On the regularity of the so-called /p/-irregular stems in Korean*

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Lee, Sechang. On the regularity of the so-called /p/-irregular sems in Korean. *Studies in Phonetics, Phonology and Morphology* 6.2, 395-414. The purpose of this paper is to show how an optimality-theoretic conception of phonology (Prince & Smolensky 1993, McCarthy & Prince 1995) overcomes some of the limitations of the traditional ways of treating the so-called '/p/-irregular stems' in Korean. Following Gorecka (1989), I adopt the Site-Articulator model. For the underlying representation of the /p/-irregular stem-final consonant, I posit /w/ which is identical with that of /u/. Therefore, it does not complicate the phonemic inventory of Korean. Investigation along these lines will lead exactly to the right predictions, which will contribute to making the grammar of Korean simpler. (Sookmyung Women's University)

Keywords: irregular stem, site-articulator, lexicon optimization, place assimilation

1. Introduction

Korean stems are typically categorized into two groups: regular and irregular. Regular stems are invariant throughout the paradigm. Irregular stems, on the other hand, show alternations before certain suffixes. In the literature on Korean (e.g., Choy 1959; Huh 1965; Martin 1992), the behavior of irregular stems is usually left unanalyzed as the alternations are considered to be phonologically unmotivated. I aim to show in this paper that irregular alternations are not really irregular but phonologically predictable.

My argumentation is organized in the following way. After a presentation of surface [p]/[u](or [w]) alternations of /p/-irregular stems, I argue that the alternation in question should be explained in terms of simplification in coda position, which will be captured through the interaction of structural and faithfulness constraints.

2. The paradigm

The /p/-regular stems are those stems that end in /p/. They do not show any alternations before suffixes, as shown in (1): an underlying phoneme /p/ is phonetically realized in its unchanged form when either a vowel or a consonant follows:

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(1) The /p/-regular stems

	Indicative	Connective	Stative	Nominal	Gloss
a.	/kop + ta/	/kop + ko/	/kop + a/	/kop + m/	'to be numb'
	↓	↓	↓	↓	
	[kop$^{=}$.t'a][1]	[kop$^{=}$.k'o]	[ko.ba]	[ko.b +m]	
b.	/kup + ta/	/kup + ko/	/kup + ə/	/kup + m/	'to bend'
	↓	↓	↓	↓	
	[kup$^{=}$.t'a]	[kup$^{=}$.k'o]	[ku.bə]	[ku.b+m]	
c.	/s'ip + ta/	/s'ip + ko/	/s'ip + ə/	/s'ip + m/	'to chew'
	↓	↓	↓	↓	
	[s'ip$^{=}$.t'a]	[s'ip$^{=}$.k'o]	[s'i.bə]	[s'i.b+m]	

However, the /p/-irregular stems show alternations, as illustrated in (2): the stems apparently end in /p/, but show an alternation of [p]~[w] before a vowel (i.e., Stative forms) while they have no such alternation before a consonant (i.e., Indicative and Connective forms). The question then is how to distinguish between those two types of stems in a natural way:

(2) The /p/-irregular stems

	Indicative	Connective	Stative	Nominal	Gloss
a.	/kop + ta/	/kop + ko/	/kop + a/	/kop + m/	'to be beautiful'
	↓	↓	↓	↓	
	[kop$^{=}$.t'a]	[kop$^{=}$.k'o]	[ko.wa]	[ko.um]	
b.	/kup + ta/	/kup + ko/	/kup + ə/	/kup + m/	'to roast'
	↓	↓	↓	↓	
	[kup$^{=}$.t'a]	[kup$^{=}$.k'o]	[ku.wə]	[ku.um]	
c.	/mip + ta/	/mip + ko/	/mip + ə /	/mip + m/	'to be hateful'
	↓	↓	↓	↓	
	[mip$^{=}$.t'a]	[mip$^{=}$.k'o]	[mi.wə]	[mi.um]	

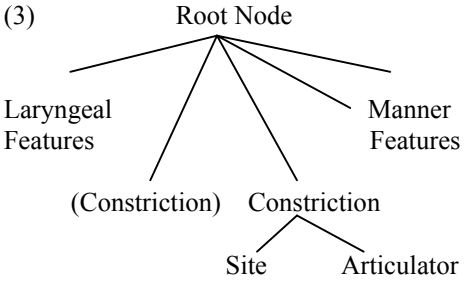
[1] In Korean, when obstruents are unrelesed in coda (e.g., [p$^{=}$]), the subsequent onset consonants undergo tensification (e.g., [t']), which I shall put to the side in this research.

3. The Site-Articulator model

Since the mid 1980's most phonologists in the autosegmental tradition have assumed a version of feature geometry closely resembling that of Sagey (1986). Sagey's model has a place node under which there are three active articulators of the vocal tract: Labial (the lips), Coronal (the tongue tip and blade) and Dorsal (the tongue body). Sageyan models have assumed the existence of those three articulators, but have not taken site features seriously. Where the simple partition into major active articulators is not sufficient, the finer distinctions are made by adding dependent features under those major articulator nodes, which is an ad hoc choice. For instance, in case dental and palatal coronals such as /ʃ/ and /s/ contrast in certain language, this will be represented by the secondary specification of [±anterior] under the Coronal node. The problem is that the SPE system is fundamentally active-articulator-oriented, but the articulatory correlate of [±anterior] is the location of the constriction: forward of or behind the alveolar ridge.

One fundamental insight of Gorecka (1989) is that the passive articulator (i.e., site) as well as the active articulator needs to be specified, which enables many analyses clearer. She argues for a phonological constituent called the Constriction Node, which represents the constriction gesture. The hierarchical representation of a segment including the Constriction Node is represented as follows:

(3)



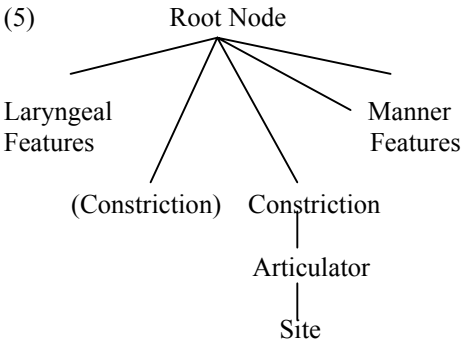
The constriction node in (3) is formally equivalent to the articulator node in the Sagey's model. The Site-Articulator model reconciles two traditions of segment characterization: the IPA tradition where the site of a constriction is one of the most important principles, and the SPE tradition where the features based on active articulator are given priority.

There are eight Site-Articulator combinations which represent physically possible gestures, after getting rid of some impossible ones:

(4) Site-Articulator combinations (after Gorecka 1989: 11)
   a. Labial/Lower Lip (labial sounds): p, b, m, u, o
   b. Anterior/Lower Lip (labiodental sounds): f, v, ɱ
   c. Anterior/Tongue Blade (anterior coronals): t, d, s, z, θ, ð
   d. Palatal/Tongue Blade (palatal coronals): č, ʒ, ʃ, ĵ
   e. Palatal/Tongue Body (non-low front vowels): c, ɟ, ç, i, e
   f. Velar/Tongue Body (velar sounds): k, g, x, ɣ, q, χ, ʁ, u, o
   g. Pharyngeal/Tongue Body: æ, ɑ
   h. Pharyngeal/Tongue Root: ħ, ʕ, a

Gorecka (1989: 120-123) suggests the possibility that the Articulator dominates the Site, which I adopt in this paper. It is illustrated below:

(5)

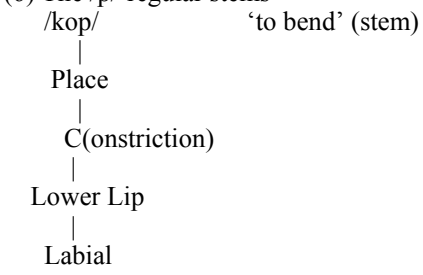


Compared with the hierarchical structure in (3), the one in (5) implies that phonological processes can make access to the Site features independently of the Articulator features.

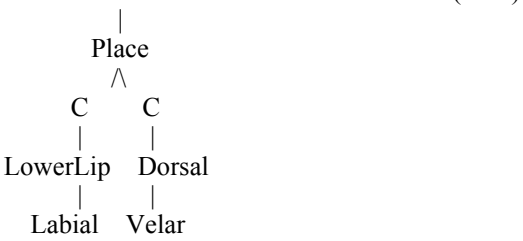
4. The proposal

From the point of view of the Site-Articulator model (Gorecka 1989) and its conception of constriction location, the alternation between [p] and [w] can be straightforwardly accounted for. Based on the combinations in (4), I suggest two different underlying representations for the two types of stems in question, as given in (6) and (7):

(6) The /p/-regular stems



(7) The /p/-irregular stems



The /p/-regular verb stem in (6) has a Labial constriction under the Place node while the /p/-irregular counterpart in (7) is assumed to have both Labial and Velar constrictions. A fact of special interest here is that positing two different underlying representations for the same stem-final /p/ does not complicate the underlying segment inventory of Korean. That is because the particular double constriction in (7) is in fact exactly the configuration of /u/ or /w/ which already exists in the phonemic inventory of Korean: (6) is simply a representation of /p/ while (7) is that of /u/ or /w/ according to Gorecka (1989). I assume that the glide /w/ is actually identical with /u/ in constriction locations, but the one differs from the other in syllable positions: /w/ is a nonsyllabic counterpart of /u/, and therefore it occupies a syllable onset position.

In fact, Martin (1992) makes the same observation: he posits a stem-final 'w' and observes that it alternates with 'p' before a consonant-initial suffix:

(8) (after Martin 1992: 223)

/tow-/	'to help'	+	/-ko/	→	[top$^{=}$.k'o]
/tow-/		+	/-a/	→	[to.wa]
/tow-/		+	/-una/	→	[to.wu.na]

Given this, we are in a position to translate the irregularity of the /w/-ending stems into the framework of Optimality Theory (OT, henceforth). In the analysis of the /p/-irregular stems, I will show that they can also be analyzed in the manner consistent with other aspects of Korean phonology throughout this paper. I propose that the alternation of the irregular stem-final /w/ in question result from the interaction between the constraint which forbids double constriction in coda position (9a) and a faithfulness constraint (9b):

(9)
a. *COMPLEX: Complex segments (i.e., segments that have more than one constriction node) are not allowed in coda.
b. MAX-IO(C): A constriction node in the input must have a correspondent in the output.

4.1 Lexicon Optimization

It has been proposed that in the absence of empirical evidence for one input form over another, the input should be selected that is closest to the output. That is, whenever the learner has no evidence to postulate a specific diverging lexical form, he or she will assume that the input is identical to the surface form. This stragegy is called *Lexical Optimization* in Prince and Smolensky (1993: 192):

(10)
Lexicon Optimization: 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 *phonetically equivalent* with respect to G. Now one of these outputs must be harmonic, by virtue of incurring the least significant violation marks: suppose this optimal one is labelled O_k. Then the learner should choose, as the underlying form for ϕ, the inpt I_k.

The original principle in (10) dealt only with morphemes with a single phonetic realization. For the purpose of dealing with alternating morphemes, Inkelas (1995: 289) offers an alternation-sensitive restatement in (11):

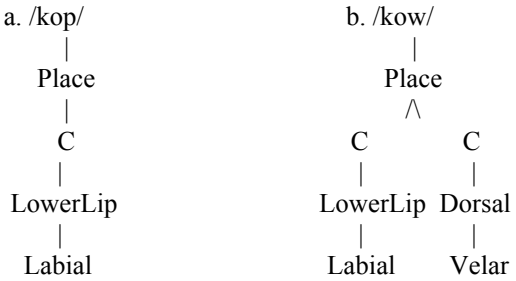
(11)
Alternation-sensitive restatement of Lexicon Optimization: Given a set S = {S_1, S_2, … S_n} of surface phonetic forms for a morpheme M, suppose that there is a set of inputs I = {I_1, I_2, … I_n}, each of whose members has a set of surface realizations equivalent to S. There is some $I_i \in I$ such that the mapping between I_i and the members of S is the most harmonic, i.e.

incurring the fewest marks in grammar for the highest ranked constraints. The learner should choose that I_i as the underlying representation for M.

In the following Lexicon Optimization tableau, (12a) and (12b) contrast two underlying representations for the /p/-irregular stem in (7):

(12)

Lexicon Optimization			example context	DEP-IO (constriction)	MAX-IO (constric.)
a.	/kop/	[kop]	kop.ko		
		[kow]	ko.wa	*!	
☞ b.	/kow/	[kop]	kop.ko		*
		[kow]	ko.wa		



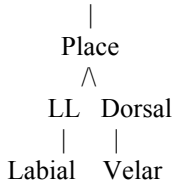
In the tableau (12), input candidate (12b) wins because its mapping to surface forms incurs no violations compared with that of candidate (12a).

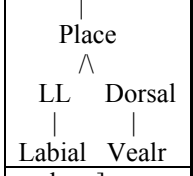
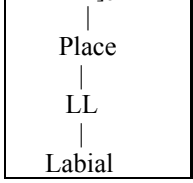
Importantly, Lexicon Optimization does not contradict the assumption of the Richness of the Base. Positing two separate underlying representations in (6) and (7), therefore, does not contradict the Richness of the base which tries not to impose any restrictions on the underlying representations.

4.2 The Analysis

From the OT perspective in the sense of McCarthy & Prince (1995), deletion of the Velar constriction means that *COMPLEX dominates MAX-IO(velar constriction). With this ranking, obedience to the structural constraint takes precedence over preservation of the input form, as illustrated below:

(13) Input: /kow/ 'to be beautiful' (stem)



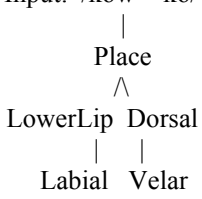
Candidates	*COMPLEX	MAX-IO(velar)
a. w]$_\sigma$ 	*!	
☞ b. w]$_\sigma$ 		*!

It is necessary to ask why there should be a deletion of Velar constriction instead of Labial constriction to satisfy the *COMPLEX. Assuming that Labial constriction is more prominent than Velar constriction, MAX-IO(labial constriction) dominates MAX-IO(velar constriction), which means that the actual output violates the latter rather than the former:

(14) *COMPLEX 》 MAX-IO(labial C.) 》 MAX-IO(velar C.)

The ranking (MAX-IO(labial C.) 》 MAX-IO(velar C.)) may contradict that of place assimilation (i.e., MAX-IO(velar C.) 》 MAX-IO(labial C.)), but it will be shown below that (8) is for formal (not casual) speech. We can see the interaction of these constraints in the following tableau, in which unfettered *COMPLEX always yields a simplification effect of complex segments (ie., with two constrictions) in coda:

(15) Input: /kow + ko/ 'to be beautiful' (Connective)



Candidates	*COMPLEX	MAX-IO(labial)	MAX-IO(velar)
a. [kow.ko]	*!		
b. [kok⁼.k'o]		*!	
☞c.[kop⁼.k'o]			*

(15a) is faithful to the input and so has two constrictions in coda, which is forbidden by *COMPLEX. Since the violation of *COMPLEX by (15a) is fatal, the decision has to be made between (15b) and (15c). (15b) lacks the Labial constriction, crucially violating MAX-IO(labial constriction). The optimal output is therefore (15c), which violates neither of these high-ranked constraints. (15c) is in violation of MAX-IO(velar constriction), which is low-ranked. Therefore, this analysis captures the fact that the glide [w] is not found in coda position in Korean.

The situation is not always straightforward, however. The ranking 'MAX –IO(labial constriction) 》 MAX-IO(velar constriction)' will apparently conflict with the widely-accepted ranking for Korean place assimilation: MAX-IO(velar constriction) 》 MAX-IO(labial constriction). In the next section, I will elaborate on this.

5. Faithfulness and place assimilation

The crux of my position in this paper is that I provide a unified account of the conflicting rankings of two faithfulness constraints (i.e., MAX-IO(velar constriction) and MAX-IO(labial constriction)). The analysis presented in the preceding section would run up against a serious problem. Let us see why.

Korean place assimilation represents the opposite state of affairs. By way of illustration, consider the following:

(16) Place assimilation in Korean

a. coronal → velar

/k**ə**t + ki/ → [k**ə**t͡=.k'i], [k**ə**k͡=.k'i] 'walking'

b. coronal → labial

/si**n** + pal/ → [si**n**.bal], [si**m**.bal] 'shoes'

c. labial → velar

/pa**p** + kaps/ → [pa**p**͡=.k'ap], [pa**k**͡=.k'ap] 'meal price'

d. *labial → coronal

/pa**p** + to/ → [pa**p**͡=.t'o], *[pa**t**͡=.t'o] 'rice also'

e. *velar → labial

/koŋ.pu/ → [ko**ŋ**.bu], *[ko**m**.bu] 'study'

f. *velar → coronal

/ča**k**tu/ → [ča**k**͡=.t'u], *[ča**t**͡=.t'u] 'a straw cutter'

I observe that in Korean, a coronal consonant, whether oral or nasal, optionally assimilates in point of articulation to the following consonant (16a, b). Labials also optionally assimilate in point of articulation to a following velar consonant (16c), but not to a coronal consonant (16d). Velars do not assimilate in any case (16e, f).

Why should this be? Given certain markedness constraint triggering assimilation, a natural answer would be that it is due to a kind of ranking with respect to faithfulness constraints, as (17) shows.

(17) Ranking of faithfulness constraints in Korean place assimilation

: ..... MAX-IO(velar constriction) 》 ..... MAX-IO(labial constriction) 》 ..... MAX-IO(coronal constriction) .....

The ranking would explain the order in which coronals assimilate to labials which in turn assimilate to velars, but not in the reverse order.

This contradicts the underlined part of the ranking of faithfulness constraints established in (14), repeated as (18) below.

(18) *COMPLEX 》 MAX-IO(labial constriction) 》 MAX-IO(velar constriction)

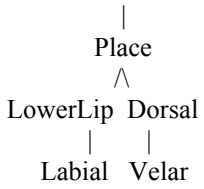
In the following section I will offer a new perspective of the analysis.

6. Optionality in OT

6.1 /p/-irregular stems before Connective and Indicative suffixes

Continuing to assume, as above, that the *COMPLEX in (9a) is a kind of coda simplification and weakening process which forces the deletion of less resistant constriction, let us consider again what happens when /p/-irregular stems are followed by consonant-initial suffixes.

(19) Input: /kow + ko/ 'to be beautiful' (Connective)



Candidates	*COMPLEX	MAX-IO(labial)	MAX-IO(velar)
a. [kow.ko] | Place /\ LL Dorsal | | Labial Velar	*!		
b. [kok$^{=}$.k'o] | Place | Dorsal | Velar		*!	
☞c.[kop$^{=}$.k'o] | Place | LL | Labial			*

For (19c), MAX-IO(velar) is violated, but this violation is forced by the out-ranking constraints. The details of the argument here are identical to those for tableau (15) above.

In casual speech, however, (19b) may be more optimal than (19c) since consonantal place assimilation is very productive, as in the case of (16c: /pa**p** + kaps/ → [pa**k**$^{=}$.k'ap] 'meal price').[2] In other words, we can have two different actual outputs determined solely by the rate of speech: /pa**p** + kaps/ 'meal + price' → [pa**p**$^{=}$.k'ap] (formal or slow speech), [pa**k**$^{=}$.k'ap] (casual or rapid speech). This is an issue of 'free variation,' also known as 'optionality':

(20)

Input → Grammar → Output1
↘ Output2

[2] cf. Ahn (1997)

Examples of optionality are abundant in natural languages, and the paradigm of place assimilation illustrated in (16) is just one of them.

So far, we have assumed that constraints are *strictly ranked*. Two conflicting constraints C_1 and C_2 are ranked in either of two ways. C_1 strictly dominates C_2, or C_2 strictly dominates C_1. 'Free Ranking' was observed as a purely theoretical option by Prince & Smolensky (1993), and since been argued to be the OT counterpart of optional rule application. When two constraints C_1 and C_2 are freely ranked, the evaluation procedure branches at that point. In one branch, C_1 is ranked above C_2, while in the other branch the ranking is reversed:

(21) Interpretation of free ranking of constraints C_1, C_2 (Kager 1999: 406)
: Evaluation of the candidate set is split into two subhierarchies, each of which selects an optimal output. One subhierarchy has $C_1 \gg C_2$, and the other $C_2 \gg C_1$.

It is notable that free ranking preserves strict domination, which holds within each subhierarchy.

Adopting Lombardi (1999: 272), I assume a constraint that enforces place assimilation in obstruent clusters:

(22) AGREE: Obstruent clusters should agree in place

An illustrative 'free ranking tableau' is shown below, where surface candidates for an underlying representation of /kow + ko/ are evaluated. When two interacting constraints are left unranked, each can dominate the other, giving two tableaux. The result is free variation (Anttila 1995, 1997). The conflict between MAX-IO(labial) and MAX-IO(velar) is resolved in favor of either the latter (23b) or the former (23a). I assume the position of AGREE in the ranking is between the relevant two faithfulness constraints:

(23) Input: /kow + ko/ 'to be beautiful' (Connective)

Candidates	*COMPLEX	MAX-IO(labial)	AGREE	MAX-IO(velar)
a.i [kow.ko] | Place /\ LL Dorsal | | Labial Velar	*!		*	
a.ii [kok$^{=}$.k'o] |/ Place | Dorsal | Velar		*!		
☞ a.iii [kop$^{=}$.k'o] | Place | LL | Labial			*	*

Candidates	*COMPLEX	MAX-IO(velar)	AGREE	MAX-IO(labial)

b.i [kow.ko] | Place /\ LL Dorsal | | Labial Velar	*!		*	
☞b.ii [kok⁼.k'o] |/ Place | Dorsal | Velar				*
b.iii [kop⁼.k'o] | Place | LL | Labial		*!	*	

Subhierarchies differ only in constraints whose ranking is not stipulated by the grammar. In the first subhierarchy, (23a.iii) [kop⁼.k'o] is manifestly more harmonic than any competitor. In the second subhierarchy, (23b.ii) [kok⁼.k'o] is correctly chosen by a reversed constraint ranking. Therefore, it offers a fairly accurate estimate of the frequency of occurrence for each output (Anttila 1995). Not surprisingly, a similar point could be made for practically all /p/-irregular stems before obstruent-inital suffixes (Indicative and Connective in (2), among others).[3]

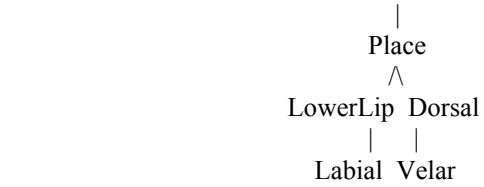
6.2 /p/-irregular stems before Nominal and Stative suffixes

Out of four suffixes (Connective, Indicative, Nominal, and Stative forms of /p/-irregular stems) in (1), two forms remain to be explained (i.e., Nominal and Stative forms). If we adopt the analysis outlined so far, their array of facts is correctly described.

First, the irregular Nominal form can receive a straightforward treatment. The analysis proceeds as follows:

[3] In Korean, the syllable-final glide [w] in (23ai) and (23bi) is independently prohibited by some high-ranking markedness constraint which forbids glides in coda position. Therefore, syllable-initial obstruent tensification does not occur because it requires a preceding consonant in the coda position.

(24) Input: /kow + m/ 'to be beautiful' (Nominal)



Candidates	*COMPLEX	MAX(lab)	MAX(vel)	DEP-IO(seg.)
☞a. [ko.um]				
b. [ko.k m]		*!		*
c. [ko.p m]			*!	*

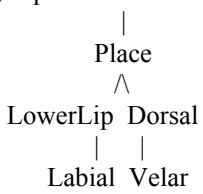
If the stem-final /w/ is syllabified as the onset of the following syllable as in (24b) and (24c), there must be an epenthesis of a nucleus to support the onset (e.g., /kow + m/ → *[ko.k m], *[ko.p m]), which is not allowed in Korean. It means that the constraint against epenthesis (i.e., DEP-IO(segment)) does not play any role in the present constraint hierarchy:

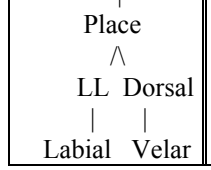
(25) DEP-IO(segment)
: Every segment in the output has a correspondent in the input.

It may be either highly- or low-ranked. But in either case, it does not complicate the situation. Besides, whatever the ranking between MAX-IO(labial) and MAX-IO(velar), it does not prevent (24a) from defeating (24b) and (24c). This tells something that we already suspected: (24a) does not violate any of constraints, which is a result of syllabification.

Finally, let us consider a case in which the stem-final /w/ is followed by a vowel-initial suffix (i.e., Stative). The following tableau compares three plausible candidates:

(26) Input: /kow + a/ 'to be beautiful' (Nominal)



Candidates	*COMPLEX	MAX(lab)	MAX(vel)	DEP-IO(seg.)
☞a. [ko.wa][4] 				

[4] The glide [w] is syllabified as an onset of the second syllable. It is a natural consequence of syllabification because the glide is allowed in syllable onset position in Korean.

b. [ko.ka] | Place | Dorsal | Velar		*!		
c. [ko.pa] | Place | LL | Labial			*!	

Three candidates fare equally well in terms of *COMPLEX: none of them has a syllable coda. (26b) is out because it violates MAX-IO(labial), and there are candidates available that do not violate the constraint. Of the two candidates that pass this second test, (26c) is excluded because it violates MAX-IO(velar). We can see that MAX-IO(velar) is active here. (26a) is faithful to the input, obeying both MAX-IO(labial) and MAX-IO(velar). Thus, it is syllabified as [ko.wa], with the stem-final /w/ keeping its double constriction in surface, as it was. In syllable onset position, *COMPLEX is inapplicable, and so it is obeyed. The optimal form (26a) uniquely satisfies all the constraints.[5]

7. Conclusion

It was argued in this paper that the so-called '/p/-irregular' stems in Korean which have been regarded as mysterious by many of the traditional grammarians of Korean (Choy 1959, Huh 1965, Martin 1992, among others) are in fact not anomalous. From the perspective of OT, there is no mystery here. On the contrary, the irregular stems turned out to be phonologically predictable, employing the language-specific ranking of universal constraints that is central to OT. Particularly, positing an underlying represetation of /w/ for the /p/-irregular stem-final consonant does not complicate the phonemic inventory of Korean because it already exists as that of /u/. In addition, the Nominal and Stative forms were a natural consequence of syllablification. It would make the grammar of

[5] In Kyungsang dialect, the so-called /p/-irregular stems do not show any alternations before a vowel-initial suffix; /təp + ə/ 'to be hot (Stative)' → [tə.bə] (Kyungsang dialect), [tə.wə] (Standard dialect). In that case, I assume that the Kyungsang dialect has no irregular stems at all. The stem-final /p/ in /təp/ would have only a labial constriction as in (6). Thus, it would behave as if it were regular stems in the Standard dialect.

Korean simpler by eliminating from it a great deal of phonological and morphological exceptions.

In the process, an issue of 'optionality' was raised and it must somehow be part of the essence of language, which is the business of the theory to capture. 'Free Ranking' was adopted and it seems intuitively defensible since the free ranking captures the occurrence frequency of two actual outputs.

8. Appendix

The following class of stems is called '/t/-irregular.' The stems in this class show a [t]~[r] alternation in the stem-final position (i.e., [r] before vowels, [t] elsewhere):

(27) The /t/-irregular stems

Indicative	Connective	Stative	Nominal	Gloss
/k t + ta/[6]	/k t + ko/	/k t + ə/	/k t + m/	'to walk'
↓	↓	↓	↓	
[k t͡.t'a]	[k t͡.k'o]	[k ə.rə]	[k .r m]	

A question arises as to why 't' and 'r' should alternate in this way.[7] One thing apparent is that it could not be analyzed just the way I analyzed the /p/-irregular stems mainly because both 't' and 'r' would have a single constriction node. I leave this issue to further research.

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[6] There are more data; /mut-/ 'to ask', /t t-/ 'to hear', etc.

[7] I am grateful to reviewers for calling this issue to my attention.

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