Phonetically Based Constraints in Cantonese Onset Realization

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0. Introduction

Yip (1993) claims that in Cantonese, some onsets which can be observed in the surface representation do not exist underlyingly. In this paper, I first examine the data in Cantonese from Yip, discussing her analysis for derivation of the obligatory onsets. I then show that there are some problems with Yip's analysis. Finally, I propose an alternative analysis in which phonetically based constraints govern the selection of correct obligatory onsets in Cantonese.

1. Yip 1993

1.1 Data

The Cantonese data which I discuss in this paper come solely from Yip. In Cantonese, onsets [y, w, ŋ, ʔ] have somewhat skewed distribution as below.

(1) Skewed Distribution of Certain Onsets in Cantonese (Yip 93 #1)

	i	u	[-high, +back]
y	yi	*	yaŋ
w	*	wu	waŋ
ʔ	*	*	free variation
ŋ	*	*	ʔa:m = ŋa:m

High glides do not occur before high tense vowels that differ in backness. [ŋ, ʔ] which are not in contrast do not occur before high vowels. To provide an account for this skewed distribution, Yip claims that the onsets in the shaded cells are underlying while all the others are derived from underlyingly vowel-initial syllables. For this claim, Yip proposes the following morpheme structure constraints:

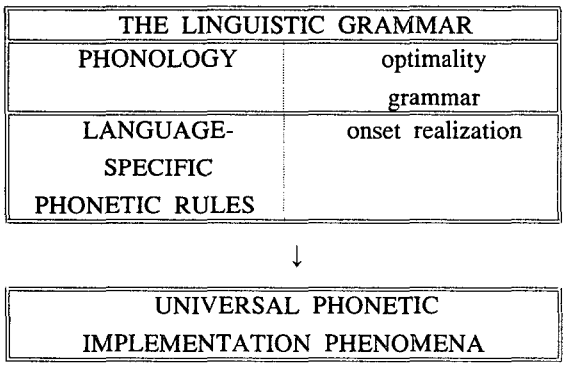
(2) a. *[+high][+high] sequence (for the absence of underlying /yi, yu, wi, wu/)
b. no underlying onset /ŋ/
c. no phoneme [ʔ]

Yip actually deals with not only word-initial onsets, but also affix-initial onsets which display somewhat different patterns. However, in this paper, I am only concerned with word-initial onsets, ignoring the discussion of affix-initial onsets which, as Yip argues, can be a result of simply reranking constraints interacting for word-initial onsets in a different level.

1.2 Yip's analysis

Yip argues that both phonology and phonetic implementation level are crucially involved in the realization of Cantonese surface onsets, assuming the model which is based on Cohn (1990:4):

(3)



In phonology which is governed by the Optimality framework (Prince and Smolensky 1993, Prince and McCarthy 1993), the following set of constraints interact for the correct onsets in Cantonese:

(4) Constraint Set for Cantonese (Yip #10)

a. **ONS**: Avoid Onsetless Syllables: (Itô 1989) $^{*}\sigma$ [V
b. **MSEG**: Every segment belongs to a morpheme
c. **PARSE**: Melody must be parsed.
d. **Margin Hierarchy**:
*Mar/a >>...>> *Mar/i, u >> ...>> *Mar/[nasal] >>...>> *Mar/[stop]

Yip emphasizes that all these constraints have been independently proven to be parts of UG in the literature (Prince and Smolensky; McCarthy and Prince). Also, the ranking of *Margin constraints simply follows the sonority hierarchy: a constraint prohibiting an

onset/coda with high sonority is ranked above that prohibiting an onset/coda with low sonority. Yip further assumes that Cantonese surface onsets [y, w, ŋ] are, in features, exactly same as the word-initial vowel in phonology, except [ʔ] which is a real epenthetic segment. Specifically, [y, w, ŋ] are derived from /i, u, a/o/ respectively. This derivation is the result of the interaction of three constraints ONS, MSEG, and PARSE, as can be seen in the following tables:

(5) /i/ (trivially revised from Yip #23)

	PARSE	ONS	MSEG
i		*	
ʔi			*
ti			*
☞ ii			
<i>	*		

(6) /a/ (trivially revised from Yip #24)

	PARSE	ONS	MSEG
a		*	
ʔa			*
ta			*
☞ aa			
<a>	*		

Notice that in each optimal output, the first segment is the one spread from the following vowel, thus abiding by MSEG which prohibits the epenthesis of new material. These optimal outputs with vowels in the onset position are transferred into the phonetic implementation level. There, the vowels [i, u, a] in the onset position change to true surface forms [y, w, ŋ], achieving a degree of closure required for onsets. Unlike phonology which is governed by the Optimality framework, Yip assumes that the phonetic implementation level is governed by the Window Theory framework (Keating 1988, Cohn 1990). In Window Theory, phonological outputs are phonetically realized in a quite flexible way. The phonetic target is no more than the entire contextual range, i.e. window. (The more detailed discussion of Window Theory will be seen in the next section.) Based on the Window Theory, Yip claims that not only features but also prosodic structure such as an onset may require implementation. Specifically, high glide onsets [y, w] which have same features as the homorganic vowels are the result of fulfilling the need to achieve the minimum degree of onset closure. For instance, in the derivation of [y] as an onset, "[+high] is realized at the extreme of its window, given the need to remain [-cons] and retain its backness." The velar nasal onset [ŋ] which is actually a transcription of a nasal glide or placeless nasal is also the result of fulfilling

the need to achieve the minimum degree of onset closure. Since raising tongue body for achieving some degree of closure is blocked due to [-high], soft palate which is mobile is instead lowered. This velum lowering leads to by-product nasalization. For closure, further backing of tongue body is also an option, leading to the pharyngeal or velar glide [ɣ]. The choice between them relies on the language-specific window. In fact, different dialects of Mandarin are reported to show both [ŋ] and [ɣ] before initial /a/.

In summary, Cantonese obligatory onsets [y, w, ŋ] are, in phonology, /i, u, a/o/ respectively which are spread from the following vowels; and the surface glide forms are simply the result of a feature's realization at the extreme of its window for achieving the minimum degree of closure for onsets.

Finally, let us consider an onset [ʔ]. Recall that [ŋ] is in free variation with [ʔ]. This can be captured simply by unranking *Mar/a and MSEG:

(7) /a/

	PARSE	ONS	*Mar/a	MSEG	*Mar/i..
a		*			
☞ ʔa				*	
☞ aa=ŋa			*		
<a>	*				

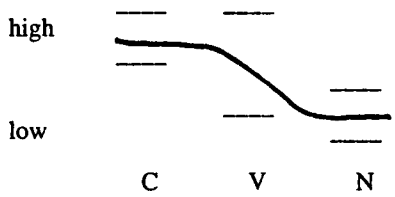
2. Problems with Yip's analysis

In this section, I discuss problems with Yip's analysis. Yip's analysis is in some sense hybrid: Optimality Theory framework governing phonology as well as Window Theory framework governing phonetics are crucial in the onset realization. In phonology, optimal outputs satisfying constraints have a vowel in onset position. Their actual surface forms, i.e. glides, are completed in the phonetic implementation level. Window Theory provides a principled account for how a vowel in onset position ends up being a surface glide. Surface forms are the result of a feature's realization at the extreme of its window for achieving some degree of closure.

Let us first discuss the role of Window Theory in Yip's analysis. According to Yip, under the assumption that "high glides are featurally identical to the homorganic vowels," a certain feature, e.g. [+high], is realized at the extreme of its window, producing high glides. Now, the question is in what window the feature is realized. For a feature [+high], it must be a tongue height window, but different segments have different tongue height windows. One might think that [+high] of high vowels in onset position is realized at the extreme of the tongue height window for high vowels; in other words, tongue

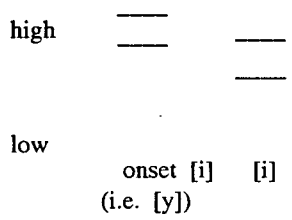
height windows are identical for glides (according to Yip, vowels in onset position) and vowels. But, this cannot be compatible with Window Theory by Keating. Window Theory is "a proposal about how successive segments are accommodated in building a continuous contour along a single articulatory dimension." Its advantgages are variability and indeterminacy. For instance, the following schematic representation shows phonetic implementation of English CVN sequence, e.g. 'son'.

(8) Schematic velum height windows (Keating 1990:460 fig. 26.4)



Notice that the phonetic path is achieved for the optimal interpolation between windows. Wide window indicates more variable phonetic values: e.g. it can be noted from the above representation that in English vowels are more easily nasalized than consonants. When windows are (empirically) determined, all the contextual factors in phonology (including prosodic structure) should be considered. Thus, an onset [y] and its homorganic vowel [i] should have different windows which may or may not overlap, shown as below:

(9) Tongue height windows for [i] and [y]

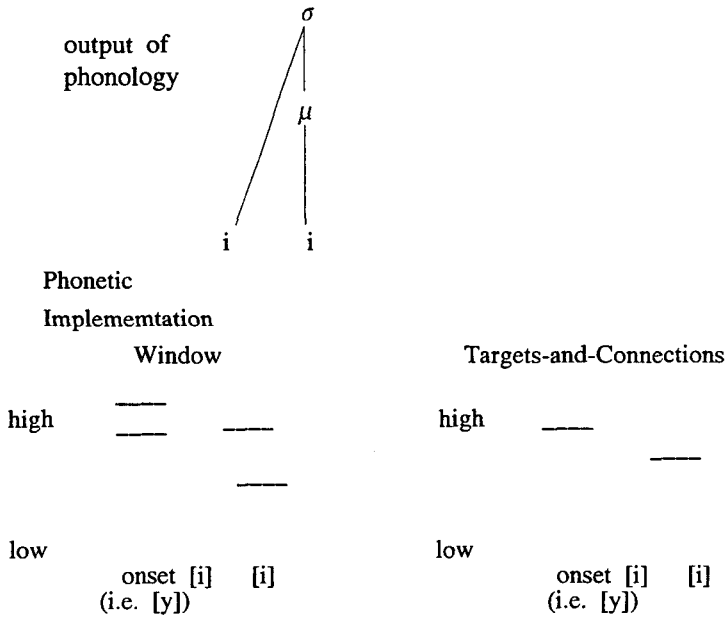


I assume that it is at least true that some phonetic values of [i] can never be occupied by [y] and vice versa. Thus, [y] must have its own tongue height window which is different from [i]. Why does [+high] then have to be "realized **at the extreme of** its window", as Yip (p.8) argues? From the definition of 'window', [+high] of high glides can be realized anywhere within the tongue height window for high glides, as long as the interpolation between neighboring windows permits.

More significantly, once we admit that high glide onsets and their homorganic vowels have different windows, we should question what special role Window Theory plays in

Yip's analysis. Put it in a different way, is Window Theory really more advantageous in Yip's analysis than other phonetic theories, e.g. "targets-and-connections" framework which assumes absolute phonetic target values? As far as I can see, Window theory provides almost no more principled account for phonetic realization of Cantonese glide onsets than a "targets-and-connections" framework. This can be seen in the following representation of phonetic implementation of [i] in onset position and [i] in nucleus:

(10) phonetic implementation of [y] and [i]



Notice that there is no significant difference between Window Theory and Targets-and-Connections framework in determining the phonetic form of a high glide. In the above, Window Theory and Targets-and-Connections framework may be different only in that the former has a range target whereas the latter an absolute value target. In conclusion, Window Theory plays no important role in deriving glide onsets [y, w, ɰ] from their vocalic counterparts [i, u, a/o]. This problem seems to undermine the validity of Yip's analysis in which optimal outputs in phonology include a vowel in onset position.

There is an additional problem with Yip's analysis. According to Yip, glides are actually vowels in phonology; thus, it is expected that glides pattern with vowels, not consonants. But, this cannot be a universal argument. In fact, Yip mentions glides of Semitic languages in the footnote #6 which pattern with consonants. In general, consonantal behaviors of glides are quite common across languages. A well-known

example is an avoidance of hiatus: e.g. in English, a yacht, *an yacht, cf. an item vs. a book. Thus, it seems crosslinguistically implausible to claim that glides are vowels in phonology.

Thus far, I have discussed problems with Yip's analysis. Based on this discussion, I conclude that Yip's analysis does not provide an optimal account for Cantonese obligatory onsets.

3. An alternative analysis

In this section, I attempt to provide an alternative analysis for obligatory onsets in Cantonese. I will provide a homogeneous account solely based on Optimality Theory, employing phonetically based constraints. The asymmetric facts on Cantonese onsets which need to be explained are summarized in the following:

(The symbol N is employed for the placeless nasal which is transcribed as [ŋ] by Yip.)

(11)

Input	Output	Input	Output
i, u	yi	a, o	wa
	wu		wo
	ʔi, ʔu		ʔa, ʔo
	Ni, Nu		Na, No

In (11), onsets in the shaded area do not occur. Onsets [y, w] can occur with following high, not non-high, vowels. In contrast, onsets [ʔ, N] can occur with following non-high, not high, vowels.

I will provide an account for the above facts mainly by relying on faithfulness constraints which are evaluated on phonetic realizations. Before providing formal constraints, let us discuss, in a somewhat informal way, the basic idea underlying the analysis of the present work.

The main idea is that the reason why onsets in the shaded area cannot occur whereas those in the transparent area can is based on the perceptual faithfulness condition, i.e., that the more similar an output is, in perception, to its corresponding input, the better it is. Specifically, it is claimed that those in the shaded area are more different in perception from their corresponding inputs than those in the transparent area.

Let us consider high vowel inputs first. For simplicity's sake, I am only concerned with /i/, comparing its candidate outputs, [yi] and [ʔi]. Obviously, [yi] and [ʔi], both of which consist of two segments, are longer in articulation, thus in perception as well, than the input which is a single segment; consequently, they are about equal in that they do

not maintain the canonical duration of their input. On the contrary, in maintaining the height of the input, [yi] and [ʔi] are clearly different. The first half of [ʔi] does not include a perceptual information of [+high]; thus [ʔi] loses much of tongue height information of its input /i/. In contrast, the perceptual information of [+high] of /i/ is maintained through the whole sequence [yi], since [y] is perceived as occuring high. In summary, in the perception of highness, [ʔi] is more different from /i/ than [yi]; thus in obeying perceptual faithfulness, the latter is better output than the former.

Regarding nonhigh vowel inputs, we consider only /a/, comparing its candidate outputs, [wa] and [ʔa]. Again, [wa] and [ʔa] are about equal in that they do not maintain the canonical duration of their input /a/. Also, they are equal in that they cannot maintain any perceptual information of tongue height, i.e. [-high, +low] of /a/. However, [wa] and [ʔa] may differ in the influence, of the onset, onto the following nucleus, i.e. [a]. [w], which is [+high], affects the place cue of [a] more than [ʔ] which is assumed to be placeless in most, if not all, phonology literature. Consequently, the difference between [wa] and /a/ is bigger than that between [ʔa] and /a/, which leads us to conclude that [ʔa] is a better candidate than [wa]. To formalize the above idea, we provide the following constraints:

(12)

a. PresDur: Preserve perceptual cues for canonical duration of an underlyingly singleton segment.
b. PresHigh: Preserve perceptual cues for canonical height of an underlying segment.
c. PresSon: Preserve perceptual cues for canonical sonority of an underlying segment.

Preservation constraints given above are a type of faithfulness constraints which deal with perceptual discrepancies between the base and surface forms. I follow Flemming (1995) in that PARSE must be evaluated at the perceptual level. As in Jun (1995), here I employ a different name, i.e. Preservation, for PARSE which is assumed to be a constraint for articulatory faithfulness by many researchers.

Let us provide an analysis for obligatory onsets in Cantonese. In addition to the constraints in (12), I employ ONS and *Mar which are also used in Yip's analysis. (13) shows the analysis for the case of the high vowel inputs.

(13) /i/

	ONS	*Mar/i,u	PresDur	PresHigh	PresSon
i	*				
☞ yi			*		*/2-α
ʔi			*	*/2	*/2
ii		*	*		

The candidate output which is exactly identical with the input /i/ violates the most dominant constraint, ONS. The candidate whose onset is occupied by [i] violates the next high-ranked constraint which prohibits vowel onsets, *Mar/i,u. Thus, [i] and [ii] are worse candidates than the other two. Now, [yi] and [ʔi] both produce a full violation of PresDur since they are obviously longer than their input. But, they are different in the evaluation of PresHigh: [yi] does not violate PresHigh whereas [ʔi] does. The reason for */2 is that only the first half of [ʔi] violates PresHigh. Thus, [yi] is chosen as the optimal output. Note that if we consider PresSon, [yi] will be even better. [yi] and [ʔi] both violate PresSon since their first half has different sonority from their input. But, if we assume that the sonority difference between [i] and [y] is smaller than that between [i] and [ʔ], violation committed by [yi] is smaller than violation committed by [ʔi], which is represented by '-α' above. The ranking between PresHigh and PresSon will be relevant to the case with nonhigh vowel inputs whose analysis is shown in the following table.

(14) /a/

	ONS	*Mar/a,i,u	PresDur	PresHigh	PresSon
a	*				
wa			*	*/2+α	*/2-β
☞ ʔa			*	*/2	*/2
☞ Na			*	*/2	*/2
aa		*	*		

Again, [a] and [aa] violate dominant constraints, ONS and *Mar/a,i,u. The other three candidates produce almost equal number of violations for the remaining constraints. But, as we discussed above, the onset [w] affects the place cue of the following nucleus more than [ʔ] and [N], both of which are assumed to be placeless. (This produces an additional degree of violation which is represented by α in the table.) Thus, [ʔa] and [Na] are better outputs than [wa]. Notice that although [wa] probably produces less violation for Pres_son than [ʔa] and [Na], the latter are still optimal, since Pres_high outranks Pres_son. The ranking for Cantonese is the following: ONS >> *Mar/a,i,u >> PresDur, PresHigh >> PresSon.

Among faithfulness constraints which preserve perceptual cues for place of articulation, only a constraint preserving the height, PresHigh, has been discussed, since the main purpose of the present study is to provide an account for the asymmetry between high vowels and nonhigh vowels in the choice of obligatory onsets. Undoubtedly, constraints preserving other places must be in effect. For instance, backness consistency between a high vowel and its preceding glide onset is due to a constraint preserving backness of an underlying segment, i.e. PresBack.

4. Conclusion

I have first discussed the data and then some problems with Yip's analysis of Cantonese obligatory onsets which consists of two major parts, Optimality Theory and Window Theory. I have then attempted to provide an alternative analysis, which is solely based on Optimality framework in which phonetically based constraints play a main role.

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