

Relationship Between Vowel Quantity and Vowel Quality

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Quantity is used in some languages for lexical and grammatical distinctions where the oral or nasal vowel is either short or long. One such language is Twi, a tone language of the Kwa group (Niger Congo) spoken in Ghana, West Africa. This language has two contrasting lengths in words in both the oral and written contexts. Our study reports observations and results of an experimental research on short and long oral/nasal vowels. Evidence from our acoustic data, based on the production of oral and nasal vowels belonging to the two phonological categories by two adult native speakers, shows that vowel duration is the determining factor in distinguishing the two classes. Acoustic results further indicate that short and long vowels are distinguished not only by vowel duration but also by post-vocalic consonant duration: phonologically short vowels are followed by phonetically long consonants. Relative values also make clear and indeed confirm the robustness of the feature in Twi. However, the control of vowel quality between the two phonological classes (short and long vowels) indicates sparse formant or qualitative differences in both the oral and nasal contexts.

METHOD & RESULTS

The data in this study consist of acoustic durations obtained from two native speakers producing a series of Twi minimal pairs, containing long and short vowels, embedded in a carrier sentence. The speakers produced the utterances at a self-selected conversational rate in two consonantal environments /p/, /k/. The randomised list of utterances was produced at least ten times.

Acoustic data were recorded in an anechoic room. By means of a sound editor, vowel durations (and formant frequencies of vowels) as well as consonant durations were measured for the following: the target vowel, the post-vocalic consonant and the syllable V+C. Statistical analyses (ANOVAs) were carried out on all measures obtained from both speakers ($p \leq 0.01$).

The overall data indicate that the most important parameter for determining vowel quantity contrasts, *i.e.* vowel duration, is highly significant ($p < 0.001$).

Absolute duration measures indicate the relevance of both vowel and consonant durations in distinguishing the two phonological classes. In the VC domain, when the vowel is phonologically short, the subsequent consonant is phonetically long. Thus concomitant consonantal differences seem to reinforce vowel quantity contrasts in Twi, where phonologically short vowels are followed by phonetically long consonants.

However, acoustic observations suggest that consonant durations of the longer counterparts are not as clear-cut as the short vowels.

A close examination of formant values (F1, F2 and F3) reveal sparse differences in formant structures of the two classes. In fact, investigations show that all phonological contrasts are durational in nature, and that sparse differences in formant structures of a given pair are non-significant.