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The Influence of Aspiration on Vowel Duration in Maithili

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svara-mātrā-vibhāga-jño gacchedācārya-saṃsadam
(He who knows the distinctions of tone and length may go and sit with the professors).

Taittirīya-Prātiśākhya, 24:6

1. Introduction

Previous studies of vowel duration in various languages, including English, have shown that some factors affecting vowel duration are: (i) the degree of opening[1] of the vowel; (ii) certain properties (voice,[2] place[3] and manner[4] of articulation, and "force"[5] of articulation) of the following consonant; (iii) linguistic structure,[6] i.e., the nature of the phonemic contrasts employed by a given language; and (iv) the amount of glottal opening and airflow.[7] Little, however, has been published on the effect of the fourth factor, i.e., aspiration, on vowel duration. Recently, in a study of Hindi (standard Delhi) vowel /a/, Maddieson and Gandour (1976) have found an interaction between phonation type (aspiration, 'murmured' or 'breathy voiced') and vowel duration. A later study of Maddieson (1977) of 5 languages (Assamese, Bengali, Hindi, Marathi and Eastern Armenian) showed that vowel lengthening before aspirated consonants is not a universal. The present study examines the influence of postvocalic consonants (voiceless unaspirated, voiceless aspirated, voiced unaspirated and voiced aspirated) on vowel duration in Maithili--an Indo-Aryan language spoken in Nepal and India.

Not much experimental work on vowel duration has been done on the languages of India and Nepal. To date, only 6 studies--dealing with the acoustical measurements of vowel formants and vowel duration--have been reported on: Hindi (Dixit 1963; Mittal and Gupta 1971; Maddieson and Gandour 1976; Maddieson 1977) and Malayalam (Velayudhan 1971; Velayudhan and Howie 1974). As far as I know, no acoustic study of any of the languages of Nepal[8] has been carried out yet.

Little has been published on the phonetics and phonology of Maithili. The only studies that I know of are: Jha (1941/1965; 1958), Yadav (1976); Ingemann and Yadav (1978) and Yadav (1979a,b).

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1. A slightly modified version of this paper has appeared in South Asian Languages Analysis: 1 (1979).

2. Dr. Ramawatar Yadav is Lecturer in English at Tribhuvan University. He wishes to express his indebtedness to Dr. Frances Ingemann for her kind help in recording the material, and constant advice and guidance.

2. Experimental Method

2.1 Materials

Twenty-eight monosyllabic minimal word pairs differing only in the final consonant were embedded in the sentence frame (p^her ekber --- kəhu) 'please say --- once again.' The test words (given in Table I) included 17 consonants in final position: [p, b, b^h; t, t^h, d, d^h; ṭ, $ṭ^h$; c, c^h; j, j^h; k, k^h; g, g^h] and six vowels [i.e, ə, a, o, u].[9] The sentences were randomized and three recordings of the randomized sentences were made. The sentences were spoken in a relaxed informal style at normal conversational speed and without contrastive stress on the test words.

TABLE I

Test Words

Sentence frame: [p^her ekber -- kəhu]
'again once say'

[i]

[biˇc] 'center'
[biˇc^h] 'pick up!'
[biǰ] 'seed'
[biǰ^h] 'rust'
[bik] 'sell'
[bik^h] 'poison'

[e]

[k^{h}ep] 'times'
[k^{h}eb] 'sail'
[k^{h}eb^h] 'plant seeds'
[bed] 'vedas'
[bed^h] 'pierce'

[ə]

[gəp] 'talk'
[gəb] 'a seedling ready to be transplanted'
[gəb^h] 'pregnancy' (i.e. of paddy crops)--a metaphorical use.
[həṭ] 'move'
[həṭ^h] 'obstinacy'

[u]

[kut^h] 'push; add pressure'
[kud] 'jump'

[o]

[kot] 'a muslim celebration'
[kot^h] 'sour'
[kod] 'dig'

[a]

[bat] 'matter; talk'
[bat^h] 'pain'
[bad] 'after'
[bad^h] 'out into the fields'
[bak] 'speech'
[bag] 'garden'
[bag^h] 'tiger'

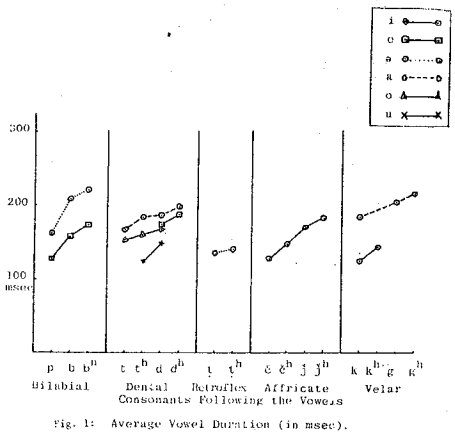

Fig. 1: Average Vowel Duration (in msec).

2.2 Speaker

The speaker (the author) was born in a village in the Tarai of Nepal and is a native speaker of Maithili.

2.3 Apparatus

Three recordings of each sentence were made on a Uher Royal Deluxe tape recorder. Eighty-four (28 x 3) wideband spectrograms were made on a Kay Sonagraph 6061B.

2.4 Measurements

Two measurements of duration were made: (1) vowel length was measured from the VOT (voice onset time) i.e., the start of the vowel to the closure of the following consonant. The results of these measurements are given in Table II and Figure 1.

TABLE II

Vowel Duration (in msec)

	Following Consonant		[i]		Average	Ratio		Following Consonant		[e]		Average	Ratio
bi-	č	135	115	135	128	1.00	k^he-	p	130	125	130	128	1.00
	$č^h$	150	150	140	147	1.14		b	175	150	150	158	1.23
	ǰ	175	160	175	170	1.32		b^h	180	160	180	173	1.35
	$ǰ^h$	190	165	185	183	1.42							
							be-	d	180	170	175	175	1.00
	k	130	115	130	125	1.00		d^h	190	190	180	187	1.06
	k^h	140	140	145	143	1.14							
			[u]							[o]			
ku-	t^h	115	125	125	122	1.00	ko-	t	150	150	160	153	1.00
	d	135	135	150	140	1.14		t^h	165	150	165	160	1.04
								d	185	160	160	168	1.09
			[ə]							[a]			
gə-	p	165	150	170	162	1.00	ba-	t	165	160	180	168	1.00
	b	210	200	215	208	1.28		t^h	175	185	195	185	1.10
	b^h	220	220	220	220	1.35		d	175	190	195	187	1.11
								d^h	190	190	210	197	1.17
hə-	ṭ	115	140	150	135	1.00							
	$ṭ^h$	120	150	150	140	1.03		k	180	185	185	183	1.00
								g	200	205	200	202	1.10
								g^h	215	215	215	215	1.17

Table II shows vowel duration in msec measured from the start of the vowel to the closure of the postvocalic consonant for each of the three utterances of each word, the average duration of vowels, and the ratio of vowel duration preceding voiced and aspirated consonants to the duration of vowels preceding voiceless unaspirated consonants. Thus, for example, the mean vowel durations in 3 tokens of the words [bic] and [bic^h] were 128 msec and 147 msec--the vowel preceding the aspirated consonant being 19 msec longer, with an average ratio of 1.00 to 1.14. Similarly, the average vowel durations in 3 tokens of the words [bij] and [bij^h] were 170 msec and 183 msec--the vowel before the voiced aspirated consonant being 13 msec longer, with an average ratio of 1.00 to 1.07; and so on. The measurements, thus, clearly show that the aspiration of the following consonant does seem to affect vowel duration in Maithili.

Average vowel duration is also shown in Figure 1. The abscissa shows the postvocalic consonants of various places of articulations that occur while the ordinate shows the vowel duration in msec. From the limited data presented here, nothing definitive can be said about the influence of place of articulation of the following consonant on vowel length.

(2) In three words beginning with a voiceless aspirated consonant, an additional measurement of vowel duration was also made from the release of the preceding consonant to the closure of the following consonant. These measurements are shown in Table III. A. and Figure 2. Table III. B. shows the duration of aspirated release in the words [k^{h}ep, k^{h}eb, k^{h}eb^h].

Table III

A. Vowel Duration (in msec) of [e]

	Following Consonant	[e] 1	2	3	Average	Ratio
k^{h}e-	p	210	200	300	203	1.00
	b	240	215	220	225	1.10
	b^h	255	220	240	238	1.17

B. Duration of Initial k^h- Release

Before	1	2	3	Average
-ep	80	75	70	75
-eb	65	65	70	67
-eb^h	75	60	60	65

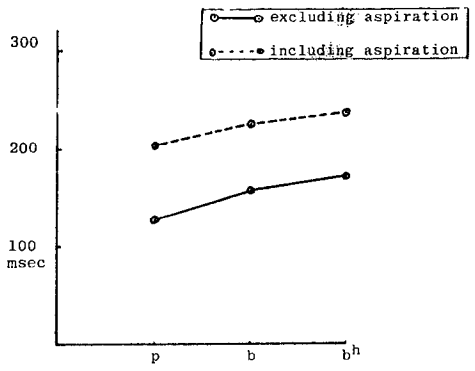

Fig. 2: Average Vowel Duration (in msec) of [e].

Figure 2 shows the average vowel duration of [ə] as derived from the two types of measurement, i.e., (i) from VOT to the closure of the following consonant, and (ii) from the release of the preceding consonant to the closure of the following consonant. The figures for the second type of measurement are naturally higher since the duration of the initial aspirated release is also included in them.

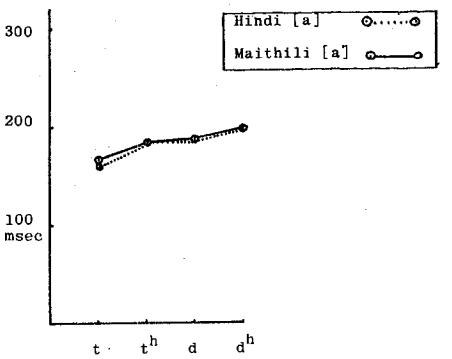

Fig. 3: Average vowel duration (in msec) of Hindi [a] and Maithili [a].

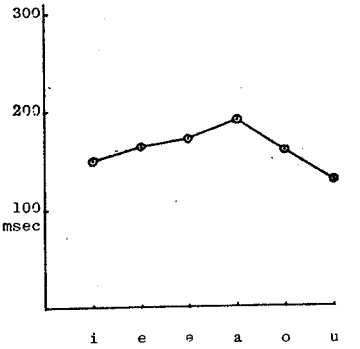

Fig. 4: Average Vowel Duration (in msec).

Figure 3 presents a comparison between the Hindi data as reported by Maddieson and Gandour (1976) and the present Maithili data. The results bear a striking similarity between the two.

Figure 4 shows the 'intrinsic' duration of the Maithili vowels based on the limited data used in this study. In Maithili, as in other languages, high vowels are shorter in duration than low vowels

3. Results and Discussion

Examination of the data reveals the following:

(i) Maithili vowels preceding voiced unaspirated consonants are longer in duration than vowels preceding voiceless unaspirated consonants, with an average ratio of 1.00 to 1.18.

(ii) Maithili vowels are longer in duration before voiceless aspirated consonants than before voiceless unaspirated consonants, with an average ratio of 1.00 to 1.09.

(iii) Maithili vowels are longer in duration before voiced aspirated consonants than before voiced unaspirated consonants, with an average ratio of 1.00 to 1.06.

(iv) The present Maithili data are completely amenable to the generalization that vowel duration appears to be correlated with tongue-height; in other words, other things being equal, a high vowel is shorter than a low vowel.

(v) The present data offer yet another support[10] for the traditional grouping of Maithili consonants (and perhaps those of all Indic languages) not only into voiced and voiceless categories but also into aspirated and unaspirated. In other words, the features of voice and aspiration do lend an increment of length to the preceding vowel.

Notes

1. See House and Fairbanks (1953); Peterson and Lehiste (1963); and House (1961), to name only a few.

2. See Halle and Stevens (1967); Chomsky and Halle (1968).

3. See Fischer - Jorgensen (1964).

4. See House and Fairbanks (1953).

5. See Belasco (1953).

6. See Zimmerman and Sapon (1958).

7. See Chen (1970).

8. A solitary exception may be Hinton's (1970) study of Gurung--a Sino-Tibetan language of Nepal--, but I have not yet been able to get a copy.

9. For inventory of Maithili consonant and vowel phonemes, see Yadav (1976).

10. For support based on temporal course and width of the glottis, see Ingemann and Yadav (1978).

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