

## **An Account of Compensatory Lengthening without Moras**

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### **0. Introduction**

Hayes' (1989) theory of Compensatory Lengthening (CL) makes two closely related predictions. 1) CL is the result of mora preservation; and 2) the loss of a segment from an onset position cannot lead to CL. Hayes' theory is embedded in a derivational conception of phonology. It might be worthwhile, then, to investigate if, and to what extent, these two predictions follow from a non-derivational theory.

It turns out that we are forced to give up the two predictions if we follow the basic premises of Optimality Theory (OT). Interestingly, as far as the first prediction is concerned this is not a disappointing result. In fact, Slovak has a type of CL that has nothing to do with mora preservation. In this respect, then, OT's suspicion towards the rule based theory of CL seems justified. However, to give up the second prediction is not desirable, because convincing cases where the loss of a segment from an onset position triggers CL have never been found. It is the main goal of this article to develop a theory of CL in OT that allows us to maintain the second prediction.

I propose that CL has nothing to do with mora preservation. Basically, it is segment preservation but with one important addition; the output segment and the input segment must be very close in terms of sonority.

In section 1, I argue that CL has nothing to do with mora preservation, a conclusion that is very welcome from the perspective of OT. In section 2, I propose that CL really is the result of segmental faithfulness, a relation that is only possible if the corresponding segments are identical in terms of sonority in a specific sense. It is this identity requirement which explains why the loss of an onset segment is not compensated for.

### **1. CL: mora preservation or segment preservation?**

In this section I proceed as follows. First, I briefly sketch Hayes' theory of CL. The central generalization of this theory is that CL is the result of mora preservation. Then I will argue that from the perspective of OT there are reasons to be

suspicious about this generalization, simply because it cannot be expressed. Then I show that this suspicion is justified because there are indeed instances of CL where mora preservation is not relevant at all.

### 1.1. CL is mora preservation; the classical view

According to Hayes, CL is what you get when a segment is deleted but its mora is maintained. The preservation of the mora triggers the spreading of an adjacent segment because the mora that is left behind is filled. This is shown in (1) in a schematic form. (1a) is an instance of what Hayes calls ‘Classical CL,’ where a consonant in coda position is dropped and replaced by a lengthened vowel (if the stray mora is filled by the adjacent vowel) or a lengthened consonant (if the stray mora is filled by the adjacent consonant). (1a) only represents the first option. (1b) exemplifies what Hayes calls ‘Double Flop.’ In this type of CL, a segment in onset position is deleted. Then a neighboring segment occupies the onset position. In doing so it flees from its original position, leaving its mora stray. This mora is then filled by the vowel or the consonant. (1b) only represents the first option. In (1) syllable structure is indicated by dots and by spacing.<sup>1</sup>

- (1) a. *Classical CL*
- | syllabification |      | segment loss |      | resyllabification |   | spreading |      |
|-----------------|------|--------------|------|-------------------|---|-----------|------|
| mm              | m    | m            | m    | m                 | m | m         | m    |
| .c v c          | .c v | .c v         | .c v |                   |   | .c v      | .c v |
- b. *Double Flop*
- | syllabification |      | segment loss |      | resyllabification |      | spreading |      |
|-----------------|------|--------------|------|-------------------|------|-----------|------|
| mm              | m    | m            | m    | m                 | m    | m         | m    |
| .c v c          | .c v | .c v         | c .v | .c v              | .c v | .c v      | .c v |

Examples of Classical CL are cases like Latin *fide:lia* ‘pot’ and *ca:nus* ‘old’, deriving from older *\*fideslia* and *\*kasnus*. An example of Classical CL illustrating lengthening of the adjacent *consonant* is the underlying Pali form */kar+ta/* ‘make’ realized as *katta*. Examples illustrating Double Flop (1b), where the loss of the consonant triggers vowel lengthening, are Doric *kha:nos* ‘goose’ (gen. sg.) and *este:la* ‘I sent’ developed from earlier *\*khansos* and *\*estelsa*. An example of Double Flop, where the loss of the consonant is compensated for by *consonantal* lengthening is the Pali form */lag+na/*, realized as *lagga* (the Greek examples are taken from De Chene and Anderson (1979); cf. Wetzels (1986) for an analysis of CL in Greek dialects in terms of Double Flop; the Pali examples are from Zec (1995)).

<sup>1</sup> The schematic examples in (1) are just two instances of CL. For a full typology I refer to Hayes’ article.

The two patterns in (1) illustrate the essence of Hayes' theory. In these configurations, segment deletion affects only the segmental layer not the mora level. Thus, after the deletion of the consonant, its mora is left behind. It is subsequently filled by spreading, creating a long vowel or a long consonant. In sum, after deletion the number of moras is the same as before deletion. That is why CL is a consequence of mora preservation, according to Hayes. Let us now look at this hypothesis from the point of view of OT.

### **1.2. Is CL really mora preservation? OT's suspicion**

The claim that CL is the consequence of mora preservation obviously implies that moras must be present *before* the relevant segment is removed. Hayes' theory of CL is embedded in a *derivational* conception of phonology, so it is quite easy to guarantee that moras are inserted before the segmental tier is affected. The theory just declares that syllabification is an 'anywhere' rule, which applies whenever it gets a chance. This means that mora construction applies to a string right after it leaves the lexicon. Consequently, moras will always be present *before* any phonological rule has a chance to apply.

In OT there are no rules (or constraints) that apply before or after some other rule or constraint, because in OT there are no derivations. As a result of the non-derivational nature of OT it is difficult to *ensure* that moras are present before segments are deleted. Consider the Pali form /*nud+na*/ 'remove' (past. part.), realized as *nunna*. The infinitive is /*nud+ati*/ realized as *nudati*. Clearly, the final consonant of the root /*nud*/ cannot be moraic underlyingly, because then it would appear as a geminate in the infinitive, giving *\*nuddati*. But if the consonant is underlyingly non-moraic, then it becomes hard to understand what the source is of the length in the past part. Why is the root consonant not simply deleted? Why does its deletion trigger lengthening of the following consonant? What we need is an *intermediate* level where moras are inserted but coda consonants are unaffected. But given its nature such a level cannot exist in OT.

From the point of view of OT, then, there is some reason to be skeptical about Hayes' hypothesis that CL is the result of mora preservation, simply because in OT this generalization cannot easily be expressed. At first this might seem something to worry about, so presumably one's first inclination would be to restructure OT, for instance by allowing intermediate levels in some form. On closer view, however, it turns out not to be a bad result, because there are cases of CL where the mora does not play a role at all. This will be shown in the next subsection.

### **1.3. CL is not mora preservation**

In his detailed analysis of Slovak, Rubach (1993) shows that the loss of a so called 'yer' triggers lengthening of a preceding vowel. Consider the following examples (a yer is indicated by a capital letter):

(2)	<i>basic form, nom. sg.</i>	<i>dim. nom. sg.</i>	<i>dim. gen.</i>
	hlas ‘voice’	hlas+Ok+O [hla:sok]	hlas+Ok+a [hla:ska] sg.
	sud ‘cup’	sud+Ok+O [su:dok]	sud+Ok+a [su:dka] sg.
	hlav+a ‘head’	hlav+Ok+a [hla:vka]	hlav+Ok+O [hla:vok] pl.

In the dim. nom. sg. of the masc. paradigm (the first two examples in (2)) and the gen. plur. of the fem. paradigm there are two yers in the underlying form. The first one is removed and replaced by a lengthened vowel in the preceding syllable. The second yer is realized in pre-consonantal position. In the dim. of the gen. masc. sg. and the nom. sg. of the fem. paradigm just one yer is present in the underlying representation. This yer is removed and replaced by a lengthened vowel in the preceding syllable. In this article we are not concerned with the rules regulating the distribution of yers, of course. What is important to us here is the fact that if a yer is deleted its loss is compensated for by lengthening of the preceding vowel. This indeed strongly suggests that this form of lengthening is a case of CL.

Now the point is that according to the dominant view a yer is a mora-less vowel in the underlying representation. This position has been taken by many authors (in particular Rubach (1993) on Slovak). If this is true, then it is clear that Hayes’ hypothesis can no longer be maintained. To see this more clearly compare the underlying form of *little head* with its surface realization.

(3)	<i>underlying form</i>	<i>surface representation</i>
	m m	m m m
	hl a v o k a	hl a v k a

The underlying form has just two moras, whereas the surface representation has three. This shows that in Slovak, CL is not a consequence of mora preservation.

From the point of view of OT this is not really a surprise, because Hayes’ hypothesis cannot easily be expressed in OT, as shown before. Having shown that Hayes’ theory is questionable both on theory internal grounds (OT) and on descriptive grounds (Slovak), I will try to suggest an alternative approach to CL.

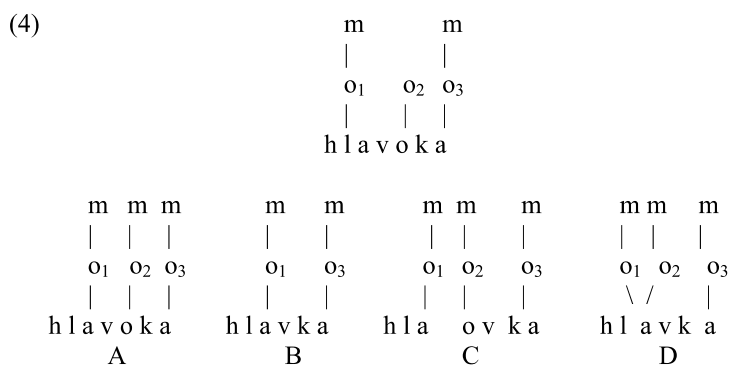
## 2. An alternative approach to CL

In this section, I first propose that CL is an instance of segmental faithfulness. Then I will make an attempt to capture Hayes’ second major insight; the loss from onset position cannot directly lead to CL (cf. (1)).

### 2.1. CL as segmental faithfulness

Consider again the underlying representation of *little head* but now in a slightly more formal version, including not only moras but also vocalic root nodes. This underlying form is located in the upper row of (4). The lower row contains several

surface candidates corresponding to this underlying form. The one at the right end (D) is the optimal candidate.



Of course there is not sufficient room to give a detailed analysis of the Slovak type of CL. But the representations already suffice to make the following point. It is possible to account for CL with the apparatus of segmental faithfulness. To make this explicit I have indicated satisfaction of MAX-seg<sup>2</sup> with subscripts. Candidate B is rejected because its second segment, the yer, does not satisfy MAX-Seg. Furthermore, it is clear that an underlying yer cannot be realized in the head position of a syllable, due to the constraint HEAD-DEP-m.<sup>3</sup> That is why the first candidate is non-optimal. This leaves us with the remaining two candidates. In candidate C, the underlying yer is realized in the non-head position, so that is good. However, by doing so a diphthong is realized. On the assumption that a violation of NODIPH<sup>4</sup> is also bad in Slovak the third candidate is also rejected. This leaves us with the optimal candidate. In this form all the important constraints of Slovak are satisfied, in particular MAX-seg.

Notice that in the optimal candidate IDENT(F) is violated.<sup>5</sup> Here we arrive at the essential point. It is possible to analyze CL with the apparatus of segmental faithfulness. What we need is non-violation of MAX-seg, and large scale violation of IDENT(F), due to some higher constraint conflicting with it (in Slovak, NO-

<sup>2</sup> This constraint requires that an underlying segment (root node) correspond to a surface segment.

<sup>3</sup> This constraint penalizes the insertion of a mora in the head position of a syllable.

<sup>4</sup> This constraint penalizes a diphthong. It does not necessarily imply that Slovak does not allow diphthongs; it depends on the position of NODIPH in the hierarchy. In fact, lengthened *e* and *o* are realized as *ie* and *uo*. The point is that *certain* diphthongs (like *ao*) cannot be produced by lengthening. Naturally, a full account has to take all these aspects of lengthening into consideration. Within the limited space of this article, however, this is impossible.

<sup>5</sup> This constraint penalizes qualitative differences between two corresponding segments.

DIPH).<sup>6</sup> In sum, in OT there is an easy way to account for CL by means of the following ranked constraints:

- (5) *CL as segmental faithfulness*  
 MAX-seg, C » IDENT(F)

In order to get CL, MAX-seg must be ranked above IDENT(F). In addition, there must be some other constraint conflicting with IDENT(F) and dominating it.

So far, I have shown that OT has reasons to be skeptical about Hayes' claim that CL is a consequence of mora preservation. Interestingly, it turns out that instances of CL contradicting Hayes' claim do exist. Finally, I have shown that, in principle, it is perfectly possible to account for CL in terms of segmental faithfulness. The constraint hierarchy in (5) clearly demonstrates that you can get CL effects without moras.

This might all be very well, but one problem remains. We still have to answer the question of whether Hayes' second generalization can be captured in a theory of CL that relies on segmental faithfulness. This will be the subject of the next subsection.

## 2.2. Restructuring the root node

Hayes' second important claim is that the loss of a segment from an onset cannot be compensated for.<sup>7</sup> Here are the two crucial cases in a schematic form:

- (6)
- |                              |              |
|------------------------------|--------------|
| a. <i>initial onset</i>      |              |
| syllabification              | segment loss |
| m                            | m            |
| c c v                        | c v          |
| b. <i>intervocalic onset</i> |              |
| m m                          | m m          |
| c v .cv                      | c v .v       |

(6a) shows in a schematic form that onset simplification cannot lead to a long vowel, because after the loss of the segment occupying the onset, no trace is left behind. Similarly, intervocalic weakening with ultimate deletion of the entire segment, the case depicted in (6b), never leads to lengthening of the adjacent vowel. These generalizations are robust, and they are explained in Hayes' theory

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<sup>6</sup> I should note that it is necessary to assume that length is represented with two root nodes, as proposed in Selkirk (1991).

<sup>7</sup> Recall from (1b) that Double Flop is not a counterexample. Although there is an onset segment being lost and although there is also another segment being lengthened, it really is the shift of the original coda segment to the onset that causes lengthening.

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in a straightforward way. In the relevant positions, segments do not have a mora. If they are deleted from such a position, they disappear once and for all.

It is immediately clear that an account of CL in terms of segmental faithfulness cannot express this generalization. This is shown in (7), where the subscripts represent the relation holding between underlying segments and their correspondents in the output (as far as it is relevant to the discussion here).

- (7) a. *initial onset*
- |                                 |                                 |  |
|---------------------------------|---------------------------------|--|
| underlying                      | segment loss accompanied by     |  |
| form                            | vowel lengthening               |  |
| m                               | m m                             |  |
| c c <sub>1</sub> v <sub>2</sub> | c v <sub>1</sub> v <sub>2</sub> |  |
- b. *intervocalic onset*
- |   |  |    |  |  |
|---|--|----|--|--|
| underlying                                      | segment loss accompanied by                      |    |  |  |
| form  | vowel lengthening                                |    |  |  |
|   | to the left                                      |    | to the right                                   |  |
| m m   | m m m  | m  | m m  |  |
| c v <sub>1</sub> .c <sub>2</sub> v <sub>3</sub> | c v <sub>1</sub> v <sub>2</sub> . v <sub>3</sub> | or | cv <sub>1</sub> .v <sub>2</sub> v <sub>3</sub> |  |

These configurations show that the ranking of (5) can easily lead to a situation in which the loss of a segment from an onset position leads to lengthening of an adjacent vowel. This surely is a very undesirable result indeed.

While this conclusion is correct in itself, I would like to suggest that this does not necessarily mean that we have to take refuge in the mora again. In fact, there are indications that this would be a false move. In a very important paper, Rialland (1993) argues quite convincingly that the mora theory of CL, or any other theory for that matter, does not explain the following characteristic of CL phenomena:

seuls les segments les plus sonorants .... peuvent donner lieu à un allongement compensatoire et seule leur chute peut laisser une unité chronématique de sonorance suffisante pour être remplie par une voyelle (91-2).<sup>8</sup>

The importance of this remark can hardly be underestimated, for it explicitly claims that it is not really moras that matter but rather identity at the level of sonority. If we restate it in OT terminology, we could say that somehow the input segment (that is going to be deleted) should be very close in terms of sonority to the output segment (by which it is going to be replaced). When we look at Rialland's remark from this angle it is clearly reminiscent of segmental faithfulness,

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<sup>8</sup> "only the most sonorant segments...can give room to compensatory lengthening and only their fall can leave behind a timing unit that is sufficiently sonorant to be filled by a vowel" (my translation).

which is precisely the track we are pursuing here. How then can we implement Rialland's insight at a more formal level, i.e. in terms of faithfulness constraints?

First of all, following the lead of Anderson and Ewen (1987), I propose that the major classes are distinguished by *c*- and *v*-elements, *c* indicating a relatively high degree of periodic energy and *v* a relatively low degree of periodic energy. Both elements constitute the root node, but if they are combined in a single segment one is dependent on the other. In the spirit of this proposal one might expect the following major classes:

- (8) *the major classes characterized by c and v elements*
- |           |                    |   |       |
|-----------|--------------------|---|-------|
| obstruent | sonorant consonant | ? | vowel |
| c         | c                  | v | v     |
|           |                    |   |       |
|           | v                  | c |       |

It is clear that an obstruent is just a *c* at the root node. It is also clear that a vowel is just a *v*. It is also reasonable to assume that a sonorant consonant is a *c*-element with a dependent *v*. But what is the third logically possible element? I propose that this feature combination is the representation of the second half of a long vowel. This representation is not unreasonable, since, as is well known, the second half of a long vowel tends to be reduced in many languages. If the categories of (8) are acceptable then we can take the next step. Look at the natural classes that can be defined by the features in (8):

- (9) *natural classes among the major categories*
- |           |                    |    |            |
|-----------|--------------------|----|------------|
| obstruent | sonorant consonant | V2 | peak vowel |
| c         | c                  | v  | v          |
|           |                    |    |            |
|           | v                  | c  |            |

Sonorant consonants can pattern with obstruents, because both categories have a *c*-head. They can also pattern with the second half of a long vowel, because these two classes are identical at the level of the entire root node; the only difference between these two classes is the dependency relation between the two root node features. Finally, the third (and from our perspective least interesting) natural class consists of the two types of vowels.

The next move consists of a reformulation of MAX-seg.

- (10) **MAX-seg**  
 A root node feature in the input should correspond to an identical feature in the output.

This formulation is based on the idea that correspondence plays a role at the feature level not the segmental level. According to the formulation in (10), it is the case that for every *c* in the input there must be a *c* in the output, and likewise, for every *v* in the input there must be a *v* in the output. Notice, however, that nothing is said about the *dependency relation* between elements. Consequently, as far as MAX-seg is concerned, the dependency relation in the domain of a root node can freely be changed. It just requires that a root node's substantial content remain the same. Let us now see what the consequences are of this new formulation of MAX-seg.

Surely, the most important consequence is that a segment of the input can only correspond to a segment of the output if both segments are very close in terms of sonority. This is a desirable consequence, because this is the most characteristic property of CL, according to Rialland (1993). Given the theory of the root node proposed in (8), this means that an underlying sonorant consonant can only correspond to a vowel if that vowel is the *second half of a long vowel*. It can never correspond to a vowel in peak position, because a sonorant consonant and a peak vowel are not members of the same major category. It is this property of MAX-seg that gives us the opportunity to maintain Hayes' second hypothesis.

To see this more clearly let us go back to (7), repeated immediately below, where all possible cases of CL triggered by onset loss are represented in a schematic form.

- (11) a. *initial onset*
- |                                 |                                 |  |
|---------------------------------|---------------------------------|--|
| underlying                      | segment loss accompanied by     |  |
| form                            | vowel lengthening               |  |
| m                               | m m                             |  |
| c c <sub>1</sub> v <sub>2</sub> | c v <sub>1</sub> v <sub>2</sub> |  |
- b. *intervocalic onset*
- |   |  |    |   |
|---|--|----|---|
| underlying                                      | segment loss accompanied by                      |    |   |
| form  | vowel lengthening                                |    |   |
|   | to the left                                      |    | to the right                                    |
| m m   | m m m  |    | m m m   |
| c v <sub>1</sub> .c <sub>2</sub> v <sub>3</sub> | c v <sub>1</sub> v <sub>2</sub> . v <sub>3</sub> | or | c v <sub>1</sub> .v <sub>2</sub> v <sub>3</sub> |

The first case (11a) might be possible in a traditional account of segmental faithfulness, but it is no longer possible in the new version proposed here. In (11a), the onset consonant corresponds to a peak vowel. According to the new proposal developed here this is not possible, because these two segment types are not sufficiently close in terms of sonority, or more formally: a vowel in peak position cannot stand in a correspondence relation to a (sonorant) consonant.

The same can be said about the second case depicted in (11b). The loss of an onset consonant cannot yield a long vowel to its right because MAX-seg cannot establish a relation between a (sonorant) consonant and a peak vowel.

We are thus left with the first case given in (11b). Here a (sonorant) consonant corresponds to the second half of a long vowel. According to the new version of MAX-seg this is a possible relation. Hence a CL process of this type should be possible. Although it might be true that the system of segmental faithfulness developed here might be able to describe a process in which the loss of an intervocalic onset triggers lengthening of a preceding vowel, there are other reasons why a process of that kind is highly unlikely. Normally, the loss of a consonant from an intervocalic position is the consequence of weakening. Obviously then we need a constraint accounting for the fact that intervocalic consonants undergo weakening (and ultimately deletion). Suppose we formulate this constraint as (12), where *c* and *v* are elements in the specific sense of this article.

(12) **INTERVOCALIC WEAKENING**

\**v* *c* *v*

According to this constraint, a segment carrying *c* is not allowed in between vowels. Notice now that it does not make sense to move the *c* to the second position of a long vowel. Such a repair strategy is useless, because in this position the *c* is still intervocalic. Consequently, the loss of intervocalic consonants, normally triggered by INTERVOCALIC WEAKENING, cannot be compensated for by lengthening of the preceding vowel. As a repair strategy it makes no sense.

I have argued that an account of CL in terms of segmental faithfulness can also make the prediction that the loss of a segment from onset position cannot be compensated for by vowel lengthening. It is necessary, however, to refine MAX-seg. It is also necessary to change our view of the root node. As a result we are led to the prediction that the loss of a segment can only lead to vowel lengthening if the input and output segments are sufficiently close in terms of sonority. This, in fact, is the property of CL that any theory should account for, according to Rialland.<sup>9</sup>

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<sup>9</sup> The attentive reader might object that the new formulation of MAX-seg cannot account for those cases where an underlying sonorant corresponds to one half of a geminate obstruent. This type of CL exists, as is shown by the Pali form /*kar+tun*/ ‘to make’ (inf.) realized as *kattun*. The new formulation of MAX-seg cannot account for the correspondence relation between the input sonorant (*c+v*) and the first half of the geminate obstruent in the output (just *c*). One way to include total assimilation in the class of possible CL phenomena is to postulate a head version of MAX-seg. This constraint would essentially say the same thing as the constraint in (10), but it would restrict its application to the HEAD-element of the root node. It would thus read as follows: A HEAD-root node feature in the input should correspond to an identical feature in the output.

### 3. Conclusion

In this paper, I have argued that the classical theory of CL proposed in Hayes (1989) is suspect from the point of view of OT, because it is derivational in nature. What is particularly disturbing is the role played by the mora. Interestingly, it turns out that Slovak has a case of CL in which the mora does not play a role at all. In this language, CL is clearly a case of segmental faithfulness; it has nothing to do with mora preservation. I have also shown that in an account of CL phrased in terms of segmental faithfulness it is still possible to maintain Hayes' second prediction that loss from an onset position cannot directly lead to vowel lengthening. This, however, is only possible if we change the formulation of MAX-seg and the structure of the root node. We are thus led to the following characterization of CL: CL is segmental faithfulness, but the corresponding segments should be sufficiently close in terms of sonority.

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