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Prosodic and phonemic awareness in children's reading of long and short words

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Abstract Phonemic and prosodic awareness are both phonological processes that operate at different levels: the former at the level of the individual sound segment and the latter at the suprasegmental level across syllables. Both have been shown to be related to word reading in young readers. In this study we examine how these processes are differentially related to reading monosyllabic and multisyllabic words. Participants were 110 children in grades four and five who were asked to read monosyllabic and three- and four-syllable words matched for frequency. Phonemic awareness was assessed via a phoneme elision task; prosodic awareness was assessed by a task asking participants to identify the syllable bearing primary stress in a spoken word. Results showed that phonemic and prosodic awareness were independent predictors of short word reading, and both phonological factors made independent contributions to multisyllabic word reading, showing that phonemic and prosodic awareness are complementary but not redundant processes. Only prosodic awareness survived control for simple decoding ability in the reading of long words, suggesting that suprasegmental phonology gives added value to our understanding of reading multisyllabic words.

Keywords Prosody · Phonemic awareness · Word reading · Multisyllabic words

Researchers have long agreed that conscious knowledge of the phonology of one's own language is one of the most potent ingredients for later success at reading and spelling in English. Phonological awareness, the ability to reflect on and manipulate sublexical units of speech, has a particular predictive power in children's literacy by

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setting the stage for the acquisition of the alphabetic principle (Adams, 1990; Liberman, Shankweiler, Fischer, & Carter, 1974). Phonological awareness is most commonly used as an umbrella term that encompasses awareness of sound units of different sizes: syllables, phonemes and rimes, but phonemic awareness has been shown to be the most significant of these for reading development (Del Campo, Buchanan, Abbott, & Berninger, 2014). Metalinguistic awareness of sublexical speech sound units develops in the absence of literacy to a point (i.e., syllables, rimes), but full awareness of phonemes develops mostly rapidly in the context of learning to read, where feedback between beginning decoding/spelling facilitates further refinement of phonological awareness in a reciprocal fashion (Anthony & Francis, 2005; Perfetti, Beck, Bell, & Hughes, 1987). Research has uncovered a great deal about phonological awareness and its role in literacy acquisition; until recently, however, one aspect of phonology has been missing from our understanding of reading development: suprasegmental phonology, or prosody.

Prosody is the rhythmic alternation of stressed and unstressed syllables in spoken language. It is applied over speech segments (therefore, *suprasegmental*), at many levels from the lexical level to the utterance. At the utterance level, it has many functions; it conveys emotion, emphasis, givenness or novelty. Prosody is also relevant at the word level, since all content words have at least one stressed syllable; multisyllabic words may also have secondary or tertiary stress. The important role played by prosody in oral language development begins early in life: evidence suggests that infants use prosodic information to lever into and segment the stream of continuous speech into units. This enables initial word learning (Cutler & Mehler, 1993; Cutler & Norris, 1988; Demuth, 1996) and the correlation between prosodic features and grammatical information provides information about syntax and morphology to early learners (Steedman, 1996). Newer theories of phonological development suggest that basic auditory processing of acoustic information related to prosody such as frequency, duration and amplitude modulation set the foundation for the establishment of representation at each level of the phonological tier, from segment to intonational phrase (Goswami, 2015; Goswami et al., 2013). Good quality representations, especially at the lower levels, are necessary for successful reading acquisition.

Prosodic awareness is a construct that is the focus of increasing research attention also because it expands the notion of phonological awareness to include suprasegmental phonology as well as the more conventional aspects that feature in the literature: syllable, rime and phoneme awareness. It also has empirical value, as reading researchers have demonstrated that awareness of various aspects of prosody is related to reading outcomes (Wade-Woolley & Wood, 2006; Wang & Arciuli, 2015). In recent work, researchers have demonstrated that prosodic awareness is correlated to phonological awareness but not redundant with it in explaining reading skills. In a recent review we examined ten studies that used regression logic to explain reading, and found that in a majority of the analyses prosodic awareness contributed unique variance after accounting for that explained by phonological awareness (Wade-Woolley & Heggie, in press). While evidence suggests that prosodic awareness can be related to both word reading and reading

comprehension (e.g., Whalley & Hansen, 2006), the scope of the current discussion is held to the former.

Recent work in this area shows that individual differences in awareness of prosody are related to word reading in a number of languages, including English (Goswami, Gerson, & Astruc, 2010; Holliman, Wood, & Sheehy, 2012; Whalley & Hansen, 2006) Spanish (Calet, Gutiérrez-Palma, Simpson, González-Trujillo, & Defior, 2015; Defior, Gutiérrez-Palma, & Cano-Marín, 2012), and Greek (Anastasiou & Protopapas, 2014). While word stress is marked in some languages (e.g., Greek, Spanish), it is not orthographically indicated in English. Nevertheless, appropriate application of word stress is required for reading accuracy across languages.

There are at least three reasons why prosody at the word level is relevant to the reading of multisyllabic words. First, it can be lexically contrastive; in the minimal pair REcord (noun) and reCORD (verb), for example, the phonemes are basically identical, but the stress placement changes grammatical category. Second, the realization of a vowel is conditioned by word stress; stressed vowels are typically full and close to their canonical pronunciation (e.g., the first *a* in *passage*), but unstressed vowels are typically reduced to schwa, despite the actual spelling (e.g., the second *a* in *passage*). Unstressed vowels can be hard to hear and are often omitted in the oral language (Kehoe & Stoel-Gammon, 1997) and spelling of children (Treiman, 1993). Third, word level prosody is intricately related to derivational morphology; a certain class of derivational suffix provides reliable information, to which both beginning and skilled readers are sensitive, about where to place word stress when reading (Jarmulowicz, Hay, Taran, & Ethington, 2008; Jarmulowicz, Taran, & Hay, 2007; Wade-Woolley & Heggie, 2015).

While the points cited above do not apply to monosyllabic words, all monosyllabic content words are stress bearing, and therefore have prosodic information encoded in the lexical entry. Therefore, prosody may support an indirect role in reading monosyllabic words, perhaps mediated by other processes that have been shown to be related to prosody such as vocabulary and phonological awareness (Wood, Wade-Woolley, & Holliman, 2009). In the current study, we hypothesized that reading long words requires knowledge of both grapheme-phoneme correspondences and word stress, thus predicting (a) that both prosodic and phonemic awareness would make unique contribution to reading multisyllabic words, but (b) that after controlling for nonword decoding ability, only prosodic awareness would independently explain variance in three- and four-syllable words. For short words, two competing hypotheses could be generated. In light of the fact that prosody appears to have a more limited scope of operation in monosyllabic words, a strong position would predict that only phonemic awareness would directly explain short words. A more nuanced position, however, would reflect the notion that, despite lacking within-word alternation of strong and weak syllables, monosyllabic words contain prosodic information by virtue of being stress-bearing content words; they are heard in connected speech as part of longer intonational phrases upon which prosody is projected.[1] In this case, one might predict that

[1] We thank an anonymous reviewer for this point.

prosodic awareness, as well as phonemic awareness, would predict short words. A corollary of this would be that one-syllable nonwords, lacking pre-existing lexical entries containing prosodic information, would be explained by phonemic awareness but not prosodic awareness.

Method

Participants

Participants were 110 children with an average age of 124.96 months (sd = 7.23 months) attending grades four or five from the publicly-funded Catholic school system in eastern Ontario. Of these, 61 children (56 %) were female. Only participants whose parents reported English as the primary language of the home were included. No other exclusionary criteria were applied. Parents of all participants received written letters of information detailing the study and submitted signed consent forms. The children provided verbal assent prior to each assessment session. Participants received no compensation for participation.

Measures

Word reading

To assess children's ability to read long and short words, we selected a set of 33 words from the Educator's Word Frequency Guide (Zeno, Ivens, Millard, & Duvvuri, 1995). Eleven of the words were short, one-syllable words and the remaining 22 were long words (11 three- and 11 four-syllable words, see "Appendix"). These words were selected to be similar in frequency (SFI for short words $M = 47.38$, $SD = 3.38$, SFI for long words $M = 48.84$, $SD = 5.62$; $t(32) = .488$, $p > .05$) and occurrence in grade 4 level (short words $M = 4.73$, $SD = 5.18$; long words $M = 2.60$, $SD = 2.01$; $t(32) = -1.22$, $p > .05$) and grade 5 level (short words $M = 5.82$, $SD = 5.95$, long words $M = 4.60$, $SD = 4.33$; $t(32) = -.53$, $p > .05$) materials as specified by Zeno et al. (1995). Long and short words were presented in a fixed random order in a list format and participants were instructed to read the words aloud from a card. Cronbach's alpha for the entire word list was .93; computed separately for long and short words, alpha remained acceptable at .89 and .84, respectively.

Nonword decoding

To determine simple nonword decoding skill, we selected the first 22 one-syllable items from the Word Attack subtest of the Woodcock Reading Mastery Test—Revised (Woodcock, 1987). This corresponded to the twenty-fourth item. All participants did this test in its entirety, and all but five achieved this level of the test before the stop rule was applied. In the analysis that employed this measure, the sample did not include the scores for these five children. In the administration of this

task, participants read aloud the words printed on each page of the easel, stopping when six consecutive errors were made. Split-half reliability is reported in the manual at .89 for this age group.

Phonemic awareness

Phoneme awareness was measured by the Phoneme Elision subtest of the Comprehensive Test of Phonological Processing (Wagner, Torgeson, & Rashotte, 1999), which requires participants to repeat a word that they hear and then say it again, omitting a specified sound. Of the 20 test items, three require the deletion of syllables, and the rest require the deletion of specific phonemes. Cronbach's alpha is reported in the manual at .89 for this age group.

Prosodic Awareness

Aural Stress Assignment task was an experimental task used to tap participants' sensitivity to prosody at the word level. This task required students to listen to words in isolation and indicate location of primary stress. Practice sufficient to communicate the nature of the task used names familiar to the participant and two practice items before the test items began. A prerecorded set of 30 words ranging from two (e.g., *answer*) to five syllables (e.g., *organization*) were played over headphones. After each word was played, the student was asked to say it aloud, and then say it a second time, clapping at the point where they heard the "main beat". Participants were allowed to self-correct. The experimenter noted the syllable where the participant reported primary stress fell at the time of task administration. Infrequently, a participant clapped between the syllables; this was a rare event, but when it occurred the experimenter reminded the participant to clap on the part of the word that contained the main beat and asked him or her to repeat the response. By far, the most frequent error was the correct pronunciation of the word but a clap on the incorrect syllable (i.e., saying SOLitary but clapping soliTARy). Cronbach's alpha was computed at .65.

Results

Table 1 reports the descriptive statistics for all measures. Long and short words are reported separately and reported values for all measures are raw scores. Reading accuracy was generally high for both types of words; considered as a percentage of items, performance on short words (75 % correct) was greater than for long words (72 % correct), $t(109) = -2.30$, $p < .05$. Participants also differed in the level of accuracy on the phonological measures; they found the prosodic awareness task significantly more challenging than the phonemic awareness task, $t(109) = -13.96$, $p < .001$.

Intercorrelations for all measures are found in Table 2. All relationships are significant. As expected because of a shared basis in the sounds of oral language, prosodic and phonemic awareness were correlated. Consistent with previous

Table 1 Descriptive statistics for all variables

	M	*MSE*	*SD*	*Min*	*Max*
Short words/11	8.36	.263	2.76	1	11
Long words/22	15.89	.600	6.15	0	22
Nonword decoding/22	16.95	.292	2.30	9	20
Prosodic awareness/30	12.65	.420	4.31	5	26
Phonemic awareness/20	14.81	.431	4.41	4	20

Short words = one-syllable words; long words = three- and four-syllable words; nonwords = one-syllable items from Word Attack subtest of Woodcock Reading Mastery Test; prosody = Aural Stress Assignment; phoneme awareness = Phoneme Elision subtest of the Comprehensive Test of Phonological Processing

Table 2 Intercorrelations of all variables

	1	2	3	4	5
1. Short words	–				
2. Long words	.89**	–			
3. Nonword decoding	.74**	.71**	–		
4. Prosodic awareness	.28**	.29**	.21*	–	
5. Phonemic awareness	.46**	.41**	.55**	.21*	–

Short words = one-syllable words; long words = three- and four-syllable syllable words; nonword decoding = one-syllable items from Word Attack subtest of Woodcock Reading Mastery Test; prosody = Aural Stress Assignment; phoneme awareness = Phoneme Elision subtest of the Comprehensive Test of Phonological Processing

** $p < .001$; * $p < .05$

findings, phonemic awareness was related to the reading measures, as was prosodic awareness.

Regression analyses tested the explanatory relationships of prosodic and phonemic awareness to word reading. The data met the conditions of normality, linearity, and homoscedasticity, which are assumptions of regression. The first hypothesis was that reading long words would exert an extra demand on the reader by the need to assign lexical stress. As well as needing phonemic awareness for the application of phoneme-grapheme correspondences, prosodic awareness would be needed for the application of correct stress placement. Thus we predicted that both phonemic awareness and prosodic awareness would make unique contributions to reading long words. Table 3 shows that this hypothesis was supported. To further test this hypothesis, a final regression analysis was conducted in which we tested the power of phonemic and prosodic awareness to explain long word reading after controlling for the ability to apply decoding skills. The results of this analysis, seen in Table 4, show that the hypothesis was supported. Prosodic awareness but not phonemic awareness predicts long word reading once decoding ability was accounted for. Multicollinearity diagnostics for the independent variables showed

Table 3 Regression analysis predicting long word reading

	R^2	R^2 change	F	df	Final **β**
1. Phonemic awareness	.17		21.27**	103	.37**
2. Prosodic awareness	.21	.04	5.47*	102	.21*

** $p < .01$; * $p < .05$

Table 4 Regression analysis predicting long word reading, controlling for decoding

	R^2	R^2 change	F	df	Final **β**
1. Nonword decoding	.50		102.81**	103	.67**
2. Phonemic awareness	.50		.238	102	.02
3. Prosodic awareness	.52	.02	4.12*	101	.15*

** $p < .01$; * $p < .05$

Table 5 Regression analysis predicting short word reading

	R^2	R^2 change	F	df	Final **β**
1. Phonemic awareness	.21		28.09**	103	.42**
2. Prosodic awareness	.25	.04	4.54*	102	.19*

** $p < .01$; * $p < .05$

the variance inflation factors to range from 1.045 to 1.426, well under the critical value of 5.0, which indicates that multicollinearity is unlikely to be a source of concern.

The strong position with regard to reading monosyllabic words was that prosody had no scope of operation in monosyllabic words and, therefore, that phoneme awareness but not prosodic awareness would account for independent variance in short words. To test this hypothesis a regression analysis was conducted with short words as the dependent variable, and phonemic awareness as the independent variable, followed by prosodic awareness (see Table 5). Results showed that the hypothesis was not supported, since both phoneme and prosodic awareness were significant predictors of short word reading. Because only real monosyllables would contain prosodic information in lexical entries, we conducted an additional regression analysis to test the more nuanced position that monosyllabic nonwords would be explained by phonemic awareness only. Therefore, we repeated the analysis seen in Table 5 with nonword decoding of one-syllable items as the dependent variable. In this analysis (see Table 6), prosodic awareness was no longer a significant predictor of nonword reading following the significant contribution of phoneme awareness.

Table 6 Regression analysis predicting nonword decoding

	R^2	R^2 change	F	df	Final **β**
1. Phonemic awareness	.30		43.92**	103	.52**
2. Prosodic awareness	.31	.01	1.67	102	.11

** $p < .001$

Discussion

The purpose of this study was to test whether phonemic and prosodic awareness are differentially related to the reading of long and short words. Consistent with the accepted notion that phonological knowledge is necessary for alphabetic reading, both phonemic and prosodic awareness were significantly correlated with all reading outcomes.

Our first hypothesis concerned long words. Long words in this study were three or four syllables in length, with stress falling on various syllables. Our predictions in this case were confirmed; both phonemic awareness and prosodic awareness were significant predictors of long word reading, each making unique contributions to the dependent variable. When reading multisyllabic words, both segmental and suprasegmental information must be processed: graphemes matched with phonemes and stress correctly assigned. When nonword monosyllable reading was accounted for in the model, however, only prosodic awareness maintained a predictive relationship with multisyllabic word reading, contributing a small but significant amount of unique variance. This is likely because multisyllabic words place additional demands on readers, such as correct syllabification (Perry, Ziegler, & Zorzi, 2010) and stress assignment and vowel reduction (Arciuli, Monaghan, & Seva, 2010; Ševa, Monaghan, & Arciuli, 2009) that are outside the scope of segmental phonology.

The second prediction concerned short words. The strong position predicted that prosodic awareness would not survive control for phonemic awareness in the reading of short, monosyllabic words because consideration of lexical prosody does not add value to the representation of a monosyllabic word, which is neither morphologically complex nor contains unstressed syllables. This position was clearly falsified; both phonemic and prosodic awareness made independent contributions to short word reading, although the largest role was played by phonemic awareness. The outcome favoured the more nuanced interpretation; the short words used in this study had acquired the status of sight words for most children, who had established several years of reading experience. Encountering sight words activates strong lexical representations; these representations contain phonological information, including the fact that a content word is stress bearing. Nonwords, on the other hand, have no such representation and must be decoded, recruiting phonemic awareness prominently, as we see in Table 6. Overall, the results are consistent with accounts of the neural encoding of speech, such that

prosodic structure is always represented in lexical structure, even in monosyllables (Goswami, 2015; Goswami et al., 2013).

Furthermore, the findings may suggest that in the early stages of reading development before readers have acquired a large sight word repertoire, phonemic awareness might play a stronger role than prosodic awareness in monosyllabic real words. This would be consistent with the findings of Goodman, Libenson, and Wade-Woolley (2010), who found that phonemic awareness but not lexical prosody predicted outcomes on a standardized test of word reading in kindergarteners. They pointed out that the young children reached the error criterion for discontinuation before the items became multisyllabic and speculated that the lack of unique contribution by prosodic awareness after phonemic awareness was due to the monosyllabic nature of the items. It is unlikely that the items read by such inexperienced readers in that study had reached the status of sight words.

Of course, there are many other factors that influence children's reading of words, such as orthography (Arciuli et al., 2010) and morphology (Kearns, 2015), but the focus here is on phonology. Our goal has been to show that suprasegmental phonology gives added value to our current practice of considering phonological awareness to comprise syllable, rime and phoneme awareness. Before children can become skilled readers, they must be able to read all types of words. Without this ability, full reading comprehension will ever be elusive (Gough, Hoover, & Peterson, 1996; Kirby & Savage, 2008). However, surprisingly little work has examined directly whether long and short words rely on the same phonological processes, despite the fact that multisyllabic words are more challenging for young readers and children are expected to read them from an early age. The results from the current study suggest that phonemic and prosodic awareness are complementary but not redundant processes in word reading. Both can contribute to the reading of long and short words, but the relative contribution of each may be dependent on the familiarity and length of the word. Indirect or mediating effects of prosody on reading through vocabulary or other processes known to impact literacy (Wood et al., 2009) could not be fully tested here.

This particular prosodic awareness task is reported here for the first time in the literature. It was a fairly challenging task for these participants, since it included words that ranged from two to five syllables in length. Although not measured here, it is possible that memory demands influenced the level of performance. The internal reliability statistic for the task used in this study was .65; this falls short of the ideal, but is representative of most prosodic tasks commonly used in the literature. Further work in this area, especially refining current measures of prosodic awareness, is required. In addition, longitudinal studies that examine the involvement of segmental and suprasegmental phonology in reading and how it changes over time, would provide a fuller picture of how phonemic and prosodic awareness are integrated to influence word reading. Ample opportunity for future research into the relationship between prosody and reading exists, and such work can only increase our understanding of literacy development.

Appendix

Long and short word list.

Trance	Ceremony
Emotion	Pyramid
Glimpse	Military
Starch	Scheme
Misery	Macaroni
Scroll	Gallery
Thrill	Cabinet
Luxury	Charity
Loyalty	Deposit
Expedition	Reality
Janitor	Intelligence
Poetry	Certificate
Hypothesis	Stride
Threat	Apology
Relaxation	Sleeve
Interruption	Sketch
Plunge	

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