North East Linguistics Society

Volume 17 *Proceedings of NELS 17 -- Volume 2* Article 16

1986

Locality Conditions and Feature Geometry

Donca Steriade
Massachusetts Institute of Technology

Follow this and additional works at: https://scholarworks.umass.edu/nels

Part of the Linguistics Commons

Recommended Citation
Steriade, Donca (1986) "Locality Conditions and Feature Geometry," *North East Linguistics Society*: Vol. 17 , Article 16.
Available at: https://scholarworks.umass.edu/nels/vol17/iss2/16

This Article is brought to you for free and open access by the Graduate Linguistics Students Association (GLSA) at ScholarWorks@UMass Amherst. It has been accepted for inclusion in North East Linguistics Society by an authorized editor of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.

Locality Conditions and Feature Geometry

Donca Steriade

Massachusetts Institute of Technology

1. Introduction

The topic of this paper is at the intersection of two lines of research in recent segmental phonology: research on the relative independence between vowel and consonant features and research on the internal structure of segments. A number of recent studies[1] have drawn attention to phenomena that point to a separation between the tiers of vowel features and those of consonant features: these are processes that appear to treat consonants as adjacent across intervening vowels and vowels as adjacent across intervening consonants. Placing vocalic and consonantal segments on distinct tiers, as shown schematically in (1), looks like a promising approach to such data.

(1)
```
α   β   γ
|   |   |
C V C V C V
  |   |   |
  a   b   c
```

We know, however, that segments are not monolithic entities, as (1) might suggest, but rather complexes of mutually linked autosegments. Clements (1985) has shown that, inside a single segment, the relation between individual feature specifications like [voice] and [coronal] is mediated by abstract autosegments, called <u>class nodes</u>. Thus, within a single <u>t</u>, [coronal] is not directly linked to [-voice]: rather, they are both linked, indirectly, to a common class node, called <u>root</u>:

(2)

```
[-voice]  [+coronal]

       \/
       root
```

The picture emerging from Clements' work, and further elaborated in Sagey (1986), is considerably more complex than (2). Place features like [anterior], [round], [high] are dominated, according to Sagey, by Articulator nodes corresponding to major points of articulation: the tongue body features [high], [back], [low] are dominated by Dorsal, [round] is dominated by Labial, [anterior], [coronal], [distributed] are dominated by Coronal. In turn, the Articulator nodes are dominated by the class node Place. The totality of supralaryngeal features, including nasality and perhaps stricture specifications like [continuant], are dominated by the class node Supralaryngeal. Laryngeal features form a separate constituent dominated by the Laryngeal node. The Laryngeal and Supralaryngeal nodes meet under the Root node, which is in turn linked to skeletal positions. The position of stricture features is less clear, but the choice of class node dominating them seems limited to Root and Supralaryngeal[2]. A segment like <u>t</u> will then look like this:

(3)

```
[+ant] [-dist]
  \   /
 Coronal
      \
       Place       [-nasal]  [-voice] [+aspirated]
        \          /              \    /
         Supralaryngeal          Laryngeal
                     \    /
                      Root
                       |
                       C
```

The hierarchical model illustrated by (3)requires us to reformulate the question of tier separation between consonants and vowels. We need to ask: Does tier separation hold of all terminal features and all class nodes ? Do consonants and vowels occupy disjoint sets of tiers ?

The hypothesis that they do, which I will refer to as the Disjoint Tier Hypothesis (DTH) is illustrated below in (4) by a partial representation of the string /buk/. (Here and below I use the following abbreviations: <u>sl</u> for Supralaryngeal, <u>pl</u> for Place, <u>lar</u> for Laryngeal, <u>r</u> for Root. The prefixes C- and V- indicate that a given tier characterizes consonant (C) or vowel (V) features. A dot indicates a node on a given tier.)

(4)

```
C-Dorsal tier         .
                      ¦
C-Labial        .     ¦
                ¦     ¦
                .     .
                 \     \
C-pl tier         .     .
                  ¦     ¦
C-sl tier         .     .
                   \ /   \ /
C-R tier            .     .
                    ¦     ¦
                    C  V  C    =  /b u k/
                       ¦
V-R tier               .
                      / \
V-sl tier            .
                     ¦
V-pl tier            .
                    /¦
V-Labial tier     .  ¦
                     ¦
V-Dorsal tier        .
                     ¦ \
                     ¦  \
V-terminal tiers [+high][+back]
```

The alternative to the DTH is based on the idea that vowels and consonants are in general not distinctively specified for the same set of terminal features. One implementation of this idea is to postulate that tongue body position corresponds to different Articulator nodes in vowels and consonants: we would reserve for the vowels the Dorsal node and the features it dominates ([high], [low], [back]) and posit a separate Articulator, Velar, for velar/uvular consonants. Aside from this, vowels and consonants will share their class tiers: they will have Place, Supralaryngeal, Laryngeal and Root nodes on the same tiers even in cases where these nodes dominate disjoint sets of terminal features. When vowels and consonants are characterized by the same Articulator nodes, these nodes will occupy the same tiers; when they happen to be specified for the same terminal features, these features too will occupy the same tiers. In other words, the alternative to the DTH is to limit tier separation to the primary Articulator nodes representing tongue body position and the terminal features they dominate[3]. I will defend this program under the name of Overlapping Tier Hypothesis (OTH). Its descriptive possibilities are illustrated in (5), a representation of the same string /buk/:

(5)
```
terminal tiers  [+round][+high] [+back]
                         \        \ /
Dorsal tier                \       .
                             \     ¦
Labial tier     .             .    ¦
                ¦             ¦    ¦
Velar tier      ¦             ¦    ¦     .
                ¦              \ /       ¦
Pl tier         .               .        .
                ¦[-nas]         ¦[-nas]  ¦[-nas]
                ¦ /             ¦/       ¦/
Sl tier         .               .        .
                ¦               ¦        ¦
Lar tier        ¦ .             ¦ .      ¦ .
                ¦/              ¦/       ¦/
Root tier       .               .        .
                ¦               ¦        ¦
                C               V        C    = /buk/
```

This paper explores certain differences between the DTH and the OTH, which emerge when the typology and formalization of certain non-local rules is examined[4]. By non-local rule I mean one involving two nodes α and β on some tier, where α is a indirectly associated to a skeletal position non-adjacent to that of β, as shown in (6)

(6)
```
α       β
¦       ¦
C V C V C
```

The non-local rules considered here involve assimilations on the Place, Supralaryngeal and Root tiers. I discuss the locality conditions of supralaryngeal dissimilation, as well as those of rules operating on articulator tiers in Steriade (1987b).

The OTH predicts that the locality of a non-local rule will depend, in part, on the tier actively involved in it: a Root node can spread either to an adjacent skeletal position or across a string of segmentally empty skeletal positions, but not across a segment, vowel or consonant. A Supralaryngeal node can spread to a skeletally adjacent segment, or across a segmentally empty slot or across a segment lacking supralaryngeal specifications (such as /h/ or /?/) but not across a segment endowed with supralaryngeal features, be it vowel or consonant. Dissimilation rules will operate under identical locality constraints.

The predictions of the DTH differ on this score: it allows Root or Supralaryngeal to spread between two consonants, both across segmentally empty positions and across a vowel. Symmetrically, the DTH allows vowels to spread their Root or Supralaryngeal nodes onto other vowels across any class of consonants.

I believe that rules whose locality conditions are predicted by the DTH occur frequently, in glaring contrast to the phenomena predicted by the OTH. Showing this, however, cannot be the task of a single study. What can be shown here is that the DTH must stipulate what the OTH explains: certain systematic relations that exist between the locality conditions a rule type is subject to and the tier it operates on.

2. Assumptions

I will refer globally to all instances of assimilation as harmony, regardless of whether it has overt non-local effects or not.

Single node spreading: In analyzing harmony, I assume that it spreads at most one node at a time. Whenever more than one feature appears to propagate, this assumption will require the formulation of a rule in which the spreading node is the one that dominates all the propagating features. The exclusion of rules spreading simultaneously two or more nodes explains the observation that only certain clusters of features (such as [anterior] and [distributed] but not [anterior] and [voice]) propagate in tandem (cf. Clements (1976) and Goldsmith (1979)). These clusters of features correspond to the class nodes postulated by Clements (1985) and Sagey (1986).

Privative and equipollent oppositions: I follow McCarthy (1985) in assuming that notations such as [-coronal] or [-labial] denote only the absence of an articulator node, not the presence of a negative specification: thus /I/ (barred /i/) differs from /u/ privatively, in the sense that /I/ lacks the Labial articulator node of /u/. There is no specification such as [-labial] or [-round] which /I/ has and /u/ lacks. In contrast the contrast between /I/, /u/and, on the other hand, /i/ is equipollent (Trubetzkoy 1970: 77) in the sense that /I/ and /u/ have [+back] terminal nodes contrasting with the [-back] node of /i/. This distinction between the absence of an Articulator node or feature and the presence of a [-F] specification explains, among other things, an asymmetry between possible propagating values: both [+back] and [-back], both [+high] and [-high] are found to spread in vowel harmony rules. But rounding harmonies spread only [+round], never [-round] (Steriade (1981)): this is because vowel segments described as [-round] simply lack the Labial node. A missing specification cannot spread, a [-F] specification can. As McCarthy points out, this distinction explains certain pervasive patterns of Articulator disharmony in Semitic and elsewhere that would be incomprehensible if, for instance, non-labials were to bear [-labial] specifications. As we shall see, this assumption does not exclude all instances of /u/ to /I/ assimilation: the Place or Supralaryngeal node of /I/ may spread onto /u/, resulting in the replacement of a Place node dominating Labial by a place node lacking Labial. We can distinguish independently this type of assimilation from a single feature or single articulator harmony rule: this is shown below.

Stipulate only prosodic locality: A further assumption, the essential one for this paper, is that phonological rules may be subject only to positive, prosodically expressed locality conditions. Thus, it is sometimes necessary to stipulate that a given rule applies within the domain of the syllable or of the stress foot. It may also be necessary to stipulate that two segments participating in a rule must be syllabically or skeletally adjacent, in the sense that they are linked to adjacent syllables or adjacent syllabic positions. An instance of the latter type of rule is Coronal assimilation in English (Clements 1985 and Sagey 1986), a rule that spreads the Coronal node of a /θ, r, t/ onto an immediately preceding coronal segment. The two segments must be strictly adjacent: since considerations of feature geometry or underspecification do not distinguish this local rule from the non-local Coronal assimilation rule of Sanskrit (Nati: Schein and Steriade 1986), we must stipulate skeletal adjacency between the participant segments. Thus prosodic locality conditions such as segments α and β must be associated to adjacent skeletal positions appear unavoidable[5]. But locality conditions that stipulate which segment class may or may not intervene between the target and the trigger of the rule can be eliminated in a large class of cases. Kiparsky (1981), Ito and Mester (1986) and others have shown how underspecification helps eliminate one class of segmental locality conditions. I will try to show here and in Steriade (1987b) that judicious use of feature geometry can eliminate another such class. Consequently, my arguments against the DTH will rest on the assumption that segmentally expressed locality conditions are not part of the vocabulary of phonological rules.

To implement this prohibition, I will assume that harmony rules differ along a very limited set of parameters. These will be: (a) the tier on which spreading takes place; (b) the direction of spreading; (c) further specifications, if any, of target and/or propagating segment; (d) the prosodic locality conditions, if any; (e) whether the rule is accompanied by delinking (feature-changing) or not (feature-filling); (f) the relative order between harmony and relevant redundancy rules. Because the harmony rule refers only to the target and trigger segments, any direct mention of neutral and/or blocking segments is automatically excluded. It follows that no segmental locality conditions can be expressed in such a format. (My debt to Archangeli and Pulleyblank (1986) should be obvious here: although they choose a different set of parameters, they advocate a very similar program of restricting the expressive power of phonological rules.)

3. The Locality of Root-Level Rules

I begin with rules involving the Root tier. An instance of Root harmony is involved in the derivation of perfect reduplication in Attic Greek. The pattern is illustrated in (7):

(7) Root Harmony: Greek Reduplication

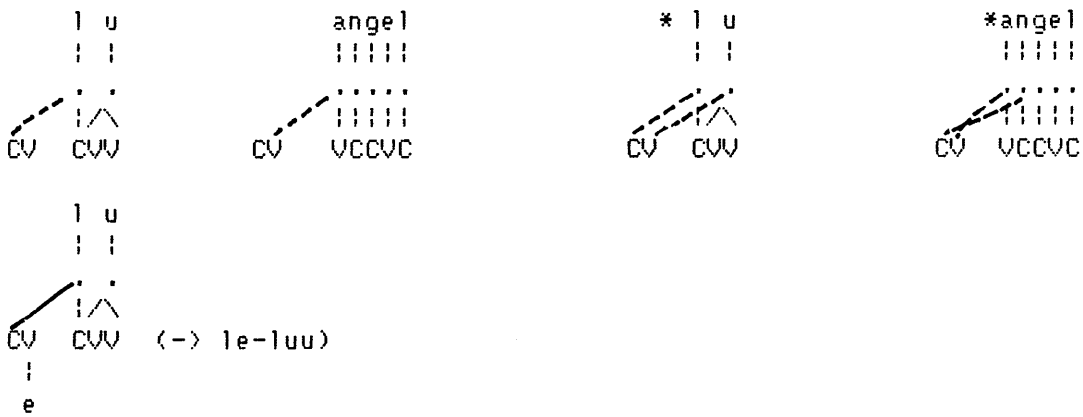
a. C-initial roots:	lu:-	le-lu:- 'untie'
	ti:ma:-	te-ti:ma:- 'honour'
	graph-	ge-graph- 'write'
b. V-initial roots:	angel-	a:ngel- 'announce'
	elenkh-	e:lenkh- 'confute'
	^{h}idru-	^{h}i:dru- 'place'
	olisth-	o:listh- 'slip'

The normal pattern of Greek perfect reduplication is that consonant-initial roots prefix a copy of their first consonant followed by the vowel e; vowel initial roots lengthen their first vowel. Reduplication is in Greek an instance of spreading rather than copying: the argument for this is based in part on the fact that a sequence of two identical vowels is phonologically distinguishable in Greek from a long vowel. Thus an underlying or intermediate /oo/ sequence is syllabified /o.o/ and optionally contracted, depending on the dialect, to a long tense /o:/. In contrast, a single long /o:/ is always monosyllabic and surfaces always as a lax /O:/. The same obtains for the contrast between underlying /e:/, which surfaces always as monosyllabic lax /E:/ and underlying or intermediate /e e/ sequences which surface either as disyllabic /e.e/ or as contracted tense long /e:/. The distinction between monosegmental and bisegmental structures can also be made for high and low vowels: although no tense/lax distinction obtains for these vowels, it is still the case that /aa/ sequences differ in syllabification from /a:/. Further analysis of these facts appears in Steriade (1982).

Vowel-initial roots yield under reduplication long vowels, not vowel sequences: all mid vowels that undergo perfect reduplication surface as lax mid long vowels and all VV sequences resulting from reduplication are obligatory tautosyllabic. I deduce from this that the process is Root harmony in this case[6]. A statement of Greek perfect reduplication based on the OTH appears below, followed by an illustrative derivation:

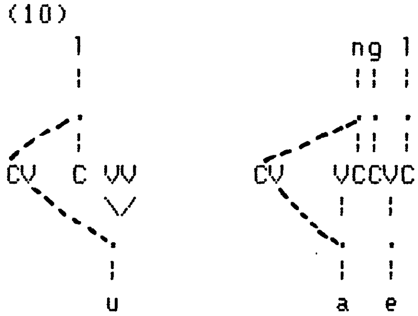
(8)
Greek Reduplication (assuming the OTH):
(i) prefix CV;
(ii) spread root segments onto prefix;
(iii) associate e with empty V (before tier conflation).

(9)



The OTH predicts correctly that only the first root segment can spread onto the prefix: the consonant in the case of C-initial roots, the vowel otherwise. Since this is predicted, the grammar of Greek wil only have to include the general provision in (8)ii, without mention of the actual location of the segments to be spread. The DTH, on the other hand, allows the possibility that both the first consonant and the first vowel could spread simultaneously, as shown in (10).

(10)



Since nothing precludes this, the statement of Greek reduplication under the DTH will have to include some explicit restraining clause: for instance "spread only the root segment associated to the first skeletal slot"[7].

4. The Locality of Supralaryngeal Harmony

There exists a fairly wide-spread process, shown schematically in (11), whereby a vocoid assimilates to another vocoid across /h/ or /?/.

Trans-laryngeal harmony
(11) $V_i \rightarrow V_j$ // (h,?) V_j

Instances of (11) may vary in a number of ways. In Acoma (Miller 1965) and Nez Perce (Aoki 1970) (11) affects all vowel pairs, while in Yapese (Jensen 1977), Arbore (Hayward 1984), Yokuts (1941) only certain vowel sequences undergo the rule. Frequently, (11) applies in the output of epenthesis: in Kekchi (Campbell 1974) and Tojolabal (Furbee-Losee 1976), epenthesis rules insert a vowel in contexts like V?/h __C , after which (11) specifies the inserted vowel as a copy of the preceding one. A similar phenomenon takes place in Mohawk (Postal 1967). Still other versions of (11) apply to glides: a sequence /glide$_i$?/h / becomes /glide$_i$?/h glide$_i$/ in Tojolabal (Furbee-Losee 1976) . Finally, there exist vowel merger rules which take place across /h/ and /?/: in Wichita (Rood 1976) /ahi/, /a?i/ sequences undergo a process of mutual assimilation and yield /ehe/, /e?e/.

But, interestingly, all instances of (11) share a cluster of properties, which are exclusively associated with the fact that the assimilation carried out by (11) counts as sole neutral segments the laryngeal consonants /h/ and /?/. The shared properties are these: trans-laryngeal harmony is always a multiple-feature harmony; it cannot be characterized by spreading any given Articulator node; it never affects the laryngeal components of participating vowels; it does not differentiate /h/ from /?/; and it never requires that they be present in the string: it merely allows them to intervene. I will now discuss and illustrate each of these properties in turn.

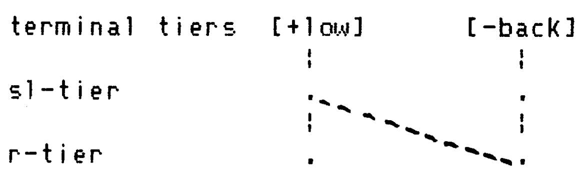
(a) No single-feature harmony: Trans-laryngeal harmony creates a complete copy of the place or supralaryngeal portion of the trigger vocoid. There are, to my knowledge, no rules with the format in (11) which involve assimilation for a single feature or for less than the totality of place features: there are no rules like (12):

(12) An unattested trans-laryngeal assimilation
i -> e / a (?,h) __

This is a striking fact, given that there exist numerous single-feature assimilation rules operating either under strict adjacency or across all consonants. An example of a strictly local rule similar to (12) is Latin Lowering, whereby /i/ lowers to /e/ when next to /a/ (cf. Schein and Steriade 1986). Such single-feature rules are not attested when /h/ and /?/ are the only segments to intervene between target and trigger. Nor do we find versions of (11) spreading more than one but less than all place features of the trigger vowel.

An apparent counterexample to the generalization outlined is reported by Press(1979:13) in her grammar of Chemehuevi. In this language /i/ "is partially lowered and sometimes backed after /a/ plus one of the glides /h/ and /?/." This statement appears to describe a rule very similar to (12). On closer examination, however, the rule turns out to be a process whereby /a/ is copied in its entirety across a laryngeal consonant. This process is optionally followed by partial assimilation of the copied vowel to a neighboring /i/. We obtain the following variant pronunciations of underlying /aLi/ sequences (L = a laryngeal consonant, /h/ or /?/) : /aLai/, /aLei/, /aLɛi/. Press writes /i/ as a superscript in these sequences (aLa^{i}, etc.), probably in order to indicate that the post-laryngeal sequence is mono-moraic. The /aLai/ sequence is the plain result of cross-laryngeal copying, a process formalized below. The /aLɛi/, /aLei/ sequences involve the results of optional assimilation for height and/or laxing between the copied /a/ and the neighboring /i/. The input to these partial assimilation rules is the process below:

(13) Chemehuevi Trans-Laryngeal Harmony 1



Prosodic condition: the segments must be heterosyllabic.

Rule (13) is not accompanied by delinking of the Supralaryngeal component of target segment: this accounts for the fact that /i/ persists in the output of the rule. The heterosyllabicity condition accounts for the fact that strictly adjacent sequences /ai/ do not appear to undergo either (13) or the partial assimilations dependent upon its prior application. I will assume that the /ai/ -> /ei/, /ɛi/ assimilations take place only in the short diphthong configurations created by (13).

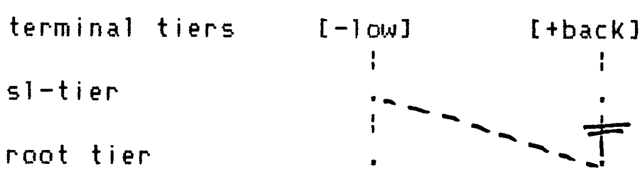
The central point illustrated by this case is that the apparent partial assimilation /aLi/ -> /aLei/, /aLɛi/ is provably taking place between strictly adjacent segments. The trans-laryngeal harmony itself is total.

(b) <u>More than one articulator node</u>: The rule type in (11) may effect assimilatory changes that cannot be described in terms of spreading any given articulator. This is the case in Chemehuevi, a language whose vowel system is composed of {i, I, u, a, o}, where /I/ is high, back, unrounded. According to Press (1979), all vowel sequences other than <u>Vi</u>, <u>Va</u>, <u>aI</u>, <u>au</u> undergo a progressive trans-laryngeal assimilation and become identical. We should bear in mind that in the case of Chemehuevi, identity at the Supralaryngeal or Place level is identity tout court, since vowels are uniformly voiced and oral. Examples of the process are given below: (14)a exemplifies the rule applying between strictly adjacent vowels, and (14)c shows that the rule can skip ?.

(14)
a. tika-vII-uka 'eat-past-it' -> tika-vII-Ika
b. kani-upaa 'in the house'.-> kaniipa
c. nukwi-jI-?umi 'run-present-plural' -> nukwi-jI-?Im
   (cf. kacu-a-ra-?umI 'not-Question-plural' -> kacu-a-ra-?um)

Examples like (14) a,c indicate that the Chemehuevi rule cannot be characterized by spreading either the Labial articulator or the Dorsal one: /I/ and /u/ differ privatively, as mentioned in the Introduction, in that /I/ lacks a Labial specification. To obtain the proper assimilatory result the /I(?)u/ sequence must therefore undergo Place or Supralaryngeal harmony. I opt, arbitrarily, for Supralaryngeal harmony. My formulation of the rule, is based on the assumption, supported by Press (1979:19), that /a/ is a front vowel. This explains why /a/ and /i/ are the only vowels which fail to undergo this rule.

(15) Chemehuevi Trans-Laryngeal Harmony 2



Rule (15) is not constrained by any prosodic adjacency condition: it will therefore operate across any segment lacking supralaryngeal specifications. It does not require heterosyllabicity, which means that the presence of the laryngeal consonant is optional (see below). In the case of the /I?u/ sequence, (15) will replace the Supralaryngeal node of /u/ with that of /I/, which lacks a labial specification. This explains the apparently paradoxical observation that a more richly specified segment (u) assimilates it its entirety to a less specified segment (I).

A related case is that of Acoma (Miller 1965). The vowels of this language are (a,e,o,i,I, u), long and short. Tautosyllabic clusters are /Vi/, /Vu/, where V is any vowel. Since onsets are obligatory in Acoma, vowel sequences other than /Vi/, /Vu/ will be separated by a consonant, including /?/. Across a /?/ vowels are supralaryngeally identical, except in a very few morphophonemically irregular cases (Miller 1965:79). This result is brought about by several harmony rules, both regressive and progressive, all of which have the same locality conditions: they apply only between heterosyllabic vowels and only across /?/. This vowel system, like that of Chemehuevi appears to require both Labial and Dorsal specifications, in order to distinguish the high vowels /i/, /u/

and /I/ from each other. The trans-laryngeal spreading rules of Acoma will therefore have to involve a node dominating both Labial and Dorsal: Place or Supralaryngeal.

(c) Laryngeal independence: In most vowel systems, where the features of voicing and glottalization are non-distinctive, it is impossible to tell whether the laryngeal components of participating vowels are distinct in the output of trans-laryngeal harmony. But Acoma, a language in which vowels may be glottalized or devoiced, shows that (11) does not affect laryngeal features. Glottalization, an underlying property, and voicelessness, a derived property, affect independently each one of the supralaryngeally identical V's in a V?V sequence. To illustrate the first point, consider forms like Ka?a'usiustya 'he is tied up' (Miller (1965: 51), pu?u'uKaca 'come out and look at the two of them' from /pV-u'uKaca/ (Miller 1965:123). The second vowel in the V?V sequence is glottalized in each case - a fact indicated by the notation V' - while the first one is not: the harmony in (11) does not transmit glottalization. The second point is that the vowel devoicing rules of the language (obligatory devoicing after an aspirated onset; optional before a voiceless segment and in other cases) affect each V in V?V separately. This is shown by examples such as ziyu'ucEE?e 'they took him', and senaa?Asi ~ senaa?asi 'my arch', where the voiceless vowels are capitalized. Both observations point to the fact that only supralaryngeal features are involved in (11).

(d) H/? solidarity: In many languages which have both /h/ and /?/ (as do Yokuts (Newman 1946; Archangeli 1984), Chemehuevi (Press 1979), Arbore (Hayward 1984), Arapaho (Salzman 1956, Trigo 1987), Tojolabal (Furbee-Losee 1976), Pame (Gibson 1956), Nez Perce (Aoki 1970), Wichita (Rood 1976)) trans-laryngeal harmony applies across both /h/ and /?/, not just one of them. I will try now to extend this generalization and claim that if one laryngeal consonant is transparent to the assimilation in (11), the other laryngeal will also be.

There are several classes of apparent obstacles to this claim. One source of difficulty are grammatical descriptions which do not generalize beyond directly observable alternations: thus in Chemehuevi both /h/ and /?/ act transparent with respect to rule (13) but only /?/ is reported transparent to rule (15). A reading of Press's grammar reveals however no instance of unassimilated /VhV/ sequences, where the first vowel is non-low and the second is back. It is quite possible that such sequences do not occur. In Wichita (Rood 1976), a process of vowel merger applies across both /h/ and /?/: /ahi/ and /a?i/ become /ehe/ and /e?e/ respectively. In contrast, a total assimilation of /i/ to /a/ (/i?a/ -> /a?a/) is described as applying only across /?/. Here too, it appears that the generalization may be incomplete: /VhV/ sequences in this language lose their first V. If /VhV/ reduces to /ChV/ after the merger of /aLi/ to /eLe/ but before the trans-laryngeal assimilation of /i?a/ to /a?a/, the facts can be described without stipulating that /h/ is opaque in the latter rule: by the time assimilation applies to the /i?a/ sequences, /h/ will no longer be found intervocalically[8].

A related class of apparent counterexamples comes from languages where either segment is marginal: this is the case of Yapese (Jensen 1977), where /h/ is non-native and extremely rare. The Yapese trans-laryngeal harmony rules operate only across /?/ (see below): but, given the marginal status of /h/, this asymmetry between the two segments need not be stipulated. Acoma, discussed above, may well fall in the same class: it has both /?/ and /h/ and its trans-laryngeal harmonies operate only across /?/. But /h/ has a restricted distribution in Acoma (Miller 1965:11-12): it is rare in morpheme-medial position and very rare in morpheme-initial position.

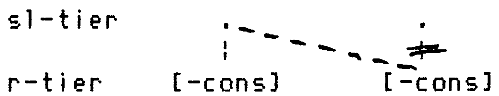
A third type of /h/ ~ /?/ asymmetries is exemplified by Yurok (Robins 1958, Gensler 1986). Yurok /V?V/ sequences are overwhelmingly composed of identical vowels, a situation which suggests translaryngeal harmony. But /VhV/ sequences differ in this respect: the vowels in this case are frequently heterorganic. However, as Gensler points out, the analysis of /V?V/ sequences suggests that they are monosyllabic rather than disyllabic: Gensler suggests that they represent single vowels "perhaps long, with a secondary glottal feature superimposed". If so, the fact that they are homorganic does not motivate a rule with the format of (11). An asymmetry between /h/ and /?/ in the Mohawk rule of Vowel Doubling (Postal 1968) is explained away by Bonneau (1986) by reference to the different syllabification of /V?C/, /VhC/ sequences in this language.

This exhausts the list of cases known to me in which /h/ and /?/ appear to pattern differently in trans-laryngeal harmony. I will conclude that no need exists for a stipulated distinction between the behavior of the two laryngeal consonants with respect to (11)[9].

(e) <u>H/?</u> <u>optionality</u>: Many, if not all instances of (11) are rules restricted to heterosyllabic vowels: this explains why, in Acoma and Chemehuevi (rule (13)) the tautosyllabic vowel sequences are the only ones not to undergo the assimilation. Bearing this in mind, I note a last important feature of the process in (11): /h/ and /?/ are never obligatory factors in the rule. They may intervene but they need not. In languages like Acoma, Yokuts, Yapese, or Arbore, where heterosyllabic vowel sequences cannot surface without some intrusive onset, it looks as if /h/ and /?/ must be written into the statement of (11), because all vowel sequences to which (11) applies are in fact separated by a laryngeal consonant. But this is just the joint consequence of the fact that onsets are obligatory in these languages and of the requirement that (11) apply only to heterosyllabic clusters. To put this observation differently, there are no instances of (11) which apply to heterosyllabic $V_i.?V_j$ but not to heterosyllabic $V_i.V_j$.

I turn now to the analysis of the observations made on trans-laryngeal harmony. I begin by asking whether /h/ and /?/, segments to which I have referred so far as neutral, are really transparent non-undergoers. My claim is that they are. The alternative is that they undergo the rule and trigger it in turn: if so, trans-laryngeal harmony would simply be an iterative rule which spreads a Supralaryngeal or Place node from one [-consonantal] segment onto another one under a condition of strict skeletal adjacency:

(16)



sequential-iterative;
r-nodes must be associated to adjacent skeletal slots.

There are several reasons for rejecting (16) as a formalization of (11). The main reason is that (11) is frequently restricted as to the pairs of vowels participating in it. For example one Chemehuevi instance of (11) - rule (15) above - is triggered only by non-low vowels and undergone only by [+back] vowels. We cannot reformulate (15) to fit the mold of (16) because the laryngeals which may intervene between the two vowels are not [+back]: they are therefore not proper undergoers of the rule. They can only be characterized as transparent segments. The same point can be illustrated more amply by reference to the trans-laryngeal harmonies of Arbore and Yapese. In Arbore (Hayward 1984), (11) applies to the following sequences:

(17)

/eLa/ -> /eLe/ : yibeh-a -> yibeh-e 'it is a hippopotamus'
gere?-a -> gere?-e 'it is a belly'

/eLo/ -> /oLo/ : ma beh-o -> boh-o 'he is not going out'
ma de?-o -> do?-o 'he is not throwing'

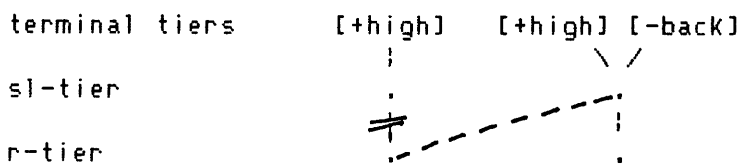
/eLi/ -> /iLi/ : ma beh-i -> bih-i 'he did not go out'
?amma dee?-i -> dii?-i 'I did not belch'

/aLi/ -> /iLi/ : ma zah-i -> ma zih-i 'don't die !'
(data from Hayward 1986:73ff)

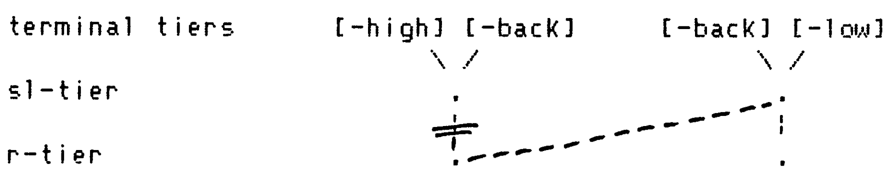
Note that we have to specify that the target of progressive harmony is /a/, while that of regressive harmony is /e/ and sporadically /a/.

In Yapese (Jensen 1977) trans-laryngeal harmony is attested in four sequences: /uLi/, /eLi/, /aLe/, /aLɛ/. We can identify here two distinct processes: a rule operating between high vowels, the second of which is front, and a rule operating between front vowels, of which the first is [-high] and the second is [-low].

(18) Yapese Trans-Laryngeal Harmony 1.



Yapese Trans-Laryngeal Harmony 2.



It is interesting to note that the first rule applies not only word-internally but also across word-boundary. Jensen discusses the word-internal and phrasal applications as two distinct processes, because word-internally the rule applies only across a laryngeal whereas in the phrasal phonology it may affect /u##i/ sequences. This disparity is simply the effect of an independent constraint of Yapese, which allows word-initial onsetless syllables but forbids them word-medially (Jensen 1977:37)[10].

The point illustrated by the Yapese, Arbore, Chemehuevi and Tzutujil is that a proper formalization of many instances of trans-laryngeal harmony will not allow laryngeal segments to count as targets. For this reason, the hypothesis that trans-laryngeal harmony is always a sequential iterative rule operating under strict skeletal adjacency must be rejected. Additionally, we note that languages like Acoma, in which glottalized vowels exist underlyingly, appear to distinguish between the first two members of a /V?V/ harmonic sequence and a /VV'/ cluster (where V' is a glottalized vowel). Had the trans-laryngeal harmony of Acoma taken the glottal stop as its intermediate target, any /V?V/ would be incorrectly turned into /VV'V/.

Having established that laryngeal segments are neutral non-undergoers in (11), and therefore that this process is non-local in the sense defined in (6), I will show that its properties can be derived from the assumptions set forth in section 2, and from the locality constraints imposed by the OTH.

The rejection of segmental stated locality conditions and the format proposed for harmony rules in section 2, force me to state any trans-laryngeal assimilation as the spread of Place or Supralaryngeal features. Let us examine how this conclusion follows. Consider a language like Arbore (Hayward 1984), which has a standard {a,e,i,o,u} vowel set and several trans-laryngeal harmonies. To effect a total vowel-to-vowel assimilation in this language we can spread four nodes: Root, Supralaryngeal, Place and, assuming that the specified features of this vowel system are {[high], [back], [low]}, Dorsal. Root assimilation must be excluded as the mechanism for the Arbore trans-laryngeal harmony under the OTH: the laryngeal segments will be blockers of such a process because they have their own Root node. Dorsal assimilation is excluded also, because it cannot explain the range of neutral segments: rules of Dorsal spread exist which count as neutral any segment lacking Dorsal specifications, not just the laryngeals (Steriade 1987b). For this reason, if we state the Arbore trans-laryngeal harmony as Dorsal spread, we will have to specifically mention /?/ and /h/ as neutral segments: but this formal option is no longer available in the format for harmony outlined in section 2. The only remaining possibilities for the formalization of (11) are Supralaryngeal and Place spread[11]. To simplify the discussion, let us assume that (11) is uniformly Supralaryngeal harmony.

We can now explain property (a): trans-laryngeal harmony never propagates less that the totality of place features of a vowel. This follows: if trans-laryngeal harmony is Supralaryngeal harmony, it cannot propagate less than the entire place component of the vowel. To make the point clearer, recall the impossible rule (12), repeated below:

(12) An unattested trans-laryngeal assimilation
i -> e / a (?/h) _

We must explain why a single-feature assimilation is perfectly natural when no segment is allowed to intervene between target and trigger (as in Latin Lowering (Schein and Steriade 1986) or English Coronal Harmony (Sagey 1986)) or when all consonants are allowed to intervene between target and trigger (as in standard vowel harmony rules) , but is impossible when the only intervening segments are the laryngeals. The reason is this: we can describe a rule like English Coronal Harmony as partial assimilation constrained by a prosodic locality condition (adjacency on the skeletal tier); we can describe a standard single-feature harmony rule as a partial assimilation not constrained by any prosodic locality condition; but we cannot describe a trans-laryngeal single-feature assimilation because the rule is demonstrably non-local (i.e. not subject to skeletal adjacency) yet it is blocked by most segments. In other words, only a segmental locality condition can correctly characterize rules like (12)[12]. Having excluded in principle segmental locality, we have explained the absence of (12).

Consider now the property in (b): (11) cannot involve, in Acoma or Chemehuevi, the spreading of any given articulator node. This again follows once we identify (11) as Supralaryngeal spread: what is being spread is not an articulator node but a node dominating all articulators or recording their absence.

The laryngeal independence of vowels participating in trans-laryngeal harmony (property (c) above) follows from the OTH: the OTH predicts that rule (11) cannot analyzed as a case of Root Harmony. The propagating node, Supralaryngeal or Place, will leave intact the laryngeal components of the assimilating vowels, both in the sense that underlying laryngeal specifications will remain unaffected and in the sense that later rules affecting laryngeal values will affect each vowel independently. This is what the Acoma evidence has demonstrated.

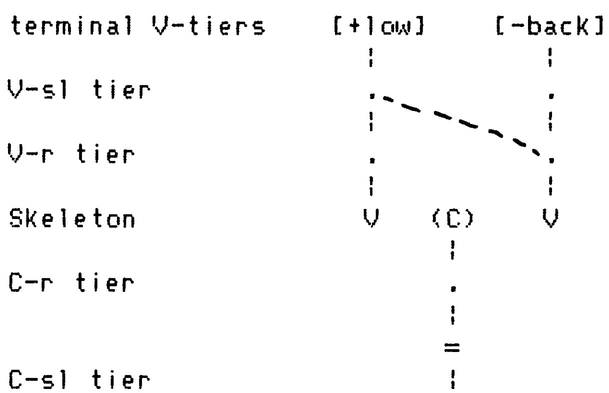
I noted in (d) that all laryngeal consonants of a given language participate in the same way in (11). This too follows from the formalization of (11) as Supralaryngeal spread and from the rejection of segmental locality conditions. It is not possible to declare /h/ as transparent while maintaining /?/ as opaque without explicit stipulation: and neither segment can be explicitly mentioned, because neither segment is a target or a trigger of the rule.

A related observation is (e): /h/ and /?/ are never obligatory factors in (11). This too follows, in the same way as (d), from the fact that non-triggers, non-targets cannot be referred to directly in a harmony rule, much less required to be present.

How will trans-laryngeal harmony be analyzed according to the DTH ? Recall that, on this view, two vowels can be strictly adjacent on the vowel tier no matter what consonants intervene. It follows then that any node in a vowel matrix may spread onto the next vowel across any consonant. Why only laryngeal consonants may intervene when Supralaryngeal or Place spreads becomes a mystery. Conversely, why only the spreading of Supralaryngeal and Place is subject to this sort of constraint is another mystery.

Let us examine in more detail the implications of the DTH for the analysis of Trans-Laryngeal harmony. The DTH can formalize the locality conditions of such rules only by referring explicitly to the fact that only the laryngeal consonants are neutral. Thus Chemehuevi Trans-Laryngeal Harmony 1, will have to be stated under the DTH as follows:

(19) Chemehuevi Trans-Laryngeal Harmony 1
(under the DTH)



Stated in English, the instructions of this rule are as follows: spread the Sl-node of a [+low] vowel onto a [-back] vowel; a consonant may intervene, if it lacks a Sl-node. Specific mention of the intervening consonant is necessary under the DTH-analysis because there is no formal reason why <u>any</u> consonant should block this assimilation rule. Perhaps (19) is not the only possible formalization of trans-laryngeal harmony under the DTH, but any other statement will have to share with (19) the explicit mention of neutral segments.

Once the DTH introduces statements like (19), it aquires enough descriptive power to formalize the non-existent types of trans-laryngeal harmony excluded in principle by the OTH. It can formalize (12) as a version of (19) by merely replacing spreading of a Sl-node with spreading of [-high]. It can formalize a trans-laryngeal harmony in which glottalization and voice specifications propagate along with supralaryngeal features: to do so, a DTH analysis need only state that the spreading must take place on the R-tier. The DTH can use statements like (19) to formalize a trans-laryngeal harmony in which the laryngeals are obligatorily present or in which only one laryngeal is neutral, to the exclusion of the other: but, again, these rule types are unattested.

The argument provided by trans-laryngeal harmony against the DTH is then double: on the one hand, the DTH must complicate the statement of harmony by introducing, in one form or another, an explicit mention of the set of transparent segments. We have seen that the OTH made such mention unnecessary. More decisively, the segmental locality constraints the DTH must resort to in order to formalize existing rules, make it possible to formalize non-existing rules as well.

5. An Overview

I have considered here one type of argument bearing on how to implement the idea of vowel/consonant tier separation. While my conclusions bear directly only on trans-laryngeal harmony, there is reason to expect that they will generalize to all harmony types: the OTH should make it possible to predict the range of locality conditions to which a rule is subject from the tier actively involved in it. Conversely, it should be possible, under the OTH, to determine which tier a rule operates on from the locality conditions that constrain it.

I have not discussed so far the evidence that made tier separation an attractive hypothesis in the first place or the extent to which the OTH can mimic the effects of tier separation. My comments on this score will only outline the more extensive discussion given this issue in a forthcoming paper (Steriade 1987b).

The OTH posits a vowel tier of sorts, exploiting the fact that the essential features distinguishing the members of most vowel inventories are the Dorsal features. Thus, an (a,e,i,o,u) vowel set can be described, with underspecification, as based on the underlying values [+high], [+back] and [+low]. In such a language, the nodes carrying all the distinctive features of vocalic segments will be the Dorsal nodes and these will be adjacent on their tier, even when velar segments intervene. It is notable then that the vowel tier effects observed in the literature (Saito (1981), Archangeli (1985), Ito (1985), Kenstowicz (1986)) come from languages whose underlying vowel systems can be described exclusively in terms of Dorsal features. If this is a viable generalization, then the distinction between the Dorsal and Velar articulators will provide the OTH with just enough descriptive power to characterize the vowel tier.

The OTH does not create a consonant tier. The features distinguishing the members of consonant inventories are not limited to place specifications but include also nasality, laryngeal features and stricture features. This means that the node on which one can compute the distinctness or identity of two consonants cannot be an Articulator node, as in the case of certain common vowel inventories, but must be the Root or Supralaryngeal node. The OTH predicts then that no total consonant-to-consonant assimilation will take place across vowels in any language; and, similarly, that no disharmony rule will be able to determine whether two consonants separated by vowels have identical Supralaryngeal or Root nodes. However, the OTH makes it possible to characterize the notion of discontinuous sequence of homorganic consonants and can describe assimilations and dissimilations involving consonantal articulators. Such phenomena have sometimes been mistaken as evidence for the consonant tier.

FOOTNOTES

[1] Archangeli (1984, 1985) (but see Archangeli and Pulleyblank 1986); Kenstowicz 1985; McCarthy (1986); Mester (1986); Prince (1986).

[2] On this point, see the discussion in Sagey (1986).

[3] The distinction between primary and secondary articulators is made by Sagey. One may represent palatalized consonants as having Dorsal (the typically vocalic articulator) as their secondary articulator. This opens up the possibility that velars may be palatalized, contrary to the predictions of the SPE feature model. Primary as well as secondary uvularization/pharyngealization is best dealt with in terms of the feature [ATR] or [Constricted Pharynx], as shown by Broselow (1976) and more recently by Cook (1986).

[4] Archangeli and Pulleyblank ((1986) and in this volume) propose a different implementation of the OTH: they add a constituent called the Secondary Place node, which dominates the typically vocalic features [high], [back], [low], [round] and [ATR]. The Secondary Place node is dominated directly by Place. The typically consonantal place features [anterior] and [coronal] are used to describe point of articulation in consonants. These features are also directly dominated by Place, without the mediation of Articulator nodes. Many arguments presented here in favor of the OTH will also carry over to the model advocated by Archangeli and Pulleyblank. I discuss in Steriade (1987) some points of difference between the two models, which emerge when rounding and [ATR] specifications in vowels are considered.

[5] Further rules requiring skeletal adjacency are discussed by Schein and Steriade (1986), who show that the condition of skeletal adjacency explains in a number of cases the incidence of geminate blockage effects.

[6] A distinct argument for Root harmony (as against copying) in Greek involves the syllabification of root-initial consonant clusters. See Steriade (1982: chapter 3).

[7] Michael Kenstowicz informs me that a similar argument has been made in Kidda (1982) on the basis of data from the broken morphology of Hausa adjectives.

[8] Ordering merger before reduction is independently required: the /ehe/ sequence derived by merger does not undergo VhV reduction, a fact that should be attributed to the fact that /ehe/ contains a multiply linked Place or Supralaryngeal node which induces geminate blockage (Hayes 1986, Schein and Steriade 1986). This explanation for the failure of /ehe/ to reduce requires that

merger be ordered before reduction, as suggested in the text.

9 David Nash has pointed out to me that a distinct source of possible /h/ ~ /?/ asymmetry is the fact that in many languages the historical/underlying source of /h/ is a segment like /s/, which does have supralaryngeal specifications. Additionally, /h/ may represent in many cases the transcription of a weakly articulated pharyngeal spirant rather than that of pure aspiration.

10 Since onsets are obligatory in word medial position, one should ask whether the /V?V/ sequences of Yapese are not derived from /VV/ by a common rule of /?/ insertion. If so, the Yapese data would be without relevance to our discussion. But Jensen (1977:25) shows that glottal stops are contrastive word-initially and occur pre- and post-consonantally in word medial position: it is therefore impossible to rule them out as underlying segments from intervocalic contexts.

11 To distinguish Supralaryngeal from Place spread, one would need languages in which (11) applies to vowel sequences that differ in nasality: Place spread predicts that nasality will not be transfered, whereas Supralaryngeal spread predicts that it will. This may turn out to be a moot point: Hayes (1986) suggests that nasality is part of the same component as the laryngeal features.

12 The reader may wonder why (12) cannot be successfully formalized within the format advocated here as the spreading of a single feature, [-high], between Supralaryngeal nodes required to be adjacent on their tier. This statement is not available to us because all direct stipulations of adjacency must involve prosodically defined units: feet, syllables or syllable terminals.

REFERENCES

Aoki, H. 1970 Nez Perce Grammar, UCPL 62.

Archangeli, D. 1984 Underspecification in Yawelmani Phonology and Morphology, MIT Ph.D. Dissertation.

Archangeli, D. 1895 "Yokuts Harmony: Evidence for Coplanar representation in Autosegmental Phonology", LI 16, 335-372.

Archangeli, D. and D. Pulleyblank 1986 "The Content and Structure of Phonological Representations", ms., University of Arizona and University of Southern California.

Bonneau, J. 1986 "/H/ and /?/ in Mohawk", ms. MIT.

Campbell, L. 1974 "Theoretical Implications of Kekchi Phonology", IJAL, 40, 269-278.

Clements, G.N. 1976 "Palatalization: Linking or Assimilation", CLS 12.

Furbee-Losee, L. 1976 The Correct Language: Tojolabal, Garland, New York.

Gensler, O. 1986 "Yurok" (a chapter of the Handbook of California Indian Language Phonologies, to appear), University of California, Berkeley.

Gibson, L. 1956 "Pame (Otomi) Phonemics and Morphophonemics", IJAL, 22, 242-265.

Goldsmith, J. 1979 "Subsegmentals in Spanish Phonology: An Autosegmental Approach", in W. Cressey and D.J. Napoli (eds.) Proceedings of the Ninth Symposium on Romance Linguistics, Georgetown University Press.

Hayward, D. 1984 The Arbore Language, Helmut Buske Verlag, Hamburg.

Ito, J. 1984 "Melodic Dissimilation in Ainu", LI 15, 505-513.

Ito, J. and A. Mester 1986 "The Phonology of Voicing in Japanese: Theoretical Implications for Morphological Accessibility" LI, 17, 49-73.

Jensen, J.T. 1977 Yapese Reference Grammar, The University Press of Hawaii.

Kenstowicz, M. 1986 "Multiple Linking in Javanese", NELS 16, 230-248.

Kiparsky, P. 1981 "Vowel Harmony", ms. MIT.

McCarthy, J.J. 1986 "OCP Effects: Gemination and Anti-Gemination", LI 17, 207-263.

McCarthy, J.J. 1985. "Features and Tiers: Semitic Root Structure Revisited", MIT talk.

Miller, W. 1965 Acoma Grammar and Texts, UCPL 40.

Newman, S. 1946 The Yawelmani Dialect of Yokuts in H.Hoijer et al. (eds.) Linguistic Structures of Native America, Viking Fund Publications in Anthropology No.6, New York.

Postal, P. 1969 "Mohawk Vowel Doubling", IJAL, 35, 291-298.

Press, M. 1979 Chemehuevi: A Grammar and Lexicon, UCPL 92.

Prince, A. 1986 "Tiers and Copying", ms. Brandeis University.

Robins, R.H. 1985 The Yurok Language: Grammar, Texts, Lexicon UCPL 15.

Rood, D.S. Wichita Grammar, Garland, New York.

Sagey, E. 1986 The Representation of Features and Relations in Autosegmental Phonology, MIT Ph.D. Dissertation.

Saito, M. 1981 "A Preliminary Account of The Rotuman Vowel System, " ms. MIT.

Salzman, Z. 1956 "Arapaho I: Phonology", IJAL 22, 49-56.

Schein, B. and D. Steriade 1986 "On Geminates", LI 17, 691-744.

Steriade, D. 1981 "Parameters of Metrical Harmony Rules", ms. MIT.

Steriade, D. 1982 "Greek Prosodies and the Nature of Syllabification," MIT Ph.D. Dissertation.

Steriade, D. 1987 "Vowel Tiers and Geminate Blockage", ms. MIT.

Steriade, D. 1987b "On The Vowel/Consonant Distinction", to appear in the Proceedings of the NIAS Workshop on Distinctive Features, Wassenaar 1986.

Trigo, L. 1987 (forthcoming) "Arapaho Harmony", ms. MIT.

Trubetzkoy, N. 1970 (=1938) Principes de Phonologie, translated by J. Cantineau, Klincksieck, Paris.