

Acoustic correlates of word stress in child and adult Polish and the acquisition of phonological rhythm

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The characterisation of linguistic rhythm hinges on proper categorisation of units of rhythm into strong and weak. Given that the primary units of linguistic rhythm are syllables and, within the syllables, the rhythmic cues are most robustly expressed in vowels, we address the question of how basic acoustic parameters measurable in vowels combine to render the category stressed versus unstressed syllable in spontaneous speech of child and adult Polish. The acquisitional data are interesting as they shed light on the naturalness of prosodic structure: ease of control over particular phonetic parameters, their perceptual salience and, on a more abstract phonological level, their underlying metrical patterns (cf. Allen and Hawkins 1980). We investigate three acoustic parameters which are considered most reliable metrics for stress placement but whose relative weighting is language-specific: fundamental frequency (F0, pitch), intensity (loudness), and duration (e.g. Fry 1955, Morton and Jassem 1965, Lehiste 1970, Beckman 1986, Dogil and Williams 1999). We argue that duration alone cannot be used as a reliable metric for the categorisation of stressed and unstressed syllables in Polish. In fact, for the two rhythmically distinct sets to emerge, F0 must be used as the most robust cue.

The study is based on spontaneous speech recordings of three Polish-speaking children (aged 2;6 – 3;8) compared with those of their parents. The material consists of 1060 vowels, grouped into stressed and unstressed sets, excised from 420 words of two or more syllables. The focus is on words rather than larger breath-group utterances because the word is the domain of the main stress rule in Polish (Rubach and Booij 1985). Each child word is paired with its adult equivalent pronounced by the child's parent so that potential differences in acoustic cues in child and adult Polish could not be ascribed to differences in vowel sets (their spectral qualities), segmental context and word length. A direct comparison of stressed and unstressed vowels in different words being impossible, the vowel tokens within a given word are normalized with the use of various ratios such as semitones for the F0 parameter, relative intensity measure in decibels for sound pressure, and duration ratio. We additionally split up the F0 and intensity parameters into two independent sub-cues: the mean and the variability measure. Measurements are done using Praat (Boersma and Weenik 1992-2007). A discriminant analysis with multiple variables is used as a method to statistically determine the hierarchy of phonetic parameters that contribute to the classification of stress in child and adult Polish (cf. Levi 2005 and her analysis of acoustic correlates of lexical accent in Turkish).

The established ranking of acoustic cues with respect to their contribution to the stressed – unstressed distinction is: F0 > intensity > duration. It is also shown that, statistically, there is a greater overlap of distributions of compared phonological categories in adult speakers than in children. These results are interpreted against previous findings on the emergence of prosodic control in child speech as well as on the acquisition of linguistic rhythm (e.g. Allen and Hawkins 1980, Klein 1984, Kehoe and Stoel-Gammon 1995): the

early control of pitch variables, the absence of adult-like vowel reduction and speech-timing control, segmental effects in truncation patterns, and ‘lexical primacy’ effects.

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