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Reconciling phonological generalizations in syllable-final position: A study of obstruent neutralization in Korean*

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Lee, Sechang. 2022. Reconciling phonological generalizations in syllable-final position: A study of obstruent neutralization in Korean. *Linguistic Research* 39(1): 1-23. This article aims to show how a Harmonic Serialism conception of optimality-theoretic phonology reconciles some of the generalizations in treating syllable-final obstruent neutralization in Korean. We shed some light on the derivational property of obstruent neutralization phenomenon in general, and also provide insights into the workings of the serial derivation in question. Previous treatments of obstruent neutralization in Korean assumes the crucial role of language-specific rule ordering or simultaneous delinking of multiple features. With the introduction of Harmonic Serialism, our intuition about neutralization as a weakening process is maintained, with the added benefit of avoiding simultaneous operations of delinking multiple features. Each step of derivation is shown to be harmonically improving and the whole range of relevant data can be nicely explained. It thus breathes a new life into Iverson and Kim's (1987) original insight into the obstruent neutralization itself. (**Sookmyung Women's University**)

Keywords obstruent neutralization, Optimality Theory, Harmonic Serialism, unreleasing, release features, coronal unmarkedness, derivation

1. Introduction

Syllable-final neutralization of obstruents is a common phonological process in Korean. Three aspects of the obstruent neutralization are reported in the literature. First, syllable-final aspirated or tense (or glottalized) obstruents lose their laryngeal features and are phonetically realized as unreleased, preserving their original place of articulation. Secondly, what is surprising is that syllable-final palatal affricates change their place of articulation to become coronal alveolar stop. Lastly, what is even more surprising is the behavior of syllable-final h, which obtains coronal place and its surface manifestation is

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an unreleased t=, just as in the case of syllable-final affricates. The intuition to be captured is as follows. It stands reason to characterize the syllable-final neutralization as a process of delinking relevant features simultaneously as the neutralization is a kind of weakening process. However, that option runs counter to a commonly held view among phonologists that no rule can affect more than one node in a single phonological operation. This conflicting state of affairs poses an apparent challenge for us.

The remainder of this article is organized as follows. Section 2 provides the necessary background and the theoretical issues for the analyses that follow. We first present neutralization data and discuss some formal problems that lead to introducing the core theoretical apparatus to be employed in the analyses to come. Also, we will see that earlier treatments of the phenomenon raise certain problems. In section 3, Harmonic Serialism is briefly reviewed. Plus, the important constraints are discussed and their relevant rankings are offered. Section 4 is devoted to our main analysis of the syllable-final obstruent neutralization phenomenon. Section 5 concludes the article.

2. Background and issues

2.1 Paradigm

As our point of departure, the consonantal phonemes and their components of Korean are perspicuously displayed in tabular form:

(1) Phonemic consonants of Korean

	Lax	Tense	Aspirated	Nasal	Liquid
Labial stop	p	p’	p^h	m	
Dental stop	t	t’	t^h	n	l
Palatal affricate	c	c’	c^h		
Velar stop	k	k’	k^h	ŋ	
Alveolar or Glottal fricative	s	s’	h		

The lax consonants in the second column are weakly articulated; in syllable-initial position they are released with a slight puff of local breath. The tense consonants are pronounced with great muscular tension, both locally and through the entire vocal tract.

The aspirated consonants begin with a lax articulation followed by heavy aspiration. When all the obstruents including even the glottal fricative /h/ occur in syllable-final position, they become unreleased.

All those shaded fifteen Korean obstruents in (1) undergo neutralization in syllable-final position, as shown in (2):

(2) Syllable-final obstruent neutralization (adapted from Iverson and Kim 1987:199)

a.	/ip + to/	→	[ip$^{=}$.t'o]	'mouth only'
	/ip^{h} + kwa/	→	[ip$^{=}$.k'wa]	'leaf and'
	/kuk + to/	→	[kuk$^{=}$.t'o]	'soup also'
	/puək^{h} + kwa/	→	[pu.ək$^{=}$.k'wa]	'kitchen and'
	/k'ək' + ko/	→	[k'ək$^{=}$.k'o]	'to break and'
b.	/nat/	→	[nat$^{=}$]	'a grain'
	/nat^{h}/	→	[nat$^{=}$]	'a piece'
	/nas/	→	[nat$^{=}$]	'a scythe'
	/nas'-/	→	[nat$^{=}$]	'was born'
c.	/nac/	→	[nat$^{=}$]	'a day'
	/nac^{h}/	→	[nat$^{=}$]	'a face'
d.	/tah-/	→	[tat$^{=}$]	'to reach'

([C^{h}]: aspirated consonant, [C']: tense consonant, [C$^{=}$]: unreleased consonant, [.]: syllable boundary)

As can be seen in (2a), the neutralization can be characterized in terms of the loss of such laryngeal features as [+spread glottis] or [+constricted glottis] on the one hand and unreleasing of the coda consonant on the other hand, preserving the obstruents' input place of articulation in both cases. (2c) seems unusual in that the original place of articulation is not preserved in the output. It is also noteworthy that the combination of (2b) and (2c) illustrates an extreme case of neutralization: one morph represents six different morphemes. Finally, in (2d), the placeless /h/ is matched with an unreleased anterior coronal stop.[1] In what follows, we make a review of previous approaches to these aspects of neutralization.

1 [h] is only characterized as possessing the laryngeal feature [+spread glottis] (Clements 1985), acquiring its oral tract phonetic characteristics from its phonetic context (Keating 1988).

2.2 Earlier treatments

In this sub-section, we will review a couple of previous approaches to the syllable-final obstruent neutralization in Korean. It will also be noted that there is a theoretical conflict that none of the previous formalisms have tried to reconcile. We will have to wait for section 2.3 to discuss it thoroughly.

2.2.1 Linear approach

In the rule-based theory current in Chomsky and Halle (1968, SPE henceforth), the facts in 2.1 can be expressed as the application of a series of following phonological rules:

(3) Obstruent unreleasing (Kim-Renaud 1974: 116)

a. $\begin{bmatrix} +\text{cons} \\ -\text{son} \end{bmatrix} \rightarrow [\text{-release}] \; / \; \left\{ \begin{matrix} \$ \\ [\text{-release}] \end{matrix} \right\}$

(One or more obstruents are unreleased in syllable-final position.)

b. $[\text{-release}] \rightarrow \begin{bmatrix} \text{-asp} \\ \text{-tense} \\ \text{-del. release} \\ \text{-cont} \end{bmatrix}$

(An unreleased segment is unaspirated, nontense, nonfricated, and nonaffricated.)

c. $\begin{bmatrix} +\text{cor} \\ -\text{rel} \end{bmatrix} \rightarrow [+\text{ant}]$

(An unreleased coronal segment is dental.)

(3b-c) are sort of redundancy statements which come as side effects of (3a), mostly of universal nature in the sense of SPE (Chapter Nine).

A syllable-final /h/ also undergoes unreleasing which can be expressed as in (4a) below:

(4) h-Unreleasing (Kim-Renaud 1974: 120)

a. h → [-release] / _____ $

(h is unreleased in syllable-final position.)

b. $\begin{bmatrix} \text{h} \\ \\ \text{-release} \end{bmatrix} \rightarrow$ [+cor]

(An unreleased h takes a coronal articulation.)

Then, the unreleased *h* becomes $\bar{t}$ with the automatic application of side effects in (4b) as well as (3b-c). In (3a), neutralization is written with a disjunction: obstruents become unreleased if it is either syllable-final or followed by an unreleased segment.

A strictly linear theory of phonology, such as that proposed in SPE, has difficulties in describing this neutralization. While the use of the symbol $ sometimes simplifies phonological descriptions, the fact that it can usually be dispensed with provides us with a piece of evidence that the symbol has no phonological status. In rule-based phonology, on the other hand, a grammar is characterized as a list of language-particular rules. The neutralization-related alternations will emerge from the application of such language-specific rules as (3-4). Is the alternation perfectly arbitrary, or does it reflect any kind of phonetic or phonological motivation? We do not want to call the adequacy of rule-based approach into question, but this is precisely the question left unanswered by the SPE-type of analysis. Our obvious concern here is that such phonological rules are *ad hoc* mechanisms, revealing nothing about markedness or the functioning of individual sound systems. The next approach to consider appears to fare better in this respect.

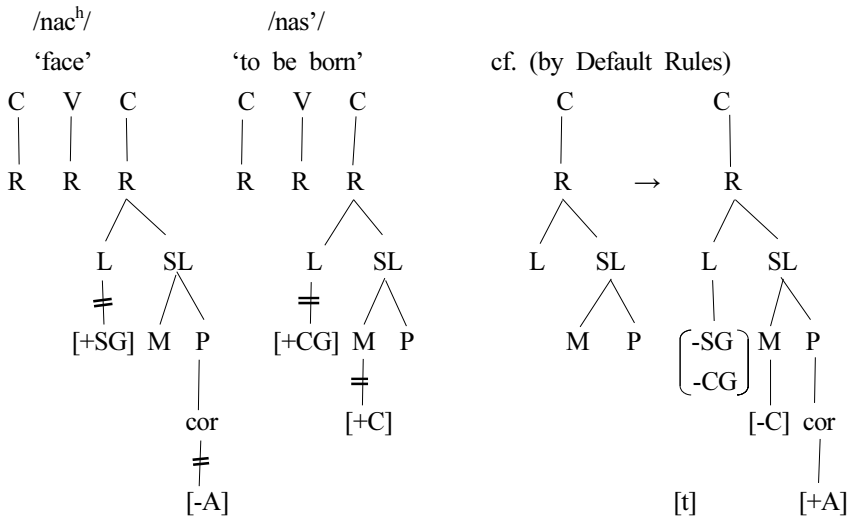
2.2.2 Non-linear approach

Combining the multi-tiered, hierarchical feature representation with underspecification theory[2], Iverson and Kim (1987, I&K henceforth) expressed the neutralization process as

2 What is interesting about underspecification proposals is that a great deal of the functioning of the phonological system is derivable from the operation of some set of features without affecting the remaining ones (Archangeli 1984; Kiparsky 1985; Wheeler 1981, among others). Therefore, it is proposed that feature representations in the lexicon should be partially specified so that the lexicon could be simplified and capture the phonological generalizations.

a delinking of all the terminal features. Their analysis goes as follows:

(5) Delinking of terminal features as neutralization and the application of redundancy rules[3] (I&K 1987: 189)



After all those terminal features such as [+SG], [+continuant], and [-anterior] are delinked from the obstruent at coda, the segment will be maximally underspecified. This state of affairs feeds redundancy rules, and the application of those default rules will supply the relevant feature and feature values to spell out the least marked consonant, [t].[4]

2.3 Crucial issue

As to the question of how features are organized in phonological representations, a considerable amount of evidence answers that features are grouped into higher-level functional units, constituting what might be called natural classes. For a solution along

3 L = Laryngeal, SL = Supralaryngeal, M = Manner, P = Place, [±SG] = [±spread glottis], [±CG] = [±constricted glottis], [±C] = [±continuant], [±A] = [±anterior]

4 As to the application of default rules in (5), a question arises as to what aspect of the neutralized structure tells context-free vocalic redundancy rules instead of consonantal ones not to apply to it? This problem can be solved by adopting McCarthy's (1988) position. That is, the two major class features [sonorant] and [consonantal] constitute root node since they differ from all other features in that they arguably never spread, delink, or exhibit OCP effects independently of all other features.

these lines, a general model of feature organization has been proposed where features regularly act together as a unit in phonological rules because they form *constituents* (Clements 1985; Sagey 1986, among others). In standard autosegmental phonology, all branches emanate from a *root node*, and lower-level *class nodes* designate functional feature groupings which include terminal features. This approach to feature organization enables us to impose a strong constraint on the functioning of phonological rules, such as the following principle (Clements and Hume 1995: 250, C&H henceforth):

(6) Phonological rules perform single operations only.

This principle says that a phonological rule should perform single operation on a constituent. In other words, it is claimed that only those feature groups that form constituents may function together in phonological rules. In the analysis of the neutralization in Korean by I&K, all terminal features are delinked simultaneously in the coda, which has the advantage of accounting for place and laryngeal neutralization at the same time but runs counter to the principle in (6).

It has been argued traditionally that consonant strengthening typically takes place in syllable-initial position while consonant weakening occurs syllable-finally (Vennemann 1972; Hooper 1976). In view of this, it makes perfect sense for I&K to say that syllable-final neutralization is to be a process of delinking all the terminal features since it should be a kind of weaking process.

It should also be noted that syllable-final affricates [c, c', c^h] all neutralize to [$t^=$], as shown in (2c). This line of neutralization has inherently derivational nature. That is because [-anterior] first deletes and then [+anterior] is supplied by default, as depicted in (5). What motivates the change of feature value here? Evidently, something systematic is going on here that must be explained.

Overall, we see I&K's proposal as essentially on the right track in that the coda position is where weakening process typically takes place, so the syllable-final obstruent neutralization should be encoded as loss of features. C&H also admit that I&K's neutralization rule is a very elegant one. Having said that, if correct, it would cause a serious problem in C&H's principle (6) above and requires a relaxation of it. We have one phenomenon, but two theories, both explaining too much to be completely wrong, both too flawed to be completely right. This is the very paradox we are currently faced with. The question is how to reconcile I&K's insight with the principle in (6). We will

propose a hybrid in which I&K are basically right about syllable-final delinking of all terminal features and C&H are basically right about one operation per each step of derivation.

Our theory needs to capture at least three generalizations that jump out at syllable-final position in Korean, as summarized below:

(7) Syllable-final obstruent neutralization
  a. Obstruents keep their primary articulator features (i.e., labial, coronal, dorsal).
  b. Palatal affricates and glottal fricative change to alveolar coronal stop.
  c. Obstruents lose all their laryngeal and release features.

The neutralization in question revolves around these three generalizations which should be expressed separately. But the principle (6) above requires the postulation of only one operation to express all of them. The question is how to reconcile the state of affairs in (7) with the principle (6).

In what follows, adopting the constraint-based grammar of the Optimality Theory (Prince and Smolensky 1993/2004, OT henceforth), we model the syllable-final obstruent neutralization in terms of harmonic improvement changes which are defined by universal constraints, and which are explicitly encoded in phonological representations.[5]

3. Harmonic Serialism and analytic tools

A generative grammar is characterized as an indirect mapping between two levels: underlying and surface representation. That is the case with phonology as well as syntax. OT relates the underlying and surface representations without any intermediate stages, and allows GEN to make many changes when it produces an output candidate. That is, GEN applies one or more operations together, in parallel, when it generates candidates. The grammar evaluates infinite number of fully formed output candidates simultaneously which contain as many as different processes, so it is called a parallel model (P-OT).

5 No attempts have been made in the recent literature to improve on I&K's explanation for the neutralization of syllable-final obstruents that has been sketched in these last few paragraphs. We failed to cite references with relevant OT-based analysis of Korean neutralization data. As far as our knowledge goes, this article should be the first attempt ever to incorporate the single-operation principle in (6) into the analysis of syllable-final obstruent neutralization in Korean.

The winning output candidate of P-OT is simply the most harmonic member of the candidate set.

As a different version of OT, Harmonic Serialism (McCarthy 2010/2016, HS henceforth) is a serial or derivational theory.[6] In HS, though, it is not enough for a surface form to be a P-OT winner; it must also be linked with the underlying form by a chain of harmonically improving intermediate form. HS's GEN is known to impose a requirement of *gradualness*, which limits the use of unfaithful operations in generating candidates:

(8) *Gradualness* (McCarthy 2008: 276)
If β is a member of the set GEN(α), then no more than one unfaithful operation is required to transform α into β.

HS has a loop in that the optimal candidate chosen by EVAL becomes a new input to GEN, which in turn forms a candidate set that goes again to EVAL, and so on and so forth. But HS derivation is supposed to converge in a finite number of steps. When there is no further harmonic improvement, there the derivation has converged and terminates.

Long before the appearance of OT, place assimilation was claimed to have a two-step process: the deletion of unlicensed place feature precedes the spreading of the licensed one (Cho 1990; Kiparsky 1993; Poser 1982). The following constraint in (9) we will also adopt in the analysis to come is independently motivated in that it motivates the spreading of the licensed place feature:

(9) HAVEPLACE (after McCarthy 2008; Padgett 1995; Parker 2001; Smith 2002)
Assign one violation mark for every segment that has no Place specification.

The regressive directionality of place assimilation is portrayed in the following tableaux by McCarthy (2010: 11):

6 HS was proposed in Prince and Smolensky (1993/2004) in the first place, but it was not carried out there and was as a matter of fact rejected in favor of P-OT. The possibility for HS was reopened in McCarthy (2000/2002/2007).

(10) Step 1 of /pamta/ → [pa͡nta]

/pamta/	CODA-COND	HAVE-PLACE	IDEN(place)
a. → paNta		*	*
b. pamta	*!		
c. pamha	*!	*	*

At step 1, high-ranking CODA-COND forces the deletion of place from the coda consonant, yielding the placeless nasal N. The satisfaction of CODA-COND comes at the cost of violating the low-ranking HAVE-PLACE. The selected optimal candidate (10a) is fed back into *GEN* as a new input, from which a new candidate set is constructed at step 2:

(11) Step 2 of /pamta/ → [pa͡nta]

/paNta/	CODA-COND	HAVE-PLACE	IDEN(place)
a. → pa͡nta			*
b. paNta		*!	

The placeless nasal [N], abstract segment, becomes alveolar nasal [n] due to the spreading of place from the following [t]. This strategy is to satisfy HAVE-PLACE in (11a), which is violated in (11b). Then, the derivation converges at step 3 (not shown).

While this line of solution illustrated in (10-11) 'works', it crucially relies on such an 'abstract' element as [N] in the intermediate step of the derivation. It seems clear that the HS derivation can only be bought at the price of considerable abstraction of nasal consonant. But if McCarthy's line of argument in (10-11) is basically correct, benefit is expected to outweigh the cost. In other words, by turning to the strategy of HS derivation, McCarthy can explain our place assimilation intuition. In so doing, the gradualness of harmonic improvement plays an important role by allowing us to preserve OT at a minimum cost of abstractness.

Abstractness issue can be minimized in HS model, where positing an abstract element can be justified on grounds of gradualness and harmonic improvement. In this respect, HS departs from SPE-type of derivation since, without the gradualness, abstract elements in the latter should be too powerful and arbitrary devices. It is also claimed in McCarthy (2010: 5) that certain generalizations cannot be expressed in underlying or surface representations, and these generalizations are expressible at intermediate levels of

derivation, which makes HS a feasible framework to deal with syllable-final obstruent neutralization in Korean at hand.

There are principal reasons for us to adopt the HS framework so far outlined. First, once the obstruent neutralization takes place syllable-finally, all coronal consonants including palatal affricates turn out to be alveolar coronal stop. This simple generalization proves to be hard to express in P-OT analysis. The underlying problem is that this generalization is inherently derivational: terminal features are delinked through neutralization and then [+anterior] for [t] is assigned by default. A parallel OT grammar must optimize the syllable-final loss of features on the one hand and the default assignment of features simultaneously, which turns out to be troublesome in description. Since HS is derivational in nature, however, each generalization can be nicely captured at each step of derivation. Second, Korean obstruents always become unreleased in syllable-final position. This is another generalization we would want to capture. HS approach will allow us a step in derivation capturing the unreleasing generalization. All in all, therefore, it should be clear that HS grammar incorporating these two generalizations is adequate on both descriptive and theoretical grounds.

Lombardi (1991) notes that the most common phonological process involving laryngeal features is laryngeal neutralization, wherein all laryngeal distinctions are lost in syllable-final position. It is claimed by her that such laryngeal features as [voice], [aspiration], and [glottalization] are privative, or single-valued. And she proposes that neutralization is the result of a well-formedness condition. Something along the lines of her position is what we need: laryngeal features are privative and all laryngeal distinctions are lost in syllable-final position. Adopting the HS version of OT grammar, we model the neutralization basically in terms of a family of unreleasing constraints in syllable-final position:

(12) A family of alignment constraints for syllable-final unreleasing
  a. ALIGN(laryngeal, L, σ, L)
     "Every laryngeal feature stands at the initial position of syllable."
  b. ALIGN([+continuant], L, σ, L)
     "Every [+continuant] stands at the initial position of syllable."

The two alignment constraints conspire to have the effect of preventing laryngeal or release feature from being licensed at syllable-final position, resulting in the syllable-final

unreleasing. They are unranked with respect to each other and the basic constraint ranking for the obstruent neutralization is shown schematically in (13):

(13) Syllable-final obstruent unreleasing
ALIGN(laryngeal, L, σ, L), ALIGN([+continuant], L, σ, L) ≫ MAX-IO(laryngeal), IDENT-IO([continuant])

The alignment constraints and faithfulness constraints are in a relation of conflict: there are pairs of competing candidates on which two constraints disagree. The ranking in (13) says that either laryngeal or release feature successfully avoids occupying the syllable coda position at the expense of deleting or changing the relevant features.

In the analysis to come, we will employ such basic members of the set of faithfulness constraints as show in (14):

(14) Faithfulness constraints (McCarthy and Prince 1995)
a. MAX-IO(Segment)
Input segments must have output correspondents. ('No deletion')
b. DEP-IO(Segment)
Output segments must have input correspondents. ('No epenthesis')
c. IDENT-IO(F)
The specification for the feature F of an input segment must be preserved in its output correspondent.

In modelling grammars, there is always a conflict between speakers' point of view and a listeners' point of view. Likewise, in OT grammar, there is always a struggle between constraints which forbid phonological material and constraints which demand the material. In case the adoption of phonological features seems inevitable, their appearance is enforced as ranking priority:

(15) Coronal unmarkedness: domination hierarchy (McCarthy and Prince 2004: 215)
*PL/Lab ≫ *PL/Cor

(15) says that it is higher priority to avoid parsing labial place than it is to parse coronal place. We assume in the following analysis of Korean that the same kind of constraint

that prohibits parsing palatal place (i.e., *PL/Palatal) or glottal place (i.e., *PL/Glottal) should be ranked somewhere above *PL/Cor.

It is very much in line with the idea in (15) regarding coronal unmarkedness that the epenthesis of coronal place is less costly than that of labial or velar place specification.

(16) Coronal place epenthesis
DEP-IO(labial/dorsal) ≫ DEP-IO(coronal)

To deal with the case at hand, it is suffice to assume that there is no constraint-ranking argument regarding DEP-IO(labial) and DEP-IO(dorsal).

4. Analysis

4.1 Derivational nature of syllable-final neutralization

In Korean, syllable-final tense or aspirated stops as well as fricative become unreleased ones, mostly preserving their original place of articulation, as we reviewed in (2a, b). This state of affairs would be simply characterized as a process of losing a release feature in syllable-final position. What is perhaps surprising in this connection is the fact that syllable-final affricates never fail to be realized as an unreleased anterior coronal stop, changing their original place of articulation, as seen in (2c). This simple generalization proves to be difficult to express in a P-OT analysis. The problem is that the generalization is inherently derivational. That is to say, the affricate should get deleted in the first place since syllable-final neutralization is typically a weakening process, and then an anterior coronal stop is provided by default. Solely for the purpose of expository clarity, we would like to provide below a general and step-by-step characterization of the obstruent neutralization in question in terms of McCarthy's (1988) feature geometry.[7]

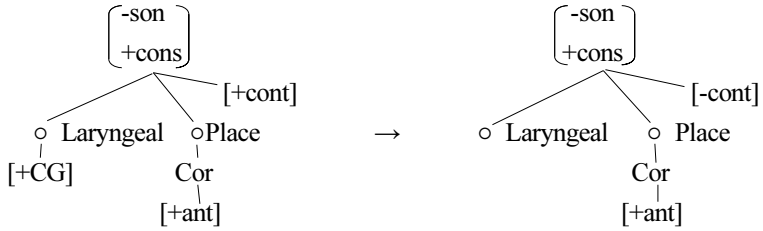
The tense fricative *s'* is realized as anterior coronal stop *t̄* only after adjusting its relevant release features: deleting [+constricted glottis] and changing the featural value

7 We would like to make it clear that we do not intend to introduce any feature-geometrical representation to the OT analyses to come. Our only reason for a look of feature geometry in this subsection is to help readers recall the featural compositions of the relevant neutralization processes at hand.

of [cont]. This line of description points ahead the HS analysis to be developed in the next subsection:

(17) Derivational nature of a tense fricative *s'* in syllable-final position

a. Tense fricative *s'* b. (Unaspirated) coronal stop $t^{=}$

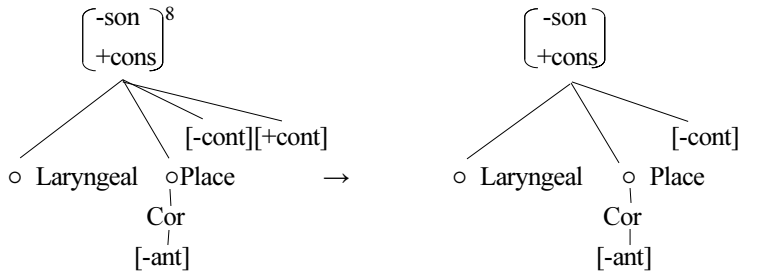


In order to have unreleased status in syllable-final position, (17a) must lose or adjust release features. The direct consequence of the operation should be the structure in (17b), an anterior coronal stop $t^{=}$.

Adopting the concept of *gradualness* shown in (8), the syllable-final affricate *c* is supposed to undergo a two-step derivation. First of all, it has to lose its release feature, [+continuant], and then change into anterior coronal place of articulation. In hierarchical feature representation, the derivation would be depicted as in (18) below:

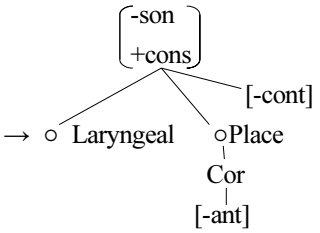
(18) Derivational nature of an affricate *c* in syllable-final position

a. Plain palatal affricate *c* b. (Unreleased) plain palatal stop $c^{=}$



8 This is a representation of a palatal affricate. It constitutes a single segment but has an internal sequence of [-cont] and [+cont] oral gestures.

c. (Unreleased) plain coronal stop $t^{=}$

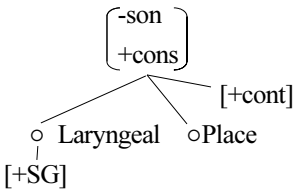


We take (18a) as our starting point, a plain palatal affricate *c*. (18a) deletes its inherent release feature, and so (18b) results in improving harmony due to the loss of [+continuant]. However, (18b) is a configuration of a palatal stop which is not allowed in the sound inventory of Korean. Therefore, there is room for further operation. The markedness of palatal place is improved by changing the feature value of [anterior] into [+anterior]. Unreleased anterior coronal stop $t^{=}$ constitutes the automatic result of the two-step derivation.

By not possessing any place of articulation in the oral tract, the case of a syllable-final *h* itself in (2d) makes a radical departure from the case of palatal affricates above. The derivation of gradual harmony-improving is expected to proceed as in (19):

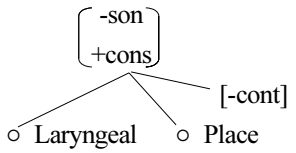
(19) Derivational nature of a fricative *h* in syllable-final position

a. Glottal fricative *h*

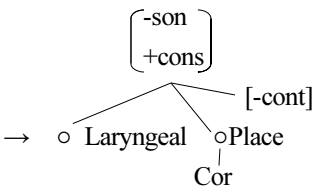


→

b. (Unreleased) glottal stop $\tilde{?}^{=}$



c. (Unreleased) coronal stop $t^{=}$



A possible line of derivation starts by observing that (19a) possesses such laryngeal or

release feature as [+SG] and [+cont]. Removing and adjusting those features result in (19b). The markedness of placelessness in (19b) is improved by the insertion of coronal place in (19c). The configuration in (19c) is interpreted as anterior coronal stop *t̻* due to the presence of [-cont]. The whole process in question must be derivational in nature: only after the release features are adequately dealt with, we obtain a glottal stop which is modified into an anterior coronal stop.

There may be further details to be worked out, but investigation along these lines may prove enough in understanding the derivational nature of obstruent neutralization in Korean. The apparentness of assuming these derivational stages will become important as the HS analysis is developed in the next subsection.[9]

4.2 Obstruent neutralization in Harmonic Serialism

Let us begin by considering the typical data of obstruent neutralization as shown in (20-21) below:

(20) /nat^{h}/ → [nat̻] 'a piece'

Input: /nat^{h}/	ALIGN(lar)	ALIGN([+cont])	MAX-IO(lar)	IDEN-IO([cont])
a. nat^{h}	*!			
☞ b. nat̻			*	

(21) /nas/ → [nat̻] 'a scythe'

Input: /nas/	ALIGN(lar)	ALIGN([+cont])	MAX-IO(lar)	IDEN-IO([cont])
a. nas		*!		
☞ b. nat̻				*

In both cases, either the laryngeal feature (i.e., [+spread glottis]) or release feature (i.e., [+continuant]) cannot be aligned with syllable-final position. These features in syllable-final position have no alternative but to disappear at the expense of relevant faithfulness violations.

We have another one-step derivation involving a conjunction of those two alignment constraints. Consider the tableau in (22):

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9 The motivation of derivational stages constitutes a strong reason to adopt an HS-approach to compensatory lengthening, too. The reader who is interested is referred to Lee (2021) for a detailed presentation of the analysis.

(22) /nas'-/ → [nat̚] 'to be born'

Input: /nas'-/	ALIGN(lar)	ALIGN([+cont])	MAX-IO(lar)	IDEN-IO([cont])
a. nas'	*!	*		
b. nas		*!	*	
☞c. nat̚			*	*

The fully-faithful candidate (22a) suffers from a violation from each of top-ranked alignment constraints. The violation is somewhat alleviated in (22b) by deleting the laryngeal feature [+constricted glottis] at the syllable-final position. With all the release features eliminated, it automatically follows that the syllable-final consonant is interpreted as an unreleased anterior coronal stop and (22c) is decided to be the winning candidate.[10]

Let us now turn to our HS analysis of /nac/ which will be realized as [nat̚]. This may seem unusual in that there is a change in the place of articulation from palatal *c* to alveolar *t̚*. Step 1 of the derivation proceeds as follows:

10 As a matter of fact, the derivation in question can be decomposed into two smaller sub-derivations as follows:

(i) Step 1 of /nas'-/ → [nat̚] 'to be born'

Input: /nas'-/	ALIGN(lar)	ALIGN([+cont])	MAX-IO(lar)	IDEN-IO([cont])
a. nas'	*!	*		
☞ b. nas		*	*	

(ii) Step 2 of /nas'-/ → [nat̚] 'to be born'

Input: /nas/	ALIGN(lar)	ALIGN([+cont])	MAX-IO(lar)	IDEN-IO([cont])
a. nas		*!		
☞ b. nat̚				*

Splitting the tableau is due to the fact that HS's GEN cannot perform two operations at once, so at the first stage of the derivation the ultimate winner [nat̚] should not be in the candidate set. Instead, the candidate set is limited to forms that differ from /nas'-/ by at most one faithfulness change: faithful *nas'* and unfaithful *nas*. The winner of step 1, *nas*, is the input to GEN at the next step of the derivation.

An anonymous Linguistic Research reviewers has observed that the two tableaux in (i) and (ii) could be collapsed into one as in (22). Apparently, such a P-OT approach may provide a simple and elegant account of the phenomenon. However, it doesn't adequately express a couple of generalizations that are distinctly captured in HS-type analysis. As we have seen, those two generalizations are expressible in HS's intermediate steps in (i-ii). Besides, the mapping from /nas'-/ to [nat̚] is derivational in nature: the syllable-final obstruent /s'/ loses its release feature and then the fricative turns into the stop. For simplicity purposes, however, we group the two alignment constraints together as a family of constraints as we did in (12). Then, it would make no difference whether we split the derivation into two or not. In the tableau shown in (22), the working of the individual alignment constraints is taken as a whole at the current stage of derivation.

(23) Step 1 of /nac/ → [nat͡ʲ] 'a day'

Input: /nac/	ALIGN (lar)	ALIGN ([+cont])	MAX-IO (lar)	IDEN-IO ([cont])	*PL/Pal
a. nac		*!			*
☞b. naℂ͡ʲ				*	*

(ℂ: palatal stop)

At the first step, the faithful candidate in (23a) violates the ALIGN([+continuant], L, σ, L) since the syllable-final *c* still remains an affricate and retains a [+continuant] component. On the other hand, (23b) trades violation of IDEN-IO([cont]) for better alignment, a smart exchange given IDEN-IO([cont])'s subordinate position in the hierarchy. Now, we have (23b) with an unreleased palatal stop in coda position, which should be the winner at this stage. A violation mark from *PL/Pal is not crucial in deciding the winner at this stage.

In step 2, the best option is to purchase the specification of [+ant] in exchange for the violation of relatively low-ranking IDEN-IO([ant]):

(24) Step 2 of /nac/ → [nat͡ʲ] 'a day'

Input: /naℂ͡ʲ/	ALIGN (lar)	ALIGN ([+cont])	MAX (lar)	IDEN-IO ([cont])	*PL/Pal	IDEN-IO ([ant])
a. naℂ͡ʲ					*!	
☞b. nat͡ʲ						*

(24a) retains the input's palatal place of articulation. But this option is ruled out by (24b) which satisfies *PL/Pal at the expense of violating the low-ranking IDEN-IO([ant]).

Finally, we have convergence at step 3. The initial input /nac/ has realized all of its potential for harmonic improvement, so the derivation has converged and the GEN/EVAL loop terminates. The output is identical with the input, as illustrated below:

(25) Step 3 of /nac/ → [nat͡] 'a day'

Input: /naℂ͡/	ALIGN (lar)	ALIGN ([+cont])	MAX (lar)	IDEN-IO ([cont])	*PL/Pal	IDEN-IO ([ant])
a. naℂ͡					*!	
☞b. nat͡						
c. nac͡					*!	*

At syllable-final position, (25a) and (25c) have palatal stop (i.e., ℂ͡) and palatal affricate (i.e., *c*͡), respectively. Both of them crucially violate *PL/Pal by their palatal place of articulation. Therefore, the current ranking decides the fully faithful candidate (25b) as the final output.

Lastly, let us turn our attention to a bit more complex case of derivation where the syllable-final placeless /h/ neutralizes into the unreleased alveolar coronal [t͡]. The current ranking of constraints dictates the deletion of [+spread glottis], the most harmonic way at step 1 to satisfy the high-ranking ALIGN(laryngeal, L, σ, L). The faithful candidate in (26a) must therefore be defeated:

(26) Step 1 of /tah-/ → [tat͡] 'to reach'

Input: /tah-/	ALIGN (lar)	ALIGN ([+cont])	MAX (lar)	IDEN-IO ([cont])	*PL/ Glottal[11]	IDEN-IO ([ant])
a. tah	*	*!				
☞b. taʔ͡	*		*	*	*	

Although both (26a) and (26b) violate ALIGN(laryngeal, L, σ, L) due to the presence of laryngeal features, the latter is selected since it does not violate ALIGN([+continuant], L, σ, L). That is, the high-ranking alignment constraints force the syllable-final /h/ to lose its laryngeal feature. What is less than immediately self-evident, however, is the extent to which a relatively plausible operation like this justifies postulating rather more abstract structure like an unaspirated glottal stop *ʔ*͡, which the winner of step 1, (26b), possesses. In the course of the review of McCarthy's (2010: 11) tableaux in (10-11) we have already observed that positing abstract segment was an inevitable course of action in the step of HS derivation. By so doing, generalizations came to be expressible in the intermediate

11 *PL/Glottal occupies the same position as *PL/Palatal in this current constraint hierarchy. They are unranked with respect to each other. In this tableau and others to come, we have suppressed the latter to save space.

representations of HS. We want to admit that the elegance of HS model outweighs the appearance of rather abstract segment in the course of derivation.

As it stands, the winner of step 1 is clearly unsatisfactory. That is, the glottal stop *ʔ* is not allowed in the sound inventory of Korean. The glottal stop in (26b) does not have any place of articulation within the oral tract. Simply by inserting coronal place only, all other features which are dependent upon this coronal place for markedness specifications can be changed to their unmarked value without adding any cost to the grammar. Such harmonic improvement is made at the second step of the derivation:

(27) Step 2 of /tah-/ → [tat͡] 'to reach'

Input: /taʔ͡/	ALIGN (lar)	ALIGN ([+cont])	MAX (lar)	IDEN ([cont])	*PL/ Glottal	IDEN ([ant])	HAVE PLACE	DEP (cor)
a. taʔ͡					*!		*	
☞b. tat͡								*

Due to the violation of *PL/Glottal, the glottal stop is under the pressure of further improvement of harmony. That pressure is relieved in (27b) by inserting coronal place at the cost of violating DEP-IO(coronal).

The derivation converges at step 3. The input is identical with the winner. The three important candidates are contrasted in (28):

(28) Step 3 of /tah-/ → [tat͡] 'to reach'

Input: /tat͡/	ALIGN (lar)	ALIGN ([+cont])	MAX (lar)	IDEN ([cont])	*PL/ Glottal	IDEN ([ant])	HAVE PLACE	DEP (cor)
a. taʔ͡							*!	
☞b. tat͡								
c. tah	*!	*						

(28a) still suffers from lack of place feature, thus violating HAVEPLACE. As for (28c), we are back in our initial state of the derivation, reintroducing alignment violations. The faithful mapping shown in (28b) emerges as optimal because it satisfies all the constraints in the hierarchy.

5. Conclusion

I&K's claim appears to be reasonably well-substantiated that the syllable-final neutralization takes place through the delinking of all the terminal features. However, this conception of neutralization leads to a major problem for the phonological principle to the effect that phonological rules perform single operations only. In this article, we have offered an alternative argument reconciling those diametrically opposed positions.

Adopting I&K's insightful idea of characterizing syllable-final neutralization as delinking all the terminal features, we have tried further to prove that the delinking of terminal features is not arbitrary, but derivational in nature. The examples of Korean neutralization in question are a good place to begin our HS analysis because the derivations are shallow: the underlying and surface forms in each derivation differ by the effect of just a couple of operations. The operations involved are obstruent unreleasing in coda and change in place of articulation.

The whole derivational process of obstruent neutralization is broken into smaller step-by-step derivations. And each step of derivation is shown to be comprised of a single operation that is harmonically improving. All of the relevant constraints are independently motivated and have universal nature. At first, we were torn between I&K's idea and the opposing phonological principle. The HS approach has turned out to be successful, and fruitful in reconciling the facts and the theory. In all cases of syllable-final obstruent neutralizations, we showed that the present system captures linguistic generalizations in a way that previous alternatives do not. Each generalization is captured at each step of HS derivation at the cost of postulating rather abstract segments. Such an analysis, although involving abstraction to some degree, can be justified on grounds of gradual harmonic improvement imposed by HS.

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