Rule Ordering and Optimality Theory[1]

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Kang, Hyunsook. 1997. **Rule Ordering and Optimality Theory.** *Studies in Phonetics, Phonology and Morphology* 3, 57-76. Lakoff (1993) argues that phonological rules in Yawelmani should be ordered to one another and therefore, that three phonological levels are motivated not only for theoretical reasons but for empirical reasons. In this paper, I examine phonological rules in Yawelmani and attempt to dispense with three phonological levels suggested in Lakoff (1993). **(Hanyang University)**

1. Introduction

It has long been a subject in phonology how surface representations are related to their underlying representations. Generative phonologists have argued for the incorporation of boundary symbols into phonology so that rules can refer to different boundaries; Lexical phonologists have argued for lexical and postlexical levels in which morphological and phonological operations take place. Recently, processual phonological rules are replaced with phonological constraints in constraint-based phonological theories; derivation of the surface form from its underlying form is refuted on some empirical evidence (cf. McCarthy and Prince 1993, etc.).

Among constraint-based phonological theories, Cognitive Phonology argues for three phonological levels for languages with considerable phonological rule ordering. For example, Lackoff (1993) argues for three level phonology to explain opaque rules in languages like Icelandic and Yawelmani. McCarthy (1995) has attempted to dispense with three phonological levels by reanalysing phonological rules in Icelandic within the framework of Optimality Theory. In this paper, I will examine phonological rules in Yawelmani and attempt to dispense with three

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phonological levels suggested in Lackoff (1993).

This paper is organized as follows: in the second section, I will examine McCarthy's (1995) proposal of how to dispense with rule orderings within the framework of Optimality Theory. In the third section, I will examine four phonological rules and their interactions in Yawelmani and the way they should be interpreted within Optimality Theory. In the last chapter, I will summarize my argument.

2. Rule ordering

In this section, I will briefly present McCarthy's (1995) analysis of post-vocalic spirantization in Tiberian Hebrew. Post-vocalic spirantization in Tiberian Hebrew takes place whether the triggering vowel is present either underlyingly or at the surface as is shown in (1). For instance, underlying /k/ appears as /x/ if it is preceded by an underlying vowel as in (1a) or (1c) regardless of whether it is present in the surface forms. An underlying /k/ also changes into /x/ if it is preceded by an epenthetic vowel as in (1b).

(1) U.R. S.R.
a. malaki:m ----> məla:xi:m
b. malk ----> melex
c. malake: ----> malxe:

In order to explain the surface forms, the following rule ordering has been suggested.

(2)				
	malaki:m	malk	malake:	U.R.
	------	malek	-----	Epenthesis
	malaxi:m	malex	malaxe:	Spirantization
	-----	-----	malxe:	Syncope
	məla:xi:m	melex	malxe:	Other ruels

Unless post-vocalic spirantization is ordered between epenthesis and syncope, an incorrect surface form would appear.

McCarthy (1995) suggests that rule ordering can be dispensed with if we adopt the correspondence theory. He proposes to decompose the conditions imposed by a phonological constraint into four, namely the featural composition of α, the featural composition of β, linear order, and adjacency, to account for opacity phenomena. In particular, he proposes that each condition must also designate the level (underlying, surface, or either) at which it obtains. Correspondence Theory allows us to make sense of conditions obtaining at one level or the other. Canonical Constraint Schema given in McCarthy (1995) is given in (3).

(3) Canonical Constraint Schema

*	condition	level
α		
β		
linear order		
adjacency		

McCarthy (1995) proposes the following constraint condition for the post-vocalic spirantization in Tiberian Hebrew.

(4) NO-V-Stop

*	condition	level
α	V	Indifferent
β	[-son, -cont]	Surface
linear order	α > β	Indifferent
adjacency	Strict	Indifferent

Note that the constraint in (4) is the surface constraint like all the other constaints in Optimality Theory. (4) should be read as "[-son, -cont] should not be allowed in the output if a vowel immediately precedes it at the surface level or if a vowel immediately precedes the underlying correspondent of [-son, -cont] at the underlying level." McCarthy (1995) illustrates three examples which violate conditions in (4). We represent two of those examples in (5).

(5)

	a.	b.
Underlying	m a l k	m a l a k e
	| | | |	| | | | |
Surface	m a l e k	m a l k e

required conditions for constraint Applicability	Conditions observed in these candidates S/U pairings	
α = V at S or U	α = V at S	α = V at U
β = stop at S	β = stop at S & U	β = stop at S & U
α>β at S or U	α>β at S	α>β at U
α⌒β at S or U	α⌒β at S	α⌒β at U
Conclusion	(4) is applicable and violated	(4) is applicable and violated

In (5a), the surface /k/ is immediately preceded by a vowel at the surface and therefore, (5a) violates the constraint (4). The underlying correspondent of the surface /k/ in (5b) is also immediately preceded by a vowel at the underlying, and thus the form in (5b) also violates the constraint (4). Therefore, conditions in (4) correctly predict that /k/s in (5) should be prohibited; rule ordering is not necessary to explain why /x/ should surface for these forms.

3. Yawelmani

Like Tiberian Hebrew, Yawelmani also shows considerable rule ordering; epenthesis, vowel harmony, vowel lowering and vowel shortening should apply to the underlying form in that order to derive correct surface forms. In this section, we will discuss how rule ordering in Yawelmani can be dispensed with. Yawelmani data in this section come from Archangeli (1984).

3.1 Epenthesis and Vowel Shortening

In this section, I will present the analysis in Archangeli (1984) why vowel epenthesis and vowel shortening should be ordered to each other in Yawelmani. In section 3.2, I will suggest how rule ordering for Yawelmani can be dispensed with within the Optimality Theory.

Yawelmani shows the following syllable structures in (6) on the surface.

(6) Possible Syllable Structures in Yawelmani
CV, CVV, CVC

If unsyllabifiable consonant clusters occur by the juxtaposition of morphemes, a default vowel /i/ is inserted to break up consonant clusters as we see in (7). A phonological rule is given in (8).

(7) t'oyx + k'a	U.R.
(t'oy)x + (k'a)	Syllabification
(t'oy) ix + (k'a)	Epenthesis
(t'o)(yix) + (k'a)	Resyllabification

(8) Epenthesis
ø ----> i / ___ C'[2]

However, not all the unsyllabified consonants trigger default vowel insertion. Consider (9).

(9) a. ?a:ml + al	U.R.
b. (?a:) m(l + al)	Syllabification
c. (?am) (l + al)	Vowel Shortening
[?amlal]	Surface Form

Note that in (9b) a default vowel is not epenthesized before an unsyllabified [m]; rather vowel shortening takes place to make the form to conform to the legitimate syllable structures. Based on the observation, Archangeli (1984) among others has suggested that in Yawelmani [CVVC] is a legitimate syllable structure which then undergoes vowel shortening, surfacing as [CVC]. Vowel shortening rule

2 C' represents an unsyllabified consonant.

is given in (10) and a sample derivation is given in (11).

(10) Vowel Shortening (V.S.): V ---> [-long] / [C__C]σ

(11)	?a:ml + hin	?a:ml + al	U.R.
	(?a:m)l + (hin)	(?a:m)(l + al)	Syllabification
	(?a:m)il + (hin)	(?a:m)(l + al)	Epenthesis (8)
	(?a:)(mil)(hin)	(?a:m)(lal)	Resyllabification
	(?a:)(mil)(hin)	(?am)(lal)	V.S (10)
	[?a:milhin]	[?amlal]	S.R.

As we see in (11), epenthesis should apply before vowel shortening; if not, an incorrect derivation in (12) would occur.

(12)	?a:ml + hin	?a:ml + al	
	(?a:m)l+(hin)	(?a:m)(l + al)	Syllabification
	(?am) l + (hin)	(?am)(l + al)	V.S.
	(?am)il + (hin)	(?am)(l + al)	Epenthesis
	(?a)(mil)(hin)	(?am)(lal)	Resyl.
	*[?amilhin]	[?amlal]	S.R.

3.2 Epenthesis and Vowel Shortening within OT

In this section, let us discuss how optimality theory can dispense with the ordering of these two rules; namely, epenthesis and vowel shortening. In Optimality Theory, phonological rules no longer exist. Rather, phonological constraints, ranked to each other, become important. Constraints in (13-15) are markedness constraints based on the syllable structures of Yawelmani. Recall that only CV, CVV and CVC structures are allowed in Yawelmani on the surface.

(13) Onset: Syllables should have an onset.
(14) NoComplex-C (NCC): No more than one C may associate to any syllable position.
(15) *LongV-C]σ (*LVC): Long vowels may not occur in closed syllables.

Constraints in (16-18) are faithfulness constraints in correspondence theory.

(16) Dep(i): [i] in the output should have a correspondent in the input.

(17) Max(μ): Every mora of the base has a correspondent in the output.

(18) Max(S): Every melodic segment of the base has a correspondent in the output.

When /?a:ml/ is added with a consonant initial suffix /-hin/ as in (19) and /-lal/ as in (20), the optimal forms /?a:milhin/ and /?amlal/ will be selected with the constraint ranking *LongV-C]σ, NCC >> DEP(i) >> Max(S) >> Max(μ). For example, /?amlhin/ in (19c) fatally violates NCC and /?amilhin/ in (19a) violates both Dep(i) and Max(μ) whereas the optimal form /?a:milhin/ in (19b) only violates Dep(i).

(19)[3]

	NCC	Dep(i)	Max(μ)
a. (?a)(mil)(hin)		*	*!
☞ b. (?a:)(mil)(hin)		*	
c. (?aml)(hin)	*!		

/?amlal/ in (20a) violates Max(μ) whereas the other candidates violate one of the constraints which is more highly ranked than Max(μ). Therefore, /?amlal/ is chosen as optimal.

(20)

/?a:m+lal/	*LVC]σ	Dep(i)	Max(S)	Max(μ)
☞ a. ?amlal				*
b. ?a:mlal	*!			
c. ?a:milal		*!		
d. ?a:lal			*!	

3 In the following tableaux, ( ) represent syllable boundaries.

With the proper constraint hierarchy, rule ordering necessary in generative phonology is no longer needed within Optimality Theory.

3.3. Vowel Harmony and Vowel Lowering

There are two more phonological rules which should intervene between epenthesis and vowel shortening; namely, vowel harmony and vowel lowering. In this section, I will briefly present the interactions of these two rules in Archangeli (1984). Vowel inventory in Yawelmani is given in (21).

(21)	Underlying	Surface
	i/ii	i
	a/aa	e/ee
	o/oo	a/aa
	u/uu	o/oo
		u

As we see in (21), long high vowels do not appear at the surface, though long high vowels exist underlyingly; Long high vowels at the underlying representation undergo some rules which change their featural or prosodic shapes. Some rules which affect underlying high long vowels are vowel harmony and vowel lowering.

Yawelmani shows vowel harmony which triggers high vowels, /i, ii/, to become rounded /u, uu/ if preceded by high round vowels. In addition, non-high vowels, /a, aa/, become rounded /o, oo/ if they are preceded by another non-high vowels. Vowel Harmony rule is given in (22). Some examples are given in (23).

(22) Vowel Harmony: Vowels become round and back
when following a round vowel of the same height.
[+syll, αhigh] ---> [+round, +back]
/ [+syll, +round, αigh] C ____

(23)

	a.	b.	c.	
	?ugn + hin	hogn + hin	?otn + al	U.R.
	?ugin + hin	hogin + hin	------l	V.E.
	?ugun+ hun	------	?otn+ol	V.H.
	[?ugunhun]	[hoginhin]	[?otnol]	

If vowel harmony applies before epenthesis, an incorrect surface form would occur for (23a) as is shown in (24).

(24)

	?ugn + hin	U.R.
	?ugn + hun	V.H.
	?ugin + hun	V.E.
	*[?uginhun]	

Another phonological rule which should intervene between epenthesis and vowel shortening is vowel lowering rule in (25). One sample derivation is given in (26).

(25) Vowel Lowering (VL)

V V ⟶ V V
 \/ ⟶ \/
[+hi] ----> [-hi]

(26)

	sudu:k + hin	c'u:m + al	U.R.
	sudu:k + hun	c'u:m + al	Harmony
	sudo:k + hun	c'o:m + al	Lowering
	sudok + hun	c'o:m + al	Shortening
	[sudokhun]	[c'o:mal]	

If vowel harmony applies after vowel lowering, an incorrect surface form will appear as in (27).

(27)

	sudu:k + hin	c'u:m + al	U.R.
	sudo:k + hin	c'o:m + al	Lowering
	sudo:k + hin	c'o:m + ol	Harmony
	sudok + hin	c'o:m + al	Shortening
	*[sudokhin]	*[c'o:mol]	

In this section, we have presented four phonological rules in Yawelmani and their rule ordering to each other. In the next section, we will consider how vowel lowering and vowel harmony should be interpreted within Optimality Theory.

3.4 Vowel Lowering and Vowel Harmony in OT

Let us consider how vowel lowering and vowel harmony should be understood within Optimality Theory. We will first consider vowel lowering. As noted, underlying long high vowels never appear on the surface. In processual phonology, vowel lowering in (25) changes an underlying high long vowel into non-high vowels. Within the framework of optimality theory, I suggest the following decomposition of the conditions imposed by *Long-High-Vowel constraint.

(28) *Long-High Vowel (*LHV)

*	Condition	Level
α	VV	Underlying
β	[+hi]	Surface
Linear Order	α=β	Underlying
Adjacency	Strict	Underlying

(28) should be read as "No surface [+hi] if its underlying correspondent is associated with a long vowel." With the proper constraint ranking, the correct output /sudokhin/ will be chosen out of /sudu:khin/. The output candidates in (29) have not yet undergone vowel harmony. Ident(V-μ) is a constraint which says "the number of the mora of the vowel segment should be identical between the input and the output."

(29)

sudu:k+hin	*LVC]σ	*LHV	Ident(V-μ)
a. (su)(du:k)(hin)	*!		
b. (su)(duk)(hin)		*!	*
☞c. (su)(dok)(hin)			*

/sudu:khin/ in (29a) fatally violates *Long V-C]σ and /sudukhin/ in (29b) violates *LHV since the underlying correspondent of the surface [+hi] is VV. These two constraints are more highly ranked than Ident(V-μ) which /sudokhin/ violates. Therefore, /sudokhin/ will be selected as optimal.

Let us now consider how vowel harmony in Yawelmani should be interpreted within the framework of Optimality Theory. In generative phonology, vowel harmony in Yawelmani is expressed as follows (Archangeli 1985):

(30)

```
  V      V                V    V
  |      |                |    |
[αhi]  [αhi]   ---->   [αhi] [αhi]
  |                       |  /
[+rnd]                 [+rnd]
```

Within the framework of optimality theory, I suggest the following constraints for round harmony. Firstly, stem initial round feature should be maintained in all circumstances.

(31) Max ([+rnd], stem) (Max(R)): [+rnd] feature in the stem of the input should have a correspondent in the output.

Secondly, spreading of the round feature in generative phonology should be interpreted as alignment of the round feature with the phonological phrase as in (32). In doing so, however, it should not skip any eligible candidate. We represent it as NO GAP constraint.

(32) Align-R ([+round], phonological phrase): The right edge of [+rnd] feature should align with the right edge of the phonological phrase.

(33) No Gap: Two vowels with a round feature should not be separated by an unround vowel.

```
  *V     V     V
   |           |
 [+rnd]      [+rnd]
```

The right constraint ranking, Max([+rnd]) >> No Gap >> Align-R, will select the right output form.

(34)

suduk+hin	Max(+rnd)	No Gap	Align-R
a.(?u)(gin)(hin)			*!*
b.(?u)(gin)(hun)		*!	
☞c. (?u)(gun)(hun)			

However, rounding harmony in Yawelmani is more complex than this. With the constraint ranking we have until now, *[co:mol] will be chosen when /cu:m/ is added with /-al/ as is shown in (35). However, the right output is /co:mal/.

(35)

cu:m+al	*LHV	Max(rnd)	No Gap	Align-R
a. cu:mol	*!			
b. co:mol				
☞ c. co:mal				*!

The problem lies in the way vowel harmony is expressed in (31-33); vowel harmony in (30) applies at a point in the derivation where vowels still carry their underlying vowel heights. However, the constraints we suggested in (31-33) consider the output forms only; therefore they can only refer to vowel heights of the output forms. To refer to the height features of the input form of the relevant segments, we need to decompose the conditions of the relevant constraints.

3.4. Two theoretical issues

Before discussing the details of the decomposition of the conditions of the constraints, we need to consider two theoretical issues. Generative phonologists have preferred to reduce the number of rules by adopting alpha-variables. For example, if a nasal assimilates to the following obstruents in place, the rule (36) is preferred to (37) since it expresses place assimilation between a nasal and the following obstruents more economically.

(36)

[C,+nas] ---> [αant,βcor] / ____ [-son, αant, βcor]

(37)

a. [C, +nas] ---> [+ant,+cor] /____ [-son,+ant,+cor]
b. [C, +nas] ---> [+ant,-cor] /____ [-son,+ant,-cor]
c. [C, +nas] ---> [-ant,+cor] /____ [-son,-ant,+cor]
d. [C, +nas] ---> [-ant,-cor] /____ [-son,-ant,-cor]

Since then phonologists have noticed that many languages show total place assimilation between a nasal and the following obstruent rather than assimilation between a nasal and some obstruent with the specific place. Therefore, nasal assimilation should not be expressed as four rules as in (37). Rather, a single rule in (36) better captures the insight of feature assmilation[4].

However, not all rules should be incorporated into one rule using alpha-variable, just because they are reducible into one. Constraint splitting has been suggested for the treatment of syllable sonority (Prince & Smolensky 1993) which looks like one and the same rule. In fact, rules reducible into one by an alpha-variable notation are often

4 The insight is captured in the structure of feature hierarchy.

suggested as two different rules. For example, refer to rules in Japanese by Ito & Mester (1995).

Likewise, I argue that for vowel harmony in Yawelmani it is not one rule as is written in (30) but two different rules with different conditions; one vowel harmony rule applies between two high vowels and another vowel harmony rule applies between two non-high vowels. In fact, languages like Warlpiri allows round harmony only between high vowels as in (38).

(38) Warlpiri

a. maliki-kirli-rli-lki-ji-li
   dog Prop-Erg-then-me-they

b. kurdu-kurlu-rlu-lku-ju-lu
   child

c. minija-kurlu-rlu-lku-ju-lu
   cat

In (38), suffixes that contain high vowels are affected by round (labial) harmony. These suffixes appear with /i/ if the root final vowel is /i/; they surface with /u/ if the root final vowel is /u/ or /a/. Therefore, high vowels show the same value of the round feature unless they are separated by an intervening non-high vowel [a]. [a] does not trigger rounding harmony (or [-rnd] harmony as Cole argues) nor undergoes it. However, high vowels in a sequence undergo [+rnd] harmony, showing the same value of [+rnd] feature.

On the other hand, Khalkha Mongolian shows round harmony only between non-high vowels as in (39) and (40).

(39) Khalkha Mongolian

	Ablative (-AAs-)	Gloss
a.	xiil-ees	'violin'
	ex-ees	'mother'
	düüƔ-ees	'younger brother'
	zuur-aas	'hundred'
b.	ax-aas	'elder brother'

c. ör-öös 'debt'
d. xot-oos 'city'

(40)
a. mol-ii-lg-ood 'having flattened'
b. nugl-xii-l-aas 'having folded'

As we see above, two harmony rules, namely front harmony and round harmony, apply in Khalkha Mongolian. Since we are interested in round harmony, let us focus on round harmony only. As we see in (39), the ablative suffix /-AAs-/ becomes rounded only if the preceding root vowel is a non-high round vowel. However, suffixes with high vowels shown in (40) does not undergo round harmony whether they are preceded by a high round vowel or a non-high round vowel. In sum, round harmony applies only between non-high vowels.

Note that unlike place assimilation between a nasal and a following obstruent, there is no motivation why round harmony should be represented as one and the same rule. Therefore, I argue that round harmony in Yawelmani consists of two rules one of which applies only between high vowels and another between non-high vowels.

Another point we need to discuss is the decomposed conditions of a constraint whose schema is shown in (3). We show it as (41) for the ease of the reference.

(41) Canonical Constraint Schema

*	condition	level
α		
β		
linear order		
adjacency		

Schema (41) allows us to consider features of segments at the underlying or the surface level or either; however, it does not allow us to consider some features of one segment at one level and another features of the same segment at another level. Correspondence Theory allows us to refer to certain features of a segment at one level and other features of the same segment at another level. I argue, therefore,

(41) needs to be modified.

3.5. Vowel Harmony in Yawelmani

Now we are ready to go back to round harmony in Yawelmani. I suggest the following conditions of Round Harmony between high vowels in Yawelmani.

(42) VH 1

*	condition	level	condition	level
α	[+rnd]	S.R.	[+hi]	U.R.
β	[+rnd]	S.R.	[-hi]	U.R.
linear order	α > β	Indifferent		
adjacency	nonstrict	Surface		

Constraint Tableau (42) should be read as "Surface [+rnd][+rnd] violates a constraint VH1 if their underlying correspondents have [+hi][-hi]." For the vowel harmony between non-high vowels, I suggest the following conditions of the constraint.

(43) VH 2

*	condition	level	condition	level
α	[+rnd]	S.R.	[-hi]	U.R.
β	[+rnd]	S.R.	[+hi]	Indifferent
linear order	α > β	Indifferent		
adjacency	nonstrict	Surface		

Constraint Tableau (43) should be read as "Surface [+rnd][+rnd] violates a constraint if the underlying correspondent of the first segment is underlyingly [-hi] and the second segment is [+hi] either at the underlying or at the surface level.

Some sample constraint tableaux are given in (44-46). Consider (44). (44a) violates Align-R since the last high vowel [i] in -hin- does not carry [+rnd] feature. (44b) violates Max(R) since the round feature of the second stem vowel is lost. Therefore, (44c) is the optimal output since it does not violate any of the constraints shown in (44).

(44) /sudu:k+hin/---> [sudokhun]

<table>
<tr><td>/sudu:k+hin/
CVCVVC+ CVC
| V |
[+h][+h] [+h]
| /
[+R]</td><td>Max(R)</td><td>NoGap</td><td>VH 1</td><td>VH 2</td><td>Align-R</td></tr>
<tr><td>a. /sudokhin/
CVCVC+ CVC
| | |
[+h][-h] [+h]
| /
[+R]</td><td></td><td></td><td></td><td></td><td>*!</td></tr>
<tr><td>b. /sudekhin/
CVCVC+ CVC
| | |
[+h][-h] [+h]
|
[+R]</td><td>*!</td><td></td><td></td><td></td><td>**</td></tr>
<tr><td>☞c. /sudokhun/
CVCVC+ CVC
| | |
[+h][-h] [+h]
| / /
[+R]</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Now, let us consider what happens if the stem with the round high vowel is followed by a suffix with non-high vowels. Consider (45). (45a) violates VH 1 since the first vowel with [+rnd] is followed by another [+rnd] and their underlying correspondents are [+hi][-hi]. (44c) violates Max(R) since the round feature of the stem is deleted in the output. (44b) violates Align-R but the other candidates violate constraints which are more highly ranked than Align-R.

(45) c′ u: m + a l [c′o:mal]

/cu:m + al/ CVVC+ VC V | [+h] [-h] | [+R]	Align-L	NoGap	VH 1	VH 2	Align-R
a. /co:mol/ CVVC+ VC V | [-h] [-h] | / [+R]			*!		
☞ b. /co:mal/ CVVC+ VC V | [-h] [-h] | [+R]					*
c. /ce:mal/ CVVC+ VC V | [-h] [-h]	*!				

As a final tableau, let us consider a case where an epenthetic vowel follows a stem with a round vowel. Consider (46). (46a) violates Align-R twice and (46b) violates Align-R once whereas (46c) does not violate any of these constraints. Note that (46c) does not violate VH1 or VH2. Even though there is a surface sequence of [+rnd][+rnd], the height of second vowel, [+hi], is not preceded by [-hi] of the underlying correspondent of the first vowel.

(46) ?ugn+ hin ----> [?ugunhun]

CVCC+ CVC | | [+h] [+h] | [+R]	Max(R)	NoGap	VH1	VH2	Align-R
a./?uginhin/ CVCVC+CVC | | | [+h][+h] [+h] | [+R]					**!
b./?ugunhin/ CVCVC+CVC | | | [+h][+h] [+h] | / [+R]					*
☞c/?ugunhun/ CVCVC+CVC | | | [+h][+h] [+h] | / / [+R]					

4. Conclusion

In this paper, we have discussed how two-level optimality theory can deal with phonological rules in Yawelmani which show considerable rule ordering. I have argued that correspondence theory, which allows us to refer to the structures of the input segment, enables us to reduce several levels into two. In doing so, I have suggested that one should be able to refer to not only some features of a segment at the surface level but also other features of its correspondent at the underlying level in the decomposition of conditions of a constraint.

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