Triggers and Alternations in Compensatory Lengthening

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1. Introduction

The term compensatory lengthening (henceforth, CL) refers to a set of phonological phenomena wherein the disappearance of one element of a representation is accompanied by a lengthening of another element. In this paper we will be concerned solely with CL of vowels, of which there are two main types. The first, CL through consonant loss (CVC CL), is the lengthening of a vowel which is correlated with the deletion of an adjacent consonant. This process is shown schematically in (1).

(1) $C_1VC_2 \rightarrow CV$:
   closed $\sigma$, short V $\rightarrow$ open $\sigma$, long V:
   one $\sigma$ $\rightarrow$ one $\sigma$

   CL through consonant loss is characterized by the lengthening of the vowel as a consequence of the loss of the consonant, and also by a change in syllable structure. A closed syllable with a short vowel (as a historical input or a synchronic input and/or underlying representation) ends up as an open syllable with a long vowel. Importantly, in the case of CVC CL syllable count is preserved; the deleting consonant is usually tautosyllabic with the lengthening vowel (except in the case of so-called double flop in Ancient Greek).

   An example of CVC CL is shown in (2). In Lithuanian (Baltic), as in many other languages, nasals are deleted if followed by voiceless fricatives, and are retained otherwise. The deletion of nasals is accompanied by the lengthening of the preceding vowel, producing synchronic $CVn \sim CV$: alternations (Mathiassen 1996).

(2) sprən-dʒa ‘decides’ sprəːsti ‘to decide’
   sun-tʃe ‘sends’ suːsti ‘to send’

The second type of CL differs strikingly from the first one. CL through vowel loss is a process whereby the loss of the second vowel in a CVCV sequence is correlated with the lengthening of the first vowel in this sequence. The properties of CVCV CL are shown schematically in (3).

(3) \(C_1V_cC_2V_2 \rightarrow C_1V_cC_2\)
   openclosed
\[\text{two } \sigma \rightarrow \text{one } \sigma\]

CL through vowel loss is characterized not only by changes in syllable structure—from two open syllables with short vowels to a closed syllable with a long vowel—but also by the fact that the syllable count is not preserved as a result of this process. A disyllabic unit of the input becomes a monosyllabic unit in the output once the second vowel is lost. Such CL is illustrated in (4), with an example of the diachronic development from Old Church Slavic (OCS) to Serbo-Croatian (Timberlake 1983).

(4) **OCS** **Serbo-Croatian**
    borU > bor 'forest'
    medU > med 'honey'

(4) shows that a short high lax vowel \([u]\) was lost at some point in the history of Slavic, which is correlated with the lengthening of the preceding vowel in modern Serbo-Croatian.

While CL through consonant loss is a widely attested process (a survey conducted for the purposes of this study located 58 languages belonging to 20 language families exhibiting this type of CL), CL through vowel loss is typologically less common, though it is by no means rare or exotic. However, while CVCV CL is quite common historically, synchronic alternations of the type CVCV \(\rightarrow CV:C\) are not frequently found. Instead of mirroring its historical development, CL through vowel loss usually results in synchronic vowel length alternations which are either lexicalized or morphologized.

In the recent years, much linguistic discussion was devoted to CL of vowels, but an important difference between the two types of CL has not been explicitly recognized. In this paper I will show that CVC and CVCV CL behave differently in synchronic grammars. While alternations which arise via CL through consonant loss usually remain phonologically transparent, phonetically natural and completely productive, alternations resulting from CL through vowel loss rarely stay transparent, often must be

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1. Only two languages surveyed, Lama (Gur) and Baasaar (Voltaic), can be argued to have synchronic CVCV \(\rightarrow CV:C\) alternations.
handled with suppletive allomorphy, and are governed by morphologically conditioned or phonetically unnatural rules. I argue that such split behavior follows from the differences in the optimizing nature of the alternations in question.

2. Recoverability

2.1. CVC CL: trigger is recoverable

One important difference between CVC and CVCV CL that contributes to the asymmetry we have seen is that in CL through consonant loss, lost segments are likely to be recoverable, while in CL through vowel loss, this is typically not the case. The historical trigger of a process is recoverable if it regularly participates in synchronic alternations. I suggest that the recoverability of the trigger of CL is a prerequisite for the purely phonological conditioning of the alternations (whether the alternation itself is transparent or opaque), since it is crucial for the transparency and productivity of the associated process of vowel lengthening.

Consider, for instance, CL through the loss of coda /l/ in the Ižma dialect of Komi (Uralic), a language in which CVC CL is a purely phonological (i.e. non-morphologized) process. In Komi Ižma, stem-final /l/ deletes before any consonant-initial suffix and word-finally (Batalova 1982). Its loss is accompanied by the lengthening of the preceding vowel, a typical case of CVC CL. Representative suffixes are illustrated in (5). (5a-b) shows verbal suffixes (the 1st singular past suffix /-i/ and the infinitive suffix /-ni/), and (5c-d) presents nominal suffixes (the elative /-ys/ and the nominative /Ø/).

(5)  

<table>
<thead>
<tr>
<th>stem</th>
<th>1 sg. past</th>
<th>infinitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. lij-</td>
<td>lij-i</td>
<td>lij-ni</td>
</tr>
<tr>
<td>munal-</td>
<td>mun-i</td>
<td>mun-ni</td>
</tr>
<tr>
<td>b. kil-</td>
<td>kil-i</td>
<td>kil-ni</td>
</tr>
<tr>
<td>sulal-</td>
<td>sulal-i</td>
<td>sulon-ni</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>stem</th>
<th>elative sg.</th>
<th>nom.sg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. gort-</td>
<td>gort-ys</td>
<td>gort</td>
</tr>
<tr>
<td>d. vọl-</td>
<td>vọl-ys</td>
<td>vọ;</td>
</tr>
<tr>
<td>nyl-</td>
<td>nyl-ys</td>
<td>nọ;</td>
</tr>
</tbody>
</table>

Note that in non-derived environments, that is, stem-internally, there are no alternations, and thus there is no length contrast before the lost consonant in Komi Ižma (6). The vowel which preceded the historically lost segment is always long.
CL alternations in Komi are phonologically transparent and phonetically natural; they apply in all relevant phonological contexts and are completely productive. There is no need to refer to the specific identity of the suffixes conditioning l-deletion and vowel lengthening. In Komi, as in many other languages with CVC CL, the synchronic alternations mirror the diachronic sound change closely, and thus the alternations are transparent as well as phonetically natural. The trigger of CL has not been lost to history.

We conclude that CVC ~ CV: alternations remain phonologically productive if the trigger of CL is recoverable synchronically. Whenever morphology creates the phonological environment required for a given alternation, the alternations are exceptionless. We will argue later that this persistent property of synchronous CVC CL is connected with its optimizing nature.

2.2. CVCV CL: trigger is not recoverable

Unlike the examples of CL through consonant loss, the trigger of lengthening in CL through vowel loss processes—i.e. CVCV CL—is often unrecoverable. Thus, processes which result diachronically from a *CVCV > CV:C change appear synchronically as either alternations of the type CV,CV, ~ CV:C, where V₂ differs from the diachronic trigger of the alternation in question, or simply as vowel length alternations of the CVC ~ CV:C type. As a result, it is difficult to relate the two forms involved in such alternations by a phonetically motivated rule.

The following examples from Slovak (West Slavic) illustrate these points. (7) shows that vowel length in the genitive plural form of ‘wife’ is the result of the diachronic loss of the high back vowel in the Late Common Slavic (Timberlake 1983).

(7) LCS Slovak
   *3enU > 3en ‘wife’ gen.pl.

In contemporary Slovak, however, the lost [U] never surfaces, and a different vowel (in this case, the nominative singular -a) participates in the alternation (8).

(8) 3en-a  ‘wife’ nom.sg.
     3en  ‘wife’ gen.pl.
In Slovak and other similar cases, the historical development of CVCV CL results in suppletive root allomorphs which may (though need not) have a phonological distribution. The unrecoverability of the trigger in CVCV CL is responsible for the fact that alternations of this type so commonly become lexicalized or morphologized. As I will argue below, even when the allomorphs have a fully or partially predictable phonological distribution, this distribution is not phonologically natural or optimizing. I propose thus that the recoverability of the historical trigger of the CL change is crucially connected with optimizing or non-optimizing nature of the change in question.

3. Optimization

Many recent theories rely on the idea of optimization to account for various phonological phenomena. Optimality theory (OT) (Prince & Smolensky 1993) is the first explicit theoretical framework to develop the concept of optimization as a constraint-based model. However, the idea of optimization is far from recent in phonological literature. It is closely related to the idea of markedness in respect to neutralization patterns, as developed, for example, in Trubetzkoy (1939) and in later work.

In this section we consider the differences between CL through consonant and vowel loss from the point of view of optimization. When we compare CVC and CVCV CL, it becomes apparent that while the first type of alternations results in the optimization of syllable structure and can be modeled in Optimality Theory (OT), the other one is problematic for a phonological optimization account.

We have seen before that while CL through consonant loss is quite common, CL through vowel loss is relatively rare. Only in a few languages the loss of vowels results in CL. Interestingly, the rarity of the CVCV CL in comparison to CVC CL is paradoxical from the point of view of moraic theory. In order for CVC CL to occur, a language is required to have closed syllables and moraic codas. This constrains the systems where CVC CL is predicted to occur in two ways. Firstly, while open syllables are present in all languages, not all languages have closed syllables. Secondly, even if a language has codas, coda consonants are not always moraic, and their moraicity is language-specific. So, the loss of a coda consonant is predicted to trigger CL only in the languages where closed syllables are heavy, that is, where coda consonants are moraic (9a). If closed syllables are treated as light (9b), CL is predicted not to occur.
There is no such restriction imposed on CL through vowel loss. Vowels are generally thought of as moraic in all languages, as schematized in (10), so moraic theory predicts that the loss of a vowel should always result in CL.

Contrary to this prediction, CL through consonant loss happens much more often than CL through vowel loss. Even though vowel deletion word-medially (syncope) and word-finally (apocope) is rampantly common, it results in vowel lengthening only in a miniscule percentage of languages which have this sound change.²

I would like to argue that the reason for the unrecoverability of the trigger in CVCV CL and thus typological rarity of CVCV ~ CV:C alternations lies in language-specific biases against certain syllable structures. In particular, CVCV ~ CV:C alternations always result in a non-optimal syllable structure. It is generally accepted on the basis of typological data that the universally preferred scale of syllable types is as in (11).  

It is not clear if CVC is less preferred than CV: cross-linguistically. Language-specific constraints on long vowels and possible codas are usually responsible for resolving this issue one way or the other. There are cases, however, where syllables with long vowels are allowed unconditionally, while closed syllables are restricted (e.g. in Japanese, the only possible codas are nasals and first parts of geminates, while no restrictions apply to long vowels in open syllables) (see Sherer 1994, 1999 for an OT analysis of rhythmic syncope in Macushi (Carib) and Southeastern Tepehuan (Uto-Aztecan).

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² For syncope and apocope without lengthening, see, for example, Hock (1991) on Germanic, Baltic, and Greek; Dixon (1977) on Yidji. See also Kager (1997, 1999) for an OT analysis of rhythmic syncope in Macushi (Carib) and Southeastern Tepehuan (Uto-Aztecan).
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Gordon 1999 for examples and discussion). This supports the view that CL through consonant loss can be modeled as optimization of syllable structure.

It is uncontroversial that closed syllables with long vowels are cross-linguistically dispreferred. Gordon’s (1999) survey of weight and weight-related phenomena in 396 languages shows that from these languages 35 have no codas, 110 have no long vowels (from these, 9 have neither codas nor long vowels), and 170 disallow CV:C syllables, as summarized in (12).

(12) Gordon’s (1999) survey

<table>
<thead>
<tr>
<th>Languages</th>
<th>396</th>
</tr>
</thead>
<tbody>
<tr>
<td>*CVC</td>
<td>35</td>
</tr>
<tr>
<td>*CV:</td>
<td>110</td>
</tr>
<tr>
<td>*CV:C</td>
<td>170</td>
</tr>
</tbody>
</table>

The 170 languages from the survey with the absence of the CV:C syllable template include languages with no coda consonants and no long vowels. However, there are still 25 languages in which both long vowels and coda consonants are allowed, but CV:C syllables are still dispreferred.

Thus, synchronic CVCV ~ CV:C alternations result in a non-optimal syllable structure. From a sequence of two open syllables with short vowels which are the most common typologically, a (super)-heavy closed syllable with a long vowel is produced.

On the assumption that optimizing changes are more common (Kiparsky 1996 et passim, Vennemann 1988), two typological predictions follow from the fact that CL through vowel loss is not optimal. Firstly, this type of CL should be more rare than the CVC -> CV: type, and secondly, CVCV ~ CV:C alternations should be even more rare in languages with moraic codas, since superheavy syllables are even less preferred cross-linguistically than CV:C syllables with non-moraic codas.

We have already seen that the first prediction holds true, and, although my corpus is small, the second prediction is also borne out. (13) shows a list of languages that have CVCV CL as a sound change. Among these languages, there are only two, Estonian and Sámi, which undoubtedly have trimoraic syllables. Note that these two languages happen to have ternary length distinctions as well.
(13) Morality of codas in languages with historical CVCV CL

<table>
<thead>
<tr>
<th>FAMILY/LANGUAGE</th>
<th>TRIMORAIC SYLLABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finno-Ugric</td>
<td></td>
</tr>
<tr>
<td>Estonian</td>
<td>yes</td>
</tr>
<tr>
<td>Sámi</td>
<td>yes</td>
</tr>
<tr>
<td>Hungarian</td>
<td>no evidence</td>
</tr>
<tr>
<td>Indo-European</td>
<td></td>
</tr>
<tr>
<td>Germanic</td>
<td>evidence from CVC CL</td>
</tr>
<tr>
<td>Rhenish “Schärbungsgebiet”, Dithmarschen, Jutland Danish</td>
<td></td>
</tr>
<tr>
<td>Old French</td>
<td>no evidence</td>
</tr>
<tr>
<td>Slavic</td>
<td>no evidence</td>
</tr>
<tr>
<td>Czech, Slovak, Upper Sorbian, (Old) Polish, Kashubian, Slovenian, Serbo-Croatian, Ukrainian, Belorussian</td>
<td></td>
</tr>
<tr>
<td>Romance</td>
<td>no evidence</td>
</tr>
<tr>
<td>Friulian, Milanese</td>
<td>no evidence</td>
</tr>
<tr>
<td>Korean</td>
<td>no evidence</td>
</tr>
<tr>
<td>Nilotic</td>
<td>Dinka no evidence</td>
</tr>
<tr>
<td>Gur</td>
<td>Lama no evidence</td>
</tr>
<tr>
<td>Voltaic</td>
<td>Baasaar no evidence</td>
</tr>
<tr>
<td>Bantu</td>
<td>Runyoro-Rutooro no evidence</td>
</tr>
</tbody>
</table>

Since there are not many cases of CVCV CL known to us, this survey is far from conclusive, but it shows that languages which treat CV:C syllables as trimoraic and have historical CL through vowel loss are indeed rare, and the treatment of the coda of a closed syllable with a long vowel as non-moraic is cross-linguistically preferred.

3.1. CL as moraic conservation

3.1.1. CVC CL as moraic conservation within a syllable

In this section, we will exemplify how CVC CL can be modeled as optimization of syllable structure. In (14), there are definitions of the two general families of constraints on deletion and insertion, proposed by McCarthy & Prince (1994). These constraints are crucial for the characterization of any optimizing process.

(14) MAX     Every element of the input has a correspondent in the output.
    DEP     Every element of the output has a correspondent in the input.
In the case of CL, the relevant constraint of the \text{MAX} family has to demand Input/Output correspondence at the moraic level (see Blevins 1997, Kager 1999 and references therein). The \text{MAX}-\mu constraint is stated in (15).\footnote{DEP-\mu would be the “anti-lengthening” constraint, prohibiting the insertion of moras.}

\begin{equation}
\text{(15) \text{MAX}-\mu} \\
\text{Every mora in the input has a correspondent in the output.}
\end{equation}

Additionally, the \text{Weight-by-Position} principle (Hayes 1989) needs to be formulated as a constraint (Sherer 1994). Since languages differ on what consonants are moraic in codas, the \text{WEIGHT-BY-POSITION} constraint requires language-specific modifications.

\begin{equation}
\text{(16) \text{WEIGHT-BY-POSITION}} \\
\text{Coda consonants are moraic.}
\end{equation}

In modeling CL, language-specific constraints on possible codas are required as well, to express prohibition of certain segments in codas. For example, to express the fact that coda \text{l} is not allowed in Komi, a general constraint in (17) can be modified as (18).

\begin{equation}
\text{(17) \text{NOCODA}} \\
\text{*C} \mkern1mu \lambda \text{ Syllables are open.}
\end{equation}

\begin{equation}
\text{(18) \text{NOCODA-L}} \\
\text{*l} \mkern1mu \lambda \text{ l is not allowed in codas.}
\end{equation}

A more specific incarnation of \text{MAX-\mu} is required to express the idea of the preservation of weight within a syllable. \text{MAX-\mu(\sigma)} is formulated in (19).

\begin{equation}
\text{(19) \text{MAX-\mu(\sigma)}} \\
\text{Every mora in the input (or an intermediate representation) has a correspondent within the same syllable in the output.}
\end{equation}

A tableau illustrating CL through \text{l}-deletion in Komi is in (20). For the reasons of space and since the choice of the version of OT responsible for syllabification is orthogonal to the analysis just presented, the input is shown to be fully syllabified.\footnote{See Kavitskaya (to appear) for the discussion of the opacity of CL.}
(20) Komi CVC CL

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>MAX-μ(σ)</th>
<th>NO-CODA-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>σ</td>
<td>σ</td>
<td>μ</td>
<td>μ</td>
</tr>
<tr>
<td>b.</td>
<td>σ</td>
<td>σ</td>
<td>μ</td>
<td>μ</td>
</tr>
<tr>
<td>c.</td>
<td>σ</td>
<td>σ</td>
<td>μ</td>
<td>μ</td>
</tr>
</tbody>
</table>

Note that the candidate (20a) can only be the winner if the constraint against long vowels (*V:) is ranked low in the language in question, that is, if that language has phonologically long vowels synchronically. This leads to an interesting, though perhaps circular, interpretation of the claim made by de Chene & Anderson (1979) that CL is always structure-preserving. The only expectation from a system from the point of view of optimization is that CL has to be structure-preserving only in order to have synchronic alternations.

3.2. CVCV CL as moraic conservation within a foot

It is not surprising that CVCV ~ CV:C alternations cannot be accounted for as an optimization of syllable structure: a disyllabic sequence is crucially involved in the alternation. Since we account for CVC CL by invoking moraic preservation within the syllable (MAX-μ(σ)), a possible optimization strategy for the second kind of CL could be sought in the reference to a higher prosodic constituent—a foot (for foot-optimization see Prince 1990, Prince & Smolensky 1993, Hayes 1995, Kager 1997, 1999 among others). This is a reasonable assumption since CL through vowel loss is necessarily confined to a disyllabic unit highly reminiscent of a foot. The advantage of such a stipulation is that it yields a unified account of synchronic CL as mora maintenance within a prosodic constituent, as in (21).
Indeed, when the trigger of CL is recoverable, as is arguably the case in Lama (Gur), the foot conservation analysis seem to account for the alternations in question. In Lama (Ourso 1989), word-final schwa deletes after sonorants with the lengthening of the preceding vowel (22).

(22) /ha-rə/   haːr  ‘benefactor’ 
    /cema-rə/   cemaːr  ‘pottery’ 
    /acamkpo-rə/  acamkpoːr  ‘bachelor’

CL in Lama is phonologically conditioned, exceptionless and transparent. Assuming that feet in Lama are built right-to-left, a (MAX-µ(foot)) constraint will pick the correct output, given higher ranking of constraints on word-final schwa after sonorants.5

However, there exists data which does not yield to a foot-based analysis. Consider examples of vowel length alternations in Czech (23):

(23) nom.sg.  diminutive

jezer-o  jezir-k-o  ‘lake’
semen-o  semin-k-o  ‘seed’
ramen-o  ramiːn-k-o  ‘shoulder’
jablon[1]  jablon'[k-a  ‘apple tree’

The examples from Czech present a problem for a foot-based account of CL. Once a moraic or segmental conservation is posited to be active within a foot, the foot structure in Czech is predicted to be as in (24a). However, since Czech has initial stress and is analyzed as a syllabic trochee language (Hayes 1995), a reasonable foot structure (if we assume binary feet as most researchers do) for it is shown in (24b).

(24) a. je[zir-k0]foot
   b. [jezir]foot-k0

This mismatch alone presents an insurmountable problem for extending the moraic conservation within the foot hypothesis to Czech.

5. Very little data are available on vowel length alternations, footing and stress in Lama.
4. CVCV CL: lexically marked alternations

As was noted above, most cases of synchronic vowel length alternations resulting from historical CVCV CL do not yield to an optimization account. Consider, for instance, alternations in Hungarian (Finno-Ugric). Vowel length alternations in Hungarian are not phonologically transparent. They do not apply across the board; rather, they affect only a subclass of stems which cannot be identified by any independent phonological criteria.

In Hungarian, there are three types of noun stems with respect to vowel length (Kálmán 1972). These are illustrated, with nominal stems, in (25). In the first type, vowel length is non-alternating, and the vowels are always short (25a). In the second type, vowel length is also non-alternating, but the vowels are always long (25b). In the third class of nouns, however, we find phonologically conditioned CVC ~ CV:C alternations. When a vowel-initial suffix is added to one of these alternating stems, the stem surfaces with a short vowel, as shown by the plural forms in (25c). If, however, a consonant-initial suffix is added to such a stem, or if the stem constitutes a prosodic word on its own, the last vowel of the stem is long. This is illustrated by the singular forms in (25c). The generalization is that in alternating stems, vowels are long in closed syllables and short in open syllables.

(25)          plural               singular
a. ember-ek  ember            'man'
   öröm-ok  öröm             'friend'
   huzs-ok  huzs            'meat'
   haz-ak  haz              'house'
b. tyz-ek  tyz               'fire'
   madar-ak  madar          'bird'
   tehen-ek  tehen           'cow'

Historically, non-alternating stems are often the result of analogical extension of length in a paradigm. This is claimed to be the case for the stems in (25a-b). Synchronically, however, the only possible way to distinguish the alternating from the non-alternating stems is to mark the latter as such in the lexicon. CVCV CL alternations in Hungarian are opaque (in the sense of Kiparsky 1973); rather than being purely phonologically conditioned, like the CVC CL alternations in Komi, the Hungarian alternations require extra-phonological conditioning.

It has been proposed that for non-alternating structure, the choice of the input forms is determined by lexicon optimization (Prince & Smolensky
Thus, non-alternating short vowels are represented as monomoraic (26a), and non-alternating long vowels are bimoraic in the input (26b). Given that alternating vowels need to be distinguished from both types of non-alternating vowels listed in (25), they require a different representation. Alternating vowels occur within an unpredictable subset of stems which do not possess any phonological properties distinguishing them from the non-alternating ones, so stems with alternating vowels have to be marked in the lexicon. I propose that alternating vowels in Hungarian are represented as in (26c).

(26) a. µ µ b. µ µ c. µ µ
     |    |    \\
    e m b e r    h a z    t u z

The representation in (26c) captures two important generalizations about alternating stems: firstly, the vowel of the stem can be either long or short, and secondly, the length of the vowel is crucially connected with the syllabic status of the following consonant. Whenever that consonant is in the coda, the vowel surfaces as long, and when it is in the onset of the following syllable, the vowel surfaces as short.

5. Conclusions

In summary, I have argued that alternations resulting from CL through consonant and vowel loss require different synchronic treatments. Synchronic alternations whose historical trigger is recoverable remain phonologically natural and exceptionless and can be modeled as optimization of syllable structure. Whenever the loss of diachronic conditioning environment results in opaque alternations which are not phonetically natural and thus not optimizing, morphological or lexical approach is warranted.

References


6. I am not proposing that moras reflect the phonetic durations of segments directly. In the case of (28), I am using the mora as a formal device for distinguishing different types of structure.


