An Investigation of Rhythmic Processes in English-Speaking Children's Word Productions

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ABSTRACT

This study examines whether English-speaking children's productions of multisyllabic words are consistent with metrical constraints or perceptual biases. Children (aged 22-34 months) produced three-syllable words which varied across stress pattern and segmental content. Overall results indicate a complex interaction between metrical and syllable-level constraints which change with development.

INTRODUCTION

There is very little research on children's development of rhythm and stress in English. There are reports, however, indicating that children delete syllables and add syllables in certain positions more than others, and alter stress patterns in systematic ways. Some investigators account for these patterns in terms of metrical constraints; other investigators propose perceptual biases as the underlying mechanism.

Proponents of the metrical constraint view argue that children have difficulty producing utterances that do not conform to a strong weak (SW) metrical pattern [1],[2]. The SW pattern denotes a trochaic foot, a unit of stress in metrical phonology. Therefore, children produce *MONkey* correctly because it conforms to a SW pattern but they delete the initial syllable of *giRAFFE* (WS) producing *RAFFE*, because it does not conform to a SW pattern. Proponents of the perceptual salience view argue that children produce stressed or word-final syllables more frequently than other syllables because of their perceptual salience [3]. Therefore, children produce *MONkey* correctly because they perceive the stressed and final syllable, but they produce *giRAFFE* as *RAFFE* because they do not perceive the unstressed non-final syllable. The predictions of these two approaches result in similar error patterns for two-syllable words, which has been the main focus of current research.

It should be noted that the perceptual salience hypothesis accounts only for children's truncation patterns. It has less predictive power when used to explain processes such as stress shift and epenthesis. However, because there is little documentation of these processes in English, their relative frequency cannot be ascertained. Investigations on the acquisition of stress in Dutch-speaking children indicate that stress shift and epenthesis also provide strong evidence of metrical templates [4]. This study examines truncation, stress shift, and epenthesis patterns in English-speaking children's productions of three-syllable words with the aim of separating out perceptual salience and metrical factors.

Predictions

The study is based on the following perceptual and metrical predictions: If a perceptual constraint is operating, children's productions of three-syllable words with the stress patterns: ŚWS (e.g., *DInoSAUR*); SWŚ (e.g., *KANgaROO*); SWW (e.g., *Elephant*) and WSW (e.g., *toMAto*) should show similar truncation patterns. Children should reproduce the stressed and final syllable equally frequently in these sets of words. If a rhythmic constraint is operating, truncation rates in these three-syllable words should vary. Truncation rates should be greatest in SWW and WSW words because application of a SW or trochaic foot results in deletion of one weak syllable. In contrast, application of a SW foot will not necessarily result in deletion of a weak syllable in ŚWS and SWŚ words, because the weak syllable is contained within the trochaic template. The pattern of truncations predicted by metrical constraints is shown in Figure 1. In terms of error patterns, different results are expected for SWW words. The prediction of the perceptual salience hypothesis is that the stressed and final syllable will be reproduced; the prediction of the metrical hypothesis is that the first weak syllable will be reproduced.

The metrical hypothesis also predicts that stress errors should be more frequent in SWŚ words, because main stress on the final syllable is an exception to the English stress rule, and that epenthesis should be associated with the stress

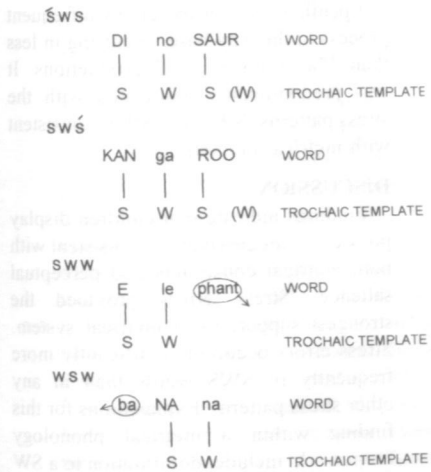

Figure 1. Pattern of truncations predicted by metrical constraints in three-syllable words.

patterns, ŚWS and SWŚ, because the addition of a syllable results in a canonical SW template.

These predictions were examined across different age ranges in order to determine if there were developmental trends in truncation patterns and across different segmental patterns, in order to determine if segmental effects influence truncation patterns. Pilot work indicated that words in which the unstressed syllable had a non-stop onset were more susceptible to deletion.

METHOD

The subjects included 18 children: 6 children aged 22-, 28-, and 34-months. The children participated in semi-structured elicitation tasks where they produced multiple tokens of both novel and familiar three-syllable words. Novel words were employed to control for familiarity and segmental effects on children's productions. The target words included four metrical patterns: ŚWS, SWŚ, SWW, and WSW words, and two segmental patterns: Words in which the unstressed syllable had a stop consonant onset versus a non-stop consonant onset. All productions were digitized and subject to both acoustic and perceptual analysis. A subset of the data was reanalyzed for inter- and intra-examiner reliability. All reliability measures exceeded 80%.

RESULTS

Results indicated significant stress and segmental pattern effects and significant age by stress pattern interactions. Results will be discussed separately for truncations, stress errors, and epenthesis.

There was a significant stress pattern effect for children's two-syllable truncations (i.e., productions in which two syllables are realized). In the novel word condition, children truncated ŚWS words significantly less than SWW and WSW words. However, there was no corresponding difference between the truncation rates of SWŚ, SWW, and

WSW words. In the familiar word condition, children truncated SWŚ words less frequently than all other stress patterns but there was no significant difference between the truncation rates of ŚWS and SWW words. These results were almost uninterpretable without further examination of segmental effects.

The study confirmed the significant segmental effect on truncations observed in the pilot study: Weak syllables were more frequently realized when they contained stop-consonant onsets than non-stop onsets. An item analysis revealed that this effect pertained specifically to internal weak syllable in ŚWS, SWŚ, and SWW words and was linked more closely to sonorant versus obstruent than to stop versus non-stop, as originally hypothesized. Words that contained intervocalic sonorants (e.g., /n/ or /l/), such as *TElePHONE* and *Animal* were more frequently truncated than words that contained intervocalic obstruents, such as *CROcoDILE* or *OCtopus*, regardless of metrical pattern. This pattern was interpreted as reflecting children's syllabification tendencies: Children are more likely to syllabify an intervocalic sonorant with the preceding stressed vowel than an intervocalic obstruent, leading to an onset-less medial syllable which is subsequently deleted. The intriguing stress pattern results described above were almost entirely interpretable in light of these segmental effects.

A comparison of stress pattern effects across age group revealed the following findings: The 22-month-old children truncated words from all stress patterns equally frequently; the 28-month-old children truncated WSW words more than all other stress patterns, consistent with the large body of evidence that weak syllables in word-initial position create difficulty for children; the 34-month-old children truncated words with intervocalic sonorants more frequently than other words.

An examination of error patterns in both novel and familiar SWW words indicated that the final weak syllable was most frequently preserved in children's truncations.

There was a significant stress pattern effect for children's stress errors. Stress errors refer to the perception of level or incorrect stress. Children displayed significantly greater numbers of stress errors in SWŚ words. They also made stress errors in other words, e.g., ŚWS words, consistent with quantity effects in a metrical framework. The analysis of stress errors across age and stress pattern revealed the following findings: 22- and 34-month-old children produced stress errors predominantly in SWŚ words whereas 28-month-old children produced stress errors in other stress patterns as well, thus suggesting that there is a period in development when stress patterns may be quite unstable. A closer examination of stress errors in the 28-month-old children showed a strong tendency for word-final stress.

Epenthesis was an extremely infrequent process in the data base, occurring in less than 1% of novel word productions. It was predominantly associated with the stress patterns, ŚWS and SWŚ, consistent with metrical predictions.

DISCUSSION

Findings indicate that children display prosodic strategies that are consistent with both metrical constraints and perceptual salience. Stress errors provided the strongest support for a metrical system. Stress errors occurred significantly more frequently in SWŚ words than in any other stress pattern. Explanations for this finding within a metrical phonology framework include: deformation to a SW metrical constraint, acquisition of an extrametricality rule, or acquisition of a main stress rule that assigns stress to the initial foot of a multisyllabic word. Epenthesis, although infrequent, was invariably associated with stressed syllables only (particularly primary stressed syllables), thus, preserving canonical feet or SW templates, as predicted in a metrical analysis.

The truncation results were the most difficult to interpret in metrical terms. Some aspects of the truncation findings showed that children were guided by metrical structure: For example, 28-month-old children truncated WSW words more frequently than other stress patterns. For the large part, however, results with two-syllable truncations did not show that children distinguished amongst the metrical patterns: ŚWS, SWŚ, and SWW. The truncation rates were most strongly influenced by a segmental effect which appeared to reflect children's syllabification tendencies.

It is hypothesized that children's truncation patterns are most consistent with a parsing strategy that scans from right to left and circumscribes at the position of stress [5]. The selection of syllables for production is guided not only by metrical templates but syllable structure constraints [2], and prominence factors, related to vowel quality and the acoustic salience of final position. The order of syllable mapping may be determined by a stored weighting system influenced by perceptual factors, or alternatively by a complex system of phonetic and phonological production constraints. The findings are less consistent with proposals that prosodic units are circumscribed [4], although it is true to say that children's one-syllable truncations (i.e., productions in which only one syllable is realized) almost always consist of the stressed syllable or foot closest to the end of the word. Nevertheless, the way children extend their productions suggest that segmental and syllable-level constraints play as important a role as metrical constraints.

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