XI. LINGUISTICS[*]

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A. ARE GLOTTAL STOP AND h SONORANTS?

Within distinctive-feature theory, there are three major class features: syllabic, consonantal, and sonorant. A rigorous definition of syllabicity is beyond the scope of this report. For the present purposes it is sufficient to say that all vowels are [+syllabic], as are vocalized liquids, nasals, and obstruents. Consonantal is the feature used to characterize sounds that are produced with a major constriction of the air flow in the mouth. Thus occlusives, fricatives, affricates, liquids, and nasal consonants are all [+consonantal]. A sonorant is a sound that allows for spontaneous vocal-cord vibration.[1] Liquids, nasal consonants, glides and vowels are [+sonorant].

Given these three binary features, there are eight possible combinations.

(1)		Consonantal	Syllabic	Sonorant
(a)	Vocalized liquids and nasals	+	+	+
(b)	Vocalized obstruents	+	+	-
(c)	Liquids and nasal consonants	+	-	+
(d)	Occlusives, fricatives and affricates	+	-	-
(e)	Vowels	-	+	+
(f)		-	+	-
(g)	Glides (w, y, h, ?)	-	-	+
(h)		-	-	-

There seems to be no apparent explanation for the absence of a sound characterized

as $\begin{bmatrix} \text{-consonantal} \\ \text{-syllabic} \\ \text{-sonorant} \end{bmatrix}$, as in row (h). It will be argued that $\underset{\sim}{?}$ and $\underline{h}$ should not be clas-

sified with the glides $\underline{w}$ and $\underline{y}$ as $\begin{bmatrix} \text{-consonantal} \\ \text{-syllabic} \\ \text{+sonorant} \end{bmatrix}$, but rather as $\begin{bmatrix} \text{-consonantal} \\ \text{-syllabic} \\ \text{-sonorant} \end{bmatrix}$.

By characterizing the glides, $\underline{w}$, $\underline{y}$, $\underline{h}$, and $\underset{\sim}{?}$, as $\begin{bmatrix} \text{-consonantal} \\ \text{-syllabic} \\ \text{-sonorant} \end{bmatrix}$ the following generalizations can be made.

(2) (a) $[\text{-consonantal}]$ (and $\begin{bmatrix} \text{-consonantal} \\ \text{+sonorant} \end{bmatrix}$); glides and vowels.

(b) $[\text{-syllabic}]$; glides, liquids, nasal consonants, and obstruents.

(c) $\begin{bmatrix} \text{-syllabic} \\ \text{+sonorant} \end{bmatrix}$; glides, liquids, and nasal consonants.

I shall call the classes defined by features in (1) and (2) <u>natural classes</u>. This schema predicts that $\underline{w}/\underline{y}$ and $\underset{\sim}{?}/\underline{h}$ will function as a natural class and provides no natural way to account for dissimilar patterning of $\underline{w}/\underline{y}$ and $\underset{\sim}{?}/\underline{h}$. It should be noted that the feature $[\text{+sonorant}]$ is redundant in specifying the class of glides and vowels. If $\underset{\sim}{?}$ and $\underline{h}$ were marked $[\text{-sonorant}]$, it would still be possible to characterize the class of glides and vowels by using the feature $[\text{-consonantal}]$.

The feature specifications generally posited[2] for the glides are given in (3).

(3)

	w	y	?	h
consonantal	-	-	-	-
syllabic	-	-	-	-
sonorant	+	+	+	+
high	+	+	-	-
low	-	-	+	+
back	+	-	-	-
stiff vocal cords	-	-	+	+
slack vocal cords	-	-	-	-
constricted glottis	-	-	+	-
spread glottis	-	-	-	+

To refer to $\underline{w}$ and $\underline{y}$ as distinct from $\underset{\sim}{?}$ and $\underline{h}$, one might employ the features $\begin{bmatrix} \text{-consonantal} \\ \text{-syllabic} \\ \text{+high} \end{bmatrix}$. Having to resort to a cavity feature such as $[\text{+high}]$, however, means that in any language containing all four glides there is no natural means to account for the class of vowels and $\underline{w}$ and $\underline{y}$ within the present theory.

In Klamath, an Amerindian language spoken in Southern Oregon, all four glides are

phonemic. w̲ and y̲, but not ʔ̲ and h̲, in some instances, pattern with the vowels.[3]

In Klamath there is a series of "reduplicative" prefixes in which a short vowel of the adjacent syllable to the right is copied.[4]

(4)

čwe:ka	'is tough'	snečwe:ka	(causative₁)
Lo:pa	'eats soup'	snoLo:pa	(causative₁)
pe:nhi	'is naked'	hespe:nhi	(causative₂)
pe:wa	'bathes'	hespe:wa	(causative₂)
twa:qa	'smears'	satwa:qa	(reflexive)
plo:qa	'smear pitch on someone's head'	soplo:qa	(reflexive)
to:ka	'hair falls out'	poto:ka	'pull hair out'
Lo:la	'comes apart'	poLo:la	'pull apart'

I shall not go into the morphological processes involved in the formation of these prefixes, but assume that morphological formation yields strings like [sne+čwe:ka] and [sna+paga].

When a reduplicative prefix precedes an open syllable with a short vowel, the vowel of that syllable deletes.

(5)

paga	'smokes'	snapga	(causative₁)
ntopa	'spoils'	snontpa	(causative₁)
toqa	'is scared'	hostqa	(causative₂)
ltoqa	'thumps'	soltqa	(reflexive)
delo:ga	'attacks'	sedlo:ga	(reflexive)
kača	'cut off the head'	pakča	'pull off someone's head'
teka	'be in pieces'	petka	'pull off bit by bit'

When a reduplicative prefix precedes a closed syllable with a short vowel, the vowel does not delete but rather undergoes reduction.[5]

(6)

wey̆li	'lisps'	snewəy̆li	(causative₁)
qlin	'choke'	sniqlən	(causative₂)
bonwa	'drinks'	hosbənwa	(causative₂)
metgal	'carries a pack'	hesmətgal	(causative₂)
katsga	'tooth falls out'	pakətsga	'pull someone's tooth out'
qos	'sprain'	poqəsli:na	'sprain by pulling'
qlin	'choke'	qliqlən	(distributive)
pčin	'twist'	pčipčən	(distributive)

w and y vocalize as o(:) and i(:), respectively, in the environments C ____ C and
C ____ #.[6] When a reduplicative prefix precedes a syllable with the underlying form
CV{w/y}C, we find, on the surface, a vocalized glide.

(7) | njoylga | 'is numb' | snonji:lga | (causative$_1$) |
qayLya	'puts on a belt'	hasqi:Lya	(causative$_2$)
siwga	'kills'	hiso:ga	(reflexive)
pewqya	'embraces'	sepo:qya	(reflexive)
siwga	'kills'	siso:qa	(distributive)
gayka	'is silly'	gagi:ka	(distributive)

To account for this, one might want to argue that vowel w/y sequences vocalize;
however, since the items in the left-hand column of (7) are well formed, such a solu-
tion is impossible. Another means of accounting for the vocalized glides in (7) might
be to reduce the vowel preceding the glide (by analogy with (6)) and then vocalize
sequences of the form ə{w/y}. Such a solution will predict incorrect derivations such
as that in (8).

(8) | [de + dewy] | 'shoot a bow and arrow (distributive)' |
| de   dəwy | Vowel Reduction |
| * de   do:y | Vocalization |

Vocalization always applies to the rightmost of two adjacent environments and the cor-
rect form of the distributive of dewy is dedwi and not *dedo:y.

If the short vowel of a syllable following a reduplicative prefix is always deleted
before a glide, then vocalization will follow correctly. These facts suggest formulation
of a rule of Vowel Deletion as in (9).[7]

(9) $\breve{V} \longrightarrow \emptyset$ / $[_{\text{Redup. Prefix}}$ C$_0$ V C$_0$ ____ $\left\{ \begin{array}{l} [+\text{cons}][+\text{syl}] \\ \left[\begin{array}{l} -\text{cons} \\ -\text{syl} \end{array}\right] \end{array} \right\}$ X #]
(a)
(b)

It is possible for more than one reduplicative prefix to precede a stem. By applying
rule (9) linearly from right to left and using the rule of vocalization mentioned above,
the correct derivations of the items in (10) are obtained.[8]

(10) (a) | [si [si + yiwgobli]] | 'push back a container (distributive/reflexive)' |
si s ywgobli	Vowel Deletion (9)
si s yo:gobli	Vocalization
sisyo:kobli	Other Rules

(b) [sa [sa + daqča]]   'scratches (distributive/reflexive)'

    sa   s   daqča   Vowel Deletion (9)

       səsdəqčə   Other Rules

(c) [po [po + q̓očǎa]]   'bend by pulling (distributive)'

    po   po   q̓čǎa   Vowel Deletion (9)

       popəq̓čǎə   Other Rules

Rule (9) fails to account, however, for data with ʔ. Glottal stop lengthens a pre-
ceding vowel in the environment V___C and deletes in preconsonantal position.[9]

(11)   Underlying   Surface

        ʔiyahʔwabg   ʔiyahwapk   'will hide plural objects'

        so + ʔodi:la   so:di:la   'puts plural objects underneath (reflexive)'

Now consider the derivation in (12) that would result from the application of Vowel
Deletion (9) and the glottal stop rules.

(12)   [so [so + ʔoǐyo:q̓a]]   'shaves (distributive/reflexive)'

        so   s   ʔy̓o:q̓a   Vowel Deletion (9)

    * so   s   y̓o:q̓a   Glottal Stop Deletion

The derivation in (12) by use of rule (9) yields the incorrect result. By case (b) of
rule (9), so+ʔoy̓o:q̓a goes to so+ʔy̓o:q̓a on the first application of Vowel Deletion.
Case (b) of (9) then applies to the string so+so+ʔy̓o:q̓a and yields so+s+ʔy̓o:q̓a. The
glottal stop then deletes, yielding so+s+y̓o:q̓a; however, the surface form of
so+so+ʔoy̓o:q̓a is, in fact, soso:y̓o:q̓a. Therefore (9b) must be blocked from applying
a second time so that the vowel does not delete before a cluster beginning with glottal
stop. Rule (9) must be reformulated as (13).[10]

(13)   V̆ ⟶ ∅ / [_Redup. Prefix_ C$_0$ V C$_0$ ___ { [-syl][+syl] / [-cons, -syl, +high] } X #]   (a) (b)

A test of rule (13) would be to consider data in which there is a consonant cluster
with an initial h in the environment of Vowel Deletion. Rule (13) predicts that in such
a case the short vowel will not delete.

(14)   [ha + sbahtnbli]   'dries off again (reflexive)'

        not applicable   Vowel Deletion

        həsbəhtəmbli   Other Rules

Rule (14) yields the correct output, thereby offering support for the statement of rule (13).

Rule (13) is not, however, descriptively adequate. Consider the items in (15).

(15) (a)   naky + a   nakya   'closes'

      (b) na + naky + a   naňakya   'closes (distributive)'

      (c)   naky + tk   naki:tk   'closed'

      (d) na + naky + tk   naňkitk   'closed (distributive)'

As predicted by rule (13), the short vowel in naky does not delete in (15b). Contrary to the prediction of (13), the short vowel of naky does delete in (15d), providing an environment for Vocalization. One might argue that (13) is indeed adequate if Vocalization is ordered before Vowel Deletion; however, this cannot be the case. First, it has been shown above that Vowel Deletion does precede Vocalization (see (7) and (8)). Second, as has been pointed out,[6] the vowel length of a vocalized glide is determined by the cluster preceding it. Note that in (15c) y vocalizes as i: and in (15d) y vocalizes as i. In (15c) y vocalizes as a long vowel because it is preceded by a weak cluster; y in (15d) vocalizes as a short vowel because it is preceded by a strong cluster, and a strong cluster must arise as the result of the application of Vowel Deletion. Therefore, Vowel Deletion must precede Vocalization. To account for (15d) rule (13) must be reformulated.

$$(16) \quad \breve{V} \longrightarrow \emptyset \,/\, \Big[_{\substack{\text{Redup.} \\ \text{Prefix}}} \; C_0 \; V \; C_0 \underline{\qquad} ([-\text{syl}]) \left\{ \begin{matrix} [+\text{syl}] \\ \begin{bmatrix} -\text{cons} \\ -\text{syl} \\ +\text{high} \end{bmatrix} \end{matrix} \right\} ([-\text{syl}]\ X) \; \# \Big]$$

Rule (16) not only accounts for the facts cited above, but also makes the prediction that, given sequences of the form CVCVV- preceded by a reduplicative prefix, Vowel Deletion will not apply. There is a rule in Klamath which takes iV sequences to yV.[11] If this rule is applied to the string Prefix + CVCiV prior to the rule of Vowel Deletion (16), the input to (16) would be Prefix + CVCyV. Vowel Deletion would not apply to such a string (just as it does not apply in (15b)). Thus, there is no crucial ordering between the i-to-y rule and Vowel Deletion. As there are no phonological rules which must precede Vowel Deletion, and since Vowel Deletion makes crucial use of morphological information, it is not unreasonable to assume that Vowel Deletion is a morphological rule and, therefore, ordered before the phonological rules. This ordering leads to derivation such as that in (17).

(17)   [to [togia:ldk]]   'little horns (distributive)'

          not applicable   Vowel Deletion (16)

          to   togya:ldk   i-to-y

            totəqya:ltk   Other Rules

Rule (16) suggests that vowels and w and y are a class. Given the present feature system, we are unable to make any general characterization of this class. If, however, ʔ and h are characterized $\begin{bmatrix} -\text{consonantal} \\ -\text{syllabic} \\ -\text{sonorant} \end{bmatrix}$ as suggested above, then there is a natural means of designating the class of vowels, and w and y. Rule (16) can then be reformulated as (18) by using the features $\begin{bmatrix} -\text{consonantal} \\ +\text{sonorant} \end{bmatrix}$ to characterize the class of vowels and w and y.

(18) Vowel Deletion

$$\breve{V} \longrightarrow \emptyset \, / [_{\substack{\text{Redup.} \\ \text{Prefix}}} \; C_0 \; V \; C_0 \underline{\hspace{1cm}} ([-\text{syl}]) \begin{bmatrix} -\text{cons} \\ +\text{son} \end{bmatrix} ([-\text{syl}] \; X) \; \# \,]$$

Rule (18) makes the claim that underlying na+nakytk goes to naŋkytk (and then naŋkitk by Vocalization) for the same reason that se+delo:ga goes to sedlo:ga.

Phonological features cannot be evaluated solely on their adequacy for phonological descriptions. They must also reflect articulatory and acoustic properties of sound. It has been shown here that the present definition of sonorants as sounds that allow for spontaneous vocal-cord vibration is not adequate in terms of phonological descriptions. It is necessary, therefore, that the notion of sonorance be redefined in terms of some other articulatory or acoustic parameter.

In giving a potential definition of the feature sonorant, data in addition to those cited above must be taken into consideration. If we classify glottal stop as [-sonorant], how are the glottalized glides, w̓ and y̓, to be classified? There are two modes of articulation for glottalized glides; one involves preglottalization and a sudden onset (as in Chontal and Navaho), and the other, sometimes called the Californian type, is less strong and appears to involve creakiness during the glide (for example, the glottalized glides in Maidu and Klamath).[12] In Klamath the glottalized glides pattern with the normal glides and vowels, as is shown in derivation (19).

(19) [mbo + mbody̓ + dk]   'wrinkled up (distributive)'
      mbo   mbdy̓   dk   Vowel Deletion (18)
      mbo   mbdi   dk   Vocalization
           mbompditk   Other Rules

I conclude from this that the glottalized glides in Klamath must be [+sonorant]. In Chontal wherein the glottalized glides are preglottalized and have a sudden onset the glides pattern with the consonants rather than with the vowels.[13] Strong phonological support for a definition of the feature sonorant which distinguishes between these two types of glottalized glides would be provided by a language in which the normal glides do not pattern with glottalized glides of the type found in Chontal

and the glottalized glides pattern with the obstruents. Alternatively, such a parameter would be unsupported phonologically by a language in which glottalized glides of the type found in Chontal pattern with the normal glides and vowels. What is clear from the Klamath data is that at least some glottalized glides must be [+sonorant].

In any attempt to define the feature sonorant, we must also consider the voiceless glides, W and Y. In Klamath, the voiceless glides, like the glottalized glides, are phonemic. The voiceless glides have been described as having a voiced onglide and then becoming voiceless.[14] W and Y pattern with the normal glides in Klamath, as is illustrated in (20).[15]

(20)   [ha + haYkanga]   'tracks around (distributive)'
       ha   hYkanga   Vowel Deletion
       ha   hyhkanga   W/Y Breaking
       ha hi:hkanga   Vocalization

Therefore, in Klamath, a voiceless glide would be [+sonorant]. Not all voiceless glides are produced as those in Klamath; in some languages they are produced with a voiceless onglide.[16] In a language where such glides are phonemic, do they pattern with the normal glides and vowels, or do they pattern with the obstruents? This is a question which must be considered in defining the feature sonorant. The only conclusion that can be drawn here is that at least some voiceless glides must be [+sonorant].

It has been the aim of this report to show that the feature sonorant as now defined is not adequate for phonological descriptions. I have also tried to point out some of the areas that must be considered in attempting to redefine sonorance.

<div align="right">Mary-Louise Kean</div>

Footnotes and References

1. Note that the feature sonorant is not to be confused with the voiced-voiceless distinction. See N. Chomsky and M. Halle, The Sound Pattern of English (Harper and Row Publishers, Inc., New York, 1968), pp. 300-302, for some discussion of the notion spontaneous voicing.

2. The vocal-tract features employed in (3) are discussed in M. Halle and K. H. Stevens, "A Note on Laryngeal Features," Quarterly Progress Report No. 101, Research Laboratory of Electronics, M.I.T., April 15, 1971, pp. 198-213.

3. The source for the data discussed here is M. A. R. Barker, Klamath Dictionary (University of California Press, Berkeley, 1963).

4. There are two causative prefixes in Klamath which differ in degrees of causation; snV- implies more forceful causation (usually by direct or applied force).

5. a reduces to ∂ when unstressed in closed syllable and word finally; other short vowels reduce in closed syllables, with some restrictions. When reduction occurs and how it is to be formulated is not of importance here.

6. In general, a glide vocalizes as a long vowel if it is preceded by a weak cluster (a short vowel followed by one consonant), and vocalizes as a short vowel if it is preceded by a strong cluster (a consonant cluster or a long vowel followed by a consonant).

7. The label "Redup. Prefix" on the bracketing of rule (9) is not meant to imply that the rule applies within the prefix. Rather it is meant to stand for the appropriate bracketing labels, e. g. , causative, reflexive, etc.

8. The notion of linear rules is developed in C. D. Johnson, "Formal Aspects of Phonological Rules," POLA 11, Phonetics Laboratory, University of California at Berkeley, 1970. A right-to-left linear rule applies first to its rightmost domain of application and then moves to the left, applying to each successive domain in turn.

9. Glottal Stop only causes lengthening on a preceding vowel if an immediately succeeding vowel has been deleted by some prior rule. Given the underlying form so+ʔodi:la in example (11), Vowel Deletion applies to yield so+ʔdi:la, thereby providing an environment for vowel lengthening and deletion of the glottal stop.

10. Environment (a) of rule (9) is [+cons][+syl], while environment (a) of rule (13) is [-syl][+syl]. This change in features is necessitated by the fact that Vowel Deletion must be able to apply to delete a vowel before glottal stop or h when either is followed by a vowel.

11. There are, to my knowledge, no VV sequences on the surface in Klamath.

12. E. Sapir, "Glottalized Continuents in Navaho, Nootka, and Kwakiutl," in D. Mandelbaum (Ed.), Selected Writings of Edward Sapir (University of California Press, Berkeley, 1968); H. S. Uldall, "Maidu Phonetics," Int. J. Am. Linguistics 20, 8-16 (1954); V. Waterhouse and M. Morrison, "Chontal Phonemes," Int. J. Am. Linguistics 16, 35-39 (1950).

13. V. Waterhouse and M. Morrison, op. cit.

14. M. A. R. Barker, Klamath Grammar (University of California Press, Berkeley, 1964).

15. In postconsonantal position W and Y go to wh and yh, respectively, thereby creating an environment for Vocalization. W and Y occur freely in postvocalic and preconsonantal positions; for example, haYkanga, 'tracks around', čiWpa, 'bends'. Vowel Deletion provides an environment for the rule of W/Y Breaking to apply in (20), taking ha+hYkanga to ha+hyhkanga. W/Y Breaking must be ordered before Vocalization. If Vocalization were to apply to ha+hYkanga, it would yield ha+hi:kanga and leave no source for the h that occurs on the surface following the vocalized glide, hahi:hkanga.

16. W. Smalley, Manual of Articulatory Phonetics (Practical Anthropology, New York, 1968).