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Stem, word and phrase as morpho-syntactic strata in Mayo*

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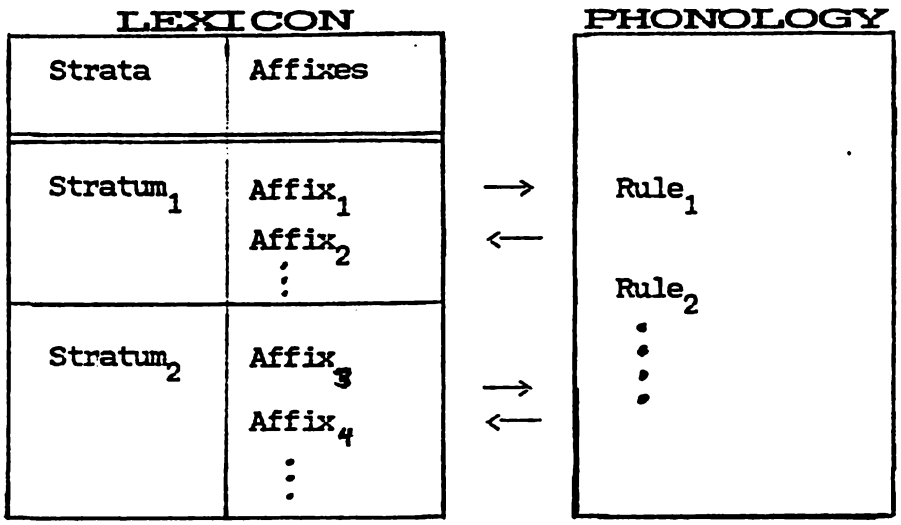
0. Introduction.

What is the relationship between phonology and morphology? Why is affix ordering so restricted? Why is it that rules appear to apply within certain domains and not others? Recent attempts to answer these and related questions have given rise to a body of theories generally referred to as Lexical Phonology. The major proposals of this theoretical framework are found in such works as Pesetsky (1979), Kiparsky (1982, 1983, 1984, 1985) and Mohanan (1982, 1986).

I am assuming a model with the following features, each of which is either argued for or assumed in each of the above works. First, the morphology and phonology of any language L are sufficiently independent of one another that they can be treated as separate components of L's grammar. Second, the affixes of L are ordered with respect to one another. Third, the set of all affixes in L is organized into a sequence of strata. During the process of word formation, the passage from one stratum to the next is via the phonological component of L, so that each phonological rule has the chance to apply cyclically (if its environment is met) in between strata.1 I further assume, following Inkelas (1989) and contrary to most of the above-cited approaches, that phonological rules refer to prosodic constituent structure but *not* to morphological structure. Henceforth, I refer to the theoretical framework defined by these four assumptions as *Lexical Phonology*. Figure (1) is a schematic representation of this theory.

1.



The arguments presented in this paper support the model of Lexical Phonology as represented in (1), but they are also consistent with a model such as that proposed in Halle (1989), in which all morphology and syntax precedes all phonology, and each morpheme is lexically marked as a trigger or non-trigger for cyclic rules. Under either approach (mine or Halle's), the data presented here support two major claims: First, the application of a phonological rule is restricted only by the environment stated in the rule; that is, all phonological rules are available at all levels of morphology and syntax. Second, phonological rules interact with morphology in a cyclic fashion. Specifically, each transition from one morphological stratum to the next sends the derivation into the phonological component of the grammar, where each rule (from the entire set of phonological rules for that particular language) is available to be applied if its environment is met.

Mayo, a Uto-Aztecan language of northern Mexico, exhibits three distinct morpho-syntactic strata in which phonological rules apply. Two of these, which I refer to as stem and word, are lexical and the third stratum is postlexical; hence the generic term *morpho-syntactic*. In this paper I demonstrate that a single phonological rule applies in each of the three

strata. The arguments are presented in the following order: Section 1 shows that Mayo has a rule which inserts a mora in a monomoraic word, and that this rule applies not only at the lexical level but also at the post-lexical level as predicted by the theory of Lexical Phonology that I am assuming. In section 2, the same rule of Mora Insertion is used as a diagnostic for subdividing the lexical level into two strata, which I refer to as the stem and the word. Section 3 provides independent evidence, based on the interaction of cliticization with Mora Insertion, that the latter applies cyclically in all three strata.

1. Lexical versus Post-lexical.

Mayo has a bimoraic word template. This is formalized as Mora Insertion (2), a rule which adds a mora to a monomoraic word.

2. Mora Insertion: $\mu \longrightarrow \mu\ \mu\ /\ [\ \_\_\_\ ]_W$

Mora Insertion is needed to account for the vowel length alternations between the (a) and (b) forms of (3) through (7). In each of these examples, the root is underlyingly monomoraic. It gains the required second mora from the present tense (PRES) suffix in the (a) forms of (3) through (7). In each of the (b) forms, however, Mora Insertion applies because the root has no affixes.[2] I assume, following Hayes (1989), that the second mora then copies the melody of the vowel.[3]

3. a.	wé-ye 'go (SG)' go-PRES	b. wée béchi'ibo go for	'in order to go (SG)'
4. a.	yá-wa 'make' make-PRES	b. yáa béchi'ibo make for	'in order to make'
5. a.	é-ya 'think' think-PRES	b. ée béchi'ibo think for	'in order to think'
6. a.	bá-re 'intend' intend-PRES	b. báa béchi'ibo intend for	'in order to intend'

7. a. ho-yé 'sit (PL)' (sit-PRES) b. hoó béchi'ibo 'in order to sit (PL)' (sit for)

I have assumed that the vowel of each verb stem in (3) through (7) is underlyingly short; the alternative is to assume that these vowels are underlyingly long. If the latter were the case, then some kind of vowel shortening rule would be needed in order to account for the (a) forms in (3) through (7). However, there are many Mayo words which contain a long vowel that never alternates with a short vowel. I know of no monosyllabic words containing an underlyingly long vowel, but several polysyllabic examples are given in (8)(a), (9)(a) and (10)(a).[4] Each of these underived forms contrasts with the unrelated (b) form, which contains only short vowels.

8. a. yóoko 'jaguar' b. yóka 'paint'

9. a. naáte 'begin' b. nátemae 'ask'

10. a. boorók 'toad' b. porówim 'type of lizard'

If it were the case that a long vowel shortens non-word-finally, as might be concluded from (3) through (7), then there would be no explanation for the vowel length in (8)(a), (9)(a) and (10)(a). If, however, each of the vowels in (3) through (7) is underlyingly short, then Mora Insertion accounts for the vowel length in (3)(b) through (7)(b), and the vowel length in (8) through (10) is underlying.

Mora Insertion is independently needed to account for the fact that monomoraic words are unattested in Mayo. Every word, even if monomorphemic, has at least two moras in phonetic representation, as illustrated in (11). In each of these forms, the vowel length disappears when a clitic or affix is added. This is discussed further in sections 2 and 3.

11. a. kee *ke 'not yet'

b. hee *he 'yes'

c. nee *ne 'me'

d. hoo *ho 'sit (pl)'

e. yáa *yá 'make'

f. wée *wé 'go (sg)'

More examples of vowel lengthening are presented in (12) through (14). However, each of these words is bisyllabic, and the first vowel lengthens when the word occurs in phrase final position but not elsewhere.

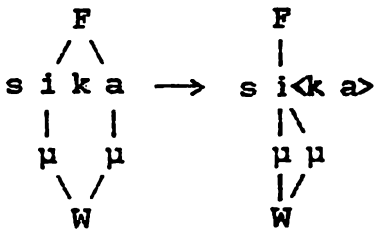
	Phrase-finally	Elsewhere	Gloss
12.	a. siíka	b. siká	'departed (singular)'
13.	a. taábu	b. tabú	'rabbit'
14.	a. kiíchul	b. kichúl	'cricket'

Since Mora Insertion has already been used to account for the vowel length in (3) through (7), I conclude that the environment for Mora Insertion is created in (12) through (14) by Phrase-Final Invisibility (PFI). This rule is stated in (15), where σ represents a syllable, $]_W$ represents the right edge of a word and ## represents a phrase boundary.[5]

15. Phrase-Final Invisibility (PFI): $\sigma\ ]_W \longrightarrow\ ]_W\ \sigma\ /\ \_\_\_\ \#\#$

Following Inkelas (1989), I assume that invisibility effects result from the exclusion of some member of a morphological string from the corresponding rule domain. Thus, PFI has the effect of rendering a phrase-final syllable invisible with respect to all subsequent rule applications within that stratum. The effect of PFI upon stress assignment and Mora Insertion is illustrated in (16), where F corresponds to the stress foot and W corresponds to the bimoraic word template.

16.



(12) through (14) demonstrate two points. First, PFI is a postlexical rule since it applies only at phrase boundaries. Second, it must be the case that MI reapplies to these forms *after* the application of PFI, since in this case PFI feeds MI.

So far, I have given evidence for the rules of Mora Insertion (MI) and Phrase-Final Invisibility (PFI) in Mayo. MI applies not only at the lexical level but also at the post-lexical level, as predicted by the theory of Lexical Phonology. In the next section, Mora Insertion is used as a diagnostic for subdividing the lexical level into a stem stratum and a word stratum.

2. Stem versus Word.

From the data presented in section 1, it might seem that MI simply applies once to each word at the end of the derivation. In this section, however, I show that some affixation occurs after MI has already applied, thus indicating that MI applies cyclically to more than one morphological stratum.

I have already shown that each of the verb roots in (3) through (7) has an underlyingly short vowel. In each of those examples, it must be the case that the PRES suffix gets attached to the root before MI applies; otherwise the root vowel would surface as long. The same roots appear in (17) through (21), but with different suffixes. Each of the root-plus-suffix combinations in (17) through (21) is a single word because it has only one

stress. Nevertheless, MI applies to each of these roots just as though the suffix were not present, as in the (b) forms of (3) through (7).

17. wée-nake 'will go'
go-FUT

18. yáa-su 'finish making'
make-CMPL

19. ée-nake 'will think'
think-FUT

20. báa-wa 'be intended'
intend-PSV

21. hoo-wá 'be seated (PL)'
sit(PL)-PSV

One other stem-level affix, the habitual (HAB) prefix, is illustrated in (22) and (23).

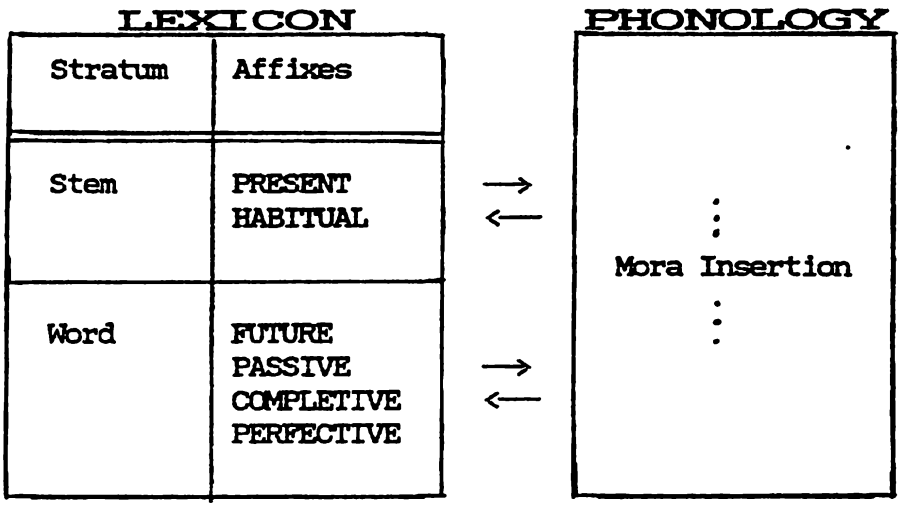
22. bá-ba-wa *bá-baa-wa 'keep being intended'
HAB-intend-PSV

23. ho-hó-wa *ho-hóo-wa 'keep being seated'
HAB-sit-PSV

The HAB prefix, which reduplicates the first syllable of its host, must be affixed to the stem before MI applies; otherwise surface vowel length would be attested in (22) and (23). (Compare these with (20) and (21)).

Thus, Mayo has two separate morphological strata at the lexical level: the stem and the word. The PRES suffix and HAB prefix are affixed to the root to form a *stem,* after which MI applies. At the next stratum, the future (FUT), completive (CMPL) and passive (PSV) suffixes are available for combining with a stem to form a *word.* This is represented schematically in (24), where the same set of phonological rules is assumed to be applicable at every stratum.[6]

24.



While the application of MI at the word stratum is vacuous for the data presented thus far, the data in (12) through (14) demonstrate that MI is available even in the postlexical stratum. In the next section I present independent evidence for the postlexical application of MI.

3. Clitics and postlexical phonology

The Mayo subject clitics listed in (25) provide an argument for the post-syntactic application of MI.

25. Mayo pronominal (subject) clitics:

	Singular	Plural
1	-ne	-te
2	-e'	-em
3	ϕ	-(ti)m

In this section I show that, even though Mayo clitics enter the derivation during the syntax, a clitic can block the application of MI when the clitic combines with a function word, i.e., a word that enters the derivation during the syntax. For example, the function word *ka* 'no' has a long vowel in (26), but the addition of a clitic in (27) prevents MI from applying. This indicates that MI applies even within the domain of the phrase, and cliticization precedes MI.

26. Kaá kó'okore. 'He is not sick.'
no be sick

27. ka-tim kó'okore. 'They are not sick.'
no-they be sick

The same quantity alternation is observed in (28) and (29) with the object pronoun *ne*. In (28), *ne* is underlyingly monomoraic so MI applies. In (29), however, the subject clitic *-chim* attaches to *ne*, and MI is not attested.

28. neé bitcha. 'He sees me.'
me see

29. ne-chim bitcha. 'They see me.'
me-they see

In order to use the above data to argue convincingly for the postlexical application of MI, I must show that the clitics and their hosts (in these cases) do not enter the derivation until the syntactic (i.e., postlexical) level. This is true for *ka* 'no' and *ne* 'me' (the hosts) because both are function words, i.e. members of a very small class of words which, although they serve as a domain for stress and other lexical phonology, cannot be uttered in isolation and never take affixes.

But how about the clitics? When do they enter the derivation? Inkelas (1989) argues quite convincingly that clitics enter the derivation at the level of syntax, completely bypassing all purely lexical processes. But, as Inkelas (1989) points out, not everything that has been labeled as a clitic is a true clitic. What, then, are the properties of a true clitic? Klavans (1980), Zwicky (1985) and Inkelas (1989) all agree on three general characteristics of a clitic: It is (a) phonologically bound but (b) not morphologically bound and (c) any semantic relationship between the clitic and its host is purely coincidental. In what follows I demonstrate that the

pronominal elements listed in (25) are indeed clitics, and that they must enter the derivation at the level of syntax.

The argument centers on the observation that a clitic always attaches to the end of the first phonological word of the sentence and becomes part of it, regardless of the word's syntactic category. For example, the clitic *-ne* 'I' attaches to a verb in (30), to an adverb in (31) and to a direct object in (32).

30. siká-ne *ne sika 'I left.'
left-I

31. béha-ne siíka *béha siká-ne 'I already left.'
already-I left

32. María-ta-ne bítchak *ne María-ta bítchak 'I saw Mary.'
Mary-ACC-I saw *María-ta bíchak-ne

Since the clitic in each of the above sentences is a part of the stress domain of a host, criterion (a) is satisfied: The clitics are phonologically bound. Criteria (b) and (c) are likewise satisfied: since the clitic can attach to a word of virtually any morphological or semantic category, there is no relationship between the clitic and its host in either of these areas. I conclude, therefore, that the forms in (25) are true clitics.

Further evidence that clitics enter the derivation during the syntax comes from the fact that the subject clitics are true arguments, and not simply agreement markers. This is shown in (33), where the subject clitic occurs in complementary distribution with the noun phrase.

33. Juan entok María sáhhak *Juan entok María-m sáhhak 'John and Mary
John and Mary left they left.'

Since clitics enter the derivation during syntax, how do they get into second position? Inkelas (1989) claims that such clitics are generated in second position. However, as far as I know, no serious theory of syntax has such counting rules. A second problem with such an analysis is that it

would violate the generalization, which holds invariably for non-clitics in Mayo, that the subject always occurs in initial position, as demonstrated in (34) through (36).

34.	ínapo siika. I left	*sika ínapo	'I left.'
35.	ínapo María-ta bítchak I Mary-ACC saw	*María-ta ínapo bítchak	'I saw Mary.' (ACC = Accusative Case)
36.	Juan María-ta bítchak John Mary-ACC saw	*María-ta Juan bítchak	'John saw Mary.'

Thus, clitics cannot start out in second position for two reasons: First, this would violate the universal properties of syntax; second, it would violate the language-particular constraint on word order in Mayo. I propose, therefore, that the syntax base-generates a subject clitic in sentence-initial position. A phonological rule of cliticization then attaches the left edge of the clitic to an adjacent word. This forces a clitic to move out of initial position, since there is no potential host to the left of the clitic; This is formalized in (37).

37. Clitic Movement: clitic word $\longrightarrow$ word-clitic / ## ____

One point remains to be demonstrated. (38) shows that clitic movement recognizes word boundaries, not stem boundaries.

38.	Sim-náke-ne. leave-FUT-I	*sim-ne-nake	'I'm leaving.'

Thus, several arguments point to the conclusion that clitics enter the derivation during the syntax. First, clitics have to be generated during syntax because their initial position is syntactically determined. Second, clitic movement is a phonological rule whose domain is the phrase. And finally, Inkelas (1989) has argued on independent grounds that clitics are universally generated in the syntactic component of the grammar. Thus,

since clitics don't enter the derivation until the syntax, and since MI applies to the function word-clitic sequences in (26)-(29), I conclude that MI applies post-lexically.

4. Conclusion.

Using data involving Mora Insertion in Mayo, I have provided evidence in support of two major claims of Lexical Phonology: First, as claimed in Inkelas (1989), the application of a phonological rule is restricted only by the phonological environment stated in the rule itself, and not by morphological constituency. Second, phonological rules interact with morphology in a cyclic fashion.

NOTES

*The data for this paper is from my fieldwork from 1983 to the present under the auspices of the Summer Institute of Linguistics. A subset of the data can be found in Collard and Collard (1962). Many thanks go to Diana Archangeli and Sandra Fulmer for clarifying the relevance of the data to the theoretical issues addressed herein. Any remaining errors are my own.

[1]Kiparsky (1985) claims that phonological rules apply after every cycle rather than only after each stratum. This distinction is not crucial to the arguments presented in this paper, but see note 6.

[2]In (2) through (6), *béchi'ibo* is a separate word rather than a suffix or clitic, so it is outside the stem domain of the verb. Evidence for the status of *béchi'ibo* as a separate word comes from the fact that it has its own stress, and Mayo exhibits only one stress per word. In contrast, Hagberg (1989 a) demonstrates that Mayo affixes and clitics are part of the stress domain of their host.

[3]An alternative would be to combine the two processes by simply saying that a vowel lengthens in a monomoraic word. However, Hagberg (1989 b) demonstrates that Mora Insertion accounts, in part, for onset gemination in certain environments as well as vowel lengthening in other environments. In order to capture this generalization, Mora Insertion needs to be stated independently of the two processes which it feeds.

[4]The absence of underlying vowel length in monosyllabic forms might be related historically to the synchronic rule of Mora Insertion. As I demonstrate in the next section, this rule applies prior to most affixation processes, so it is conceivable that underlying vowel length arose as a result of the lexicalization of certain morphological processes in certain words. For example *naáte* 'begin', which has an underlyingly long vowel in modern Mayo, may have resulted from the combination of a hypothetical stem of the form *na* plus *-te*, which is still productive as a causative suffix. If the Mora Insertion rule existed at that time and had the same domain as it has now, then it would have applied to *na* prior to affixation. If the stem and suffix became inseparable through a diachronic process of lexicalization, then the presence of underlying vowel length in *naáte* would be explained. If this is correct, it would also explain the absence of underlying vowel length in monosyllabic stems.

[5]Except where otherwise noted, all data presented in this paper (including all the preceding examples) is in the 'elsewhere' (non phrase-final) form.

[6]Kiparsky (1985) claims that phonological rules apply after every cycle rather than only after each stratum. I have represented the latter situation in (22) only for the sake of simplicity; Hagberg (1989 a) shows

that stress is assigned after present tense affixation and again after reduplication. Since both of these affixes are in the first stratum, it is true that at least one phonological rule (i.e., stress assignment) applies after every cycle.

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