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Compensatory lengthening in Harmonic Serialism*

Sechang Lee
(Sookmyung Women's University)

Lee, Sechang. 2021. Compensatory lengthening in Harmonic Serialism. *Linguistic Research* 38(1): 99-121. This article aims to overcome the limitations of classical analyses of compensatory lengthening in Middle English and offer a viable alternative solution, where deletion of the coda consonant and subsequent vowel lengthening constitute separate steps in derivation. The basis of our analysis is that Hayes (1989)' analysis fails to capture the universal nature of the phenomenon. Also, it is noted that the principle of unmarked one-to-one mapping between tiers is violated in his theoretical framework. I make a critical review of Torres-Tamarit's (2016) account for compensatory lengthening in Harmonic Serialism. That mechanism turns out not to be satisfying in that its first step of the derivation starts with a structure that should not be allowed to undergo vowel lengthening at all, and this point had already been called into attention by Hayes. Besides, Torres-Tamarit's analysis can be further reduced by the elimination of debuccalisation. Staying under the framework of Harmonic Serialism, I provide a new universal constraint responsible for assigning different indexes to segments when they belong to different syllables. This markedness constraint of universal nature will be instrumental in our analysis of compensatory lengthening throughout this article. We bring to light more examples from Latin illuminating the workings of this new constraint on compensatory lengthening. **(Sookmyung Women's University)**

Keywords compensatory lengthening, MEOSL, Harmonic Serialism, derivation, indexing, moraic phonology

1. Introduction

During the Middle English period (14th century), there occurred a major vowel length change by the name of Middle English Open Syllable Lengthening (MEOSL). What happened was that in general, a short vowel in the first open syllable of a disyllabic word underwent lengthening. The most characteristic feature of MEOSL lies in the fact that "its domain extends over and across a syllable boundary and that its effect is constrained to the stressed vowel of items comprising two syllables" (Jones 1989: 100). This means that such a vowel timing adjustment or stretching in one syllable should take place to

* I am grateful to anonymous reviewers for drawing my attention to some important issues, which I had previously overlooked.

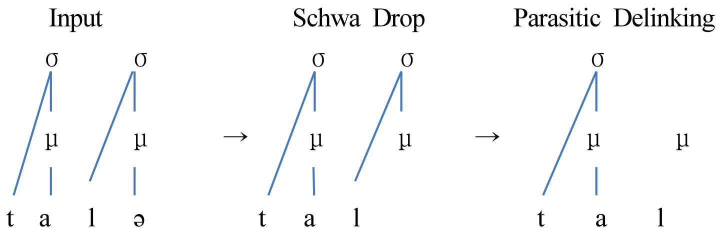
compensate for certain lost or replaced elements in another syllable. This constitutes a common direction of cause and effect in the literature to be mentioned below. Minkova (1982) analyzed the phenomenon and concluded that MEOSL was contingent upon schwa apocope (e.g., nǎma > nāme 'name', nǒsu > nōse 'nose', mĕte > mēte 'meat', etc). Hayes (1989: 266-269) went on to formalize this analysis within moraic theory as a straightforward case of compensatory lengthening (CL). In this article, we propose to show that a grammar incorporating Hayes' classical viewpoint of CL is inadequate on theoretical grounds. It will be shown that theoretically, his model not only suffers from an inherent serious problem but also is not capable of explaining the universal nature of CL. We also make a review of a recent analysis of the classical CL which is formalized within a framework known as Harmonic Serialism (HS), but cannot be well supported on empirical grounds. We offer a different treatment of CL which resolves the problems while preserving the insights of moraic phonology and HS.

2. Previous treatments

In this section we make a review of two theoretically different analyses of CL. In the course of the review we will observe that neither Hayes' (1989) nonlinear approach nor Torres-Tamarit's (2016) HS approach can be defended satisfactorily when a closer look is taken at what their ideas entail for the organization of the phonology and for the universal property of the phenomenon. We also provide a brief overview of HS at the beginning of 2.2.

2.1 Hayes' (1989) classical analysis

It is observed by Minkova (1982) that the well-known Middle English sound change, MEOSL, was a sporadic phenomenon. Hayes (1989: 266) points out as a real generalization that a stressed open syllable in penult is lengthened only when a word-final schwa was dropped, as is clear in Middle English *tale* [talə]→[ta:l], which accounts for 97% of the relevant cases. He assumes that delinking of a vowel segment implies loss of syllable structure, as illustrated in the final stage of the derivation shown in (1):

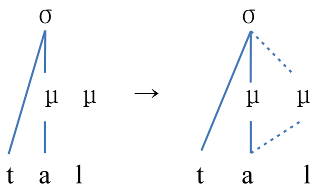
(1)


Once a stray mora is available, it becomes quite straightforward to get vowel lengthening by linking the mora to the preceding vowel. The following is the mechanism Hayes motivated:

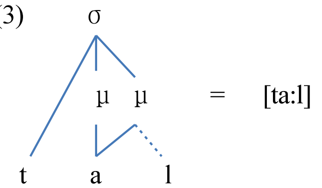
(2) Compensatory vowel lengthening (Hayes 1989: 269)

a. Compensatory Lengthening (Middle English)

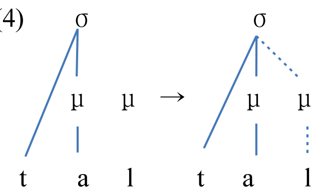
Fill empty moras by spreading from the left.

b.


The resyllabification of final [l] is the finishing touch:

(3)


However, this account is problematic with trying to derive a long vowel by linking the floating mora to the preceding vowel as in (2b): after Parasitic Delinking in (1), why does the floating mora bother to dock onto the vowel skipping the final consonant? Concern over this analytical problem has been independently voiced by Riad (1992: 335-336), Bickmore (1995: 148), and Bermúdez-Otero (1998: 187) among others. In particular, Riad notes that mora-to-segment association should be one-to-one by default, which is based on the universal nature of the Association Convention (AC, henceforth) in Goldsmith (1990).[1] The AC has a universal nature in that it has an effect on any phonological representation that are not totally unassociated. That is to say, if a phonological representation has at least one association line, the AC may affect the representation in terms of one-to-to association between the opposing tiers. Then, the lengthening step in (2b) cannot be regarded as the result of the AC at all but must be stipulated. The prediction made by the AC therefore predicts that the association process should proceed as in (4). This yields the argument against Hayes' analysis in (2b). In this vein, we argue in this article that the following step in (4) should be the unmarked one, obeying the one-to-one association dictated by the AC:

(4)


We also claim that this line of argument against Hayes is basically correct and it will be justified by adopting HS framework in the analysis of CL to come in section 4.

2.2 Resolution through HS by Torres-Tamarit (2016)

The classical theory of generative phonology in The Sound Pattern of English (Chomsky and Halle, 1968) can be characterized as a mapping between two levels of representation. This mapping implies two possibilities. A common strategy is the indirect mapping: intermediate steps are allowed in a derivation. The classical Optimality Theory (OT, henceforth) in the sense of Prince and Smolensky (1993, 2004), however, adopted the direct mapping: there are no intermediate steps between underlying and surface representations. Hence, it is called Parallel OT (P-OT). That is, in classical OT, the effects of different phonological operations are evaluated together, in parallel. A variant of OT called Harmonic Serialism (HS) is a derivational version of OT. The development

1 **Association Convention** (Goldsmith 1990: 14)
When unassociated vowels and tones appear on the same side of an association line, they will be automatically associated in a one-to-one fashion, radiating outward from the association line.

of these two types of OT was already forecasted. The following has become the standard passage that elucidates the issue:

> "Universal grammar must provide a function Gen that admits the candidates to be evaluated. In the discussion in chapter 2 we have entertained two different conceptions of Gen. The first, closer to standard generative theory, is based on serial or derivational processing: some general procedure (Do-α) is allowed to make a certain single modification to the input, producing the candidate set of all possible outcomes of such modification. This is then evaluated; and the process continues with the output so determined. In this serial version of grammar, the theory of rules is narrowly circumscribed, but it is inaccurate to think of it as trivial. There are constraints inherent in the limitation to a single operation to a single operation and in the requirement that each individual operation in the sequence improves Harmony." (Prince and Smolensky 1993, 2004: 94-95)

In HS (Prince and Smolensky 1993, 2004; McCarthy 2006, 2007, 2008ab; Pruitt 2008; Shaw 2007; Wolf 2008, among others) the derivations of candidates are implemented through a series of steps. Each step of derivation is subject to a couple of conditions, gradualness and monotonic harmonic improvement. The graualness requires only a single step in each derivation. Gen is allowed to add violations of only one basic faithfulness constraints at a time (McCarthy 2007: 61-62, 77-79).[2] On the other hand, monotonic harmonic improvement makes any HS derivation $i_1 \rightarrow i_2 \rightarrow ... \rightarrow i_n \rightarrow i_n$ improve harmony steadily until it converges, as shown in the last step of the derivation $i_n \rightarrow i_n$. Gradualness makes HS's candidate sets finite while P-OT's candidate sets are infinite.

It is pointed out by Torres-Tamarit (2016) that the classical version of CL by Hayes is opaque in that we have no coda consonant in the surface representation whose presence would justify the second mora linked to the preceding vowel.[3] Translated straightforwardly into the OT system, according to Torres-Tamarit, a CL output form in

2 Basic faithfulness constraints in Gen include such operations as deletion (MAX), insertion (DEP), and changing a feature value (IDENT), etc.

3 In fact, this was pointed out earlier in McCarthy (2007: 32):
"... Compensatory lengthening is a type of counterbleeding opacity: a deleted segment projects a mora, but that mora is pronounced with a different segment, thereby lengthening it..."

terms of P-OT is harmonically bounded by the transparent winner.[4] That is, in Latin the intended winner in (5b) cannot win under any permutation of the whole constraint set:

(5) Classical CL in P-OT (Torres-Tamarit 2016: 303)

/kasnus/	WBP	*s[+son, +ant]	DEP-μ	MAX-C
a.→ $(ka_{\mu})(nu_{\mu}s_{\mu})$			L	1
b.☹ $(ka_{\mu\mu})(nu_{\mu}s_{\mu})$			1	1
c. $(ka_{\mu}s_{\mu})(nu_{\mu}s_{\mu})$		1W	L	L
d. $(ka\mu s)(nu_{\mu}s_{\mu})$[5]	1W	1W	L	L

Most importantly in the tableau, the desired output candidate (5b) incurs one violation of DEP-μ which militates against inserting moras that are not positionally licensed (Bermúdez-Otero 2001).

Torres-Tamarit offers an alternative treatment of CL which apparently overcomes the problem while preserving the advantages of the OT analysis. The offered treatment takes the position that syllabification is gradual and deletion of the coda consonant constitutes a two-step process. His HS analysis crucially relies on McCarthy's (2008a) assumption that consonant deletion or assimilation is composed of two derivational steps, with a Placeless consonant as the intermediate step. So, if a language has this constraint ranking, the /patka/ will map to [pa.ka] by way of [paH.ka]:

(6) Harmonic improvement in <pat.ka, paH.ka, pa.ka> (McCarthy 2008a: 280)

/patka/	CODA-COND	HAVE-PLACE	MAX[Place]	MAX
a. pat.ka *is less harmonic than*	*!			
b. paH.ka *is less harmonic than*		*!	*	
c. pa.ka			*	*

4 If the violation marks of Candidate1 is in a proper subset relation with those of Candidate2 in a violation tableau, then the latter cannot beat the former under any permutation of the constraint ranking in that tableau. In such a case, we say that Candidate2 is harmonically bounded by Candidate1 under that constraint set (Pince and Smolensky 1993, Samek-Lodovici 1996, Samek-Lodovici and Prince 1999).

5 A subscript mora '$_{\mu}$' stands for a mora linked to the preceding segment, and a regular mora 'μ' stands for a shared one.

McCarthy formulates CODA-COND as assigning one violation mark for every token of Place that is not associated with a segment in the syllable onset. HAVE-PLACE dictates to assign one violation mark when a segment has no Place specification. Following McCarthy's idea of Placeless, unstable status of to-be-deleted coda consonant, Torres-Tamarit offers a schematic HS derivation scenario below:

(7) Classical CL in HS (Torres-Tamarit 2016: 310-312)

a. Step 1: core syllabification

/CVC/	PARSE-SEG	MAX(place)	HAVE-PLACE
①→ $(CV_{\mu})C$	1		
② $C(V_{\mu})C$	2W		
③ CVC	3W		
④ CVH	3W	1W	1W

b. Step 2: coda adjunction

$/(CV_{\mu})C/$	PARSE-SEG	WBP	μ/C	CODA-COND	MAX (place)	HAVE-PLACE
①→ $(CV_{\mu}C_{\mu})$			1	1		
② (CVμC)		1W	L	1		
③ $(CV_{\mu})C$	1W		L	L		
④ $(CV_{\mu})H$	1W		L	L	1W	1W

c. Step 3: debuccalisation

$/(CV_{\mu}C_{\mu})/$	CODA-COND	MAX(place)	HAVE-PLACE
①→ $(CV_{\mu}H_{\mu})$		1	1
② $(CV_{\mu}C_{\mu})$	1W	L	L

d. Step 4: deletion

$/(CV_{\mu}H_{\mu})/$	HAVE-PLACE	MAX-C	*FLOATINGμ
①→ $(CV_{\mu}{}^{\mu})$[6]		1	1
② $(CV_{\mu}H_{\mu})$	1W	L	L

6 A superscript mora '$^{\mu}$' stands for a floating one. A subscript mora '$_{\mu}$' and a regular one 'μ' stands for a mora linked to the preceding segment and a shared mora, respectively.

e. Step 5: lengthening

$/CV_\mu{}^\mu/$	MAX-μ	*FLOATINGμ	DEP-LINK-μ	*V:
①→ $(CV_{\mu\mu})$			1	1
② $(CV_\mu{}^\mu)$		1W	L	L
③ (CV_μ)	1W		L	L

At the first step in (7a), the candidate which maximally satisfies PARSE-SEG (i.e., (7a①)) is selected as the most harmonic one. The intermediate winner of (7a) constitutes the input to the second step in (7b). At step 2, a mora is projected to the coda consonant under the pressure of the weight by position. It is the third step when debuccalisation of the coda consonant takes places. And the root node of the coda consonant is finally deleted at step 4. At the final step of the HS derivation in (7e), the whole process of CL is completed by linking the floating mora to the vowel.

Some crucial problems we are raising regarding this scenario is the following. In the first place, inducing Place assimilation appears to be what mainly motivated McCarthy to posit an intermediate Placeless segment in his HS analysis. Other than that, there should be no need to assume that the two-step deletion is harmonically improving. In Torres-Tamarit's HS derivation scenario also, we can totally dispense with debuccalisation. In other words, the input of step 3 in (7c) does not have to undergo debuccalisation-then-deletion. From the input form $/(CV_\mu C_\mu)/$ in Step 3, the second C can be directly deleted and the floating mora can induce the lengthening of the immediately preceding vowel, resulting in CL. Secondly, it is noted in Ingria (1980: 472) that in Latin case, when /s/ appeared before a voiced stop, it first voiced to /z/. This /z/ later deleted before dental stops, causing CL to happen.[7] The Latin case tells something that we already suspected: Debuccalisation is not independently motivated and cannot constitute a necessary stage before deletion. Again, on simplicity grounds, the step 3 in (7c) cannot be justified. Thirdly, Hayes (1989: 266) points out that an account positing the derivational sequence of changes [talə]→[tal]→[ta:l] is untenable. That is mainly because words that originally had the syllable structure of [tal] did not lengthen.[8] In a nutshell, according to Hayes, the vowel lengthening in question was genuinely compensatory. In the light of this, the input structure of the first step in (7a) is not motivated to undergo

7 Ingria's Latin case is to be discussed in detail and analyzed within HS in 4.2.

8 We will draw our attention to this issue again in 4.1.

any compensatory operation as it did not lose anything to be compensated for in the first place.

In what follows, we will try to make explicit the reasoning that will lead to the adoption of HS and the revision of Torres-Tamarit's analysis in CL.

3. Proposal

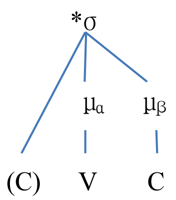
In this section, we introduce a couple of constraints that will play crucial roles in selecting the ultimate output of the grammar. Supposing that vowel reduction (and deletion) involves loss of the vowel's place features, McCarthy (2008b) formulates the following markedness constraint:

(8) *V-PLACE$_{weak}$ (McCarthy 2008b: 508)
Assign a violation mark when a place-bearing vowel is in either of the metrically weak positions such as (i) the non-head syllable of a disyllabic foot or (ii) a syllable that is immediately dominated by the word node.

The *V-PLACE$_{weak}$ is to be violated by a place-bearing vowel in either metrically-weak positions (i) or other (ii), the first sense of which will be instrumental in the analyses to be made in the following section.

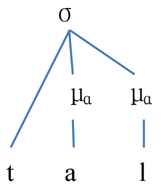
There is another constraint that we would like to create at this stage in the argument. We propose that moras projected within the same syllable should be required to share the same index, under the pressure of COINDEXING(μ):

(9) COINDEXING(μ)



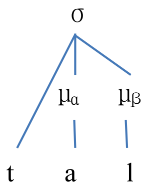
Differently said, the moras under the same syllable are not allowed to have different indices because that means those moras are projected from different syllables. The basic idea is that a preference for some universally unmarked structure, such as COINDEXING (μ)-satisfying one, should be expressed as in (10):

(10) COINDEXING(μ)-satisfying representation



It should be unmarked for the two moras in the same syllable to carry the same index (i.e., α). Descriptively, we clearly want to say that moras projected within the same syllable are prohibited from carrying different indices. The COINDEXING(μ) assigns a violation mark if mora-projections are not coindexed within a syllable. The following configuration helps us to gain an understanding of how the constraint works:

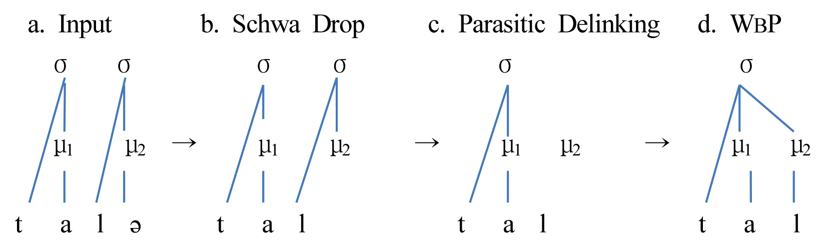
(11) COINDEXING(μ)-violating representation



We propose that CL should be triggered to achieve the satisfaction of COINDEXING(μ), which in fact militates against the presence of any extra mora not co-indexed with the mora of nucleus within the same syllable. The representation in (11) violates COINDEXING(μ), although it gets to satisfy weight by position (WBP).

Let us in this light explore the derivation of [tal] from /talə/ in the following:

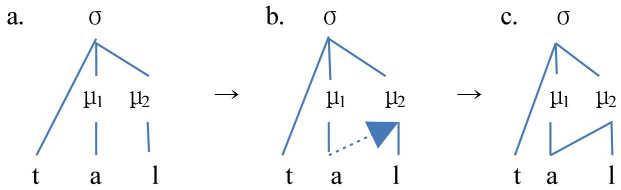
(12) Derivation of the mapping /talə/ → [tal]



Derivational stages from (12a) through (are the same as those of Hayes (1989) illustrated in (1), unlike which we take (12d) as the local optimum.

Having established this, our next question is how to obtain CL from (Let us consider the derivation of the mapping /tal/ → [ta:l], the process of which is discussed below:

(13) Derivation of the mapping /tal/ → [ta:l]



In the first representation given in (13a=it should be noted that the syllable-final lateral carries μ_2 while the nucleus carries μ_1. They have different indices because the μ_2 dominating the lateral came from a different syllable in the first place. WBP is satisfied here, while violating COINDEXING(μ), meaning that the former dominates the latter in the constraint hierarchy. Then (13b) can be made to satisfy COINDEXING(μ) by means of adding a link between the vowel and μ_2 already associated with the lateral. In the final stage (two segments carry the same index (i.e., μ_2): 'a' projects [$\mu_1\mu_2$] and 'l' projects [μ_2]. There is no one-to-one association any more between differently-indexed moraic tier and segmental one, vacuously satisfying COINDEXING(μ).

4. Analysis

The explanation for CL of both English and Latin cases is well within the purview of the framework outlined in section 3. Employing basically the same set of constraints, the characteristic aspects of CL for both languages will be explained through the interaction of relevant constraints.

4.1 Middle English

Under the definition in (14), PARSE-SYLLABLE can compel metrical-structure assignment prior to syncope:

(14) PARSE-SYLLABLE (after McCarthy and Prince 1993: 91)
Assign one violation mark for every syllable that is not dominated by some foot.

The derivations in (12) and (13) above portray the intended analysis. Those results translate straightforwardly into the present HS system, which characterizes CL in terms of repeated application of the same set of relevant constrains. The following tableau in (15) shows that assigning foot structure is harmonically improving because it eliminates one violation of PARSE-SYLLABLE in its first step[9]:

(15) Step 1 of /talə/ → [ta:l]

/ta$_{\mu1}$lə$_{\mu2}$/	PARSE-SYLLABLE	*V-PLACE$_{weak}$	MAX	…
a.→ (tá$_{\mu1}$.lə$_{\mu2}$)		1		
b. ta$_{\mu1}$.lə$_{\mu2}$	2W			
c. ta$_{\mu1}$l$_{\mu2}$	1W		1W	

(The period/full stop marks a syllable boundary. A subscript '$_{\mu}$' stands for a moa projected from and linked to the preceding segment.)

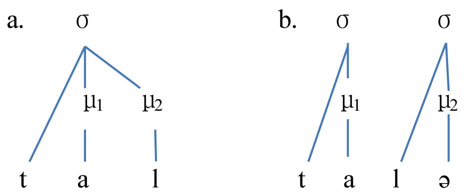
9 Trochaic parse wins because FOOTFORM=TROCHEE dominates FOOTFORM=IAMB. But I will suppress this constraint ranking in the hierarchy to save space.

Since PARSE-SYLLABLE dominates *V-PLACE$_{weak}$, syncope cannot precede assignment of foot structure. Therefore, (is selected as the most harmonic candidate at step 1.[10]

Because of gradualness, stress assignment and syncope cannot occur simultaneously. At the second step, the unstressed schwa undergoes deletion.[11] This occurs to satisfy *V-PLACE$_{weak}$, which (16b) violates.[12] Below the tableau, I provide relevant structures for the purpose of expository clarity:

(16) Step 2 of /talə/ → [ta:l]

(tá$_{\mu1}$.lə$_{\mu2}$)	PARSE-SYLLABLE	*V-PLACE$_{weak}$	MAX	…
a.→ (tá$_{\mu1}$l$_{\mu2}$)			1	
b. (tá$_{\mu1}$.lə$_{\mu2}$)		1W	L	



CL applies at the third step of the derivation. Let us consider how the explanation is supposed to work here:

10 Tableaux in this article is in the comparative format introduced by Prince (2002). The counts of asterisks are indicated by the integers. For each losing candidate in the tableau, each constraint favors the winner over this loser (W), or vice versa (L), or neither (blank). One advantage of this format is that constraint ranking relations can be presented very transparently: every L has a W somewhere to its left across a solid line in the tableau.

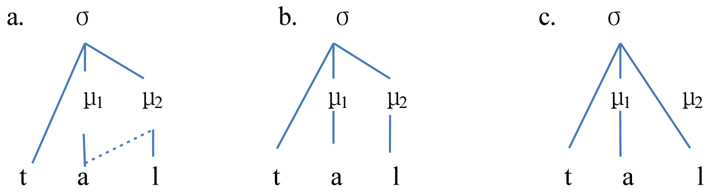
11 McCarthy (2010: 6) notes that (re)syllabification comes "for free" in each step of HS derivation, while other changes are mutually exclusive in HS's GEN. His claim is based on the observation that syllabification does not seem to be contrastive in any language. This very explanation would hold for the schwa deletion and consequent automatic resyllabification offered in (16a). I am grateful to the anonymous reviewer who has called this issue into my attention.

12 We assume that schwa also bears V-place. In that case, *V-PLACE$_{weak}$ assigns a violation mark to every vowel in a metrically weak position, which would lead to deletion of schwa and reduction of full vowels.

(17) Step 3 of /talə/ → [ta:l]

($tá_{\mu1}l_{\mu2}$)	PA-SY	*V-PL$_{weak}$	MAX	WBP	COIN(μ)	*LONGVOWEL
a.→($tá_{\mu1}\mu_2 l$)						1
b. ($tá_{\mu1}l_{\mu2}$)					1W	L
c. ($tá_{\mu1}l_{<\mu2>}$)				1W		L

(A regular mora 'μ' and a bracked subscripted mora '$_{<\mu>}$' stand for a shared mora and unparsed floating mora, respectively.)



(17c) is eliminated by WBP, as it failed to incorporate μ_2 into the syllable-final 'l', as opposed to (17b).[13] Both remaining candidate (17a-b) satisfy WBP, hence they are passed on for evaluation by the next-lower-ranked constraint in the hierarchy, COINDEXING(μ). (17b) is faithful to the input of the current step, but it is a clear violation of COINDEXING (μ), as illustrated in (11) above: its mora sequence is not co-indexed, as witnessed in a sequence of $\mu_1\mu_2$ within the same syllable. The current constraint ranking makes realization of a long vowel the most harmonic way to satisfy the high-ranking COINDEXING(μ) at the cost of violating the relatively low-ranking *LONGVOWEL.[14] The derivation then converges at step 4 (not shown).

Below in (18), I give a harmonic improvement tableau, which summarizes the story and shows that each step in above derivation is more harmonic than its predecessor.

13 There is and will be a need for a constraint penalizing the unparsing of mora in (17c) and (21b) to come. We have suppressed it to save space in the tableaux.

14 Long vowels as well as long consonants reflect universally marked status of linguistic structure. Hence, positing constraints prohibiting them does not add any cost to the grammar. As for the OT constraint prohibiting long consonants, readers are referred to Lee (2019).

(18) Harmonic improvement tableau for <talə, tal, ta:l>

/$\text{ta}_{\mu1}\text{lə}_{\mu2}$/	PARSE-SYLL	*V-PLACE$_{\text{weak}}$	MAX	WBP	COIN(µ)	*LONG VOWEL
a. $\text{ta}_{\mu1}\text{lə}_{\mu2}$ *is less harmonic than*	1!					
b. ($\text{tá}_{\mu1}.\text{l}_{\mu2}$) *is less harmonic than*			1!		1	
c. ($\text{tá}_{\mu1}\mu_2\text{l}$)						1

The exclamation point in (18) signals a crucial violation whose removal improves harmony. The constraint PARSE-SYLL compels the presence of foot structure, while MAX does the rest of the work.

As discussed earlier in 2.2, according to Hayes, an account positing the derivational sequence of changes [talə]→[tal]→[ta:l] is untenable since words that originally had the syllable structure of [tal] did not lengthen in the first place, representation-wise. That is, the vowel lengthening in Middle English was really compensatory. Apparently, this could be quite the opposite of what would be expected in the light of what has been said in (16) just before. However, it is not difficult to show that the original [tal] which is not the output of schwa deletion could not lengthen in the current constraint hierarchy of CL, which is consistent with Hayes' claim. To illustrate, consider the following derivations:

(19) Step 1 of /tal/ → [tal]

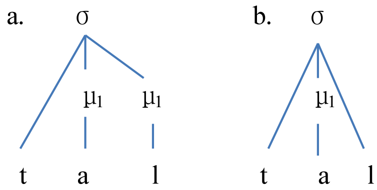
/$\text{ta}_{\mu1}\text{l}$/	PA-SY	*V-PL$_{\text{weak}}$	MAX	WBP	COIN(µ)	*LONGVOWEL
a.→ ($\text{tá}_{\mu1}\text{l}$)				1		
b. $\text{ta}_{\mu1}\text{l}$	1W			1		

Top-ranked PARSE-SYLL favors the winner (19a) over the loser (19b) because the loser is unfooted.

At the second step of the derivation, a mora is assigned (or projected) to the input lateral with a view to satisfying WBP:

(20) Step 2 of /tal/ → [tal]

(tá$_{\mu1}$l)	PA-SY	*V-PL$_{weak}$	MAX	WBP	COIN(μ)	*LONGVOWEL
a.→ (tá$_{\mu1}$l$_{\mu1}$)						
b. (tá$_{\mu1}$l)				1W		

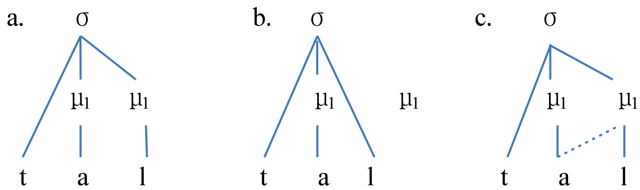


What is noteworthy from the step 2 of the derivation is that the winner in (20) has a co-indexed sequence of mora, unlike the output in (16) of the CL case. Not surprisingly, there is no place for the COINDEXING(μ) to play any role in selecting the intermediate winner (20a).

Conversion is reached at the next step of the derivation. Underlying /tal/ has realized all of its potential for harmonic improvement under this grammar, so the output of EVAL and the input to GEN are identical, as shown in (21):

(21) Step 3 of /tal/ → [tal] (conversion)

(tá$_{\mu1}$l$_{\mu1}$)	PA-SY	*V-PL$_{weak}$	MAX	WBP	COIN(μ)	*LONGVOWEL
a.→ (tá$_{\mu1}$l$_{\mu1}$)						
b. (tá$_{\mu1}$l$_{<\mu1>}$)				1W		
c. (tá$_{\mu1}$μ$_1$l)						1W



(21b) loses out due to the violation of WBP. The faithful candidate (fares better on *LONGVOWEL than (21c). This is how the derivation converges.

4.2 Latin

Compensatory vowel lengthening is triggered by the deletion of a nearby segment. The examples of interest are those from Ingria (1980) and shown below. The Latin segment /s/ was deleted and triggered vowel lengthening when placed before an anterior sonorant /n/ as in (22a), while word-initial /s/ also deleted before /n/ without accompanying any CL as in (22b):

(22) (/s/-deletion and compensatory lengthening in Latin (Hayes 1989: 260-261)

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

In Hayes' moraic theory, CL has received insightful treatment within the autosegmental framework. The deletion rule in (23a) deletes the segment /s/ on the segmental tier only. The CL rule in (23b) associates an immediately preceding vowel with a stranded mora by spreading:

(23) Compensatory Lengthening in Latin (Hayes 1989: 262)

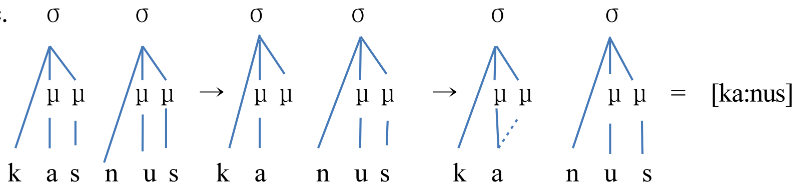
a. $s \rightarrow \emptyset \ / \ \_\_\_ \begin{bmatrix} +\text{son} \\ +\text{ant} \end{bmatrix}$ (segmental tier only)

b. Compensatory Lengthening

μ μ' where μ' is a segmentally unaffiliated mora

a

c.



In (23c) of the CL derivation, the assignment of a mora to the syllable-final /s/ is well motivated as CVC syllables in Latin are counted as heavy for the purpose of stress assignment.[15]

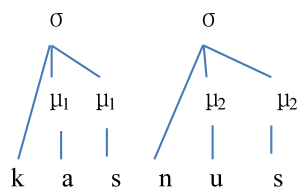
As observed, the general prediction of this entire derivation in (23c) is that the whole process of CL is depicted as if it resulted from a language-specific phonological rule, which is clearly not the case. For this very reason, it led Ingria (1980), Steriade (1982), and others to suggest some universal conventions to yield a CL effect automatically. On top of this, CL of this type is attested in many languages, as Hock (1986) shows. We suspect that this is where OT analysis should come in. The interactions of universal OT constraints will allow us greater insight into the universal nature of this familiar phonological process of CL.

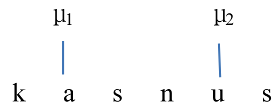
In analyzing Lain case of CL, I adopt essentially the same set of constraints as in 4.1 for the Middle English case but with a slightly different ranking. Let us consider how the apparent language-specific process in (23c) can be translated straightforwardly into the present HS system of universal nature. In the first step of HS derivation, the candidate (24a) satisfying WBP is selected as the intermediate winner:

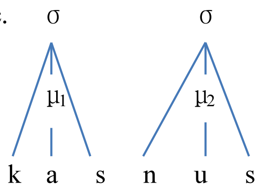
(24) Step 1 of /kasnus/ → [ka:nus]

/$ka_{\mu1}snu_{\mu2}s$/	PARSE - SEG	WBP	COIN(μ)	*s[+son, +ant]	PARSE-μ	*LONG VOWEL
a.→$ka_{\mu1}s_{\mu1}.nu_{\mu2}s_{\mu2}$				1		
b. $ka_{\mu1}snu_{\mu2}s$	1W			1		
c. $ka_{\mu1}s.nu_{\mu2}s$		2W		1		

15 In Latin, most words are stressed at the second-last (penultimate) syllable.

a. 

b. 

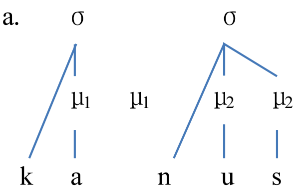
c. 

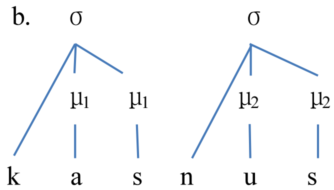
The imperative to parse segments into syllable is provided by the constraint PARSE-SEG, which is violated by (24b) that is faithful to the input. WBP correctly rules out (24c).

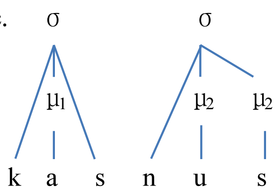
At step 2 of the derivation, the intermediate winner (24a) can improve harmony by deleting /s/:

(25) Step 2 of /kasnus/ → [ka:nus]

$ka_{\mu1}s_{\mu1}.nu_{\mu2}s_{\mu2}$	PARSE-SEG	WBP	COIN (μ)	*s[+son, +ant]	MAX	PAR-μ	*LONG VOWEL
a.→$ka_{\mu1<\mu1>}.nu_{\mu2}s_{\mu2}$					1	1	
b. $ka_{\mu1}s_{\mu1}.nu_{\mu2}s_{\mu2}$				1W			
c. $ka_{\mu1}s.nu_{\mu2}s_{\mu2}$		1W		1W			

a. 

b. 

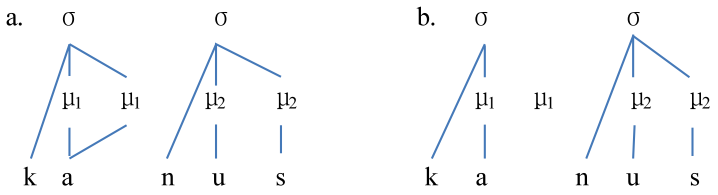
c. 

(25b-c) failed to remove the input ‘s’, thereby violating *s[+son, +ant]. (25c) is even worse because WBP assigns it one violation mark for the syllable-final ‘s’ that does not project a mora. The winning candidate is the one where the input ‘s’ is deleted at the expense of violating MAX-IO(segment) and PARSE-μ, as in (25a).

The current constraint hierarchy leaves room for further harmonic improvement. Consider our final step of the HS derivation below:

(26) Step 3 of /kasnus/ → [ka:nus]

ka$_{\mu1<\mu1>}$.nu$_{\mu2}$s$_{\mu2}$	PARSE-SEG	WBP	COIN (μ)	*s[+son, +ant]	MAX	PAR-μ	*LONG VOWEL
a.→ ka$_{\mu1\mu1}$.nu$_{\mu2}$s$_{\mu2}$							1
b. ka$_{\mu1<\mu1>}$.nu$_{\mu2}$s$_{\mu2}$						1W	



From the immediate winner (25a), there is another possibility for further improvement for harmony—namely, satisfying PARSE-μ by lengthening the vowel saves the day. This is the last possible harmonic improvement and the whole derivation converges. What is noteworthy from our point of view is that COINDEXING(μ) has played no role in the HS derivation of Latin examined so far. This is totally predictable from the formulation of COINDEXING(μ) given above, since the constraint is actively enforced by attracting a differently-indexed mora from the following syllable, resulting in a configuration that violates COINDEXING(μ). In the Latin case at hand, no critical situation arises like that in English case.

The following tableau in (27) makes summary of the whole derivation discussed so far. It is evident that each step of derivation is gradual, harmonically improving, and locally optimal.

(27) Harmonic improvement tableau for <$ka_{\mu1}snu_{\mu2}s$, $ka_{\mu1}s_{\mu1}.nu_{\mu2}s_{\mu2}$, $ka_{\mu1<\mu1>}.nu_{\mu2}s_{\mu2}$, $ka_{\mu1\mu1}.nu_{\mu2}s_{\mu2}$>

/$ka_{\mu1}snu_{\mu2}s$/	PARSE-SEG	WBP	*s[+son, +ant]	MAX	PARSE-μ	*LONG VOWEL
a. $ka_{\mu1}snu_{\mu2}s$ *is less harmonic than*	1!					
b. $ka_{\mu1}s_{\mu1}.nu_{\mu2}s_{\mu2}$ *is less harmonic than*			1!			
c. $ka_{\mu1<\mu1>}.nu_{\mu2}s_{\mu2}$ *is less harmonic than*				1!	1	
d. $ka_{\mu1\mu1}.nu_{\mu2}s_{\mu2}$						1

5. Conclusion

The most interesting aspect of the analysis presented so far is that CL, as triggered by the presence of an underlying (reduced) vowel, becomes a non-surface-apparent generalization due to the deletion of the relevant vowel in surface. We argued in this article that CL can only be adequately accounted for in HS if gradualness and harmonic improvement are guaranteed in each step of derivations. The central descriptive requirement that flows from this guarantee is that in CL, the effects of consonant deletion and subsequent vowel lengthening be optimized at different steps of derivation. This line of investigation proved fruitful in expressing clearly the cause and effect sequence of the CL derivation in theoretical terms. Hayes' classical treatment of CL suffered from inability of expressing the universal nature of CL, let alone violating the default association between mora tier and melody one. Torres-Tamarit's HS analysis began with the first step of derivation that could not develop into CL from Hayes' viewpoint. As noted, there is good reason to discard Torres-Tamarit's debuccalisation proposal in CL, since its only apparent advantage crucially resides in assimilation process. We also showed that the proposed constraint COINDEXING(μ) of universal nature turned out to play an important role in solving the theoretical and empirical problems in question. This conception is successfully carried over and extended into the Latin case of CL.

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Sechang Lee
Professor
Division of English Language and Literature
Sookmyung Women's University
Cheongpa-ro 47-gil 100, Yongsan-gu,
Seoul 04310, South Korea
E-mail: sechangl@sm.ac.kr

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