had to decide whether a word was correctly stressed (e.g., “CRoodle” or incorrectly stressed (e.g., “Cronoodle”). Cron增加 reliability coefficient was .29.
• 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. Cron增加 reliability coefficient was .47.
• Phrase Stress: Children had to decide which of two utterances (e.g., “apple pie” [strong-weak-strong] and “tomatoes” [weak-strong-weak-strong]) were the same or different. Cron增加 reliability coefficient was .786. The inter-reliability (Cron增加 of the whole task was an impressive .91.)

The task was administered on a laptop using a Microsoft PowerPoint Presentation with audio files. For each subtest there were 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 for this was found to be good (p < .05). The internal reliability (Cron增加 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).

<table>
<thead>
<tr>
<th>Task</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matrices (Max = 51)</td>
<td>5.02</td>
<td>2.05</td>
</tr>
<tr>
<td>Vocabulary (Max = 10)</td>
<td>8.67</td>
<td>1.69</td>
</tr>
<tr>
<td>Morphology (Max = 28)</td>
<td>22.50</td>
<td>5.12</td>
</tr>
<tr>
<td>PS: Syllabic Segmentation (Max = 12)</td>
<td>1.13</td>
<td>2.05</td>
</tr>
<tr>
<td>PS: Rhyme Awareness (Max = 12)</td>
<td>3.52</td>
<td>2.62</td>
</tr>
<tr>
<td>PS: Phoneme Isolation (Max = 14)</td>
<td>7.48</td>
<td>3.88</td>
</tr>
<tr>
<td>PS: Letter Knowledge (Max = 32)</td>
<td>15.74</td>
<td>6.66</td>
</tr>
<tr>
<td>PS: Compound Nouns (Max = 12)</td>
<td>3.52</td>
<td>2.62</td>
</tr>
<tr>
<td>PS: Word Stress (Max = 14)</td>
<td>8.36</td>
<td>3.96</td>
</tr>
<tr>
<td>PS: Letter Knowledge (Max = 14)</td>
<td>7.32</td>
<td>2.68</td>
</tr>
<tr>
<td>PS: Phrase Stress (Max = 14)</td>
<td>7.65</td>
<td>3.03</td>
</tr>
</tbody>
</table>

Table 1. Summary of means for 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, X2(1, N = 101) = 0.97, p = .26; Word Stress, X2(1, N = 101) = 64.644, p < .001; Intonation, X2(1, N = 101) = 13.554, p < .001; and Phrase Stress, X2(1, N = 101) = 10.26, 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).

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, and morphological awareness) and phonological awareness (syllable segmentation, rhyme awareness, phoneme isolation, letter knowledge) measures loaded together. The sample sizes of 12 participants per variable was satisfactory; the Kaiser-Meyer-Olkin value was .850, and Bartlett’s Test of Sphericity was highly significant, X2(56, N = 101) = 543.820, p < .001. The correlation matrix contained a significant number of correlations, with no evidence of singularity or multicollinearity; thus, our data met the requirement for factor analysis. The method used for factor extraction was a varimax component analysis and the rotation method was varimax with Kaiser Normalisation. Table 3 shows the results from the factor analysis, sorted by size.

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%, 19.9%, and 14.2% of the variance respectively. Factor 1 comprised all four prosodic measures, with factor loadings ranging from .91 to .95. Factor 2 comprised phoneme isolation and letter knowledge from the phonological awareness battery, with factor loadings of .45 and .83 respectively, and Factor 3 comprised rhyme awareness and syllabic segmentation from the phonological awareness battery, with factor loadings of .79 and .78 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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