Language, Information and Computation(PACLIC 11), 1996, 415-424

Coronal Unmarkedness and Clusters in Correspondence Theory

Shinsook Lee and Mi-Hui Cho
Hoseo University and Pukyong National University
leess@dogsuri.hoseo.ac.kr and mhcho@dolphin.pknu.ac.kr

Abstract

This paper examines paradoxes involving coronal specification. Although several phonological phenomena such as place assimilation, insertion and deletion argue for coronal underspecification, other facts like morpheme structure conditions demand coronal specification. This paper shows that this problem can be solved with the markedness hierarchy which ranks coronals low under Correspondence Theory. The hierarchy also accounts for the distributional bias of coronals in word clusters without appealing to Yip's Cluster Condition and coronal underspecification.

1. Introduction

Until recently, phonological theories crucially depended on the assumptions of underspecification and feature-filling application of rules in a derivational mode. In particular, Paradis and Prunet (1991) and Cho (1991), among others argue that coronals are underspecified due to their asymmetrical behavior in several phonological phenomena such as place assimilation, deletion, and epenthesis.

However, there has been some evidence against coronal underspecification. For example, morpheme structure conditions in both English and Korean need to refer to the unmarked coronals to rule out certain sequences of coronal consonants (McCarthy and Taub 1992). English plural and past tense suffixes should also refer to coronals in order to account for vowel insertion between "two like (or similar) coronals".

Then how can we account for the paradoxes involving coronal specification? That is, on the one hand, coronals should be underspecified because of the asymmetrical behavior, but on the other hand, coronals should be specified due to their reference in the description of some other phonological phenomena. In this paper we argue that coronal paradoxes can be resolved in Correspondence Theory which assumes constraint interactions in a parallelistic mode (McCarthy and Prince 1995). In specific, we contend that with the low ranking of Coronal, coronal unmarkedness is naturally derived, without appealing to coronal underspecification. We also argue that Yip's Cluster Condition (1991) which crucially depends on coronal underspecification cannot be maintained. Rather we show that the fact that coronals frequently show up in clusters can receive a unified account within Correspondence Theory.

The organization of this paper is as follows: Section 2 examines the analysis of coronal unmarkedness in terms of underspecification theory. Section 3 provides evidence against coronal underspecification from several phonological phenomena, in languages such as English and Korean. Section 4 gives a unified account of coronal unmarkedness and cluster facts within Correspondence Theory, solving the problem of coronal paradoxes. Section 5 summarizes our findings.

2. Coronal Unmarkedness in Underspecification Theory

It has been assumed in the literature that coronals are underspecified because of their unmarked status in several phonological phenomena, as reviewed in Paradis and Prunet (1991). First, coronals are potential targets of

rules like place assimilation in languages like English and Korean. Some relevant data are given in (1) and (2) (Gimson 1962, Jun 1995, Cho 1991):

(1) Place assimilation in English

a. coronal --> labial

that pen [ðæp pen]	ten pounds [tem pawndz]

b. coronal --> velar

hot cake [hɒk kejk]	ten cups [teŋ kʌps]

c. * velar --> labial, * labial --> velar, *velar --> coronal

jack pot [ʤæk pat]	*[ʤæp pat]
leap quickly [lip kwɪkli]	*[lik kwɪkli]
book dealer [buk dilər]	*[but dilər]

(2) Place assimilation in Korean[1]

a. coronals --> labials, velars

kotpalo [kopp'aro]	*[kottaro] 'straight'
pat+ko [pakk'o]	*[patto] 'to receive and'
sinpal [simbal]	*[sintal] 'shoes'
hankaŋ [haŋgaŋ]	*[hantan] 'the Han river'

b. * labials, velars --> coronals

pap+to [papt'o]	*[patto] *[pappo] 'rice also'
kaŋto [kaŋdo]	*[kando] *[kaŋko] 'robber'

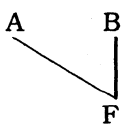
c. labials, palatals --> velars, *velars --> labials

kamki [kaŋki]	*[kampi] 'a cold'
əp+ko [əkk'o]	*[əppo] 'to bear on the back'
kuk+mul [kuŋmul]	*[kupmul] *[kukŋul] 'soup'
kuk+pap [kukp'ap]	*[kuppap] *[kukkap] 'rice soup'

As can be seen in (1), coronals in English assimilate to labials (1a) and velars (1b). The data in (2) show that place assimilation in Korean also targets coronals, but they show additional asymmetry effects not shown in English. While coronals assimilate to labials and velars (2a), and labials and palatals to velars, velars never undergo assimilation (2c).

The fact that place assimilation targets coronals in English is accounted for by the leftward spreading of marked (i.e., specified) features (or nodes) to the less marked (i.e., unspecified) feature or node with the assumption that coronals are underspecified. Place assimilation in Korean is accounted for in a similar line; but in order to account for the fact that labials as well as coronals undergo assimilation unlike English, it has been assumed that coronals are unspecified for place and that labial is the unmarked daughter of the peripheral node which groups labials and velars together. Then Korean place assimilation can be accounted for by the leftward spreading of a more marked (specified) node to the preceding less marked (specified) node, as shown in (3) (Avery and Rice 1991, Lee 1994):

(3)



Condition: the node B contains one more specified dependent node (or feature) F than does the node A.

Thus, the fact that place assimilation targets primarily coronals is explained in terms of coronal underspecification.

Now let's examine the second argument for coronal underspecification. Coronals, especially /t/ and /n/ are frequently inserted or deleted in several phonological processes. Some relevant data from Korean are shown in (4) (H. Kim 1982, K. Kim 1987):

(4) a. /t/ is inserted between the two elements of a compound: /ko/ 'nose' + /tiŋ/ 'ridge' --> [kot.t'iŋ] 'the ridge of the nose'.
b. /n/ is (optionally) inserted at the beginning of an /i/- or /y/- initial stem when the preceding morpheme ends in a consonant. (Feeds total assimilation of /t/ to a following nasal): /citikita/ --> [cin.ni.gi.da] 'to mash' (intensive), /pat^{h}/ 'field' + /ilaŋ/ 'ridge' --> [pan.ni.raŋ] 'the ridge of a field'.
c. All coronal obstruents are neutralized to /t/ in syllable final position: t, t', t^{h}, s, s', c, c', c^{h} --> t.
d. Coronal obstruents are deleted regardless of their position in cluster simplification: /moks+to/ --> [mok.to] 'share also', /salmta/ --> [sam.da] 'to boil'.

Underspecification theory explains the facts above by underspecifying the place feature for coronals. Namely, coronals can be inserted or deleted more frequently than labials or velars since they are underspecified for place and thus are less complex than other segments.

The distributional bias of coronals in the lexicon also seems to support coronal underspecification. For example, in monomorphemic words, English clusters never include more than one non-coronal. The data from Clements (1988) and Yip (1991) show the possible range of medial and final clusters.

(5) Clements (1988: 35), Yip (1991: 63):

a. stop-stop	C_2 = t, d		chapter, factor, abdomen
b. stop-fricative	C_2 = s, z		capsule, axle, adze
c. fricative-stop	C_2 = s, or C_2 = t, d		whisper, whisker, clasp, brisk, often, lift
d. nasal-stop	homorganic		whimper, winter, wrinkle
e. stop-nasal	C_2 = n		signify, open
f. liquid-stop	all OK		alder, garden, help, elk
g. stop-liquid	all OK		atlas, poplar, topple, wicker
h. fricative-fricative		C_1 =s	asphalt, aesthetic (rare)
i. nasal-fricative		C_1 = n	answer, panther, anvil, tense
j. fricative-nasal		vary rare	prism
k. liquid-fricative		all OK	wealth, hearth, elf, scarf
l. fricative-liquid		all OK	Teflon, whiffle, wither

Yip accounts for the facts above by the following Cluster Condition and coronal underspecification (1991: 62):

(6) Cluster Condition:
Adjacent consonants are limited to at most one place specification.

According to Yip, coronal consonants can occur freely compared to other places of articulation since they are underspecified and thus are not subject to the Cluster Condition.

In the following section, we examine some evidence against coronal underspecification in English and Korean.

3. Problems in Coronal Underspecification

Although there are some arguments for coronal underspecification as was shown in section 2, in this section we give evidence against coronal underspecification from several phonological phenomena in English and Korean. First, coronal underspecification requires that the English plain alveolars /t, d, l, r/ and /n/ are underspecified for [coronal], whereas the dentals /θ, ð/ and palato-alveolars /č, ǰ, š, ž/ are fully specified because of the dependent features [distributed] and [anterior]. As a consequence, the plain alveolars are assumed not to function with the other coronals until application of the [coronal] default rule. But, in English, plain coronals like /t/ and marked ones like /š/ and /θ/ pattern together with regard to some morpheme structure conditions, as shown in (7) (McCarthy and Taub 1992: 365).[2]

(7) a. Initial coronal+/yu/ is prohibited in American English: *θyu, *tyu
b. Syllable-initial clusters of coronal+/l/ are prohibited: *tl, *dl, *θl
c. The syllable appendix is restricted to coronals: rind, range, *r[aj]mp, *r[aj]nk

Thus, the data given in (7) show that there is a problem in coronal underspecification.

Second, the regular preterite (and participial) ending and the plural suffixes in English have three allomorphs. The voiceless segments [-t] and [-s] appear, respectively, after a stem final voiceless consonant while the voiced ones [-d] and [-z] after a voiced stem final consonant including sonorants or a vowel; and [-əd] and [-əz] appear when the stem final consonant is identical in the relevant sense to the suffix consonant. Some examples which show these alternations are given in (8) (Borowsky 1986: 138):

(8)	a. past: -t	-d	-əd
	liked	loved	hated
	popped	booed	kidded
	hissed	tamed	
	b. plural: -s	-z	-əz
	hikes	doves	gases
	pops	dells	roses
	cats	bees	churches
	cuffs	combs	bushes

The underlying forms of the inflectional morphemes for past (and participial) and plural suffixes are /-d/ and /-z/, respectively, and the above alternations can be explained by voicing assimilation and vowel epenthesis along with syllabification. Namely, vowel epenthesis occurs when suffixation creates the sequence of (near) identical coronal segments in examples in the third column because of the Obligatory Contour Principle (hereafter OCP) (Leben 1973). This means that English plural and past tense suffixes should refer to coronals contradicting coronal underspecification.

In addition, Korean provides evidence against coronal underspecification. The underived native Korean words prohibite the sequences of coronal consonants and a palatal glide because of the OCP as shown in (9):

(9) *ty- *t'y- *t^hy- *sy- *s'y- *cy- *c'y-

In order to account for the above morpheme structure condition, coronals in Korean should be underlyingly specified, similarly to the English onset cluster

case.

Then how can we account for the cases involving coronal underspecification on one hand and coronal specification on the other hand? In the following section, we offer a unified account of coronal paradoxes within Correspondence Theory.

4. A Unified Account in Correspondence Theory

Correspondence Theory (McCarthy and Prince 1995) is a recent development of Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993a, McCarthy and Prince 1993b). Like Optimality Theory, Correspondence Theory is a model of constraints and constraint interactions which claims that an optimal output form is selected through the evaluation of an array of candidate outputs in a parallel mode. Unlike Optimality Theory, however, Correspondence Theory puts an emphasis on faithfulness between related representations such as input and output. It also abandons Containment in Optimality Theory in the sense that, unlike the Parse/Fill system, actual segments (or features) can be inserted or deleted in phonology proper.

Following the traditional view of the place of consonant markedness, we assume the markedness hierarchy for the consonant places in (10) (cf. Paradis and Prunet 1991, Prince and Smolensky 1993).

(10)

Vel	Lab	Cor

We show that with this hierarchy, several phonological phenomena such as place assimilation, insertion, and deletion receive a unified explanation. In addition, we show that the distributional bias of coronal consonant in clusters can be accounted for with this markedness hierarchy without adopting Cluster Condition and coronal underspecification as proposed in Yip (1991).

First, let's examine place assimilation in English. We propose the following constraint hierarchy for English place assimilation, as shown in (11).

(11) Ident(Vel)>>Ident(Lab)>>Noncrispness Onset(Cor), Onset->Coda>>Non Complexity>>Ident(Cor), Noncrispness Onset(Noncor)

In (11) the constraint Onset->Coda captures the directionality of place assimilation in English (and Korean). Namely, consonants in onset position are triggers of place assimilation. The motivation for this constraint comes from the fact that onset position is phonologically more prominent than coda position and thus onset consonants usually keep their identities compared to coda consonants. The constraint Noncrispness Onset(Cor), which prohibits double association between consonants, is motivated to account for the fact that coronal consonants never trigger place assimilation although they are in onset position. There is some phonetic evidence for this constraint. The articulatory gesture of coronal consonants is very rapid and consequently, its formant structure is brief. Thus, coronal consonants usually do not affect the neighboring consonants.[3] By contrast, the constraint Noncrispness Onset(Noncor) reflects the idea that the gestures of noncoronal consonants in onset position are slow, and thus more affecting neighboring consonants than the corresponding coronal consonants do. As a result, they can be double linked with neighboring consonants, violating Noncrispness Onset(Noncor). The constraint of Non Complexity captures the fact that, in consonant sequences, one consonant tends to assimilate to a neighboring consonant due to ease of articulation. This constraint also accounts

for the partial assimilation between the coda and onset consonants which is attested in many other languages. Finally, the constraints Ident(Vel), (Lab), (Cor) are ranked as in (11), which reflects the markedness hierarchy of consonant places in English (also in Korean).

With the ranking in (11), let's consider the tableaux in (12), (13), and (14).

(12) English Place Assimilation: Cor --> Vel[4]

hot cake Cor Vel	Ident (Vel)	Ident (Lab)	Noncrisp Onset (Cor)	Onset ->Coda	Non Complexity	Ident (Cor)	Noncrisp Onset (Noncor)
a. t]σ σ[k Cor Vel					*!		
b. t]σ σ[t Cor	*!		*	*			
c. ☞ k]σ σ[k Vel						*	*

In (12) candidate (a) does not show any change, thus violating the constraint Non Complexity, which is fatal. Candidate (b) violates the highly ranked constraint Ident(Vel) at the cost of having coronals in both onset and coda position. Candidate (c) only violates the low ranked constraints Ident(Cor) and Noncrispness Onset(Noncor), with the result that the coronal in coda position is assimilated to the velar in onset position. Thus, (c) is the optimal output.

(13) English Place Assimilation: * Vel --> Cor

book dealer Vel Cor	Ident (Vel)	Ident (Lab)	Noncrisp Onset (Cor)	Onset ->Coda	Non Complexity	Ident (Cor)	Noncrisp Onset (Noncor)
a. ☞ k]σ σ[d Vel Cor					*		
b. k]σ σ[k Vel				*!		*	*
c. t]σ σ[d Cor	*!		*				

In (13) the optimal form (a) violates only Non Complexity. In contrast candidate (b) violates several constraints: Onset->Coda, Ident(Cor), and Noncrispness Onset(Noncor). Candidate (c) violates the highest ranked constraint Ident(Vel) which is fatal. It also violates Noncrispness Onset(Cor).

(14) English Place Assimilation: * Lab --> Vel

leap quickly Lab Vel	Ident (Vel)	Ident (Lab)	Noncrisp Onset (Cor)	Onset ->Coda	Non Complexity	Ident (Cor)	Noncrisp Onset (Noncor)
a. ☞ p]σ σ[k Lab Vel					*		
b. p]σ σ[p Lab	*!			*			*
c. k]σ σ[k Vel		*!					*

In (14) the optimal candidate (a) does not show any change, violating only Non Complexity. However, candidate (b) violates the highest ranked constraint Ident(Vel) along with Onset->Coda and Noncrispness Onset(Noncor). Similarly, candidate (c) violates the highly ranked constraint Ident(Lab).

Now let's examine place assimilation in Korean. The ranking hierarchy of constraints for Korean is given in (15).

(15) Ident(Vel)>>Noncrispness Onset(Cor), Onset->Coda>>Non Complexity>> Ident(Lab)>>Ident(Cor), Noncrispness Onset(Noncor)

Here note that the constraints Noncrispness Onset(Cor), Onset->Coda and Non Complexity are ranked above the constraint Ident(Lab) because a labial consonant assimilates to a following velar consonant in Korean unlike in English. Korean place assimilation can be accounted for along the same lines as in English as can be seen in (16).

(16) Korean Place Assimilation: Lab --> Vel (kamki 'a cold')

kam ki Lab Vel	Ident (Vel)	Noncrisp Onset (Cor)	Onset ->Coda	Non Complexity	Ident (Lab)	Ident (Cor)	Noncrisp Onset (Noncor)
a. m]σ σ[k Lab Vel				*!			
b. m]σ σ[p Lab	*!		*				*
c. ☞ ŋ]σ σ[k Vel					*		*

In (16) candidate (a) violates Non Complexity which is fatal. Candidate (b) violates the constraints Ident(Vel) along with Onset->Coda and Noncrispness Onset(Noncor). By contrast, the optimal output form (c) violates the low ranked Ident(Lab) and Noncrispness Onset(Noncor). As a result, the labial in coda position assimilates to the following velar in onset position. Thus, with the ranking hierarchy as in (11) and (15), we can account for place assimilation in English and Korean.

Now let's consider insertion and deletion in Korean. As was shown in (4), the unmarked coronal /t/ is inserted between the two elements of a

compound (e.g., /ko/ 'nose' + /tiŋ/ 'ridge' -> [tot.t'iŋ] 'the ridge of the nose'). And coronal obstruents are deleted in cluster simplification (e.g., /moks/-> [mok] 'share'). Insertion and deletion can also be accounted for with the markedness hierarchy given in (10), as analyzed in (17) and (18) respectively.

(17) Insertion

ko + tiŋ	Dep(Vel)	Dep(Lab)	Dep(Cor)
a. kop.t'iŋ		*!	
b.☞ kot.t'iŋ			*
c. kok.t'iŋ	*!		

(18) Deletion

moks	*Cluster	Max(Vel)	Max(Lab)	Max(Cor)
a. moks	*!			
b.☞ mok				*
c. mos		*!		
d. mo		*!		*

In (17) candidate (b) with the inserted coronal [t] is selected as optimal since it violates the low ranked constraint Dep(Cor). Similarly in (18) the optimal output form (b) with the deleted coronal [s] is selected because it only violates the low ranked constraint Max(Cor). In contrast, (a) violates the highly ranked constraint *Cluster which forbids consonant clusters in coda position. Candidates (c) and (d) violate the constraint Max(Vel) which is fatal.

Finally, let's move on to the clusters in English. As shown in (5), coronals appear more frequently than labials or velars in word clusters. If we assume that any place specification has a penalty (cf. Prince and Smolensky 1993, Itô and Mester 1994), then we can account for the distributional bias of coronals with the markedness ranking in (10). Consider the following tableau.[5]

(19)

	*Vel	*Lab	*Cor
chapter		*	*
alder			*
whimper		*	
*pk%	*	*	

As seen in (19) *alder* has a fused *Cor specification which is low ranked, and thus it is a well-formed word. Also, *chapter* is well-formed since it has a low ranked *Cor specification along with a *Lab specification. In contrast, the illicit *pk* or *kp* clusters have highly ranked *Vel and *Lab specifications and are thus ruled out. The same holds for Italian clusters. Namely, medial clusters in Italian also show the frequent occurrence of coronals, as can be seen in (20) below. This fact receives the same explanation as in English with the marked hierarchy given in (10).[6]

(20) Medial clusters in Italian (Nagy and Napoli 1996)

alto 'high'	marcio 'rotten'	conscio 'conscious'
calza 'stocking'	capro 'goat'	bifronte 'bifrontal'
gatto 'cat'	riccio 'curl'	baffi 'mustache'

Thus, with the markedness hierarchy in (10), we can account for several phonological phenomena involving coronal unmarkedness in a unified way under Correspondence Theory.

5. Conclusion

In this paper we show that paradoxes involving coronal specification can be resolved under Correspondence Theory. That is, the theory of coronal underspecification faces severe challenges because some phonological phenomena such as morpheme structure conditions in English and Korean require coronal specification, although there are many arguments for coronal underspecification. We show that this problem can be handled with the markedness hierarchy given in (10) which assumes a low ranking of coronal specification. This ranking also accounts for the distributional bias of coronals in clusters, dispensing with Yip's Cluster Condition which crucially relies on coronal underspecification.

Endnotes

*We deeply thank Stuart Davis and Hyunsook Kang for providing valuable comments on the earlier version of the paper.

1. We do not deal with some phonological phenomena such as tensification and voicing in Korean which are not relevant to this paper.
2. Stuart Davis points out that morpheme structure conditions may have no formal status in Optimality Theory because the constraints in Optimality Theory are constraints on the output forms while morpheme structure conditions are constraints on the nature of the input forms. However, we believe that his point does not go against coronal specification. That is, morpheme structure conditions require coronal specification even in the input representation to rule out sequences like **tl* and **dl*.
3. We thank Jongho Jun for bringing the phonetic facts about this constraint to our attention.
4. Here note that the constraints Noncrispness Onset(Cor) and Onset->Coda are not ranked. Here also note that by ranking the phonological constraints Onset->Coda and Non Complexity under the faithfulness constraint Ident(Cor), we can account for the optionality of place assimilation. That is, place assimilation does not occur when the phonological constraints are ranked under the faithfulness constraint Ident(Cor).
5. Here we count place specifications with respect to word medial clusters only and ignore word initial or final place specification for expository convenience.
6. The constraint Non Complexity which accounts for place assimilation in English and Korean may be generalized to account for the high frequency of homorganic clusters and geminates in many languages.

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