

Glide Formation and Compensatory Lengthening in Korean Verbal Conjugation*

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Lee, Yongsung. 1997. *Glide Formation and Compensatory Lengthening in Korean Verbal Conjugation*. *Studies in Phonetics, Phonology and Morphology* 3, 223-246. This paper deals with glide formation in connection with compensatory lengthening in Korean verbal conjugation. Glide formation in Korean is obligatory in certain environments while optional in other environments. Sometimes the glide formation is accompanied by compensatory lengthening while in other times it is not. The complicated phenomena involved in glide formation, however, can be systematically explained with an Optimality Theoretic approach. This paper makes use of two crucial constraints *Onset* and *NoComplex* and their interaction with syllable wellformedness constraints such as *Parse-μ* and *Fill*. With the assumption that the two constraints *Onset* and *NoComplex* are unordered in their ranks, the obligatory and the optional nature of glide formation are neatly captured. Further it is seen that the compensatory lengthening found in initial syllables comes from the interaction of syllable wellformedness constraints and alignment requirement of a heavy or long syllable. (Pusan University of Foreign Studies)

1. Introduction

Glide formation shows interesting complications in connection with other phonological processes in Korean. In verbal conjugation, when /ə/ is added after vowel final verbs, two things may happen. First, the suffixal vowel /ə/ harmonizes to the stem final vowel. Second, the stem final vowel, if it is [+high] or [+round], turns into a glide either /y/ or /w/. Consider the following examples:

(1) Glide formation and vowel harmony¹⁾

*This is a written version of the paper presented in the Linguistic Society of Korea Fall Conference, 1996. This paper is greatly benefited from discussions

a) /talu + ə/	[talua]	[talwə]	(to deal with)
b) /tolpo + ə/	[tolpoa]	[tolpwa]	(to take care of)
c) /ik + ə/	[ikia]	[ikyə]	(to win)

Vowel harmony as witnessed in (1b), where the conjugational affix is realized as /a/, should be treated separately and is not intrinsically connected to glide formation. This is evidenced by the existence of the similar harmony processes in Korean ideophones as studied in J.S. Lee (1992) and Y. Lee (1993), for example. For simplicity of exposition, however, vowel harmony will not be dealt with in this paper and the conjugational suffix is represented as /A/ hereafter.

Putting vowel harmony aside, we find that glide formation is optional as the outputs in the second column in (1) show. One complication, however, is that the same process is obligatory in the following examples:

(2) Obligatory glide formation (Y. Lee (1993, 1996))

a) /seu + A/	[sewA]	*[seuA]	(to erect)
b) /c ^h a: + A/	[c ^h æwA]	*[c ^h æuA]	(to lock up)
c) /o + A/	[wA]	*[oA]	(to come)
d) /moi + A/	[moyA]	*[moiA]	(to gather together)

An intuitive observation that we can make in (2) is that in the sequence of two vowels, V1 and V2, where V2 is the conjugational suffix /A/, glide formation is optional if V1 is preceded by a consonant and it is obligatory when there is no such consonant.

One more twist in dealing with glide formation is that sometimes the glide formation results in initial long vowels as illustrated by the

with A. Prince, Sangdon Kim, Kijung Lee, Jongho Jun, Minkyung Lee and members of PRO. The usual disclaimer applies.

1) There are other phonological processes relevant to the outcome of verbal conjugation. It should be noted that /r/ in (1a) is ultimately realized as [r] in intervocalic positions. Also stops are realized as voiced consonants in the same environments. These phonological processes, however, are not dealt with in this paper, since they do not have any direct relationship with the glide formation process.

examples given in (3):

(3) Glide formation and vowel lengthening (B. K. Lee (1979), Y. S. Kim (1993) etc.)

a) /cu + A/	[cuA]	[cwA:]	(to give)
b) /ki + A/	[kiA]	[kyA:]	(to crawl)
c) /po + A/	[poA]	[pwA:]	(to see)

Such compensatory lengthening, however, does not take place in non-initial syllables as shown in the examples in (1). Given the observation so far, any comprehensive analysis of glide formation in Korean must deal with two complicated and contradictory issues: the optional and/or obligatory nature of glide formation on the one hand, and the presence and/or absence of compensatory lengthening on the other.²⁾

In this paper, an attempt will be made to present a comprehensive analysis of glide formation in connection with compensatory lengthening within the framework of Optimality Theory. It will be shown that the theory of constraint interaction provides simple and convincing explanation. In the next section, the previous analysis in Lee (1996) will be discussed and its problematic aspects will be pointed out. In Section 3, a new analysis of glide formation will be given with relevant comparison with the former analysis. Further, this section deals with some of the residual problems, such as lack of compensatory lengthening in non-initial syllables or even in initial syllables in some monosyllabic stems. Section 4 is the conclusion of this paper.

2) It should be noted that there are problems related to glide formation and compensatory lengthening other than those specified here. For example, CV: stems are shortened before /A/ as illustrated in (a) under. Further glides do not show up in the surface representation as in the examples (b) and (c):

(a) /k'u: + A/	[k'uA]	[k'wA:]	(to dream)
(b) /ci + A/	[cA:]	[ciA]	*[cyA(:)] (to lose)
(c) /pu + A/	[pA]	[pwA(:)]	(to ladle)

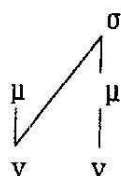
These apparent counter-examples, however, do not pose serious problems in dealing with glide formation, as will be discussed in 3.2. Please refer to Y. S. Kim (1993) for detailed elaboration on these matters.

2. Previous analysis in Lee (1996)

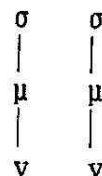
In Lee (1996), moraic syllable structure as in McCarthy & Prince (1986) was adopted. Glide formation is assumed to be triggered to avoid onsetless syllables in outputs. Assuming that glides are moraless vowels, the analysis suggests that the glide formation result in the failure in parsing one of the underlying moras. Consider the following representation:

(4) Syllabified forms

a) Moraic underparsing



b) No glide formation



As shown in (4a), glide formation may be viewed as moraic underparsing. In (4a), the first vowel loses its mora and serves as an onset. If we parse the mora, the resultant structure looks like (4b). Here it should be noted that the second syllable is without an onset. Making use of this difference, Lee (1996) claims that glide formation results in the violation of *Parse-μ*. As such glide formation entails *Parse-μ* violation, while the non-application of glide formation results in the violation of *Onset*.

2.1 Obligatory and optional glide formation

In this subsection, we will briefly survey how the obligatory/optional glide formation is previously dealt with. The following constraints and their ranking are employed in Lee in line with Prince & Smolensky (1993) and McCarthy & Prince (1993a, b):

(5) The rankings of relevant constraints

a) Glide formation is optional

Parse-μ = *Onset*

b) Vowel deletion is not witnessed to resolve vowel hiatus in Korean

Parse-Seg >> *Onset*

c) No consonant epenthesis is witnessed in Korean³⁾

Fill >> {*Parse-μ*, *Onset*}

d) Syllable final consonant clusters are reduced without vowel epenthesis.

Fill >> *Parse-Seg*

e) Overall ranking

Fill >> *Parse-Seg* >> {*Parse-μ*, *Onset*}

Referring to phonological alternation found in Korean, Lee (1996) maintains that these constraints are well-motivated and the rankings can be fully justified. With the ranking given in (5e), the optional glide formation effect is due to multiple outputs, coming out of an evaluation with two tied constraints, *Parse-μ* and *Onset*. Consider the following modified evaluation table:

(6) Evaluation table of /po + A/

	po + A	<i>Fill</i>	<i>Parse-Seg</i>	<i>Onset</i>	<i>Parse-μ</i>
a)	.pwA.				*
b)	.po.A.			*	
c)	.po.ΔA.	*!			
d)	.pA.		*!		*

(Dots in candidates represent syllable boundaries.)

3) In suffixing vocative markers in Korean, /a/ is used after consonant-final names and /ya/ is used after vowel final names. In analyzing /ya/, it is often suggested that the glide is inserted in between vowels to avoid vowel clash. But it is an open question whether this constitutes a real case of /y/ insertion or just a matter of choosing from allomorphs, /a/ and /ya/, and the choice is controlled by the stem final segment type.

The candidate in (6a) has a glide form in the output and thus this represents a violation of *Parse- μ* . On the other hand, that in (6b) does not undergo glide formation and as a result, the second syllable violates *Onset*. The candidate (6c) has an epenthetic consonant as represented by Δ . This is a clear case of *Fill* violation.⁴⁾ In (6d), we see that the candidate $/pA/$, where the stem final vowel as well as the mora associated to it are deleted resulting in a violation of *Parse- μ* , and *Parse-Seg*. Given the ranking in (5e), we see that both (6c) and (6d) are ruled out due to the high ranking nature of the constraints they violate. Comparing (6a) and (6b), we see that there is no way to select one out of the two, since their scope of violation is all the same because of the tied ranking between *Onset* and *Parse- μ* . As a result, both are selected as optimal outputs. This renders the effect of the application of optional glide formation rule.

Now let's turn to where glide formation is obligatory. Consider the following evaluation table:

4) We may think about another candidate where a specified segment is inserted as an epenthetic consonant. In earlier Optimality framework, the epenthesis of non-null segment is strictly forbidden as stated in the basic principles of GEN: Containment and Consistency of Exponence. But later in Correspondence Theory, the epenthetic segment is allowed in GEN, but considered as the violation of *DEP-IO*, which specifies that all the outputs must have their counterparts in the input. As such *DEP-IO* is the mixture of *Fill* and Containment principle. But the familiar constraint names are used here for following reasons. First, that way, we can make an easy comparison of the present analysis with the former one. Second, glide formation and compensatory lengthening do not involve any feature changes, and finally the nature of mora in correspondence is not yet clear in the literature. That is, McCarthy & Prince use *Max* and *DEP* constraints for segments and *IDENT* constraint for features and do not mention about moras. It is an open question whether moras should be treated as entities like segments or as properties of a segment like features.

(7) Evaluation of /meu + A/

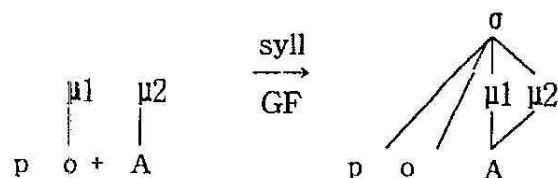
meu + A	Fill	Parse-Seg	Onset	Parse-μ
a) .me.wA.				*
b) .me.u.A.			**!	
c) .me.△u.A.	*!		*	
d) .me.A.		*!		*

Almost the similar explanation of (6c) and (6d) may be given to (7c) and (7d) respectively. But in comparing (7a) and (7b), we find that the situation is a little different. (7a) has just one violation of *Parse-μ*, while (7b) has two onsetless syllables thus two-time violation of *Onset*. Given that these two constraints are tied, we see that (7b) has more violation than (7a). The problem of undecidedness in (6) is resolved here and there is just one optimal form, (7a).

2.2 Problems of the analysis

The analysis given above has a few serious problems, though it can capture the general observation that the glide formation of V1 in V1V2 sequence is optional when it is preceded by a consonant and it is obligatory elsewhere. One of the most prominent problems is that compensatory lengthening is not dealt with properly. W. J. Kim (1972), B. K. Lee (1979), Y. S. Kim (1993) and many others points out that the optional glide formation that involves monosyllabic stem and the conjugational suffix is usually accompanied by lengthening of the following vowel. In moraic syllable structure, we may represent the compensatory lengthening as in (8):

(8) Glide formation and compensatory lengthening



Such evident data cannot be dealt with in Lee (1996). Notice that since glide formation is defined as moraic underparsing, the μ l of the stem final vowel should not appear on the surface. This is a serious misrepresentation of the surface form and thus a clear case of misanalysis. Facing such data, the analysis given in Lee (1996) cannot be a correct explanation of Korean glide formation.

Putting problematic aspect of the analysis with the compensatory lengthening aside, we see that there are other theoretical issues as well. The analysis crucially depends on the notion of tied ranking. *Onset* and *Parse- μ* are not just unranked with respect to each other: they should be the one and the same constraints. Notice that if we assume that these two constraints are simply unranked, then it fails to explain the obligatory nature of glide formation. Consider the following evaluation tables.

(9) Undecided order between *Onset* and *Parse- μ*

(i) *Onset* >> *Parse- μ*

meu + A	Fill	Parse-Seg	Onset	Parse- μ
a) .me.wA.				*
b) .me.u.A.			**!	
c) .me.△u.A.	*!		*	
d) .me.A.		*!	*	*

(ii) *Parse- μ* >> *Onset*

meu + A	Fill	Parse-Seg	Parse- μ	Onset
a) .me.wA.			*!	
?? b) .me.u.A.				**
c) .me.△u.A.	**!			*
d) .me.A.		*!		*

If the two constraints, *Onset* and *Parse-μ*, are unranked with respect to each other, then it means that the evaluation takes either of the ranking given in (9). But if we were right, we would find that the constraints fail to explain the obligatory nature. Consider (9ii) where *Parse-μ* is ranked higher than *Onset*. The evaluation will pick out a wrong form as optimal ones. Notice that the apparently optimal form which is marked with double question marks, (9iib), is not witnessed in Korean. But still the evaluation in (9ii) chooses it as the optimal form. As such, the relative unranking of the constraints, *Onset* and *Parse-μ*, cannot properly deal with obligatory nature. Considering that the ranking schema is related to the typological variations of languages, we see that the proposal that two constraints are tied, and not just unranked with respect to each other brings about unnecessary and unwitnessed language typology. On top of that, though we admit the peculiar ranking, it still fails to present coherent explanation for the obligatory nature of glide formation.

One final point knocks out the former analysis. Assuming that constraints are universal as claimed in McCarthy & Prince (1995), we have to think about the evaluation of the optimal form in connection with another constraint, *NoComplex*, which prohibits the consonant clusters within a syllable. Going back to the evaluation given in (6), we find that there are two optimal forms, if we consider only four constraints. The evaluation will, however, be completely different if we assume that *NoComplex* is involved in the evaluation. Note that the candidate in (6a) has a complex onset, while that in (6b) does not. No matter where *NoComplex* stands in the constraint ranking, it will definitely choose (6b) over (6a), since it has one less violation than (6a).⁵⁾ Therefore to make the argument viable, it should be assumed that some

5) It should be noted that the constraint *NoComplex* is placed in a relatively high rank in Korean phonology. Complex consonants which leads the violation of *NoComplex* are absolutely forbidden in coda positions. Some may argue that *NoComplex-Coda* and *NoComplex-Onset* should be treated as separate constraints and that a consonant and a glide do not make a complex onset since the glide is considered to be a part of nucleus. This paper, however, adopts the view that glides before vowels are part of the onset, and not of the nucleus. For Onset hypothesis and its comparison to Nucleus hypothesis of Korean glides, please refer to Lee (1994).

of the constraints are not universal and *NoComplex* is one of them. But this is a serious departure from the basic premises of optimality theory and also a serious distortion of Korean phonology.

So far, we have discussed the shortcomings of the former analysis of Korean glide formation within the framework of Optimality Theory. It is shown that the analysis in Lee (1996) fails to deal with compensatory lengthening and thus it is found to be an inadequate analysis of the often obligatory nature of the glide formation. In the next section, a more advanced analysis will be presented and comparisons will be made.

3. Proposal for Comprehensive Analysis

In this subsection, a newer proposal is made, making use of two unranked constraints *Onset* and *NoComplex*. It will be argued that the analysis given in this chapter can properly deal with the obligatory/optional nature of glide formation and the presence or absence of compensatory lengthening in glide formation.

3.1 Glide formation

Taking into consideration of the drawbacks of the earlier analysis given in the preceding section, it is suggested that the glide formation can be better explained through the interaction of the constraints *Onset* and *NoComplex*. The basic assumption is given in (10):

(10) Basic assumptions

- a) A vowel shows up as a glide to avoid onsetless syllable.
- b) But the surface glide may make a complex onset.

(10) tells us that the so called glide formation is invoked to avoid onsetless syllables in the output. In Optimality Theory, this may be viewed as a change to satisfy the syllable wellformedness constraint, *Onset*. In CV1V2 environment, if V1 turns into a glide, it is combined with the preceding consonant to make a complex onset, which leads to the violation of *NoComplex*. So the scenario is that if an input vowel

shows up as a glide in the output, it may incur a *NoComplex* violation, and that if an input vowel surfaces as a vowel, it may have an *Onset* violation. If we assume that *Onset* and *NoComplex* are unranked with respect to each other, but still be dominated by such faithfulness constraint as *Parse-Seg* and *Fill*, we can explain the optionality of glide formation. Slightly revising the constraint ranking given in (5e), the following ranking is posited:

(11) Constraint ranking

Fill >> *Parse-Seg* >> {*Onset*, *NoComplex*}

Here again there is no ranking between *Onset* and *NoComplex*. But as we will see, the ill-fated assumption that they should be tied is not included. Now consider the following evaluation table:

(12) Evaluation tables for optional glide formation

(i) *Onset* >> *NoComplex*

po + A	<i>Fill</i>	<i>Parse-Seg</i>	<i>Onset</i>	<i>NoComplex</i>
a) .pwA:				*
b) .po.A.			*!	
c) .po.ΔA.	*!			
d) .pA(:).		*!		

(ii) *NoComplex* >> *Onset*

po + A	<i>Fill</i>	<i>Parse-Seg</i>	<i>NoComplex</i>	<i>Onset</i>
a) .pwA:			*!	
b) .po.A.				*
c) .po.ΔA.	*!			
d) .pA(:).		*!		

Since the two constraints are not specifically ranked, we can think of two possibilities as in (12i) and (12ii). If *Onset* occupies the higher rank than *NoComplex* as in (12i), vowels are turned into glides at the sacrifice of *NoComplex* and (12ia) will be selected as an optimal form. But if *NoComplex* is given higher rank, then the evaluation will select (12iib) as the optimal form.

One interesting observation that we can make here is the nature of these two unranked constraints. *Onset* and *NoComplex*, unlike *Onset* and *Parse-μ*, are intrinsically related to each other. We may note that these two constraints conspire to produce CV syllables, the simplest and most natural syllable type. *Onset* forces a syllable to have onset consonants, but *NoComplex* disapproves the presence of more than one consonant in onset. As such, that these two constraints are equal in ranking simply means there exists the combined effort to produce the most unmarked syllable structure found in human language.

Also note that the glide formation results in lengthening of the suffix vowels. In (6), on the other hand, we have to wrongly assume that the stem vowel is not long, since glide formation is considered as moraic underparsing. If the suffixal vowel shows up as short in (12), it ends up violating *Parse-μ*. Thus another candidate [pwA] is always worse than [pwA:] and therefore cannot appear as an optimal form. Such an approach will surely explain the plain fact that the optional glide formation in verbal conjugation of the monosyllabic stem will be generally accompanied by lengthening of the suffix. We will go into more details of the lengthening in 3.2.

Now let's think about obligatory glide formation. Consider the following evaluation table:

(13) Evaluation tables for obligatory glide formation

(i) *Onset* >> *NoComplex*

meu+A	Fill	Parse-Seg	Onset	NoComplex
a) me.wA.				
b) me.u.A.			**!	
c) me.u.△A.	*!		*	
d) me.A.		*!	*	

(ii) *NoComplex* >> *Onset*

	meu+A	Fill	Parse-Seg	NoComplex	Onset
a)	me.wA.				
b)	me.u.A.				**!
c)	me.u.ΔA.	*!			*
d)	me.A.		*!		*

We find that regardless of the relative ranking of *Onset* and *NoComplex*, the optimal form is all the same as shown in (13i) and (13ii). What is crucially important to understand the obligatory glide formation is that if we turn the first vowel into a glide, we can satisfy both *Onset* and *NoComplex* at the same time. To look at this in more detail, let's compare the glide formation of V1 in the environment of CV1V2 and (V)V1V2. In the former case, if V1 shows up as a glide, it is combined with the preceding consonant to produce a complex onset. But in the latter, the surface glide from V1 constitutes a single onset and there is no violation of *NoComplex* at all. Seen from this perspective, the glide formation is the only option for (V)V1V2 sequence since it is the way to satisfy both of the constraints, *Onset* and *NoComplex*. This was not captured in the former analysis.

One more aspect that we have to consider is the dialectal variation. In Kyungsang dialect, /po + A/ is realized as [pA:]. With the basic assumption that language difference is explained by different ranking, we correctly get the optimal form by positing that {*Onset*, *NoComplex*} is ranked higher than *Parse-Seg* in that dialect.⁶⁾ Consider the following evaluation table:

6) There are other data that illustrate that the Kyungsang dialect does not allow complex onset. Lee (1993) surveyed these data and propose Single Onset Consonant Constraint in Kyungsang dialect. Within Optimality theory, we can achieve the same effect by invoking unranked *Onset* and *NoComplex* that dominates *Parse-Seg*. For more discussion of Single Onset Consonant Constraint, please refer to Chapter 5 of Lee (1993).

(14) Evaluation in Kyungsang dialect

po + A	Fill	NoComplex	Onset	Parse-Seg
a) p ^w A:		*!		
b) p ^h .A			*!	
c) po.△A	*!			
d) p ^h u				*

The evaluation table in (14) clearly shows that the dialectal variation can also be explained within the present analysis. The crucial argument is that *NoComplex* and *Onset* are unranked with respect to each other, and they conspire together to produce the most unmarked syllable type. As a matter of fact, in Kyungsang dialect, glide formation in (14) is obligatory, unlike in the standard Korean. The accepted form /po.A/ in Standard dialect is not allowed in Kyungsang dialect. The evaluation in (14) correctly predicts that there is only one optimal form, that is (14d), regardless of the relative ranking of *Onset* and *NoComplex*. This provides another evidence that the analysis presented in this section fares better than the former analysis.

The discussion so far shows that the new analysis offers better explanation for the glide formation found in verbal conjugation in Korean without the theory internal problems that the former analysis suffers from.

3.2 Compensatory lengthening

In this subsection, we will see how compensatory lengthening is dealt with. Since the analysis in this section does not crucially rely on underparsing of mora, it is predicted that there will be moraic stability in the sense that the total number of moras in the conjugation remains all the same. It will be tentatively assumed that the constraint *Parse-μ* is ranked under {*Onset*, *NoComplex*}. Consider the following evaluation table:

(15) Evaluation table for /po + A/

μ po	μ A	Fill	Parse-Seg	Onset	No Complex	Parse- μ
a) $\mu\mu$ pwA:					*	
b) $\mu\mu$ po.A				*		
c) μ pwA					*	*!
d) $\mu\mu$ po.ΔA		*!				
e) $\mu(\mu)$ pA(:)			*!			(*)

What really interests us in (15) is the comparison between (15a) and (15c). The former analysis predicts that (15c) is the optimal form as shown in (6). But in (15) it is shown that (15a) is less marked than (15c) given the constraint ranking. Thus to satisfy the constraint, *Parse- μ* , the mora in the stem vowel is realized in the suffix making it a long vowel.

One would argue that the moras are associated to vowels in the underlying representation and that the changing of association line, i.e. delink mora from the stem vowel and relink it to the affix results in the change of association line. From this perspective, he would further argue that such an operation is not allowed by GEN since it violates Containment principle that disallows any change of input representation.

Such a claim, however, crucially relies on the assumption that moras are linked to vowels in the underlying representation. But that is not the only way to look at the underlying representation. We may as well assume that there are moras present in the underlying representation but they are not associated to vowels. Though the nature of moras and vowels is subject to further research, this paper assumes that moras are not associated to vowels and the universal association principle in line with Goldsmith (1976) works to have moras associated to vowels. In Optimality theory, *Parse- μ* and *Fill- μ* work

together to make sure that all the moras are correctly associated to vowels. If an underlying mora does not appear in the output, then it is *Parse-μ* violation. If, on the other hand, there are moras in the output which does not have a corresponding input mora, then it results in the violation of *Fill-μ*. Therefore without underlying association, we can account for the surface vowel-mora association correctly.⁷⁾

The compensatory lengthening is not witnessed in non-initial syllables as the following examples show:

(16) Lack of compensatory lengthening

- a) /səu + A/ [sewA] (to erect)
- b) /talku + A/ [talgwA] (to make hot)
- c) /ilɪ + A/ [igyA] (to win)
- d) /samk^{hi} + A/ [samk^{hi}yA] (to swallow)

The discussion up to this point along with the proposed constraints leads us to choose an output with long vowels as illustrated in the following evaluation of the word in (16a):

(17) Wrong evaluation table

$\mu\mu$ seu + A	<i>Fill</i>	<i>Parse-Seg</i>	<i>Onset</i>	<i>No Complex</i>	<i>Parse-μ</i>
μ $\mu\mu$?? a) se.wA:					
μ μ b) se.wA.					*!
$\mu\mu$ μ c) se.j.A.			**!		

7) The containment principle of GEN is problematic in other areas too. If changes in the input is not allowed, then it may be extremely difficult to explain assimilation in the optimality theory. Given that assimilation is a feature changing process, it will surely change the featural composition of the input. This and other similar observation such as insertion of specified segments in the output leads to giving up the containment and new approach Correspondence Theory comes to replace it as in McCarthy and Prince (1995).

The evaluation predicts that (17a) is the optimal form while the correct and witnessed form is (17b). But the attested surface form clearly is inferior to (17a) since it has a violation of *Parse- μ* . To correctly explain this, we have to look into other areas of Korean phonology. We find that the lack of compensatory lengthening in non-initial syllables is not just confined in glide formation. The same effect is also witnessed in vowel coalescence in Korean too, as the following data show:

(18) Vowel coalescence and compensatory lengthening

a) /ai/	[æ:]	(a child)
/kai/	[ka:l]	(autumn)
/te+i/	[te:]	(to be burn)
b) /sanai/	[sanæ]	(a man)
/khin + ai/	[khinæ]	(a big boy)
/onil + næil/	[onilnæ]	(today or tomorrow)

Given these examples, we find long vowels, or heavy syllables, are found only in the initial syllables in Korean. In segmental phonological framework, a vowel shortening rule was invoked, that shortens all the long syllables in noninitial syllables as in Kim-Renaud (1982). The basic spirit of the vowel shortening rule is that long vowels are allowed only in the initial syllables in Korean. This observation lead us to posit the following constraint in line with the alignment schema of McCarthy & Prince (1993b):

(19) Heavy syllable in initial position

Align (σ_{μ} , *L*, *PrWd*, *L*) (= *Align- σ_{μ}*)

Heavy syllables are in the initial position of a prosodic word.

The constraint (19) will mark any output form with a long vowel in non-initial syllables in the evaluation table. Given that there is absolutely no long syllables found in non-initial syllables, we come to know that the constraint, *Align- σ_{μ}* , is observed by all surface forms, which, in turn means that it is an undominated constraint in Korean. Introducing the undominated constraint, *Align- σ_{μ}* , to the evaluation table

in (17), we see that we can correctly select out the optimal form as shown under:

(20) Revised evaluation table of (17)

	$\mu \mu$ s <u>u</u> +A	<i>Align-</i> $\sigma_{\mu\mu}$	<i>Fill</i>	<i>Parse-</i> <i>Seg</i>	<i>Onset</i>	<i>No</i> <i>Complex</i>	<i>Parse-</i> μ
a)	$\mu \mu$ s <u>e</u> .wA:	*!					
b)	$\mu \mu$ s <u>e</u> .wA.						*
c)	$\mu \mu \mu$ s <u>e</u> .u.A.				**!		

Thus we see that the constraint, *Align- $\sigma_{\mu\mu}$* , interact with the rest of the relevant constraint to give out the correct output forms.⁸⁾

There is one more problematic aspect in the compensatory lengthening analysis given in this subsection. We find that, for some words, compensatory lengthening does not take place in initial syllables. Consider the following data from B. K. Lee (1979), K. M. Koh (1991), and Y. S. Kim (1993):

8) One possible problem in this analysis is the nature of the proposed *Align- $\sigma_{\mu\mu}$* constraint. Under the basic principles as laid out in McCarthy and Prince (1995), the constraints are universal. And the proposed constraint is subject to the verification from data of other languages, to see whether it really is a universal constraint and whether there are other languages where the constraint is visibly working in selecting optimal form. Admittedly it is an open question whether the constraint is truly universal.

Another possible explanation not pursued in this paper is to treat the vowel shortening outside of the phonological evaluation. In other words, the vowel shortening may be interpreted as a phonetic interpretation rule under the following two reasons:

- (a) vowel shortening is an automatic process without any exception.
- (b) vowel shortening does not require any phonological, morphological or syntactic information.

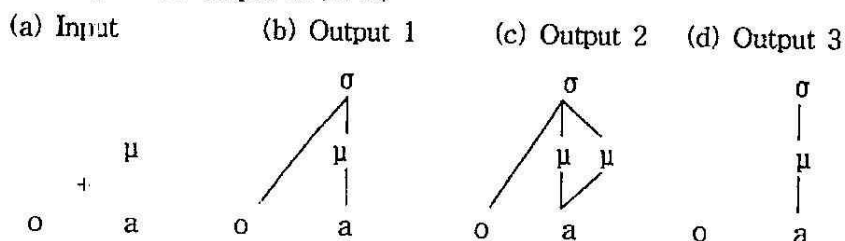
But that approach also suffers from deficiency, not being able to explain the lack of shortening in the initial positions and simply ignoring the problems involved in the vowel shortening.

(21) Lack of compensatory lengthening in the initial syllables.

a) /o+A/	[wA]	*[wA:]	(to come)
b) /ci + A/	[cA]	*[c(y)A:]	(to lose)
c) /c'i + A/	[c'A]	*[c'(y)A:]	(to boil)
d) /c ^h i + A/	[c ^h A]	*[c ^h (y)A:]	(to hit)
e) /p ^h u + A/	[p ^h A]	*[p ^h (w)A:]	(to ladle)

The data given in (21), presumably the exhaustive list of words without compensatory lengthening, look like counter-examples of the analysis given here. The answer to these examples lies in the nature of the underlying representation of the stem vowels of the words in (21). Following Lee's (1993) assumption, it is assumed that the stem vowels do not have underlying moras. Consider the following representation:

(22) Input and output of /o+A/



Given that the input is like (22a), it is only natural that (22b) is the optimal output, since it does not violate any of the proposed constraints. (22c) has an additional mora not present in the input, which is the violation of *Fill-μ*. (22d) fares better than (22c) in mora count. But this candidate has more crucial violations like *Parse-Seg* and *MParse*.⁹⁾

9) Prince & Smolensky (1993) proposed the constraint *MParse* (Failure to achieve morphological parsing is fatal). It is only natural that a morpheme should be realized in any morphological concatenation. In the given example, /o/ is the stem and underparsing the segment means no stem on the surface, which is not acceptable in any case. This constraint, ranked higher than *Fill*, is also responsible in providing a mora when there is CV suffix after the stem as shown in the following evaluation:

Virtually same explanation can be given to the rest of the examples in (21). The vowels do not come with a mora in the underlying representation. Therefore there is no violation of *Parse-μ* involved here. One more complication in these examples, however, involves the nature of segmental representation. In other words, we have to deal with the fact that the glide does not show up in the outputs in (21b) through to (21e). As a matter of fact, forms with output glides are not acceptable. This may present a challenge to the analysis given here. Y. S. Kim (1984, 1993), however, convincingly argues that the monosyllabic stems in (21b) to (21d) have underlying /i/ vowels. The surface vowels /i/ or /u/ results from progressive place assimilation.¹⁰⁾

Given that /i/ is the least marked vowel, which perhaps is devoided of any phonological property of its own, we understand that it fails to show up before a vowel. Seen from this perspective, these examples do not have compensatory lengthening effect because of lack of underlying moras and they fail to turn into glides since their underlying forms have /i/, which cannot be a glide.¹¹⁾ A contrast of

μ o +ta	MParse	Fill	Parse-Seg	Onset	No Complex	Parse-μ
μ μ a.o.ta		*		*		
μ b.<o>ta	*!		*			

This clearly shows that the exceptional lack of compensatory lengthening is due to the input representation of the stem form.

10) As a matter of fact, we can actually witness that there is a historical progressive assimilation found in Korean. S. D. Kim (1990) observes that the vowel /i/ assimilated to the preceding consonant in the 17th century. As a result, it changed into /u/ after labial consonants and into /i/ after (alveo)palatal consonants.

11) The vowel /i/ is almost always deleted next to another vowel as the following examples show:

ton + ilo → toniro 'with money' mæli + ilo → mæriro 'with head'
 mæk + imyən → 'if ... eat' ka + imyən → kamyən 'if .. go'
 mak + ini → magini 'to block and' seu + ini → seuni 'to erect and'

These data supports the vowel deletion analysis given in this paper. But there emerges one problem. Non-appearance of /i/ in the output results in *Parse-Seg* violation, which is ranked rather high in our discussion. A detailed analysis may involve the nature of *Parse-Feature*, and its interaction with *Parse-Seg*. An

the difference of underlying representation may explain the different behavior of similar words. Consider the following pairs from Kang (1987) and Y. S. Kim (1993):

(23) Comparison of phonologically similar words

a) ci + A (to lose)	cA	*cA:	*cyA	*cyA:	*ciA
b) ci + A (to carry)	*cA	cA:	*cyA	*cyA:	ciA
c) c ^h i + A (to hit)	c ^h A	*c ^h A:	*c ^h yA	*c ^h yA:	*c ^h iA
d) c ^h i + A (to run over)	*c ^h A	c ^h A:	*c ^h yA	*c ^h yA:	c ^h iA

Compare (23a) with (23b) and (23c) with (23d) respectively. We find similar contrasts in these pairs. What is common here is that the output with [y] are all illformed. But there is a definite difference. (23b) and (23d) have long vowels in the outputs and they can also have vowel /i/ followed by the suffix, both of which are not allowed in (23a) and (23c).

One way of explaining the deviance witnessed in (23) is to resort to the nature of their underlying representation. Consider the underlying representation given in (24):

(24) Underlying representations

a) (23a) & (23c)	b) (23b) & (23d)
$\begin{array}{ccc} & \mu & \\ & + & \\ c^{(h)} i & & A \end{array}$	$\begin{array}{ccc} & \mu & \mu \\ & + & \\ c^{(h)} i & & A \end{array}$

As shown in (24), all these verbs share the same underlying vowel, /i/. This explains the lack of glides in the optimal outputs. But (24a) and (24b) are different in the nature of the underlying vowel. (24a) has underlying vowels which are not moraic, while the vowels in (24b) are. This explains why there is compensatory lengthening in the latter: the

important observation in this connection is that though i-deletion results in the violation of Parse-Seg, it may not mean the violation of Parse-Feature in any significant way. Such underspecification approach, though subject to further research, may provide answer for i-deletion phenomena.

satisfaction of *Parse- μ* . Further that is why surface vowel /i/ appears in the latter examples: the underlying mora guarantees the appearance of a vowel and the assimilation process changes the vowel into /i/. As such the presence of these data does not pose insoluble problems to the analysis in this paper.

4. Conclusion

In this paper, we have observed the complicated issues surrounding glide formation in Korean. In xV1V2 environment, the application of glide formation to V1 is optional if it is preceded by a consonant and it is obligatory in other environments. Further glide formation is sometimes accompanied by vowel lengthening of the initial syllables, while such lengthening is not witnessed in some words.

The phenomena, however, can be explained with the assumption that glide formation is a solution for onsetless syllables, but sometimes it may result in complex onset, which is more marked than syllables with single onset consonants. This is expressed by two interacting constraints *Onset* and *NoComplex* which are equal in constraint ranking. Glide formation without creating complex onset is always the best choice. This explains the obligatory glide formation in (V)VV environment. But in CVV environment, application of glide formation results in the violation of *NoComplex* and non-application violates *Onset*. There is a crucial constraint conflict between the two. Assuming that these two constraints are equal in ranking, we come to have two optimal forms, hence the optionality of glide formation in CVV environments.

If the stem has only one vowel, the application of glide formation results in compensatory lengthening. But if the vowel is non-moraic in the underlying representation, then the surface form cannot have a lengthened affix. As such, the presence or absence of compensatory lengthening depends on the nature of input vowels. Further, this paper shows that the lack of compensatory lengthening in non-initial syllables is due to the presence of undominated constraint *Align- σ_{mu}* in Korean.

It is argued in this paper that the present analysis fares better than the former analysis given in Lee (1996), in that it can deal with

compensatory lengthening in connection with glide formation and that there are no theory internal problems in the analysis. Though there are other issues involved in glide formation and compensatory lengthening, this paper shows that a simple and systematic account can be given within optimality theory.

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