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Publication Date

2003-12-29

PROJECTIVE FEATURE GEOMETRY: A CASE STUDY IN KOREAN ASSIMILATION*

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1 Introduction

Sonorant assimilation in Korean, a well-known phenomenon in phonology, exhibits a very complicated set of data. But Iverson & Sohn (1994) provide a surprisingly simple account of the facts based on two ideas: feature geometry and the structure preservation convention. The former allows us to grasp the nature of the assimilation process as spreading of features from more marked sites to less marked ones; the latter prohibits segments not employed in the lexicon from entering into phonological representation during the process of the phonological derivation.

I consider Iverson & Sohn's work a rare showpiece that can demonstrate in a nutshell the impressive advances our science of language has achieved in the last decades. Nonetheless, their presentation does not necessarily mean the end of the story. Only a fraction of the feature geometry minimally necessary for fitting their account is provided. It is not clear what system they envision as the entire feature geometry. It would be fair to assume that their account, or a notational equivalent of it, can easily be embedded in any viable system of feature geometry; the descriptive adequacy of the account is not at issue. However, subtler points, like possible redundancy in description could arise and lead to theoretically significant issues when one tries to embed Iverson & Sohn's account into a more encompassing system of feature geometry than the fragment they present.

One such issue is the relation between voicing and nasality, or more generally, between sonority and nasality. This is of course a perennial issue in phonological theory, not particular to Iverson & Sohn's account. This paper is not the place to take up this issue in a broad and general perspective. What I intend to do here is to present one conceivable step one might take in the design of feature geometry in connection with this issue, without arguing for this particular alternative as opposed to any other possible alternatives. I then point to a problem of redundancy that would arise with Iverson & Sohn's account and show how it might be resolved. During this process, I will introduce

* Earlier versions of this work were presented at talks given at University of California, Irvine (October, 2002) and Kyoto University (November, 2002). I would like to express my deeply felt gratitude to Sharon Rose, who not only contributed to much needed improvement of the content as well as the readability of the paper, but who also devoted precious time to preparing the article for electronic publication. I would also like to thank Nayoung Kwon for providing me with much needed help about the Korean language while I was writing this paper. Susan Fischer also helped in many ways in preparing this paper. Needless to say, I am solely responsible for any mistakes or shortcomings that might be found in the paper.

the idea of projection reversal that allows us to contextualize markedness conventions in the framework of features geometry.

This attempt to eliminate one conceivable redundancy in a particular way in fact results in a considerable improvement beyond Iverson & Sohn's account. As a consequence, we will be able to see that in spite of the surprisingly complex appearance at the phonetic level, the Korean assimilation can be understood as a nearly optimal solution in phonology for adjusting sonority at the syllable boundary when two consonants come into contact with each other.

This work was initially undertaken as part of my project for exploring a new conception of feature geometry, Aerodynamic Feature Geometry (ADFG): Kuroda (2002). Here I present my arguments in more conventional terms without reference to ADFG for the sake of easier accessibility. Indeed, the theoretical significance of this work is not necessarily bound to ADFG. Nonetheless, the insight we gain by the present account of Korean assimilation, I believe, renders considerable support to the approach of ADFG.¹

2 Korean sonorant assimilation: the data

I describe the observed facts following Iverson & Sohn.² The facts are first divided into

¹ Davis and Shin (1999) develop an optimality-theoretic analysis which, crudely put, recapitulates the main feature of Iverson and Sohn's analysis without the benefit of feature geometry. Davis and Shin "point to three general advantages of [their] optimality-theoretic analysis over previous approaches": first, their analysis is not reliant on a particular view of feature geometry and/or feature specification; second, their analysis is able to directly account for the role of syllable contact; third, their analysis requires no intermediate stages. My analysis is indeed devoid of all of these "general advantages," if they are indeed advantages. My analysis is based on, and in fact is intended to be a test case for, a particular view of feature geometry (ADFG) that is intended to overcome a degree of arbitrariness involved in past views of feature geometry. My analysis, following Iverson and Sohn's lead, is able to indirectly account for the role of syllable contact as a direct consequence of the geometry of features. My analysis requires intermediate stages, but it is hard to assess in abstract what general characteristic of one approach is an advantage or disadvantage over what general characteristic of another approach. In any case, the primary purpose of this paper is to take another step for testing the validity of the leading idea for the construction of ADFG. A general defense of the feature geometric approach vis-a-vis the optimality-theoretic non-geometric approach is beyond the bounds of this paper.

² See also Martin (1954). Kang (2002) extended the database for the analysis by drawing our attention to the case where sonorant assimilation takes place across word-boundary in complex words of the form *w#x*, where *w* is typically a two-morph Sino-Korean word and *x* is a suffix, e.g., $[\text{in}+\text{mul}]\#\text{nan}/ \Rightarrow [\text{inmullan}]$ 'a shortage of talented men' (Kang 2000:50). Kang revised Davis and Shin's analysis by adding a constraint to the effect that words's output forms are invariant across paradigms. Kang's insight about the integrity of word form is certainly sound, and will have to be incorporated in some form in a proper analysis of the expanded data. However, my preliminary inquiry into more data in this area than found in Kang's work makes me suspect that more than assimilation is at issue. For example, my consultant judges that both $[\text{insinlon}]$ and $[\text{insinnon}]$ are possible for $[\text{in}+\text{sik}]\#\text{lon}/$ 'epistemology' and, what is more remarkable, both $[\text{suimnan}]$ and $[\text{suimlan}]$ for $[\text{su}+\text{ip}]\#\text{nan}/$ 'a shortage of import'. Then, the analysis of assimilation presented in this paper must be supplemented by a revision incorporating Kang's insight as well as an effect of VARIATION, a third factor in phonology that obliterates contrasts alongside ASSIMILATION and NEUTRALIZATION. A full treatment of the extended data, however, is beyond the scope

two apparently different processes, Regressive and Progressive Sonorantization; they are further subdivided into apparent distinctive processes.

2.1 Regressive sonorantization³

Sonorantization is divided into nasalization and lateralization. There are two types of nasalization, one involving obstruent-to-nasal assimilation, as in (1) and another involving obstruent-to-liquid assimilation, as in (2):

(1) **Nasalization: obstruent-to-nasal assimilation**

-Q+N- > -NN- (Iverson & Sohn 1994:81)

- | | | | |
|----|---------------------------|-------------|------------------------|
| a. | /han-kuk+mal/ | [hanɡuŋmal] | 'Korean language' |
| b. | /pat ^h +noŋsa/ | [pannoŋsa] | '(dry) field farming' |
| c. | /ap ^h +nal/ | [amnal] | 'front+day' > 'future' |

(2) **Nasalization: obstruent-to-liquid assimilation**

-P/K+L- > -NN- (Iverson & Sohn 1994:82 [8a])

- | | | | |
|----|------------|-----------|--------------|
| a. | /pəp-lyul/ | [pəmnyul] | 'law' |
| b. | /pək-lam/ | [pəŋnam] | 'exhibition' |

Lateralization involves obstruent-to-liquid assimilation (3) and nasal-to-liquid assimilation (4).

(3) **Lateralization: obstruent-to-liquid assimilation**

-T+L- > -LL- (Iverson&Sohn 1994:82 [8b])

- | | | | |
|--|--------------|-------------|--------------------------------------|
| | /tikət+liəl/ | [tikəlliəl] | 't..l' (sequence in Korean alphabet) |
|--|--------------|-------------|--------------------------------------|

(4) **Lateralization: nasal-to-liquid assimilation**

-n+L- > -ll- (Iverson&Sohn 1994:84 [10b])

- | | | | |
|----|------------------------|-----------------------|---------------|
| a. | /han-lyəŋ/ | [hallyəŋ] | 'limit' |
| b. | /c ^h ən-li/ | [c ^h əlli] | 'natural law' |

2.2 Progressive Sonorantization

Progressive nasalization only involves liquids as in (5)

(5) **Nasalization: nasal to liquid assimilation**

-(m/ŋ)+L- > -(m/ŋ)n- (Iverson&Sohn 1994:84 [10a])

- | | | | |
|----|-----------|----------|--------------|
| a. | /sam-lyu/ | [samnyu] | 'third rate' |
| b. | /yəŋ-lak/ | [yəŋnak] | 'down fall' |

of this paper and will be presented in a separate work.

³ Notation: Q: obstruent; P: labial obstruent; K: dorsal obstruent; T: coronal obstruent; N: nasal; L: liquid.

Lateralization involves only the coronal nasal [n] as in (6). Other lateral-nasal sequences show no assimilation, i.e. (7).

(6) **Lateralization: lateral to nasal assimilation**

-L+n- > -ll- (Iverson&Sohn (1994:86 [13]))

- a. /mul+nan+li/ [mullalli] 'flood' (<'water-disaster')
- b. /səl-nal/ [səllal] 'New Year's Day'
- c. /tūl+namul/ [tūllamul] 'wild vegetables'

Cf:

(7) **Lateral to nasal nonassimilation** (Iverson&Sohn 1994:87 [17])

-L+m-

- /kal+maŋ/ [kalmaŋ] 'longing'

N.b. No morpheme-initial ŋ in Korean.

The following table summarizes the above data. Nasal-nasal and liquid-liquid combinations are not discussed and are shaded. Regressive assimilation is indicated with boldface, and progressive assimilation with italics.

(8) Summary: data

C1 \ C2	N		L
	n	m	
Q P	mn	mm	mn
T	nn	nm	ll
K	ŋn	ŋm	ŋn
N m			<i>mn</i>
n			ll
ŋ			<i>ŋn</i>
L	<i>ll</i>	lm	

3 The Iverson-Sohn account of Korean sonorant assimilation

3.1 Features

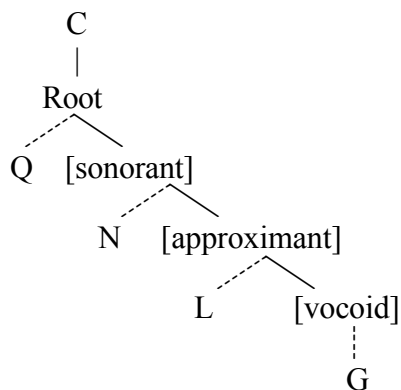
Iverson & Sohn base their feature geometry on the classificatory feature system of Clements (1990) given in the following table (G = glide)

(9) Classificatory feature system (Clements 1990)

Q	N	L	G	
-	-	-	-	syllabic
-	-	-	+	vocoid
-	-	+	+	approximant
-	+	+	+	sonorant
0	1	2	3	(relative sonority ranking)

This feature system is designed to represent the sonority degree of consonants by the number of plus entries; the more pluses, the more sonorant the consonant is. Iverson & Sohn convert the above classificatory table into the following feature geometry tree.

(10) Feature geometry tree (Iverson-Sohn (1994:80))



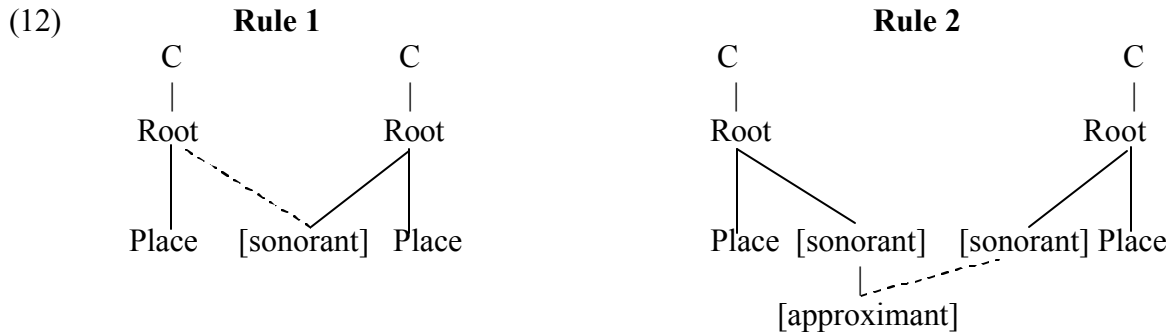
Under the assumption that more structure equals greater markedness, this tree indicates that the obstruent is the least marked and the glide the most marked consonant.

3.2 Rules and conventions

Iverson & Sohn introduce the following two rules to account for the data shown in section 2 above.

- (11) **Rule 1.** Spread [sonorant] to the left. (Iverson-Sohn (1994: 82 (7))
Rule 2. Spread [approximant] to the right (Iverson-Sohn (1994: 86 (14))

An illustration is given in (12):



In addition, they propose the following two conventions. Source \geq Target indicates that the Source consonant must have an equal amount or more structure than the target.

- (13) **The target-absorption convention:** Spread applies as a unification operation with the constraint: Source \geq Target

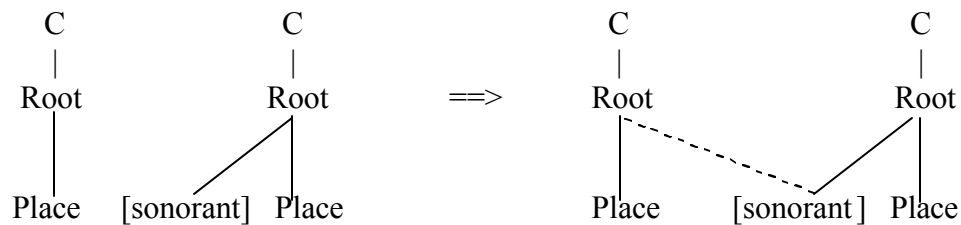
The structure preservation convention: The output of a Spreading application is subject to delinking to respect the structure preservation principle (SP).

As a consequence of the structure preservation (SP) convention, the constraint: ‘No labial or dorsal liquid (i.e., non-nasal labial or dorsal sonorant)’ may be introduced. Formally, the SP convention has the effect of delinking [approximant] when it coexists with an occurrence of Place dominating [dorsal] or [labial].

3.3 Derivations

We can examine the assimilation process according to the above rules and conventions case by case.

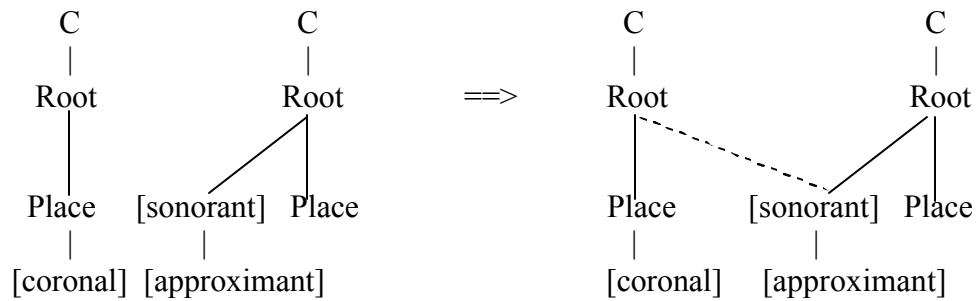
- (14) **Nasalization: obstruent-to-nasal assimilation**
 -Q+N- > -NN-
 ex. /han-kuk+mal/ \Rightarrow [hanɟuŋmal] 'Korean language'



(15) **Lateralization: obstruent-to-liquid assimilation**

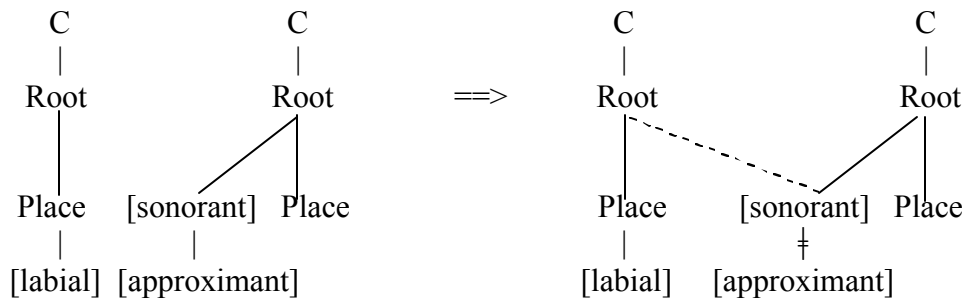
-T+L- > -LL-

ex. /tikʌt+liʌl/ ==> [tikʌlliʌl] 't..l' (sequence in Korean alphabet)

(16) **Nasalization: obstruent-to-liquid assimilation**

-P/K+L- > -NN-

ex. /pəp-lyul/ ==> [pəmnyul] 'law'

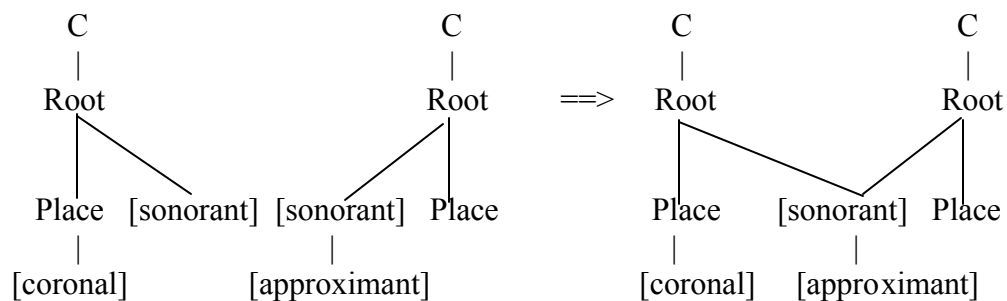


In (16), the [approximant] feature delinks due to the SP convention.

(17) **Lateralization: nasal-to-liquid assimilation**

-n+L- > -ll-

ex. /han-lyʌŋ/ ==> [hallyʌŋ] 'limit'

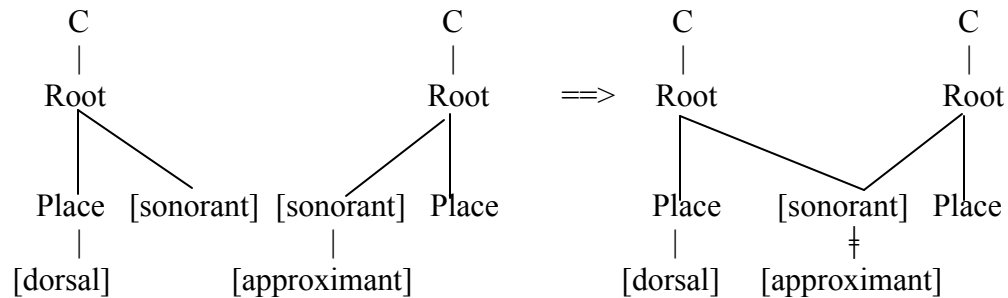


In (17-18) the target-absorption convention causes a unification operation on the [sonorant] features as the source has more structure than the target.

(18) **Nasalization: nasal to liquid assimilation**

-(m/ŋ)+L- > -(m/ŋ)n-

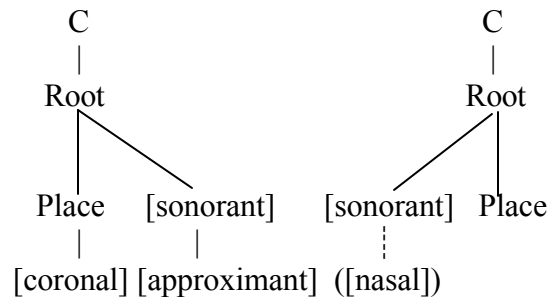
ex. /yəŋ-lak/ ==> [yəŋnak] 'down fall'



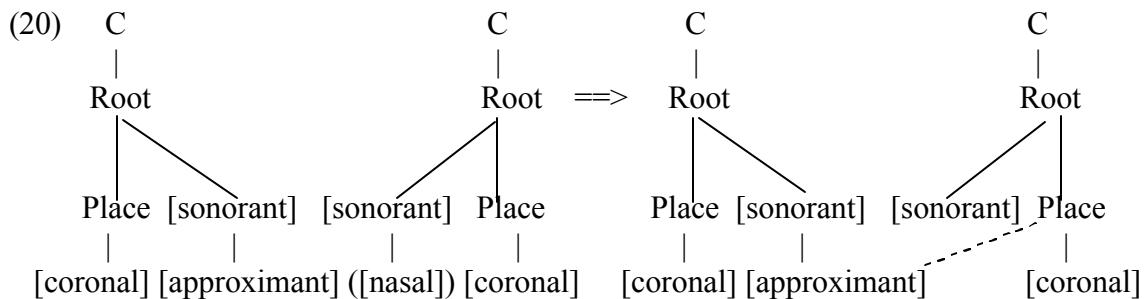
(19) **Lateralization: lateral to nasal assimilation**

-L+n- > -ll-

ex. /səl-nal/ ==> [səllal] 'New Year's Day'



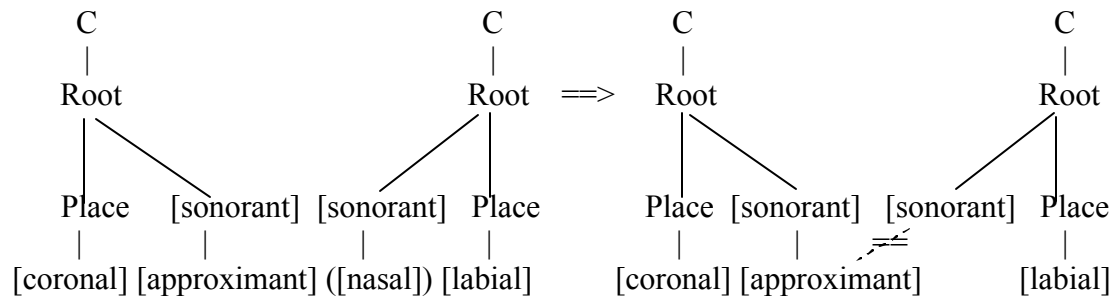
The nonapplication of Spread [sonorant] accounts for the case where N- = /m-/, but not for the case where N- = /n-/. Hence, we also need Rule 2, Spread [approximant] to the right; as in (20)



(21) **Lateral to nasal nonassimilation**

-L+m-

ex. /kal+maŋ/ ==> [kalmaŋ] 'longing'



The [approximant] feature may not cooccur with the feature [labial], hence it is spread, but delinked, and no assimilation occurs.

3.4 Summary

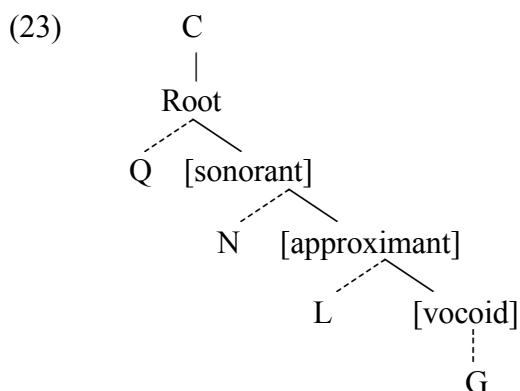
We can summarize the above results in the table below:

(22) Summary: data

C2 \ C1	N	L
Q	<== [son]	<== [son]
N		<== [son]
L	[approx] ==>	

4 The account proposed in this paper**4.1 The issue to be addressed**

There is one shortcoming in Iverson & Sohn's account. This point is not obvious from their presentation, because it contains only the part of feature geometry that is necessary for the account of sonorant assimilation. Feature geometry as a whole must deal with other aspects as well, in particular, for our present concern, the issue of the relation between voicing and nasality, or more broadly, between sonority and nasality. Let us recall Iverson & Sohn's fragment of geometry:



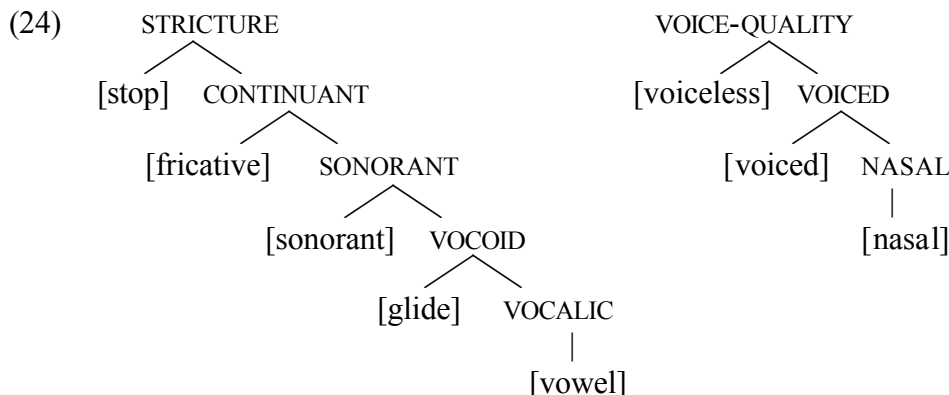
Voicing is not distinctive for Korean, but it can be in general. Nasals, liquids and glides are in general redundantly voiced. One could assume that this redundancy is accounted for by a redundancy rule of the form [sonorant] => [voiced]. But there is another problem. The Iverson-Sohn geometry implies that nasality is not distinctive for sonorants: sonorants are either nasal or non-nasal. This may well be true, as long as we understand sonorants as consonants. In fact, that is how [sonorant] is to be understood with the Iverson-Sohn geometry, since the whole fragment is dominated by C[onsonantal]. However, it is not the case that nasality is confined to sonorants in this sense. There are languages where nasal and non-nasal vowels phonologically contrast. Then, the issue arises how to accommodate nasality in a bigger picture of feature geometry.

It is plausible, if not necessary, to assume that in a bigger picture the Iverson-Sohn geometry is to be extended to the branch that represents the whole dimension where the sonority (or, in articulatory terms, stricture) aspect of segments, including vowels, is to be accounted for. But this perspective raises the question of how to deal with the issue of nasality. We can leave N as is in the Iverson-Sohn tree and introduce another nasal node or feature to deal with nasal vowels; or we can remove N from the sonority tree and find a host somewhere else in order to make it responsible for consonantal as well as vocalic nasality. I would like to suggest a way for the second alternative below.

The key to the success of Iverson & Sohn's account of Korean sonorant assimilation lies in the design of their geometry that makes N(asal) the unmarked [sonorant]. Here, N(asal) means nasal "obstruents" such as /m/, /n/. But in a broader perspective, this was achieved at the expense of excluding the possibility of accounting for other nasal sonorants and nasal vowels as N(asal). If we wish to remedy the apparent lacuna of Iverson & Sohn's geometry, we need to keep in mind how we preserve this key point of their geometry.

4.2 Feature geometry: initial presentation

I propose feature geometry **G** which has the following main branches:



In this geometry, VOICED dominates NASAL. The redundancy of voicing in nasals is accommodated in this dominance relation. However, to understand how this pre-theoretic perception of redundancy is expressed formally in theory may require some caution. This dominance relation indeed entails that nasals and voiced sounds form a natural class; however, segments do not form this natural class by sharing the feature [voiced]; rather, they form a natural class by sharing the node VOICED. The dominance relation may be taken as meaning that nasal ‘implies’ voiced; but this does not mean that nasal sounds, i.e., segments with the feature [nasal], have the redundantly assigned feature [voiced]; rather, it means that they are necessarily dominated by the node VOICED. Caution must also be taken in order not to read more than theoretically warranted from the names given to the nodes. These issues will become a matter of more concern when the idea of projection reversal is introduced in the next section. So, I will return to them below in sections 4.3.2 and 4.3.3.

The feature [sonorant] is shared by nasals and liquids: nasals are NASAL SONORANT and liquids are non-NASAL SONORANT. I do not assume a universal redundancy to the effect that SONORANT => VOICED; voicing is not distinctive in Korean obstruents and it is useful to extend this lack of distinction to liquids, leaving them unmarked as to the feature VOICED.

Geometry **G** also has another main branch, PLACE of articulation. It suffices to note that the distinction between Coronal, Dorsal and Palatal is made under this branch. We are not concerned with the problem of exactly how these nodes are arranged under PLACE.

4.3 Projective feature geometry

4.3.1 Projection Reversal

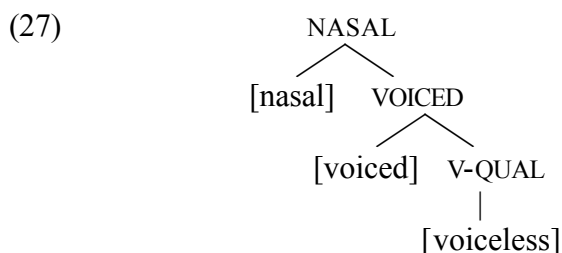
According to the geometry in 4.2, nasals and liquids are distinguished by the presence or absence of NASAL under VOICE-QUALITY. Since absence corresponds to unmarked, it would follow that liquids are the unmarked member of SONORANT. This unwelcome consequence follows from our failure to recognize that markedness characteristics are context-dependent. Indeed, it is obvious that if voicing is a marked feature for obstruents, it should be an unmarked feature for vowels. For sonorants, it may not be

obvious that nasals count as unmarked as opposed to liquids, but phonological research over the past decades has brought this point forward; Iverson & Sohn's account of Korean sonorant assimilation has provided further evidence for this proposition.

In order to accommodate this insight in feature geometry, let me introduce the following conventions/hypotheses. The idea is that some sites get designated as sonorant sites; at such sites, the branch V-QUAL reverses its markedness structure. How sonorant sites are determined is an empirical issue. I propose the following hypothesis and convention:

- (25) **The sonorant hypothesis:** A SONORANT segment adjacent to another SONORANT segment is a SONORANT SITE.
- (26) **The sonorant projection reversal convention:** The V-QUAL is "projected upside down" at a sonorant site.⁴

As the result of "projected upside down," we have the following tree that represents the markedness degrees at sonorant sites:



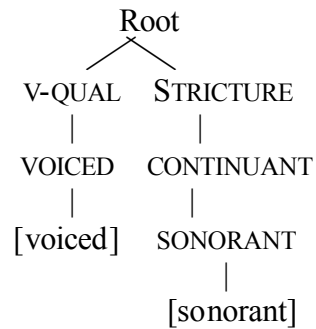
Due to this reversal, at a sonorant site [nasal] counts as unmarked and [voiceless] the most marked voice-quality. As a consequence, nasals are unmarked and voiceless liquids the most marked sonorants at sonorant sites.

4.3.2 Tree representations of segments

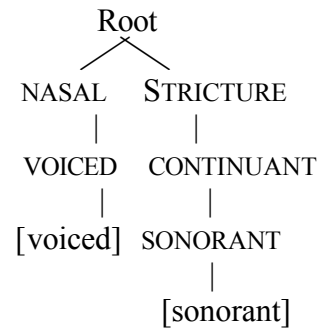
Consider, for example, the representations of the liquid /l/, ignoring place and possibly other features that distinguish it from other liquids such as /r/. At a non-sonorant site, i.e., unmarked consonantal site, it contains the representation in (28a). Projection reversal alters this tree to the one in (28b).

⁴ We can also define vocalic sites where the branch STRUCTURE gets reversed, but this perspective is not relevant to our present study.

(28) a. /l/ at a non-sonorant site



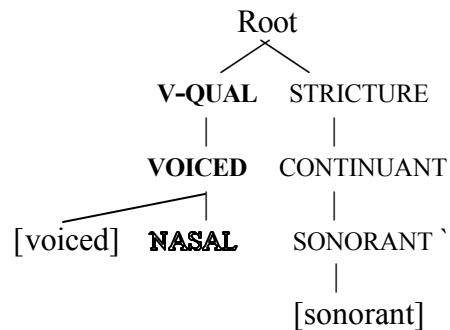
b. /l/ at a sonorant site



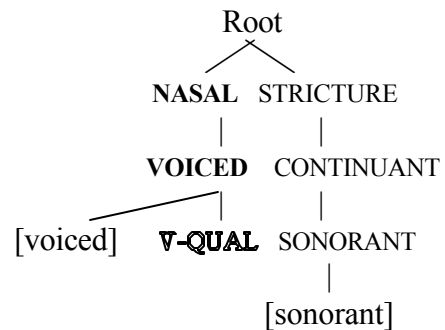
Note that the node *NASAL* is absent on the tree in (28a) and *V-QUAL* is absent on the tree in (28b).

Instead of these conventional forms of trees, I propose to conceive of a tree structure in which nodes are all present but are partially highlighted (bold-faced) and partially shadowed; the highlighted part represents the features active in the projection at the site and the shadowed part those dormant at the site. Ignoring to reformat the parts under stricture, we get the following representations in the new format:

(29) a. /l/ at a non-sonorant site



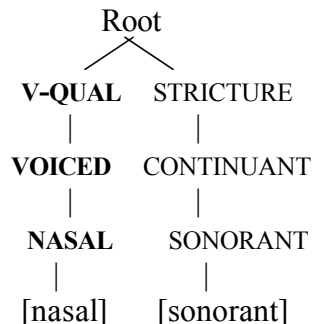
b. /l/ at a sonorant site



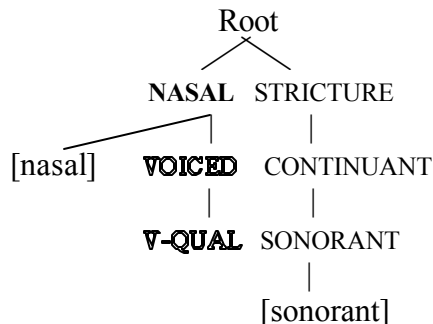
The perspective reversal changes shadowed nodes under the lowest highlighted node into highlighted nodes and the highlighted ones above it into shadowed ones in the projection-reversed tree.

The nasal sound /n/, again ignoring place features that distinguish it from /m/ etc., is represented in this new format at a non-sonorant and a sonorant site by the (a) and the (b) trees below, respectively.

(30) a. /n/ at a non-sonorant site



b. /n/ at a sonorant site

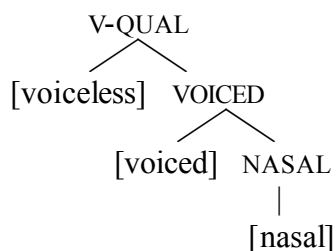


For the sake of simplicity, however, I will dispense with this form of full representation and use the conventional tree form below.

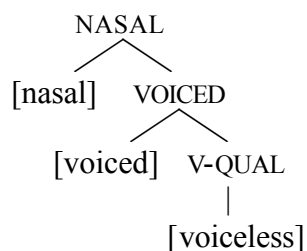
4.3.3 The dominance relation between nodes

The dominance relation between nodes must be understood as determining the markedness degree between two nodes (and, equivalently, between the default features of the two nodes), the dominating node being less marked than the dominated one. This markedness degree reverses with the reversal of the projection. Formally, this is what the feature trees signify, and we should not draw unwarranted inferences from the names given to nodes. In order to guard against such confusion, some remarks may be in order. Let us return to the VOICE-QUALITY tree defined in 4.2 and its reversal given above, which I repeat here:

(31) TREE 1: Projection at a non-sonorant site



TREE 2: Projection at a sonorant site



According to Tree 1, NASAL appears to imply VOICED, as seems desired, while according to Tree 2, VOICED appears to imply NASAL, an apparent absurdity. But labels such as VOICED and NASAL are not chosen to represent the formal, conceptual content of the dominance relation. The statement ‘VOICED implies NASAL in Tree 2’ is a legitimate statement, provided that we understand exactly what the intended conceptual content of these names in this context is. But it might be difficult to dissociate these words from their common meaning. In order to guard against unwarranted confusion caused by labels, we could, or indeed we should, have labels of nodes that adequately correspond to the intended conceptual content used with this dominance relation. Let us, then,

assume, first of all, that 1, 2 and 3 are assigned to [voiceless], [voiced] and [nasal] as the measure of markedness, respectively. Now let us rename the nodes VOICE-QUALITY, VOICED and NASAL node #1, node #2 and node#3. In Tree 1, node #n dominates features of a markedness measure equal to or greater than n. This is the conceptual content of node #n in Tree 1. In Tree 2, the conceptual content of node #n changes; node #n dominates features of a markedness measure equal to, or less than, n. Note that at a non-sonorant site, as presented by Tree 1, the greater their markedness measures, the more marked the nodes/features are. In contrast, at a sonorant site, the markedness degrees reverse: the less their markedness measures, the more marked the nodes/features are, as represented by Tree 2.

With this terminological preparation, let us go back to Tree 1 and consider the statement ‘NASAL implies VOICED’. Translated into the new labeling system, this statement reads: ‘#3 implies #2’. By interpreting #3 and #2 by their intended conceptual contents, we get “‘a markedness measure equal to, or greater than, 3’ implies ‘a markedness measure equal to, or greater than 2’”. This is a true statement. On the other hand, the statement ‘VOICED implies NASAL’ in Tree 2 translates into ‘#2 implies #3’, and, then this in turn translates, due to the conceptual change due to projection reversal, into the following statement: “‘a markedness degree equal to, or less than 2’, implies ‘a markedness degree equal to, or less than 3’”. This statement is indeed also true. To conclude, if we understand exactly what each label signifies in Tree 1 and Tree 2, then statements such as ‘NASAL implies VOICED in Tree 1’ and ‘VOICED implies NASAL in Tree 2’ can be taken as true statements, in spite of the apparent contradiction or absurdity.⁵

4.4 Rules, Conventions and hypotheses

Iverson & Sohn's rules are replaced by the following two rules.

- (32) **Rule 1.** SPREAD CONT to the left.
Rule 2. SPREAD NASAL

Rule 1 is formulated in terms of CONTINUANT instead of SONORANT; the rule is generalized to account for spirant assimilation as well. See (40) below. Rule 2 is left unspecified as to its direction of application, keeping the most general, hence the simplest form.

SPREAD must respect the same target-absorption convention (repeated below) as in §3.2.

- (33) **The target-absorption convention:** SPREAD applies as a unification operation with the constraint: Source \geq Target.

Thus, the Source must be able to absorb the Target by the application of SPREAD. See §4.5 below for the reason why this convention is formulated in terms of =, not of >.

SPREAD CONT derives sonorant sites when the CONT node that is spread dominates a

⁵ In the ADFGI envision the abstract markedness measures I assigned to nodes in the voice-quality branch must correspond to a certain aero-dynamic scalar parameter. Whether this expectation from theoretical phonology is fulfilled by experimental phonology or not is a question left for future research.

SON node; at both the source and target sites, the original projection changes to the "sonorant" projection. The following convention is assumed to apply at these sites.

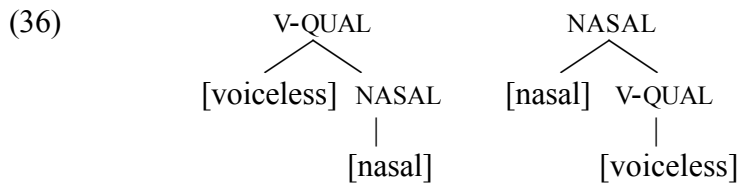
- (34) **SPREAD-first convention for SPREAD NASAL:** SPREAD NASAL applies *before* the projection changes at the target and the source segments of the application of SPREAD CONT to the left.

The intuition behind this convention is this: take a sequence of the form C+L, where C is a consonant and L, a sonorant (i.e., dominated by SON). At this stage, L still functions as a "consonant." SPREAD CONT applies to this sequence as an assimilation rule between two consonants. SPREAD NASAL conceivably can function either as an assimilation rule between two *consonants* or as one between two *sonorants*; its application before the projection change means that the first function is given priority.

I introduce a hypothesis particular to Korean phonology:

- (35) **The Nonvoice Hypothesis (Korean phonology):** The voice/voiceless contrast is neutralized.

Thus, VOICED is suppressed in Korean phonology until it reaches the phonetic level. The suppressed form of the V-QUAL branch and its "upside down" projection are:



Note, in particular, that the liquid /l/ is NOT specified as [voiced] in phonology.

In addition, we have the structure preservation convention as in Iverson & Sohn's account. Taking the Nonvoice Hypothesis into consideration, we see the effect of this convention as stated below:

- (37) **The effect of the SP (structure preservation) convention:** Delink V-QUAL at a sonorant site if PLACE dominates [dorsal] or [labial].

I supplement the SP with the following convention that restricts the application of the delinking:

- (38) **The no-delink convention for bi-directionally linked sites:** Delink is blocked for a node dominating two sites that are linked to each other in two directions (to the left and to the right).

I will explain and discuss the significance of this convention below in §4.5.

4.5 Derivations

First, let me note that the assimilation process I am describing can be generalized to cover the case of spirantization. In Korean, the sequence /t-s/ undergoes assimilation to [ss]:

(39) /kut+so/ => [kusso] 'harden+ending' (Cho: §3.4.2, (65))

This example is shown in the following representation as **Spread CONT**

(40)

STRICTURE [stop]	STRICTURE CONT [fricative]	=>	STRICTURE STRICTURE \ / CONT [fricative]
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We can now go through the examples described above in Iverson & Sohn's account.

(41) **Nasalization: obstruent-to-nasal assimilation**

-Q+N- > -NN-

ex. /han-kuk+mal/ => [hanɡuŋmal] 'Korean language'

Rule 1: Spread CONT to the left

STRICTURE [stop]	STRICTURE CONT SON [sonorant]	=>	STRICTURE STRICTURE \ / CONT SON [sonorant]
--------------------------	---	----	---

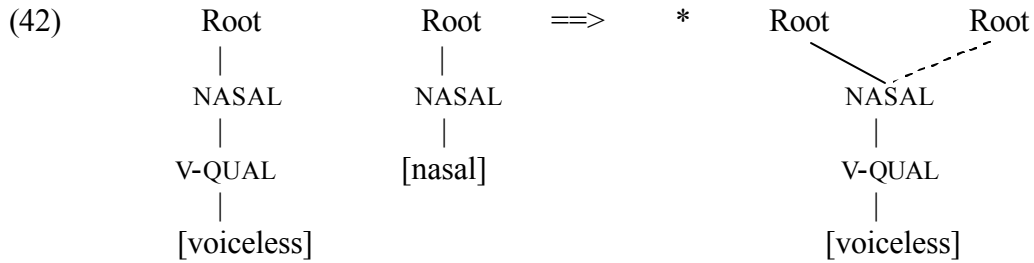
Rule 2: Spread NASAL

V-QUAL [voiceless]	V-QUAL NASAL [nasal]	=>	V-QUAL V-QUAL \ / NASAL [nasal]
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Convention: sonorant site reversal

NASAL [nasal]

If Spread NASAL were to apply after the sonorant site reversal convention, we would have the following undesired derivation.

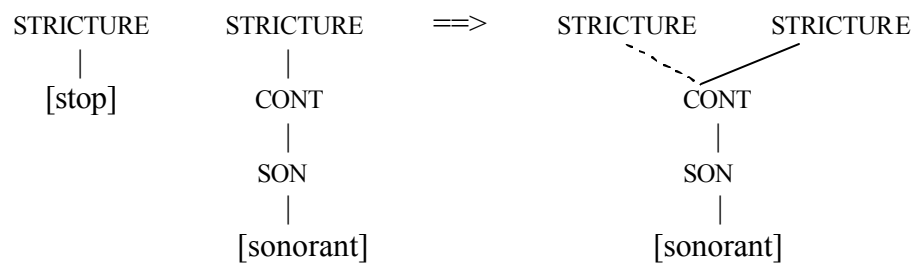


(43) **Lateralization: obstruent-to-liquid assimilation**

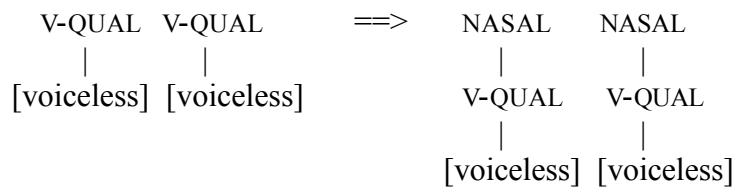
-T+L- > -LL-

ex. /tikʌt+liʌl/ \implies [tikʌlliʌl] 't..l' (sequence in Korean alphabet)

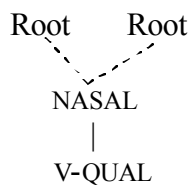
Rule 1: Spread CONT to the left



Convention: sonorant site reversal



Rule 2: Spread NASAL



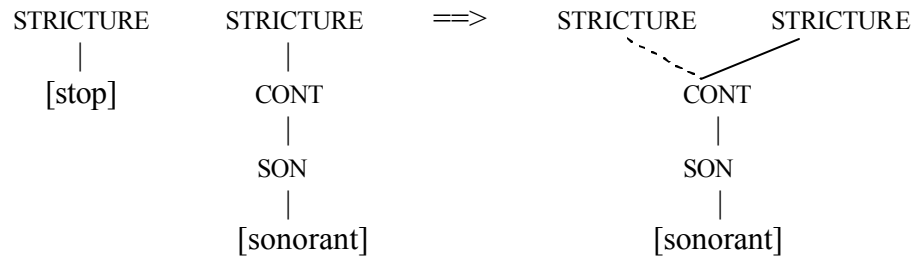
The direction of Spread NASAL cannot be determined and is immaterial.

(44) **Nasalization: obstruent-to-liquid assimilation**

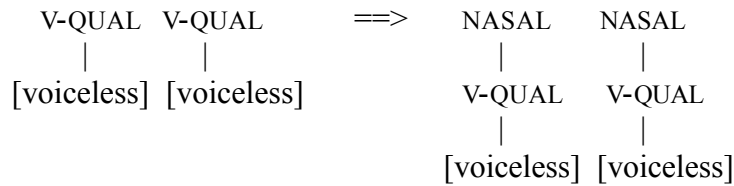
-P/K+L- > -NN-

ex. /pəp-lyul/ ==> [pəmnyul] 'law'

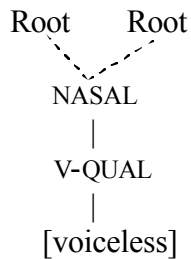
Rule 1: Spread CONT to the left



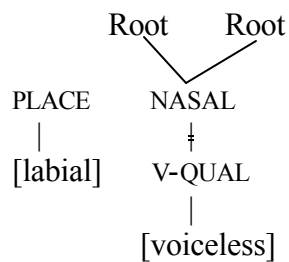
Convention: sonorant site reversal



Rule 2: Spread NASAL



Convention: structure preservation (delink V-QUAL if PLACE dominates [labial])



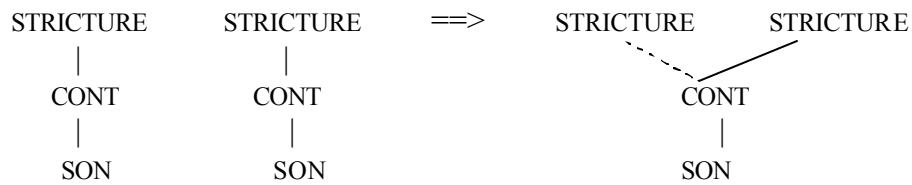
This example shows that the target-absorption convention must be formulated in terms of \geq , not in terms of $>$. If it were formulated in terms of $>$, Spread NASAL would not apply and we would have an undesired result: the delinking due to structure preservation would apply only to the first segment, and the result would be an m-l sequence.

(45) **Lateralization: nasal-to-liquid assimilation**

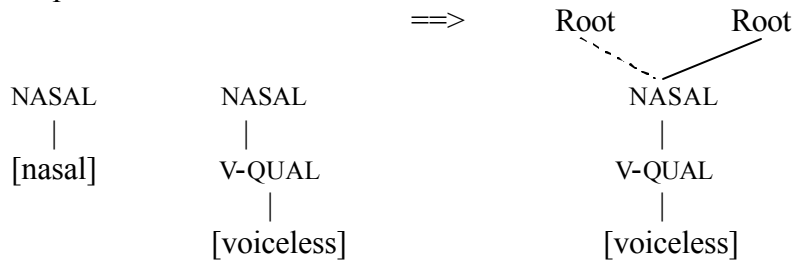
-n+L- $>$ -ll-

ex. /han-lyan/ \implies [hallyan] 'limit'

Rule 1: Spread CONT to the left



Rule 2: Spread NASAL



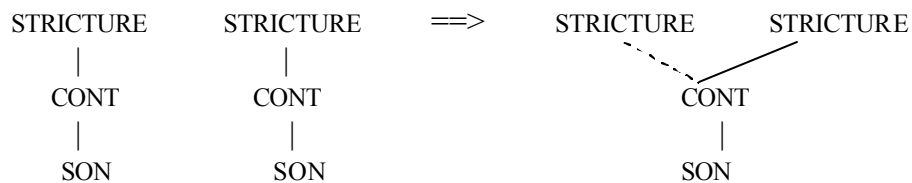
The two segments in question here are adjacent and both dominated by a SON node. Hence they are at sonorant sites before the derivation starts.

(46) **Nasalization: nasal to liquid assimilation**

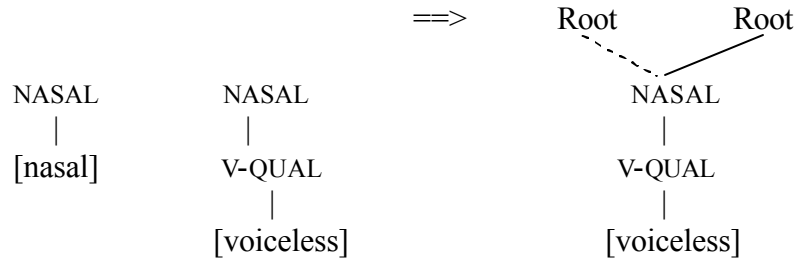
-(m/ŋ)+L- $>$ -(m/ŋ)n-

ex. /yən-lak/ \implies [yənək] 'down fall'

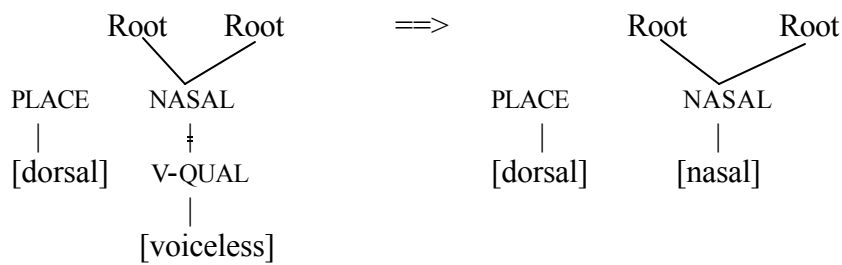
Rule 1: Spread CONT to the left



Rule 2: Spread NASAL



Convention: structure preservation (delink V-QUAL if PLACE dominates [dorsal])

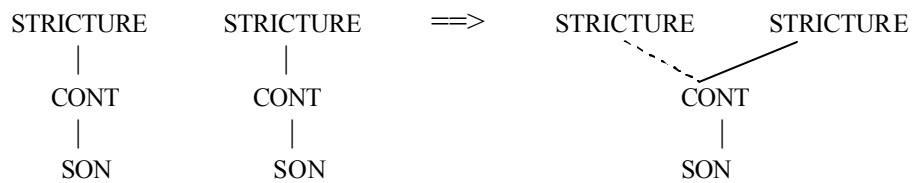


(47) **Lateralization: lateral to nasal assimilation**

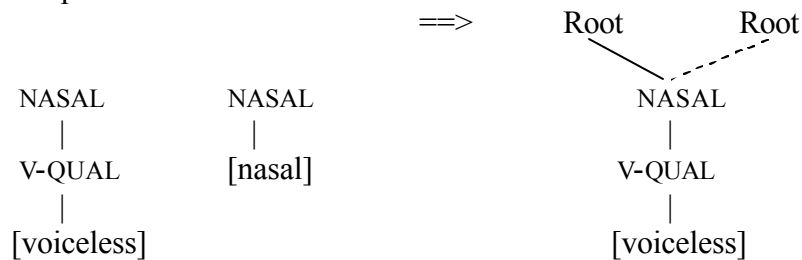
-L+n- > -ll-

ex. /səl-nal/ ==> [səllal] 'New Year's Day'

Rule 1: Spread CONT to the left



Rule 2: Spread NASAL



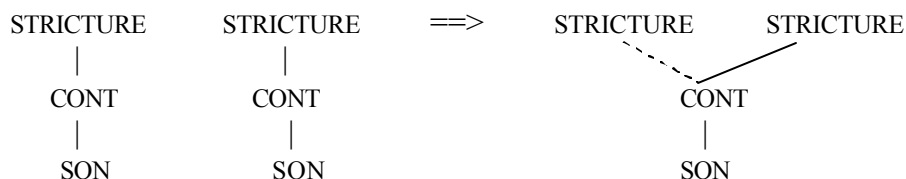
Unlike the Iverson & Sohn analysis, we do not need a rightward spread rule here as we have Source \geq Target. Therefore, the leftward SPREAD CONT has the same effect as a rightward spread rule. SPREAD NASAL, in contrast, effectively applies to the right, due to the SOURCE = TARGET convention imposed on it.

(48) **Lateral to nasal nonassimilation**

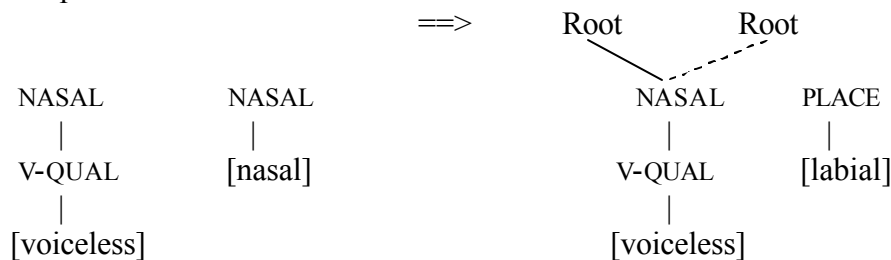
-L+m-

ex. /kal+maŋ/ \implies [kalmaŋ] 'longing'

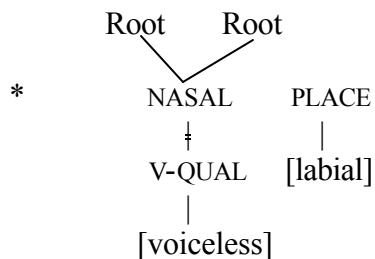
Rule 1: Spread CONT to the left



Rule 2: Spread NASAL



Convention: structure preservation (delink V-QUAL if PLACE dominates [labial])



The last step of this derivation must be blocked, hence *; otherwise we would get an incorrect form *[kanmaŋ]. Delink V-QUAL must apply in (46) but may not in (48). In (46), both SPREAD CONT and SPREAD NASAL link leftward; in (48) SPREAD CONT links to the left and SPREAD NASAL links to the right. The no-delink convention for bi-directionally linked sites blocks the delinking of V-QUAL. But, then, the violation of structure preservation, a general principle, resulting from the first step of the above derivation would not be removed. Hence, the first step may not take place, either. /kal+maŋ/ comes

out as [kalmaŋ].

The intuition behind the no-delink convention for bi-directionally linked sites is this. More branches linked to one direction means the increase in the degree of the process of gemination by the marked member; the limiting case is total assimilation resulting in the genesis of a true geminate. Branches of two sites being linked in opposite directions counters this move toward the assimilation of one member (the less marked one) to the other (the more marked one). The delinking is a process to help the assimilation of the two sites by removing a violation of structure preservation at one site, possibly at the expense of the branch of the other site by forcefully neutralizing the offending marking. Thus, the delinking is inconsistent with the counter-assimilation effect of the bi-directional multiple linking.

4.6 Spread NASAL OR Spread V-QUAL?

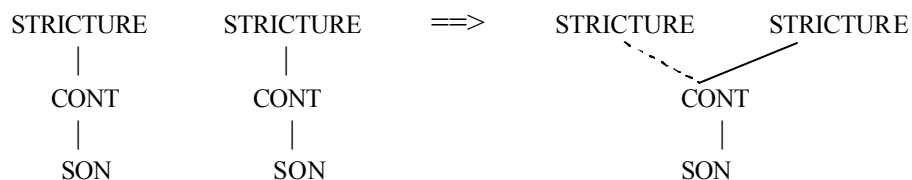
In general, when node A immediately dominates another B, it is evident that Spread A and Spread B have different effects. For example, Spread CONT causes spirantization but not Spread SON. However, if all feature trees have node A, it is not evident that Spread A has any different effect from SPREAD B. The question posed here, however, is more intricate than it first appears, and needs more careful formulation because of the possible reversal of the dominance relation due to perspective changes, but I ignore this complication for the presentation of the problem here. We then face the problem of choosing between Spread V-QUAL and Spread NASAL. The choice derives different tree structures, yielding different configurations for possible delinking. To see this point, consider (46) above. If we have Spread V-QUAL instead of Spread NASAL, we would have the following derivation:

(49) Nasalization: nasal to liquid assimilation

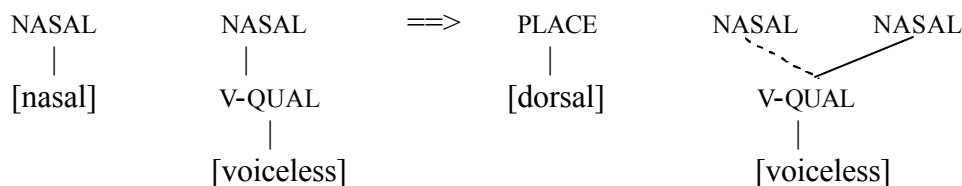
-(m/ŋ)+L- > -(m/ŋ)n-

ex. /yəŋ-lak/ ==> [yəŋnak] 'down fall'

Rule 1: Spread CONT to the left

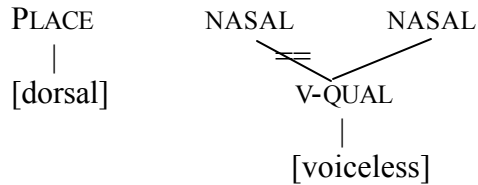


Rule 2: Spread V-QUAL

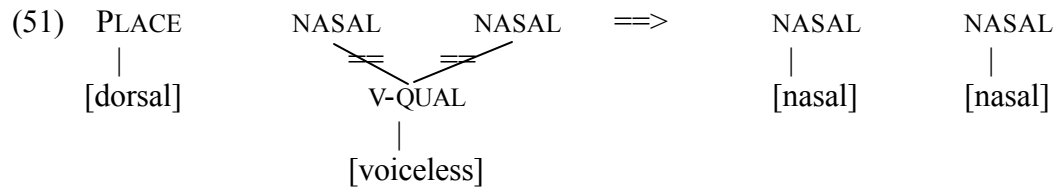


At this point, V-QUAL on the left branch would be delinked due to the violation of structure preservation:

- (50) **Convention:** structure preservation (delink V-QUAL if PLACE dominates [dorsal])



This tree looks ill-formed. We would be able to overcome this difficulty only with the expense of introducing an undesirable convention that allows the delinking of the offending right branch as well, once the left branch is delinked:



For this reason, choosing Spread NASAL is preferred.

5 Summary and Conclusion

5.1 Summary

The Korean assimilation observed in §2 (and §4) is explained as the combined effects of the two independent rules:

- (52) Rule 1. Spread CONT to the left.
 Rule 2. Spread NASAL

Rule 1 is asymmetric and unidirectional. The unidirectionality is empirically dictated, by the fact that the sonorant (and spirant) assimilation does not apply progressively. However, this fact is a manifestation of the universal tendency that the succeeding onset may not be more sonorant than the preceding coda: the Syllable Contact Law cited by Iverson and Sohn (1992:81).

Rule 2 is symmetric and non-directional; the direction is determined by the context of application. The rule functions (i) as assimilation between *consonants* in the consonantal context, thus as nasalization as in (41) as well as spirantization (40), and (ii) as assimilation between *sonorants* (ii-a) as lateralization in the sonorant context, (ii-a.1) either derived (43) or (ii-a.2) underlying (45),(47) and also (ii-b) as nasalization (failed lateralization) due to the intervention of structure preservation (44),(46) and, finally, (iii) the rule fails to cause assimilation due to conflicting forces among the two assimilation

rules and the structure preservation constraint (48).

Let us also note that no assimilation takes place in the sequence of a sonorant followed by an obstruent. The sequence NQ is affected neither by Rule 1 nor by Rule 2. It is not affected by Rule 1, because it spreads only to the left; it is not affected by Rule 2, because NASAL linked to Q to the right is delinked due to structure preservation: no nasal obstruent can exist in the lexicon. Neither Rule 1 nor Rule 2 affects LQ.

5.2 Conclusion

Iverson & Sohn's account has two rules and ours, too. However, the reason why we have two rules is that we have two separate branches for sonority and voice-quality in our more encompassing geometry. Our two rules in effect correspond to one in Iverson & Sohn's framework, by itself a significant simplification.

If we examine the content of these two rules, we realize that the effect of the rules is nothing but the realization of a number of constraints imposed on Korean by interface conditions mediated by universal grammar. We may assume that the following principles are imposed on phonology from outside of it as interface conditions: the Syllable Contact Law [perception], Structure Preservation Principle [acquisition], and the two default (unmarkedness) conditions (the stop being the default consonant and the nasal the default sonorant) [acoustics/articulation]. These conditions are incorporated into the rules and the conventions introduced above and the design of our feature geometry. No condition specific to Korean is introduced except for the Nonvoice Hypothesis. This means that we do not specify anything special for Korean phonology other than the fact that the process of sonority assimilation exists. The leftward directionality of Rule 1 is imposed on it by the Syllable Contact Law; hence it should not need to be so stated. Rule 2 simply functions to dictate that less marked sites assimilate to more marked sites, which is exactly what assimilation is. What counts as unmarked and marked sonorants are built into the design of our feature geometry. Then, the following rule must substitute for Rule 1 and Rule 2 in Korea grammar:

(53) **Sonority Assimilation Rule:** Sonority, assimilate!

The data given in §3, complicated and disorderly as it is, turns out to be evidence for language being the best design meeting the interface conditions, rather a surprising outcome.

Reversing the perspective, we might also note that providing as it does an account of Korean as the best design under the interface conditions, our feature geometry proves itself as the best theory in the relevant respects.⁶ Such is the outcome from the encounter of the spirit of our feature geometry with the genius of the Korean language.

⁶ For the best design and the best theory, see, for example Chomsky (2002:104).

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REFERENCES

- Cho, Young-Mee Yu (1990). *Parameters of Consonantal Assimilation*. PhD Dissertation, Stanford University.
- Chomsky, Noam (2002). *On Nature and Language*. Cambridge: Cambridge University Press.
- Clements, George N. (1990). The role of sonority cycle in core syllabification. In J. Kingston and M. E. Beckman (eds.) *Papers in Laboratory Phonology 1: Between the Grammar and Physics of Speech*. New York: Cambridge University Press. 283-333.
- Davis, Stuart and Seung-Hoon Shin (1999). The syllable contact constraint in Korean: an optimality-theoretic analysis. *Journal of East Asian Linguistics* 8: 285-312.
- Iverson, Gregory K. and Hyang-Sook Sohn (1994). Liquid representation in Korean. In Young-Key Kim-Renaud (ed.) *Theoretical Issues in Korean Linguistics*. Stanford: CSLI. 77-100.
- Kang, Hyunsook (2002). On the optimality-theoretic analysis of Korean nasal-liquid alternations. *Journal of East Asian Linguistics* 11: 43-66.
- Kiparsky, Paul (1985). Some consequences of lexical phonology. *Phonology Yearbook* 2: 25-138.
- Kuroda, S.-Y. (2002). Contrasts in Japanese: explorations into feature geometry 1. Ms. prepared for a talk given at Second International Conference on Contrast in Phonology, Toronto.
- Martin, Samuel E. (1954). *Korean Morphophonemics*. Baltimore, MD: Linguistic Society of America.

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