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Feature Geometry and Phonological Rules in Korean*

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0. Introduction

Recently Clements (1985), Sagey (1986) and others have shown clearly that distinctive features are hierarchically organized, and that the hierarchy includes a laryngeal tier, a supralaryngeal tier and a place of articulation constituent. Proposals differ, however, regarding the organization of segment structure. In addition to the theory of Feature Geometry, the Radical Underspecification Theory is proposed by Archangeli (1988). Underspecification includes only unpredictable values for features or nodes in the underlying representation and can lead to the simplification of a segmental structure. Current research tries to explain various phonological processes by means of fewer rules and to refine the theory itself. This paper is devoted to explaining phonological phenomena in a sequence of Korean consonants and to justify the absence of Place Node for coronals. I try to find how spreading of marked feature or node to an empty position and fusion of nodes should operate in order to give an adequate explanation the phonological processes in Korean.

1. 0 Assimilation

Assimilation phenomena in Korean have been described in the papers by C.-W. Kim (1973), Y.-Y. Cho (1988) and G.K. Iverson and K.-H. Kim (1987). In the latter two papers, they adopt Underspecification Theory (Kiparsky 1982, Archangeli 1988) and the theory of Feature Geometry (Clements 1985, Sagey 1986). Assimilation processes are regarded as the spreading of an element of one tier to an adjacent tier. Within the theory of Underspecification, only one type of assimilation is predicted which is one-way assimila-

tion from marked to unmarked feature.

Kim (1987) assumes that in the feature spreading assimilation, the triggering segment, while the relevant features of the target are simultaneously delinked. Following current phonological research (Yip 1988), however, we hold the position that phonological processes are explained through a focus on the representational component rather than on the rule component (P. Avery and K. Rice 1989). According to Avery and Rice (1989), the rule component involves at most three operations, spreading, fusion and delinking. They assume that spreading is a language-particular process which may include trigger and target conditions as well as a parameter. The principles of spreading are stated as follows:

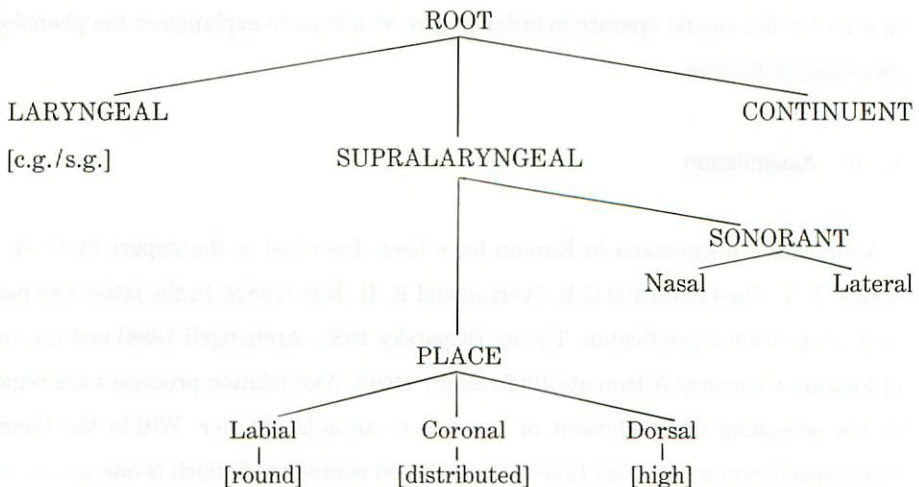
(1)

- a. Spreading can occur only if a structural target is present
- b. A feature or node can spread only to an empty

According to (1a), a new node cannot be generated by spreading and (1b) prohibits any spreading that triggers delinking.

Fusion is an operation which takes identical primary content nodes and fuses them, provided that the nodes are non-distinct (Avery and Rice 1989). Fusion creates a true geminate and obeys the Obligatory Contour Principle (McCarthy 1986). Fusion cannot apply to organisational nodes such as Supralaryngeal, Sonorant and Place. A hierarchical model of distinctive features that I adopt is shown below:

(2)



Labial, Coronal and Dorsal are called primary nodes.

Delinking is a neutralization process which eliminates content nodes in neutralization positions, such as syllable-final in Korean.

The assimilation processes in Korean occur in the environments illustrated as follows:

(3)

(a)

- pat + ko → pakko 'to receive'
 kot + palo → koppalo 'straight'
 ket + co → kecco 'to unwrap'
 hankan → haŋkan 'the Han river'
 sinpal → simbal 'stores'
 nac + ko → nakko 'to be low'

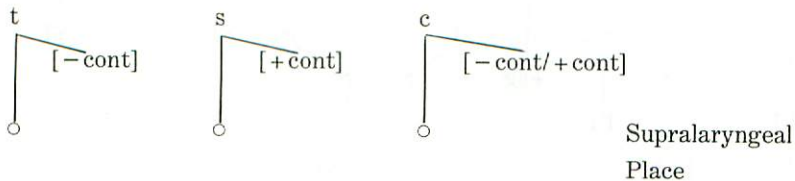
(b)

- papkaps → pakkap' 'board'¹
 kamki → kaŋgi 'flu'

(data are from Cho 1988 and Iverson and Kim 1987)

The examples in (3a) shows coronal assimilation whereas labial assimilation is exemplified in (3b). Following Cho 1988 and Iverson and Kim 1987, I assume that /t/ is the least marked segment among Korean consonants. This means that /t/ can be represented without the Place Node in underlying representation and the Underspecification Theory permits the parameterization of the Place Node for coronals (Davis 1990, Paradis and Prunet 1989). Korean has three plain coronal obstruents /t,s,c/. I adopt the representations of coronal obstruents, as given in (4).

(4)

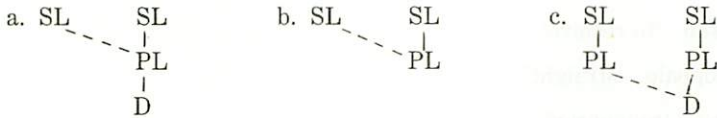


As there are no contrasts the places of articulation within the coronals in this inventory,

the Place Node as well as the Coronal Node can be underspecified. Following the line with this underspecification of nodes, the Labial Node can also be underspecified if the Place Node is present for labials.

In assimilation, marked features are spread to an empty node where the features in question are not present. The coronal and labial assimilation processes are expressed by the spreading node, as shown in (5):

(5)

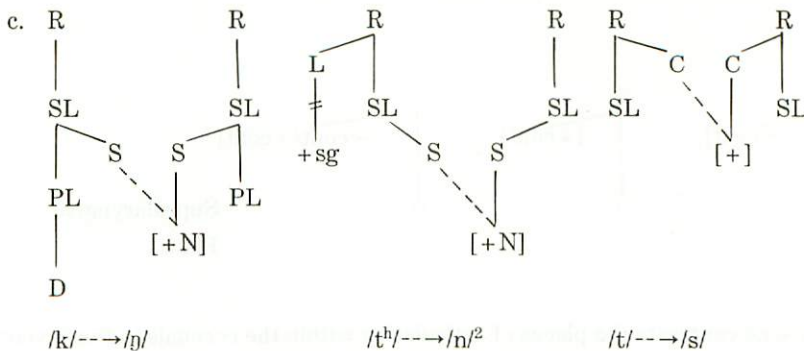


(5a) and (5b) shows the coronal assimilation and (5c) illustrates the labial assimilation. Default rules that apply as a part of phonetic implementation insert redundant primary and secondary nodes later in the derivation. The formalization shown in (5) can easily explain why the velar and labial consonants do not assimilate to coronals and the velars do not assimilate to labials. The direction of assimilation is unilateral and the spreading is not allowed in these two processes because there is no docking site.

There are two other assimilations in Korean, first, Nasalization and second, the assimilation of /t/ to the continuency and laterality of the following consonant (Cho 1988).

- (6) a. kokmok → koŋmok 'wood'
 nap + nita → namnita 'to spout'
 kat^h + ni → kanni 'to be the same'
- b. kutso → kusso 'to harden'
 tiki + tli + l → tuki + lli + l 'the letters t and l'

(from Cho 1988)



In Korean there are no lateralized velars and no continuant ones, and labials do not have continuant or lateral counterparts. This is why labials and velars do not assimilate to the continuency and laterality of the following consonant. This indicates that labials and velars do not have a Lateral Node in Feature Geometry. This is a language-particular representation in Korean inventory.

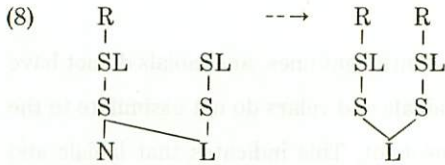
Lastly I would like to discuss the proposition that so-called lateralization takes place when /n/ totally assimilates to the preceding or following lateral consonant and generates a true geminate as Hayes (1986) states.

(7) wenlae--→wellae 'originally'

kalnip--→kallip 'reed'

(From Cho 1988)

A mirror-image rule can account for the lateralization of the nasal. It seems that this is a case of spreading. However, the spreading of the Lateral Node triggers the delinking of the Nasal Node and violates the principle of spreading in (1). According to OCP, a geminate cannot be represented as a sequence. One of the possible solutions is that the Nasal Node is delinked before the lateralization rule is applied. Can the lateralization be regarded as fusion but not assimilation? Again this violates the principle of fusion, since the Sonorant Node dominates different nodes and the primary content nodes are not identical. As the Sonorant node cannot dominate both the Nasal Node and the Lateral Node in one segment, the Nasal Node must be delinked by an independent well-motivated rule. Korean phonology has no independent delinking rule like that. The principles of Avery and Rice (1989) are unable to explain this apparent paradox. What is important, however, is that the lateral is maintained and the nasal is delinked in the process from the Sonorant Node and the process generates a true geminate. Though the delinking of the nasal in this case is ensured by the Universal Constraint of node organisation, this operation should not be regarded as spreading, but fusion and be incorporated into the rule component. The lateralization in Korean is shown as in (8):



Since the lateralization cannot be explained by the operations of fusion or spreading in the theory advocated by Avery and Rice, this forces us to slightly modify the fusion theory in the following way so that it takes into account the process illustrated in (8):

- (9) a. Primary nodes are fused if a target node is a primary node above the Place Node.
 b. A feature or node can be replaced by a trigger node.

Accordingly to the principle (9), fusion includes two possible operations, (i) delinking or (ii) feature changing. Note that the primary nodes above the Place Node dominate articulatory features. It should be considered that they perform slightly different functions, since they directly carry articulatory features.

2. 0 Aspiration

In this section, I would like to discuss a phonological process that occurs on the laryngeal node. This process is called Aspiration in Korean in which a plain obstruent is aspirated by the preceding or the following /h/. Let us consider the relevant examples listed in (10):

- (10) a. kup+hi--→kup^{hi} 'to make bent'
 mac+hi--→mac^{hi} 'meeting'
 b. coh+ta--→cot^ha 'good'
 c. manh+ta--→mant^ha 'many'

(Data from Iverson and Kim 1987)

As shown by the data (10), it seems at first glance that a feature [+s.g] in the Laryngeal Node can spread to a target node which is unspecified for the feature in question. The feature [+s.g] must be delinked from /h/ and then /h/ is unfaithfully deleted after spreading. This process does not violate the theory of spreading. There seem to be the counter-

examples to the explanation of aspiration as spreading, as shown in (11):

(11)

a.

kak + k^ho → kakk^ho

kak + p^ha → kakk^ha

b. amh + kkachi → amkkachi

(Data from Cho 1988, Iverson & Kim 1987)

c. ap^h + koke → apkoke 'a pass before us'

The example in (11a) has a tense consonant /kk/ after /h/ which has a feature [+c.g.] in the Laryngeal Node. As the node dominates the feature [+c.g.], the spreading of the feature [+s.g.] to the node is blocked. /h/ in (11b) is deleted later by the rule of consonant cluster simplification which I will discuss later.

Korean has so-called Neutralization in a syllable-final position. The Neutralization may give some hint in settling the difficulty caused by (11a, c). Therefore I would like to take a closer look at Neutralization. In Neutralization, a syllable-final obstruent never gets released. The coronal obstruents and /h/ are neutralized into /t/ regardless of whether they are stops, affricates, or fricatives, as listed in (12):

(12) a.

pap → pap' 'a meal'

ap^h → ap' 'front'

kuk + to → kuk'tto 'soup and'

puɔk^h → puɔk' 'a kitchen'

pakk → pak' 'outdoor'

b. kot → kot' 'at once'

nas → nat' 'a scythe'

pie → pit' 'a debt'

kkoc^h → kot' 'a flower'

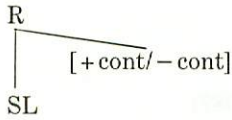
kess → ket' 'a suffix for the future'

hi+h → hit' 'the letter h'

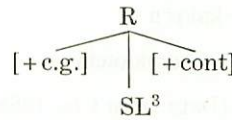
In the framework of Feature Geometry, Neutralization is accounted for by the operation

of delinking. All the terminal features or nodes of syllable-final obstruents are delinked and later the obstruents such as /s,c,c^h, ss, h/ are spelled out [t'] by default rules. Neutralization is expressed, as presented in (13):

(13) nac



kess



Now let us return to the discussion concerning aspiration. The spreading rule predicts that aspiration can occur in the examples listed in (11a, c) since the obstruent before the aspirate obstruent has an empty Laryngeal Node. But this process does not happen in this case. To avoid this difficulty, we can assume that the neutralization rule must be applied before the aspiration rule. This assumption enables aspiration to be ruled out by the fact that the syllable-final obstruent has become implosive. This solution does not work well because /h/ loses its [+s.g.] feature through the neutralization process.

A second solution also relies on the neutralization if we assume that aspiration in fact occurs but its effect is cancelled out later by the application of the neutralization rule. However, there are serious problems with this option. In the case of (11c), the rule of laryngeal assimilation would generate the wrong sequence, *[ap'k^hoke], as the surface form. Another problem pointed out by Cho (1988) is that the neutralization rule generates */kat'so/ instead of the correct form /kasso/. This derivation is apparently against the Integrity principle assumed by Hayes (1986).

The difficulties mentioned above can be solved by the assumption, following Iverson (1989), that /h/ has no specific place of articulation features, but rather takes on qualities influenced by the following segmente. I assume that the laryngeal assimilation is a double spreading process, the spreading of [+s.g.] to an obstruent and the spreading of the Supralaryngeal Node to /h/. The spreading of the Supralaryngeal Node ensures that the segment /h/ acquires the features or nodes of articulation.

This observation offers the reasonable explanation of why the words in (11a, c) do not undergo aspiration and /h/ is realized as /t/ after the application of Neutralization. The forms in (11a, c) include the obstruents on the target position of the assimilation which carry the SL Nodes with them. Their SL Nodes block the spreading of the SL Node of the neighboring aspirate obstruent. This solution is well supported by the fact that /h/ is

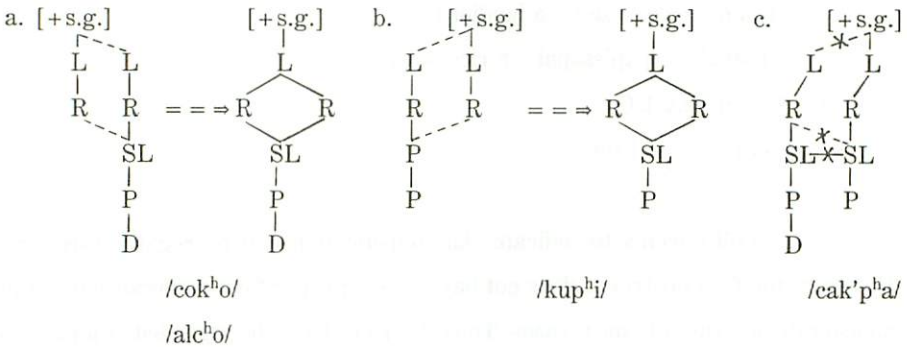
realized as the homoorganic neutralized obstruent of the following obstruent in slow or formal speech. The examples are cited from Iverson and Kim (1987):

(14)

coh + ta^h → cot^ha
 coh + ko^h → cok^hk^ho

These examples suggest that the laryngeal assimilation includes the spreading to the empty or unspecified supralaryngeal node of /h/. Later the surface forms such as /cot^ha, cok^ho/ are derived as the result of the application of fusion. However, this does not happen in normal speech. Korean aspiration proceeds in the following way, as presented in (15):

(15) Aspiration (mirror-image)



As the process in (15) indicates, the aspiration rule should be considered to be fusion, but not spreading, since the rule creates a Supralaryngeal Node in the segment structure of /h/. According to the modified principle of fusion, a feature [+cont] must be replaced by [-cont] in the course of laryngeal assimilation, as /h/ is specified for its feature. Iverson and Kim (1987) assume that /h/ loses its laryngeal feature due to the obstruent neutralization rule and has no Supralaryngeal Node. They also assume that /h/ in the course of the derivation of /mant^ha/ is deleted as a consequence of the Stray Erasure Convention. Their explanation suggests that two different processes are involved in Korean aspiration and that aspiration triggers the deletion of a segment. In the framework proposed here, the form [cok^hk^ho] surfaces when the feature [+s.g.] in /h/ is delinked after the Supralaryngeal Node spreads to it. In Korean phonology, the segment derived by aspiration

functions as a unit and its structure can show whether it is a derived segment or an underlying one.

3. 0 Tensification

The rule component of phonology is equipped with spreading, fusion and delinking. These operations can account for the phonological phenomena in Korean, as seen in the previous section. I would like to briefly discuss another process called tensification or the tensing of consonant in which in a sequence of two obstruents the second obstruent becomes tense. Consider the following examples:

(16)

A.

pakwi--→pak'ccwi 'a bat'
 cipcuin--→cip'ccuin 'a landlord'
 papsapal--→pap'ssapal 'a rice bowl'

b. C--→[+c.g.]/C _____
 [-son] [-son]

The rule in (16b) seems to indicate that tensification can be regarded as spreading. However, the first obstruent does not have a [+c.g.] specification because it is a plain or an aspirate obstruent in most cases. Thus this rule should be regarded as a rule whereby a feature is freely inserted a feature into a node, and this kind of rule is known as Insertion. Phonology needs this operation. Though it is desirable that the rule component involves as few operation as possible, at least four basic rules are needed. Even so, Feature Insertion may be limited to a laryngeal feature like [s.g./c.g.].

Next I will reconsider the discussion about Inalterability presented by Cho (1988). He argues that tensing can be applied to any two obstruents as well as to a geminate created by assimilation. He believes that the tensing rule mentions both CV tier and melodic tier as mentioned by Hayes (1986) and the assimilation rule must be applied before the tensing rule. If this is true, the tensing rule violates the Inalterability Condition. However, the general assimilation rule must be ordered after the tensing rule, since the assimilation rule is optionally applied to a sequence of two obstruents. If the rule order is reversed, a variant /pit'ppoin/ in formal speech cannot be realized as the output. Therefore the

tensing rule does not violate the Inalterability Condition.

4. 0 Nodes in Feature Geometry

In this section, I would like to consider a consonant cluster simplification occurring in a syllable-final position. In the Korean language, a sequence of two consonants appears in a syllable at the end of a word or in the middle of a word, and one of the two consonants is deleted in standard Korean. This phenomena can be explained by delinking, but not by the rule of assimilation proposed by Cho (1988). Furthermore, this process produces an important theoretical consequence in Feature Geometry. First consider the relevant data in (17):

(17)

- | | |
|---|--------------------------------|
| a. ops + ta-- → opta 'there is no' | b. ilk + ta-- → ikta 'to read' |
| tols-- → tol 'a full year' | nɔlp + ta-- → nɔpta 'wide' |
| nɔks-- → nɔk' 'soul' | ɨlph + ta-- → ɨpta e'to write' |
| anc + ta-- → antta 'to sit down' | |
| halt ^h + ta-- → haltta 'to lick' | |
| manh + ta-- → mant ^h a 'many' | |
| silh + ta-- → silt ^h a 'to hate' | |

The examples in (17a) show the case in which the first consonant surfaces, while in the words in (17b) the second consonant is not deleted. At first glance, it seems that less marked segments tend to be deleted. The coronal consonants which do not have Place Node and are the most unmarked are never realized on the surface representations. The segment /h/ is specified for Laryngeal and Continuent and is a less marked segment than Lateral and Nasal which are dominated by the Sonorant Node.

The same principle can account for the consonant reduction in (17b). However, this solution has its problems, since /p/ has only two specified nodes such as Place and Supralaryngeal Node. Even if the number of specified feature is taken into consideration in the framework of the Radical Underspecification Theory, the situation is much the same because /p/ is specified only for [-coronal]. Now note that the consonants which are not reduced have a lower node specification in the hierarchical structure shown in (1). The consonant cluster simplification in Korean is produced by delinking under the following

language-particular condition:

(18) Cluster Simplification

A Root node of a segment with a higher node in a sequence of two consonants should be delinked.

This simple explanation suggest that the Supralaryngeal Node should exist in Feature Geometry.

5. 0 Conclusion

Adopting the Theory of Underspecification and of Feature Geometry, the phonological processes occurring in Korean consonants are can be explained simply by four basic operations, spreading, fusion, delinking and insertion. I would like to propose a modified principle of fusion and the necessity of considering the insertion operation. This modification may have some influence on the interpretation and the status of the organising nodes: Laryngeal, Place and Sonorant. Though the rule component is enriched with the addition of insertion, the representation component plays a more important part in explaining the phonological processes in Korean such as the consonant reduction. In the discussion of the consonant cluster simplification, I suggest that the Supralaryngeal Node should not be removed from the configuration of Feature Geometry, and that the organizing nodes need to be arranged hierarchically. In Feature Geometry, the Place Node is regarded as a lower node than the Sonorant Node, since the former dominates the more refined articulatory feature nodes. The violation of the Inalterability Condition can be avoided by rule ordering, which shows it is an essential tool in phonological theory. Further research will judge the validity of the proposals discussed in this paper especially with much more evidence from other languages.

NOTES

* I thank George, N. Wickstead, a foreign instructor of our college, who kindly read over the author's first draft and corrected his English phrasings. Of course, I am solely responsible for any mistakes.

1. In this paper, I use /pp, tt, etc/ as a phonological representation of a tense consonant /2p/, and /' / as that of an implosive stop.

2. The assimilation rule does not allow an iterative application, and rule ordering plays an important part in Korean phonology. This example shows that a rule of syllable-final neutralization must be ordered before the assimilation rule.
3. The Supralaryngeal Node is not necessary in Feature Geometry. Iverson (1989) presents a detailed discussion of the elimination of the category Suprasegmental. Through the discussion presented here, SL Node is not distinctive. But it functions as a parameter in the simplification of the syllable-final consonant cluster.

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