THE EMERGENCE OF THE FAITHFUL[1]

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1. Introduction

Traditionally, phonological processes like compensatory lengthening (CL), metathesis, and coalescence have been regarded as diverse and dissimilar processes. In Optimality Theory (Prince & Smolensky 1993), in particular, in Correspondence Theory (McCarthy & Prince 1995), however, these processes, including some others, far from each being idiosyncratic or random, can be integrated into a single process, namely, they can be governed by specific instantiations of a single general ranking schema. Correspondence Theory thus provides a unified framework to capture the generalization that fundamentally a single ranking schema is at work for all of those processes. Significantly, Rotuman "incomplete phase" supplies compelling evidence that some of these processes are dealt with by one and the same ranking, which resolves into the general ranking schema. Ultimately, it will be demonstrated that the afore-mentioned processes are all the outcome of an endeavor to conserve to the utmost extent possible the numerical integrity of segments of a morpheme. This endeavor is formally expressed in the form of the general ranking schema, under which the faithfulness constraint $\text{M}{\small\text{AX}}_{IO}$ is satisfied at the cost of other faithfulness constraint(s), in the face of the irresistible satisfaction of crucially-dominating markedness constraint(s). Moreover, it will be shown that the phenomena of CL and those of tonal stability which give rise to conserving the numerical integrity of moras and tones respectively can also be incorporated into practically the same general ranking schema.

2. Compensatory Lengthening

2.1 Introduction – "Classical" Compensatory Lengthening

The "classical" type of CL is the lengthening of a vowel triggered by the deletion of a following coda consonant, as Hayes (1989) points out. He further states that he has located 38 rules of this pattern from 26 languages from Hock (1986), de Chene & Anderson (1979) and his own research; he thus rightly claims that this type of CL is not at all rare. Adapting his schematic presentation, we may represent this pattern as follows:

[1] I am grateful to John McCarthy whose comments encouraged me to set about writing this article when I was skeptical about its fructification.

(1) a. VCCV → V:∅CV
b. VCC]$_{LexWd}$ → V:∅C]$_{PrWd}$
c. VC]$_{LexWd}$ → V:∅]$_{PrWd}$

To begin with, we can account for this pattern of CL as in the following summary tableau without recourse to the moraic theory Hayes adopts in dealing with the phenomenon of CL[2]. For (1a) and (1c), the constraint NOCODA (Itô 1990, Yip 1991, Itô & Mester 1994) is needed, and, for (1b), the constraint NOCOMPLEX (Prince and Smolensky 1993) is needed. (Henceforth, the underlined V is epenthetic.)

(2) Summary Tableau for the "Classical" Compensatory Lengthening
NOCOMPLEX, NOCODA >> MAX$_{IO}$, DEP$_{IO}$ >> UNIFORMITY, IDENT$_{IO}$ (F)[3]

	a. NOCOMPLEX b. NOCODA	a. MAX$_{IO}$ b. DEP$_{IO}$	a. UNIFORMITY b. IDENT$_{IO}$ (F)
/$V_1C_2C_3V_4$/			
☞ $V{:}_{1,2}C_3V_4$			a.* b.*
$V_1C_3V_4$		a.*!	
$V_1C_2\underline{V}C_3V_4$		b.*!	
/$V_1C_2C_3]_{LexWd}$/			
☞ $V{:}_{1,2}C_3]_{PrWd}$			a.* b.*
$V_1C_3]_{PrWd}$		a.*!	
$V_1C_2\underline{V}C_3]_{PrWd}$		b.*!	
/$V_1C_2]_{LexWd}$/			
☞ $V{:}_{1,2}]_{PrWd}$			a.* b.*
$V_1]_{PrWd}$		a.*!	
$V_1C_2\underline{V}]_{PrWd}$		b.*!	

The markedness constraints NOCOMPLEX and NOCODA should crucially overrank the faithfulness constraint MAX$_{IO}$, since the former, by their very nature, destroy the numerical integrity of segments of a morpheme. But its effect is invisible because the latter dominates other faithfulness constraints, resulting in its satisfaction in the end, creating CL. The hypothetical transposed ranking UNIFORMITY, IDENT$_{IO}$ >> MAX$_{IO}$ would evaluate, for example, the actual output form $V{:}_{1,2}C_3V_4$ as less optimal than the failed candidates. Furthermore, it is clarified beforehand that, in the rankings to be operative throughout this article, no hypothetical reversion of the constraint pair 'MAX$_{IO}$ >> the other faithfulness constraint(s)' could guarantee the actual output forms. And it is assumed that no ranking exists between MAX$_{IO}$ and DEP$_{IO}$, because the satisfaction of both of these two constraints ensures the numerical integrity of segments of a

[2] Still, we do not deny that there are cases that require moraic account. We will come to this issue later in section 5.
[3] Throughout this article, refer to McCarthy & Prince (1995) for the faithfulness constraints unless noted otherwise.

morpheme. Thus, for the case at hand, we have established the following ranking exploited in the tableau above:

(3) Ranking for the “Classical” Compensatory Lengthening
NoComplex, NoCoda >> Max$_{IO}$, Dep$_{IO}$ >> Uniformity, Ident$_{IO}$ (F)

As is evident from reviewing the results in the summary tableau above, under this ranking, the faithfulness constraint Max$_{IO}$ is defended, predominating over other faithfulness constraints, notwithstanding the higher-ranking markedness constraints. Hence, it follows from this introductory survey that the “classical” type of CL is brought about as a consequence of an endeavor to conserve the numerical integrity of segments of a morpheme. This result can be achieved only by relying upon the device of multiple correspondence of a segment, which is made possible by sacrificing the featural identity between the correspondent segments.

2.2 Turkish *v*-Loss

We will next deal with a real-life example of the “classical” CL, citing Turkish data discussed in Sezer (1986: 228-229, 231-232). An optional rule deletes *v* when it is followed by a labial consonant or a vowel, or when it is preceded by a labial vowel.[4] It is to be observed, however, that only the deletion of coda *v* induces CL. This phonological process may be thought of as a variant of the pattern (1a), since the coda consonant *v* can optionally be deleted before a labial consonant.

(4) a.

Infinitive	3. Aorist	3. Past	
övmek ~ ö:mek	över~ öer	övdü~ * ö:du	‘praise’
ovmak ~ o:mak	ovar ~ oar	ovdu ~ * o:du	‘rub’
savmak ~ sa:mak	savar ~ * saar	savdɨ ~ * sa:dɨ	‘rebuff’
sevmek ~ se:mek	sever ~ * seer	sevdi ~ * se:di	‘love’

b.

davul ~ daul	‘drum’
duvar ~ duar	‘wall’
tavɨr ~ * taɨr	‘attitude’

Although Hayes claims that onsets are not moraic and hence are inert with respect to CL process (for this inertness of an onset, see also Hyman 1984, 1985, McCarthy & Prince 1986), the inertness may be attributed to the violation of the constraint StRole (McCarthy & Prince 1993a: Ch. 7, 1995), as is exemplified in the failed candidate $d_1a{:}_{2,3}u_4l_5$ (5iic) in the following tableau. The constraint responsible for *v*-Loss is stated roughly as *v {[+lab], V}. The state of affairs as regards *v*-Loss can now be digested in the following tableau:

[4] But Sezer notes that it is not easy to formulate the *v*-Loss in a straightforward fashion.

(5) Summary Tableau for Turkish *v*-Loss

*v{[+lab], V}, STROLE >> MAX_{IO}, DEP_{IO} >> UNIFORMITY, IDENT_{IO} (F)

	a.*v{[+lab],V} b. STROLE	a. MAX_{IO} b. DEP_{IO}	a. UNIFORMITY b. IDENT_{IO} (F)
i. /$s_1a_2v_3m_4a_5k_6$/			
☞ a. $s_1a{:}_{2,3}m_4a_5k_6$			a.* b.*
b. $s_1a_2m_4a_5k_6$		a.*!	
c. $s_1a_2v_3$ $\underline{V}$ $m_4a_5k_6$	a.*! b.*!	b.*	
ii. /$d_1a_2v_3u_4l_5$/			
☞ a. $d_1a_2u_4l_5$		a.*	
b. $d_1a_2v_3$ $\underline{V}u_4l_5$	a.*!	b.*	
c. $d_1a{:}_{2,3}u_4l_5$	b.*!		a.* b.*

The failed candidate $d_1a{:}_{2,3}u_4l_5$ (iic) violates STROLE because the syllabic structure $a{:}_{2,3}]_\sigma$ is not identical to the input syllabic structure $_\sigma[v_3$; hence, as was mentioned above, it is made clear that the inertness of an onset with respect to CL is directly attributable to the violation of the constraint STROLE. And the opposite ranking MAX_{IO}, DEP_{IO} >> STROLE would choose this failed candidate as optimal. In addition, the markedness constraint *v{[+lab], V} should rank over MAX_{IO}; otherwise, we could not acquire the expected output form *daul* (iia).

Part of the constraint *v{[+lab], V}, that is, *v[C, +lab] is equivalent to the constraint NOCODA employed in the tableau (2) in that *v* is not admitted as coda before labial consonant. Accordingly, this constraint may be restated as NOCODA (*v[C, +lab]). Thus, the ranking relevant to yielding CL in the tableau above, NOCODA (*v[C, +lab]) >> MAX_{IO}, DEP_{IO} >> UNIFORMITY, IDENT_{IO} (F), is practically identical to the ranking (3). Hence, we witness that the real-life example of the “classical” CL also comes from an exertion to preserve the numerical integrity of segments of a morpheme, as is clear from the summary tableau above. These two rankings are compared below:

(6) a. Ranking for the “Classical” Compensatory Lengthening

NOCOMPLEX, NOCODA >> MAX_{IO}, DEP_{IO} >> UNIFORMITY, IDENT_{IO} (F)

b. Ranking for Turkish *v*-Loss

NOCODA (*v[C, +lab])} >> MAX_{IO}, DEP_{IO} >> UNIFORMITY, IDENT_{IO} (F)

The faithfulness constraint MAX_{IO}, on the one hand, is crucially dominated by the markedness constraint(s) M (i.e. NOCOMPLEX, NOCODA and *v{[+lab], V}) responsible for lessening the number of the input segments, and, on the other, it crucially dominates other faithfulness constraint(s) F_{IO} (i.e. UNIFORMITY and IDENT_{IO} (F)). We may thus present a ranking schema for “classical” CL as follows:

(7) Ranking Schema for the “Classical” Compensatory Lengthening

M >> MAX_{IO} >> F_{IO}

Under this ranking, the obedience to the faithfulness constraint $\text{M}\textsc{ax}_{IO}$ is achieved at the cost of other faithfulness constraint(s) F_{IO}, in spite of the crucially-dominating markedness constraint(s) M. This is none other than a formal expression of an effort toward conserving the numerical integrity of segments of a morpheme (henceforward, NISM). Going a step further, we may dub this phenomenon of conserving NISM *emergence of the faithful* (henceforward EOF), mimicking McCarthy & Prince's (1994) renowned coinage 'emergence of the unmarked.' The point is that the structure faithful to the faithfulness constraint $\text{M}\textsc{ax}_{IO}$ emerges in the face of the crucially-dominating markedness constraint(s) subversive to such faithfulness, at the cost of other faithfulness constraint(s). It thus seems to be in order to observe in advance that this ranking schema will also serve as the general ranking schema for any phonological phenomenon arising from an endeavor to maintain NISM, that is, for EOF:

(8) General Ranking Schema for EOF

$M >> \text{M}\textsc{ax}_{IO} >> F_{IO}$

An additional remark should be made that there is no choice but to comply with the violation of $\text{M}\textsc{ax}_{IO}$ in deriving the optimal output form *daul* (5iia) in which NISM is not protected. This is why the general ranking schema (8) is asserted to be a formal expression of an endeavor to maintain NISM, namely, to attain EOF, *to the utmost extent possible.*

2.3 Compensatory Lengthening of Consonant in Korean

Differently from the CL of vowel for the deleted consonant, Korean provides a case in which consonant is lengthened to compensate for the deleted vowel. It is the so-called *lɨ*-irregular conjugation (Lee 1976). The adjective and verb roots ending in *lɨ* have been called 'irregular,' because *l* becomes geminate after ɨ is deleted. This situation is illustrated by the following data:

(9)[5] a. /pulɨ-ta/ → [pulɨ-ta]   pulɨ ‘call’
/hɨlɨ-ko/ → [hɨlɨ-ko]   hɨlɨ ‘flow’
/talɨ-či/ → [talɨ-či]   talɨ ‘different’
/kolɨ-ta/ → [kolɨ-ta]   kolɨ ‘choose’
b.[6] /pulɨ-ɨmyə/ → [pulɨ-myə]   /hɨlɨ-ɨni/ → [hɨlɨ-ni]
/talɨ-ɨni/ → [talɨ-ni]   /kolɨ-ɨmyə/ → [kolɨ-myə]
c.[7] /pulɨ-ə/ → [pull-ə]   /hɨlɨ-ə/ → [hɨll-ə]
/talɨ-a/ → [tall-a]   /kolɨ-a/ → [koll-a]

The forms in (b) are derived by the constraint pair *Vɨ (mirror image) >> MAX$_{IO}$ which deletes suffix-initial ɨ after vowel. The forms in (c), in which our main interest lies, are derived by lengthening *l* to compensate for the deleted ɨ. The following tableau certifies this. (Henceforth, the underlined C is epenthetic.)

(10) Tableau for *l*-Lengthening in Korean
*Vɨ (mirror image) >> MAX$_{IO}$, DEP$_{IO}$ >> UNIFORMITY, IDENT$_{IO}$ (F)

/pul$_1$ɨ$_2$-ə$_3$/	*Vɨ (mirror image)	a. MAX$_{IO}$ b. DEP$_{IO}$	a. UNIFORMITY b. IDENT$_{IO}$ (F)
☞ pul:$_{1,2}$-ə$_3$			a.* b.*
pul$_1$-ə$_3$		a.*!	
pul$_1$ɨ$_2$<u>C</u>-ə$_3$		b.*!	
pul$_1$ɨ$_2$-ə$_3$	*!		

In the optimal output form, the second member of the geminate *l* takes the place of ɨ$_2$. Confronted with the crucially-dominating markedness constraint *Vɨ (mirror image), the faithfulness constraint MAX$_{IO}$ is satisfied, though the replacing element is a non-identical correspondent of ɨ$_2$, at the sacrifice of the faithfulness constraints UNIFORMITY and IDENT$_{IO}$ (F). The root-final ɨ of the adjective and verb roots ending in ɨ other than *l*ɨ-irregular conjugation is simply deleted before suffixal vowel *ə/a* without lengthening the preceding consonant. For example, /k^{h}ɨ-ə/ becomes [k^h-ə] (k^{h}ɨ ‘grow’)[8]. This establishes the ranking *Vɨ (mirror image) >> MAX$_{IO}$. Thus, the ranking functioning in the tableau above, *Vɨ (mirror image) >> MAX$_{IO}$

[5] In dealing with Korean, the results of the constraints yielding allophonic segments are ignored.
[6] In accordance with McCarthy & Prince’s (1994, 1995) meta-constraint Root-Faith >> Affix-Faith, the suffix-initial ɨ is deleted in these forms. The ranking relevant here is *Vɨ (mirror image) >> Root-Faith (ɨ) >> Affix-Faith (ɨ), as shown below:
(i)

/pulɨ-ɨmyə/	*Vɨ (mirror image)	Root-Faith (ɨ)	Affix-Faith (ɨ)
☞ pulɨ-myə			*
pul-ɨmyə		*!	

[7] The alternation between ə and *a* of the suffixal vowel is determined by vowel harmony (Lee 1985, 1990).
[8] With regard to the derivation /k^h ɨ-ə/ → [k^h-ə], the compensatorily-lengthened candidate *[k^{h}k^h-ə] is ruled out by the undominated constraint NOCOMPLEX.

>> UNIFORMITY, $IDENT_{IO}$ (F), conforms exactly to the general ranking schema (8), even though the lengthening is that of consonant in compensation for the deleted ɨ, differing from the previous cases of CL of vowel for the deleted coda consonant. In a word, this CL too is an obvious case of EOF to maintain NISM.

2.4 Compensatory Lengthening of Vowel in Korean

Here we will consider the case in which vowel is lengthened in order to compensate for the following deleted vowel. In Korean, the constraint *Vɨ (mirror image) applies optionally to morpheme-internal sequence in casual speech. This CL is different from those dealt with up to now in that vowel is lengthened to compensate for the deleted vowel.

(11) /maɨm/ → [maɨm] ~ [ma:m] ‘mind’
/kaɨl/ → [kaɨl] ~ [ka:l] ‘autumn’
/taɨm/ → [taɨm] ~ [ta:m] ‘next’

The optional forms are derived as illustrated in the following tableau:

(12) Tableau for Vowel Lengthening in Korean
*Vɨ (mirror image) >> MAX_{IO}, DEP_{IO} >> UNIFORMITY, $IDENT_{IO}$ (F)

/$ma_1ɨ_2m_3$/	*Vɨ (mirror image)	a. MAX_{IO} b. DEP_{IO}	a. UNIFORMITY b. $IDENT_{IO}$ (F)
☞ $ma{:}_{1,2}m_3$			a.* b.*
ma_1m_3		a.*!	
$ma_1\underline{C}ɨ_2m_3$		b.*!	

Subordinating the faithfulness constraints UNIFORMITY and $IDENT_{IO}$ (F) , the obedience to the faithfulness constraint MAX_{IO} is achieved in the face of the unavoidable satisfaction of the markedness constraint *Vɨ (mirror image). The ranking *Vɨ (mirror image) >> MAX_{IO} was established in 2.3 above. The ranking in the tableau above is exactly the same as that employed in the tableau (10); moreover, it is certainly in line with the general ranking schema (8). Hence, it is indisputable that this type of vowel lengthening, namely, this type of CL is also a manifestation of an effort to preserve NISM, a sure case of EOF.

2.5 Conclusion

In this section, we have explored several types thought to be typical of CL which can be integrated into the general ranking schema (8). According to this schema, the faithfulness constraint MAX_{IO} is observed ultimately at the price of the lower-ranking faithfulness constraints F_{IO}, confronted with the higher-ranking markedness constraints M. Put differently, the various phenomena of CL are the end result of an endeavor to attain the common goal to preserve

NISM by exploiting the formal mechanism of the general ranking schema, all resolving into EOF.

3. Further Cases of EOF

3.1 Introduction

In this section, we will advert to the phonological phenomena which appear to be entirely extraneous to CL to illustrate that they are also in the range of the specific instantiations of the general ranking schema (8), with the data from Korean. As a consequence, these phenomena too will be proven to be the result of an endeavor to maintain NISM for EOF.

3.2 Alternation Between *namk* and *namo*

We will consider the data coming from the 15th-century Korean (Huh 1975). The verb roots ending in the consonant cluster *mk* and the noun roots ending in the consonant cluster (*l*)*mk* or *nk* have alternants ending in vowel ɨ, *u*, ɔ or *o* in place of the deleted root-final *k*:

(13) a. Verb Roots

/simk-ə/ → [simk-ə] ~ /simk-ko/ → [simɨ-ko]   simk ‘plant’

/čɔmk-om-i/ → [čɔmk-om-i] ~ /čɔmk-ko/ → [čɔmɔ-ko]   čɔmk ‘lock’

b. Noun Roots

/kumk-ɨl/ → [kumk-ɨl] ~ /kumk-to/ → [kumu-to] ~ $/\text{kumk}]_{\text{LEXWD}}/ \rightarrow [\text{kumu}]]_{\text{PRWD}}$ kumk ‘hole’

/namk-i/ → [namk-i] ~ /namk-wa/ → [namo-wa] ~ $/\text{namk}]_{\text{LEXWD}}/ \rightarrow [\text{namo}]]_{\text{PRWD}}$ namk ‘tree’

/pulmk-i/ → [pulmk-i] ~ $/\text{pulmk}]_{\text{LEXWD}}/ \rightarrow [\text{pulmu}]]_{\text{PRWD}}$ pulmk ‘bellows’

/nyənk-ɨl/ → [nyənk-ɨl] ~ $/\text{nyənk}]_{\text{LEXWD}}/ \rightarrow [\text{nyənɨ}]]_{\text{PRWD}}$ nyənk ‘ordinary thing’

In Lee (1990), this alternation is accounted for as in the following manner. First, the unsyllabified *k* in the environment ‘____ {C, ##}’ is deleted and then the default vowel is inserted where *k* is deleted. Thirdly, the inserted vowel becomes ɨ after the vowel *u*, ə , ɨ, or the neutral vowel i, and it becomes ɔ after the vowel *o*, *a* or ɔ, by vowel harmony (for the vowel harmony of the 15th-century Korean, see Lee 1985, 1990). Besides, in noun roots, the inserted default vowel becomes [-low], simultaneously becoming [+round], assimilated to the preceding labial consonant *m*.

These phenomena can now be concisely summarized in the following tableau, where rounding and raising are not involved:

(14) Tableau for /simk-ko/ → [simɨ-ko]

NOCOMPLEX >> MAX_{IO}, DEP_{IO} >> IDENT_{IO} (F)

/sim_1k_2-k_3o/	NOCOMPLEX	a. MAX_{IO} b. DEP_{IO}	IDENT_{IO} (F)
☞ sim_1V_2-k_3o			*
sim_1-k_3o		a.*!	
sim_1k_2V-k_3o		b.*!	
sim_1k_2-k_3o	*!		

As shown, in confrontation with the crucially-dominating markedness constraint NOCOMPLEX, the faithfulness constraint MAX_{IO} is obeyed, subduing the faithfulness constraint IDENT_{IO} (F). In the optimal output form *sim_1V_2-k_3o*, *V_2*, the least marked vowel which is realized as ɨ, takes the place of the input segment *k_2* in an exertion toward maintaining NISM despite the fact that the segments involved are non-identical correspondents. Thus, this too is an example of EOF. The constraint NOCOMPLEX should rank over MAX_{IO}, as was argued with respect to the ranking (3) in 2.2. In consequence, the constraint ranking at work here is virtually the same as that in (3) for the “classical” CL, not to speak of its coincidence with the general ranking schema (8).

3.3. Metathesis

In ‘standard’ Korean, a few morphemes begin with consonant cluster; they are *pč’a* (salty), *ps’ɨ* (bitter) and *ps’al* (rice) (Lee 1996)[9]. The root-initial clusters are reduced to a single consonant word-initially but they emerge intact in the phonologically-reduplicated reduplicants (a-b) (for phonological reduplication, see Lee 1996, Lee (in prep.) and 3.5) and elsewhere (c):

(15) i. Word-Initially	ii. In Phonological Reduplication and Elsewhere
a. /pč’a-ko/ → [č’a-ko]	/pč’a-l-ha/→ [č’a-pč’a-l-ha]
b. /ps’ɨ-ta/ → [s’ɨ-ta]	/ps’ɨ-l-ha/ → [s’ɨ-ps’ɨ-l-ha]
c. /ps’al/→ [s’al]	/čo-ps’al/ → [čo-ps’al]

The alternation between the consonant cluster and the single consonant disclosed above may be claimed to vindicate the underlying consonant clusters.

In Kyung-Sang dialects of Korean, these morphemes were historically restructured as shown in the right column below, getting rid of the cumbersome morpheme-initial consonant clusters:

[9] The historical root-initial consonant clusters of *ps’ɨ* ‘use’ and *pt’æ* ‘time’ survive vestigially in frozen forms like *mo-ps’ɨ-l* ‘bad, immoral’ (← /mos-ps’ɨ-ɨl/ ‘not, never, can’t - use - suffix’) and *čə-pt’æ* ‘not long ago, the other day’ (←/čə-pt’æ/ ‘that - time’). Synchronically, however, there is no grammar-internal evidence found to justify the underlying consonant clusters. They are simply *s’ɨ* and *t’æ* underlyingly.

(16) i. 'Standard' Korean — ii. Kyung-Sang Dialects

	i. 'Standard' Korean	ii. Kyung-Sang Dialects
a.	pč'a	č'ap
b.	ps'ɨ	s'ip
c.	ps'al	s'al

First, the historical restructuring shown in (a) is illustrated in the following tableau:

(17) Tableau for the Historical Change /pč'a/ > /č'ap/

NOCOMPLEX >> MAX$_{IO}$, DEP$_{IO}$ >> LINEARITY, O-CONTIG

/p$_1$č'$_2$a$_3$/	NOCOMPLEX	a. MAX$_{IO}$ b. DEP$_{IO}$	a. LINEARITY b. O-CONTIG
☞ č'$_2$a$_3$p$_1$			a.*
p$_1$a$_3$č'$_2$			a.* b.*!
č'$_2$a$_3$		a.*!	
p$_1$a$_3$		a.*!	
p$_1$<u>V</u>č'$_2$a$_3$		b.*!	b.*

Observe, in this historical change, that, in the face of the crucially-dominating markedness constraint NOCOMPLEX, every segment of the original root *pč'a* is conserved by protecting the faithfulness constraint MAX$_{IO}$, subjugating the faithfulness constraint LINEARITY.[10]

Next, the historical change of /ps'ɨ/ > /s'ip/ (16b) was accomplished by the same constraint ranking as that utilized in the tableau above except that ɨ was changed to i by the constraint pair *sɨ >> IDENT$_{IO}$ (+back). In Kyung-Sang dialects, ɨ was changed to i after the fricatives *s*, *s'*, *č*, *č'* and *č^h*. The constraint *sɨ thus bans the occurrence of ɨ after the coronal fricatives. This situation is portrayed in the following tableau:

(18) Tableau for the Historical Change /ps'ɨ/ > /s'ip/

NOCOMPLEX >> MAX$_{IO}$, DEP$_{IO}$ >> LINEARITY, O-CONTIG; *sɨ >> IDENT$_{IO}$ (+back)

/p$_1$s'$_2$ɨ$_3$/	NOCOMPLEX	a. MAX$_{IO}$ b. DEP$_{IO}$	a. LINEARITY b. O-CONTIG	*sɨ	IDENT$_{IO}$ (+back)
☞ s'$_2$i$_3$p$_1$			a.*		*
s'$_2$ɨ$_3$p$_1$			a.*	*!	
p$_1$ɨ$_3$s'$_2$			a.* b.*!		
p$_1$ɨ$_3$		a.*!			
s'$_2$ɨ$_3$		a.*!		*	
p$_1$<u>V</u>s'$_2$i$_3$		b.*!	b.*		*

[10] The tie between the failed candidates *č'a* and *pa* in the tableau (17) is settled by the constraint I-CONTIG.

In this tableau, too, faced with the crucially-dominating markedness constraint NOCOMPLEX, every segment of the original root *ps'ɨ* is kept intact by means of metathesis, namely, by satisfying the faithfulness constraint MAX_{IO}. This can happen by making ineffective the faithfulness constraint LINEARITY, even though i of *s'ip* is the non-identical correspondent of ɨ of *ps'ɨ* by reason of the phonological constraint *sɨ.

Finally, regarding the historical change /ps'al/ > /s'al/ (16c), the preservation of *p* of the original *ps'al* in the restructured morpheme was unattainable despite the domination of the faithfulness constraint MAX_{IO} of the faithfulness constraint LINEARITY. This is illustrated in the following tableau:

(19) Tableau for the Historical Change /ps'al/ > /s'al/

NOCOMPLEX >> MAX_{IO}, DEP_{IO} >> LINEARITY, O-CONTIG

$/p_1s'_2a_3l_4/$	NOCOMPLEX	a. MAX_{IO} b. DEP_{IO}	a. LINEARITY b. O-CONTIG
☞ $s'_2a_3l_4$		a.*	
$p_1\underline{V}s'_2a_3l_4$		b.*	b.*!
$p_1s'_2a_3l_4$	*!		
$s'_2a_3l_4p_1$	*!		a.*

As observed, there is no means of satisfying the faithfulness constraint MAX_{IO} in spite of the greatest exertion of the pressure to preserve the segment *p* of the original morpheme by means of the ranking that achieves such purpose successfully elsewhere. What was said with respect to the derivation of *daul* in the tableau (5) applies exactly to this case. Incidentally, it is shown obviously in the tableau above that NOCOMPLEX should overrank MAX_{IO}.

To sum up, the same constraint ranking NOCOMPLEX >> MAX_{IO}, DEP_{IO} >> LINEARITY, O-CONTIG, which is consistent with the general ranking schema (8), is operative throughout the tableaux (17-19). Hence, it is evident that the restructuring by metathesis is also the outcome of an endeavor to guard NISM by making the faithfulness constraint MAX_{IO} obeyed as much as possible, suppressing the faithfulness constraint LINEARITY, in the face of the crucially-dominating markedness constraint (on metathesis, see also Hume 1994, McCarthy 1995). In other words, it is EOF that brought forth this metathetical restructuring.

3.4 Coalescence

In Korean, back vowels are fronted when followed by i with no consonant intervening, the latter being concomitantly deleted. And the fronting applies optionally morpheme-internally (Lee 1976). The following data exemplify this coalescence phenomenon:

(20) a. $/k^hɨ\text{-}iu/ \rightarrow [k^hi\text{-}u]$ cf. $/k^hɨ\text{-}ko/ \rightarrow [k^hɨ\text{-}ko]$ $k^hɨ$ 'grow'
/sə-iu/ → [se-u] cf. /sə-ta/ → [sə-ta] sə 'stand'
/čа-iu/ → [čæ-u] cf. /ča-na/ → [ča-na] ča 'sleep'
b. /ai/ → [ai] ~ [æ] 'child'

/sai/ → [sai] ~ [sæ] 'gap'

With the constraint *[V, +back]i responsible for the coalescence, we can now have the following tableau:

(21) Tableau for Coalescence in Korean

*[V, +back]i >> $\text{M}{\small\text{AX}}_{IO}$, $\text{D}{\small\text{EP}}_{IO}$ >> UNIFORMITY

/k^hɨ$_1$-i$_2$u/	*[V, +back]i	a. MAX_{IO} b. DEP_{IO}	UNIFORMITY
☞ $k^h i_{1,2}$-u			*
k^hɨ$_1$-u		a.*!	
k^hɨ$_1$C̲-i$_2$u		b.*!	

In the optimal form $k^h i_{1,2}$-*u*, the input sequence ɨ$_1$-i$_2$ coalesced into i$_{1,2}$. This is an instance in which NISM is defended in the form of coalescence by satisfying the faithfulness constraint MAX_{IO} at the cost of the faithfulness constraint UNIFORMITY, in spite of the higher-ranking markedness constraint (on coalescence, see also Gnanadesikan 1995, Lamontagne & Rice 1995, Pater 1995). That is, this is an instance where structures faithful to the faithfulness constraint MAX_{IO} emerge. Here also, the operative ranking is in full harmony with the general ranking schema (8).

The constraint *[V, +back]i takes precedence over MAX_{IO}, albeit its consequence is not observable because the coalesced segment has multiple correspondents in the input, resulting from strangling the lower-ranking UNIFORMITY. Let us take into consideration only the markedness constraint(s) and the faithfulness constraint MAX_{IO} relevant to the constraint rankings to be discussed throughout this article. Then, as was noted in 2.1, it will be obvious that the former should take precedence over the latter, since it destroys, by its very nature, the numerical integrity of segments of a morpheme, invisible as its effect is in most cases. The invisibility is due to the crucial domination of MAX_{IO} of other faithfulness constraint(s), resulting in its satisfaction in the end. At this juncture, thus, it appears to be pertinent to note that this ranking assumption holds in all cases to be discussed in this article in case no overt evidence is found to contribute to determining their ranking.

In Kyung-Sang dialects, the cluster CG (G = glide) is not permitted in onset position due to the constraint *CG, a variant of NOCOMPLEX. Accordingly, the syllable-initial CG cluster in 'standard' Korean was historically simplified as a single C in Kyung-Sang dialects (Lee 1993)[11]. The case bearing upon the present purpose is that in which the syllable-initial sequence '*Cy* plus back vowel' historically turned to the sequence '*C* plus front vowel' as a consequence of the coalescence of *y* and the back vowel. For instance, the syllable-initial sequence *Cy*ə- was simplified as *Ce*- (e.g. /kyə/ > /ke/ 'chaff,' /p'yə/ > /p'e/ 'bone,' /p^hyə/ > /p^he/ 'spread'). What is true of the regressive fronting case above applies equally to this case except that the fronting is progressive and the trigger is *y* instead of i.

[11] Even in 'standard' Korean, apart from those discussed in 3.3, no consonant cluster other than CG is allowed syllable-initially. In contrast, in Kyung-Sang dialects, no consonant cluster whatsoever is allowed syllable-initially.

3.5 Phonological Reduplication in Korean Mimetics

Finally, we will examine the data coming from Korean mimetics, in which an endeavor to defend NISM for EOF is manifested (see Lee 1996, Lee (in prep.) for details). In the sublexically-determined mimetics, the root-initial consonant is deleted by the constraint $*_{ROOT}$[[+cons], but it is of great interest to note that the *t*-initial roots alone have *w* in lieu of the deleted *t*:

(22) a. /talkak/ → [walkak-talkak] 'rattling and clattering'
/tækak/ → [wækak-tækak] 'rattling and clattering'
/teŋkəŋ/ → [weŋkəŋ-teŋkəŋ] 'tinkling and jingling'
b. /pəŋčəŋ/ → [əŋčəŋ-pəŋčəŋ] 'rattling on'
/čəŋki/ → [əŋki-čəŋki] 'in a jumble'
/paŋkɨl/ → [aŋkɨl-paŋkɨl] 'smiling continuously'
c. /əlluk/ → [əlluk-təlluk] 'mottled, spotted'
/als'oŋ/ → [als'oŋ-tals'oŋ] 'vague, puzzling, ambiguous'
/əlkɨn/ → [əlkɨn-təlkɨn] 'rather hot-tasting, rather peppery'

The forms in (b) are the general case in which the root-initial consonant is simply deleted; in (c), *t* is epenthesized reduplicant-initially to satisfy the constraint ONSET (Prince & Smolensky 1991, 1992, 1993)[12].

The reduplicants of this class of mimetics are the strings of phonologically epenthesized segments resulted from the interaction of constraints, not the exponents of the morphological RED. For this reason, they are claimed to be reduplicated phonologically. In this reduplication, the following two constraints fulfill the significant role:

(23) a. MAX_{RA} (Lee 1996)
Every segment of the root has a correspondent in the augmented string.
b. DIPODY (Lee (in prep.))
$\text{PRWD} = [\text{FT FT}]_{\text{PRWD}}$
"Prosodic words must be dipodic."

In addition, we need the IDENT_{IO} constraint family ranked as given below:

(24) IDENT_{IO} (Lab, Dor, [Cor, -ant]) >> MAX_{IO}, DEP_{IO} >> IDENT_{IO} ([Cor, +ant])

This ranking ensures that the *t*-initial roots have *w* in place of the deleted *t* (22a), while preventing it from taking the place of other deleted consonants (22b).

With this much as background, we can now have the following tableaux for the forms in (22b-c):

[12] It is assumed that non-epenthesized candidates like *[əlluk-əlluk] violate ONSET twice due to the alignment constraint Align (Root, R, σ, R) (see McCarthy & Prince 1993b for alignment constraints).

(25) Tableau for /pəŋc̆əŋ/ → [əŋc̆əŋ-pəŋc̆əŋ]

*$_{\text{ROOT}}$[[+cons], IDENT$_{IO}$ (Lab, Dor, [Cor, -ant]) >> MAX$_{IO}$, DEP$_{IO}$; MAX$_{RA}$, DIPODY

/pəŋc̆əŋ/	*$_{\text{ROOT}}$[[+cons]	IDENT$_{IO}$ (Lab, Dor, [Cor, -ant])	a. MAX$_{IO}$ b. DEP$_{IO}$	MAX$_{RA}$	DIPODY
☞ əŋc̆əŋ-pəŋc̆əŋ			a.*		
əŋc̆əŋ-C V C V			a.*	*!*****	
əŋc̆əŋ			a.*		*!
pəŋc̆əŋ-pəŋc̆əŋ	*!				
wəŋc̆əŋ-pəŋc̆əŋ		*!			

(26) Tableau for /əlluk/ → [əlluk-təlluk]

*$_{\text{ROOT}}$[[+cons] >> MAX$_{IO}$, DEP$_{IO}$; MAX$_{RA}$, DIPODY, ONSET

/əlluk/	*$_{\text{ROOT}}$[[+cons]	a. MAX$_{IO}$ b. DEP$_{IO}$	MAX$_{RA}$	DIPODY	ONSET
☞ əlluk-təlluk					*
əlluk-əlluk					**!
əlluk-luk			*!*		*
əlluk-C V C V			*!****		*
wəlluk-təlluk		b.*!			
təlluk-təlluk	*!	b.*			

Finally, for the class of mimetics to which the forms in (22a) belong, the constraint pair *$_{\sigma}$[y >> *$_{\sigma}$[w is required. And the examination of the derivation given in the tableau (25) establishes the ranking *$_{\text{ROOT}}$[[+cons] >> MAX$_{IO}$.

(27) Tableau for /talkak/ → [walkak-talkak]

*$_{\text{ROOT}}$[[+cons] >> MAX$_{IO}$, DEP$_{IO}$ >> IDENT$_{IO}$ ([Cor, +ant]); MAX$_{RA}$, DIPODY;
*$_{\sigma}$[y >> *$_{\sigma}$[w

/talkak/	*$_{\text{ROOT}}$[[+cons]	a. MAX$_{IO}$ b. DEP$_{IO}$	IDENT$_{IO}$ ([Cor, +ant])	MAX$_{RA}$	DIPODY	*$_{\sigma}$[y	*$_{\sigma}$[w
☞ walkak-talkak			*				*
yalkak-talkak			*			*!	
walkak-kak			*	*!**			
alkak-talkak		a.*!					
talkak-talkak	*!						

If the trace of the deleted root-initial *t* were not filled up with *w*, the distinction between the *t*-initial roots of the forms in (22a) and the vowel-initial roots of the forms in (22c) would be obliterated. Thus, the replenishment with *w* may be thought of as an instance of an effort toward preserving NISM, an instance of EOF. The constraint ranking relevant to generating the output forms in (22a) is *$_{\text{ROOT}}$[[+cons] >> MAX$_{IO}$ >> IDENT$_{IO}$ ([Cor, +ant]), which is in full agreement with the general ranking schema (8). In this case too, despite the crucially-dominating markedness constraint $*_{ROOT}$[[+cons], the faithfulness constraint MAX_{IO} is observed, repressing another faithfulness constraint IDENT_{IO} ([Cor, +ant]).

3.6 Conclusion

In this section, we have demonstrated that the general ranking schema (8) naturally generalizes to the phonological phenomena seemingly as wide apart from one another as the replenishment with the least marked vowel in the 15th-century Korean, metathesis, coalescence and the replenishment with *w* in Korean mimetics. Moreover, it is no accident that both these processes and those discussed in 2 that can be collected under the title of CL are subsumed under one general ranking schema. In this integrated schema too, it is invariable that the faithfulness constraint MAX_{IO} is observed at the cost of the lower-ranking faithfulness constraint(s) F_{IO}, meeting with the higher-ranking markedness constraint(s) M. It is thus, as usual, a formal expression of an effort to defend NISM, which forces the structures faithful to MAX_{IO} to emerge ultimately.

4. Incomplete Phase in Rotuman

Building on McCarthy (1995), we will discuss a case in which four phonological processes, deletion, metathesis, coalescence and diphthongization, are involved in realizing the output forms belonging to a single morphological category, the "incomplete phase," in Rotuman. Rotuman has the morphological "phase" distinction in major-category words, the complete phase and the incomplete phase. Let us consider the following data. (Brackets delimit the stress-foot of bimoraic trochee, the sequences *ue* and *ea* in (b) are light diphthongs and the sequences *ui* and *ei* of the incomplete-phase forms in (d) are diphthongs.)

(28)

	Complete	Incomplete	
a. Deletion	{rako}	{rak}	'to imitate'
	to{kiri}	to{kir}	'to roll'
b. Metathesis	{pure}	{puer}	'to rule'
	se{sevɑ}	se{seɑv}	'erroneous'
c. Umlaut	{mose}	{mös}	'to sleep'
	{futi}	{füt}	'to pull'
d. "Diphthongization"	pu{pui}	pu{pui}	'floor'
	le{lei}	le{lei}	'good'
e. No Distinction	{rī}	{rī}	'house'
	{sikɑ̄}	si{kɑ̄}	'cigar'

It is of significance to note that the final two-syllable foot of the complete-phase forms is realized as a monosyllabic two-mora foot in the incomplete-phase forms. For the realization of the monosyllabic foot in the incomplete-phase forms, McCarthy proposes an alignment constraint:

(29) INC-PH

Align (Stem$_{\text{INC.PH}}$, R, $[\sigma]_{\text{FT}}$, R)

"Every incomplete-phase stem ends in monosyllabic foot (or heavy syllable)."

And following Kaye (1983), Kaye & Lowenstamm (1984) and Rosenthall (1994), he posits the constraint LIGHT-DIPH which says that light diphthongs rise in sonority. Accordingly, *ue* and *ea* of the incomplete-phase forms in (28a) are licit light diphthongs.

For the incomplete-phase forms in (28a), we can now have the following tableau. (In what follows, syllabification is indicated by ".".)

(30) Tableau for /rako/$_{\text{INC.PH}}$ → {.rak.}

LIGHT-DIPH, INC-PH >> MAX$_{\text{IO}}$, DEP$_{\text{IO}}$ >> LINEARITY

/rak$_1$o$_2$/$_{\text{INC.PH}}$	LIGHT-DIPH	INC-PH	a. MAX$_{\text{IO}}$ b. DEP$_{\text{IO}}$	LINEARITY
☞ {.rak$_1$.}			a.*	
{.ro$_2$k$_1$.}			a.*	*!
{.rao$_2$k$_1$.}	*!			*
{.ra.k$_1$o$_2$.}		*!		

Moreover, compare the following failed candidates for the incomplete-phase form of /ra$_2$ko$_4$/$_{\text{INC.PH}}$ with the complete-phase output form {.ra$_2$.ko$_4$.} and the actual incomplete-phase output form {.rak.}:

(31) a. *.ra$_2$.{o$_4$k.} b. *.ra$_2$.{k$\bar{o}_4$.} c. *.ra$_2$.{ko$_4$ʔ.} d. *.a$_2$.{ro$_4$k.}

To filter out these incorrect candidates, McCarthy posits a constraint permitted by a correspondence relation between the complete-phase output form and the incomplete-phase output form. On the assumption that any vocoid in the main-stressed nucleus is a prosodic head of the word, this constraint is stated as follows:

(32) HEAD-MAX

If α is the prosodic head of the word, then $f(\alpha)$ is the prosodic head of the word.

Even though the forms in (31) all satisfy INC-PH, they violate HEAD-MAX. Only the actual output form {.rak.} satisfies it. And it is needless to say that the incomplete-phase forms in (28) all satisfy it.

The constraint HEAD-MAX has the same ranking with the constraints LIGHT-DIPH, and INC-PH, and the last one in charge of diminishing the size of the input string should rank over MAX$_{\text{IO}}$, as shown in the tableau (30) above; we have thus the following ranking for Rotuman incomplete phase:

(33) Ranking for Rotuman Incomplete Phase

HEAD-MAX, LIGHT-DIPH, INC-PH >> MAX_{IO}, DEP_{IO} >> LINEARITY, UNIFORMITY, $IDENT_{IO}$ (+voc)

In the tableaux which follow, it will be confirmed that the output forms of the incomplete phase in (28), the results of what might be regarded as unrelated phonological phenomena of deletion (28a), metathesis (28b), umlaut (i.e. metathesis and coalescence) (28c) and diphthongization (28d), are all generated by the single ranking given above.

(34) Tableau for $/pure/_{INC.PH} \rightarrow$ {.puer.}

$/pur_1e_2/_{INC.PH}$	HEAD -MAX	LIGHT -DIPH	INC -PH	a. MAX_{IO} b. DEP_{IO}	LIN	UNI	$IDENT_{IO}$ (+voc)
☞ $\{.pue_2r_1.\}$					*		*
$\{.pur_1.\}$				a.*!			
$.pu.\{r_1e_2.\}$	*!		*!				

(35) Tableau for $/mose/_{INC.PH} \rightarrow$ {.mös.}

$/mo_1s_2e_3/_{INC.PH}$	HEAD-MAX	LIGHT -DIPH	INC -PH	a. MAX_{IO} b. DEP_{IO}	LIN	UNI	$IDENT_{IO}$ (+voc)
☞ $\{.mö_{1,3}s_2.\}$					*	*	
$\{.mo_1s_2.\}$				a.*!			
$.mo_1.\{s_2e_3.\}$	*!		*!				

(36) Tableau for $/pupui/_{INC.PH} \rightarrow$ .pu.{pui.}

$/pup_1u_2i_3/_{INC.PH}$	HEAD -MAX	LIGHT-DIPH	INC -PH	a. MAX_{IO} b. DEP_{IO}	LIN	UNI	$IDENT_{IO}$ (+voc)
☞ $.pu.\{p_1u_2i_3.\}$							*
$.pu.\{p_1ü_{2,3}.\}$			*!			*	
$.pu.\{p_1u_2.i_3.\}$			*!				

Phonological phenomena as diverse and dissimilar as deletion, metathesis, coalescence and diphthongization involved in Rotuman incomplete phase have been shown to be the consequences brought about by one and the same constraint ranking (33), the superficial diversity arising merely from the different compositions of input structures. If we disregard the constraints HEAD-MAX and LIGHT-DIPH, this ranking conforms exactly to the general ranking schema (8). It is thus incontrovertible that various phonological processes participating in realizing the output forms of a single morphological category, the incomplete phase, regardless of the superficial diversity, is under the control of the ranking schema. The faithfulness constraint MAX_{IO} is satisfied, subduing other lower-ranking faithfulness constraints F_{IO}, confronted with the crucially-dominating markedness constraints M. This gives rise to the conservation of NISM, to wit, EOF in the end. Consequently, it may be deduced from this that the phonological processes, including those discussed in 2 and 3 as a matter of course, which have the common property of exerting an effort to conserve NISM, namely, of making the faithful emerge, are all integrated into this schema. It is thus hardly necessary to emphasize that, in this integrated schema too, the faithfulness constraint MAX_{IO} is observed at the price of the lower-ranking faithfulness constraint(s) F_{IO}, notwithstanding the crucially-dominating markedness constraint(s) M.

5. Moraic Account of Compensatory Lengthening

5.1 Introduction – "Classical" Compensatory Lengthening Again

Hayes explores the phenomena of CL, essentially resorting to the prosodic unit mora (for moraic theory, see also van der Hulst 1984, Hyman 1984, 1985, McCarthy & Prince 1986, 1988, 1993, etc.) The moraic account is illustrated by taking a simple example from Ingria (1980). In Latin, *s* was deleted before anterior sonorants (i.e. *m*, *n* or *l*). (The intermediate stage of *s* > *z* and other complications are ignored.) In addition, when the deleted *s* followed a vowel, the vowel became long. This is shown in the following:

(37) a.	kasnus > ka:nus	'gray'
	kosmis > ko:mis	'courteous'
	fideslia > fide:lia	'pot'
b.	snurus > nurus	'daughter-in-law'
	smereo: >mereo:	'deserve-1 sg.-pres.'
	slu:brikus > lu:brikus	'slippery'

This CL proceeds as follows: *s* is deleted only on the segmental tier by the rule of *s*-Deletion (38a), and the mora emptied is filled by spreading from an immediately preceding vowel by the rule of Compensatory Lengthening (38b). The derivation /kasnus/ > /ka:nus/ is illustrated in (38c):

(38) a. *s*-Deletion

s → ∅ ____ [+son, +ant] (segmental tier only)

b. Compensatory Lengthening

```
μ μ'  where μ' is a segmentally unaffiliated mora
 \↗
 α
```

```
c. μμ  μμ    by (38a)   μμ' μμ    by (38b)   μ μ'  μμ
   ||  ||       →       |   ||       →        \↗   ||   = [ka:nus]
  ka s n us             ka  nu s              k a: n us
```

In contrast, since the word-initial *s* has no moraic value, the word-initial deletion of *s* by *s*-Deletion (38a) does not occasion any empty mora, thus creating no CL:

```
(39)  μ  μμ     by (38a)    μ  μμ
      |  ||        →        |  ||   = [nurus]
```

snu ru s nu r us

The rule of Compensatory Lengthening (38b) may be said to be the moraic version of Ingria's Empty Node Convention, the effect of which is "to maintain the integrity of a complex syllabic nucleus, that is, it keeps a heavy syllable heavy." Hayes expresses the rule of Compensatory Lengthening (38b) in a more general form as a "conservation law," which also reflects the insight of Ingria's Empty Node Convention:

(40) Moraic Conservation

Compensatory lengthening processes conserve mora count.

However, there is no way to build this general law of Moraic Conservation in serial rule-based derivations, as is shown in the derivation (38c) above. The best alternative attainable is to make the rule of Compensatory Lengthening (38b) play as a substitute for it.

In Correspondence Theory, we can account for this phenomenon of CL by essentially the same ranking as that utilized in dealing with Turkish *v*-Loss, a specific instantiation of the general ranking schema (8), without recourse to the prosodic unit mora. This is illustrated in the following tableaux:

(41) Tableau for /kasnus/ > /ka:nus/

*s[+son, +ant], STROLE >> MAX$_{IO}$, DEP$_{IO}$ >> UNIFORMITY, IDENT$_{IO}$ (F)

/$k_1a_2s_3n_4u_5s_6$/	a. *s[+son, +ant] b. STROLE	a. MAX$_{IO}$ b. DEP$_{IO}$	a. UNIFORMITY b. IDENT$_{IO}$ (F)
☞ $k_1a{:}_{2,3}n_4u_5s_6$			a.* b.*
$k_1a_2n_4u_5s_6$		a.*!	
$k_1a_2s_3\underline{V}n_4u_5s_6$		b.*!	

(42) Tableau for /snurus/ > /nurus/

*s[+son, +ant], STROLE, NOCOMPLEX >> MAX$_{IO}$, DEP$_{IO}$ >> UNIFORMITY, O-CONTIG, IDENT$_{IO}$ (F)

/$s_1n_2u_3r_4u_5s_6$/	a. *s[+son, +ant] b. STROLE c. NOCOMPLEX	a. MAX$_{IO}$ b. DEP$_{IO}$	a. UNIFORMITY b. O-CONTIG c. IDENT$_{IO}$ (F)
☞ $n_2u_3r_4u_5s_6$		a.*	
$s_1\underline{V}n_2u_3r_4u_5s_6$		b.*	b.*!
$s_1n_2u_3r_4u_5s_6$	a.*!		
$n_2u{:}_{1,3}r_4u_5s_6$	b.*!		a.* b.* c.*
$n{:}_{1,2}u_3r_4u_5s_6$	c.*!		a.* c.*

The tableau above certifies that the constraints *s[+son, +ant], STROLE and NOCOMPLEX precede MAX$_{IO}$. Certainly, the ranking operating for CL in the tableau (41) is in line with the general ranking schema (8). Faced with the crucially-dominating markedness constraint, the faithfulness constraint MAX_{IO} is obeyed in the end, bringing other faithfulness constraints into submission. Here also, the CL is proven to be an expression of an effort to protect NISM, a clear case of EOF.

5.2 Double Flop: VCV → V:C∅

In this pattern of CL, dropping of a vowel lengthens compensatorily the vowel of the preceding syllable that is not adjacent. Even though this CL is dealt with under the head of "CL by Vowel Loss" by Hayes, it seems that it can also be dealt with by the device Hayes calls 'double flop.' Hayes discusses an example from a well-known Middle English sound change. For a moraic analysis of sound change like /talə/ > /ta:l/ (Modern English 'tale'), he proposes the following two principles besides the rule of Schwa Drop:

(43) a. Parasitic Delinking

Syllable structure is deleted when the syllable contains no overt nuclear segment.

b. Compensatory Lengthening (Middle English)

Fill empty moras by spreading from the left.

Now the derivation proceeds as follows:

(44) μ μ Schwa Drop μ μ Parasitic Delinking μ μ
| | → | → |
$[ta]_\sigma[lə]_\sigma$ $[ta]_\sigma[l\ ]_\sigma$ $[ta]_\sigma$ l

Compensatory Lengthening μ μ Resyllabification of the Stranded *l*
→ ∨↗ →
$[ta:]_\sigma$ l

μ μ
∨ ↖ = [ta:l]
$[ta:]_\sigma l$

This phenomenon can also be dealt with by a specific instantiation of the general ranking schema (8), without depending upon the moraic analysis:

(45) Tableau for /talə/ > /ta:l/

SCHWA DROP, NOCOMPLEX >> MAX_{IO}, DEP_{IO} >> LINEARITY, UNIFORMITY, IDENT_{IO} (F)

$/t_1a_2l_3ə_4/$	a. SCHWA DROP b. NOCOMPLEX	a. MAX_{IO} b. DEP_{IO}	a. LINEARITY b. UNIFORMITY c. IDENT_{IO} (F)
☞ $t_1a{:}_{2,4}l_3$			a.* b.* c.*
$t_1a_2l_3$		a.*!	
$t_1a_2l_3ə_4$<u>C</u>		b.*!	
$t_1a_2l_3ə_4$	a.*!		

$t_1a_2l:_{3,4}$	b.*!		b.* c.*

We can do without the constraint corresponding to the principle of Compensatory Lengthening (43b). For the failed candidate $t_1a_2l:_{3,4}$ is ruled out by the top-ranked constraint NOCOMPLEX, as shown in the tableau above. The constraint ranking here is consistent with the general ranking schema (8). In this case too, confronted with the crucially-dominating markedness constraint SCHWA DROP, MAX_{IO} is guarded, incurring the violations of other faithfulness constraints. And this pattern of CL can be construed as a variant of metathesis, which forces LINEARITY to be violated. In brief, it is scarcely necessary to say that this phenomenon of CL is nothing less than EOF to conserve NISM.

5.3 Double Flop Again

We will examine another pattern of CL which Hayes accomplishes by the mechanism of 'double flop,' based on Steriade's (1982) and Wetzels's (1986) account of Greek. As in the case of Middle English, the vowel that is lengthened compensatorily is not adjacent to the deleted consonant. For instance, in East Ionic and other dialects, the deleted *w* caused the vowel that preceded it across an intervening consonant to be lengthened. (According to Wetzels, *w* was lost when followed by a tautosyllabic sonorant segment.)

(46) a. odwos > o:dos 'threshold'
b. woikos > oikos 'house'
newos > neos 'new'

According to Hayes's moraic account, *o:dos* is derived as follows: the deletion of *w* provokes *d* to be resyllabified, emptying a mora and subsequently allowing the preceding vowel to lengthen:

```
(47) μμ   μμ          μμ μμ         μμ μμ          μμ    μμ
     | |  | |    →    | | | |   →    |  | |    →     \↗    | |
     od w os          od  os         od o s          o:  d  os
```

This phenomenon of double flop can be accounted for by a specific instantiation of the general ranking schema (8), plus a constraint taking advantage of the prosodic unit mora. This constraint requires that every mora of the input syllable have a correspondent in the output syllable, which reflects the purport of Ingria's Empty Node Convention and Hayes's Conservation Law (40): MAX_{IO} $(\mu]_{\sigma})$. This situation is portrayed in the following summary tableau:

(48) Summary Tableau for Greek Double Flop

[...w[+son]...]$_\sigma$, STROLE >> MAX$_{IO}$, DEP$_{IO}$, MAX$_{IO}$ ($\mu]_\sigma$) >> LINEARITY, UNIFORMITY, IDENT$_{IO}$ (F)[13]

	a. [...w[+son]...]$_\sigma$ b. STROLE	a. MAX$_{IO}$ b. DEP$_{IO}$ c. MAX$_{IO}$ ($\mu]_\sigma$)	a. LINEARITY b. UNIFORMITY c. IDENT$_{IO}$ (F)
μ μ μ μ /$o_1d_2w_3o_4s_5$/			
☞ μμ μμ $o{:}_{1,3}d_2o_4s_5$			a.* b.* c.*
μ μμ μ o_1d_2 $o{:}_{3,4}s_5$		c.*!	b.* c.*
μ μ μ $o_1d_2o_4s_5$		a.*! c.*!	
μμ μ μ /$w_1o_2i_3k_4o_5s_6$/			
☞ μμ μ μ $o_2i_3k_4o_5s_6$		a.*	
μμ μ μμ $o{:}_{1,2}$ $i_3k_4o_5s_6$	b.*!	c.*	b.* c.*
μμ μμ μ $o_2i_3k_4o{:}_{1,5}s_6$	b.*!	c.*	a.* b.* c.*

Since the constraint MAX$_{IO}$ ($\mu]_\sigma$) does not conflict with the constraints MAX$_{IO}$, it is assumed to have the same ranking with the latter. Yet, note that the constraint [...w[+son]...]$_\sigma$ crucially dominates MAX$_{IO}$ ($\mu]_\sigma$) as well as MAX$_{IO}$. The ranking functioning for the CL is practically in accord with the general ranking schema (8). In the face of the crucially-dominating markedness constraint, both MAX$_{IO}$ and MAX$_{IO}$ ($\mu]_\sigma$) are obeyed at the price of other faithfulness constraints. This pattern of CL is not only a manifestation of an effort toward preserving NISM, bringing about EOF. It is also an effort toward preserving the numerical integrity of moras of a syllable, bringing about emergence of the structure faithful to the faithfulness constraint MAX$_{IO}$

[13] To differentiate from the constraint MAX$_{IO}$ ($\mu]_\sigma$), the argument (Segment) should be specified in the constraint MAX$_{IO}$, but the plain MAX$_{IO}$ is to be construed as MAX$_{IO}$ (Segment) as default.

($\mu]_\sigma$). And this pattern of 'double flop' CL is also a variant of metathesis, which compels LINEARITY to be violated, as in the case of Middle English. Now, to mirror this point, the general ranking schema (8) should be restated as in the following:

(49) General Ranking Schema for EOF
M >> MAX$_{IO}$ (MAX$_{IO}$ ($\mu]_\sigma$)) >> F$_{IO}$

5.4 Prenasalization and Compensatory Lengthening

The CL triggered by prenasalization widespread in Bantu languages which Hayes cites from Odden (1981) and Clements (1986) also utilizes the constraint MAX$_{IO}$ ($\mu]_\sigma$). For instance, the hypothetical word *amba* becomes *a: ^{m}ba*. According to Clements, the rule of Prenasalization delinks a nasal segment from its underlying skeletal position and reassociates it to the following C-position, provided that the nasal is in postvocalic position. This rule can be translated into the constraint *V[+nas]C.

Eventually, we can have the following tableau:

(50) Tableau for /amba/ → [a:^{m}ba]
*V[+nas]C >>MAX$_{IO}$, DEP$_{IO}$, MAX$_{IO}$ ($\mu]_\sigma$) >> UNIFORMITY, IDENT$_{IO}$ (-long)

μ μ μ │ │ │ /$a_1m_2b_3a_4$/	*V[+nas]C	a. MAX$_{IO}$ b. DEP$_{IO}$ c. MAX$_{IO}$ ($\mu]_\sigma$)	a. UNIFORMITY b. IDENT$_{IO}$ (-long)
☞ μμ μ │ │ │ $a{:}_1\,{}^mb_{2,3}a_4$			a.* b.*
μ μ μ │ │ │ $a{:}_1\ b_3a_4$		a.*!	b.*
μ μ μ │ │ │ $a_1m_2\underline{V}b_3a_4$		b.*! c.*!	
μ μ │ │ $a_1{}^mb_{2,3}a_4$		c.*!	a.*
μ μμ │ │ │ $a_1{}^mb_{2,3}a{:}_4$		c.*!*	a.* b.*

The constraint ranking operative here is in agreement with the general ranking schema (49). Despite the crucially-dominating markedness constraint *V[+nas]C, the faithfulness constraint MAX$_{IO}$ ($\mu]_\sigma$) as well as the faithfulness constraint MAX$_{IO}$ is observed, making invisible other faithfulness constraints. This CL too is an instance of EOF, having arisen as a consequence of an endeavor to defend NISM and the numerical integrity of moras of a syllable.

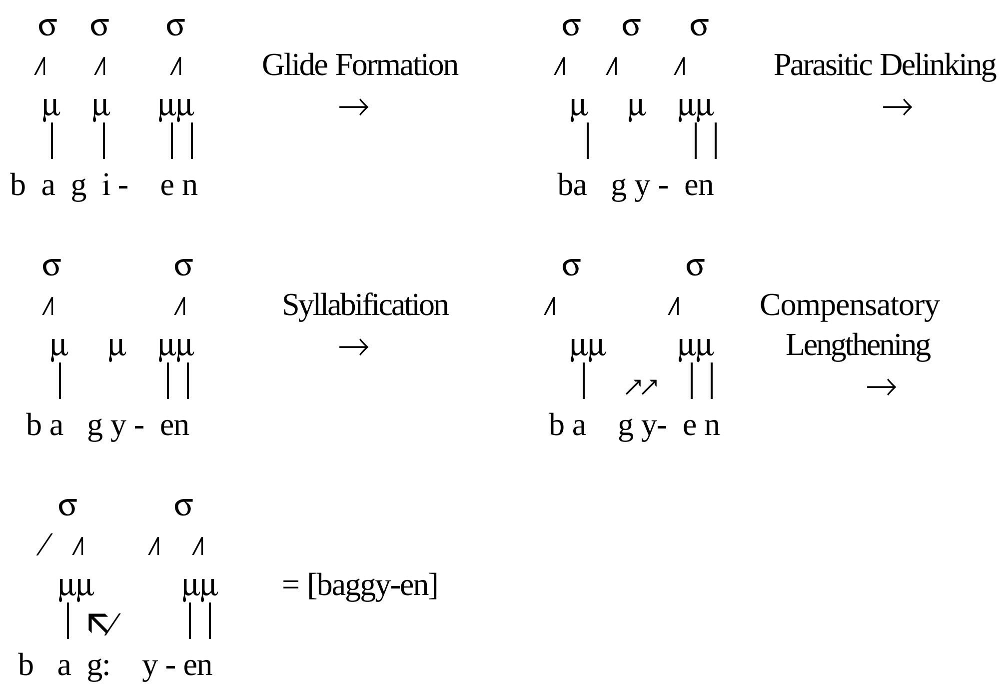
5.5 Glide Formation and Compensatory Lengthening

Hayes adduces a case from Ilokano in which glide formation often triggers CL (i.e. gemination) of the preceding consonant. In Ilokano, the stem-final vowels i, *e* and *o* usually convert to glides *y*, *y* and *w* before suffix-initial vowel respectively. (Various additional complications not bearing upon the present discussion are ignored.) For instance, /bagi-en/ (/bagi/ ‘body, self,’ /bagi-en/ ‘to have as one’s own’) surfaces as *baggy-en*.

According to Hayes’s moraic account of Ilokano CL, the gemination proceeds as follows: Glide Formation disassociates the stem-final vowel from its mora and its output undergoes Parasitic Delinking (43), followed by Syllabification and Compensatory Lengthening (51).

(51) Compensatory Lengthening (Moraic Version)
Fill empty moras by spreading from the right.

Now the following derivation illustrates the CL procedure:

(52)


In Optimality Theory, this CL can be dealt with by making use of the constraint MAX$_{IO}$ (μ) which also reflects the insight reified in Ingria’s Empty Node Convention and Hayes’s Moraic Conservation (40). As with the constraint MAX$_{IO}$ (μ]$_{\sigma}$) in the rankings for Greek CL and prenasalization in Bantu languages, the constraint MAX$_{IO}$ (μ) is assumed to have the same ranking with MAX$_{IO}$, because they do not conflict with each other. The moraic account of Ilokano CL exemplified above is now replaced by the following tableau:

(53) Tableau for /bagi-en/ → [baggy-en]

*[V, -low] V >> MAX$_{IO}$, DEP$_{IO}$, MAX$_{IO}$ (μ) >> INTEGRITY, IDENT$_{IO}$ (+voc)

μ μ μμ │ │ ││ /b a g i - en/	*[V, -low] V	a. MAX$_{IO}$ b. DEP$_{IO}$ c. MAX$_{IO}$ (μ)	a. INTEGRITY b. IDENT$_{IO}$ (+voc)
☞ μ μ μμ ││ ││ b a g g y - en			a.* b*
μ μ μ │ │ │ b a g i - n		a.*! c.*!	
μ μ μμ │ │ ││ b a g i <u>C</u> - en		b.*!	
μ μ μ │ ││ b a g y - en		c.*!	b.*

The present case is different from the former two cases in two respects, even though they all make use of the constraints referring to the prosodic unit mora. First, the markedness constraint does not crucially dominates MAX$_{IO}$; it only does MAX$_{IO}$ (μ). Second, MAX$_{IO}$ (μ) demands that every mora of the input have a correspondent in the output without regard to its affiliation with a syllable. Nonetheless, the ranking in the tableau above is virtually equivalent to the rankings in the tableaux (48) and (50), and so it is nearly consistent with the ranking schema (49). Faced with the crucially-dominating markedness constraint *[V, -low]V, the observance of MAX$_{IO}$ (μ) is achieved, suppressing the faithfulness constraints INTEGRITY and IDENT$_{IO}$ (+voc). This phenomenon of CL is thus simply a case of emergence of the faithful to the faithfulness constraint MAX$_{IO}$ (μ) to conserve the numerical integrity of moras.

5.6 Conclusion

In this section, it has been shown that not all the phenomena of CL dealt with by means of the prosodic unit mora by Hayes should be done so within the framework of Optimality Theory. Those phenomena of CL which take advantage of the constraints employing the prosodic unit mora are under the domination of the following ranking schema:

(54) M >> MAX$_{IO}$, MAX$_{IO}$ (μ) >> F$_{IO}$

To the MAX$_{IO}$ (μ) constraint family belongs any MAX$_{IO}$ constraint whose argument is μ, including MAX$_{IO}$ (μ]$_{\sigma}$) functioning in Greek CL and prenasalization in Bantu languages. Consequently, the ranking schema (49) can now be restated as in the following:

(55) General Ranking Schema for EOF

M >> MAX$_{IO}$ (MAX$_{IO}$ (μ)) >> F$_{IO}$

Even under this integrated general ranking schema, it remains unchanged that the faithfulness constraints MAX$_{IO}$ and/or MAX$_{IO}$ (μ) are obeyed after all, repressing other faithfulness constraint(s) F$_{IO}$, in the face of the crucially-dominating markedness constraint(s) M. And, ultimately, this schema entails, as usual, the conservation of NISM for emergence of the structures faithful to MAX$_{IO}$ and/or the numerical integrity of moras for emergence of the structures faithful to MAX$_{IO}$ (μ]$_{\sigma}$) or MAX$_{IO}$ (μ).

6. Tonal Stability in Optimality Theory

The following discussion of Margi tonology is based on Kenstowicz (1994:321-322; see also Hoffman 1963). Margi has six vowel phonemes i, *u, e, o, a* and ə. (In what follows, "´" represnts high tone (H), "`" low tone (L) and "ˇ " rising tone.) When the definite suffix /-árì/ is added to a stem ending in vowel, the stem-final vowel changes to glide if it is high, *a* of the definite suffix deletes when the stem-final vowel is mid, and the stem-final vowel deletes when it is ə. When the stem-final vowel and the suffix-initial vowel are both *a*, the first is assumed to delete. The ordered rules in (56b) now account for these segmental alternations:

(56) a.	ʔímí	ʔímy-árì	'water'
	kú	kw-árì	'goat'
	šèré	šèré-rì	'court'
	tóró	tóró-rì	'threepence'
	ə́ncàlá	ə́ncàl-árì	'calabash'
	tì	ty-ǎrì	'mourning'
	hù	hw-ǎrì	'grave'
	cédè	cédě-rì	'money'
	fà	fǎ-rì	'farm'

b. [i,u] $\rightarrow$ [y,w] / ____ V
V$\rightarrow$ ∅ / [e,o] ____
V$\rightarrow$ ∅ / ____ V

In an autosegmental representation, the disassociated tone is left *floating* on the tonal tier after the associated vowel is devocalized or deleted, which phenomenon Goldsmith (1976) dubs *tonal stability.* Now a principle is stipulated to associate the floating tone to the timing tier. Clements & Ford (1979) suggest that the disassociated tone typically associates to the tone bearing unit (TBU) that causes the original TBU to be lost. This Stranded Tone Principle correctly associates the floating tones, as shown in the following derivations:

```
(57) a. hu-ari        b. cede-ari        UR
         |  | |           |  | | |
        L HL             H  LHL
        hw-ari        b. cede- ri        Glide Formation and Elision
            | |           | |   |
         L  HL            H LHL

        hw-a r i      b. ced  e- ri      Stranded Tone Principle
            ^  |          |   ^   |
           LH L           H LH  L
```

In Optimality Theory, our account of CL which have established the ranking (54) can be extended very naturally to the analyses of these phenomena of tonal stability. The markedness constraints *[V, +high]V and *[V, -high, -low]V crucially rank over the faithfulness constraints $\textsc{Max}_{IO}$ and $\textsc{Max}_{IO}$ (τ) which requires that every tone of the input have a correspondent in the output.[14] In addition, we need the constraint UNIFORMITY (τ) which says that no element of output has multiple correspondents of tones in input.

[14] Although there is no evidence that the markedness constraint *[V, +high]V crucially dominates the faithfulness constraint $\textsc{Max}_{IO}$, it is assumed that it does so that the ranking in question may be integrated into the general ranking schema. The same remark can be made with respect to the ranking between *[V, -low]V and $\textsc{Max}_{IO}$ in the tableau (53).

(58) Summary Tableau for Margi Tonal Stability

*[V, +high]V, *[V, -high, -low]V >> $\textsc{Max}_{IO}$, $\textsc{Dep}_{IO}$, $\textsc{Max}_{IO}$ (τ) >> UNIFORMITY (τ), $\textsc{Ident}_{IO}$ (F)

	a. *[V, +high]V b. *[V, -high, -low]V	a. $\textsc{Max}_{IO}$ b. $\textsc{Dep}_{IO}$ c. $\textsc{Max}_{IO}$ (τ)	a. UNIFORMITY (τ) b. $\textsc{Ident}_{IO}$ (F)
/hu-ari/ │ │ │ LH L			
☞ hw-ar i ∧ │ LH L			a.* b.*
hw-ari │ │ H L		c.*!	
/ced e-a ri/ │ │ │ │ H L H L			
☞ ced e- ri │ ∧ │ H LH L		a.*	a.*
ced e-ri │ ∨ H L		a.* c.*!	

In order for the claim made here to stand, by the way, it must be assumed that the input to phonology satisfies OCP (OCP is originally due to Leben (1973)). Thus, the lexical representations, for example, ʔimi-ari and toro-ari are adjusted by OCP to become

∨ │ │ ∨ │ │
H HL H HL

the phonological inputs ʔimi-ari and toro-ari respectively. Simultaneously with the

∨ / │ ∨ / │
H L H L

the devocalization, the glide *y* in *ʔimy-ari* is delinked from the multiply-linked H, and, similarly, simultaneously with the vowel-deletion, the association line linking the suffix-initial vowel *a* to the multiply linked H in *toro-ari* is deleted. The result is that the output forms ʔimy-ari and toro-ri satisfy the constraint $\textsc{Max}_{IO}$ (τ).

\ / │ ∨ │
H L H L

To return, the markedness constraint *[V, +high]V does not crucially dominates $\textsc{Max}_{IO}$, but it does $\textsc{Max}_{IO}$ (τ). Meanwhile, the markedness constraint *[V, -high, -low]V crucially dominates both MAX$_{IO}$ and MAX$_{IO}$ (τ), the former being unsatisfied by any means. In the face of the crucially-dominating markedness constraints, the faithfulness constraint MAX$_{IO}$ (τ) is satisfied, victimizing other faithfulness constraints. This phenomenon of tonal stability is a manifestation of an endeavor to preserve the numerical integrity of tones, namely, an instance of emergence of the structures faithful to the faithfulness constraint MAX$_{IO}$ (τ).

In the 15th-century Korean tonology (Kim 1977, Lee 1986), the high-toned nominative suffix and causative suffix i turns to *y* after the stem-final vowel. After the devocalization, the floating tone associates to the stem-final vowel:

```
(59) a. putʰyə-i → putʰyə-y      putʰyə  'Buddha'
            ∨    |       ∨  |
            L    H       L  H
     b. po-i → po-y                po  'see'
          | |      ∧
          LH      LH
```

This phenomenon of tonal stability can also be accounted for by the ranking virtually equivalent to that operative in the tableau (58) above.

It may now be asserted that the phenomena of tonal stability is nothing less than an expression of an effort to conserve the numerical integrity of tones for emergence of the structures faithful to MAX$_{IO}$ (τ). Thus, the ranking operative in the phenomena of Margi tonology is compatible with the general ranking schema (55), only the argument τ of MAX$_{IO}$ (τ) is substituted for the argument μ of MAX$_{IO}$ (μ). The consequence is that the general ranking schema (55) is restated as in the following, where the argument α of MAX$_{IO}$ (α) is a variable ranging over μ and τ:

(60) General Ranking Schema for EOF

M >> MAX$_{IO}$ (MAX$_{IO}$ (α)) >> F$_{IO}$

Under this integrated general ranking schema too, it remains unvaried that the observance of the faithfulness constraints MAX$_{IO}$ and/or MAX$_{IO}$ (α) is achieved, bringing other faithfulness constraint(s) F$_{IO}$ into submission, in confrontation with the crucially-dominating markedness constraint(s) M. As before, this general ranking schema, is thus a formal expression of an endeavor to conserve NISM and/or the numerical integrity of moras or tones.

7. Conclusion

Conventionally, phonological processes like CL, metathesis, coalescence, the phenomena of tonal stability and other phonological processes that give birth to the conservation of NISM non-vacuously have all been considered to be as many distinct phonological processes. In this article, however, it has been demonstrated that all of those phonological processes can be embodied in a single general ranking schema (60), with markedness constraint(s) M at the top, MAX$_{IO}$ and/or MAX$_{IO}$ (α) in the middle and other faithfulness constraint(s) F$_{IO}$ at the bottom, each crucially dominating the lower-ranking constraint(s). That is, they are all in the range of the trinity of the constraints where the faithfulness constraints MAX$_{IO}$ and/or MAX$_{IO}$ (α) are ultimately satisfied, in the face of the crucially-dominating markedness constraint(s) M, by subjugating other faithfulness constraint(s) F_{IO}. This is only made possible within Optimality Theory, specifically, within Correspondence Theory. In most cases, it would be impossible to attain the expected consequence without taking advantage of the mechanism of the multiple correspondence of a segment, arising from violating UNIFORMITY, INTEGRITY or IDENT$_{IO}$, which is permitted by Correspondence Theory. Significantly enough, the analysis of the incomplete phase in Rotuman definitely substantiates the claim that the afore-mentioned phonological processes are all subsumed under the schema. It has also been proven conclusively that it is a formal expression of an effort to conserve NISM and/or the numerical integrity of moras or tones for EOF. Overall, the generalization to be drawn is this: the ranking schema (60) governs any phonological process that manages to conserve NISM and/or the numerical integrity of moras or tones against unfavorable circumstances, ultimately resulting in EOF.

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