The Effect of Stress on Vowel Length in Aleut

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Abstract: This study establishes three facts about duration as a phonetic correlate of stress in Aleut, a language with phonemic vowel length. First, duration is a correlate of stress. Second, lengthening caused by stress does not neutralize the contrast between short and long vowels. Third, stress assignment precedes the process of final vowel deletion common in Aleut.

BACKGROUND

All three vowels of the Pribilof Island dialect of Eastern Aleut can be either long and short. The stress system is quantity sensitive, and both long and short vowels can be stressed or unstressed (1). However, a stressed short vowel can sound long, and an unstressed long vowel can sound short; hence, stress apparently neutralizes length contrasts. This observation is at odds with (2), which hypothesized that languages with phonemic vowel length do not use duration as a correlate of stress. This discrepancy motivated an acoustic study of vowel duration.

METHOD

Data was recorded in home and classroom settings on DAT and analog equipment with a flat frequency response throughout the auditory range, using a close-talking, noise-canceling microphone so that the signal to noise ratio was always better than 40 dB. For all data, vowel duration was measured from the spectral analysis produced on a Kay CSL 4300B speech analysis system. The section of the spectrogram where formant structure was visible was examined. Only the steady state formant structure was measured in order to mitigate the influence of surrounding consonants. To check accuracy, a random sample of approximately seven percent of the data was measured independently by another phonetician. The difference between the means of the two sets of measurements was 3 ms, and the mean of the differences was 18 ms, with a standard deviation of 13 ms. The subjects were four native speakers, one female and three male, ages 50 to 80, who were born on the Pribilof Islands. The measured vowels have three sources: a connected two minute narrative, a set of citation forms elicited from the same subject, and a set of sentences elicited from each of the three other subjects. The stimuli were designed without regard to vowel length, so include a realistic sampling of long and short vowels in stressed and unstressed positions. Although the translations of the stimuli from English to Aleut were not uniform across speakers, no amendments were suggested so that the responses remained as natural as possible. When responses were repeated, corresponding measurements were averaged. As the interaction between deletion and stress assignment is one of the questions addressed, words in which deletion has occurred were excluded from the set of data used to determine whether duration is a correlate of stress and whether stress obscures vowel length contrast.

RESULTS

Results are shown in Figure 1. The Mann-Whitney rank sum test showed that the mean durations of short vowels in stressed and unstressed positions are different, as are the mean durations of long vowels in stressed and unstressed positions, with p ≤ 0.01 in both cases. Therefore, since stress lengthens vowels, duration is a correlate of stress. To test whether the lengthening effect of stress obscures phonemic length contrast, the means of short stressed and long unstressed vowels were compared. Application of the rank sum test showed with p ≤ 0.01 that the two means are different. Thus, lengthening due to stress does not neutralize the contrast between long and short vowels, even when the short vowel is lengthened under stress.
To ascertain the order of the stress and deletion rules, words with deleted final syllables were examined. There were seven words where the ordering of these rules is crucial to the placement of stress. In each of these words, if stress were to occur before final syllable deletion, the penult would be stressed. If, on the contrary, final syllable deletion were to occur before stress, the antepenult would be stressed. All vowels in these seven words are short, and in each case, the vowel with greatest duration is penultimate. Thus, words receive stress before the final syllable is deleted. Additional support for this conclusion is found in the nature of the deletion process. The output is variable: sometimes the final syllable does not delete, sometimes it deletes entirely, and sometimes it only devoices. Variable output is one of the characteristics of a post-lexical rule (3); hence, final syllable deletion must occur after stress.

DISCUSSION

This study shows that duration is indeed a robust correlate of stress, that can be used even in a language with phonemic vowel length, countering (2). Moreover, the use of duration as a correlate of stress does not compromise the phonemic use of duration. In addition, this study provides phonetic verification of the transcription of vowel length in (4): the duration of vowels transcribed as long is about twice that of vowels transcribed as short. Likewise, it provides phonetic verification of the stress rule in (1): the duration of vowels assigned main stress by this rule is about twenty percent greater than that of vowels not assigned main stress. Finally, this study suggests the possibility that languages with phonemic vowel length use duration as a weaker correlate of stress than do languages without phonemic vowel length.

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