THE INFLUENCE OF ASPIRATION ON VOWEL DURATION

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ABSTRACT

In the present paper an attempt is made to put forward the results of an electroglottographic study on the influence of aspiration on vowel duration in Maithili—a modern Indo-Aryan language spoken by a total of about 21 million people both in Nepal and India. The main aim of our study was to investigate whether phonation types other than voicelessness and voicing also affect the length of vowels preceding a consonant. Our results clearly show that the lengthening of vowels before aspirated consonants does affect vowel duration in Maithili. In fact, in Maithili the features of both voice and aspiration do independently lend increments of length to the preceding vowel.

INTRODUCTION

There have been in the past quite a few studies on vowel duration in various languages of the world. One of the major findings of most of these studies has been that, other things remaining the same, vowels are longer before voiced consonants than before voiceless ones. This phenomenon has usually been considered [e.g. 1; 2; 3] to be due to an inherent property of the speech production mechanism of a language. Different proposals have so far been made as to what precise mechanism is responsible for this lengthening of vowels. Some proposals [e.g. 4; 5] aim only to account for the lengthening of vowels before voiceless consonants, while others also aim to account for such factors as: the degree of opening of the vowel [e.g. 6; 7; 8]; place, manner and force of articulation [e.g. 9; 10; 11] of the following consonants; the structure of the syllable in which the vowel occurs [e.g. 12; 13]; vowel duration and phonetic contrasts employed by the language in question [e.g. 14]; and the degree of glottal opening [e.g. 15; 16] as well as the airflow [e.g. 17] of the following consonants.

It is known that comparatively little has so far been published on the effect of aspiration on vowel duration. Relatively recently, Maddessen and Gaudur [17] studied the effect of aspiration on the duration of the Hindi vowel /a/—as spoken in Delhi—and found some interaction between aspiration and vowel duration. In a later study [18], Maddessen investigated five languages—i.e. Hindi, Bengali, Assamese, Marathi and Eastern American—and came to the conclusion that vowel lengthening before aspirated consonants is not universal.

In the present paper an attempt is made to put forward the results of an electroglottographic study on the influence of aspiration on vowel duration in Maithili—the vowels studied here are those of a variety of the 'standard' dialect of this language. The main aim of the paper is to investigate whether phonation types other than voicelessness and voicing also affect the length of vowels preceding a consonant.

EXPERIMENTAL METHOD

Test Utterances

For the purpose of the present study, appropriate test utterances— as given in Table I—were prepared. This table lists 24 monosyllabic test utterances containing the following six Maithili oral vowels: /i e a e o u/, each followed by phonetically contrasting series of stop or affricate consonants—i.e. voiceless unaspirated, voiceless aspirated, voiced unaspirated, voiced aspirated. Where complete minimal series of words containing all the stops with differing phonation types in a given place of articulation did not exist, all possible utterances—i.e. utterances which are not available in the Maithili lexicon and which therefore do not seem anything in this language—were added to fill the gap in distribution. Only three such nonsense items were required for the purpose of this study: /s[e][e][e]/, /s[e][i][e]/ and /s[u][e][e]/, as given in Table II. It must also be pointed out that all the nonsense utterances thus added in this table are phonologically possible items in the Maithili language.

Apparatus Used

Each test utterance was afterwards put in a normal conversational sentence context, the frame of the sentence being /"[s]"e-[s]e-[s]e-[s]e-[s]e-
frame, were recorded in a soundproof studio of Essex University. All recordings were made on a Revox B 77 tape-recorder. The glottal signal was obtained using an Electroglottograph F—J Electronics Type B 810. Spectrum of waveform and amplitude produced from the recorded readings were obtained using a Nicolet Type 5057. Calculations relating to the 'mean', the 'standard deviation'(SD) and the 'coefficient of variation' of all tokens of each test utterance were made using a Tektronix 413 calculator.

Duration Measurements

Of the sixteen tokens of each test utterance, the first two as well as the last two tokens were ignored, and all the remaining twelve tokens of the middle were used to obtain the duration measurements of all the vowels investigated in this study. The first measures of vowel duration were made from the vowel in question to the closure of the following consonant. In the case of words beginning with voiced stops and even voiceless unaspirated stops and fricatives, the measurement was begun at the release of the concerned initial stop or fricative. Afterwards, a simple arithmetic mean of the actual measured values of all tokens of each test utterance was worked out. In order to ascertain the reliability of the arithmetic mean as a quantified abstract value representing the realization of the speaker's intention, the range of the variability occurring in all the 12 tokens of every test utterance was as taken into account. For this, the standard deviation of each test utterance was worked out. To relate the variation between the different sets of data presented in this paper, the coefficient of variation was worked out. To relate the variation of each test utterance, the equation used being: v = 100 (SD)/X. Results and Discussions

Since from a preliminary survey of some published sources [e.g. 19; 20; 21; 22] we received no readily discernible patterns of environmental influence on duration of the following vowels, in the present study we have restricted our analysis of the influence of the following consonants on the duration of the stressed vowel to only one factor. The results of this study [see 20, pp. 351-54, for more details] shows the mean duration values of the six oral vowels as obtained from the 12 tokens of each test utterance. The standard deviation of the 12 tokens of each test utterance, the coefficient of variation...
of every utterance as well as the ratio of the duration of vowels preceding voiced and aspirated consonants to the duration of vowels preceding voiceless unaspirated consonants. A diagrammatic representation of these various phonetic values of this table is given in Figure 1. The horizontal axis of this figure shows postvocalic stop and in milliseconds (ms). The vertical axis is given in Figure 1. The horizontal axis of this figure shows postvocalic stop and voiceless unaspirated consonants. The results may be written as in (1) below:

1. vowels are relatively longer in duration before voiced unaspirated consonants than before voiceless unaspirated consonants;
2. vowels preceding unaspirated consonants are relatively longer in duration than those preceding either voiceless unaspirated or voiceless aspirated consonants;
3. vowels are relatively longer in duration before voiced aspirated consonants than before voiced unaspirated consonants; and
4. in general, other things being equal, open vowels are relatively longer than close vowels.

CONCLUSION

To conclude, the present study clearly shows that phonetic rules' operate in Maithili. These may be written as in (1) below:

1. vowel adds 1 increment of length before voiceless unaspirated or voiceless aspirated consonants, and
2. vowel adds 2 increments of length before voiced unaspirated consonants.

We therefore hope that the results of our study will urge a rethink of current and recent explanations of the interaction of phonation type and vowel duration, and will assist in the formulation of new phonetic rules to account for vowel lengthening before aspirated consonants

References


