VOWEL SPELLING IN MULTISYLLABIC WORDS: THE ROLES OF PHONOLOGY, STRESS, AND MORPHOLOGY

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Abstract

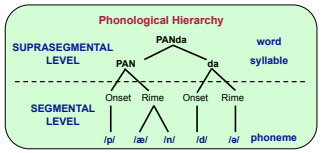
English orthography encodes both phonological and morphological information, necessitating the use of multiple spelling strategies. The phonological quality of vowels depends in part on lexical stress patterns. When vowels appear in stressed syllables, they tend to be full and phonologically clear (e.g. the "a" in *major*), whereas vowels in unstressed syllables reduce to the toneless phoneme schwa (/ə/; e.g. the "o" in *major*). Morphological derivations can provide an additional source of vowel spelling information when they drive lexical stress shifts (*MAjor–maJORity*), as this shift allows a change in phonemic vowel quality to occur.

This study investigates children's spelling of stressed and unstressed vowels in grades 3, 5, and 7. Both morphological awareness and phonological processing predicted vowel spelling, though the predictive type of phonology differed for the two types of vowels: prosodic sensitivity predicted stressed vowel spelling, whereas phonological awareness predicted unstressed vowel spelling. We propose the use of a two-tiered phonological hierarchy to explain this pattern.

Introduction

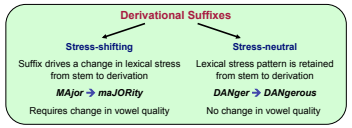
A fundamental part of successful spelling is the ability to encode speech sounds, or phonology, into the appropriate graphemes. Phonological information can be most elegantly modeled with two tiers: one suprasegmental and the second segmental (for a simplified version of this hierarchy, see Box 1). The suprasegmental level deals with stress-related information; representation at this level can be assessed with measures of prosodic sensitivity (the ability to detect features of speech rhythm). The segmental level deals with the phonemic features of words; phonological awareness (sensitivity to speech sounds) acts as a behavioural measure of segmental representation.

Box 1.



Phonological awareness has long been established as a strong predictor of spelling (see NIH, 2000: NRP Report). Examinations of the role of the second aspect of phonological representation, prosodic sensitivity, have been more recent. Research has found that prosodic sensitivity makes a unique contribution to spelling variance (Wood, 2006). Additionally, individuals at risk for learning disabilities have trouble judging and reproducing stress patterns (Highman & Morris, 1987; de Bree, Wijnen, & Zonneveld, 2006). Lexical stress patterns are of particular importance in English spelling; in multisyllabic English words, there is a fairly regular alternation between strong, stressed syllables and weak, unstressed syllables. The phonemic quality of vowels varies depending on syllable stress. Vowels in stressed syllables are overt and phonologically clear (e.g. the "a" in *major*), whereas vowels in unstressed syllables reduce to the phoneme schwa; it is not readily apparent which grapheme should represent this sound (e.g. the "o" in *major*). In general, children make more errors when spelling vowels in unstressed syllables than in stressed syllables (Treiman, Berch, & Weatherston, 1993).

Box 2.



English orthography frequently sacrifices phonological regularity to encode morphological information (Bourassa & Treiman, 2001); as a result, the use of phonologically motivated spelling strategies is not always sufficient. The addition of a derivational suffix to a stem word (e.g. adding *–ity* to *major*) creates a new word that is distinct from the original but related in meaning, and the ability to recognize and navigate the morphological links between such words provides an advantage when spelling in English (e.g. Nunes, Bryant, and Olsson, 2003). There are two categories of derivational suffixes (see Box 2), and notably, one type changes the location of the primary stress from stem to derivation. As a consequence, it is possible for a formerly reduced vowel to become stressed in a morphologically related word. This means that morphological cues can be employed to recover sound information that may aid children in spelling unstressed vowels.

Research Questions

This study examines **(1)** how children spell stressed and unstressed vowels in multisyllabic, morphologically related word pairs, and **(2)** investigates the predictive roles of sensitivity to morphology and the two phonological tiers in vowel spelling.

Predictions

1. Stressed vowels will be spelled better than unstressed vowels; as grade level increases, spelling of both vowel types will improve, and the difference in ability between the two types will narrow.
2. Because the spelling items are morphologically related pairs, we predict that morphological awareness will account for variance in vowel spelling.
3. Phonological processing at both the segmental and suprasegmental levels will be related to successful vowel spelling.

Method

PARTICIPANTS

Ninety-two students from five Eastern Ontario schools took part in this study. Five were excluded as outliers due to extreme spelling task scores (>3*IQR). The sample's remaining 87 participants included 37 students in grade 3, 26 in grade 5, and 24 in grade 7. All participants were fluent English speakers; no other screening criteria were used.

MEASURES

Cognitive Control Measures

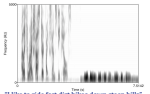
Matrix Analogies Test (MAT; Naglieri, 1985)**:** Used as a measure of children's nonverbal reasoning ability.

Test of the Reception of Grammar (TROG; Bishop, 1989)**:** Administered as a measure of verbal ability.

Prosodic Sensitivity Measures

Sentence Matching Task (Wood & Terrell, 1998)**:** To test sensitivity to metrical stress, children listened to a prerecorded, undistorted sentence followed by a filtered sentence matched for number of syllables (see Figure 1). They then indicated whether the two sentences were the same or different.

Figure 1.



Stress Contour Matching Task (Whalley and Hansen, 2006)**:** As a measure of phrasal prosodic sensitivity, children listened to a series of titles from popular books and movies. After each, they heard two phrases wherein each syllable had been replaced with the reiterative syllable 'dee.' One of these had the same prosodic contour as the original, whereas the other had a different prosodic contour; children were asked to indicate which of the two 'dee' phrases matched the original phrase (e.g. HUMPty DUMPty → DEEdee DEEdee).

A prosodic sensitivity composite score was created based on scores on the Sentence Matching and Stress Contour Matching Tasks.

Phonological Awareness

Phoneme Elision (CTOPP; Wagner, Torgesen, & Rashotte, 1999)**:** Administered as a measure of children's phonological awareness skills.

Morphological Awareness

Morphological Awareness Task (adapted from Carlisle, 1988)**:** Children were provided with a stem and an unfinished sentence. They were asked to respond with a word that completed the sentence and was related to the stem (e.g. "Appear: He cared about his… [appearance]"). Half of the target responses involved stress-shifting suffixes, whereas the other half involved stress-neutral suffixes.

Vowel Spelling

Prosodic Spelling Task: Vowel spelling was assessed using a series of stem–derivation word pairs. In each pair, the addition of a suffix resulted in a stress shift, allowing formerly reduced vowels to become full, stressed vowels (e.g. *MAjor–maJORity*). Stems and derivations were presented in separate subtasks; each task contained 24 words, and each word had two target vowels. The order of these tasks was counterbalanced. (See Box 3).

Box 3.

Spelling Task

Subtask	Prompt
1.	"***Combine***. I am going to ***combine*** the ingredients together." **c__mb__ne**
2.	"Last time, you spelled combine. Now spell ***combination***." **c__mb__nation**

PROCEDURE

Children took part in 3-4 testing sessions of approximately 30 minutes each. During this time, they completed three batteries of tests in a quiet, semi-private location in the school.

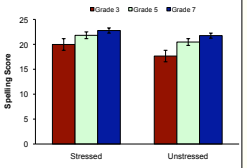
Results

All analyses use log-transformed spelling scores to correct for a significant negative skew. No effects were found based on the order of spelling subtask presentation.

QUESTION 1: Do children make use of stress placement information when spelling vowels in multisyllabic words?

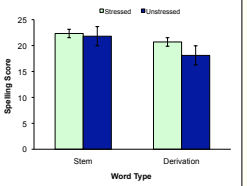
To address this question, we conducted a 3(grade) x 2(vowel type) x 2(word type) mixed-model ANOVA with spelling score as the dependent variable. Two significant interactions emerged from this analysis: Grade x Vowel Type, $F(2, 84) = 5.52$, $p < .005$, and Vowel Type x Word Type, $F(1, 84) = 6.87$, $p = .01$.

Figure 2. ***Grade x Vowel Type***



Post hoc analyses on the Grade x Vowel interaction (Figure 2) revealed that unstressed vowel spelling scores improved with each increase in grade level ($ps < .05$). When spelling stressed vowels, however, students in grades 5 and 7 scored significantly higher than grade 3s ($ps < .01$), but no difference emerged between grade 5s and grade 7s ($p = .12$). Analysis of spelling difference scores indicated that the gap between stressed and unstressed vowel spelling ability changed across grade levels, $F(2, 85) = 5.18$, $p < .01$, though the only significant difference was between grades 3 and 7 ($p = .005$).

Figure 3. ***Vowel Type x Word Type***



Overall, unstressed vowel scores were lower than stressed vowel scores, particularly when they occurred in derivations rather than stems. Vowels in stems were also spelled more accurately than those in derivations (see Figure 3).

QUESTION 2: Do individual differences in phonological and morphological processing predict children's vowel spelling abilities?

To determine the relationship between phonological and morphological sensitivities and vowel spelling, we conducted two regression analyses, first using stressed vowel spelling scores (see Table 1) and then using unstressed vowel spelling scores (see Table 2) as dependent variables.

We found that both prosodic sensitivity and morphological awareness relating to stress-shifting suffixes predicted stressed vowel spelling after controlling for age in months, nonverbal ability, and verbal ability.

In contrast, we found that unstressed vowel spelling was predicted by phonological awareness and stress-shifting morphological awareness, along with age in months and verbal ability.

Table 1. **Hierarchical Linear Regression showing predictors of Stressed Vowels**

Step	Variable	R	ΔR^2	Final β
1.	Age	.584	.341°°	.177
	MAT			.096
	TROG			.088
2.	PA	.633	.060*	.133
	Prosodic Sensitivity			**.215***
3.	**MA (shift)**	.672	.050*	**.409****
	MA (neutral)			-.161

* $p < .05$ ** $p < .01$ ° $p < .005$ °° $p < .001$

Table 2. **Hierarchical Linear Regression showing predictors of Unstressed Vowels**

Step	Variable	R	ΔR^2	Final β
1.	**Age**	.712	.507°°	**.293°**
	MAT			.073
	TROG			**.209***
2.	**PA**	.752	.059°	**.226****
	Prosodic Sensitivity			.130
3.	**MA (shift)**	.775	.035*	**.334***
	MA (neutral)			-.210

* $p < .05$ ** $p < .01$ ° $p < .005$ °° $p < .001$

Discussion

Phonological quality differs for stressed and unstressed vowels, and as this study demonstrates, children's ability to successfully spell the two vowel types differs. Overall spelling accuracy was high, and this was particularly true of stressed vowels, which were spelled more correctly than unstressed vowels. Spelling accuracy improved with each increase in grade, though stressed vowel spelling did not improve significantly between grades 5 and 7. We confirmed past findings (e.g. Tsesmeli & Seymour, 2006) that children generally spell more correctly in stems than in derivations, and it seems that unstressed derivation vowels are particularly problematic. Furthermore, phonological processing at different levels of the representation are involved in the successful spelling of stressed and unstressed vowels. We found that stressed vowel spelling was predicted by prosodic sensitivity, but not by phonological awareness. For unstressed vowel spelling, the reverse was true.

Vowels in stressed syllables tend to carry reliable cues about their identity. Due to the phonological salience of stressed vowels (greater duration and amplitude), it appears that phonological processing at the suprasegmental level to identify location of primary stress is sufficient for determining the vowel.

When it comes to unstressed vowels, however, stress information is not sufficient; children may be able to recognize that the second syllable in *major* is unstressed, but this does not help them to correctly spell the "o". As this study and others (e.g. Bebout, 1985) have found, children have more difficulty when spelling reduced, unstressed vowels than they do stressed vowels, which places increased importance on the use of multiple linguistic cues in order to spell correctly. Unstressed vowels require phonological processing that goes deeper than the suprasegmental level; the syllable must be processed at the segmental level. Children with strong phonological awareness skills are most likely to hold fully specified representations of unstressed syllables (Wood, 2006), making the ability to tap into the phonemic level of representation an important part of spelling those vowels.

When a word's spelling is not apparent based on overt phonological information, morphological information may be useful. The morphologically complex words used in this study offered a source of stress-related information, and given that we found stress-shifting morphological awareness to be a predictor of both stressed and unstressed vowel spelling, it seems that children who were able to capitalize upon the stress information from morphological manipulations were at an advantage. In contrast, morphological awareness related to stress-neutral suffixes, which provide no additional information about a word's vowels, was not a predictor for either type of vowel spelling.

Morphology and stress are intimately linked in oral language. Interestingly, both prosodic sensitivity and stress-shifting morphological awareness were predictive of stressed vowel spelling. The results suggest that stressed vowel spelling is not simply a morphological task, since stress-neutral morphological awareness was not a predictor. Furthermore, it is not simply stress related to morphology that is important, or the predictive power of the prosodic sensitivity measures would not remain significant following the inclusion of the morphological awareness measures. It appears that, for stressed vowels, a combination of prosodic and morphological cues are involved in successful spelling.

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