

The opacity of *s*-irregular verbs in Korean: Confronting Optimality Theory approaches

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Abstract

In Korean phonology, the vowel *ɪ* deletes when it appears in a vowel hiatus context across the boundary between a root word and a suffix (e.g. [pɛ:na] (/pɛ:-ɪna/) ‘since (it) goes’). The class of “*s*-irregular verbs”, however, exhibits opacity in that *ɪ* fails to delete in some surface forms although the conditioning environment appears to be present. Instead, these verbs undergo a process of vowel shortening (e.g. [kɪəsə] (/kɪ:s-əsə/) ‘marks and’), despite the fact that long vowels are allowed in other forms as shown above.

This paper treats the underapplication of *ɪ*-deletion and the overapplication of vowel shortening as potentially two instances of opacity exhibited by the same class of verbs in Korean. Standard Optimality Theory (OT) cannot model problems of opacity, but other OT approaches for dealing with opaque processes have been proposed. I show that Comparative Markedness (McCarthy 2003) is a more suitable OT approach in accounting for the opacity of these *s*-irregular verbs compared to Sympathy Theory (McCarthy 1999) and Contrast Preservation Theory (Lubowicz 2003), although not without new implications.

1. Introduction

This paper investigates two different types of opacity, which occur in Korean using Optimality Theory (OT) approaches. Instances of opacity are problematic for OT, a theory that posits constraints on surface forms, because they do not have overt variations that would violate such surface constraints. Three OT approaches: Sympathy Theory (McCarthy 1999), Contrast Preservation Theory (Lubowicz 2003), and Comparative Markedness (McCarthy 2003) are applied to Korean data in this paper. I show that Comparative Markedness is superior to the other theories in accounting for the opacity problems in Korean.

To begin, I introduce the data relevant to two phonological generalizations in Korean and discuss how these forms exhibit opacity. One instance of opacity is the underapplication of *ɨ*-deletion. We expect the high back unrounded vowel to delete because the surface forms present an environment in which this normally takes place in other forms, but *ɨ* fails to delete. The second case of opacity is the overapplication of vowel shortening, where long vowels unexpectedly become short in some forms despite the fact that they remain long in other forms. Crucially, the environment that would trigger vowel shortening does not seem to be present in the forms in which long vowels become short.

Standard OT (Prince and Smolensky 1993) does not fare well in its predictions when dealing with problems of opacity traditionally manipulated by rule ordering serial derivations, as I will later discuss. Therefore, the three OT approaches mentioned above which were devised specifically for handling opacity are presented and used to analyze the data. Each theory provides us with a different view with which we can analyze the opacity phenomena in Korean. The explanations that they propose are compared and consequently, evaluated in terms of how well they account for the data.

2. Data

An unresolved question in Korean phonology concerns a process of deletion that applies only to the high back unrounded vowel¹, when it appears in a vowel hiatus context across a morpheme boundary (more specifically, the boundary between a root word and a suffix). For example, a suffix-initial *ɨ* deletes when the root morpheme ends in a vowel. This occurs regardless of whether the root is a verb or a noun as shown in examples (1) and (2) respectively.

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|-----|----|-------------|-----------|-------------------|-------------------------|
| (1) | a. | /ka-ɨni/ | [kani] | ‘since (it) goes’ | (Ahn, 1991: 8) |
| | b. | /po-ɨlä/ | [porä] | ‘in order to see’ | (Ahn, 1991: 2) |
| | c. | /s’a-ɨmyan/ | [s’amyän] | ‘to be cheap’ | (Sohn, 1986: 126) |
| | d. | /pe:-ɨna/ | [pe:na] | ‘cuts but’ | (Kim-Renaud, 1982: 477) |
| (2) | a. | /ka-ɨro/ | [karo] | ‘to the edge’ | (Ahn, 1991: 7) |
| | b. | /cincu-ɨro/ | [cincuro] | ‘with pearl’ | (Sohn, 1986: 118) |

When the root ends in *ɨ* and is followed by a vowel-initial affix, *ɨ*-deletion also occurs as in the examples of (3) which are all verbs.

¹ When vowel hiatus occurs and neither of the vowels is *ɨ*, no vowel deletion takes place. This paper does not deal with the question of why only *ɨ* and not other vowels deletes in this context, but one possible explanation was proposed by Sohn (1986). Sohn suggests that only *ɨ* deletes because it is the only unspecified vowel in Korean.

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|-----|----|-------------|-----------|--------------------------|-------------------------|
| (3) | a. | /camki-i/ | [camgi] | ‘to be locked’ | (Ahn, 1991: 2) |
| | b. | /kənni-ita/ | [kənnida] | ‘lets cross’ | (Kim-Renaud, 1982: 475) |
| | c. | /pap’i-a/ | [pap’a] | ‘to be busy’ | (Sohn, 1986: 122) |
| | d. | /s’i-äto/ | [s’ädo] | ‘although we write’ | (Ahn, 1991: 7) |
| | e. | /s’i-iuta/ | [s’iuda] | ‘let... wear (of a hat)’ | (Sohn, 1986: 120) |

There are some exceptions however. *i* does not delete at the end of some verbs before a vowel-initial suffix:

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|-----|----|------------------------|----------------------|----------------|-------------------------|
| (4) | a. | /s’i-i/ | [s’i] | ‘to be used’ | (Ahn, 1991: 8) |
| | b. | /s’i-ita/ | [s’ida] | ‘is used’ | (Kim-Renaud, 1982: 475) |
| | c. | /t ^h i-i/ | [t ^h i] | ‘to be opened’ | (Ahn, 1991: 8) |
| | d. | /t ^h i-ita/ | [t ^h ida] | ‘is opened’ | (Kim-Renaud, 1982: 475) |

The one noun that ends in *i* in Korean, when combined with a vowel-initial suffix, also does not undergo *i*-deletion:

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|-----|----|----------|---------|----------|-------------------------|
| (5) | a. | /ki-eke/ | [kiëge] | ‘to him’ | (Kim-Renaud, 1982: 475) |
|-----|----|----------|---------|----------|-------------------------|

Furthermore, deletion of the epenthesis *i* vowel in loanwords does not occur as shown below in (6).

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|-----|----|---------------------------------------|--------------------------------------|---------------|-------------------------|
| (6) | a. | /sɪmis’i-e/ | [sɪmisɪe] | ‘Smith’s’ | (Kim-Renaud, 1982: 475) |
| | b. | /milk ^h i-e/ | [milk ^h ɪe] | ‘in the milk’ | (Kim-Renaud, 1982: 475) |
| | c. | /bəsɪ-e/ | [bəsɪe] | ‘in the bus’ | (Sohn, 1986: 126) |
| | d. | /k ^h o:t ^h i-e/ | [k ^h o:t ^h ɪe] | ‘in the coat’ | (Sohn, 1986: 126) |

Following Sohn (1986), I treat the exceptions in (4) as true exceptions. I attribute the examples of (5) and (6) to lexical specification, such that *i*-deletion does not affect segments in noun roots². These will not be addressed here.

I focus on a particular group of exceptions in which the root morpheme ends in a consonant underlyingly. This consonant is absent in the surface form, leading to vowel hiatus, yet the vowel *i* does not delete in these forms:

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|-----|----|------------|---------|-------------|-------------------------|
| (7) | a. | /kɪs-a/ | [kɪa] | ‘to draw’ | (Sohn, 1986: 125) |
| | b. | /ci:s-ɪni/ | [ciɪni] | ‘to build’ | (Sohn, 1986: 125) |
| | c. | /kɪ:s-əsə/ | [kɪəsə] | ‘marks and’ | (Kim-Renaud, 1982: 477) |

These examples belong to a group called *s*-irregular verbs.³ (Kim-Renaud (1982) and Ahn (1991) deal with *l*-irregular and *h*-irregular verbs respectively, however I will only address the problems of opacity as they pertain to *s*-irregular verbs in this paper.)

² See Smith (1997) on domain specific noun faithfulness.

The data presented here raises two important questions. First, why does *ʃ* delete in some vowel hiatus contexts (as in examples (1), (2), and (3) above), but not in others (such as in *s*-irregular verbs)? Second, why do the underlying long vowels in the input of the forms in (7b) and (7c) surface as short vowels, while example (1d) shows that an underlying long vowel can remain long in the output?

In response to the second question, it seems apparent that the presence of a vowel after the long vowel causes the latter to shorten. This view is maintained by Kim-Renaud (1974/75) and Kim (1980), although Kim-Renaud (1974/75: 25) admits that “the loss of vowel length in verb stems (but not noun stems) when a vowel initial affix follows is not clearly motivated by phonetic considerations”. Kim-Renaud (1982) makes use of rule-ordering to explain why vowel shortening does not occur in (1d), [pe:na] (/pe:-ina/) ‘cuts but’, such that *ʃ*-deletion occurs before vowel shortening as shown below:

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|-----|----|---|--|------------------------|
| (8) | a. | /pe:-ina/
pe: na
-
[pe:na] | ‘cuts but’
Affixal <i>ʃ</i> -Deletion
Verb Stem Vowel Shortening | |
| | b. | /ci:s+ina/
-
ci: +na
[ci +ina]
[ci+ina] | ‘though one builds’
Affixal <i>ʃ</i> -Deletion
<i>s</i> -Extreme Weakening
Verb Stem Vowel Shortening | |
| | c. | /kɪ:s-əsə/
-
kɪ: əsə
[kɪ əsə]
[kɪəsə] | ‘marks and’
Verb Stem Final <i>ʃ</i> -Deletion
<i>s</i> -Extreme Weakening
Verb Stem Vowel Shortening | (Kim-Renaud 1982: 477) |

Note however, that if the process of *s*-Extreme Weakening occurred last, after vowel shortening, the same output forms could be predicted as shown in (9) below. One would be required to assume that *s*-Extreme Weakening could occur in the intervocalic environment regardless of whether the preceding vowel is long or short⁴. This last assumption implies a third case of opacity between forms (*s*-irregular verbs), which delete intervocalic *s*, and forms (*s*-regular verbs), which do not⁵. I do not deal with this potential instance of opacity in this paper.

³ Kim Renaud (1974/75: 29) and Ahn (1985: 147) provide justification for an underlying *s* in *s*-irregular verbs despite the fact that *s* does not appear on surface forms.

⁴ Kim-Renaud (1974/75) states that the presence of a long vowel causes *s*-Extreme Weakening to take place. There is, however, an exception. The verb root /u:s-/ does not undergo *s*-Extreme Weakening. When followed by a suffix, it surfaces as [us+ni] (/u:s+ni) according to Kim-Renaud (1974/75: 34).

⁵ Sohn (1997) shows that intervocalic *s* appears in surface forms of *s*-regular verbs.

- (9) a. /ci:s-ina/ ‘though one builds’
 - Affixal *ɨ*-Deletion
 cis ina Verb Stem Vowel Shortening
 [ci ina] *s*-Extreme Weakening
 [ciina]
- b. /kɨ:s-əsə/ ‘marks and’
 - Verb Stem Final *ɨ*-Deletion
 kɨs əsə Verb Stem Vowel Shortening
 [kɨ əsə] *s*-Extreme Weakening
 [kɨəsə]

I entertain the possibility that the underlying *s*, rather than the following vowel, is the cause for vowel shortening in the *s*-irregular verbs in the absence of counterevidence against such a claim. In this manner, I treat the vowel shortening in *s*-irregular verbs as opaque since there is no *s* in the surface form to demonstrate that an environment exists in which long vowels must shorten.

In the next section, I discuss the nature of the two instances of opacity exhibited by the data presented above. I also state the implications that these, and opacity in general, have for standard OT before testing some specific OT approaches which may be able to account for the opaque cases in Korean.

3. Opacity

The two problems of opacity that I address are summarized below in (10) and (11).

- (10) a. V.V → V e.g. /ka-ɨni/ [kani]
 b. V.sV → V.V e.g. /ci:s-ɨni/ [ciɨni]
- (11) a. V:.sV → V.V e.g. /ci:s-ɨni/ [ciɨni]
 b. V:.V → V: e.g. /pe:-ina/ [pe:na]

Essentially, the formulas in (10) show that when vowel hiatus occurs at the morpheme boundary, *ɨ* deletes (10a), but when the vowel hiatus is derived as a result of *s*-weakening, *ɨ* does not delete (10b). This is an example of counter-feeding, or non-surface true opacity (McCarthy 1999: 332). When we encounter vowel hiatus in surface forms, we expect *ɨ*-deletion to take place, but it does not, so we are left with the problem of explaining why the process does not apply in the derived forms. Standard OT, however, cannot provide an adequate account because it predicts that *ɨ*-deletion occurs in all forms (both underlying and derived), or that it does not occur at all.

On the other hand, (11) shows a different kind of opacity called counterbleeding, or non-surface apparent opacity (McCarthy 1999: 332) in which a process overapplies rather than underapplies. In (11a), a long vowel becomes a short vowel although the conditioning environment (underlying *s*) for vowel shortening is absent at the surface. It seems that the long vowel shortens in the derived forms even though underlying long vowels remain long in other

surface forms as shown by (11b). This is an example of a derived environment effect since the process only applies to the derived forms. Standard OT cannot handle this case of counterbleeding opacity either. It incorrectly predicts that the long vowel either shortens or stays long in both derived and non-derived forms.

This opacity poses a problem for standard OT because the reason that a phonological generalization underapplies or overapplies is not apparent at the surface. As a result, there is nothing in some output candidates that OT could constrain with its surface constraints; despite the fact that there are differences in the underlying forms of competing candidates. Therefore, in the absence of contrasts in the conditioning environments at the surface, standard OT predicts the same output for both derived and non-derived forms.

The attested outputs for derived and non-derived environments differ however. The two cases of opacity discussed here can be thought of as chain shifts that “preserve a given underlying contrast on the surface but manifest it in a different way than in the underlying form” (Lubowicz 2003: 316)⁶. The underlying root forms differ in that some have an *s*, while others do not. The outputs of the *s*-irregular forms and the forms without the underlying *s* contrast in terms of whether they surface with vowel hiatus or not.

Although standard OT cannot model this, there may be some OT approaches that can. I now compare Sympathy Theory, Contrast Preservation Theory, and Comparative Markedness in terms of how well they each describe and explain the two instances of opacity in Korean that I have defined up to this point.

4. Analyses

4.1. Sympathy Theory

The first of the three approaches I use to account for the Korean data is Sympathy Theory. According to McCarthy (1999: 5), *sympathy* is defined as “a kind of faithfulness”. One output candidate is faithful to a particular constraint (called the “selector” constraint), and is thus similar to the underlying form in terms of this constraint. However, this faithful candidate is not chosen as the optimal output, but rather, it is identified as the “sympathetic” candidate. There is also a “sympathetic” constraint. The optimal candidate must be faithful to the sympathetic candidate in terms of the sympathetic constraint. In this manner, the failed sympathetic candidate exerts influence on the optimal output.

The tableau in (12) illustrates how Sympathy Theory accounts for the fact that *ɪ* does not delete when a vowel hiatus appears in a derived environment.

(12) Sympathy applied to non-surface true opacity in Korean

	V.sV	*V.sV	⊗ Max-μ	*V.V	Max-μ	☆ Max-C
Opaque	a. V.V			ɪ*		*
Transparent	b. V		*!		*	*
Sympathetic & Faithful	c. V.sV	*!				✓

The sympathetic candidate (c) is faithful to the selector constraint marked by the star, Max-C, in that it retains the intervocalic consonant *s*. The sympathetic constraint Max-μ, marked

⁶ Kim (1977: 189) also suggests that the “*ɪ* deletion rule must be able to have access to the derivational history of the relevant forms”, although she relates *ɪ*-deletion to the length of the preceding vowel.

by the flower, checks the candidates in terms of whether they match the sympathetic candidate. Since (a) is faithful to the number of moras in the sympathetic candidate, but (b) is not, (a) is selected as the optimal candidate. The failed (b) form, labeled here as *transparent*, is what we would expect if the sympathetic candidate did not exert any influence on the optimal output. The sympathetic candidate itself is eliminated because it violates the *V.sV constraint.

It is because the optimal output must be faithful to the form with intervocalic *s* that (b) is rejected, while (a) is tolerated even though it contains vowel hiatus. On the other hand, forms without an underlying *s* undergo *r*-deletion, resolving the vowel hiatus. This is because no candidates violate the selector constraint, Max-C, since there is no consonant in the input. Consequently none of the candidates are chosen as the sympathetic candidate. Since there is no sympathetic candidate to which the optimal candidate must remain faithful, the leftmost Max- μ constraint does not apply. Output forms with vowel hiatus are thus eliminated by the *V.V constraint, and a candidate with a single vowel at the syllable boundary is chosen as optimal.

Turning now to the case of counterbleeding opacity, tableau (13) shows that Sympathy Theory correctly selects a form with a short vowel as the optimal output when the input contains an underlying *s*, but a form with a long vowel when the input has no *s*.

(13) Sympathy applied to non-surface apparent opacity in Korean

	V:.sV	*V.sV	☼ *V:	☆ Max-C	Max- μ
Opaque	a. ☞ V.V			*	; [*]
Transparent	b. ☞ V:.V		*!	*	
Sympathetic	c. ☼ V.sV	*!		✓	*
Faithful	d. V:.sV	*!		✓	

Here again, the sympathetic candidate (c) is faithful to the Max-C selector constraint by retaining the intervocalic *s*, but it is eliminated along with the faithful candidate (d) because they violate the *V.sV constraint. The sympathetic constraint, ☼ *V:, checks the remaining candidates. Candidate (a) matches the sympathetic candidate with respect to vowel length so it is chosen as the optimal output, over the transparent candidate (b).

If the input does not contain an *s* however, Max-C cannot select a form as the sympathetic candidate. There is consequently no candidate to which the output must be faithful in terms of vowel length (other than the faithful candidate through the Max- μ constraint) so the ☼*V: constraint does not apply. The result is that the candidate with the long vowel instead of the short vowel is optimal.

As shown here, Sympathy Theory correctly predicts the surface forms in both the non-surface true and non-surface apparent cases of opacity. McCarthy (1999) notes that there seems to be a connection between Sympathy Theory and serialism. As shown in (9), when phonological rules are ordered, the intermediate form is one that retains the intervocalic *s*, just like the sympathetic candidate in the tableaux of (12) and (13). Both the sympathetic candidate and the intermediate stage of a series are already affected by a phonological process, but both remain faithful to the underlying form in some respect.

Sympathy Theory does, however, present a potential hazard as compared to serialism. Recall that in formulating tableau (13) above for non-surface apparent opacity in Korean, it is assumed that a long vowel shortens because the root form contains an underlying *s*. Under this assumption, it is possible to rank constraints such that the attested forms are selected as optimal outputs. Note however, that if vowel hiatus is understood to be the cause for vowel shortening in

s-irregular verbs, as suggested by the rule ordering in (8) presented by Kim-Renaud (1982), a Sympathy Theory account is impossible. This is because vowel shortening is not opaque when it is triggered by a following vowel. The second vowel is still present in the output so the conditioning environment for the phonological process is apparent at the surface.

Whereas serialism forces one to order the phonological rules and consequently discover that two rule orderings, (8) and (9), are possible, Sympathy Theory provides no indication that vowel shortening could be the result of a derived vowel hiatus rather than an underlying *s*. If one assumes that the *s* in the input is the reason that the long vowel shortens, there is no reason to look further. I make no commitment as to the true cause of vowel shortening, but if it is the case that long vowels shorten because weakening of the *s* places them beside another vowel and this derived vowel hiatus must be resolved, then the non-surface apparent opacity I have identified in this paper is non-existent. Thus, Sympathy Theory may present a pitfall in that it might be able to account for cases of opacity that are not real.

Additionally, there are some other problems with employing Sympathy Theory in accounting for opacity, in general, and particularly in explaining the Korean data. For example, the psychological reality of the failed candidates' influence on the optimal output is certainly questionable.

Moreover, Sympathy Theory does not capture the essence of preserving contrasts between forms that undergo a phonological process and forms that do not. Although the tableaux of (12) and (13) ensure that two different outputs are selected as optimal given two different inputs, this is by virtue of the fact that the output candidates' violation of faithfulness constraints depends on the underlying representation of the input, as in any other phonological problem formalized by OT. Sympathy Theory does not in itself convey that a contrast in two surface forms maintains a contrast in their underlying representations. This is a key difference between Sympathy Theory and the next OT approach I apply to the Korean data.

4.2. Contrast Preservation Theory

Contrast Preservation Theory (PCT) proposed by Lubowicz (2003) attempts to account for chain shift effects in OT with the view that some contrast of surface forms maintains a contrast of the inputs. PCT makes use of PRESERVE CONTRAST constraints, $PC_{IN}(P)$ where *P* is a phonological property, which are defined as follows:

- (14) $PC_{IN}(P)$
 For each pair of inputs contrasting in *P* that map onto the same output in a scenario, assign a violation mark. Formally, assign one mark for every pair of inputs, in_a and in_b , if in_a has *P* and in_b lacks *P*, $in_a \rightarrow out_k$, and $in_b \rightarrow out_k$.
“If inputs are distinct in P, they need to remain distinct.” (Lubowicz 2003: 318)

What this means for the Korean cases of opacity is that input forms with an underlying *s* cannot map to the same output as input forms without *s*. Otherwise this would constitute a violation of a PRESERVE CONTRAST constraint, where the phonological property *P* is the presence of a segment.

PCT as applied to the problem of *ɨ*-deletion in Korean is shown in tableau (15). It does not predict the correct output.

(15) Contrast Preservation Theory applied to non-surface true opacity in Korean

	Scenarios	*V.sV	PC _{IN} (Seg _C)	PC _{IN} (Seg _V)
a. Counter-feeding	V.sV → V.V V.V → V V → V			*!
b. Identity	V.sV → V.sV V.V → V.V V → V	*!		
c. Transparent	V.sV → V.V V.V → V.V V → V		*!	
d. Counterbleeding	V.sV → V V.V → V.V V → V			

In the tableau, each candidate is actually a set of input-output mappings. The counter-feeding candidate (a) is the attested scenario in Korean. It involves an underlying form with intervocalic *s* becoming a series of two consecutive vowels at the syllable boundary resulting in a derived vowel hiatus, and an underlying vowel hiatus being resolved through *ɨ*-deletion. Candidate (b) is a set such that the outputs for each form are faithful to the inputs. Standard OT would predict a set like candidate (c) where two different inputs map onto the same output. Candidate (d) is a counterbleeding scenario in which it is the derived form that undergoes *ɨ*-deletion to resolve the vowel hiatus, while the input with the underlying vowel hiatus remains unchanged.

The leftmost constraint, *V.sV, eliminates candidate (b) with the faithful outputs. The transparent candidate (c) violates the next constraint, PC_{IN}(Seg_C), because the inputs differ with respect to the presence of a segment (*s*), but this contrast is not preserved in the outputs, which are identical. The rightmost constraint PC_{IN}(Seg_V) aims to preserve the distinction between an input form with two consecutive vowels and an input form with a single vowel. The attested scenario (a) violates this constraint since the vowel hiatus is resolved with *ɨ*-deletion deriving a single vowel, but no change occurs for forms with a single vowel underlyingly. Candidate set (d) is consequently predicted to be optimal according to PCT. It maintains both contrasts, that between the input forms with and without *s*, and that between the input forms with and without vowel hiatus.

It is not the case, however, that *s*-irregular verbs undergo the process of *ɨ*-deletion. PCT should have chosen the attested counter-feeding candidate (a) rather than the counterbleeding candidate (d). Therefore, it appears that PCT cannot account for counter-feeding opacity in Korean. In fact, PCT may be descriptively inadequate in addressing any problems of non-surface true opacity. The reason that the correct candidate set is chosen in Lubowicz's analysis of counter-feeding opacity in Polish is because a counterbleeding scenario is not included in the tableau as a possible candidate, leaving the counter-feeding set as the optimal output. It seems plausible however, that a derived (instead of underlying) vowel hiatus could undergo *ɨ*-deletion in order to preserve a contrast between different inputs. For that reason, the counterbleeding scenario, which depicts this, is listed as a possible candidate in tableau (15).

PCT also fails in accounting for the case of non-surface apparent opacity in Korean as shown in tableau (16) below.

(16) Contrast Preservation Theory applied to non-surface apparent opacity in Korean

	Scenarios	*V.sV	PC _{IN} (Seg _C)	PC _{IN} (Length)
a. Counter-feeding ☞	V:.sV → V:.V V:.V → V.V V.V → V			
b. Identity	V:.sV → V:.sV V:.V → V:.V V.V → V	*!		
c. Transparent	V:.sV → V:.V V:.V → V:.V V.V → V		*!	
d. Counterbleeding ☞	V:.sV → V.V V:.V → V:.V V.V → V			

The counterbleeding candidate set (d) should be chosen as the optimal output. It represents the shortening of the long vowel in *s*-irregular verbs and the maintenance of the long vowel in non-derived forms. Candidate set (b) with its outputs faithful to its inputs is eliminated by the *V.sV constraint, and candidate set (c) violates the PC_{IN}(Seg_C) constraint since an input with intervocalic *s* maps onto the same output as an input without *s*. PCT should provide some means of eliminating the unattested counter-feeding scenario (a), but it does not. Both (a) and (d) are deemed optimal according to the tableau.

Although PCT seemed promising in that it might be able to model contrast preservation in chain shift effects, it proves to be descriptively inadequate in dealing with either of the problems of opacity in Korean. It cannot narrow down the set of possible candidates to the optimal scenario.

One last OT approach, Comparative Markedness, is used to analyze the data. As shown in the next section, Comparative Markedness does not suffer from the shortcomings of Sympathy Theory and PCT that we have encountered thus far.

4.3. Comparative Markedness

Comparative Markedness splits markedness constraints into “old” markedness constraints (_OM) and “new” markedness constraints (_NM). An output that exhibits a marked structure violates _OM if the input also contained the marked structure and the output form is faithful to it. Conversely, if a marked structure does not exist in the input form, but the output shows the marked structure, it violates _NM. This means that if _OM is ranked higher than _NM a marked structure present in the underlying representation is not permitted in the output, but a derived one is allowed. On the other hand, if _NM outranks _OM, then an output form with a marked structure that has been derived is eliminated while one that has the marked structure as a result of faithfulness to the input is acceptable.

The constraint rankings for the counter-feeding opacity of *ɪ*-deletion in Korean are shown in tableau (17a) below. It demonstrates that a derived vowel hiatus is tolerated in *s*-irregular verbs, which do not undergo *ɪ*-deletion because of the low ranking of the *_NV.V constraint.

(17) a. Comparative Markedness applied to non-surface true opacity in Korean

/V.sV/	* _O V.V	*V.sV	Dep-IO	Max-μ	* _N V.V
a. V.sV		*!			
b. ☞ V.V					*
c. V				*!	

Since there is no vowel hiatus in the input, the *_OV.V “old” markedness constraint is not violated by any of the possible output candidates. The *V.sV constraint eliminates the form with intervocalic *s*. The Max-μ constraint, ranked higher than the *_NV.V “new” markedness constraint, ensures that an output form that does not delete *ɪ* is selected.

When there is vowel hiatus in the underlying representation, forms that retain the vowel hiatus in the output are eliminated by the *_OV.V constraint. The Dep-IO constraint prevents the vowel hiatus from being resolved through consonant epenthesis. As a consequence the resulting output shows the effect of *ɪ*-deletion. This is illustrated by tableau (17b).

(17) b. Comparative Markedness applied to non-surface true opacity in Korean

/V.V/	* _O V.V	*V.sV	Dep-IO	Max-μ	* _N V.V
a. V.CV			*!		
b. V.V	*!				
c. ☞ V				*	

In dealing with the opacity in vowel shortening, many of the same constraints are in play as shown in (18).

(18) a. Comparative Markedness applied to non-surface apparent opacity in Korean

/V:.sV/	* _O V.V	*V.sV	Dep-IO	*V:	* _N V.V
a. ☞ V.V					*
b. V:.V				*!	*
c. V.sV		*!			
d. V:.sV		*!		*	

The *V: constraint eliminates output forms retaining a long vowel such that a surface form with a short vowel is chosen as the optimal output when the input is an *s*-irregular verb. The optimal candidate in tableau (18a) is however eliminated in (18b) by the *_OV.V “old” markedness constraint. This is because the input for tableau (18b) has two consecutive vowels at the syllable boundary in the absence of the intervocalic *s* present in *s*-irregular verbs. The *_OV.V constraint does not permit this vowel hiatus of the underlying representation to be retained in the surface form. On that account, *ɪ*-deletion takes place while vowel shortening does not as the *V: constraint is ranked too low to have an impact on the selection of the optimal candidate.

(18) b. Comparative Markedness applied to non-surface apparent opacity in Korean

/V:V/	* _O V.V	*V.sV	Dep-IO	*V:	* _N V.V
a. V:CV			*!	*	
b. V:V	*!			*	
c. \leftarrow V:				*	
d. V.V	*!				

Comparative Markedness is able to predict the attested surface forms for both the non-surface true and non-surface apparent processes in Korean. Therefore, in accounting for the data, it is certainly superior to Contrast Preservation Theory, which cannot.

In a sense, Comparative Markedness also models the preservation of contrasts with more accuracy than PCT. While PCT aims to explain opacity by showing that two different inputs should yield different outputs, Comparative Markedness indicates that the two underlying forms contrast in that one of them has a certain marked structure and that this same marked structure appears in one of the two output forms.

Unlike other accounts, Comparative Markedness does not seem to suggest that the cause for vowel shortening is the underlying *s*, except in its role as a separator of two vowels. Serialism (as shown in (9) above) indicates that the *s* following the long vowel triggers vowel shortening. Sympathy Theory considers the presence of *s* a property to which the sympathetic candidate, which influences the output, must be faithful. Yet another account proposed by Ahn (1985) suggests that vowel length is inextricably tied to the underlying *s* such that a long vowel must shorten when *s* deletes. Comparative Markedness, however, seems to treat the intervocalic *s* as a placeholder preventing vowel hiatus from occurring in the input.

Oddly, for the non-surface apparent case of opacity in Korean, *_OV.V outranks *_NV.V, just as it does for the non-surface true problem, although it was mentioned at the beginning of this section that _NM is ranked higher than _OM for derived environment effects. The Comparative Markedness analysis of the Korean data presents both instances of opacity as resulting from a constraint ranking which resolves an underlying vowel hiatus, but allows a derived vowel hiatus to be tolerated. The paradox is that a single constraint ranking, combining those of tableaux (17) and (18) cannot be formulated to deal with both types of opacity, even though it is the same sets of data involved in the two opaque processes. This leads us to consider two possibilities.

The first possibility is that the two processes operate concurrently on the same inputs, but that they are subject to different constraint rankings. If we can assume this to be true, then it appears that Comparative Markedness can successfully account for the data and deal with both cases of opacity with its “old” and “new” markedness constraints.

The second possibility is that vowel shortening in Korean is not opaque at all and should not be treated as such. Although Comparative Markedness enables the correct output forms to be predicted, the fact that an “old” markedness constraint is ranked higher than a “new” markedness constraint causes us to consider the possibility that vowel shortening is not a derived environment effect, and actually not a case of non-surface apparent opacity. If this is the case, Comparative Markedness is a more reliable approach than Sympathy Theory in that it does not allow us to model artificial cases of opacity.

5. Conclusion

Of the three OT approaches I have assessed, Comparative Markedness appears to be most effective in dealing with the two cases of opacity in Korean: *ɪ*-deletion and vowel shortening.

We have discovered Contrast Preservation theory to be descriptively inadequate since it cannot predict the correct surface forms for *s*-irregular verbs. Comparative Markedness not only represents the preservation of underlying contrasts between input forms with and without an intervocalic *s*, but it also models the tendency for marked structures to be accepted in derived forms and not in non-derived forms in a counter-feeding process. These are benefits of employing Comparative Markedness rather than Contrast Preservation Theory to account for the data.

A potential danger of using Sympathy Theory, which Comparative Markedness avoids, is that it may be able to account for too wide of a range of opaque processes. If vowel shortening in Korean is not opaque after all, it would seem that Sympathy Theory could model a case of opacity that is not real. This is one significant disadvantage about using a largely theoretical tool like Sympathy Theory to deal with opacity.

Nevertheless, adopting the Comparative Markedness approach does not come without further implications. It can only account for the data discussed in this paper if a different constraint ranking is posited for the two processes of *ɪ*-deletion and vowel shortening even though these two processes affect the same data items in Korean. Whether we can accept the possibility of a single input being subject to two different sets of constraint rankings at the same time is a question for further investigation.

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