Some Methodological Issues in Phonetic Typology Research: Cantonese Contour Tone Revisited

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0. Introduction

Gordon (1999, 2001) argues that the distribution of Cantonese contour tones is typologically unusual: CVO and CVVO syllables (O = obstruents) do not host contour tones while phonemic CV syllables do. This pattern violates the generalization that longer syllables should be able to host contour tones if short syllables do in the language. Gordon rationalizes the Cantonese pattern with an acoustic analysis of the relevant syllables: rime duration of CV syllables is significantly longer than that of CVO and CVVO syllables. Gordon argues that this finding brings Cantonese into conformity with his implicational hierarchy of tone bearing ability, whereby "the tolerance of contour tones on syllables which are inherently less well suited to carrying tonal information implies the tolerance of contour tones on syllables which are better suited to manifesting tone" (Gordon 2001: 447).

This study addresses two problems with Gordon's study: one theoretical and one empirical. From a theoretical perspective, while I generally agree with Gordon's conclusion that certain syllable types are more suitable for manifesting contour tones than others (see also Zhang 2001 for a similar proposal), I find his interpretation of the Cantonese facts questionable. Gordon assumes that the non-occurrence of lexical rising tones in checked syllables (i.e. CVO and CVVO syllables) is a principled gap requiring a synchronic explanation. However, as I will demonstrate, it is in fact an accidental gap resulting from historical developments in Cantonese, and thus does not require a synchronic explanation. The details of this argument appear in section 2.

On the empirical side, Gordon's claim that no contour tones exist on CVO and CVVO syllables is simply false. As Section 3 illustrates, contour tones occur on CVO and CVVO syllables on two robust morphological contexts. Gordon, while acknowledging this in a footnote, dismisses them as irrelevant since such syllables are derived rather than lexical. It is, however, unclear why a phonetic study should *a priori* rule out morphologically derived data. Following this practice in general would limit phonologists to seeking phonetic explanations only for

tautomorphemic phonological structures, rather than to surface patterns of words or phrases, surely an untenable position.

Although seriously flawed in the two respects just mentioned, Gordon's essential claim does still find support in Cantonese, in an area where he wasn't looking. In section 4 I offer phonetic evidence from Cantonese that supports Gordon's claim that contour tones prefer to occur in longer syllables than shorter ones. This study examines the phonetic realization of morphologically- and sandhi-derived rising toned CVVO syllables in Cantonese, revealing that these syllables are significantly longer than their level tone counterparts.

1. Typology without diachrony

Cantonese has six tone classes. Traditional Chinese philology treats syllables with final stops (i.e. checked syllables) as distinct tone classes (i.e. checked tones), which yields nine tones instead. Until recently, there was also a contrast between high level and high falling. However, this distinction has collapsed for most speakers today. Open syllables are generally treated as phonemically CV since there is no phonemic vowel length contrast in Cantonese, even though phonetically they are more accurately represented as CVV.

(1)

Tone	Examples
55 (~53)	si 'poetry'
11 (21)	si 'time'
35	si 'to send'
13 (23)	si 'market'
33	si 'to try'
22 (21)	si 'affairs'
55	sɪk˥ 'to know'
33	sɛ:k˧ 'to kiss'
22	sɪk˨ 'to eat'

As noted above, Gordon contends that the distribution of Cantonese contour tones is typologically unusual since checked syllables do not host contour tones while phonemic CV syllables do. One might rephrase this observation in terms of the question: why do no checked syllables in Cantonese host rising tones, whereas both rising and level tones occur in CV syllables? Gordon, seeking a synchronic, phonetically motivated answer, attributes the distribution of rising tone to the shorter phonetic duration of checked syllables relative to CV syllables. The implicit assumption behind this is that rising tones, as a type of contrastive tones in Cantonese, should be evenly distributed among the different syllable types, *all things being equal*. The crucial part of Gordon's assumption is, of course, the last four words – all things being equal. If there were evidence, for example, that the grammar of Cantonese flattens lexical contour tones when they would otherwise fall on checked syllables, such an account would be motivated. However, there is

no evidence for such a process, either synchronically or diachronically, in Cantonese; thus there is no direct evidence that the absence of rising tone on checked syllables in Cantonese is causally related to the shorter duration of these syllables. In what follows, I will demonstrate that all things were indeed ***not*** equal in the history of Cantonese tonal development. Smooth syllables that host rising tones have quite a different pedigree from that of the checked syllables, making Gordon's synchronic phonetic account anomalous.

1.1 From Middle Chinese to Cantonese

Middle Chinese (*circa.* AD 200 to AD 900; MC), reflected in the pronouncing dictionary *Qieyun* (AD 601), has four tonal categories:

(2)

	Traditional name	gloss
I	ping	'level'
II	shang	'rising'
III	qu	'departing'
IV	ru	'entering'

Tones I-III were associated with smooth syllables (i.e. CV, CVV, CVN), while Tone IV occurs exclusively with checked syllables (i.e. CVO & CVVO). Phonetically speaking, Ting (1996:152), for example, reconstructs the following tonal value for MC:

(3)

	Traditional name	reconstructed phonetic values
I	Level 'ping'	level, probably low
II	Rising 'shang'	high-rising
III	Departing 'qu'	falling, probably mid-falling
IV	Entering 'ru'	abrupt and short

The loss of the initial voicing contrast gave rise to the high versus low register distinction in Cantonese tones for all four MC tones. The high register checked tones further bifurcated into high and mid level tones. The correspondence between MC tonal categories and modern Cantonese tones are given in (3). The notation *a/b* after the MC tonal category corresponds to the two tonal registers after the loss of the initial voicing contrast in obstruents.

(4)

Middle Chinese	Register Split	Cantonese
Level 'ping'	Ia	55
	Ib	11 (21)
Rising 'shang'	IIa	35
	IIb	13 (23)
Departing 'qu'	IIIa	33
	IIIb	22 (21)
Entering 'ru'	IVa	55

IVa	33
IVb	22

The history of Cantonese tones, thus, clearly demonstrates that the two types of rising tones in the language (i.e. 35 and 13) originated from the same source, namely, MC tone II. This also speaks to the fact that the reason why checked syllables do not host contour tone has little to do with its intrinsic shortness. CV syllables tolerate rising tones while checked syllables do not because the development of rising tones in Cantonese was restricted to the set of MC tone II syllables, which are all smooth syllables. The source of the contour nature of the MC tone II and III is a controversial matter. Haudricourt (1954a, b, 1961) hypothesized that MC tone II and III originated from *CV?* and *CVs* respectively. If this theory is correct, then the fact that checked syllables in Cantonese do not generally host contour tones is presumably due to the fact that these syllables have not lost their final consonant.[1] Thus, contour tones were unable to originate in checked syllables – but for reasons completely unrelated to phonetic duration.

To be fair, Gordon's methodological assumptions toward phonetic typological studies are not unique. Thus, the problem illustrated by this case study is actually symptomatic of the general methodology of phonetic typology. The results of a synchronic typological survey only allow us to establish inductive generalizations. The actual locus of explanation, however, lies in the diachrony, that is, in the convergence of historical developments. By ignoring this fundamental aspect of typological research, phonetic typologists risk obscuring the actual insights behind their own observations.

Given this understanding of the distribution of rising tones in Cantonese, does this mean that Cantonese is irrelevant to the discussion of the general properties of contour tone distribution? The answer here is undoubtedly no. In the second half of this paper, I look at another problem in Gordon's study of Cantonese contour tone distribution, namely, Gordon's claim that checked syllables cannot host contour tones in Cantonese.

2. Rising tones in checked syllables in Cantonese

Despite the standard description, rising tone in CVVO syllables is indeed found in Cantonese as the result of two distinct, characteristically colloquial, processes in the language: the so-called 'changed tone' and an elision-induced sandhi process.

2.1 Changed tone in Cantonese

A historical, possibly marginally productive synchronic, process, known as *changed tones*, derived mid-rising tones from semantically related level toned syllables (5).

[1] Thanks to Larry Hyman for pointing this out to me.

(5)	Level tone	Gloss	Rising tone	Gloss
	$ts^hat˥33$	'to brush'	$ts^hat˥35$	'a brush'
	$p^hak˥33$	'to pat'	$p^hak˥35$	'a racket'
	kɛp˥33	'to clip'	kɛp˥35	'a clip'
	$t^hɔk˥33$	'to support'	$t^hɔk˥35$	'a stand'
	kak˥33	'to separate'	kak˥35	'a square'
	$tʃ^hap˥33$	'to insert'	$tʃ^hap˥35$	'an insert'
	tsɔk˥22	'to chisel'	tsɔk˥35	'a chisel'
	tip˥11	'to pile up'	tip˥35	'a plate'

The productivity of the changed tone process in unclear. Its function is generally nominalizing, but with various complex semantic nuances (Jurafsky 1988). As Kam (1977) reported, many native speakers do not recognize any relationship between the derived forms and its alleged base. The situation is perhaps analogous to the relationship between *brother* and *brethren* in English. However, it should be noted that the number of these changed tone derived syllables is sizable.

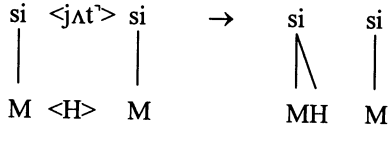
2.2 Sandhi derived rising tones in Cantonese

Sandhi can also give rise to rising tones in Cantonese. The verbal diminutive reduplication construction in Cantonese is formed by the reduplication of a verb root; the base and its reduplicative copy are separated by the word *jʌt˥55* 'one'. This medial high-level tone word, however, is often omitted in conversational speech style, creating a sandhi situation. The elision of this medial syllable (i.e. *jʌt˥55* 'one') causes the first syllable to change to a mid-rising toned syllable (6).

(6)				
	si33 jʌt˥55 si33	→	si35 si33	'to give it a try' (lit. try one try)
	$p^hat˥$ 33 jʌt˥55 $p^hat˥$ 33	→	$p^hat˥$ 35 $p^hat˥$ 33	'to hit a little' (lit. hit one hit)
	$ts^haat˥33$ jʌt55 $ts^haat˥33$	→	$ts^haat˥35$ $ts^haat˥33$	'to brush a little' (lit. brush one brush)

Phonologically, this sandhi process is often characterized as the re-association of a high tone, set afloat by the deletion of an originally high toned syllable, with the preceding level toned syllable (Chen 2000: 60).

(7)



This is a productive construction, meaning that rising tones in checked syllables are quite commonly derived in Cantonese.

To summarize briefly, checked syllables in Cantonese can in fact host rising tones, albeit only through morphological and post-lexical processes such as Changed Tone and sandhi respectively. It is therefore extremely puzzling that Gordon chooses to ignore these forms in his phonetic study of Cantonese tone and syllable type. One should note that since his study focuses on the phonemic status of syllable types, morphological and syntactic considerations should therefore be irrelevant to begin with.[2]

3. Contour tone-induced lengthening

In the remainder of this paper, I present a phonetic study of these checked syllables with derived rising tones in Cantonese, showing that syllables with deriving rising tones are significantly longer than their level toned counterparts. This novel finding, while based on words which counterexemplify Gordon's attempt to derive Cantonese tonal contrasts within roots from phonetic principles, does lend support for Gordon's more general claim that durationally longer syllables are better host to rising tones than shorter ones.

3.1 Methodology

Two native speakers of Cantonese (a college-age male and a middle-age female) recited a list of Cantonese target disyllabic words/phrases in the carrier phrase /ŋɔ tɔkˀ ___ pɛi nɛi tʰæŋ/. Two sets of tokens were recorded. In Set 1, the target words were eleven doublets of CVVO Cantonese syllables. The doublets consisted of segmentally identical CVVO syllables with lexical level tones and their morphologically derived rising toned counterparts (8). While the derived rising tones are all mid-rising (˧˥ or 35), the lexical level tones may be extra-low (˩ or 11), low (˨ or 22), or mid (˧ or 33) (see Appendix for the entire corpus).

(8) Lexical level ˧ (or 33)
(tɔɔ 55) **tsʰɐtˀ33** 'to brush (more)'

Morphologically derived ˧˥ (or 35)
(tsʊkˀ55) **tsʰɐtˀ35** 'a (bamboo) brush'

[2] On a related methodological note, it is interesting to point out that three out of five of the tokens chosen in Gordon's phonetic study are based on reading pronunciations of standard Chinese characters (e.g., *mà* 'to curse', *làp* 'to stand', *sàm* 'very'). While the phonetic differences between reading versus colloquial pronunciations have not been extensively studied, some difference has been noted in the literature (e.g., Bauer & Benedict 1997:94-107).

In Set 2, the target syllables are couched within the sandhi context described in section 2.2. The target syllables consisted of eight CVVO Cantonese syllables reduplicated according to rules of the truncated diminutive reduplication construction (9).

(9) Sandhi-derived 35
ts^{h}ɐt˥35 ts^{h}ɐt˥ 33 'to brush a little'

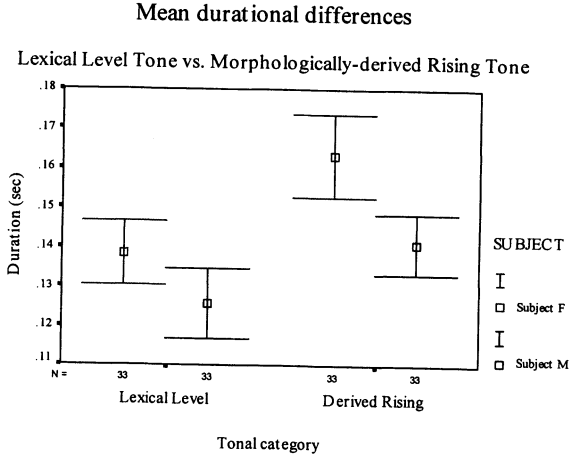
3.2 Analysis and results

The duration of the target syllables in Set 1 were measured. Table 1 shows the mean durations of the CVVO syllables with lexical level or morphologically derived tones for both subjects. A one-way ANOVA reveals that the duration of the CVVO syllables with the morphologically derived rising tone is significantly longer than their lexical level toned counterparts ($p < 0.05$) for both subjects (see Figure 1).

Table 1: Mean durations of CVVO syllables with lexical level tones and morphological-derived rising tones.

	Subject F	Subject M
Lexical Level	0.1384 (0.0229) N=33	0.1255 (0.0251) N=33
Morphologically-derived Rising	0.1631 (0.0293) N=33	0.1409 (0.0217) N=33
	(p = 0.000)	(p= 0.010)

Figure 1: Mean durations of CVVO syllables with lexical level tones and morphological-derived rising tones.

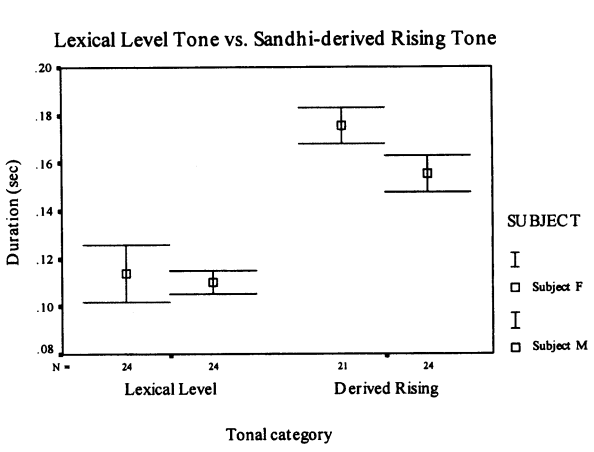


To control for any speaking rate effects, syllables with sandhi-derived rising tones (i.e. the Set 2 tokens) are compared only to the syllable immediately following it. This syllable is identical to the target CVVO except that it preserves its original level tone (e.g., *ts^{h}ɐt˧˥35 ts^{h}ɐt˧˧33*). Table 2 shows, for both subjects, the mean durations of CVVO syllables with lexical level or sandhi-derived tones. A one-way ANOVA reveals that the sandhi-derived rising toned syllables are significantly longer than their level toned counterparts ($p < 0.05$) for both subjects (see Figure 2).

Table 2: Mean durations of CVVO syllables with lexical level tones and sandhi-derived rising tones

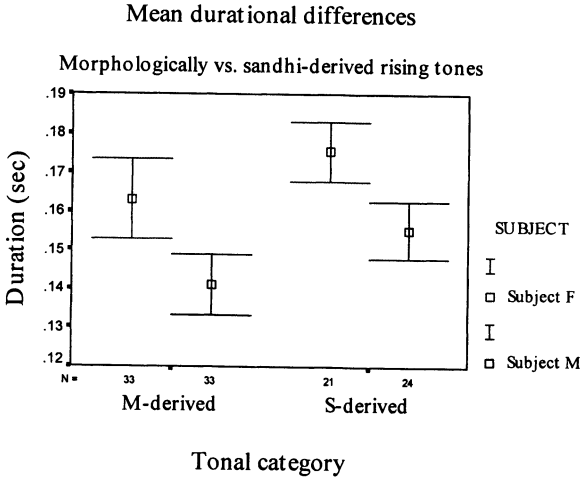
	Subject F	Subject M
Lexical level	0.1138 (0.0282) N=24	0.1100 (0.0121) N=21
Sandhi-derived Rising	0.1809 (0.0241) N=24	0.1552 (0.0176) N=24
	($p = 0.000$)	($p = 0.000$)

Figure 2: Mean durations of CVVO syllables with lexical level tones and sandhi-derived rising tones



The mean durational differences between the CVVO syllables with morphologically-derived and sandhi-derived rising tones are compared in Figure 3. A one-way ANOVA shows that, for Subject M, the sandhi-derived rising toned syllables are significantly longer than the morphologically-derived ones ($p < 0.05$), while there is no significant durational difference in the speech of Subject F between these two types of derived rising toned syllables (see Figure 3).

Figure 3: Mean durations of CVVO syllables with morphological (M)- and sandhi (S)-derived rising tones



4. Discussions

This study demonstrates that syllables with derived contour tone in Cantonese are significantly longer than their underived level toned counterparts. This phenomenon in Cantonese is, to my knowledge, unheard of prior to this study. The results of this study also support the phonetic explanation of the durational properties of contour tone bearing units and Gordon's implicational hierarchy. *A priori*, the lengthening effect is unexpected. By comparing segmentally identical syllables in their derived versus underived contexts, I was able to ascertain that contour tones indeed prefer a longer duration of the sonorous phase of its host.

Interestingly, it should also be noted that, while it is commonplace for rising tones to have a more limited distribution than the other tone types, the process of rising tone-induced lengthening appears to be relatively rare across the world's languages. Zhang (2001), for example, in his typological survey of the distribution and the phonological properties of contour tones, reports only three documented cases (i.e. Mitla Zapotec (Briggs 1961), Wuyi Chinese (Fu 1984), Gã (Paster 1999)). He, however, attributes this asymmetry to greater attention devoted to documenting the restrictions of contour tones on syllable types in his data sources. The durational change of contour tone syllables might have escaped the attention of many grammarians. Thus, instrumental studies demonstrating the effect of contour tone-induced lengthening such as the one presented here should be a welcoming development.

As mentioned in the last section, the duration of the sandhi-derived rising toned syllables is significantly longer than the duration of the morphologically-derived ones in Subject M's speech. While the difference between these two types

of derived syllables in Subject F's speech is not statistically significant, the overall trend, nonetheless, mimics that of Subject M. That is, Subject F's sandhi-derived rising toned syllables are generally longer than the morphologically-derived ones. *A priori*, this is unexpected, since both types of derived syllables host a type-similar rising tone, namely a 35 mid-rising tone. Several factors, however, might contribute to this disparity. First, the contexts which these two types of syllables appear are different. Following the standard metrical analysis of Cantonese phonology, the target syllables in the sandhi environment occurs in the head of a trochaic foot, while the target syllables in the derived morphological context is in the dependent position of a trochaic foot. Thus, the extra duration of the target syllables in the sandhi environment might be the result of some form of a stress-induced lengthening effect. However, since no available study has looked at the phonetic effects of stress in Cantonese, this explanation remains speculative. The target syllables in sandhi-derived environment might also be longer due to some form of a compensatory lengthening effect as the result of the elision of the syllable immediately following the target syllable. Further study is underway to discern the actual mechanism(s) contributing to this durational disparity.

5. Conclusions

This paper has focused on Gordon's analysis of the distribution of contour tones in Cantonese, showing that the absence of lexical contour tones in checked syllables is better explained through diachronic means rather than synchronic phonetic properties. While durational factors may correlate with certain tonal patterns, the actual direction of influence must be established on an individual basis. At least in Cantonese, durational variation is a side effect of tonal realization, rather than a predictor of it. I also point out that contour tones indeed occur in checked syllables in Cantonese, but only in derived contexts. By ignoring these syllables in his phonetic study, Gordon misses an important generalization about Cantonese: contour tones induce a lengthening effect on its host syllable. A study looking at the durational properties of these derived contour toned syllables in Cantonese confirms the predictions of the phonetic interpretation of tone bearing ability. That is, the derived contour toned syllables are significantly longer than their lexical level toned counterparts. The use of contrasts introduced by morphological and sandhi considerations in phonetic studies, I argue, provide a powerful tool to testing hypotheses in phonological and phonetic theories alike.

APPENDIX: Cantonese corpus

(10) Lexical level tone target syllables (The target syllable is underlined)

Word	Gloss	Word	Gloss
sa:55 kɔk˥33	(a place name)	kʌp˥55 tʃʰap˥33	'to insert quickly'
tɔ:55 tsʰat˥33	'to brush more'	kʌp˥55 tsɔk˥22	'to chisel quickly'
tɔ:55 pʰak˥33	'to pat more'	fʊŋ55 jip˥22	'maple leaf'
hæŋ55 tʰɔk˥33	'to support a little'	kwɔŋ55 mɔk˥22	'a screen'
fʌn55 kak˥33	'to separate squarely'	hak˥55 mʌk˥22	'black ink'
		hæŋ55 tip˥11	'to pile up gently'

(11) Morphologically-derived mid-rising target syllables

Word	Gloss	Word	Gloss
sa:55 kɔk˥35	(a type of food)	kʌʌm55 tʃʰap˥35	'a golden insert'
tsʊk˥55 tsʰat˥35	'a bamboo brush'	kʌʌm55 tsɔk˥35	'a golden chisel'
pɔ:55 pʰak˥35	'a ball racket'	kɛi55 jip˥35	'a propeller'
pui55 tʰɔk˥35	'a cup stand'	kɔn55 mɔk˥35	'a liver
fɔŋ55 kak˥35	'a square'	hak˥55 mʌk˥35	'a mole'
		kwɔŋ55 tip˥35	'a CD'

(12) Sandhi-derived mid-rising target syllables

Word	Gloss
tsʰat˥35 tsʰat˥33	'to brush a little'
pʰak˥35 pʰak˥33	'to hit a little'
kɛp˥35 kɛp˥33	'to clip a little'
tʰɔk˥35 tʰɔk˥33	'to support a little'
kak˥35 kak˥33	'to separate a little'
tʃʰap˥35 tʃʰap˥33	'to insert a little'
tsɔk˥35 tsɔk˥22	'to chisel a little'
tip˥35 tip˥22	'to pile up a little'

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