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A study of common behavior in /s/-irregular and /h/-final stems of Korean*

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Lee, Sechang. 2019. A study of common behavior in /s/-irregular and /h/-final stems of Korean. *Linguistic Research* 36(2), 263-288. The main purpose of this article is to bring to light the common behavior of the so-called '/s/-irregular' and '/h/-final' stems in Korean, focusing on the similarly opaque phonological behavior of those stems when they encounter vowel-initial suffixes. It is proposed that their phonological similarity should be due to the lack of place feature in their input specifications of the stem-final consonants. The proposal follows from the discussion that combining the notion of Richness of the Base with Lexicon Optimization in optimality-theoretic framework, language learners should consult surface alternations and choose input forms that map onto outputs in the least offensive way with respect to the grammar of ranked constraints. Adopting placeless specifications as their input for both /s/-irregular and /h/-final stems, their apparent opaque alternations are adequately dealt with employing independently motivated universal constraints. The irregular status of /s/-irregular stems in Korean is still maintained but the source of their peculiar behavior turns out to be the lack of place feature just like /h/. Under the proposed ranking of constraints, it is also best explained that the stem-final /s/ in /s/-irregular stems gets their empty place node filled through the help of spreading from the following obstruent while that in /s/-regular stems is simply brought into the purview of place assimilation. I conclude that all relevant cases of /s/- and /h/-final stems can be dealt with successfully in a framework that has recourse to input specifications. **(Sookmyung Women's University)**

Keywords irregular stems, place feature, opacity, coda condition, h-deletion

1. Introduction

There are several of so-called 'irregular stems' in the literature on traditional Korean linguistics (Chey 1959; Huh 1965; Kim 1973; Kim-Renaud 1974; Lee 1976, among others). These stems are called 'irregular' because their stem-final

* I am grateful to anonymous reviewers for their invaluable comments.

consonants show unpredictable alternations in suffixation. Among others, each behavior of irregular stem-final /s/ and /h/ is usually left unexplained and is generally considered phonologically unmotivated. I would like to reexamine the various aspects of these two stems from a new perspective, developing the necessary apparatus as we proceed. Contrary to appearances, the seemingly irregular behavior of the so-called /s/-irregular and /h/-final stems will turn out to have their own inherent regularity once their source of peculiarity is identified.

It is observed that the irregular stems in question display unpredictable alternations when they are put before vowel- or consonant-initial suffixes. Let us begin our discussion with the following paradigm. For expositional convenience, I give only one typical example for each category in (1):

(1) Alternations of /s/-final and /h/-final stems

a. /s/-regular stem[1]

Indicative	Connective	Stative	Conditional	
/sos-/+/ta/	/sos-/+/ko/	/sos-/+/a/	/sos-/+/ɨmjən/	'to soar'
↓	↓	↓	↓	
[sot͡ .t'a]	[sok͡ .k'o]	[so.sa]	[so.sɨ.mjən]	

(Period denotes a syllable boundary.)

b. /s/-irregular stem[2]

Indicative	Connective	Stative	Conditional	
/nas-/+ ta/	/nas-/+/ko/	/nas-/+/a/	/nas-/+/ɨmjən/	'to be better'
↓	↓	↓	↓	
[nat͡ .t'a]	[nak͡ .k'o]	[na.a]	[na.ɨ.mjən]	

c. /h/-regular stem[3]

Indicative	Connective	Stative	Conditional	
/čoh-/+/ta/	/čoh-/+/ko/	/čoh-/+/a/	/čoh-/+/ɨmjən/	'to be good'
↓	↓	↓	↓	
[čot͡ .t^{h}a]	[čok͡ .k^{h}o]	[čo.a]	[čo.ɨ.mjən]	

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1 Additional /s/-regular stems include /pəs-/ 'to take off', /s'is-/ 'to clean', /wus-/ 'to laugh', etc.

2 Other examples of the same sort are /pus-/ 'to pour', /is-/ 'to connect', /čəs-/ 'to stir', etc.

3 Such /h/-final stems as /noh-/ 'to put', /tah-/ 'to reach', and /s'ah-/ 'to heap' show the same phonological behavior.

d. /h/-irregular stem[4]

Indicative	Connective	Causative	Conditional	
/norah-/+/ta/	/norah-/+/ko/	/norah-/+/ɨni/	/norah-/+/ɨmjən/	'to be yellow'
↓	↓	↓	↓	
[no.rat$^{\urcorner}$.t^{h}a]	[no.rak$^{\urcorner}$.k^{h}o]	[no.ra.ni]	[no.ra.mjən], *[no.ra.hɨ.mjən]	

In (1a), the stem /sos-/ ending in /s/ shows regular alternation.[5] This is in sharp contrast with their regular stem /nas-/ in (1b). The input form of /nas-/ also ends in /s/ and shows the same alternation before Indicative and Connective as in the regular stem /sos-/. The stem /nas-/ is irregular in that the stem-final /s/ deletes before vowel-initial suffixes for no phonetically apparent reason, as illustrated in Stative form [na.a] and Conditional form [na.ɨ.mjən].

In Korean, when a suffix begins with /n/, /l/, or /m/ and the immediately preceding stem ends in a consonant, [ɨ] is typically inserted. But when the suffix follows a stem-final vowel, the insertion does not take place, as contrasted in (2a) and (2b) respectively:

(2) [ɨ]-insertion (Choy 1959; also cited in Kim 1973)
   a. /mək-/ 'to eat': [mək$^{\urcorner}$.t'a], [mək$^{\urcorner}$.k'o], [mək.č'a], [mə.kɨ.mjən], [mə.kɨ.na], [mə.kɨ.ra]
   b. /po-/ 'to see': [po.ta], [po.ko], [po.ča], [po.mjən], [po.na], [po.ra]

Kim-Renaud (1974: 51-53) drew a distinction between /h/-regular stems (1c) and /h/-irregular ones (1d), based on *-ɨmjən/mjən* allomorphy. That is to say, the stem /čoh-/ in (1c) is regarded regular because the surface form [čo.ɨ.mjən] takes up *-ɨmjən* when the Conditional suffix combines with the consonant-final /čoh-/, thus complying with the generalization captured in (2). By parity of reasoning, we must say that the /h/-final stem /norah-/ in (1d) is irregular owing to the

4 Color-denoting adjectives are typically /h/-irregular: /p^{h}arah-/ 'to be blue', /p'alkah-/ 'to be red', /hajah-/ 'to be white', etc.

5 In all Indicative and Connective forms of (1a-d), stem-final /s/ or /h/ is realized as an unreleased [t$^{\urcorner}$] while the following syllable-initial consonants go through tensification in (1a-b). The contexts of tensification are more complex than the limited examples suggest, and a more detailed discussion is beyond the scope of this article.

fact that the surface form [no.ra.mjən] contains *-mjən*, thus challenges this basic generalization.

At this point, a couple of considerations are in order. First, the 'regular' status of /h/-regular stems is suspect to the extent that phonology fails to provide a principled account of why the stem-final /h/ in /čoh-/ deletes intervocalically. Second, careful examination of (1d) tells us another interesting story: the /h/-irregular stems are not completely irregular. Note that the stem-final /h/ in /norah-/ is arguably concatenated with /ɨmjən/ in underlying level, and the /h/ went through deletion along with /ɨ/ for some reason. In view of these facts, the stem /norah-/ cannot be claimed to be irregular: /čoh-/ and /norah-/ behave basically the same with respect to the intervocalic /h/-deletion.

In the following sections, I begin with discussing the opacity of intervocalic /s/- or /h/-deletion: there is no clear reason why they should get deleted. I turn next to the issue of universal nature of intervocalic *h*-deletion: positing a universal constraint requiring intervocalic *h*-deletion does not exact any price in OT grammar. After a presentation of questions related to input feature specification and *learnability*, I develop an optimality-theoretic conception of positing input forms for placeless consonants, illustrating and motivating it by means of an analysis of /h/-final and /s/-irregular stems. Under the analysis to come, it will be argued that the irregularity in question follows naturally from input forms posited on universal grounds. I conclude the article with a summary of main results.

2. Phonological opacity of irregular stems

In a rule-based phonology in the tradition of Chomsky and Halle (1968, *SPE* henceforth), the derivation of irregular stems results in phonological opacity. Consider the following derivations:

(3) Derivational opacity

a. Irregular stems

	/nas-/ + /a/ 'to be better'	/čoh-/ + /a/ 'to be good'
s/h-deletion	naa	čoa
	[na.a]	[čo.a]

b. Regular stems

	/sos-/ + /a/ 'to soar'
s-deletion	N/A
	[so.sa]

A serious question immediately arises when we regard /s/- or /h/-deletion in (3a) as a phonological rule in the context before a vowel-initial suffix. Why does the rule fail to apply to the regular stem /sos-/ in (3b)? The stem-final /s/ in (3b: /sos-/) contains phonological structure that looks like it should have gone through the /s/-deletion but in fact did not. In the derivation /sos- +a/→ [so.sa] in (3b), the deletion rule is opaque under clause (a) of McCarthy (2007)'s definition:

(4) Opacity (McCarthy 2007: 11)

A Phonological Rule P of the form $A \rightarrow B / C\_\_\_D$ is *opaque* if there are surface structures with any of the following characteristics:

a. instances of *A* in the environment *C*___*D*,

b. instances of *B* derived by P that occur in environments other than *C*___*D*,

or c. instances of *B* not derived by P that occur in the environment *C*___*D*.

Also, an incoherent situation arises with respect to such a derivation as (3b): why should it be treated as opaque in spite of the fact that its phonological behavior seems perfectly regular as they show no alternation at all? On top of this, the deletion rule itself suffers from weak motivation because it lacks phonetic grounds.

Opaque generalizations lurk at a level deeper than surface representation. Those opaque generalizations can be made transparent once we postulate a level mediating between the underlying and surface representation. In the standard

derivation model in the sense of *SPE*, it is strongly motivated to posit abstract intermediate levels between the two levels.

On the other hand, Classic Optimality Theory[6] (OT, henceforth) has difficulty in dealing with opacity since it allows no intermediate levels: it recognizes just two levels of representation, input and output. It is pointed out in this vein by McCarthy (2007: 27) that OT has an inherent bias toward transparent interactions and so opaque process is usually intractable. The opaque processes that we actually find in languages are considered natural. For this reason, opacity appears to be an actual property of phonological systems and any desirable phonological theory should try to properly accommodate it. McCarthy's thesis is that there is something fundamentally correct about rule-based phonology's serial derivation, leading to the idea that the best theory of phonological opacity is a synthesis of OT with derivations. Admitting that there is some fundamental truth to the derivational view of opacity, he combines the derivational insight with OT's essential properties. This is where McCarthy (2007)'s OT-CC (OT with candidate chains) comes in. PREC constraints in OT-CC resembles more or less the statements about rule ordering in *SPE*. That is, under certain circumstances, PREC constraints demands opaque outcomes by preferring candidate chains with particular orderings of faithfulness violations.

How will all of this help us? Let us take a brief review of Jun (2014)'s OT-CC analysis of irregular stems. He proposed such a constraint hierarchy as in (5) to handle the behavior of /h/- and /s/- irregular stems:

(5) Constraint ranking of Korean (Jun 2014: 395)
*VhV, *VsV
» *o(C)ʌ, *aʌ, MAX-C
» PREC(MAX-V, MAX-C), PREC(ID(syl), MAX-C)
» *V_iV_i, *uoi-V
» MAX-V
» ID(syl), *aCʌ, ID(low)

Consider the following tableau:

6 Prince and Smolensky (1993, 2004); McCarthy and Prince (1993, 1995), among others.

(6) OT-CC analysis: /čoh-ʌ/ [čoa] 'to be good' (Jun 2014: 396)

		*VhV	MAX	PREC	*V_iV_i	FAI
a.	čohʌ	*!				
b.	čohʌ, čoha ID(low)	*!				*
c.☞	čohʌ, čoha, čoa ID(low), MAX		*	*	*	*
d.	čohʌ, čoha, čoa, čwa ID(low), MAX, ID(syl)		*	**!		*

(PREC=PREC(ID(syl), MAX-C); MAX=MAX-C; FAI=ID(syl), ID(low))

In (6), the Stative suffix is assumed to be /ʌ/ to provide as well an account for the vowel harmony with the stem vowel. Note that PREC(ID(syl), MAX-C) is one crucial ingredient of Jun's account. PREC(ID(syl), MAX-C) demands that every LUM[7] violating MAX-C be preceded and not followed by an ID(syl)-violating LUM in all the partial pairwise orders except reflexive ones. (6c) gets a violation mark from PREC(ID(syl), MAX-C) since the violation of MAX-C is not preceded by that of ID(syl). (6d) gets two violation marks from the PREC constraint because (i) the violation of MAX-C is not preceded by ID(syl)-violation and (ii) the violation of MAX-C is followed by ID(syl)-violation. Among these two candidates, the former is selected as it has one fewer violation of the PREC constraint than its competitor.

We examine now the problems of the phonological model incorporating this idea of the PREC constraint. A closer look at the evaluation given above shows that this PREC constraint could be a stipulation, for the following reasons. First, on what independent grounds does PREC(A, B) force us to prefer a candidate chain with particular orderings of their LUMs? That is, why do we have to stipulate that B's violation must be preceded by A's violation, not the other way around? This is quite reminiscent of extrinsic rule ordering which was considered to have undesirable *ad hoc* character in rule-based phonology. Second, as a theoretical characterization Jun's expression PREC(ID(syl), MAX-C) gives no insight as to why the stem-final /h/ should get deleted before a vowel: it could have been other consonants but /h/, but why /h/ (or /s/) specifically? The

7 According to McCarthy (2007), a single violation of such basic constraints as MAX(x), DEP(x), IDENT(f), and LINEARITY in a specific location in a form is a localized unfaithful mapping or *LUM*.

PREC(ID(syl), MAX-C) could be understood as an attempt to account for opaque outputs, imposing a universal format of precedence relations of faithfulness.[8] However, introducing the PREC(ID(syl), MAX-C) to the tableau (6) essentially presupposes the deletion of /h/ but provides no phonetic motivation for the fact that only stem-final /h/ or /s/ does get deleted before a vowel, but no other consonants. In the next section, I attempt to answer the fundamental question of what factors motivate the opacity in question.

3. Proposal

To get our discussion of /h/- or /s/-deletion onto a concrete footing, let us make a review of a previous OT treatment of /h/-deletion by McCarthy and Prince (1995) and recognize that their proposed formulation of constraint is of completely *ad hoc* nature. Attention will be drawn to the fact that both /s/-irreglular and /h/-final stems of Korean have much in common in their input specifications. Then it will be argued that their apparently irregular phonological behavior can be captured in a natural fashion if approached from this new perspective. After offering phonological representations of irregular stems in question, I will introduce some useful constraints to be employed in the analysis to come.

3.1 Diagnosing problems

Just like the /h/-regular-stem case in Korean, /h/-deletion between vowels is commonly attested cross-linguistically. Consider, for example, Javanese where a case of this kind is provided. Javanese has a general process deleting *h* intervocalically, as illustrated below (Horne 1961; Dudas 1976):

(7) Javanese Intervocalic *h*-Loss

Root	*Root* + *'my'*	*Root* + *Dem.*	*Gloss*
anɛh	anɛh-ku	anɛ_-e	'strange'
arah	arah-ku	ara_-e	'direction'

8 This point was called into attention by one of the anonymous reviewers.

Since this kind of *h*-deletion is visibly active in Javanese, some phonological constraint must dominate MAX-IO in the grammar of this language. The following tableau is what McCarthy and Prince (1995) presented in their analysis of *h*-deletion in Javanese:

(8) *VhV ≫ MAX-IO in Javanese (McCarthy and Prince 1995: 37)

/arah-e/	*VhV	MAX-IO
☞ a. ara_-e		*
b. arah-e	*!	

As is evident from the examples in (7) and the analysis in (8), the required effect can be derived by positing a markedness constraint *VhV which crucially dominates a faithfulness constraint prohibiting the deletion of *h*. But this should not be quite the end of the story. The obvious drawback to this analysis is that positing and formulating *VhV is *stipulative* rather than *explanatory*. That is to say, the way the constraint is formulated does not provide us with any insight into why *h* should be deleted in intervocalic position. From an OT perspective, therefore, *VhV cannot be justified as a universal constraint even though it could be used effectively as a constraint in many OT analyses. We have to question the justification for this sort of constraints from a universality perspective. That is, *VhV does not provide us with a deeper understanding of the general behavior of /h/ that has been sketched above. In other words, any arbitrary unmotivated constraints such as *VpV, *VtV*, VkV, *VbV, *VpV, *VmV, *VnV should have the same phonological status as *VhV and are expected to be widely used in the analyses. But this is clearly not the case.[9]

It certainly seems as though McCarthy and Prince (1995) posited *VhV as a temporary expedient in their OT analysis of Javanese: its use is solely for the purpose of expository clarity. To simply include an *ad hoc* stipulation on the deletion of *h* in their tableau thus fails to account for the more fundamental property of the phenomenon. That is mainly because prohibiting other consonants than *h* intervocalically does not prove to be natural cross-linguistically. For this reason, as for Jun's *VsV, the way the constraint is expressed cannot be of any universal nature. And positing such a

9 This particular point is originally due to Lee (2002).

language-specific constraint in OT grammar must be costly. The following quote is revealing:

(9) ..... For the purposes of discussion, we assume a constraint *V*h*V which summarizes the effect adequately enough for our purposes. This constraint, whatever its ultimate character, is ranked as follows[10].....
(McCarthy and Prince 1995: 37)

As a matter of fact, McCarthy and Prince seem to have left the proper characterization of the adequate OT constraint as a question for future research. In the following section, I attempt to answer their question, by exploding the role of *V*h*V into a few already independently-motivated universal constraints, which will conspire to take over the role of *V*h*V. By adopting those constraints in OT analysis, the *ad hoc* *V*h*V could be elegantly dispensed with: the new constraints will be shown to be responsible for the deletion of the Korean stem-final /h/ or /s/, but not others.

3.2 Selecting input forms in OT grammar

According to Prince and Smolensky (1993/2004: 205, 225), languages cannot differ systematically in their lexicons. This idea is called *richness of the base* (ROTB, henceforth). ROTB says that in OT, the base (= input to the grammar = lexicon) contains a large quantity of diverse forms because it is not subject to any language-particular restrictions:

(10) Richness of the Base (Kager 1999: 19)
No constraints hold at the level of underlying forms.

ROTB is a thesis that there are no language-particular constraints on inputs. If ROTB is assumed in phonology, such devices as lexical redundancy rules, morpheme structure rules, or lexical underspecification, etc. are no longer available. Instead, all aspects of well-formedness come under the control of

10 The underlined part of the quote is the author's choice.

EVAL and the constraint ranking, and all systematic differences between languages are obtained through differences in constraint hierarchy.[11]

An ROTB-related source of anxiety concerns the possibility of unfaithful mapping from the rich base. Is the English word *dog* (phonetically [dɔg]) derived by the underlying representation /ŋæt/ by an unfaithful mapping? English definitely has no *d*/ŋ, ∅/æ, or *g*/*t* alternations. What does the learner do, then? As for an infant acquiring English, what underlying representation is responsible for the surface form [dɔg], and why?

Suppose that the rich base offers the inputs /dɔg/ and /ŋæt/, and the grammar maps both of them to [dɔg]. Learners then do not need to posit distinct vocabulary items /dɔg/ and /ŋæt/. That is because the contrast between those two items will always be neutralized. This is where *lexicon optimization* comes in:

(11) Lexicon Optimization (LO, Prince and Smolensky 1993: 192)
Suppose that several different inputs I_1, I_2, ..., I_n when parsed by a grammar G lead to corresponding outputs O_1, O_2, ..., O_n, all of which are realized as the same phonetic form Φ -- these inputs are all *phonetically equivalent* with respect to G. Now one of these outputs must be the most harmonic, by virtue of incurring the least significant violation marks: suppose this optimal one is labeled O_k. Then the learner should choose, as the underlying form for Φ, the input I_k.

Any apparent restriction on inputs is then a secondary phenomenon caused by the interactions of markedness and faithfulness constraints, when the interactions are responsible for the input-output mappings. A conceptually appealing interpretation of Lexicon Optimization was made by Kager (1999: 33) that "this principle is, in its turn, an elaboration of an idea of Stampe (1972), who suggested that underlying forms should always match surface forms in the

11 McCarthy (2008a: 89) provides two arguments in support of ROTB. The first one is parsimony issue. That is, it is hypothesized that constraint ranking is the only possible difference between languages. The second one is the conspiracy issue in the 1970s. ROTB is OT's instantiation of solving the Duplication Problem (Clayton 1976; Kenstowicz and Kisseberth 1977) by eliminating restrictions on the lexicon.

absence of evidence to the contrary." Importantly, it is also pointed out by Kager (1999: 34) that the principle of LO does not contradict the assumption of ROTB, in spite of the fact that the former may impoverish the lexicon in terms of feature specification. That is because the burden of explanation is still left with the interactions of markedness and faithfulness constraints.

Think about a child who is in the process of language acquisition. First and foremost, he or she must be exposed to linguistic data (= output forms). Then, they must form an opinion about input forms that is based on the information that they already have about output forms. By the same token, it is evident that Korean infants acquire the input forms of /s/-irregular stems by reflecting on the alternation of their output forms in the first place. Acquisition of Korean /s/-irregular stems would proceed along the following line of reasoning. At first, children do not recognize any restriction on the input forms of those irregular stems. After observing their alternations before vowel- and consonant-initial suffixes, they get to realize that the stem-final /s/ of /s/-irregular stems behaves as if they were placeless in the input forms and they posit the input forms just like /h/ which is placeless. That is how the children posit placeless inputs for the /s/-irregular stems. This will constitute the crux of my position in the following sections to come.

3.3 Positing constraints

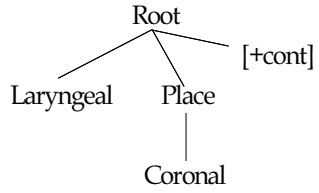
The /s/-regular and /s/-irregular stems show different alternations before a vowel-initial suffix, as illustrated in (1) earlier. The problem is how to explain this difference. In addition to this difference, we also need to explain why /s/-irregular and /h/-final stems show quite the same phonological behavior between vowels as well as before consonant-initial suffixes. The argument to be offered in this section is twofold: (i) learner of Korean imputes the different behavior of /s/-regular and /s/-irregular stems to different phonological representations, and (ii) the apparently unrelated but similar alternations of /s/-irregular and /h/-final stems correlate with the possibility of having something in common in their underlying representations. Learners of Korean select the input form that is closest to the output, in case there is no empirical

evidence for one input form over another. This strategy should be compatible with the Lexicon Optimization principle in (11).

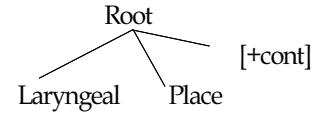
It should be noted that [h] does not have a precise place of articulation in the oral cavity, which means that it is placeless. From an articulatory point of view it is the voiceless counterpart of the surrounding sounds (Ladefoged 2006: 43). Therefore, [h] is essentially placeless in feature geometry. There seems good reason, then, to treat both /h/ and irregular stem-types /s/ as instances of a quite similar input form due to their virtually identical surface alternations. For this reason, learners posit the input forms of both /h/ and stem-final /s/ in question as placeless. In this light, consider the following schematic representations of the input forms the learners posit:

(12) Phonological representations of /s/ and /h/

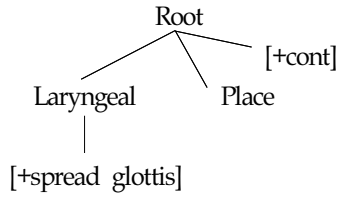
a. Stem-final /s/ in regular stems



b. Stem-final /s/ in /s/-irregular stems



c. Stem-final /h/ in /h/-final stems



(12a) illustrates the phonological representation of /s/-regular stems: the stem-final /s/ is phonologically transparent. On the other hand, (12b) represents the phonologically opaque stem-final /s/ of irregular stems. There is one important contrast between these two representations. The latter holds an empty place node while the former holds Coronal under Place node. The stem-final /h/ in (12c) has a common property with (12b) in that Place node is empty. The absence of place features in irregular stem-final /s/ and /h/ can be attested in their paradigms in (1b-d) earlier. The prediction is therefore made that the /s/-

and /h/-irregular stems will necessarily behave in unison with respect to the empty place tier.[12] We shall see exemplification of this as we go on and the prediction will be dramatically confirmed.

Clearly, the best aspect of my analysis to come is that it does not add any new stipulation to the OT mechanism but makes use of some independently motivated universal constraints, as follows:

(13) HAVE-PLACE (after Pagett 1995, Parker 2001, Smith 2002, McCarthy 2008b)
Assign one violation mark for every segment that has no Place specification.

(14) UNIFORMITY-IO (after McCarthy and Prince 1995)
No element of the output has multiple correspondents in the input. ('No coalescence')

(15) MAX-IO (after McCarthy and Prince 1995)
a. MAX-IO(consonant): Input consonants must have output correspondents. ('No deletion of consonantal Root node')
b. MAX-IO(place): Input place features must have output correspondents. ('No deletion of place feature')

(16) AGREE(place) (after Bakovic 2000; Lombardi 1999; Pulleyblank 2004)
Obstruent clusters should agree in place.

In order to incorporate the idea articulated so far into the theoretical framework of OT, we need to add two more constraints. In the first place, there is a requirement found in many languages, restricting syllable codas to the first segment of a geminate or a consonant homorganic to the onset of the next syllable (Steriade 1982; Itô 1986).[13] Such a requirement is expressed by Itô (1989) as a nonlinear filter:

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12 Besides the lack of place features, the representations in (12b) and (12c) also have [+continuant] in common. Nevertheless, sharing just [+continuant] cannot be crucial because (12a) contains that feature, too. Placelessness should be the most prominent common property between the two representations in question.

13 Following the work by Itô (1986), there appears to have been a strong tendency for a negative condition prohibiting place feature in syllable-final position (Goldsmith 1990; Lombardi 1991,

(17) CODAFILTER (Itô 1989: 224)

*C]$_\sigma$

|

[PLACE].

Translated into the present OT system, the CODAFILTER in (17) penalizes any syllables licensing place feature syllable-finally, where licensing is defined as a single motherhood.[14]

Secondly, in autosegmental representation (cf. Goldsmith 1990), the unmarked association between tiers should be one-to-one. Since geminates are single segments mapped onto, typically two skeletal slots, they deviate from this unmarked linking and should get a violation mark in OT terms. This is what the following markedness constraint is all about:

(18) *GEMINATE

Geminate consonants are not allowed.

Viewed from a universal perspective, the unmarked member of an opposition occurs more frequently than the marked counterpart. Since geminates are less frequently attested than simple consonants, the former is more marked than the latter and should get a violation mark from (18).

4. Analysis

4.1 Alternation before a vowel-initial suffix

In this section a unified account is to be provided of /s/-irregular and

among others).

14 One of the anonymous reviewers insightfully pointed out that CODAFILTER was originally intended for such a language as Japanese in which syllable coda is placeless or constitutes a part of geminate. Therefore, the constraint may not be adequate to deal with Korean data which allows place feature in coda position (e.g. [sik$^{\neg}$.t'a]). The criticism can be answered satisfactorily under a basic tenet of OT grammar. That is, a re-ranking of universal constraints produces an adequate factorial typology: the re-ranking of CODAFILTER and the relevant faithfulness constraint accounts for the typological difference between Korean and Japanese.

/h/-final stems, in which their commonly opaque property will be captured in a natural fashion. On top of this, the transparent behavior of /s/-regular stems will also be shown to be analyzed within the same single constraint hierarchy.

First of all, let us consider a case where /h/-final stems delete their stem-final /h/ before vowel-initial suffixes. The result of deleting oral place features is the loss of the constriction in the oral cavity. In what follows, a placeless oral consonant like (12b) or (12c) is written as an underlined boldfaced letter [**h**]15 or [**s**]:

(19) /čo**h**-/ 'to be good' + /a/ 'Stative' → [čo.a]

/čo**h**-/ + /a/	HAVE-PLACE	MAX-IO(C)
a. čo.**h**a	*!(**h**)	
b. čo**h**.a	*!(**h**)	
☞c. čo.a		*(**h**)

The higher-ranking constraint HAVE-PLACE requires that every segment should hold at least one place feature, which (19a, b) fatally violate due to the presence of [**h**] which is placeless. The final decision is therefore passed down to the lower-ranking constraint MAX-IO(C) which correctly selects candidate (19c) as optimal. It is therefore turned out to be a higher priority to avoid placeless consonants than it is to keep all input consonants. The constraint configuration in tableau (19) constitutes the core of the proposal in this article, which will be fleshed out in crucial respects as we proceed.

The stem-final /s/ of /s/-irregular stems in (12b) is in fact a faithful copy of the stem-final /h/ of /h/-final stems in (12c), representation-wise, except for laryngeal specification. Therefore, it would stand to reason to attribute the phonologically opaque behavior of the relevant stems to their input specifications. That is, the lack of place features in (12b) and (12c) would lead us to expect that they will phonologically behave in a similar fashion -- and this expectation is borne out by the following analysis:

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15 As mentioned earlier in 3.3, [h] does not hold any feature under Place node in feature geometry. Therefore, the underlined [**h**] does not imply the existence of a place-holding [**h**] which is not underlined. The author decided to use the symbol [**h**] just to bring it in line with the notation of placeless [**s**].

(20) /na**s**-/ 'to be better'+ /a/ 'Stative' → [na.a]

/na**s**-/ + /a/	DEP-IO(place)	HAVE-PLACE	MAX-IO(C)
a. na.**s**a		*!(**s**)	
b. na**s**.a		*!(**s**)	
☞c. na.a			*(s)
d. na.sa	*!(**s**)		

Compared with the tableau in (19), each of the candidates (20a-c) incurs exactly the same violation marks of the relevant constraints. (20d) differs minimally from (20a) in that it replaced the placeless /**s**/ in the input with the place-holding [s] in the output, which results in the violation of the top-ranking DEP-IO(place). Among these four major candidates, (20c) is selected as optimal that violates the lowest-ranking MAX-IO(C) to satisfy the higher-ranking constraints.

Of course, this cannot be the complete story. Let us now turn to how the /s/-regular stems alternate before a vowel-initial suffix. Their alternations are transparent:

(21) /sos-/ 'to soar' + /a/ 'Stative' → [so.sa]

/sos-/+/a/	DEP(pl)	HAVE-PL	CODAFIL	MAX(C)	MAX(pl)
☞a. so.sa					
b. sos.a			*!(s)		
c. so.a				*!(s)	*(Cor)[16]
d. so.**s**a		*!(**s**)			*(Cor)

The stem-final /s/ of the input shown in (21) is a regular segment with Coronal place feature specified, and so the first two candidates in (21a-b) satisfy HAVE-PLACE, and (21c) satisfies it vacuously. (21d) is ruled out because of the placeless [**s**], the existence of which is in violation of HAVE-PLACE. (21b) is faithful to the input segment-wise, but violates CODAFILTER due to the fact that

16 The deletion of a place-holding /s/ incurs a violation of MAX-IO(place) as well as MAX-IO(C) as the latter implies the former. In case of deleting a placeless /**s**/, MAX-IO(C) will be violated but MAX-IO(place) is irrelevant. The issue of redundancy between MAX-IO(C) and MAX-IO(place) has been raised by one of the anonymous *Linguistic Research* reviewers. It goes without saying that the deletion of Root node implies that of Place node. Hence, redundancy issue arises. I argue that both MAX-IO(C) and MAX-IO(place) are independently motivated: the former by consonant deletion, the latter by place assimilation. So, OT grammar is in need of both faithfulness constraints anyway. It just so happens that both of them play their roles in current analysis.

the output consonant [s] keeps a place feature in syllable-final position. (21c) is out of running because the stem-final /s/ in the input has no corresponding consonantal root node in the output.[17] The optimal output should be transparent one as in (21a), which violates none of the constraints. If we had not introduced the input distinction between (12a) and (12b), their differences in alternation would have remained unexplained. In other words, without the input distinction, the current constraint hierarchy would treat the two stems involved in (20) and (21) are in fact of the same type, and would treat them likewise in OT grammar. This is clearly the wrong prediction to make.

An important clarification of positing the input form for /s/-irregular stems is in order before we move on. The strongest hypothesis of OT is that explanations can be achieved through the interactions of output constraints alone. However, there are also *learnability* factors that have to be considered in the choice of input forms, requiring that underlying forms should be inferable, in the simplest way, from the constraint hierarchy. For our purposes, this means that the learner will choose the input leading to the fewest faithfulness violations.

With ROTB and LO as a guideline, I below offer a tableau-des-tableaux schema applied to the input form of [na.a] in (20), to compare each of the winning outputs from two different inputs.[18] As noted, the stem-final /s̲/ in (22a) is placeless while the corresponding /s/ in (22b) is place-specified as [Coronal]:

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17 An important insight, due to an anonymous reviewer, is that the current ranking of MAX-IO(Consonant) dominating MAX-IO(Place) is the opposite of an example of the general case/special case scenario. It should be familiar from the Elsewhere Condition (Kiparsky 1973) as well as a more recent work in OT (the "Pāṇinian relation" of Prince and Smolensky (1993)). But what exactly is 'being general'? If we view generality in terms of frequency, MAX-IO(Consonant) should be more general than MAX-IO(Place). However, if we take the amount of information involved in deletion into consideration, the converse should be true since the former involves more information than the latter. This is an open question and matter of debate, and is certainly an area worthy of further investigation.

18 The following quote is revealing (Prince and Smolensky 1993: 192): ... Consider first the task of the abstract learner of grammar. Under exposure to phonetically interpreted grammatical outputs, the underlying inputs must be inferred. Among the difficulties is one of particular interest to us: the many-to-one nature of the grammatical input-to-output mapping, arising from the violability of FAITHFULNESS ...

(22) Tableau des tableaux: Evaluating outputs of two different inputs for [na.a]

Input	Output	DEP(pl)	HAVE-PLACE	CODA FILTER	MAX(C)	MAX(pl)
✌a. /na**s̲**-/+/a/	☞[na.a]				*	
b. /na**s**-/+/a/	☞[na.a]				*	*!

As shown, the "V sign" chooses the /na**s̲**-/ as the optimal input as the deletion of the placeless /s̲/ does not incur the violation of MAX-IO(place). The tableau des tableaux schema therefore settles matters in favor of (22a) as the real input. It is this systematic evaluation of the input forms which typically surface as identical that leads to the conclusion that the stem-final /s̲/ in /s/-irregular stems is placeless just as the [h] in /h/-final stems.[19]

4.2 Alternation before a consonant-initial suffix

Now let us see what happens when the /h/-final stems encounter a consonant-initial suffix:

(23) /čo**h̲**-/ 'to be good' + /ko/ 'Connective' → [čok˥.k^{h}o]

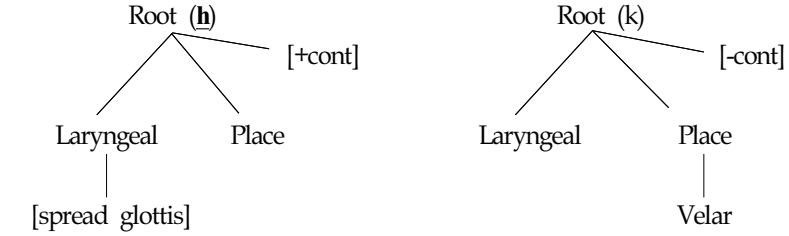
/čo**h̲**-/+/ko/	HAVE-PLACE	CODA FILTER	MAX (C)	MAX (pl)	UNIFORMITY	*GEMINATE
a. čo**h̲**.ko	*!(**h̲**)					
b. čo.**h**o	*!(**h̲**)		*(k)	*(Vel)		
c. čo.ko			*!(**h̲**)			
d. čo.k^{h}o					*!(k^{h})	
☞e. čok˥.k^{h}o						*

19 It is interesting to note that in Kyengsang and Cenla dialects of Korean /s/-irregular stems behave exactly like /s/-regular stems by surfacing the /s/ intervocalically, e.g., [i.sə.sə] for [i.ə.sə] in Standard Dialect (< /i:s-əsə/) 'connect and' (Kim-Renaud 1974: 29). My current position is that in such dialects learners should not find any surface alternations from /s/-irregular stems that are distinct from those from /s/-regular ones, leading to the absence of the former. One of the reviewers pointed out that current analysis relying on input forms as well as surface constraints may introduce 'duplication problem', which is 'the observation that rules of grammar often duplicate in their dynamic mappings the restrictions that are imposed statistically by lexical redundancy rules' (McCarthy 2002: 71). But it is crucial that each and every of the surface constraints in current analysis is arguably universal and does not directly refer to any input generalization. For this reason, the duplication effect is more apparent than real in this case.

The lack of place feature in the [**h**] of (23a, b) forces violation of HAVE-PLACE, which makes both candidates taken out of race. The deletion of /**h**/, as in (23c), successfully avoids HAVE-PLACE, at the expense of only one violation of MAX-IO(C). In (23d), two consonantal root nodes /h/ and /k/ are merged, violating the even lower-ranking UNIFORMITY-IO. (23e) satisfies CODAFILTER by having its coda share the Velar place with the following [k'] and all the other candidates (23a-d) vacuously satisfies it; (23a) in particular satisfies it because [**h**] is not place-holding. Therefore, CODAFILTER is not relevant in evaluation. (23e) turns out to be the most successful competitor, which satisfies all the high-ranking constraints by filling the empty place node of /**h**/ with the aid of spreading. This state of affairs is portrayed below:

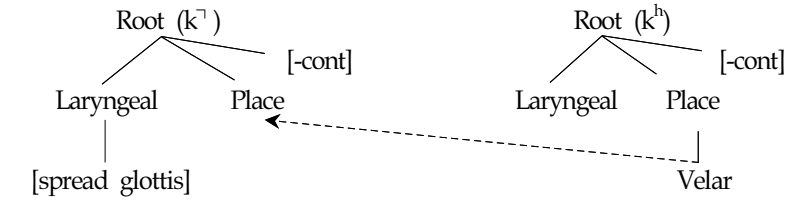
(24) Spreading of Velar place to the empty Place node of /**h**/

a. Input: /**h**/ + /k/



↓

b. Ouput: [k˺ .k^{h}]



As can be seen in the schematic representation in (24b), (23e: [čok˺ .k^{h}o]) avoids the violation of all the four high-ranking constraints by having the /**h**/ share place with the following /k/, thus violating the lowest-ranking *GEMINATE. It is significant that the [k^{h}] in (23e) is not the result from the merger of two input consonants but from the filling of empty Place node, which leads to the gemination of Velar place. Candidate (23e) therefore does not violate

UNIFORMITY-IO and is chosen as optimal under the ranking at hand.[20]

When /s/-irregular stems combine with a consonant-initial suffix, we obtain the same result as in (23). The following is in fact exactly what happened under (23) above:

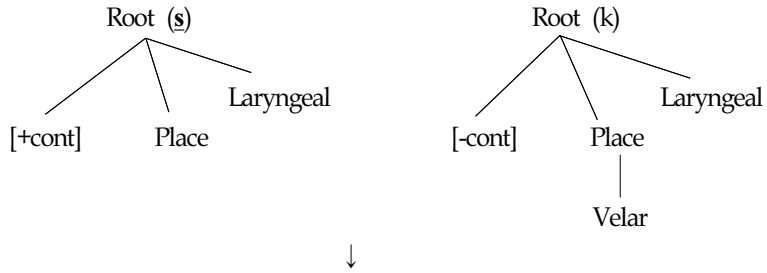
(25) /na**s̲**-/ 'to be better' + /ko/ 'Connective' → [nak˺.k'o]

/na**s̲**-/ + /ko/	HAVE-PLACE	CODA FILTER	MAX (C)	MAX (pl)	UNIFORMITY	*GEMINATE
a. na**s̲**.ko	*!(**s̲**)					
b. na.**s̲**o	*!(**s̲**)		*(k)	*(Vel)		
c. na.ko			*!(**s̲**)			
☞d. nak˺.k'o						*

The overall distribution of violation marks in (25) should be almost a carbon copy of (23). The optimal output should be (25d) where the placeless /**s̲**/ gets its empty place node filled through the spreading of the following consonantal Velar place:

(26) Spreading of Velar place to the empty Place node of /**s̲**/

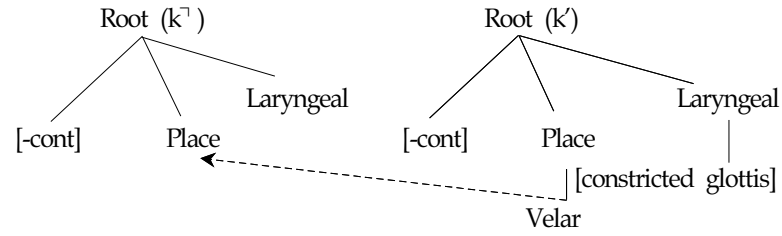
a. Input: /**s̲**/ + /k/



↓

20 In order to produce the correct output [čok˺.k^{h}o],we need to make the [spread glottis] in (24b) appear in the onset of following syllable. A constraint might be needed that aligns the final edge of [spread glottis] with the final edge of syllable onset. This move may well provide us with a potential clue to the nature of the so-called '/h/-irregular stems' illustrated earlier in (1d), where the stem-final /h/ in /norah-/ fails to survive before [m] in the output, as in [no.ra.mjən]. Space does not permit arguing the point in detail, but I would claim that in this case the [spread glottis] of the stem-final /h/ cannot be aligned with the following onset sonorant [m]. The traditional way of treating /h/-regular and /h/-irregular stems of Korean no longer obtains once the universal nature of /h/-deletion and the [spread glottis] alignment issue are taken into account.

b. Ouput: [k˺.k′]



The spreading of Velar place to the preceding empty place results in a doubly-linked marked structure [k˺.k′] in violation of the least expensive constrain, *GEMINATE. Therefore, (25d) is selected to be the most harmonic candidate.

The last but not least case to consider is how /s/-regular stems behave in the same environment as in (23) or (25). That is, what happens to the stem-final /s/ of regular stems before a consonant-initial suffix /-ko/? We will get the same result as in (23) or (25) but for a very different reason. To see why this is so, consider the following:

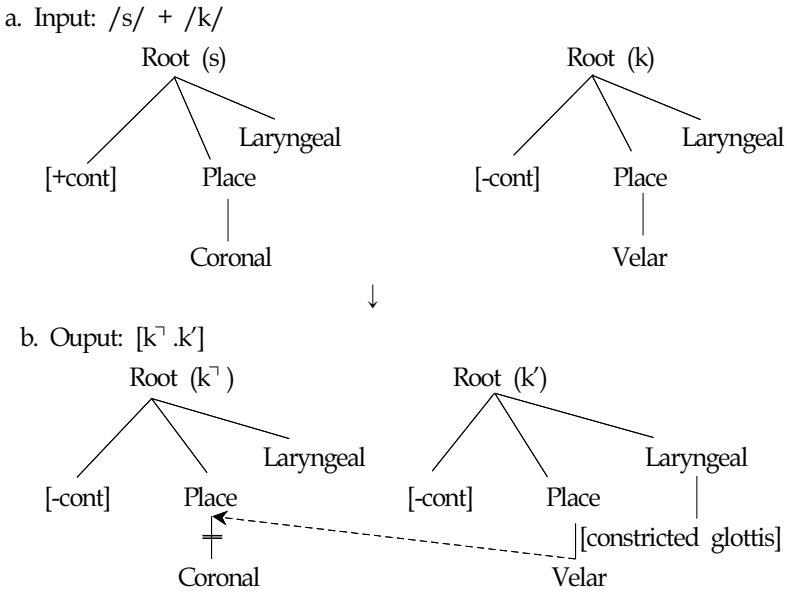
(27) /sos-/ 'to soar' + /ko/ 'Connective' → [sok˺.k′o]

/sos-/ + /ko/	AGREE(pl)	HAVE-PL	COFIL	MAX(C)	MAX(pl)
a. sos.ko	*!(s.k)		*(s)		
b. so.so				*!(k)	*(Vel)
c. so.ko				*!(s)	*(Cor)
☞d. sok˺.k′o					*(Cor)

The input stem /sos-/ is a regular one, so we are dealing with a case with a stem-final /s/ holding Coronal place feature. Here, the Coronal consonant /s/ gets to concatenate with the Velar consonant /k/ of Connective, which comes to constitute a typical configuration where place assimilation should take place, as portrayed below[21]:

(28) Place assimilation of the Coronal place of /s/ to the following Velar place

21 Remember that there was no adjacent consonantal place features in either (23) or (25) because of placeless /**h**/ or /**s**/.



(27a) is out by failing to place-assimilate the syllable-final Coronal to the following Velar. Like the earlier tableaux in (23) and (25), HAVE-PLACE does not show any preference for certain candidates. (27a) allows a place-holding [s] in syllable-final position, thereby violating CODAFILTER, but this violation is not crucial because of the more important violation of AGREE(place). To avoid violating CODAFILTER, (27b-c) deletes /k/ or /s/ violating the next low-ranking MAX-IO(C). (27d) is a configuration resulted from place assimilation: the Coronal place feature of the input /s/ gets deleted as a result of the Velar place spreading.[22] In the process of place assimilation, only place feature [Coronal] was affected, so (27d) eludes the violation of the costlier MAX-IO(C) and becomes victorious.[23]

22 The unreleasing of the syllable-final [k˺] and the tensification of the syllable-initial [k′] are so well attested. As noted in footnote 5, they are beyond the scope of this article.

23 The reader is referred to Lee (2017) for a more detailed presentation of place assimilation.

5. Conclusion

By reviewing ROTB and LO from a learnability perspective, it is discussed that input is not always unconstrained in OT grammar. Related to this point is the important discovery that the opaque alternations of /s/-irregular and /h/-final stems have been shown to be due to the lack of place features in their input specifications. Phonologically similar behavior of these stems should not come as a surprise given their virtually identical input specifications: both irregular stem-final /s/ and stem-final /h/ get deleted before a vowel-initial suffix. Their unpredictable alternations turn out in fact quite easy to explain. Before consonant-initial suffixes, both /s/-irregular stem-final /s/ and stem-final /h/ let their empty place node filled with the help of the following syllable-initial consonant, which is derivable from the interaction of already existing constraints in the hierarchy. On the other hand, the place-holding /s/ of regular stems turned out to undergo place assimilation because of adjacent consonantal place features. Some important conclusions can be drawn from this presented OT analysis. We still need to draw a line between '/s/-regular stems' and '/s/-irregular stems'. But the distinction entirely depends on whether or not a language learner posits a place specification in the input in the process of learning. That should be the source of the irregularity. The irregularity of /h/-final stems results from the fact that *h* is essentially placeless. All available evidence converges to show that such a universal constraint as HAVE-PLACE dominating faithfulness is responsible for the universal nature of *h*-deletion between vowels. These conclusions are well supported by the fact that all the irregular alternations in question are able to be explained by the interactions of independently-motivated universal constraints.

References

Bakovic, Eric. 2000. *Harmony, dominance, and control*. PhD Dissertation. Rutgers University.

Chey, Hyen-Pay. 1959. *Wuli-malpon* (A grammar of our language). Seoul: Cengum-sa.

Chomsky, Noam and Morris Halle. 1968. *The sound pattern of English*. New York: Harper and Row.

Clayton, Mary L. 1976. The redundance of underlying morpheme-structure conditions. *Language* 5: 295-313.

Dudas, Karen. 1976. *The phonology and morphology of modern Javanese*. PhD Dissertation. University of Illinois, Urbana-Champaign.

Goldsmith, John. 1990. *Autosegmental and Metrical Phonology*. Oxford and Cambridge, Mass.: Basil Blackwell.

Horne, Elinor. 1961. *Beginning Javanese*. New Haven, CT: Yale University Press.

Huh, Woong. 1965. *Kuke Umwunhak* (Korean Phonology). Seoul: Cengum-sa.

Itô, Junko. 1986. *Syllable theory in prosodic phonology*. PhD Dissertation. University of Massachusetts, Amherst.

Itô, Junko. 1989. A prosodic theory of epenthesis. *Natural Language and Linguistic Theory* 7: 217-259.

Jun, Jongho. 2014. Hiatus resolution and opacity in Seoul Korean stemal paradigm. *Studies in Phonetics, Phonology and Morphology* 20(3): 379-401.

Kager, René. 1999. *Optimality Theory*. Cambridge: Cambridge University Press.

Kenstowicz, Michael and Charles Kisseberth. 1977. *Topics in phonological theory*. New York: Academic Press.

Kim, Chin-Woo. 1973. Regularity of the so-called irregular predicates in Korean. Reprinted in Charles Wayne Kisseberth (ed.), *Studies in generative phonology*, 104-113. Edmonton, Canada: Linguistic Research Inc.

Kim-Renaud, Young-Key. 1974. *Korean consonantal phonology*. PhD Dissertation. University of Hawaii.

Kiparsky, Paul. 1973. "Elsewhere" in phonology. In Stephen R. Anderson and Paul Kiparsky (eds.), *A festschrift for Morris Halle*, 93-106. New York: Holt, Rinehart and Winston.

Ladefoged, Peter. 2006. *A Course in phonetics*. 5th ed. Boston: Thomson Higher Education.

Lee, Byung-Gun. 1976. *Hyentay hankwuke-uy sayngseng umwunlon* (Generative phonology of modern Korean). Seoul: Ilcisa.

Lee, Sechang. 2002. Markedness constraints and Optimality Theory. *Korean Journal of Linguistics* 27(1): 85-105.

Lee, Sechang. 2017. A study of unmarked sequence of place features in place assimilation. *Linguistic Research* 34(2): 247-265.

Lombardi, Linda. 1991. *Laryngeal features and laryngeal neutralization*. PhD Dissertation. University of Massachusetts, Amherst.

Lombardi, Linda. 1999. Positional faithfulness and voicing assimilation in Optimality Theory. *Natural Language and Linguistic Theory* 17: 267-302.

McCarthy, John J. 2002. *A Thematic guide to Optimality Theory*. Cambridge: Cambridge University Press.

McCarthy, J. John. 2007. *Hidden Generalizations: Phonological opacity in Optimality Theory*.

London: Equinox Publishing.
McCarthy, J. John. 2008a. *Doing Optimality Theory: Applying theory to data*. Malden, MA: Blackwell Publishing.
McCarthy, J. John. 2008b. The gradual path to cluster simplification. *Phonology* 25: 271-319.
McCarthy, John J. and Alan Prince. 1993. Prosodic morphology I: Constraint interaction and satisfaction. Ms. University of Massachusetts at Amherst and Rutgers University.
McCarthy, John J. and Alan Prince. 1995. Faithfulness and reduplicative identity. Rutgers Optimality Archive 60. [http//www. rutgers.edu/]
Padgett, Jaye. 1995. Partial class behavior and nasal place assimilation. Rutgers Optimality Archive 113. [http//www. rutgers.edu/]
Parker, Steve. 2001. Non-optimal onsets in Chamicuro: An inventory maximized in coda position. *Phonology* 18: 361-386.
Prince, Alan and Paul Smolensky. 1993. Optimality Theory: Constraint interaction in generative grammar. Ms. Rutgers University, New Brunswick and University of Colorado, Boulder.
Prince, Alan and Paul Smolensky. 2004. *Optimality Theory: Constraint interaction in generative grammar.* Malden: Blackwell Publishing.
Pulleyblank, Douglas. 2004. Harmony drivers: No disagreement allowed. In *Proceedings of the Twenty-eighth Annual Meeting of the Berkeley Linguistics Society*. Berkeley, CA: Berkeley Linguistics Society.
Smith, Jennifer L. 2002. *Phonological augmentation in prominent positions*. PhD Dissertation. University of Massachusetts, Amherst.
Stampe, David. 1972. *How I spent my summer vacation*. PhD Dissertation. University of Chicago.
Steriade, Donca. 1982. *Greek prosodies and the nature of syllablification*. PhD Dissertation. MIT.

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