On the Description of Vowel and Consonant Harmony*

Languages with vowel (or consonant) harmony impose a limitation on the specification of certain features of vowels (or consonants) within a word. Finnish, for example, shows a vowel harmony in which the vowels of a word are either all grave (back) or all acute (front); *ulkoa* 'from outside', but *hyvää yöä* 'good night'. NW Karaite is reported to have a consonant harmony in which the consonants of a word are either all sharp (palatalized) or all plain (non-palatalized): *kunjadán* 'from days', but *kunjardan* 'from servants'.

Two different methods of describing vowel (consonant) harmony have been proposed by earlier investigators: one method (§1 below) treats harmony as a form of assimilation, whereas the other method (§2 below) treats harmony as a manifestation of an inherent property of root-morphemes. In this article we shall examine both methods of description and shall show the inadequacy of the description which regards harmony as a form of assimilation. Because of the almost exceptionless nature of vowel and consonant harmony in Classical (pre-sixteenth century) Mongolian, we shall confine our discussion to this language, although the nature of both methods of description is general and is applicable to languages such as Finaish or Turkish in which the harmony is somewhat obscured by concomitant phenomena.

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2. Thus, e.g., the regularity of vowel harmony in Turkish is obscured by the presence of a large number of Arabic and Persian loan words which do not show vowel harmony. R. Lees, *The Phonology of Modern Standard Turkish* (Indiana University Publications, Vol. 6 of the Ural and Altaic Series, The Hague, 1961), p. 14, is certainly correct in requiring a "diacritic" to distinguish native from borrowed morphemes. In Finnish, the harmony is obscured not only specially treated; cf., e.g., and *hallinen* (sub-standard).

3. *In this article phonetic discussion of the final consonant phonological features will be considered abbreviations of the complex": *vocalic* = *vocalic* + *vocalic* (vocalic + vocalic)

4. Thus, e.g., N. K. Grenoble and J. Kruten (1955), N. Tribes and other works, used the method to describe vowel languages (pp. 98, 93, 93, 51).
on of Vowel and Consonant Harmony

Segment: u i i o a ø
Diffuse: + + + - - -
Grave: + - + + - -
Flat: + + + + +

Table I. The Vowel Phones of Classical Mongolian

All segments are assumed to be specified [+ vocalic - consonantal]; omitted are specifications for the redundant features compact, striated, voiced, and so on.

In Classical Mongolian vowels in a word are either all grave or all acute, except that acute i occurs in words with both grave and acute vowels:
- Grave: uyuta 'bag'
- Acute: köbegü 'son, boy'
- i with grave: qubijin 'transformation'
- i with acute: kötelüri 'instruction'

§1. The first method of describing these facts is to require that the first vowel in a word be specified distinctively for gravity, and to predict the gravity of the remaining vowels in the word by application of an assimilation rule.

Mongolian is obscured not only by foreign loans but also by certain suffixes which must be specially treated; e.g., the suffix -laien with grave a in both tuullaien 'that kind of' and tälläinen (sub-standard täläinen) 'this kind of'.

In this article phonological representations are given in terms of feature complexes. For discussion of the feature theory used here, see Jakobson, "Observations sur le classement phonologique des consonnes," Selected Writings (The Hague, 1962), I, pp. 272-279; Jakobson, Fant, and Halle, Preliminaries; Jakobson and Halle, Fundamentals of Language (The Hague, 1956); N. Chomsky, "Review of Fundamentals of Language," International Journal of American Linguistics XXII (1957), 234-242. The latter symbols used throughout this article have no status in themselves and are to be considered abbreviations for distinctive feature complexes; thus a is an abbreviation for

<table>
<thead>
<tr>
<th>+ vocalic</th>
<th>- consonantal</th>
<th>+ vocalic</th>
<th>- consonantal</th>
</tr>
</thead>
<tbody>
<tr>
<td>diffuse</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>grave</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>flat</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

§4. This method of describing vowel harmony is used in standard works on Classical Mongolian; see, e.g., N. Poppe, Grammar of Written Mongolian (Wiesbaden, 1954), K. Grønbøck and J. Krueger, An Introduction to Classical (Literary) Mongolian (Wiesbaden, 1955), N. Trubetzkoy, Grundzüge der Phonologie (Göttingen, 1939) used this method to describe vowel harmony in Mongolian (p. 104), in Finno-Ugric and Turkic languages (pp. 88, 93, 95), and in other languages such as Ibo, Lambda, etc. (pp. 250-251).
This method of acco
of a grave, diffusel, no
words whose first vow
icgiri: ičA
but: čilayun: čil

In spite of the ini
for two reasons.
In the first place, thi
the velar harmony wh
vowels have grave vel
velars k and g. In oth
velar assimilation wo
adAG, degere 'above' f
from GailAn, gerid.

In the second place,
to which remaining ve
have chosen the final v
assimilation would th
roots) and in following
postulate both pro
postulation of both pr
just as natural (and ju
assimilation of vowels
§2. The second met
avoids the difficulties:
With each root we
binary feature GRAV
(+ GRAVE) or the n
fused with the binary i
is a phonological feat
features are properties
struct idiosyncratic pr

Although the descri
Mongolian contained tw
only in words with grave
vowels. See Poppe, Gramm
For further discussion of
7 F. de Sausure, Cours
on of vowel harmony in
8 A variant of the meth
Components," Structural
This method of accounting for vowel harmony requires the postulation of a grave, diffuse, non-flat vowel \( i \) in order to explain the existence of words whose first vowel is \( i \) and whose remaining vowels are grave: 6

\[ \text{ičegūri: ičAgUrI} \rightarrow 1 \rightarrow \text{ičegūri 'shame'} \]

But: \[ \text{ičλayun: ičλAyUn} \rightarrow 1 \rightarrow \text{ičλayun} \rightarrow 2 \rightarrow \text{ičλayun 'stone'} \]

In spite of the initial attractiveness of this description, we must reject it for two reasons.

In the first place, this description presents a difficulty in accounting for the velar harmony which accompanies vowel harmony. Words with grave vowels have grave velars \( g \) and \( \gamma \); words with acute vowels have palatal velars \( k \) and \( g \). In other words, within the framework of this description, velar assimilation would have to be both progressive (\( \text{adAy 'end'} \) from \( \text{adAG, dēgēre 'above'} \) from \( \text{deGArA, etc.} \) and regressive (\( \text{yadana 'outside'} \) from \( \text{GadAnA, gerūd 'tents'} \) from \( \text{GerUrD, etc.} \).

In the second place, the choice of the first vowel of the word as the vowel to which remaining vowels assimilate is arbitrary. We could equally well have chosen the final vowel of the root as the vowel specified for gravity; 7 assimilation would then occur both in preceding vowels (of polysyllabic roots) and in following vowels (of suffixes and endings). If we are required to postulate both progressive and regressive assimilation of velars, a postulation of both progressive and regressive assimilation of vowels seems just as natural (and just as arbitrary) as a postulation of only progressive assimilation of vowels.

§2. The second method of accounting for vowel and velar harmony avoids the difficulties associated with the method given above. 8

With each root we shall associate an abstract marker specified for the binary feature GRAVE. Each root will thus carry either the marker \( [\text{+GRAVE}] \) or the marker \( [\text{-GRAVE}] \). This marker is not to be confused with the binary distinctive feature grave. The distinctive feature grave is a phonological feature like vocative, diffuse, and so forth; distinctive features are properties of sound segments. The marker GRAVE is an abstract idiosyncratic property of roots, analogous to the markers ANIMATE,

6 Although the description given here is synchronic, it is interesting that Proto-Mongolian contained two diffuse, non-flat (unrounded) vowels—grave \( \text{i} \) which occurred only in words with grave vowels, and acute \( \iota \) which occurred only in words with acute vowels. See Poppe, Grammar, p. 11, and Grenbech and Krueger, An Introduction, p. 18. For further discussion of the vowel \( \text{i} \) in Proto-Mongolian, see §2 below.


8 A variant of the method given below may be found in Z. Harris, "Phonemic Long Components," Structural Linguistics (Chicago, 1951), pp. 125-149.
TRANSITIVE, and others; the markers ANIMATE, TRANSITIVE have primarily syntactic reflexes, the marker GRAVE primarily phonological reflexes.

If we associate this abstract marker with each root of the language, we no longer need to specify the feature grave for any vowel or velar. In addition to a specification for this abstract marker, we now require only the following basic vowel and velar segments:

<table>
<thead>
<tr>
<th>segment</th>
<th>U</th>
<th>I</th>
<th>O</th>
<th>A</th>
<th>G</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>vocalic</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>consonantal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>voiced</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>diffuse</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>flat</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>compact</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table II. THE VOWEL AND VELAR SEGMENTS OF CLASSICAL MONGOLIAN

Rule (1) of page 3 may now be written as follows:⁹

\[ \begin{align*}
(1a) & \quad [\vocalic \quad -\, \consonantal] \\
(1b) & \quad [\vocalic \quad +\, \consonantal \\
& \quad +\, \compact \\
& \quad -\, \stressed] \\
& \quad \rightarrow [\grave] \text{ when the root is specified } [\grave] \\
\end{align*} \]

⁹ In a formal description, rules (1a) and (1b) will be somewhat differently stated. We assume as a fact about language that each phonological segment of a word is associated with the abstract markers of the root. Since this is a general statement about language, independent of any one individual language, it may be stated once in the meta-theory of grammar and need not be stated in the individual grammars of each language. Given this, rules (1a) and (1b) assume the following form:

\[ \begin{align*}
(1a) & \quad [\vocalic \quad -\, \consonantal] \\
(1b) & \quad [\vocalic \quad +\, \consonantal \\
& \quad +\, \compact \\
& \quad -\, \stressed] \\
& \quad \rightarrow [\grave] \text{ in env: } [\grave] \\
\end{align*} \]

For theoretical discussion and justification of these assumptions about language, see N. Chomsky and M. Halle, *The Sound Pattern of English* (in preparation).

We will still require a acute vowel i. Applicative following type:

\[ \begin{align*}
\text{uyuta} & \quad [\text{the root is m} \\
& \quad \rightarrow 1b \rightarrow \text{uyuta}] \\
\text{kébégü} & \quad [\text{the root is KûbeGûn} \rightarrow 1] \\
\text{qûbiyan} & \quad [\text{the root is KûbiGûn} \rightarrow 1] \\
\text{kêtelbür} & \quad [\text{the root is Kêtelbûr} \rightarrow 1] \\
\text{ičegüri} & \quad [\text{the root is Gûri} \rightarrow 1b \rightarrow \\
& \quad \text{čilayūn} \quad [\text{the root is čilayûn} \rightarrow 1b] \\
\text{adayi} & \quad [\text{the root is a} \rightarrow 1b \rightarrow \text{adayi}] \\
\end{align*} \]

Rule (2) did not apply in some instances in which we may say Mongolian developed from...
ON THE DESCRIPTION OF VOWEL AND CONSONANT HARMONY

We will still require application of rule (2) in order to account for the acute vowel i. Application of these three rules will give derivations of the following type:

\[
\begin{align*}
\text{uyuta} & \quad [\text{the root is marked } (+\text{GRAVE})] : UGUA \rightarrow 1a \rightarrow uGua \\
& \quad \rightarrow 1b \rightarrow uyuta \\
\text{kőbegün} & \quad [\text{the root is marked } (-\text{GRAVE})] : KObAGUn \rightarrow 1a \rightarrow \\
& \quad \rightarrow KőbeGün \rightarrow 1b \rightarrow kőbegün \\
\text{gubiljan} & \quad [\text{the root is marked } (+\text{GRAVE})] : KUBilGAN \rightarrow 1a \rightarrow \\
& \quad \rightarrow KubiGan \rightarrow 1b \rightarrow gubiljan \rightarrow 2 \rightarrow gubiljan \\
\text{kölbelüri} & \quad [\text{the root is marked } (-\text{GRAVE})] : KOtAlBUrl \rightarrow 1a \rightarrow \\
& \quad \rightarrow Kötelüri \rightarrow 1b \rightarrow kötelüri \\
\text{içeği} & \quad [\text{the root is marked } (-\text{GRAVE})] : IċAGU I \rightarrow 1a \rightarrow iče-
\rightarrow Güri \rightarrow 1b \rightarrow içeği \\
\text{ciłąyn} & \quad [\text{the root is marked } (+\text{GRAVE})] : ĉIAlGUn \rightarrow 1a \rightarrow \\
& \quad \rightarrow ĉIaGun \rightarrow 1b \rightarrow ciłąyın \rightarrow 2 \rightarrow ciłąyın \\
\text{adeği} & \quad [\text{the root is marked } (+\text{GRAVE})] : AdA GI \rightarrow 1a \rightarrow adaGi \\
& \quad \rightarrow 1b \rightarrow adeği \rightarrow 2 \rightarrow adeği (\text{the end (accusative)})
\end{align*}
\]

Rule (2) did not apply in the grammar of Proto-Mongolian, in which grave i occurred in forms like gubiljan, ciłąyın, or adeği (cf. fn. 6). Diachronically we may say that in terms of vowel harmony, Classical Mongolian developed from Proto-Mongolian by the addition of rule (2).

§3. Returning now to general considerations, we can see that interpretation of harmony as an assimilation process leads us to question which segment is to be considered basic—whether the first vowel of the root, whether the second vowel of the root and so forth. In clear cases, such as the one presented by Classical Mongolian, the answer to this question will be arbitrary, and the resulting description will require complex statements of both regressive and progressive assimilation.\(^{10}\)

What is needed, then, is a linguistic formalization of statements which capture the notion of harmony, statements like “a Finnish word cannot contain both grave and acute vowels”\(^ {11}\) or “in some languages of the Far East the vowels of a word unit must be either all compact or all diffuse.”\(^ {12}\) The postulation of abstract morpheme-markers which, by application of

\(^{10}\) A formal statement of rules of this type for Turkish is given in Lees, The Phonology, pp. 53–54.


\(^{12}\) Jakobson, Fant, and Halle, Preliminaries, p. 41.
rules like (1a) and (1b), govern the specification of the harmonic features provides a means of formalizing these intuitively correct statements.

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ROBERT G. GOI

Late Mediae and Cho

A glance at the revisable popularity of form but in other centers of volitional change of basic principles of Art many linguists of the y dictum that the linguist psychological or other guistic symbols. The grammarians, American militant group of form pireist methodology \textit{analysis of the sounds} and the ordering the followers of Bloom from linguistics. Acco terest is in the higher logical now seems much of language, than do sentence, since it is v primarily manifested.

Many of the misund, turalists have now be the theoretical consequent In the process the i structuralism in so far prescriptive grammar,

\footnote{For a defense of this \textit{Language} XL (April–June, L}}

\footnote{Leonard Bloomfield, L}
A NOTE ON VOWEL HARMONY

KARL E. ZIMMER

In a recent article, Theodore M. Lightner argues for the description of vowel (and consonant) harmony in terms of markers (e.g., [+GRAVE], [-GRAVE]) that are associated with roots and to which phonological rules refer in such a way as to enter the appropriate values for the distinctive features involved in the feature complexes that underlie the words of the language. Thus, to use an example from Classical Mongolian given by Lightner, the rule

\[(1a)\]
\[
\begin{array}{c}
\text{vocalic, -consonantal, -diffuse, -flat} \\
\text{vocalic, +consonantal, +diffuse, +flat, +grave}
\end{array}
\]

\[(1b)\]
\[
\begin{array}{c}
\text{vocalic, -consonantal, -diffuse, -flat} \\
\text{vocalic, +consonantal, +compact, -strident, +voiced, +grave}
\end{array}
\]

\[\text{When the root is}\]
\[\text{specified (e.GRAVE)}\]

In which \(\alpha\) is a variable ranging over the values + and - will rewrite the root UGU\(\alpha\)A bog, marked [+GRAVE], as uyut\(\alpha\): Rule (1a) first enters the feature +grave for each segment to which it applies, i.e., it re-writes U (+vocalic, -consonantal, +diffuse, +flat) as u (+vocalic, -consonantal, +diffuse, +flat, +grave) and A

\[\text{The rule in question is formulated as:}\]
\[\begin{array}{c}
\text{[vocalic]} \\
\text{[consonantal]} \\
\text{[diffuse, flat, grave]}
\end{array}\]

\[\text{The terms in quotes are Lightner's. Strictly speaking, if}\ q\ \text{and}\ \gamma\ \text{are to be analyzed as +grave, while}\ k\ \text{and}\ g\ \text{are assigned the feature specification +grave, the latter pair of sounds should be palatal (as e.g., in Turkish). But in Mongolian the distinction seems rather to be one between posterior q and}\ \gamma\ \text{and midvowel k and g, and it is thus probably not the case that the 'velar harmony' involves the same distinctive feature as the vowel harmony, namely gravity. For the sake of the argument I shall, however, assume that the following feature specifications are correct:}\]

\[\begin{array}{c}
\text{q} \\
\text{\gamma} \\
\text{k} \\
\text{g}
\end{array}\]

\[\text{The first vowel of}\ t\ \text{is arbitral equally well can require a progressive vowel in suffix}\ \text{the non-final vo required.}\]

One of argument. The late progressive, namely the fact determined in the verse, and hence rule works hard to see if matters by ad rule for roots one that needed for suff more consonants by the same 1 which gravity consonant, is gravity, and t vowels and the progressive as would be derived outside would. From the point of view, it is seemingly of statements, the other to be found here.

\[\text{This is in t the rules for 'C as given in}\ \text{Modern Standards and}\ \text{The Hague, that Less' rules harmony involve assimilation, he}\]
first vowel of the root as the determining vowel is arbitrary; the last vowel could equally well have been chosen, which would require a progressive assimilation rule for the vowels in suffixes and a regressive one for the non-final vowels of the root. "If we are required," Lightner concludes, "to postulate both progressive and regressive assimilation of velars, a postulation of both progressive and regressive assimilation of vowels seems just as natural (and just as arbitrary) as a postulation of only progressive assimilation of vowels."

One can of course quarrel with this argument. There is a good reason to postulate progressive assimilation of vowels, namely the fact that suffix vowels can be determined in terms of root vowels but not vice versa; and since a progressive assimilation rule works for root vowels as well, it is hard to see why one should complicate matters by adding a regressive assimilation rule for roots to the progressive one that is needed for suffix vowels anyway. Furthermore, consonant harmony can be handled by the same rule if the first segment for which gravity is relevant, be it vowel or consonant, is specified distinctively for gravity; and the gravity of the subsequent vowels and velars' is determined in terms of progressive assimilation. 6 Thus aday end would be derived from adaG, while yadinu outside would be derived from γAdAnA.

From the point of view of traditional (= pre-generative) American phonology this would presumably constitute an undesirable mixing of statements, one relating to allophones and the other to full-fledged phonemes, but I am not concerned with that particular objection here.

(It is perhaps worth noting at this point, however, that for Classical Mongolian there is evidence that, to put it informally, the vowels are determined by a vowel harmony rule and then in turn determine the distribution of q and k and of γ and g. 6 Classical Mongolian has a seven-vowel system, in which all the possible combinations of high-low, front-back, and rounded-unrounded occur with the exception of 'high back unrounded' (i, which is assumed for an earlier stage, had merged with its front counterpart i by the Classical Mongolian period). Both of Lightner's rules, i.e. Rule (1a) and the rule given in footnote 4, generate a high back unrounded vowel, which is then re-written as a high front unrounded one by another rule. However, in Classical

1 I am using the term 'Classical Mongolian' in the sense in which Nicholas Poppe defines it in his Grammar of Written Mongolian (Wien, 1934), i.e. to refer to the language of the seventeenth and subsequent centuries (cf. Poppe 2). Lightner writes that he is describing 'Classical (pre-sixteenth century) Mongolian', which would seem to correspond to what Poppe occasionally calls 'the pre-classical language'. While it seems to me that the point I want to make here also applies to the pre-classical language, there are orthographic differences between the two periods which make the situation at the earlier stage somewhat less clear-cut (see below); but in any case the following remarks apply to Classical Mongolian of the seventeenth century, i.e. to the period after the orthographic reform.

A similar point can incidentally be made for Turkish on the basis of the by large predictable (in terms of vowels) distribution of the velar and palatal stops in loan words that violate vowel harmony (e.g. in guise newspaper, where the back vowel in the first syllable is followed by two front vowels, and which is thus not vowel-harmonic, the g stands, predictably, for a velar stop, while the g in gunah arm, which again is not a vowel-harmonic word, stands just as predictably for a palatal stop). There are a number of exceptions to this statement, and the distribution of the two laterals poses some additional problems, but it seems to me undeniable that rules (such as those given by Lees in the work referred to above) which treat vowel and consonant harmony together, and must therefore be prevented from applying to stems that violate vowel harmony, miss a valid generalization about the consonants.

(C, V)/C,
Mongolian only the letter representing either \( k \) or \( g \) (let us designate it by the symbol \( K \)), not the letters for \( q \) and \( \gamma \), occurs before \( i \) in both front-vowel and back-vowel words, so that it would appear to be the vowel \( i \) and not the general harmonic character of the word with respect to gravity that determines the phonetic nature of the consonants in question. One exception to this is the orthographic sequence \( \langle \gamma i \rangle \), which occurs just in case the \( \langle \gamma \rangle \) is stem-final and the \( \langle i \rangle \) is suffix-initial. I do not know whether this orthographic sequence should be taken as having represented at any time in the history of Classical Mongolian a phonetic sequence distinct from that represented by \( \langle Ki \rangle \) (where \( K \) has the value \( g \)) after a back vowel; it is certainly not infeasible to assume that its use has at all times been due to a convention which keeps the spelling of the stem constant in all its occurrences without necessarily thereby indicating phonetic invariance. With regard to the preclassical language the situation appears to be the following: \( i \) and \( i' \) were never distinguished orthographically (a distinction that is also absent in the Uyghur script on which the Mongolian one is based), but the occurrence of \( \langle K \rangle \) in front-vowel words and of \( \langle q \rangle \) and \( \langle \gamma \rangle \) in back-vowel words before the same letter \( \langle i \rangle \) is taken to be evidence of the existence of the \( i'i \) opposition at the time the writing system was developed, i.e., \( \langle i \rangle \) is assumed to have at one time represented both \( i \) and \( i' \). The spellings \( \langle q \rangle \) and \( \langle \gamma \rangle \) in back-vowel words, which were replaced by \( \langle Ki \rangle \) in Classical Mongolian, persisted throughout the preclassical period, but there seems to be no particular reason why one should believe that they represent, for that portion of this period which followed the \( i' > i \) merger, anything more than an orthographic tradition which no longer accurately reflected the phonetic facts. In other words, the conventions of the writing system need not, as far as I can see, be taken as evidence that the replacement of \( q \) by \( k \) and of \( \gamma \) by \( g \) in the environment in question took place as a development separate from and subsequent to the change of \( i' \) to \( i \), and that there was a stage at which \( q \) and \( \gamma \) occurred before \( i \).10

To return to the question of the choice of rules for the description of vowel harmony: Although Lightner's arguments in favor of what might be called root-marker rules for vowel harmony (and associated consonant harmony) do not, as I have attempted to show above, appear to be compelling, there may of course nevertheless be good reasons which would support the solution he advocates. One such reason would be furnished by the existence of languages with vowel harmony that have both prefixes and suffixes with determined vowels; clearly such languages would require both progressive and regressive assimilation rules for the affix vowels, whereas a single root-marker rule can handle both prefixes and suffixes.11 Languages that meet this requirement do in fact exist. One is Igbo, and as far as I can judge from looking at descriptions of the relevant data, the sort of rule proposed by Lightner would be eminently appropriate in this case (at least for what Joseph Greenberg calls the two 'principal grades' of vowels, characterized, according to him, by 'relative height' and 'relative lowness').12 Another language in which conditioning of vowels is both progressive and regressive is Ns Perce,13

1 For data relevant to the present argument cf. Poppe 14-15.
2 I am most grateful to James Bosson of the Department of Oriental Languages, University of California, Berkeley, for answering my many questions about Mongolian. The use I am making of the information with which he has provided me is of course my own responsibility.
3 In terms of general phonological theory one could presumably also argue that if rules for vowel harmony must in some cases determine the vowels of suffixes and in others those of prefixes, whether or not these occur in the same language, a type of rule that will deal with both cases equally is to be preferred to one that must take a different form in each of the two cases.
4 Cf. Joseph H. Greenberg, Vowel Harmony in African Languages, Actes du second colloque international (Dakar 12-16 av. J. Carnot African Languageberg, after screen paper, has just published article of African Stud. Tongue Boc. T (mimeographed, the articulator), Aaka, Igbo, etc. found not in rel. vs. laxness, but tongue, the v called 'relative neutralizer by a' while the 'relative neutralizer by a' feature.
5 Cf. Haruo and Proto-Saharan, Ns Per feature that th vowel harmony this case one 'root-markers'; marker' might.
and although the rules required for this language apparently require a formulation somewhat different from the one suggested by Lightner for Mongolian, what can be described as an essentially prosodic treatment seems to be indicated here too.13

A further argument for root-marker rules might be based on the criterion of economy of statement. Let us, leaving the 'velar harmony' aside, compare Rule (1a) and the corresponding assimilation rule, first adopting a general convention suggested by Lightner to the effect that each phonological segment of a word is associated with the abstract markers of the root. This convention enables us to re-state Rule (1a) simply as:

\[ [+\text{vocalic}] \rightarrow [\alpha \text{GRAVE}] \text{ in env.: } [\alpha\text{GRAVE}], \]

and it is now obvious that Rule (1a) mentions fewer terms than the assimilation rule, while the number of terms mentioned in the lexicon remains the same (a system that uses the assimilation rule must specify gravity for the first vowel of the root, while a system using the root-maker rule need not do so, but must specify a value for the marker [GRAVE]). What is not so clear to me is how a simplicity measure that relies on the counting of distinctive phonological features is to deal with root-markers. To assume that a root-marker is to be counted as equivalent to one phonological feature seems quite arbitrary—just as arbitrary, in fact, as counting it as .5, 2, 10, or any other number. I do not see, therefore, how the usual feature-counting measure can be applied in this case in any motivated way; which is not to say, of course, that some reasonable measure could not be devised that would assign a higher value to one of the rules in question in a non-arbitrary way.14

But quite apart from this problem, there is a strong point that can be made in favor of the root-marker rule, namely that it is not constrained, as is the assimilation rule, to refer to the quite irrelevant matter of intervening consonants between vowels. These consonants clearly have nothing to do with vowel harmony, and a rule should be given credit for not having to mention them. This appears to be a good reason for preferring the root-marker rule even though the question of establishing a rate of exchange for root-markers and phonological distinctive features remains in abeyance.

It would nevertheless be premature to assume that we should at this point give our wholehearted allegiance to the root-marker or prosodic school of thought, for in spite of Lightner's claim that "the nature of both methods of description is general and is applicable to languages such as Finnish or Turkish in which the harmony is somewhat

13 Cf. Haruo Aoki, Nez Perce Vowel Harmony and Proto-Sahaptian Vowels, to appear in Language. Nez Perce incidentally has the interesting feature that the morpheme which determines the vocal harmony of a word need not be the root. In this case one could therefore hardly speak of 'root-markers'; the more general term 'morphomarker' might be used instead.

14 In her article On System-Structure Phonology, Lg. 41:601-609 (1965), Victoria Fromkin advocates a prosodic solution to the description of vocal harmony in Twi on the grounds of both economy of features and general revealingness. She does not, however, discuss the problem of just what we should assume the 'feature-economic' value of prosodic markers to be.
obscured by concomitant phenomena [such as loan words], there are in fact types of vowel harmony for the description of which the root-marker type of rule would appear to be less appropriate than a directional assimilation rule.

One example of such a phenomenon is provided by the so-called labial harmony in Turkish. The relevant facts can be summarized as follows: Turkish has eight vowels, i e ọ i u o, the articulatory features involved being front-back, unrounded-rounded, and high-low. All eight vowels can occur in monosyllables and in the first syllable of roots with more than one syllable, but o and o do not occur in non-initial syllables of native roots or in suffixes (with the exception of the verbal suffix [-High Vlycr]). In terms of progressive assimilation the vowel harmony can be described by using two morphophonemes, I (representing the high vowel alternation i ~ ọ ~ i ~ u) and E (representing the unrounded low vowel alternation e ~ a), in non-initial syllables. With very few exceptions the vowels in words containing roots of Turkic origin will be either all +grave or all −grave; but any word with a rounded vowel in the first syllable will have vowels exhibiting the feature +flat only up to and including the vowel preceding the first E encountered in going through the word from left to right. Thus:

\[
\begin{align*}
\text{soml} & \rightarrow \text{somun} \quad \text{loaf} \\
\text{somIn-lmlz} & \rightarrow \text{somumuz} \quad \text{our loaf (acc.)} \\
\text{somIn-lmlz-I} & \rightarrow \text{somuanuz} \\
\text{tütIn} & \rightarrow \text{tütün} \quad \text{tobacco (acc.)} \\
\text{tütIn-lmlz-I} & \rightarrow \text{tütümüzi} \\
\end{align*}
\]

but:

\[
\begin{align*}
\text{somIn-lEr-lmlz-I} & \rightarrow \text{somularimizi} \quad \text{our loaves (acc.)} \\
\text{tütIn-lEr-lmlz-I} & \rightarrow \text{tütünderimizi} \\
\end{align*}
\]

Any E thus 'switches' +flat to −flat for the remainder of the word, and the description of labial harmony in Turkish is clearly best formulated in terms of a rule which refers to the immediately preceding vowel rather than to some marker associated with the word root, for any rule of the latter type would have to refer to the phonological environment too, in addition to incorporating a mention of a marker such as [+FLAT].

Let us now look briefly at gravity harmony in Turkish. As has already been remarked in words with roots of native origin are by and large harmonic with respect to this feature; however, there is a good reason for treating gravity harmony too in terms of a progressive assimilation rule, namely the fact that the vowels in suffixes occurring with non-harmonic roots are determined in the great majority of cases by the last vowel of the root (e.g. pilotlar 'pilots', büketler 'bouquets').

To sum up: While root-marker rules are clearly to be preferred for the description of vowel-harmonic phenomena such as encountered in Igbo, there do exist systems of vowel harmony, such as the labial harmony of Turkish, for which such rules are not an appropriate descriptive device and which require directional assimilation rules. In Mongolian there is apparently no obvious structural for both prefixes or of 'harmonization' on the other, one or the other as has been rules are in simpler, they would be eh golian. Such unmarked; assimilation; some language might Lighten the same sense (more adequate the basic for harmony.

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The entire American Jr and 1960 coper. This is one remeants man-speaking schelel. Books scientific publication a pleasant sc. The author Freie Univ linguists he pioneering u (Versuch on Kharia-Sperr has also writ can language 28.61).

Pinnow's 1 of contents

Karl-Heinz Guersey

The entire German literature on North American Indian languages between 1900 and 1960 consists of about half a dozen papers. This is a deplorable fact, especially if one remembers how great an influence German-speaking scholars—Buschmann, Gatschet, Boas—had during the beginnings of the scientific study of these languages. The publication of Pinnow's book, therefore, was a pleasant surprise to German Americanists. The author is Professor of Indology at the Freie Universität Berlin. To American linguists he is probably known best for his pioneering monograph on Munda linguistics (Versuch einer historischen Lautlehre der Khari-Sprachen, Wiesbaden, 1930), but he has also written two papers on North American languages (abstracts in TIAL 27, 259 and 28, 01).

Pinnow's book contains an extensive table of contents (v-viii), a foreword (ix-xiv), a long introduction with a detailed classification of the North American languages (1-34), a survey of the most important and characteristic features of the grammatical structures of these languages (35-93), then as an illustration of these features a text in Tlingit with extensive annotations (96-105), an appendix on writing systems developed for North American languages with four tables (105-112, 115-138), another appendix on transcription systems which are or were used by Americanists (118-118), a list of the more important languages with a selected bibliography (119-138), and finally two maps.

In his foreword Pinnow explains that he has written his book mainly for two groups of potential readers: first for those who are primarily interested in the culture and history of North American Indians but who also want to obtain some insight into the nature of the languages of these people; second for German linguists who want to obtain some orientation in these languages which, because of their highly complicated structures, radically different from European models, are of great importance for generalizations about the phonemen language. The disparity between these two kinds of readers was of course a great impediment to the author. On the one hand Pinnow had to explain such basic concepts as 'phoneme' and 'morpheme'; on the other hand he had to give information which was useful to the linguist also. Pinnow has mastered this difficulty as well as might reasonably be expected.

In his introduction Pinnow delineates the two main difficulties which everyone who wishes to become acquainted with North American languages has to overcome: first the fact that modern structuralist descriptions are inaccessible to a non-linguist because of their highly technical terminology, and second the great diversity of these languages. Then Pinnow gives a very detailed genetic classification but gives more subgroups, often down to the level of dialects. For each language he states in his classification the original
TWO PROPOSALS CONCERNING THE SIMPLICITY METRIC IN PHONOLOGY

1. A standard example for the influence of context on the variation of speech sounds is the determination of front and back allomorphs of the velar stops in languages like English. There must be few students of linguistics who have not been confronted in introductory courses with pairs like keep vs. cool or peak vs. Luke, give vs. good or dig vs. dog. A statement about this variation might take the form:

   1. A velar stop varies in the dimension front to back ( heaviness) according to the quality of the preceding or following vowel. How might this statement be rendered in a generative phonology of English, a theory which is intended to reflect generality of statement in shortness of rules? The best that we can do is the following.1

      Rule 1.1

      \[
      \begin{align*}
      [-\text{cnt}] & \rightarrow [\text{grv}] / [-\text{cns}] \quad [\text{grv}] \\
      \end{align*}
      \]

   1-The theory of phonology assumed here is essentially that developed by Morris Halle and associates, see Chomsky and Halle, 1968, and Harris, 1968. The features used in most of the examples follow modifications introduced by McCawley, 1967. Note in particular the use of the features high (hi); [-hi] replaces [-df] for vowels, [-df] [+comp], for consonants; the features obstruent (obst), sylablic (syl), and consonantal (eliminating vocalic) for a four-way classification of segments: vowels are [+syl, -cns], (and [-obst]); glides are [-cns,-syl] (and [+obst]); liquids and nasals are [+cns, -obst]; stops, spirants, affricates are [+obst] (and [+cns,-syl]);. An earlier version of this paper was read at the Winter meeting of the Linguistic Society of America, December, 1966. I am indebted to Robert T. Harris for discussion and clarification of many of the problems raised in the paper.

   It is apparent that we Generalization. For the abbreviatory devices, v the same way as a rule hypotetical statement:

   11. A velar stop varies in the dimension of a preceding v

      Rule 1.2

      \[
      \begin{align*}
      [-\text{cnt}] & \rightarrow \\
      [\text{hi}] & \rightarrow \\
      \end{align*}
      \]

   Hence, we should be able to have an extent to which English is more highly (given a low than II. My first ipation which can be applied to express the greater capture the obvious fact specified in both parts preceived by clearing the convention the will following. For a significant number of languages which can be adopted the proposed nato present some historical the neighborhood convention.

   2. Let us first state abbreviate by our conv First, the order of the if we have an environment must make some stipulations.

   With regard to the fi velar stops in English specification can apply occur between vowels make no difference, if the two vowels are diffe becalm, etc. It is appan
It is apparent that we have here another Case of the Missing Generalization. For the simplicity metric, making use of current abbreviative devices, would evaluate the above rule in exactly the same way as a rule we might write to express the following hypothetical statement:

II. A velar stop varies in graveness according to the graveness of a preceding vowel or the voicing of a following stop.

Rule 1.2

\[
\begin{array}{c}
\text{[cns]} \\
\text{[grv]} \\
\text{[cns]} \\
\text{[grv]}
\end{array}
\]

I think it is obvious that I is a more general statement than II. Hence, we should be able to express I in a form that is evaluated more highly (given a lower measure by counting feature specifications) than II. My first proposal is, then, a new abbreviative notation which can be applied in the first instance but not the second to express the greater generality of the first example and to capture the obvious fact that the same class of segments is specified in both parts of Rule 1.1. A rule like 1.1 will be abbreviated by eliminating the environment dash: a \( \rightarrow \) b/c. Let us call the convention the 'neighborhood' convention. My arguments will be the following. First, I shall exhibit what I believe to be a significant number of examples of situations in different languages which can be expressed in a simple fashion only if we adopt the proposed notation (or some equivalent). Second, I shall present some historical evidence which supports the claim that the neighborhood convention expresses a 'significant generalization.'

2. Let us first state exactly what it is that we are trying to abbreviate by our convention. There are two points to consider. First, the order of the environments can be significant. Second, if we have an environment consisting of several segments, we must make some stipulation about the order of these several segments.

With regard to the first point, let us consider what happens to velar stops in English when both parts of the environmental specification can apply, that is, when we have velar stops that occur between vowels. If the two vowels are the same it will make no difference, of course. But consider examples in which the two vowels are different: buggy, eager, Augie, bookie, Rocky, becalm, etc. It is apparent that it is the second vowel which de-
terminates the value of the stop. Thus, we tentatively decide that
the abbreviation will be an abbreviation for the sequence of rules
giving a value first after and then before a given environment,
since whatever value is given to a segment which follows the
determining segment, it will be changed by the second rule ab-
abbreviated by the convention.

Second, suppose we have a rule that involves an environment
consisting of several segments, schematically 'a₁a₂...aₙ.' The
question is this: Given an abbreviated rule 'c → d / a₁a₂...aₙ
should this be defined as the abbreviation of Rule A or B?

A. c → d / \begin{align*}
\{ & a₁a₂...aₙ \cr
& \underline{a₁a₂...aₙ} \}
\end{align*}
B. c → d / \begin{align*}
\{ & a₁a₂...aₙ \cr
& \underline{aₙ...a₂a₁} \}
\end{align*}

There seems to be fairly clear evidence that the second alterna-
tive is correct, that is, that the neighborhood abbreviation should
be read 'after a certain environment or before the mirror-image of
that environment.' I shall present below several cases where this
decision works. I know of no rules involving a sequence of se-
veral segments where a particular specification is made after or
before that sequence in the same order (which seems inherently
implausible).

3. Let us now consider some examples of rules of this sort
drawn from a number of languages. My reasoning here is that a
notational convention can be partly justified by finding many
examples of its use. It is true, as Kiparsky (1968) has argued,
that there is no limit to the number of absurd notational conven-
tions that could be invented and for which widespread 'use' could
be found in the languages of the world. Thus, the value of ex-
amples such as those given here is dependent partly on the feel-
ing of the linguist that what is expressed is somehow a valid
generalization. Beyond that, however, the examples have a cer-
tain negative evidential value in that we would be suspicious of
abbreviatory conventions for which we could not find fairly wide-
spread employment.

3.1. The following statements are frequently made about the
assimilations of voicing of stops and spirants in Modern Dutch

(e.g. Koolhoven 1962:19
I. In a sequence of so is the other.
II. In a sequence the voicing value of the
III. A sequence of t
The regularities underlying by two ordered rules:

Rule 3.1  [ +obst ]
[ +cnt ]

Rule 3.2  [ +obst ]

In the first rule all split
other obstruents. In the
they occur in the envi-
rants will not under-
voiceless.

Without the use of t
ecessary to repeat the
would be no way to
achieved in the rules if
were made voiceless. If
obstruents were voiced a
be noted that the order
viated rules) can play a
lar value is assigned for
settling the quest.
rules involving Gre-

2. Aart Kuipers has p o l
about Dutch are overs im-
least, there appears to be
in compounds and must tel
ever turn out to be the st
statements above in sev e
but it is likely that the
cluding some necessary re
Thus, we tentatively decide that condition for the sequence of rules in a given environment, a segment which follows the hunged by the second rule absent that involves an environment schematically \( a_1a_2...a_n \). The violated rule \( c \rightarrow \text{d} / a_1a_2...a_n \) and violation of Rule A or B?

\[ a_1a_2...a_n \]

\[ \text{d} / a_1a_2...a_n \]

Hence that the second alternation neighborhood abbreviation should or before the mirror-image of any several cases where this involving a sequence of the specification is made after or order (which seems inherently examples of rules of this sort. My reasoning here is that a by justified by finding many Kiparsky (1968) has argued, of absurd notational convention which widespread 'use' could world. Thus, the value of ex-dependent partly on the feel-expressed is somehow a valid er, the examples have a certainty we would be suspicious of we could not find fairly wide-

frequently made about the mild spirants in Modern Dutch (e.g. Koolhoven 1962:19). 2:

1. In a sequence of two stops, if one of the stops is voiced, so is the other.
2. In a sequence of a stop and a spirant, the stop determines the voicing value of the spirant.
3. A sequence of two spirants is always voiceless.

The regularities underlying these statements can be characterized by two ordered rules:

Rule 3.1

\[
\begin{align*}
\text{+obst} \rightarrow \text{+vce} \\
\text{-obst} \rightarrow \text{-vce}
\end{align*}
\]

Rule 3.2

\[
\begin{align*}
\text{+obst} \rightarrow \text{+vce} \\
\text{-obst} \rightarrow \text{-vce}
\end{align*}
\]

In the first rule all spirants are made voiceless in clusters with other obstructions. In the second rule all obstructions are voiced if they occur in the environment of a voiced stop. Clusters of spirants will not undergo Rule 3.2, hence will correctly remain voiceless.

Without the use of the neighborhood convention, it would be necessary to repeat the specifications in each environment. There would be no way to distinguish the degree of generalization achieved in the rules from that of two rules in which, say, spirants were made voiceless before obstructions or after glides and obstructions were voiced after voiced stops and before /r/. It should be noted that the order of expansion (i.e. the order of the abbreviated rules) can play no role in rules like these where a particular value is assigned to a feature. Hence, the crucial examples for settling the question of ordering will have to be found in rules involving Greek-letter variables (for assimilations and the like).

---

2: Acc. Kiparsky has pointed out to me that the statements made here about Dutch are oversimplified and perhaps incorrect. In his dialect, at least, there appears to be a terminal devoicing rule which operates within compounds and must take effect before the rules given above (or whatever turns out to be their correct formulation). Since I have seen the statements above in several published sources, I have left them stand, but it is likely that they must be modified at least to the extent of including some necessary restriction by means of various boundary elements.

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3.2. In Modern German, clusters of obstruents are always voiceless within morphemes (and 'words' suitably specified by means of the appropriate boundaries—i.e. there can be sequences of voiceless and voiced obstruents only within compounds). Hence, whenever we have such a cluster it is not necessary to specify the feature of voicing in the underlying segments. We can add this specification by the rule.

Rule 3.3. \([-\text{obst}] - [-\text{vce}] / [-\text{obst}]\)

This rule states the fact noted above in the most direct possible way. Suppose we do not have some such device as the neighborhood convention. Using the usual formalism, we would have to repeat the environmental specification twice and again the rule would not reflect the obvious generalization. An alternative formulation might use the framework of a Structural Description and Structural Change:

Rule 3.4. SD: \([-\text{obst}] / [-\text{obst}]\)

SC: 1, 2 → \([-\text{vce}]\)

The defect of this notation is that there is no obvious way to show that it is more general than a rule with the same SD but a different SC, say '1 - [-vce]', in which only one of the segments is affected. Since there are independent reasons for using the neighborhood abbreviation, there is no need to set up a special stipulation for evaluating rules like 3.4.

It should be noted that rules like those given above must be assumed to be embedded within a full analysis of the phonological system of the language in question (in so far as we can anticipate it) and must apply at the appropriate place in the sequence of rules. Thus, in German the phonetic obstruent [v] would seem to provide counter-evidence to the claim made since we have forms like Zwei, quer with [t+\text{v}, kv] and the like. But there are various reasons for considering phonetic [v] in German as derived from an underlying semivowel /w/ (or perhaps even vowel /u/). The rule above is one small part of the justification for this analysis (Ross 1967, Bach and King, 1966). Further, anomalous forms like Dauchor, Dachuk will be marked as exceptions to the rule (note that in popular speech they usually have [t^\text{s}]).

3.3. Examples like those cited in 1 (front and back allophones of velars) can be matched by many neighborhood assimilations at the level of phonetichood of rounded (flat) \(\text{v}\) more or less rounded. I suspect such a situation labiovelars as plain \(\text{v}\). Similarly, in Russian thinned by the presence of environment (Halle 1955) convention proposed here 3.4. Let us consider a languages exhibit a series way that the vowels can such that more common instance, in Modern Grz the following rule apply

Rule 3.5

\[ \text{v} \rightarrow \text{null} / \]

That is, any vowel is eliding morpheme boundary vowel except /a/ and ": interesting since it sho two abbreviatory device Peters). That is, if we and then into

we will get the right re-vision of our first example of our notation. Any suc of this character and it dealing with such pheno
obstruents are always voice-suitably specified by means there can be sequences of y within compounds). Hence, is not necessary to specify lying segments. We can add

obstruents are always voice-suitably specified by means there can be sequences of y within compounds). Hence, is not necessary to specify lying segments. We can add

3.1. Let us consider next rules of vowel elision. A number of languages exhibit a series of rules for eliding vowels in such a way that the vowels can be set up in a hierarchy of 'dominance' such that more dominant vowels elide less dominant ones. For instance, in Modern Greek (Koutsoudas 1962:16-17) it seems that the following rule applies:

Rule 3.5

\[ V \rightarrow \text{null} / \begin{cases} a \\ u \\ i \end{cases} \]

That is, any vowel is elided by a neighboring /a/ with intervening morpheme boundary (+), any vowel except /a/ by /o/, any vowel except /a/ and /o/ by /u/ etc. This rule is especially interesting since it shows the necessary order of expansion of two abbreviative devices (this was pointed out to me by Stanley Peters). That is, if we expand the environment above first into

\[ \begin{cases} a+ \\ o+ \\ u+ \\ i+ \end{cases} \]

and then into

\[ \begin{cases} a+ \\ -o+ \\ -u+ \\ -i+ \end{cases} \]

we will get the right results, otherwise not. Also, Rule 3.5 provides our first example in support of the 'Mirror-image' character of our notation. Any such rule working across a boundary will be of this character and it is difficult to imagine a rule of the form

\[ a \rightarrow b / \begin{cases} c+ \\ -c+ \end{cases} \]

dealing with such phenomena (e.g. a certain vowel is elided if it
follows a second vowel with intervening boundary or if it precedes the second vowel in prefinal position.

Similarly, in Amharic (extrapolating slightly from the statement in Obolensky et al., 1964:24) the three central vowels reduce when they occur together according to the hierarchy (from most to least dominant): a > i. We can give the following rule to account for these elisions:

\[
\begin{align*}
\text{Rule 3.6} & \\
[+\text{sy}] & \rightarrow \text{null} / \begin{cases} 
[+\text{sy}] \\
[+\text{cmp}] \\
[-\text{hi}] \\
[-\text{hi}] \end{cases} + 
\end{align*}
\]

(Note the order of expansion: first the braces are placed around the segment brackets:

\[
\begin{cases} 
[+\text{sy}] \\
[+\text{cmp}] \\
[+\text{sy}] \\
[-\text{hi}] \\
[-\text{hi}] \end{cases} + 
\]

then we proceed as above. I am assuming it is not necessary to specify [−tns] or whatever is used to distinguish the central vowels because of rules inserting glides between other vowels.)

3.5. A number of languages like German exhibit neutralization of voicing oppositions and the like before word boundaries. Sometimes, however, such neutralizations (as well as allophonic variations) are determined merely by the presence of a word boundary (hence, the common phrase in phonological descriptions ‘initially and finally’). Thus, in Tubalalabal voiced stops and affricates occur only in ‘intersyllabic, syllable-initial position’ (Swadesh and Voegelin 1939), and we may state a rule:

\[
\begin{align*}
\text{Rule 3.7}. & \\
[−\text{cnt}] & \rightarrow [+\text{vce}] / \begin{cases} 
\neq \\
[+\text{obst}] \end{cases} + 
\end{align*}
\]

Similarly, in Amharic geminate consonants are simplified initially and finally (but only after a rule lengthening vowels before single consonants.

I have by no means exhausted the number of examples of situations where neighborhood rules seem to offer the best method of expressing the regular logical rules. One part of various kinds of ‘voe’ the second convention to cussion until a later part 4. So far my argument have been of two s based on the ‘linguist’s than another. And on the examples that show that us now consider some s that the convention does tions.’ This evidence is 4.1. An important type special rule becomes gen is a matter of historical observed in the making. On Marshal’s Vineyard ‘/ay/’ was followed by a the environment of a rul vowel ‘/a/’ was simpl graveness specification:

---

4. See Becker 1967 for s dialects. In a paper read at Kazazis discussed an inter reduction of ‘/i/’ to a glide layer of vocabulary the ord convention posited here, it opposite. This would seem sider in line with the ques of such rules as considera verse the values for ‘syl’ i then the order of environ holtz (personal communic which can be neatly han sumably to be discussed in It may be, incidentally, the clude more constraints on particular orders of environ actual segments specifi ing steps, but in most lang lowed by (nonsyllabic) has occur, e.g. German Bank ("
rvening boundary or if it precedes
ating slightly from the statement
the three central vowels reduce
ling to the hierarchy (from most
in give the following rule to ac-
\[
\begin{aligned}
&\{+syl\} \\
&\{-cmp\} \\
&\{-hi\}
\end{aligned}
\]

st he braces are placed around

\[
\text{assuming it is not necessary to}
\text{sed to distinguish the central}
glides between other vowels.}

German exhibit neutralization
like before word boundaries.
izations (as well as allophonic
by the presence of a word
in phonological descriptions
Tubatulabal voiced stops and
metric, syllable-initial position
we may state a rule:

\[
\left\{ \begin{array}{c}
\ne
\{\text{tabst}\}
\end{array} \right\}
\]

sonorants are simplified initially
thening vowels before single
a number of examples of situa-
to offer the best method

on Anheiric by Marvin Bender of

of expressing the regularities apparent at various levels in phonological rules. One particularly interesting set of facts are those of various kinds of 'vowel harmony,' but since such rules involve the second convention to be considered here, I shall defer dis-
cussion until a later part of this paper (7.).

4. So far my arguments in favor of the neighborhood convention have been of two sorts. On the one hand, they have been based on the 'linguist's intuition' that one rule is more general
than another. And on the other hand, I have given a sampling of examples that show that the convention is a useful device. Let us now consider some stronger evidence in support of the idea that the convention does indeed capture 'significant generalizations.' This evidence is drawn from the history of German.

4.1. An important type of sound change is that in which a
special rule becomes generalized. That such changes take place
is a matter of historical fact. Moreover, such changes have been
observed in the making. William Labov (1965) cites two cases.
On Martha's Vineyard a centralization of the first element of
/ay/ was followed by a centralization of /aw/, that is to say,
the environment of a rule producing this variant of the compact
vowel /a/ was simplified —i.e., generalized—by dropping the
graveness specification.

4-See Becker 1967 for several instructive examples in three German
dialects. In a paper read at the Winter meeting of the LSA, 1966, Kastas
Kazazis discussed an interesting problem in Modern Greek involving
the reduction of /i/ to a glide before and after another vowel, where in one
layer of vocabulary the order of environments is as in the neighborhood
convention posited here, in the other ('nonlearned' forms) it is just the
opposite. This would seem to be an especially interesting case to con-
sider in line with the question of historical evidence for the generality
of such rules as considered in the next section. Note also that if we
reverse the values for 'syl' in this case, that is, start with underlying /i/,
then the order of environments will be just the opposite. James Fidel-
holtz (personal communication) has pointed out several cases in Micmac
which can be neatly handled with the neighborhood convention, pre-
sumably to be discussed in his M.I.T. dissertation on Micmac phonology.
It may be, incidentally, that when phonological theory is enriched to
include more constraints on the substance of rules, it will turn out that
particular orders of environment and affected segment will depend on the
actual segments specified. Thus, nasals typically assimilate to follow-
ing stops, but in most languages that I know of where stops can be fol-
lowed by (nonsyllabic) nasals, the corresponding assimilation does not
occur, e.g., German Bank ([gk]) but Knabe ([kn]).
In this case, the simplicity metric (based on counting feature specifications) correctly reflects the greater generality of the second environment. Similarly, in New York (Labov 1965:106) raising of /eh/ (in Labov's transcription) was followed by raising of the corresponding non-rhotic vowel /oh/. For an example from history we may cite the change of ß (orthographic th, dh, d etc.) to ð in Old High German, which took place first medially and finally and then was generalized to all positions (Braune-Mitza 1963: §§ 166-7).

A consideration of the way in which languages are learned and rules borrowed makes the process of rule generalization seem quite natural. Suppose—as in the cases given by Labov above—that there are two closely related and contiguous dialects A and B and that A is a more prestigious dialect in some sense. Suppose that dialect A undergoes a sound change of a very restricted sort, adding a late phonetic rule with a special environment, say, one lowering high front vowels if immediately followed by [n]. It may happen then that speakers of B under the influence of A will add a new rule to their grammar. On a priori grounds it seems likely that such a new rule will be at least as general as the rule of A, quite possible that it will be more general, highly unlikely that it will be more special. Thus, in the case considered speakers of B might add a rule lowering both /i/ and /u/ before [n], or the same before any nasal (any segment marked [nas]). We would not expect them to add a rule with a more restricted environment such as 'before a cluster of [n] and a stop,' or 'between [b] and [n].' For to suppose the latter we would have to imagine that speakers of B heard just the accidental set of forms that would be covered by such a rule, and furthermore added a rule formulated to cover exactly the heard forms. (Cl. Hams, 1966a and 1967 for discussion and examples of the process of rule generalization.)

These considerations point up what I believe to be the fallaciousness of the following kind of argument. A very general sound change takes place in a certain dialect. Contiguous dialects show (with increasing distance) more and more specialized instances of the same phenomena. The argument is then that the change originated in the area that shows the most general form of the rule and spread ly becoming attenuate. Some examples of this monophthongization of Saxon, and the NHG di typical arguments of th 70. Thus in Old Saxon where, but in the OHG i ting that there is a dis account we must imagin conservatively borrowed r before /x r w/ and /x me obvious that quite t obtained.

Kiparsky (1968) has view according to whic ized form (while chil guage—we might call th Taxonomic Adults). As one example—NHG diph two theories leading claims, we must look to tion. The cases given claim directly. In the hi mentary evidence, in th there does not seem to other, while the High mand a full-scale stud though with interpretati evaluate the statements clear cases of rule gene zation, I conclude that me mechanism and use the

5 We have much fuller g than for Old Saxon. It is po from about 765 (Braune-Mit at about 830, the Genesis later and most of the same centuries (Haithausen 1921 do no more than raise ques by detailed philological wor
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of the rule and spread from the area of 'strongest' effect gradually
becoming attenuated as it spread (like ripples in a pond).
Some examples of this are the High German sound shift, the
monophthongization of ai and au in Old High German and Old
Saxon, and the NHG diphthongization of high tense vowels. (For
typical arguments of this sort we may take A. Bach 1956: §§ 59,
70). Thus in Old Saxon ai and au were monophthongized every-
where, but in the OHG area only in special environments. Assum-
that there is a direct connection, to believe the traditional
account we must imagine that speakers of Old High German con-
servatively borrowed rules in such a way as to apply them only
before /x r w/ and /x r/ and dentals respectively! It seems to
me obvious that quite the opposite direction of spread must have
obtained.

Kiparsky (1968) has stated an almost diametrically opposed
view according to which adults borrow rules in a more special-
ized form (while children generalize when learning their lan-
guage—we might call this the Theory of Generative Children and
Taxonomic Adults). As Becker (1967) has pointed out, Kiparsky's
one example—NHG diphthongization—breaks down. Since we have
two theories leading to opposite interpretations and factual
claims, we must look to independent evidence to settle the ques-
tion. The cases given by Labov seem to contradict Kiparsky's
claim directly. In the historical examples we must consider docu-
mentary evidence. In the case of the German monophthongization
there does not seem to be any clear evidence one way or the
other, 6 while the High German sound shift would obviously de-
mand a full-scale study. Most accounts are shot through and
through with interpretations so that it is exceedingly difficult to
evaluate the statements made in the handbooks. Since there are
clear cases of rule generalization and no clear cases of speciali-
ization, I conclude that the former type of change is the expected
mechanism and use the hypothesis as a necessary part of the

5 We have much fuller and older documentation for Old High German
than for Old Saxon. It is possible to follow the change in OHG documents
from about 765 (Braune-Mitzka 1963: §§ 43, 45). The OS Halland is dated
at about 830, the Genesis is later but the manuscripts are considerably
later and most of the smaller texts come from the tenth and eleventh
centuries (Holtzhausen 1921: §§ 13-20). As with the HG sound shift I can
do no more than raise questions here that must be answered if possible
by detailed philological work.
argument below. (To say that rules can be both generalized and specialized without adding some further factors determining one or the other effect is, of course, to say exactly nothing. For some discussion of this whole problem see Becker 1967).

4.2. If the above reasoning is correct, then various sound changes that can be expressed as differences in rules can be used as evidence for the hypothesis that the neighborhood convention expresses a significant generalization.

In the OHG area, the following sound changes took place in the order given (over a period of about 200 years, the last two approximately contemporaneous):

A. \( ai > ei \)
B. \( au > ou \)
C. \( ua > uo \) (<\( \beta_2 \))
D. \( ia > ie \) (<\( \beta_2 \))

It is crucial to the following argument to show that these sound changes have their counterparts throughout the period as actual synchronic rules in the phonology of the language. The full justification for this cannot be presented here but only briefly sketched. The evidence for the first two involves a consideration of the system of rules for the forms of strong verbs, which in Old High German (as in all the older Germanic dialects) are still completely phonologically predictable. The assumption of underlying diphthongs of the form ou, ai (or possibly aw, ay) can be shown to yield a simpler set of rules for the preterit and past participle forms, since we have complete parallelism throughout for the first three classes (and partial parallelism for all of the first five classes—note that \( T \) is derived from underlying \( ei \)):

I. ret- ret- ret-
   II. fleug- flaug flug- (-flug-)
   III. helf- helfe half- (-half-)
   IV. stel- stel- stel-
   V. gab- gab-

With some simple rules of adjustment of the sort considered here all the strong verbs can be handled with two or three rules. The total set of rules then can be shown to be much simpler than would be the rules which did not incorporate the synchronic correspondents to A and B above. Further support comes from the rules for \( e/u \) umlaut. The \( ua \) and \( ia \) are not underlying forms but intermediate between systematic phonemic and phonetic. The justification of rules corresponding to C and D is rooted in the treatment of the so-called ‘reduplicating’ verbs (which again can be made quite simple).

Now, the series of just a progressive ger

Rule 4.1 \([+syl] +\text{cmp}\]

Rule 4.2 \([+syl] +\text{cmp}\]

Rule 4.3 \([+syl] +\text{cmp}\]

Rule 4.2 is more gene counting Greek letter minuses. But 4.3 can if we adopt the neigh evaluated as more get way that the environm rule as 4.2.

5. The second sit which the determining from the segment under segments. Consider th
I. A mid front \( c \) followed by a high for
II. A mid front \( o \) high front vowel.

Since Statement I in would appear to be me following:

Rule 5.1 \([+syl] +\text{grv} +\text{cmp}\]

Rule 5.2 \([+syl] +\text{grv} +\text{cmp}\]

I am not aware of any like ‘X’ in the simpli choose to count them than 5.1. If we do not, in either case the grethe metric.

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- lbg: (-flag)
- ulf: (-half)
- -stal-

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C and D is rooted in the
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be made quite simple).

Now, the series of changes given above can be shown to be
just a progressive generalization of a single rule:

Rule 4.1
\[ [+syl] \rightarrow [-cmp] / \rightarrow [-cns] \rightarrow [l-grv] \]

Rule 4.2
\[ [+syl] \rightarrow [-cmp] / \rightarrow [-cns] \rightarrow [hi] \]

Rule 4.3
\[ [+syl] \rightarrow [-cmp] / \rightarrow [-cns] \rightarrow [hi] \]

Rule 4.2 is more general than 4.1 if we incorporate some way of
counting Greek letter variables as less costly than pluses or
minuses. But 4.3 can be counted at least as general as 4.2 only
if we adopt the neighborhood convention. Furthermore it can be
evaluated as more general than 4.2 only if we stipulate in some
way that the environment dash '---' is to be counted in such a
rule as 4.2.

5. The second situation I would like to consider is that in
which the determining environment for some rule is separated
from the segment undergoing the rule by an irrelevant stretch of
segments. Consider these two statements:

I. A mid front vowel becomes high front when immediately
followed by a high front vowel.

II. A mid front vowel becomes high front when followed by a
high front vowel.

Since Statement II includes Statement I as a special case it
would appear to be more general. Yet as rules we have the fol-

Rule 5.1
\[ [+syl] \rightarrow [-hi] \rightarrow [-syl] \rightarrow [-hi] \]

Rule 5.2
\[ [-syl] \rightarrow [-hi] \rightarrow [-syl] \rightarrow [-hi] \]

I am not aware of any discussion in print of the role of variables
like 'X' in the simplicity metric (but see Harms 1968). If we
choose to count them then 5.2 will be evaluated as less general
than 5.1. If we do not, then the two rules will be equally simple.
In either case the greater generality of 5.2 is not expressed by
the metric.
Let us consider, then, that a rule like 5.2 is to be counted as simpler than a corresponding rule without the variable X. A discussion of the exact details of this evaluation seems somewhat academic at the moment, in view of the many problems involved in deciding how to count symbols like 'C_o', 'C_f', and the like. Since 'X' is defined to be any sequence of segments 'a_1, a_2 ... a_n' with n ≥ 0, we may think of the measure as stipulating that we count in some manner the concatenation sign which is 'officially' present in the Rule 5.1:

\[
\text{Rule 5.1:} \quad \begin{array}{c}
\text{\texttt{(syl)}} \\
\text{\texttt{(syl)}} \\
\text{\texttt{hi}} \\
\text{\texttt{grv}} \\
\end{array}
\]

but covered by the variable in 5.2.

Note that the notion of having rules of various 'levels' (depending on the hierarchy of boundary symbols, that is, morpheme-level, word-level rules, etc.), makes it unnecessary to add any special stipulations about the boundary symbols that may be covered by 'X'. Further, a rule like 5.2 makes no sense without such a hierarchy of levels. If 5.2 is a word-level rule then the stretch covered by 'X' may contain any boundaries lower than word boundaries, if phrase-level, then any boundaries lower than phrase level and so on (on the hierarchy of boundary-symbols see McCawley 1965, also Harms 1968).

5.1 Since I am not introducing a new notational convention here, but rather suggesting a method of evaluating rules involving an already widely used device, it will be unnecessary to adduce examples in any great number. The most obvious use for variables like 'X' is, perhaps, in rules for vowel-harmony and the like, where a value of some segment determines the value of all the other segments of a certain type in a 'word.' The two rules for vowel harmony in Turkish, for example, differ precisely in that 'graveness-harmony' involves an X-variable, while 'flatness-harmony' does not:

\[
\text{Rule 5.3:} \quad \begin{array}{c}
\text{\texttt{(-syl)}} \\
\text{\texttt{(-grv)}} \\
\text{\texttt{(syl)}} \\
\end{array}
\]

\[
\text{Rule 5.4:} \quad \begin{array}{c}
\text{\texttt{(-syl)}} \\
\text{\texttt{(-hi)}} \\
\text{\texttt{(-grv)}} \\
\end{array}
\]

Thus, two forms like gelsikleri 'their having come' and gülükleri 'their having laughed' (Swift 1963:46) harmonize throughout in graveness, but the flatness of a sequence of high vowels is deter-mined by the immaterial rewrite 5.4 with 'X' for X-rules are rules and the like. I return 6. Once again we are involving an 'X' is mal-able.

The regular correspondence analysis of the Ablaut above together with a dialects shows that the following form:

\[
\text{Rule 6.1:} \quad \begin{array}{c}
\text{\texttt{(+syl)}} \\
\text{\texttt{(-cmp)}} \\
\text{\texttt{(-grv)}} \\
\end{array}
\]

This rule remains syntactically for essentially the same reason. Apparently later in the development...
le like 5.2 is to be counted as without the variable $X$. A dis-
iss evaluation seems somewhat of the many problems involved
like $C_0$, $C_1$ and the like.
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$$
\begin{align*}
\text{-syl} & \\
\text{-cmp} & \\
\text{-grv} & \\
\text{-hi} & 
\end{align*}
$$

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$$
\begin{align*}
\text{-syl} & \\
\text{-cmp} & \\
\text{-grv} & \\
\text{-hi} & \rightarrow
\end{align*}
$$

having come’ and ‘gültükleri
5) harmonize throughout in-
ce of high vowels is de-
termined by the immediately preceding vowel (if not, that is if we
rewrote 5.4 with ‘X’ we would get ‘gültükleri.’ Other examples
for $X$-rules are rules for stress assignment, consonant-harmony
and the like. I return to the question of vowel harmony below (7).

Once again we may turn to history for evidence that a rule
involving an ‘X’ is more general than a rule without such a vari-
able.

The regular correspondent for IE $oi$ (or $ey$) in Germanic is $i$. An
analysis of the Ablaut system of the older dialects as alluded to
above together with a consideration of the vowel systems of these
dialects shows that we may posit a rule for Proto-Germanic of
the following form:

$$
\begin{align*}
\text{Rule 6.1} & : \text{[+syl]} & \rightarrow & \text{[+hi]} / \text{[+hi]} \\
\text{[+grv]} & \\
\text{[+syl]} & \rightarrow & \text{[+hi]} / \text{X} \\
\text{[+grv]} & \\
\text{[+syl]} & \rightarrow & \text{[+hi]} / \text{[+syl]} \\
\text{[+grv]} & \\
\end{align*}
$$

This rule remains synchronically operative in the older dialects
for essentially the same reasons as those sketched above (4.2).

Apparently later this rule was generalized by the insertion of
‘X’:

$$
\begin{align*}
\text{Rule 6.2} & : \text{[+syl]} & \rightarrow & \text{[+hi]} / \text{X} \\
\text{[+grv]} & \\
\text{[+syl]} & \rightarrow & \text{[+hi]} / \text{[+syl]} \\
\text{[+grv]} & \\
\end{align*}
$$

(The chronology is quite unclear, cf. Hirt 1931, Krause 1963. It
should be noted that the generalization here can work in either
direction, by inserting ‘X’ as above where the rule $oi \rightarrow i$ now
applies when the determining element is in another syllable, or
changing ‘$C_0$’ to ‘$X$’ in which case the rule now applies to
immediately contiguous segments). The rule now accounts for alter-
nations like OHG hiltan/ hiltis. In Old High German (and Old
Saxon) the rule is further generalized by striking the specification
[+grv] from the environment, so that we also get hilfu etc.

Now turn to a number of interesting cases in which both of
the conventions discussed above can play a role. The first is
taken from Diola-Fogny (Sapir 1965). Fogny has a set of five lax
and five tense vowels. In any word the vowels are all either lax
or tense, but the situation is not exactly a typical case of vowel
harmony (as Sapir calls it) since tense vowels are ‘dominant’.
That is, rather than having a rule with alpha-variables (as in
Turkish or Finnish) we have a rule which assimilates lax vowels to tense vowels. The assimilation works in both directions and is independent of the distinction between root and affix. We might state the rule as follows:

\[ \text{Rule 7.1} \quad [+\text{syl}] \rightarrow [+\text{ts}] \]

A word consisting of morphemes with inherently lax vowels will (correctly) escape the effect of the rule. If any tense vowel occurs in a word then all the vowels will be tense. If all vowels are inherently tense then the rule applies vacuously. Thus, it seems as if we have satisfactorily accounted for the facts presented by Sapir (11-12).

The rule above works correctly, it will be noted, only if we assume that all vowels are specified for tenseness at the point where the rule applies. Since there are no morphemes containing both tense and lax vowels it is possible to specify the tenseness value for just one vowel (say the first) and predict the tenseness of following vowels by means of a morpheme-structure (MS) rule:

\[ \text{Rule 7.2} \quad [+syl] \rightarrow [+\text{ts}] \]

Actually, both 7.1 and 7.2 can be simplified to cover all segments, cf. Sapir 1965:5: 'all consonants are tense in the presence of tense vowels.' Diola-Fogny then provides another case of allophonic and phonemic variation determined by the same rule.6

6. In a theory of phonology which restricts blank-filling rules to the MS component it is necessary to have a separate rule like 7.2, even for the true vowel-harmony situations considered below. It might be objected that essentially the same constraint is being handled in two different places in the grammar. If all vowels in words must agree in tenseness, then a fortiori so must they within morphemes. But within current phonological theory it is impossible to use one rule both to fill in redundant specifications and switch features in the case of Diola-Fogny. Note, however, that if the theory is modified to include an asymmetry of feature specifications in terms of marked versus unmarked values, then a rule like 7.1 can be used to give the marked value for tenseness to all segments in the presence of one marked-tense segment within the word, while presumably universal rules would apply to interpret unmarked-tense vowels as lax, marked-tense vowels as [+ts]. Sapir says that the tense vowels are relatively higher and 'closer than the corresponding lax vowels'. Whether the distinction involves merely height or muscular tension or tongue-root retraction as in many African vowel-harmony systems, it would seem reasonable to consider the tense vowels marked. If the simplicity measure then counts only marked values in the lexicon, we find a correlation in the frequencies in the lexicon: lax vowels appear to be about ten times as frequent as tense vowels in Diola-Fogny (estimate based on Sapir's morpheme index and a short text on p. 116).

7.1. Two writers have discussed vowel harmony within (Lightner 1965; Zimmer 1961) as a basis, has argue like GRAVE (not to be ec His arguments are against a morphological features and in left to right) may be summan clearly must be made as vowel in a root as well as others in terms of gravity with preceding i to have both progressive why not also for vowels? universal of language) every morpheme feature of simple rule of roughly the

\[ \text{Rule 7.3} \quad [+\text{syl}] \rightarrow \]

\[ \begin{cases} \text{[+obst]} \\ \text{[+str]} \\ \text{[+hi]} \end{cases} \]

(adapting Lightner's rule 12 paper).

The introduction of the of the arguments in favor of vowel consonant is brought a vowel harmony. But if it i:

velar segment can be give the rule for choice of vel

began our discussion (1).

7-As it stands Lightner's a logical segment of a word is root' (248, fn. 9, my emphasis: the case of Diola-Fogny constant that he would presumably pos word by the value for the re languages where root morpher EIGN, -LEARNED are com -LEARNED etc.) affixes.
7.1. Two writers have dealt recently with the general problem of vowel harmony within the framework of generative phonology (Lightner 1965; Zimmer 1967). Lightner, using Classical Mongolian as a basis, has argued in favor of using morpheme features like GRAVE (not to be confused with the phonological feature). His arguments against a more traditional analysis (based on phonological features and involving rules determining gravity from left to right) may be summarized as follows: (1) an arbitrary decision must be made as to whether to specify the first or last vowel in a root as to its gravity, since (2) velar obstruents agree in gravity with preceding and following vowels and (3) if one has to have both progressive and regressive rules for consonants, why not also for vowels? Since by a general convention (i.e. a universal of language) every segment in a word is specified for every morpheme feature of the root, it is possible to state a very simple rule of the form:

\[
\text{Rule 7.3} \quad \begin{cases} \text{[+syl]} \mapsto \{\text{[+grv]} \} / \{\text{[-GRAVE]}\} \\
\text{[+obs]} \mapsto \{\text{[+str]} \} / \{\text{[+hi]}\} \end{cases}
\]

(adapting Lightner's rule to the feature system used in the present paper).

The introduction of the neighborhood convention undercuts one of the arguments in favor of Lightner's solution. As Zimmer points out, it is unlikely that the determination of the quality of the velar consonant is brought about by the same rule that affects the vowel harmony. But if it is, then the rule for choosing the correct velar segment can be given as a neighborhood rule very similar to the rule for choice of velar allophones in English with which we began our discussion (1). To Zimmer's arguments one can add

7-As it stands Lightner's statement cannot be accepted ('each phonological segment of a word is associated with the abstract markers of the root' (246, in. 9, my emphases). Lightner's arguments would apply to the case of Diola-Fogny considered above but the abstract marker TENSE that he would presumably posit is not determined for every segment of a word by the value for the root. There are further many cases in many languages where root morphemes that carry abstract features like +FOR- EIGN, +LEARNED are combined with perfectly regular (-FOREIGN, -LEARNED etc.) affixes.
that such a rule is probably a universal rule that does not need to be stated in the phonology of Classical Mongolian. But even if we accept Lightner's formulation we can maintain the uniform assignment of the gravity value to the first vowel of the root and restate 7.3 as follows:

Rule 7.4

\[
\begin{align*}
\{ +\text{syl}\} & \quad \rightarrow [+\text{grv}] / [+\text{grv}] X \\
\{ +\text{obst}\} +\text{hi} +\text{str} & \quad \rightarrow [+\text{grv}] / [+\text{grv}] \text{X}
\end{align*}
\]

By the conventions assumed above we expand this rule first into

Rule 7.4'

A. \(+\text{syl} \rightarrow [+\text{grv}] / [+\text{grv}] \text{X}

B. \(+\text{obst}\) +hi +str \rightarrow [+\text{grv}] / [+\text{grv}] \text{X}

Then into

Rule 7.4''

A. \(+\text{syl} \rightarrow [+\text{grv}] / \{ [+\text{grv}] \text{X - - - - - X [+\text{grv}] } \}

B. \(+\text{obst}\) +hi +str \rightarrow [+\text{grv}] / \{ [+\text{grv}] \text{X - - - - - X [+\text{grv}] } \}

The convention for expanding the remaining abbreviations is that rules with 'X' apply first to the longest domain possible, then the next longest etc. (Harms 1968). Now it can be easily seen that 7.4 operates correctly. First all vowels in a word are made to agree in gravity with the first vowel (necessarily the first vowel of the root in Classical Mongolian). The second part of 7.4'' A applies vacuously. Now, the rule (7.4'' B) applies to bring all velars into line with the vowels whether they follow or precede the vowels.

Zimmer (1967) has proposed the use of an abstract Classical Mongolian, F of his note he seems to repeat his discussion is one cogent argument which has not been put forward and simple rule the feature GRAVE is a thing to do inherently: it bears no more relation to would, say, the feature the latter features it plays this rule. If we consider there is nothing to prevent this in a language like of course, no constraint gravity) which can occur in the only grave or non-grave markers HARMONIC and of the phonology are marked HARMONIC fications by a rule very: Makauitar, Ulu, Usel, A Naur, etc.: note that wri tions' all monosyllabic consists of two syllabl of the second vowel can so on.

7.2. One morpheme functions of vowel harmony but rather independently distinguishes roots or stem distinction often plays a especially in determining in determining segments are built out of a very: quge; moreover, the set the maximal differential spirant /s/, one liquid.
The rule that does not need classical Mongolian, but even we can maintain the uniform first vowel of the root and the vowels.

Zimmer (1967) has presented several arguments against Light-ner's use of an abstract root marker GRAVE for languages like Classical Mongolian, Finnish and Turkish (although at the end of his note he seems to retract that position). There is no need to repeat his discussion here. It seems to me, however, that there is one cogent argument against a treatment like that of Lightner's which has not been put forward. Rule 7.3 looks like a very straightforward and simple rule but its generality is spurious. Note that the feature GRAVE is a completely ad hoc feature which has nothing to do inherently with the phonological feature 'grave'. It bears no more relation to the phonological feature of gravity than would, say, the features NOUN or ANIMATE. Moreover, unlike the latter features it plays no role in the language outside of just this rule. If we consider that such ad hoc features are allowable there is nothing to prevent us from effecting the following 'economy' in a language like German or English. In German there is, of course, no constraint on the kinds of vowels (say, in terms of gravity) which can occur in a word or root. Nevertheless, a significant portion of the lexicon will consist of items which exhibit only grave or non-grave vowels. Suppose we set up the abstract markers HARMONIC and GRAVE, Now we can leave out the specification of the phonological feature of 'grave' for all items which are marked -HARMONIC and reintroduce these 'predictable' specifications by a rule very much like 7.3 (applying to words like Mekulur, Uhu, Esei, Auto, Kuckuck, Popo, Vopa, Notur, etc.; note that we can exploit various further 'generalizations': all monosyllables are predictably -HARMONIC: if a form consists of two syllables and is -HARMONIC, then the gravity of the second vowel can be predicted from that of the first, and so on).

7.2. One morpheme feature which is typically relevant to situations of vowel harmony is one which is not ad hoc like GRAVE but rather independently justified, namely the feature which distinguishes roots or stems from affixes. It seems that such a distinction often plays a role throughout a phonological system, especially in determining stress assignment and the like, but also in determining segments. Thus, in German, inflectional suffixes are built out of a very small subset of the segments of the language; moreover, the selection of the segments seems to exploit the maximal differentiations in the system: one stop /t/, one spirant /s/, one liquid /l/, one vowel /o/, one nasal /n/ (with
minor exceptions). Further, it seems likely that we can define this distinction in a quite natural way in terms of the machinery of a grammar: by and large, lexical elements will be -AFFIX, everything else +AFFIX. That is to say, it is not necessary to mark elements for this feature (as it is for GRAVE), since it is predictable in a language-independent way.

Zimmer adduces Igbo as an example of a language in which both suffixes and prefixes harmonize. In such languages one can give a straightforward rule corresponding to the statement: the tenseness of the vowel in an affix is determined by the tenseness of the vowel of the root. Zimmer takes such situations as precisely those in which we would use Lightner's solution by use of a morpheme feature like TENSE, but with the feature AFFIX it is not necessary to use any such ad hoc device:

\[
\begin{align*}
+\text{syl} & \Rightarrow \left[ +\text{tens} \right] / \left[ +\text{tens} \right] \\
& \left[ +\text{tens} \right] \\
& \left[ -\text{AFFIX} \right] \\
& X
\end{align*}
\]

Note that the adoption of the various conventions used here—the neighborhood convention for after and before (in that order), the expansion of rules with 'X' to apply first to the longest domain—and the principle that rules must be stated in the most general possible way lead us to a decision that it must be the first vowel of a stem or root that is distinctively marked for the feature in question: graveness in Finnish, Turkish, Mongolian, tenseness in Igbo, ijo (Williamson 1965). We know of languages where this is the correct decision, namely those in which the rules for determining vowels of any value for vowels within there are no independent last vowel to be distinct redundant. In such long conventions, but there in languages where the charged leads to incorrect say, in which there was (and only) harmonizing p last vowel as distinct a for situations like view that (at least in tion is predominantly progressive (when one valu ly, Nats Perce, Aoki 1 affix elements as in Ig 1 take this as being s reality of the proposed c 9-The arguments here de logical rule can be used morphemes and to effect a linguisist that I know of wive framework have mad several unpublished treat Lightner 1965). Without can be used to decide wh pheme in forces us to favor progre within morphemes. It is d be used to support this dence (predominance of p again (cf. fn. 4, end) the involved.

8-There seem to be a number of such languages in West Africa. Jakobson, Font, Halle (1951:59-60) also mention Baru and Masai—incidentally the reference given (p. 61) to Tuerker and Moayyed 1955 is wrong: p. 260 is a page in the glossary, apparently what is meant is 240 but see the entry in the index under 'vowel harmony' for a number of cases where affixes determine the quality of vowels in the root. I suspect that the system is of the kind considered above for Fagny.
is likely that we can define it in terms of machinery elements will be -AFFIX, say, it is not necessary to is far GRAVE), since it is way.

of a language in which both such languages one can give to the statement: the tense-

minated by the tenseness of such situations as precisely its solution by use of a mor-

the feature AFFIX it is not ce;

s conventions used here-

and before (in that order), ly first to the longest do-

be stated in the most gen-

that it must be the first-

tively marked for the fea-

in West Africa, Jakob-

Bari and Maasai-incidental-

Mpaayei 1955 is wrong:

What is meant is 240 but see

for a number of cases where the root, I suspect that the
gy.

determining vowels of suffixes can also be used to determine the value for vowels within the root. We know of languages where there are no independent grounds for choosing the first or the last vowel to be distinctively specified for some feature elsewhere redundant. In such languages, there is no reason to follow our conventions, but there is likewise no reason not to. I know of no languages where the choice forced on us by the conventions suggested leads to incorrect results. Such a language would be one, say, in which there was vowel harmony within the root and also (and only) harmonizing prefixes which would lead us to set up the last vowel as distinctive. The use of the neighborhood convention for situations like vowel harmony, in short, expresses the view that (at least in situations like vowel-harmony) the direction is predominantly progressive, possibly progressive and regressive (when one value is dominant like in Fogny or, apparently, Nez Perce, Aoki: 1966: or when lexical elements determine affix elements as in Igbo, Ijo, etc.) but never purely regressive. I take this as being strong evidence in favor of the linguistic reality of the proposed convention.

9. The arguments here depend in part on the assumption that a phonological rule can be used both to fill in redundant specifications within morphemes and to effect alternations in affixes and the like. In fact, all linguists that I know of who have dealt with vowel-harmony in a generative framework have made this assumption (Lees 1961; McCawley in several unpublished treatments of Finnish; Harms 1966b; Zimmer 1967; Lightner 1965). Without this assumption no morphophonemic evidence can be used to decide whether to mark the first or last segment of a mor-

pheme for the feature in question. The adoption of the notation still forces us to favor progressive assimilations over regressive ones even within morphemes. It is difficult to see what synchronic evidence could be used to support this idea. It may be possible to use historical evidence (predominance of progressive assimilations ?), although it seems again (cf. fn. 4, and) that something more than a purely formal device is involved.
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