



The Effect of Speech Rate on the Temporal Organization of Syllable Production in Cantonese

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Abstract

The study investigates the effect of speech rate on the temporal organization of syllable production of in Hong Kong Cantonese. The results show that all the component segments of the test syllables, including the vowel-nasal transitions and element-element transitions in the diphthongs, contribute to the reduction of the entire syllable durations in fast speech. While the percentages of duration reduction for the syllable-initial consonants in all the test syllables are similar, the percentages of duration reduction for the vowels, vowel-nasal transitions, syllable-final nasals, first vowel elements, element-element transitions, and second vowel elements vary according to the types of syllable structure in the language.

1. Introduction

In Hong Kong Cantonese (henceforth, HKC), five basic types of syllable structures may be distinguished: (C₁)V:, (C₁)V:C₂, (C₁)VC₂, (C)D₁, and (C)D₂, where C₁ is an aspirated or unaspirated stop, an aspirated or unaspirated affricate, a fricative, a nasal, a liquid, or a glide; V a short vowel; V: a long vowel; C₂ an “-N”, i.e., a syllable-final nasal [-m, -n, -ŋ] or “-S”, i.e., a syllable-final unreleased stop [-p, -t, -k], and D a diphthong. In HKC, two types of diphthongs, D₁ and D₂, may be distinguished in terms of their internal temporal structure. D₁ refers to the diphthongs [ui, iu, ai, au, ɔi] and D₂ to the [ei, ɛi, ɛu, ou, ɔy]. In D₁ diphthongs, the first element is longer than the second, whereas in D₂ diphthongs, the durations of the two elements are similar [1]. The study investigates the effect of speech rate on the temporal organization of syllable production in HKC.

2. Procedures

The wordlist contained 33 meaningful test monosyllables of different syllable structures as shown in Table 1. The syllable-initial consonant in the test monosyllables is [t, t^h, ts, ts^h] or [s], the syllable-final consonant is a stop [t] or nasal [n],

Table 1: 33 test words of 7 syllable types: CV: CV:S, CVS, CV:N, CVN, CD₁, and CD₂.

CV:	CV:S	CVS	CV:N	CVN	CD ₁	CD ₂
[taŋ]	[tat-ɿ]	[tət-ɿ]	[tanŋ]	[tɛnŋ]	[taiŋ]	[tɛiŋ]
[t ^h aŋ]	[t ^h at-ɿ]	[t ^h ət-ɿ]	[t ^h anŋ]	[t ^h ɛnŋ]	[t ^h aiŋ]	[t ^h ɛiŋ]
[tsaŋ]	[tsat-ɿ]	[sət-ɿ]	[tsanŋ]	[tsɛnŋ]	[tsaiŋ]	[tsɛiŋ]
[ts ^h aŋ]	[ts ^h at-ɿ]		[ts ^h anŋ]	[ts ^h ɛnŋ]	[ts ^h aiŋ]	[ts ^h ɛiŋ]
[saŋ]	[sat-ɿ]		[sanŋ]	[sɛnŋ]	[saiŋ]	[sɛiŋ]

the vowel is [a] or [ɛ], and the diphthong is [ai] or [ɛi]. The test monosyllables in the word list were randomized. The list was recorded by three native speakers of HKC who were all college students. However, in this presentation only data from one speaker is reported. Each recorded the list two times, first, at a normal conversational rate, and then at a fast rate. Before

recording, each speaker was given time to practice. Temporal organization of the test syllables was determined by measurements of the durations of the successive component segments contained in the syllables. Durations of the successive component segments in the test syllables were measured directly from the speech waveforms, using CSL (Computerized Speech Lab) 4300B speech analysis software by Kay Elemetrics on a 586 PC. In the cases where the test syllables contained a diphthong or a nasal ending, durations were measured from the speech waveforms as well as from the formant trajectories.

3. Results and Discussion

3.1. CV: Syllables

Table 2a shows the durations (in ms) of the syllable-initial consonants and vowels in the CV: syllables at normal and fast speech rates. Table 2b shows the difference in duration between the syllable-initial consonants and between the vowels in the test monosyllables uttered at two speech rates, and the percentages of duration reduction for the consonants and vowels in the CV: syllables in fast speech.

Table 2a: The durations (in ms) of the syllable-initial consonants and vowels in the CV: syllables at normal and fast speech rates.

CV: Syllables	Consonant		Vowel	
	Normal	Fast	Normal	Fast
[taŋ]	6.2	5.2	386.1	141.3
[t ^h aŋ]	74.2	39.2	380.6	156.4
[tsaŋ]	48.6	30.6	408.5	185.4
[ts ^h aŋ]	93.7	45.9	417.1	161.8
[saŋ]	176.4	96.5	420.7	186.4

Table 2b: The differences in duration (in ms) between the syllable-initial consonants and between the vowels uttered at two speech rates; and the percentages of duration reduction for the syllable-initial consonants and vowels in the CV: syllables in fast speech.

CV: Syllables	Consonant		Vowel	
	Diff.	%	Diff.	%
[taŋ]	1.0	16.13	244.8	63.40
[t ^h aŋ]	35.0	47.17	224.2	58.91
[tsaŋ]	18.0	37.04	223.1	54.61
[ts ^h aŋ]	47.8	51.01	255.3	61.21
[saŋ]	79.9	45.29	234.3	55.69

The test monosyllables used for analyzing the CV: syllables were [taŋ], [t^haŋ], [tsaŋ], [ts^haŋ], and [saŋ] (Table 1). The duration reduction in the syllable-initial consonant in fast speech varies. By consonant duration, I refer to the VOT of [t, t^h, ts, ts^h] or frication of [s]. The respective durations of [t, t^h, ts, ts^h, s] are 6.2 ms, 74.2 ms, 48.6 ms, 93.7 ms, and 176.4 ms in normal speech and 5.2 ms, 39.2 ms, 30.6 ms, 45.9 ms, and 96.5 ms in fast speech. The percentages of reduction in fast speech for [t, t^h, ts, ts^h, s] in the CV: syllables are 16.13%,

47.17%, 37.04%, 51.01%, and 45.29%, respectively. Thus, the percentage of duration reduction in fast speech is smaller for [t] than for [t^h, ts, ts^h, s], whereas in normal speech [t] has the shortest VOT compared to those for [t^h, ts, ts^h, s].

As for the vowels [a] in the test monosyllables, the respective durations of the vowels [a] in [taɪ], [t^haɪ], [tsaɪ], [t^haɪ], and [saɪ] in normal speech are 386.1 ms, 380.6 ms, 408.55 ms, 417.1 ms, and 420.7 ms and 141.3 ms, 156.4 ms, 185.4 ms, 161.8 ms, and 186.4 ms in fast speech. The percentages of duration reduction for the vowels [a] in [taɪ], [t^haɪ], [tsaɪ], [t^haɪ], and [saɪ] are 63.40%, 58.91%, 54.61%, 61.21%, and 55.69%, respectively.

3.2. CV:S Syllables

Table 3a shows the durations of the syllable-initial consonants and vowels in the CV:S syllables at normal and fast speech rates. Table 3b shows the differences in duration between the syllable-initial consonants and between the vowels in the CV:S syllables uttered at two speech rates, and the percentages of duration reduction in fast speech for the syllable-initial consonants and vowels in the CV:S syllables.

Table 3a: The durations (in ms) of the syllable-initial consonants and vowels in the CV:S syllables at normal and fast speech rates.

CV:S Syllables	Consonant		Vowel	
	Normal	Fast	Normal	Fast
[tat-]	6.6	4.9	208.0	126.3
[t ^h at-]	60.9	35.2	201.4	138.6
[tsat-]	48.1	25.6	212.6	144.9
[ts ^h at-]	89.3	54.3	203.9	137.9
[sat-]	184.8	87.5	210.3	143.1

Table 3b: The differences in duration (in ms) between the syllable-initial consonants and between the vowels uttered at two speech rates; and the percentages of duration reduction in fast speech for the syllable-initial consonants and vowels in the CV:S syllables.

CV:S Syllables	Consonant		Vowel	
	Diff.	%	Diff.	%
[tat-]	1.7	25.76	81.7	39.28
[t ^h at-]	25.7	42.20	62.8	31.18
[tsat-]	22.5	46.78	67.7	31.84
[ts ^h at-]	35.0	39.19	66.0	32.37
[sat-]	97.3	52.65	67.2	31.95

The test monosyllables were [tat-], [t^hat-], [tsat-], [ts^hat-], and [sat-] (Table 1). The respective durations of [t, t^h, ts, ts^h, s] in normal speech are 6.6 ms, 60.9 ms, 48.1 ms, 89.3 ms, and 184.8 ms and 4.9 ms, 35.2 ms, 25.6 ms, 54.3 ms, and 87.5 ms in fast speech. The percentages of duration reduction in fast speech for [t, t^h, ts, ts^h, s] in the CV:S syllables are 25.76%, 42.20%, 46.78%, 39.19%, and 52.65%, respectively. Similar to the syllable-initial consonants in the CV: syllables, the percentages of duration reduction in fast speech are smaller for [t] than for [t^h, ts, ts^h] and [s].

As for the vowel [a] in the CV:S syllables, the respective durations of [a] in [tat-], [t^hat-], [tsat-], [ts^hat-], and [sat-] in normal speech are 208.0 ms, 201.4 ms, 212.6 ms, 203.9 ms, and 210.3 ms, respectively, and 126.3 ms, 138.6 ms, 144.9 ms, 137.9 ms, and 143.1 ms, respectively, in fast speech. The percentages of duration reduction in fast speech for the vowels [a] in [tat-], [t^hat-], [tsat-], [ts^hat-], and [sat-] are 39.28%, 31.18%, 31.84%, 32.37%, and 31.95%, respectively.

The percentages of duration reduction for the vowels [a] in the CV:S syllables (Table 3b) are smaller than for the vowels [a] in the CV: syllables (Table 2b). Since in normal speech the percentages of duration reduction for the vowels [a] in the CV: syllables are approximately

twice as long as the vowels [a] in the CV:S syllables, the larger duration reduction in the vowels in the CV: syllables in fast speech indicates that longer the vowel duration is in normal speech, larger the reduction will be in fast speech.

3.3. CVS Syllables

Table 4a shows the durations of the syllable-initial consonants and vowels in the CVS syllables uttered at normal and fast speech rates. Table (4b) shows the difference in duration between the segments of the test monosyllables uttered in two speech rates, and the percentages of duration reduction for the syllable-initial consonants and vowels in the CVS syllables in fast speech.

Table 4a: The durations (in ms) of the syllable-initial consonants and vowels in the CVS syllables at normal and fast speech rates.

VS Syllables	Consonant		Vowel	
	Normal	Fast	Normal	Fast
[tet-]	8.3	5.0	117.3	109.7
[tset-]	68.6	35.5	120.1	110.9
[set-]	182.5	93.6	128.5	111.5

Table 4b: The differences in duration (in ms) between the syllable-initial consonants and between the vowels uttered at two speech rates; and the percentages of duration reduction for the syllable-initial consonants and vowels in the CVS syllables in fast speech.

CVS Syllables	Consonant		Vowel	
	Diff.	%	Diff.	%
[tet-]	3.3	39.76	7.6	6.48
[tset-]	33.1	48.25	9.2	7.66
[set-]	88.9	48.71	17.0	13.23

The test monosyllables were [tet-], [tset-], and [set-] (Table 1). The durations of [t, ts, s] are 8.3 ms, 68.6 ms, and 182.5 ms, respectively, in normal speech and 5.0 ms, 35.5 ms, and 93.6 ms, respectively, in fast speech. The percentages of duration reduction in fast speech for [t, ts, s] in the CVS syllables are 39.76%, 48.25%, and 48.71%, respectively.

As in the cases of the CV: and CV:S syllables, the percentage of duration reduction in fast speech in the CVS syllables is smaller for [t] than for [ts] or [s]. Thus, in the CV:, CV:S, and CVS syllable the longer syllable-initial consonants [t^h, ts, ts^h, s] in normal speech undergo a larger percentage of duration reduction in fast speech than does the shorter [t] in normal speech. The positive correlation does occur among [t^h, ts, ts^h, s], as although [ts] is shorter than [t^h, ts^h] and [s] in the CV:, CV:S, and CVS syllables, the percentages of duration reduction for [ts] are not always smaller. Maybe such a positive correlation as such requires a much larger difference in duration between two syllable-initial consonants, as between [t] and [t^h, ts, ts^h] or [s].

The percentages of duration reduction in fast speech for the vowels [e] in the CVS syllables (6.48%, 7.66%, and 13.23%) are smaller in comparison with those for the vowels [a] in both the CV: (63.40%, 58.91%, 54.61%, 61.21%, and 55.69%) and CV:S (39.28%, 31.18%, 31.84%, 32.37%, and 31.95%) syllables. As shown in Tables 2a, 2b, 3a, 3b, 4a, and 4b, the percentages of duration reduction in fast speech for the vowels in the CV:, CV:S, and CVS are positively correlated with the vowel durations in normal speech. That is, the percentage of reduction in vowel duration in fast speech decreases as the vowel duration decreases in normal speech.

3.4. CV:N and CVN Syllables

Table 5a shows the durations (in ms) of the syllable-initial consonants, vowels, transitions, nasals, and rimes in the CV:N

and CVN syllables uttered at normal and fast speech rates. Table 5b shows the differences in duration between the syllable-initial consonants, between the vowels, between the transitions, between the syllable-final nasals, and between the rimes uttered at two speech rates, and the percentages of duration reduction in fast speech for the syllable-initial consonants, vowels, transitions, nasals, and rimes in the CV:N and CVN syllables.

The test monosyllables were the CV:N syllables [tan̩], [tʰan̩], [tsan̩], [tsʰan̩], and [san̩], and the CVN syllables [tən̩], [tʰən̩], [tsən̩], [tsʰən̩], and [sən̩] (Table 1).

As shown in Table 5b, the percentages of duration reduction of the syllable-initial consonants [t, tʰ, ts, tsʰ, s] in the CV:N and CVN syllables in fast speech are similar to those of the same consonants in the CV:, CV:S, and CVS syllables.

The percentages of duration reduction in fast speech are larger for the vowels [a] in the CV:N syllables (43.46%, 30.39%, 42.16%, 40.58%, and 32.45%) than the vowels [ɐ] in

the CVN syllables (15.20%, 16.14%, 31.29%, 1.88%, and 37.26%). This constitutes another case where the percentages of duration reduction in fast speech for the vowels are positively correlated with the vowel length in normal speech, as in normal speech the durations of the vowels [a] in the CV:N syllables are approximately twice as long as the durations of the vowels [ɐ] in the CVN syllables (Table 5a).

The vowel-nasal transitions in the CV:N syllables are much longer than those in the CVN syllables (Table 5a). The percentages of duration reduction in fast speech are larger for the vowel-nasal transitions in the CV:N syllables than the transitions in the CVN syllables. Again, this is a case where the percentage of duration reduction in fast speech is positively correlated with the duration in normal speech.

However, in the case of the syllable-final nasals, in which the percentages of duration reduction in fast speech are larger for the nasals in the CV:N syllables than those in the CVN syllables, despite that the nasals are shorter in the CV:N syllables than the CVN syllables.

Table 5a: The durations (in ms) of the syllable-initial consonants, vowels, transitions, nasals, and rimes in the CV:N and CVN syllables uttered at normal and fast speech rates.

CV:N/CVN Syllables	Consonant		Vowel		Transition		Nasal		Rime	
	Normal	Fast	Normal	Fast	Normal	Fast	Normal	Fast	Normal	Fast
[tan̩]	7.7	5.9	197.2	111.5	103.1	53.3	207.4	61.9	507.7	226.7
[tʰan̩]	90.1	45.2	173.1	120.5	132.3	47.8	192.8	54.9	498.2	223.2
[tsan̩]	64.4	33.3	222.0	128.4	104.1	57.6	246.6	49.1	572.7	235.1
[tsʰan̩]	99.7	65.4	217.6	129.3	125.7	48.1	234.6	38.6	577.9	216.0
[san̩]	197.4	106.0	212.3	143.4	105.4	42.0	259.2	64.0	576.9	249.4
[tən̩]	7.5	6.0	92.1	78.1	45.5	37.6	279.5	101.4	417.1	217.1
[tʰən̩]	74.2	39.9	91.7	76.9	63.1	42.6	255.0	112.5	409.8	232.0
[tsən̩]	56.8	26.9	105.8	72.7	64.3	42.0	278.6	115.4	448.7	230.1
[tsʰən̩]	122.4	59.0	90.2	88.5	66.7	32.5	265.1	155.8	422.0	276.8
[sən̩]	194.2	122.9	102.8	64.5	37.2	47.6	268.4	108.3	408.4	220.4

Table 5b: The differences in duration (in ms) between the syllable-initial consonants, between the vowels, between the transitions, between the nasals, and between the rimes in the CV:N and CVN syllables uttered at two speech rates; and the percentages of reduction in duration (in ms) for the syllable-initial consonants, vowels, transitions, nasals, and rimes in the CV:N and CVN syllables uttered in fast speech.

CV:N/CVN Syllables	Consonant		Vowel		Transition		Nasal		Rime	
	Diff.	%	Diff.	%	Diff.	%	Diff.	%	Diff.	%
[tan̩]	1.8	23.38	85.7	43.46	49.8	48.30	145.5	70.15	281.0	55.35
[tʰan̩]	44.9	49.83	52.6	30.39	84.5	63.87	137.9	71.52	275.0	55.20
[tsan̩]	31.1	48.29	93.6	42.16	46.5	44.67	197.5	80.09	337.6	58.95
[tsʰan̩]	34.3	34.40	88.3	40.58	77.6	61.73	196.0	83.55	361.9	62.62
[san̩]	91.4	46.30	68.9	32.45	63.4	60.15	195.2	75.31	327.5	56.77
[tən̩]	1.5	20.00	14.0	15.20	7.9	17.36	178.1	63.72	200.0	47.95
[tʰən̩]	34.3	46.23	14.8	16.14	20.5	32.49	142.5	55.88	177.8	43.39
[tsən̩]	29.9	52.64	33.1	31.29	22.3	34.68	163.2	58.58	218.6	48.72
[tsʰən̩]	63.4	51.80	1.7	1.88	34.2	51.27	109.3	41.23	145.2	34.41
[sən̩]	71.3	36.71	38.3	37.26	-10.4	-27.96	160.1	59.65	188.0	46.03

Table 6a: The durations (in ms) of the syllable-initial consonants, two vowel elements, transitions, and diphthongs in the CD₁ and CD₂ syllables uttered at normal and fast speech rates.

CD ₁ /CD ₂ Syllables	Consonant		1st Vowel Element		Transition		2nd Vowel Element		Diphthong	
	Normal	Fast	Normal	Fast	Normal	Fast	Normal	Fast	Normal	Fast
[tai̯]	7.6	6.9	225.0	136.6	225.0	72.0	124.6	21.3	574.6	229.9
[tʰai̯]	76.9	48.2	258.1	130.0	197.6	85.2	111.7	34.0	567.4	249.2
[tsai̯]	69.8	35.9	297.9	127.7	193.4	77.0	126.8	48.7	618.1	253.4
[tsʰai̯]	97.5	56.9	276.4	137.3	203.3	60.2	86.2	38.1	565.9	235.6
[sai̯]	195.5	98.3	266.2	149.9	199.2	75.4	123.1	22.9	588.5	248.2
[tei̯]	8.1	7.7	99.7	74.6	256.8	117.4	138.7	54.8	495.2	246.8
[tʰei̯]	72.2	48.9	108.1	50.8	216.2	102.5	117.6	54.3	441.9	207.6
[tsei̯]	60.8	31.5	131.4	84.8	186.5	92.3	123.0	63.0	440.9	240.1
[tsʰei̯]	99.2	50.6	122.7	59.4	213.1	105.3	110.9	73.3	446.7	238.0
[sei̯]	192.9	117.9	130.0	84.3	197.1	79.5	90.9	56.5	418.0	220.3

Table 6b: The differences in duration (in ms) between the syllable-initial consonants, between the first vowel elements, between the transitions, between the second vowel elements, and between the diphthongs in the CD₁ and CD₂ syllables uttered at two speech rates; and the percentages of reduction in duration for the syllable-initial consonants, two vowel elements, transitions, and rimes in the CD₁ and CD₂ syllables uttered in fast speech.

CD ₁ /CD ₂ Syllables	Consonant		1st Vowel Element		Transition		2nd Vowel Element		Diphthong	
	Diff.	%	Diff.	%	Diff.	%	Diff.	%	Diff.	%
[tai̯]	0.7	9.21	88.4	39.29	153.0	68.00	103.3	82.91	344.7	59.99
[t ^h ai̯]	28.7	37.32	128.1	49.63	112.4	56.88	77.7	69.56	318.2	56.08
[tsai̯]	33.9	48.57	170.2	57.13	116.4	60.19	78.1	61.59	364.7	59.00
[ts ^h ai̯]	40.6	41.64	139.1	50.33	143.1	70.39	48.1	55.80	330.3	58.37
[sai̯]	97.2	49.72	116.3	43.69	123.8	62.15	100.2	81.40	340.3	57.82
[tɕi̯]	0.4	4.94	25.1	25.18	139.4	54.28	83.9	60.49	248.4	50.16
[t ^h ɕi̯]	23.3	32.27	57.3	53.01	113.7	52.59	63.3	53.83	234.3	53.02
[tsɕi̯]	29.3	48.19	46.6	35.46	94.2	50.51	60.0	48.78	200.8	45.54
[ts ^h ɕi̯]	48.6	48.99	63.3	51.59	107.8	50.59	37.6	33.90	208.7	46.72
[sɕi̯]	75.0	38.88	45.7	35.15	117.6	59.67	34.4	37.84	197.7	47.30

As for rimes, the percentages of duration reduction in fast speech, as shown in Table 5b, are larger for the rimes in the CV:N syllables than the rimes in the CVN syllables. This is another case where the percentage of duration reduction in fast speech is positively correlated with duration in normal speech, as the rime durations are longer in the CV:N syllables than those in the CVN syllables (Table 5a).

Finally, the duration reduction in the nasals contributes most to the duration reduction in the rimes in both the CV:N and CVN syllables in fast speech. As shown in Table 5b, the differences in duration between the nasals are larger than the differences between the syllable-initial consonants, between the vowels, or between the transitions uttered at fast and normal speech rates.

3.5 CD₁ and CD₂ Syllables

Table 6a shows the durations (in ms) of the syllable-initial consonants, first vowel elements, transitions, second vowel elements, and rimes in the CD₁ and CD₂ syllables uttered at normal and fast speech rates. Table 6b shows the differences in duration between the syllable-initial consonants, between the first vowel elements, between the transitions, between the second vowel elements, and between the rimes in the CD₁ and CD₂ syllables uttered at two speech rates, and the percentages of duration reduction for the syllable-initial consonants, first vowel elements, transitions, second vowel elements, and rimes in the CD₁ and CD₂ syllables in fast speech. The test monosyllables were the CD₁ syllables [tai̯], [t^hai̯], [tsai̯], [ts^hai̯], and [sai̯], and the CD₂ syllables [tɕi̯], [t^hɕi̯], [tsɕi̯], [ts^hɕi̯], and [sɕi̯].

As shown in Table 6b, the percentages of duration reduction for the syllable-initial consonants [t, t^h, ts, ts^h, s] in the CD₁ and CD₂ syllables in fast speech are similar to those for the same consonants in the CV:, CV:S, CVS, CV:N, and CVN syllables (Tables 2b, 3b, 4b, and 5b).

In the CD₁ syllables, the first vowel elements [a] are longer than the second vowel elements [i] in normal speech (Table 6a), and the percentages of duration reduction are smaller for the first vowel elements than for the second vowel elements in fast speech (Table 6b).

In the CD₂ syllables, the durations of the first vowel elements [ɐ] and second vowel elements [i] in normal speech are similar (Table 6a), and the percentages of duration reduction in fast speech for both are also similar (Table 6b).

A comparison of the CD₁ and CD₂ syllables shows that in normal speech the first vowel elements [a] in the CD₁ syllables are longer than the first vowel elements [ɐ] in the CD₂ syllables (Table 6a), and the percentages of duration

reduction for the first vowel elements in the CD₁ and CD₂ syllables in fast speech are similar (Table 6b). Furthermore, the durations of the second vowel elements [i] in the CD₁ syllables and those in the CD₂ syllables in normal speech are similar (Table 6a), and the percentages of duration reduction are larger for the second vowel elements [i] in the CD₁ syllables than in the CD₂ syllables. Concerning the transitions between the first and second vowel elements, as shown in Table 6a, the durations of the transitions in the CD₁ and CD₂ syllables in normal speech are similar, and in fast speech the percentages of duration reduction are slightly larger for the transitions in the CD₁ syllables than in the CD₂ syllables (Table 6b).

As for the diphthongs (Table 6a), the D₁ diphthongs are longer than the D₂ diphthongs, and the percentages of duration reduction in fast speech are slightly larger for the D₁ diphthongs than the D₂ diphthongs (Table 6b). A comparison of the differences in duration reduction among the first vowel elements, second vowel elements, and the transitions in the D₁ diphthongs shows that the duration reduction in the first vowel elements contribute most to the reduction in the diphthong durations in fast speech, to be followed by the transitions and then the second vowel elements. As for the D₂ diphthong, it is the transitions that contribute most to the reduction in the diphthong durations in fast speech and both the first and second vowel elements contribute less and the amount of their contributions are similar.

4. Conclusion

The paper has presented the effect of fast speech on the temporal organization of syllable production in HKC. All the component segments of the test syllables CV:, CV:S, CVS, CV:N, CVN, CD₁, and CD₂, including the vowel-nasal transitions in the CV:N and CVN syllables and element-element transitions in the CD₁ and CD₂ syllables, contribute to the reduction of the entire syllable durations in fast speech. While the percentages of duration reduction for the syllable-initial consonants in all types of syllable are similar, the percentages of duration reduction for the vowels, vowel-nasal transitions, syllable-final nasals, first vowel elements, element-element transitions, and second vowel elements vary according to the types of syllable structure in the language.

5. Reference

- [1] Zee, E., 1999. Chinese (Hong Kong Cantonese). In the *Handbook of the IPA*. Cambridge, Cambridge University Press, p. 58-60.