Steady State Vowel duration as an Acoustic Cue for Garhwali Hindi database

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ABSTRACT

The present study investigated the developmental changes in steady state vowel duration in Garhwali in normal subject. Steady State Vowel duration is one of the acoustical cues that provide information about speech intonation. Intonation contours contribute to information about the prosodic structure of an utterance. In tonal languages, linguistic information is also carried in the intonation contours of speech. Thus, sensitivity to speech intonation is an important aspect of speech perception. This paper presents a study of Steady State Vowel duration of Garhwali Hindi syllables abutted with ten vowels / a , a:, i, i:, u, u:, e, e:, o, o:/ of different position of the words i.e. initial, middle and final position. These tokens were spoken in isolation by 15 adult male and 15 adult female speakers. These speakers are different district of Uttarakhand and they all are native Garhwali speaker. Garhwali Hindi is a regional dialect of Uttarakhand. Male speaker has the higher Steady State Vowel duration than female native speaker. The effect of aspiration on steady state vowel duration for aspirated and unaspirated sounds have been calculated and it is found that unaspirated voice sound has higher steady state vowel duration than unaspirated voiceless sounds and also found that aspirated voice sound has higher steady state vowel duration than aspirated voiceless sounds for both male and female speakers.

Introduction

Vowels can be produced as long, isolated, and steady-state, but that is not how they are found in natural speech. Instead natural speech consists of almost continuously changing (i.e., dynamic) acoustic forms from which mature listeners recover underlying phonetic form. Some theories suggest that children need steady-state information to recognize vowels (and so learn vowel systems), even though that information is sparse in natural speech.

When stop –vowel syllables are presented dichotically with a temporal delay between syllables at the two ears, the lagging stop is recalled more accurately on the average then the one which leads (Studdert-Kennedy, 1970; Lowe, 1970). Porter (1969) have reported finding a slight lead advantage rather than a lag advantage when the competing stimuli were steady state vowels rather than stoop consonants.they interpret the difference between stops a vowels as evidence that the lag effect in recall of dichotic stimuli is associated with special speech decoding processes. They attribute the absence of the effect for vowels to the vowels' being treated perceptually like nonspeech stimuli.

METHOD

Participants: Fifteen male and fifteen female in the age range of 16-30 years participated in a study. None of the subjects had any significant history of ENT, speech or hearing problems.

Procedure: The subjects were instructed to read the token written on the flash card as naturally as possible. The recording was done in partial acoustically treated room for individual subjects by

presenting one flash card at a time using a SANYO voice activated recording system (TRC-860C). This was connected to the computer (Pentium IV) having PRAAT Speech software. The speech signal was digitized at the sampling frequency of 16 kHz.

RESULTS AND DISCUSSION

Aspirated sounds for male speakers

Table- 1 shows that the S.S.V.D. for voice and voiceless consonants. The range of S. S. V. D. varies from 20.36 to 40.89 m sec. for voiced and 18.74 to 34.39 m sec. for voiceless consonants.

Table: - 1: Effect of aspiration on S.S.V.D. (in m sec.) for voice and voiceless consonants in isolation for male speakers

Vowel	Voice					Voiceless				
	Labial	Dental	Retrof-lex	Velar	Average Values	Labial	Dental	Retrof-lex	Velar	Average Values
/a/	24.77	22.48	--	25.28	24.18	20.01	21.69	26.70	18.85	21.81
/a:/	29.61	25.60	--	28.66	27.96	28.95	23.70	25.82	23.47	25.49
/i/	20.67	24.21	--	26.94	23.94	19.21	23.33	23.27	21.28	21.77
/i:/	36.38	39.52	--	35.12	37.01	26.37	32.37	31.74	27.00	29.37
/u/	22.67	23.33	--	20.36	22.12	21.11	20.00	20.12	18.74	19.99
/u:/	25.83	23.36	--	22.42	23.87	20.90	22.31	22.00	19.01	21.06
/e/	35.82	28.93	--	30.99	31.91	34.39	27.66	30.51	28.66	30.31
/e:/	40.12	32.52	--	35.71	37.12	30.31	28.83	30.48	33.61	30.81
/o/	29.00	31.68	--	32.78	31.15	28.39	30.28	31.61	31.51	30.45
/o:/	31.07	40.89	--	33.07	35.01	28.25	33.92	32.20	31.28	31.41
Avg.	29.59	29.25	--	29.13	29.33	25.79	26.41	27.45	25.34	26.25

Table 1 shows that the S.S.V.D. for voice consonants (Avg. 29.33 m sec.) is greater than that for voiceless consonants (Avg. 26.25 m sec.) and ratio of the average S.S.V.D. of voiced to voiceless consonants varies from 1.02 to 1.26 and average ratio is 1.12. The difference of S.S.V.D. between voice and voiceless consonants is varies from 0.7 to 7.64 m sec. and average difference is 3.12 m sec.

Effect of place of articulation on S.S.V.D. was studied by analyzing the data presented in table- 7.8.3.1.1. It has been found that the order of the average S.S.V.D. for voiced consonants is large for labial (Avg. 29.59 sec.) followed by dental (Avg. 29.25 m sec.) and velar (Avg. 29.13 m sec.) sounds. The order for voiceless consonants is retroflex (Avg. 27.45 m sec.) followed by dental (Avg. 26.41 m sec.), labial (Avg. 25.79m sec) and velar (Avg. 25.34 m sec.) sounds.

Unaspirated sounds for male speakers

Table 2 shows that the S.S.V.D. for voice and voiceless consonants. The range of S. S. V. D. varies from 18.02 to 46.82 m sec for voiced and 17.79 to 46.04 m sec. for voiceless consonants.

Table: 2: Effect of aspiration on S.S.V.D. (in m sec.) for voice and voiceless consonants in isolation for male speakers

Vowel	Voice					Voiceless				
	Labial	Dental	Retrof-lex	Velar	Average Values	Labial	Dental	Retrof-lex	Velar	Average Values
/a/	42.51	22.44	33.31	26.70	31.24	20.79	22.09	30.81	25.20	24.72
/a:/	31.03	26.06	39.43	26.93	30.86	30.12	24.12	33.31	26.47	28.51
/i/	23.83	22.09	25.37	25.95	24.31	22.06	20.51	23.15	25.35	22.77
/i:/	33.40	29.88	31.00	33.51	31.95	28.50	28.91	30.31	29.50	29.31
/u/	21.97	18.02	21.02	22.96	20.99	21.83	17.79	20.67	20.60	20.22
/u:/	23.78	18.57	22.00	22.30	21.66	21.46	19.61	20.03	21.61	20.68
/e/	33.49	32.20	28.91	35.84	32.61	33.22	29.00	28.81	27.19	29.31
/e:/	46.82	28.01	42.75	40.83	39.60	46.05	23.46	40.28	28.31	34.53
/o/	33.13	28.66	27.91	41.28	32.75	31.72	26.70	27.18	39.63	31.31
/o:/	44.17	31.14	32.77	30.37	34.61	36.76	30.40	32.44	26.70	31.58
Avg.	33.41	25.71	30.45	30.67	30.06	29.25	24.26	28.70	26.96	27.29

Table 2 shows that the S.S.V.D. for voice consonants (Avg. 30.06 m sec.) is greater than that for voiceless consonants (Avg. 27.29 m sec.) and ratio of the average S.S.V.D. of voiced to voiceless consonants varies from 1.05 to 1.3 and average ratio is 1.1. The difference of S.S.V.D. between voice and voiceless consonants is varies from 0.77 to 7.52 m sec. and average difference is 2.86 m sec.

Effect of place of articulation on S.S.V.D. was studied by analyzing the data presented in table 2. It has been found that the order of the average S.S.V.D. for voiced consonants is large for labial (Avg. 33.41 sec.) followed by velar (Avg. 30.67 m sec.), retroflex (Avg. 30.45 m sec.) and dental (Avg. 25.71 sec.) sounds. The order for voiceless consonants is labial (Avg. 29.25 sec.) followed by retroflex (Avg. 28.7m sec.), velar (Avg. 26.96 m sec.) and dental (Avg. 24.26 sec.) sounds.

The average S.S.V.D. for all categories of stops is maximum for labial (Avg. 29.51 m sec.) followed by retroflex (Avg. 28.87 m sec.), velar (Avg. 28.03 m sec.) and dental (Avg. 26.41 m sec.) sounds.

Table: 3: Effect of aspiration on S.S.V.D. (in m sec.) for voice and voiceless consonant in isolation for male.

Vowels	Unaspirated				Aspirated			
	Voice	Voiceless	Ratio	Difference	Voice	Voiceless	Ratio	Difference
/a/	31.24	24.72	1.3	7.52	24.18	21.81	1.11	2.37

/a:/	30.86	28.51	1.08	2.35	27.96	25.49	1.10	2.47
/i/	24.31	22.77	1.07	1.54	23.94	21.77	1.10	2.17
/i:/	31.95	29.31	1.09	2.64	37.01	29.37	1.26	7.64
/u/	20.99	20.22	1.04	0.77	22.12	19.99	1.11	2.13
/u:/	21.66	20.68	1.05	0.98	23.87	21.06	1.13	2.81
/e/	32.61	29.31	1.11	3.30	31.91	30.31	1.05	1.60
/e:/	39.60	34.53	1.15	5.07	37.12	30.81	1.19	5.67
/o/	32.75	31.31	1.05	1.44	31.15	30.45	1.02	0.70
/o:/	34.61	31.58	1.10	3.03	35.01	31.41	1.11	3.60
Avg.	30.06	27.29	1.10	2.86	29.33	26.25	1.12	3.12

Table: –4: Effect of voicing on S.S.V.D. (in m sec.) spoken in isolation.

Vowels	Voice	Voiceless	Ratio	Difference
/a/	27.71	23.27	1.19	4.44
/a:/	29.41	27.00	1.09	2.41
/i/	24.19	22.27	1.09	1.92
/i:/	34.48	29.34	1.18	5.14
/u/	21.56	20.11	1.07	1.45
/u:/	22.77	20.87	1.09	1.90
/e/	32.26	29.81	1.08	2.45
/e:/	37.86	32.67	1.16	5.19
/o/	31.95	30.88	1.03	1.07
/o:/	34.81	31.50	1.11	3.31
Avg.	29.70	26.77	1.11	2.93

Table 4 presents the effect of voicing on S.S.V.D. It has been observed that the average S.S.V.D. for voiced consonants (Avg. 29.70 m sec.) is larger than that for the voiceless consonants (Avg. 26.77 m sec.). The variation of ratios of the S.S.V.D. for voiced to voiceless consonants is from 1.03 to 1.19 and average ratio is 1.11. The variation of difference between voiced and voiceless consonants is from 1.07 to 5.19 m sec and average difference is 2.93 m sec.

Aspirated sounds for female speakers

Table 5 shows that the S.S.V.D. for voice and voiceless consonants for female speaker. The range of S. S. V. D. varies from 17.57 to 39.64 m sec for voiced and 15.13 to 33.61 m sec. for voiceless consonants.

Table 5 shows that the S.S.V.D. for voice consonants (Avg. 27.64 m sec.) is greater than that for voiceless consonants (Avg. 24.41 m sec.) and ratio of the average S.S.V.D. of voiced to voiceless consonants varies from 1.08 to 1.21 and average ratio is 1.13. The difference of S.S.V.D. between voice and voiceless consonants varies from 1.53 to 5.11 m sec. and average difference is 3.24 m sec.

Table: 5: Effect of aspiration on S.S.V.D. (in m sec.) for voice and voiceless consonants in isolation for female speakers

Vowel	Voice					Voiceless				
	Labial	Dental	Retrof-lex	Velar	Average Values	Labial	Dental	Retrof-lex	Velar	Average Values
/a/	25.48	27.14	--	23.43	25.35	23.74	6.93	20.97	21.10	23.19
/a:/	31.39	27.22	--	30.22	29.61	27.48	23.57	24.41	22.52	24.50
/i/	22.27	24.72	--	25.55	24.18	19.56	22.67	20.89	22.26	21.35
/i:/	23.68	20.15	--	25.89	23.24	21.53	19.28	17.38	23.82	20.51
/u/	21.56	22.82	--	17.57	20.65	19.38	19.62	16.29	15.13	17.61
/u:/	21.44	20.23	--	21.08	20.92	19.71	19.44	19.77	18.65	19.39
/e/	32.89	33.58	--	34.25	33.57	31.96	29.53	28.11	30.72	30.08
/e:/	39.64	31.32	--	32.72	34.56	33.61	28.35	30.82	29.61	30.60
/o/	30.62	29.79	--	33.44	31.28	29.17	25.55	28.67	27.52	27.73
/o:/	34.47	33.46	--	31.32	33.08	30.35	33.27	24.10	28.76	29.12
Avg.	28.34	27.04	--	27.55	27.64	25.65	24.82	23.14	24.01	24.41

Effect of place of articulation on S.S.V.D. was studied by analyzing the data presented in table 5. It has been found that the order of the average S.S.V.D. for voiced consonants is large for labial (Avg. 28.34 sec.) followed by velar (Avg. 27.55 m sec.) and dental (Avg. 27.04 m sec.) sounds. The order for voiceless consonants is labial (Avg. 25.65 m sec.) followed by dental (Avg. 24.82 m sec.) velar (Avg. 24.01 m sec) and retroflex (Avg. 23.14 m sec.) sounds.

Unaspirated sounds for female speakers

Table 6 shows that the S.S.V.D. for voice and voiceless consonants. The range of S. S. V. D. varies from 18.43 to 45.92 m sec for voiced and 15.22 to 34.59 m sec. for voiceless consonants.

Table: 6: Effect of aspiration on S.S.V.D. (in m sec.) for voice and voiceless consonants in isolation for female speakers

Vowel	Voice					Voiceless				
	Labial	Dental	Retrof-lex	Velar	Average Values	Labial	Dental	Retrof-lex	Velar	Average Values
/a/	23.40	28.92	23.9	26.24	25.62	21.36	24.83	20.89	21.20	22.07
/a:/	28.29	30.07	36.81	32.00	31.79	23.87	25.79	26.47	25.77	25.48
/i/	25.48	29.53	23.25	22.83	25.27	21.44	21.83	21.79	21.98	21.76
/i:/	23.22	20.93	25.82	23.46	23.36	22.11	20.13	24.83	20.89	21.99
/u/	19.45	18.43	20.46	22.65	20.25	17.34	15.22	19.28	19.21	17.76
/u:/	21.75	22.88	20.63	21.28	21.64	18.33	19.00	17.58	19.28	18.55

/e/	31.75	32.05	29.71	32.31	31.46	28.92	30.51	26.57	30.75	29.19
/e:/	40.17	31.87	36.29	33.57	35.48	30.05	28.61	24.95	26.37	27.50
/o/	33.19	38.57	36.00	46.70	38.62	30.42	28.56	30.46	27.64	29.27
/o:/	36.08	34.61	38.83	45.92	38.86	26.65	34.59	32.41	32.89	31.64
Avg.	28.28	28.79	29.17	30.70	29.24	24.05	24.91	24.53	24.60	24.52

Table 6 shows that the S.S.V.D. for voice consonants (Avg. 29.24 m sec.) is greater than that for voiceless consonants (Avg. 24.52 m sec.) and ratio of the average S.S.V.D. of voiced to voiceless consonants varies from 1.06 to 1.32 and average ratio is 1.19. The difference of S.S.V.D. between voice and voiceless consonants is varies from 1.37 to 9.35 m sec. and average difference is 4.71 m sec.

Effect of place of articulation on S.S.V.D. was studied by analyzing the data presented in table- 7.9.3.1.6. It has been found that the order of the average S.S.V.D. for voiced consonants is large for velar (Avg. 30.7 m sec.) followed by retroflex (Avg. 29.17 m sec.), dental (Avg. 28.79 m sec.) and labial (Avg. 28.28 sec.) sounds. The order for voiceless consonants is dental (Avg. 24.91 m sec.) followed by velar (Avg. 24.6m sec.), retroflex (Avg. 24.53 m sec.) and labial (Avg. 24.05 sec.) sounds.

The average S.S.V.D. for all categories of stops is maximum for velar (Avg. 26.72 m sec.) followed by labial (Avg. 26.58 m sec.), dental (Avg. 26.39 m sec.) and retroflex (Avg. 25.61 m sec.) sounds.

Table: 7: Effect of aspiration on S.S.V.D. (in m sec.) for voice and voiceless consonant in isolation for female.

Vowels	Unaspirated				Aspirated			
	Voice	Voiceless	Ratio	Difference	Voice	Voiceless	Ratio	Difference
/a/	25.62	22.07	1.16	3.55	25.35	23.19	1.09	2.16
/a:/	31.79	25.48	1.25	6.31	29.61	24.50	1.21	5.11
/i/	25.27	21.76	1.16	3.51	24.18	21.35	1.13	2.83
/i:/	23.36	21.99	1.06	1.37	23.24	20.51	1.13	2.73
/u/	20.25	17.76	1.14	2.49	20.65	17.61	1.17	3.04
/u:/	21.64	18.55	1.17	3.09	20.92	19.39	1.08	1.53
/e/	31.46	29.19	1.08	2.27	33.57	30.08	1.12	3.49
/e:/	35.48	27.50	1.29	7.98	34.56	30.60	1.13	3.96
/o/	38.62	29.27	1.32	9.35	31.28	27.73	1.13	3.55
/o:/	38.86	31.64	1.23	7.22	33.08	29.12	1.14	3.96
Avg.	29.24	24.52	1.19	4.71	27.64	24.41	1.13	3.24

Table: 8: Effect of voicing on S.S.V.D. (in m sec.) spoken in isolation.

Vowels	Voice	Voiceless	Ratio	Difference
/a/	25.49	22.63	1.13	2.86
/a:/	30.70	24.99	1.23	5.71
/i/	24.73	21.56	1.15	3.17
/i:/	23.30	21.25	1.10	2.05
/u/	20.45	17.69	1.16	2.76
/u:/	21.28	18.97	1.12	2.31
/e/	32.52	29.64	1.10	2.88
/e:/	35.02	29.05	1.21	5.97
/o/	34.95	28.50	1.23	6.45
/o:/	35.97	30.38	1.18	5.59
Avg.	28.44	24.47	1.16	3.98

Table 8 presents the effect of voicing on S.S.V.D. It has been observed that the average S.S.V.D. for voiced consonants (Avg. 28.44 m sec.) is larger than that for the voiceless consonants (Avg. 24.47 m sec.). The variation of ratios of the S.S.V.D. for voiced to voiceless consonants is from 1.1 to 1.23 and average ratio is 1.16. The variation of difference between voiced and voiceless consonants is from 2.05 to 6.45 m sec and average difference is 3.98 m sec.

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