Feature Geometry of Vowels and Co-occurrence Restrictions in Cantonese

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This paper discusses three different co-occurrence restrictions in Cantonese: labial, dorsal and coronal. The labial and dorsal co-occurrence restrictions are dissimilatory in nature while the coronal one is assimilatory. Recent works in Feature Geometry (Clements 1985, Mester 1986 and Sagey 1986) provide a framework to investigate these co-occurrence restrictions. I propose a different feature geometry for vowels and show that this revision together with a mechanism of checking Obligatory Contour Principle (OCP) violations, accounts for the co-occurrence restrictions in Cantonese in a unified way.

After a brief introduction to the sounds of Cantonese, I discuss the three co-occurrence restrictions in question. I argue that the distinction between frontness and backness in vowels is due to the presence and absence of the coronal articulator. Moreover, the degree of closure also needs to be specified for vowels. It will be shown that a pair-wise checking from right to left can account for both the labial and dorsal restrictions. I conclude with a discussion of the consequences and implication of this proposal.

1. Cantonese Vowels and Consonants

1.1.. Vowels

Cantonese has the following phonemic vowels (taken from Cheung (1986:30)):

(1)

i	ü	u
e	ö	o
		a
		a:

Length is only phonemic in low unrounded vowels (/a/ and /a:/). The front vowels contrast in roundness: (/i/ vs. /ü/ and /e/ vs. /ö/). The non-low back vowels (/u/ and /o/) are always round .The low vowels /a/ and /a:/ are the most unmarked vowels because no co-occurrence restrictions refer to them. In other words, they occur with any combination of consonants as long as the consonants themselves can co-occur.

1.2. Consonants

Cantonese has the following phonemic consonants:

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*This is a shorter version of my phonology generals paper. I would like to thank the following people for their helpful comments and discussions: the members of my committee: Noam Chomsky, Michael Kenstowicz, and Richard Larson; and Moira Yip, Morris Halle, Keren Rice, Donca Steriade, Francois Dell, Hamida Demirdash, Eulàlia Bonet, Michael Hegarty and Alicija Gorecka.

(2)	p	t	ts	k	k^{ω}	(unaspirated stops)
	p'	t'	ts'	k'	k^{ω}'	(aspirated stops)
	f		s		h	
	m	n		ŋ		
		l				
			y		w	

All consonants including the glides can occur as an onset, while only nasals (m, n, ŋ), glides (y, w) and unaspirated stops (p, t, k) can be in a coda /f/ in Cantonese patterns with velar consonants There are proposals which treat /f/ as an underlying /x^{ω}/ (see Hashimoto 1972 and Cheung 1986)

Finally, there are seven tones in Cantonese and they are not relevant to the discussion in the paper

2. Co-occurrence Restrictions

In this paper, I examine three co-occurrence restrictions in Cantonese A question which arises in discussing the "gaps" in Cantonese syllables is are these true gaps or accidental gaps? As I will show later on, based on evidence using loan words and onomatopoeic expressions, some gaps which were assumed to be true gaps are accidental I will discuss labial, dorsal and coronal in turn The labial restrictions have been discussed extensively in the literature (Yip 1988 and 1989, Lin 1989) while the other two are sometimes mentioned but no analysis have been given [1]

2 1 Labials

There are three separate environments which have labial restrictions [onset coda], [nucleus-coda] and [onset-nucleus] Descriptively, the generalization is that two labials do not co-occur in a syllable

2 1 1 Onset-coda pairs

In Cantonese, the onset and the coda of a syllable cannot both be labial

(3) *pim *k^{ω}am *fap *mip

However, it should be noted that there are loan words and onomatopoeic expressions which violate this restriction (Bauer 1985, Cheung 1986 and Ellison 1989)[2]

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[1] An Analysis is proposed in Yip (1988, 1989) and Lin (1989) In Cheng (1989), I discuss the problems that each analysis has

[2] There is a contrast between *pim and pam in (3) and (4) I assume that given [pam] is allowed, [pim] is an accidental gap That is, with lexical borrowing, it is not clear why no word such as [pim] is borrowed but if one were to create new words, [pim] should be allowed

(4) pam 'to pump'
pip 'the sound of beeping'
mam 'food' (in [sek mam mam] 'eat mam mam')

(4) suggests that the combinations summarized in (5) are in fact permitted. That is, the identical pairs (sharing one root node) or pairs which have the same place of articulation (sharing one place node) are the permitted pairs. In contrast, the combinations in (6) are not found (even in loan or onomatopoeic expressions).

(5)	p-p	m-p	p'-p	(6)	f-p	k^{ω}-p	k^{ω}'-p
	m-m	p-m	p'-m		f-m	k^{ω}-m	k^{ω}'-m

We can see this more clearly if we also consider other co-occurrence restrictions. There are no exceptions to other restrictions (i.e. there are no loans words that can violate other restrictions). Thus, I consider the presence of the pairs in (5) in loan words evidence that they are in fact well-formed combinations.

2.1.2. Nucleus-coda pairs

The labial restriction on nucleus-coda pair is very strong. There is no exception. There is no syllable with a round vowel (either front or back) and a labial coda. That is, both front round and back round vowels cannot co-occur with labial codas.

(7)	*up	*op	*üp	*öp
	*um	*om	*üm	*öm
	*uw	*ow	*üw	*öm

There are no loanwords or onomatopoeic expressions which violate the restriction on nucleus-coda combinations.

2.1.3. Onset-Nucleus pairs

There is an asymmetry when it comes to onset-nucleus pairs. The asymmetry is between front round and back round vowels. As shown in (7), both back round and front round vowels cannot co-occur with labial codas. In contrast, in (8) and (9), only front round vowels cannot co-occur with labial onsets.

(8)	p'un	'a plate'	(9)	*pü	*pö
	p'o	'an old lady'		*fü	*fö
	mo	'slow'		*mü	*mö
	fo	'commodities'			

Thus, there are two questions to address: (a) why do front vowels behave differently from back vowels? (b) why does this asymmetry show up only in the onset-nucleus pairs?

2.2. Dorsals

The dorsal restriction here refers to the following descriptive constraint:

(10) A high vowel (regardless of back or front) cannot occur with a velar coda.

Once again, there is an asymmetry here. This constraint restricts only NUCLEUS-CODA pairs while allowing ONSET-NUCLEUS pairs. That is, a high vowel can occur with a velar onset. Compare (11) with (12):

(11) Nucleus-coda pairs		(12) Onset-nucleus pairs	
*ik	*iŋ	kiw	'to call'
*uk	*uŋ	kin	'to meet'
*ük	*üŋ	ku	'guess'

The reason that I call this restriction a dorsal restriction is because velar consonants use the dorsal articular and the height of vowels are indicated by [high] which is a feature dominated by the dorsal node.[3]

2.3. Coronals

The coronal restriction is in nature different from the dorsal and the labial restrictions. In both the dorsal and labial restrictions, it is clear that there is a requirement of dissimilation. That is, in a certain environment, there cannot be two similar sounds (i.e. two labials and two dorsals). However, in the coronal restriction, there is a requirement of similarity:

(13) A coronal onset cannot occur with a coronal coda in the same syllable if the vowel is non-low and back.

Thus, both (14a) and (14b) are not legitimate:

(14) a. *COR u COR
b. *COR o COR

(15)	mun	'bored'	kon	'dry'
	put	'to wipe out'	kot	'to cut'
(16)	t'ok	'to support'	tsok	'to create'

(15) shows that the back vowels /u/ and /o/ can occur with a coronal coda as long as the onset is not coronal. (16) shows that a coronal onset can occur with /o/ if the coda is not coronal. Note that a coronal onset cannot occur with /u/ independently (while /u/ can occur with a coronal coda). However, this may be an accidental gap for two reasons: (a) based on the asymmetry that we have seen (from the labial and the dorsal restriction), the generalization is that if a certain onset-nucleus pair is not allowed, the corresponding nucleus-coda pair is also not allowed (i.e. *pü → *üp), and **not** vice versa (i.e. *up ×→

[3]I am using [high] as a privative feature. See Steriade 1987 for details.

pu). There is no other restriction such as [*COR u], in that the onset-nucleus pair is ruled out while the nucleus-coda pair is well-formed (i.e. the nucleus-coda restriction is always strong); (b) [COR o] pairs are good, as shown in (16). Since /u/ and /o/ form a natural class, it seems reasonable to say that [*COR u] is an accidental gap.

In view of this, back vowels (except /a/ and /a:/) cannot occur in a syllable with both a coronal onset and a coronal coda. If we consider coronals to be "front" consonants, this restriction essentially states that when there are two "front" consonants, the vowels cannot be back and low:

(17)	tit	'iron'	(18)	*tut	*tot
	tüt	'to take off'		*tsot	*tsut
	tön	'a shield'			

(17) and (18) show that when both the onset and the coda are coronals, the vowel have to be a front vowel (i.e. /i/, /ü/, /e/ or /ö/).

It is thus clear that the constraint checks the whole syllable and if there are two coronal consonants, the vowel has to be "similar" in frontness.

3. Proposal

In this section, I propose a different feature geometry of vowels. In particular, I propose that (a) similar to consonants, vowels should be specified for the degree of stricture; (b) frontness of vowels is due to the presence of the coronal articulator and the absence of the coronal articulator indicates backness; (c) the dorsal articulator is only responsible for the height of vowels. In addition, I propose that a pair-wise, right to left checking together with the major articulator of the vowels accounts for the asymmetry between the onset-nucleus and the nucleus-coda pairs. In Section 3.1, I present the new system of feature geometry for vowels. I will show in 3.2.-3.4. how the new system, together with the checking mechanism, accounts for the co-occurrence restrictions in a unified way.

3.1. The Feature Geometry of Vowels

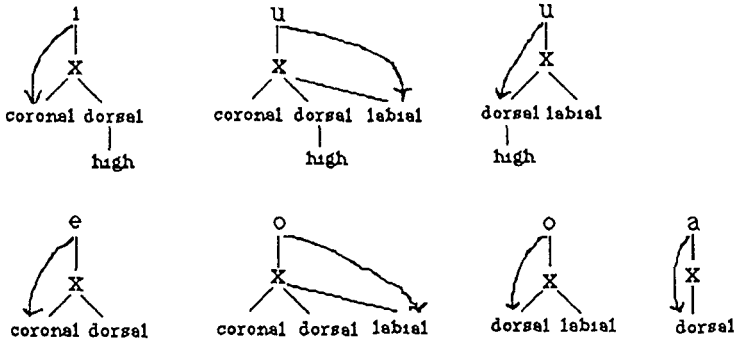
In Sagey (1986), all vowels have the dorsal articulator and round vowels have an additional labial articulator. The dorsal articulator dominates the features [high], [back] and [low]. One major inadequacies of this system is that the phenomenon of palatalization is not explained. As Clements (1976), and Itô and Mester (1989) point out, palatalization involves adding [+anterior] to a consonant (p.42).[4] Thus, palatalization is treated as

[4]See also Lahiri and Blumstein (1984) and Ohala (1981) for discussions on the feature coronal.

coronalization If front vowels are simply represented as dorsal with [-back], the phenomenon of palatalization cannot be explained as an assimilation process

I extend Itô and Mester (1989) and propose that the difference between front and back vowels is represented by the presence of the coronal articulator for front vowels and the absence of it for the back vowels There is no feature [±back] The dorsal articulator is only responsible for height Moreover, I extend Steriade's (1987) position in claiming that there are only privative features Thus, the presence of [high] indicates that the vowel is high The absence of [high] indicates that the vowel is not high [5] (19) gives a summary of the vowel geometry in Cantonese

(19)



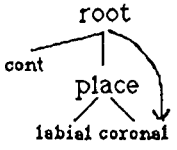
The front vowels /ɪ/, /ʊ/, /e/ and /o/ all share the coronal node Since they involve both the coronal and the dorsal articulator, they are complex segments The dorsal node dominates [high] which is shared by the high vowels /ɪ/, /ʊ/ and /u/ Thus, it cuts across front and back vowels In addition, I follow works by Goldsmith (1985), Kaye, Lowenstamm and Vergnaud (1985) and Schane (1987), that in languages with seven vowels (such as Cantonese), the non-high vowels are all low Thus, the non high vowels also have the dorsal articulator The dorsal articulator for the non-high vowels simply does not dominate anything The absence of the [high] feature indicates that they are low The distinction between /a/ and /o/ is simply that /o/ is round while /a/ is not

As expected, the labial articulator is shared by all the round vowels /ʊ/, /o/, /u/ and /o/ The simplest vowel is the vowel /a/ which has only one articulator unmarked for anything This reflects the fact that /a/ is the most unmarked vowel and that no co-occurrence restrictions refer to the vowel /a/

[5]Features may not be privative universally Data in other languages may show this is parametrized

Furthermore, I follow Sagey in assuming that there is a relationship between the root node and the major articulator. In Sagey (1986), she points out that sounds which are complex segments (i.e. sounds which have more than one articulator), there is a distinction between the major articulator and the minor ones. She states that "the property of being a major articulator is a relation between an articulator and the node the closure features are attached to, e.g. the root node. Since being a major articulator is a relation between the root node and an articulator node, I represent it as a pointer between the root and the major articulator" (p.206)[6]. (20) is an example of a representation which indicates the closure feature with the major articulator noted.

(20)

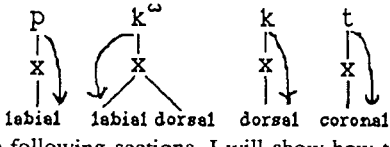


The pointer simply indicates an application of the closure features specified at the root to the articulator that the pointer points to. If there is only one articulator, by default, the pointer points to that articulator. If there is more than one articulator, then language specific rules indicate which articulator is the major one that the pointer should point to.[7]

Hence, in (19), the unround front vowels /i/ and /e/ have the coronal articulator as the major one while the round front vowels /ü/ and /ö/ have the labial articulator as the major one. This captures the fact that /ü/ and /ö/ are marked for labiality. The back vowels /u/ and /o/ have the dorsal articulator as the major one and this also captures the fact that their labiality is not marked. The simplest vowel /a/ by default, has dorsal as its major articulator since it is the only one.

In (21), I give some examples of the representation of consonants (irrelevant information is left out in (21)).

(21)



In the following sections, I will show how this system accounts for the co-occurrence restrictions in Cantonese. In Section 4, I will discuss the consequences of this proposal.

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[6]The degree of closure is indicated by the feature [continuant] for instance.

[7]See Sagey (1986), in particular, chapter 3.3 for a detailed discussion on the issues involving major articulator and closure features.

3.2 The Labial co-occurrence restrictions

(22) summarizes the labial co-occurrence restrictions:

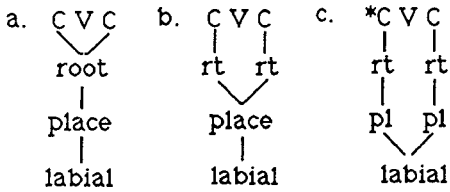
(22) a. onset-coda: *labial labial
b. onset-nucleus: *labial [front round vowels]
c. nucleus-coda: *[round vowels] labial

The labial restriction can be stated as an Obligatory Contour Principle (OCP) violation, as in (23). That is, two adjacent labial nodes are not allowed.

(23) *labial labial

Recall that identical labial pairs are allowed and so are pairs with the same place of articulation I follow McCarthy (1989) in assuming that languages like Cantonese which have a simple and predictable syllable structure have v/c segregation. Specifically, there is V/C segregation at the lexical entry in Cantonese. And I propose that double linking of the root node or the place node is allowed, while double linking of the labial node is not, as in (24).

(24)

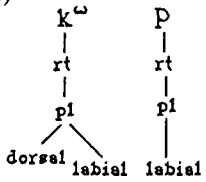


(24a) allows p-p, and m-m pairs while (24b) allows p-m, and m-p pairs. (24c) rules out any combination in (6), repeated below. This certainly raises the question of what kind of node cannot be doubly linked and which kind can be. I will come back to this question in the section 4.

(6) f-p k^{ω}-p k^{ω}'-p
f-m k^{ω}-m k^{ω}'-m

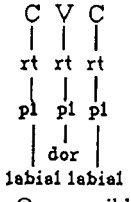
(25) is the representation of [k^{ω}-p]. It shows that since neither the root nor the place node can be linked (since /k^{ω}/ and /p/ have distinct root nodes and place nodes), and double linking of labial is ruled out by (24c), the pair [k^{ω}-p] violates (23) because there are two adjacent labial nodes.

(25)



A question which arises is after plane conflation, when vowels and consonants are on the same plane, why are the pairs in (5) still well-formed (i.e. the identical pairs and the pairs with the same place of articulation). That is, after conflation, for both V's and C's, there is a root tier and place tier. The root and place nodes of the two consonants therefore cannot be doubly linked since they are no longer adjacent (with the vowel's root or place node intervening). As a result, according to OCP, if both consonants are labial (while the vowel is not), the pairs in (5) should be ruled out since there are two adjacent labial nodes (although the place and root nodes are not adjacent), as shown in (26).

(26)



One possible and reasonable way to treat this problem is related to the hypothesis that Cantonese has v/c segregation. If Cantonese has v/c segregation, then strictly speaking, at the level of the lexical entry, the consonants of a syllable are adjacent by the mere fact that consonants and vowels are on separate planes. That is, at the consonant plane, the onset and coda are strictly adjacent because their root nodes are adjacent. However, after tier conflation, the adjacency between the consonants is destroyed. In other words, at the level after v/c segregation, adjacency is still defined by the root node. Thus, with a representation such as (26), the labial nodes are not adjacent because the root nodes which dominate the labial nodes are not adjacent.

Therefore, the pairs in (5) are allowed both in the lexical entry and in later derivations. On the other hand, the pairs in (6) are not allowed in the lexical entry and therefore ruled out in the language.

Let us now turn to the problem with glides. (27) shows that a labial onset can occur with /w/ but [w-w] pairs are ruled out.

(27) p'aw 'run' *kwaw
faw 'to float' *waw
miw 'to aim'

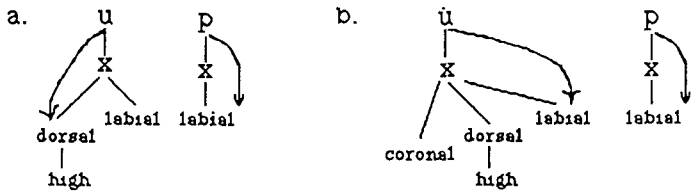
If /w/ only has a labial node (pairing /w/ with /p/ and /m/), the pairs [p'aw] and [miw] and the illegitimate one *[kwaw] are accounted for. However, there remains a problem for [faw]. Recall that pairs such as [f-p] and [f-m] are ill-formed. Thus, by treating /w/ as simply labial does not account for all the data. The fact that [w-w] pairs are also ill-formed may be unrelated to the labial restriction because [y-y] pairs are also ill-formed. Thus, there might be a restriction against having two glides in a syllable in Cantonese. I will leave this problem open and we need to look into the nature of glides further before tackling this problem.

Consider now the asymmetry between the nucleus-coda and onset-nucleus pairs. The contrast is summarized in (28).

(28) a. nucleus-coda: *up, *üp
b. onset-nucleus: pu, *pü

Following Itô (1988) who proposes a directionality of syllabification to account for different epenthetic positions, I propose that the checking of violations in Cantonese is from right to left and the checking is done pair-wise.[8] Further, the checking is based on the major articulator of the right member of the constituent. Consider first the nucleus-coda pairs in (29):

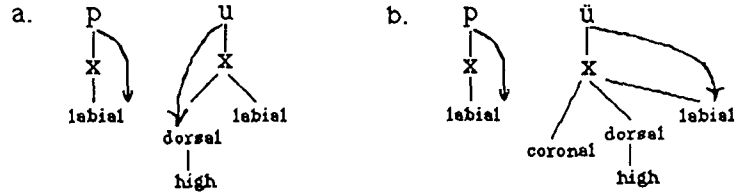
(29)



(29) illustrates the nucleus-coda pairs. In (29a), the right to left checking starts with /p/'s major articulator 'labial'. It checks to see whether there is a labial node adjacent to it (to the left). Since /u/ has a labial articulator, there is a violation. Thus, *[up] is ruled out. Similarly, in (29b), the checking starts from the labial articulator of /p/ and finds the labial articulator of /ü/. Thus, *[üp] is ruled out. Consider now the onset-nucleus pairs in (30).

[8]Note that directionality is independently necessary in phonology. For instance, stress assignment requires directionality. Itô's recent work is another example of directionality in phonology.

(30)



In (30a), the right to left checking starts from /u/'s major articulator 'dorsal'. On the left of /u/, there is no other dorsal node. Thus, the sequence, /pu/ is well-formed. In contrast, in (30b), the right to left checking starts from /ü/'s major articulator 'labial'. On the left of 'labial', there is another labial node (from /p/). Thus, [pü] is ruled out.

It should be noted that the presence of the dorsal node for the vowel /o/ is crucial in accounting for the well-formed [po]. If there is only labial, it is predicted that sequences such as [po] are ill-formed because the checking would start with the labial articulator and the presence of the labial articulator of /p/ predicts a violation. Having the dorsal node not only prevents this problem, it also naturally indicates that the labiality of the back vowels is predictable (therefore cannot be major) (see section 4 for a discussion of major articulator and underspecification).

The asymmetry between the nucleus-coda and the onset-nucleus pairs are accounted for by the fact that the front rounded vowels and back rounded vowels have different major articulators. The asymmetry is a result of certain representation of the vowels.

3.3. The dorsal co-occurrence restriction

The dorsal co-occurrence restriction can be accounted for in the same way. (31) summaries the dorsal data:

(31) A high vowel (regardless of back or front) cannot occur with a velar coda:

*ik,	*ük,	*uk
ki,	kü,	ku

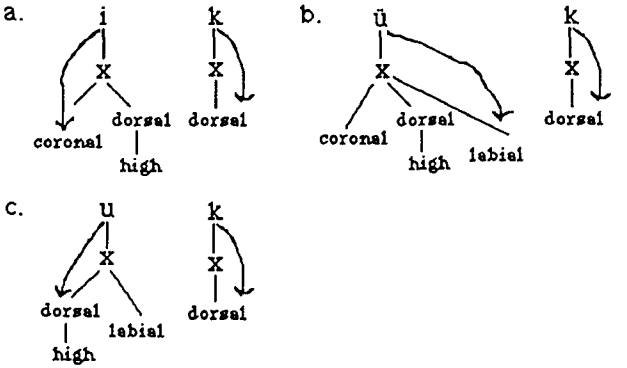
I state the dorsal restriction as follows:

(32) *dorsal dorsal

Note that there is no constraint against double linking of the dorsal node. Thus, if there are two non-distinct dorsal nodes, OCP will ensure that they merge into one node (see Yip 1988 for a discussion of various operations that are performed because of OCP).

Consider first the nucleus-coda pairs. The representations are as in (33):

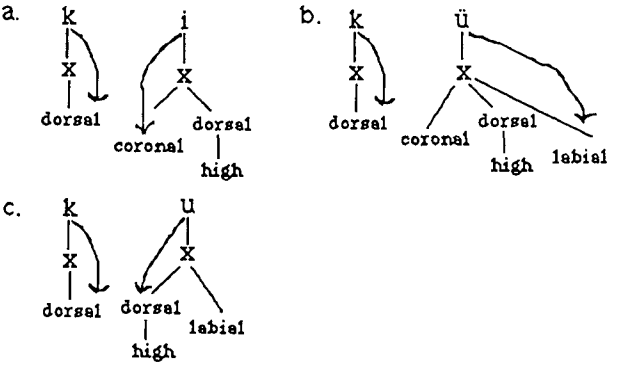
(33)



In (33a), the right to left checking starts from the dorsal articulator of /k/ since it is the only articulator and therefore, the major articulator. To the left of the dorsal node, there is another dorsal node (from the vowel /i/) and thus it violates (32). It should be noted that the constraint in (32) is not sensitive to whether the place node is identical or not. Thus, as long as there is a dorsal node, there is a violation. Similarly, in (33b) and (33c), the dorsal articulator of /k/ is always adjacent to another dorsal articulator, hence both forms are ruled out by (32).

The contrast between the nucleus-coda pairs and the onset-nucleus pairs is again a consequence of different major articulators. (34) shows why the onset-nucleus pairs are well-formed.

(34)



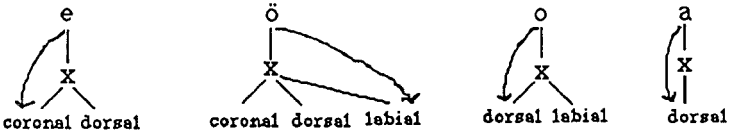
In (34a), the right to left checking starts with the major articulator of /i/, the coronal articulator. It checks whether there is another coronal to the left of it. There is none and therefore /ki/ is good. Similarly, in (34b), the checking starts with the major articulator of

/ü/, the labial articulator. There is no other labial articulator to the left of it and the sequence is predicted to be good.

(34c) requires further explanation. The checking starts with the major articulator of /u/, the dorsal articulator. Note that there is another dorsal articulator to the left of it. Thus, it predicts that /ku/ is ill-formed. However, it should be noted that the dorsal articulator of /u/ dominates the feature [high]. Thus, the two dorsal nodes are not identical. I propose that , the checking in facts starts from the lowest node (i.e. the terminal node) of the major articulator. If the major articulator node does not dominate any node, it itself is the lowest node. In other words, in (34c), the checking starts with [high], which is the terminal node of the major articulator, dorsal. It checks whether there is another [high] to the left of it and there is none. Thus, the sequence /ku/ is predicted to be good.

In Section 3.1., when I introduced the geometry of the vowels, I proposed that for the vowels /e/, /ö/, /o/ and /a/, there is also a dorsal node. (35) repeats the geometry of these vowels.

(35)



Given the fact that they have the dorsal node, the question which arises is why they can occur with velar codas? In fact, this is predicted by the theory because there is no constraint against double linking of the dorsal nodes, thus when there are two adjacent dorsal nodes, OCP predicts that they merge (see Yip (1988) for a discussion on the processes resulting from OCP). However, for the high vowels, the dorsal node is specified with the feature [high]. Thus, the dorsal node of a velar consonant cannot be merged with it because there are non-distinct. In other words, for the vowels /e/, /o/ and /a/, it is predicted that they can occur with velar codas and that there is no violation.

Again, the asymmetry between the onset-nucleus and nucleus-coda pairs is a result of different representations of the sounds and of the right to left checking of violations.

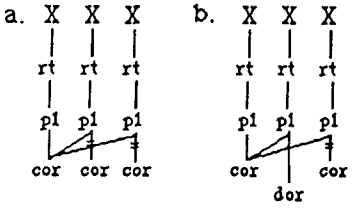
3.4. The coronal co-occurrence restriction

As pointed out in Section 3, the coronal co-occurrence restriction is assimilatory in nature. The restriction is summarized in (36):

(36) *coronal u coronal
*coronal o coronal

If there are two coronal consonants in a syllable, the vowel has to be front. Intuitively speaking, it is natural that two coronals only occur with front vowels because if we divide consonants by frontness vs. backness, coronal consonants are "front" consonants. The representation proposed in 3.1., following works in palatalization, incorporates this idea. With front vowels having the coronal articulator, following Pulleyblank (1989), I propose that there is an assimilation when there are two coronals:

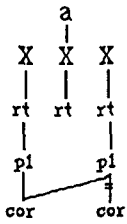
(37)



In (37a), the coronal node of the onset spreads to both the nucleus and the coda. The coronal node of the nucleus has to be delinked before the coronal node of the onset can spread to the coda (otherwise there is crossing of the association line). On the other hand, as shown in (37b), if the nucleus is not coronal, the articulator node of the nucleus does not block spreading. Thus, the coronal node is simply added to the place node of the nucleus. If the nucleus is coronal, the spreading does not affect it. Hence, [tit] is still [tit] and [tet] is still [tet]. However, if the nucleus is not coronal, (either dorsal or labial or both), the quality of the nucleus is changed by the addition of the coronal as a result of spreading. Given (37), there are no surface sequences such as *[tut], *[tsot] and *[sut] because by (37), they all become [tüt], [tsöt] and [süt].

A problem arises with the vowel /a/. In the representation in (19), /a/ has a dorsal articulator. (37) spreads the coronal of the onset onto /a/ and the prediction is that /a/ should be changed to /e/ and that there is no surface sequence of [coronal a coronal]. Yet, this is the wrong prediction. Following a suggestion by Steriade (p.c.), I propose that /a/ in Cantonese is ATR. Thus, /a/ only has a root node and the place node is completely missing. With no place node, the spreading of the onset coronal node does not affect the nucleus since there is no place node for the coronal to spread to. Thus, the spreading continues to the coda, as shown in (38).

(38)



Note that being an ATR vowel naturally explains why /a/ never enters into any co-occurrence restrictions. Since there is no place node, and the co-occurrence restrictions all refer to either place or articulator nodes, /a/ in Cantonese can never be in conflict with any sound.

The coronal co-occurrence restriction is accounted for by spreading the coronal node of the onset onto the vowel when there is a coronal coda. By this spreading, back vowels such as /u/ and /o/ are fronted. Thus, on the surface, we never find sequences with two coronal consonants with either /u/ or /o/. It should be noted that the analysis presented here assumes that with v/c segregation, the consonants and the vowel do not interact at the lexical level. Thus, the constraint is not at the lexical level, but instead, after plane conflation.

4. Consequences and Implications

The proposal here has some interesting consequences. With the coronal articulator indicating frontness vs. backness, front vowels are complex segments. This presents an interesting question with respect to epenthesis. Normally, the least marked vowel is the epenthetic vowel. This predicts /a/ in Cantonese to be the epenthetic vowel. However, normally, the epenthetic vowel in Cantonese is /i/.[9] Why this is so deserves further attention. In addition, the dorsal node no longer dominates a [back] feature. It is incorporated into the coronal articulator.

The claim that vowels also have distinctions between major vs. secondary articulators has support from the labial and dorsal co-occurrence restrictions in Cantonese. A question which arises in the representations shown in section 3 is whether one can predict which articulator is the major one based on the underspecification of the vowels. I propose that the representations used in this paper are not the underlying representations of

[9]Some evidence for the epenthetic vowels comes from loanwords. Cantonese does not have onset clusters and when a word such as 'stamp' is borrowed, there is an epenthetic vowel breaking up the cluster. The result is /sitam/. /basi/ for 'bus' is another example. Cantonese does not allow /s/ to be in the coda, thus a vowel is inserted and /s/ becomes an onset.

the vowels. Instead, they represent vowels after redundancy rules have applied. I would like to suggest that before the redundancy rules are filled in, the vowels at least have their major articulator. More work on the major articulator of each vowel is needed before we can determine the relationship between underspecification and the major articulator of vowels.

In addition, it is shown that the checking mechanism is sensitive not only to the distinction between major and non-major articulators but also to the terminal node of major articulators because the checking is done based on the lowest, the terminal, node.

Finally, I would like to make a remark on why labial nodes cannot be doubly linked. If the constraint is simply stated such that there is a filter filtering out doubly linked labial nodes, it seems to be a language particular and also ad hoc constraint. I would like to suggest that there is a principle behind what can be doubly linked and what cannot be. The principle is stated in (39).

(39) Terminal nodes do not branch in underlying representations.

(39) rules out double linking in the lowest expansion. Note that this is not a surface constraint because assimilation rules such as voicing assimilation requires the lowest expansion [voice] to be doubly linked. Languages may differ as to whether an articulator node is terminal, based on the inventory of sounds in the particular languages. However, features such as [high] cannot be non-terminal nodes.[10]

Consider the sound inventory of Cantonese. There is no contrast such as /p/ vs. /p^{ω}/. Thus, there is no need to have a distinction between a labial articulator which does not dominate anything (/p/) and a labial articulator which dominates [round] (/p^{ω}/). Thus, the labial articulator in Cantonese is in fact terminal. Thus, the fact that there is no double linking of the labial node follows from (39). The dorsal node in Cantonese is not a terminal node because it dominates the feature [high] since there is a distinction between high and non-high vowels. The question which arises is the coronal node. The analysis given in the previous section requires that the coronal node be a non-terminal node because spreading is double linking. As far as the vowels are concerned, there is no need to specify beyond coronality. With respect to the consonants, the consonant inventory in Cantonese does not make a contrast between anterior sounds and non-anterior sounds. Thus, it seems to be the case that the coronal node should be a terminal node. I will leave this question

[10]See Mester (1986) for a different view using the notion of dependency tiers.

open since it requires a careful study of the consonants. In sum, (39) provides a potential explanation to why labial nodes cannot be doubly linked.

In conclusion, I have proposed that vowels are specified for the degree of stricture. The presence of the coronal node indicates frontness and the dorsal node only indicates the height of vowels. There is a checking mechanism for OCP from right to left which checks from the lowest node (the terminal node). Finally, terminal nodes do not branch at underlying representation.

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External Arguments in Basque

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Williams (1981) proposes that there is a designated argument within the thematic structure of the verb which must be realized external to the VP, in the specifier of a functional phrase (IP). In contrast, Kuroda (1986) and Koopman and Sportiche (1988) among others propose that all the arguments of the verb are realized internal to the VP.[1] We argue that in Basque, all the arguments of the verb are external arguments in the sense of Williams (1981). That is, we propose a third alternative, namely, that all the arguments of the verb are projected external to the VP in the specifier positions of functional phrases and INDIRECTLY THETA-MARKED by a functional head.

We first discuss the basic properties of a Basque sentence. In section 2, we show that all the arguments in Basque, in particular the absolutive argument, must be external to the VP at S-structure. To this effect, we will discuss Agreement and pro-drop, the morphological structure of the Auxiliary, control and Case and finally wh-movement. We then argue that it is precisely this hypothesis, namely, that all the arguments of the verb must be in specifiers outside the VP at S-structure, which is incompatible with the VP-internal hypothesis. This leads us to propose that all arguments of the verb are external arguments in the sense of Williams (1981). We then propose an account of wh-movement and free word order in Basque. We conclude with a discussion of the similarities between the VP-internal and the VP-external hypothesis.

1. Basic properties of a Basque Sentence

1.1. Case

Basque has morphological ergative Case-marking. That is, subjects of transitive verbs are assigned ergative Case while objects of transitive verbs are assigned absolutive Case, as shown in (1).

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[1]There are various versions of the VP-internal subject hypothesis (Hale 1980, Kitagawa 1986, Speas 1986 and Zagona 1982). Our arguments against the VP-internal hypothesis for Basque hold regardless of the particular instantiations of this hypothesis.