

YUROK: VOWEL AND CONSONANT FEATURES  
AND THEIR INTERACTION

Norval Smith, Heleen de Wit & Roland Noşke

Instituut voor Algemene Taalwetenschap

University of Amsterdam

16-2-88

## Foreword

This represents the final report of the "Retroflex" subgroup of the Yurok Phonology Research Seminar. This research seminar took place in the second semester of the academic year 1984/85.

The participants in the workgroup were Marja Out, Margo Stolz, Heleen de Wit, Roland Noske, and Norval Smith.

The report of the "Glottality" subgroup will appear later in another form.

## Contents

0. Introduction.....	1
1. The Vowel System.....	2
2. The Consonant System.....	4
a. The Default Consonant.....	4
b. The Place Features of Consonants.....	4
3. Restrictions on CV Combinations.....	6
4. Retroflex Harmony: Introduction.....	9
5. The Characterization of the Yurok Vowel System.....	10
6. The Data concerning Retroflex Harmony.....	10
a. Nouns.....	11
b. Verbs.....	11
c. Infixation.....	13
d. Retroflex Suffixes.....	13
7. Retroflex Harmony: Triggers and Undergoers.....	13
8. Analysis.....	14
a. Retroflex Harmony in General.....	14
b. The Mode of Application of Retroflex Harmony.....	16
c. The Optionality Question.....	18
9. Conclusion.....	19
10. Bibliography.....	20

0. Introduction

In this report we seek to do two main things. Firstly to provide an account of the feature specifications of the vowel and consonant articulations of the Yurok language of Northern California as described in Robins 1958. The emphasis will be on vocalic features, with consonantal features involved principally insofar as they are involved in interactions with the vocalic features.

A very important aspect of the interaction of vocalic and consonantal features concerns restrictions on syllabification of homorganic and tautosyllabic vowel-glide and glide-vowel sequences.

The second thing we attempt to do is to provide a reasoned account of the so-called Retroflex Vowel Harmony in Yurok. We conclude finally that this is possibly better characterized as a form of Umlaut than strictly as Vowel Harmony.

1. The Vowel System

Yurok has a six-vowel system which we may represent as follows:

- (1)
- |     |     |     |
|-----|-----|-----|
| /i/ |     | /u/ |
|     | /j/ |     |
| /e/ |     | /o/ |
|     | /a/ |     |
- (/j/ = retroflex)

The feature representations associated with these vowels are as follows:

- (2)
- |     |   |                    |
|-----|---|--------------------|
| /i/ | = | [I <sup>1</sup> ]  |
| /j/ | = | [A <sup>1u</sup> ] |
|     |   | [A <sup>1u</sup> ] |
| /u/ | = | [I <sup>u</sup> ]  |
| /e/ | = | [A <sup>1</sup> ]  |
| /a/ | = | [A]                |
| /o/ | = | [A <sup>u</sup> ]  |

For more detail on the nature of single-valued features see Ewen and van der Hulst 1988 and Smith 1988. In particular for the feature representation of retroflex consonants as [IU] see the latter article. The meaning of the various features in this vowel system is as follows:

- (3)
- |     |   |            |
|-----|---|------------|
| [I] | = | high vowel |
| [A] | = | low vowel  |

This vowel system is what van der Hulst 1988 terms a vertical system, as against the triangular system which is characterized by the three features [I], [A] and [U]. Such a system leads to a different set of definitions since the vowel space is partitioned in a different fashion.

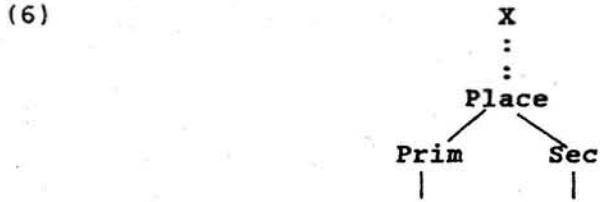
- (4)
- |     |   |                         |
|-----|---|-------------------------|
| [I] | = | palatal articulation    |
| [A] | = | pharyngeal articulation |
| [U] | = | velar articulation      |

These are the values adopted when these features are attached to the primary place node. If attached to the secondary place node - and the relevance of this will become apparent later - different values appear:

- (5)
- |     | <u>triangular system</u>     | <u>vertical system</u>    |
|-----|------------------------------|---------------------------|
| [I] | pharyngeal expansion (ATR)   | =/palatal articulation    |
| [A] | oral expansion (lowered jaw) | =/pharyngeal articulation |
| [U] | labial expansion (rounded)   | =/velar articulation      |

In the case of the Yurok vertical vowel system the interpretations of the secondary features [I] and [U] are respectively **palatal** and **velar**.

The hierarchical relation between primary and secondary features envisaged by us is as follows. The Place node dominates two other nodes, Primary and Secondary in the following fashion:



Combinations of the primary features result in intermediate articulations.

/e/ in affixes must be assumed to be unassociated with any feature underlyingly. /e/ is therefore the default vowel. One illustration of this concerns the so-called pronominal prefixes:

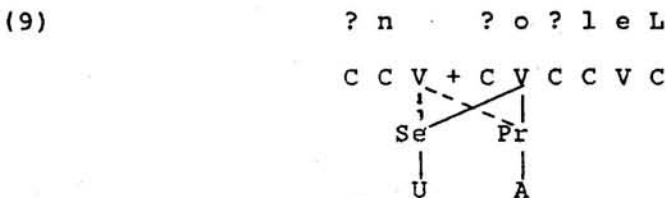
- (7)
- |        |                 |
|--------|-----------------|
| (?)ne- | "first person"  |
| k'e-   | "second person" |
| (?)we- | "third person"  |

These undergo optional spreading of a first stem syllable /a/ or /o/ to the prefix syllable if the initial consonant of the stem is a glottal stop.

- (8)
- |            |         |                 |            |
|------------|---------|-----------------|------------|
| ?ahspeyu?r | "soup"  | (?)ne?ahspeyu?r | "my soup"  |
|            |         | (?)na?ahspeyu?r |            |
| ?o?leL     | "house" | (?)ne?o?leL     | "my house" |
|            |         | (?)no?o?leL     |            |

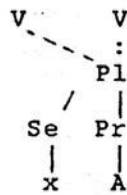
Although assuming a segmental hierarchy along the lines of Clements 1985 and Sagey 1986, we will not in practice make much use of this type of representation. However, our representations should in fact be interpreted in this fashion.

The glottal stop - the initial consonant in (4) - we will represent as carrying the feature [G] attached to the Glottal node in the feature hierarchy. It will lack all place features however. This lack of place features - shared with one other Yurok consonant, i.e. /h/ - is responsible for the fact that assimilations of place features that do not occur across other intervocalic consonants will take place if a glottal consonant intervenes.



Note that the line-crossing in this diagram is only apparent - in fact the [U] and [A] are in distinct subtiers. The rule of spreading required in this case is as follows:

(10)



This rule has the effect of spreading /a/, /o/ and also /e/ and /j/ across a glottal stop from a stem to a prefix. This last is not a problem. It will never be necessary as the more specific rule of R-harmony (see next article) will always take precedence.

## 2. The Consonant System

### a. The Default Consonant

Corresponding to /e/ as the default vowel we have /h/ as default consonant. Stem-initial /h/ following a vowel lacking place features disappears except in most cases where /i/ is the following vowel.

- (11) a.        hooloh     "basket"        (?)nooloh     "my basket"  
               ha?aag    "rock"            \*(?)nehooloh  
   (?)na?aag     "my rock"  
   \*(?)neha?aag
- b.        hinkjh     "small acorn"  
   (?)nehinkjh    "my small acorn"

If we did not have the exceptional behaviour of /i/ to account for here we could explain things in terms of the following very simple rule:

- (12)                      V C > 0  
                               :    :  
                               Pl Pl  
                               †    †

As it is we have to provide an explanation for the non-participation of the /i/-cases. As it is extremely awkward to characterize this situation in phonological terms - either in the SPE framework, or in a nonlinear framework - we are forced to face the option of entering words in /hi/ in the lexicon as exceptions to (8). In fact only about ten roots are involved here. Additionally one noun requires to be treated as undergoing the rule anyway despite the fact that the vowel is /i/. For these reasons we will regard most of the /i/-words as exceptions.

### b. Place Features of Consonants

We assume the various places of articulation of consonants to correspond to the following features:

(13) a. labials:	[U]	p	p'	m			
b. coronals:	[I]	t	t'	n	s	L	l
c. cor. retroflex:	[IU]						r
d. palatoalveolars:	[IA]	c	c'		ʃ		
e. palatal:	[I]						y
f. velars:	[A]	k	k'		x		g
g. labiovelars:	[A <sup>u</sup> ]	k <sup>w</sup>	k' <sup>w</sup>				
h. back glide:	[U]						w
i. glottal:	[-]	ʔ				h	

Note that the normal interpretation of consonantal place differs from their vocalic interpretation (see Smith 1988):

- (14) [I] = coronal  
 [U] = labial  
 [A] = dorsal

Palatoalveolars are regarded as [IA] because in addition to their coronal articulation, they automatically have a significant dorsal component.

The status of the retroflex /r/ is less clear. Retroflex articulations involve a degree of velar constriction, so that strictly speaking a retroflex consonantal articulation would receive the representation:

- (15) [IA<sup>u</sup>]

with the secondary feature [U] having the implication of velar constriction rather than rounding. We assume, however, because of the parallelism existing between /w/, /y/ and /r/, that these are all vocalic rather than consonantal articulations, so that the feature specifications will be interpreted as in accordance with the vocalic interpretation of these features. The status of nonsyllabics as consonantal or vocalic will be determined by the presence or absence of the feature [consonantal] attached to the root node (cf. Dogil, GPW-lecture, Leiden, Sept. 1987).

In addition to the above consonant inventory, which is basically as in Robins 1958, we assume that what Robins interprets as:

- (16) ʔm ʔn ʔw ʔl ʔr ʔy ʔg

should in fact be interpreted as:

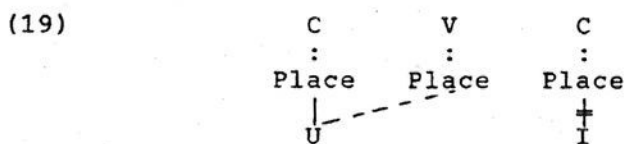
- (17) m' n' w' l' r' y' g'

The third person pronominal prefix /(?we/ takes the form /?u/ preceding consonants of types a), f), g), and h). In other words:

(18) labials	[U]	but not	coronals	[I]
velars	[A]		palatoalveolars	[IA]
labiovelars	[A <sup>u</sup> ]		retroflex	[IU]
back glide	[U]		palatal	[I]

The distinguishing factor between the two columns seems to be the absence or presence of the feature [I]. Here we seem to have a rather unnatural rule:





In fact this rule is not so strange as it appears at first sight. It encapsulates the closer relationship between [I] and [U] than between either and [A] (see Ewen and van der Hulst 1988; Smith 1988). In one sense [I] and [U] represent two sides of the same coin.

### 3. Restrictions on CV Combinations

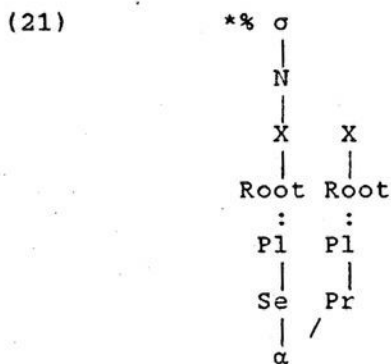
Robins 1958 notes that sequences /wu/, /yi/, and /rj/ are forbidden. He does not mention the equally salient fact that /uw/, /iy/, and /jr/ are also forbidden in the same syllable. Tautosyllabic combinations of homorganic syllabic and nonsyllabic are forbidden in other words. To put it in terms of features, the following combinations are disallowed:

(20)

	<u>syllabic</u>	<u>nonsyllabic</u>
a.	I <sup>u</sup>	U
b.	I <sup>i</sup>	I
c.	A <sup>i u</sup>	IU

Note that the distinction vertical - triangular is not relevant for systems of semivowels. In a triangular vowel system the relationship between vowels and their corresponding semivowels will be expressed in terms of primary features. In a vertical vowel system the relationship will hold between the secondary features of vowels and the primary features of the semivowels.

Now we can state our restriction on homorganic glides and vowels in a neat fashion:



However, there is another fact that we would wish to incorporate. This the restriction on tautosyllabic /k<sup>w</sup>u/, /k<sup>i</sup>wu/.

It is not clear that this is possible in an elegant fashion. The simplest solution would be to assume that /k<sup>w</sup>/ and /k<sup>i</sup>w/ are in fact clusters. This solution is eminently possible since clusters with /w/ are in fact allowed:

(22)           tw   t'w   sw  
              cw   c'w

With noncontinuants the only restriction involving place is the frequent restriction on labial + /w/ combinations.

Ill-formed homorganic tautosyllabic combinations such as those just described do occur, however.

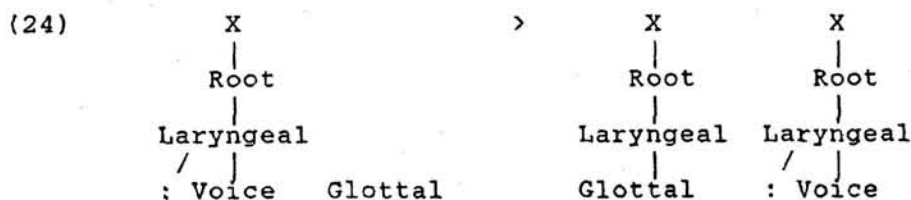
As we have seen above the third person pronominal prefix takes the form /?u/ before consonants not involving the feature [I]. We assume that in fact the outcome of rule (16) is /\*(?)wu/, and that the ill-formed nature of the structure is expressed by not fully syllabifying it. To avoid going into too much detail at this juncture we will content ourself with illustrating the kinds of ill-formed structures that occur, and examining the therapeutic measures taken to avoid them in practice.

(23)	<u>Robins 1958</u>	<u>underlying</u>	<u>output</u>
a.	f?wuC-	fW'uC-	f?uC-
b.	-Cu?wɸ	-Cuw'ɸ	-Cu?ɸ
c.	-Ci?yɸ	-Ciy'ɸ	-Ci?ɸ
d.	-Vyi?ɸ	= -Vyi?ɸ	-Vy?ɸ
e.	-Vwu?wɸ	= -Vwuw'ɸ	-Vw?ɸ
f.	-k*u?wɸ	= -kwuw'ɸ	-ku?ɸ
g.	fCCyii-	= fCCyii-	fCCii-

The nature of the working of the maximal onset principle in Yurok (see Smith, in prep.) implies a right-to-left syllabification algorithm in Yurok.

These represent all the occurring/created types of ill-formed structures.

Syllabification operates at the word-level in the lexical phonology, i.e. postcyclically. Prior to this another word-level rule operates, sequentializing voiced glottalized segments as follows:



We assume that the syllabification algorithm for Yurok proceeds as follows:

- (25) a. Identify the nucleus  
      b. Identify the coda  
      c. Identify the (maximal) onset

A structure created by the cyclic and postcyclic lexical rules such as /pi?i?y/ ("he gathers mussels") will be syllabified as follows:

- (26) a. N of  $\sigma_2$  = /i/  
 b. C of  $\sigma_2$  = /?y/  
 \*

Note that /?/ does not count as far as establishing what are legitimate sequences is concerned. It has no Place features. /y/ cannot follow /i/ due to restriction (21) so only /?/ is syllabified in the coda.

This is basically what is involved in cases (23) b. and c. above.

Cases a. and g. are identical. Let us take the case of the third person pronominal prefix in its /?wu/ allomorph. This is of course the last syllable to be syllabified in any word containing it.

- (27) a. N of  $\sigma_n$  = /u/  
 b. C of  $\sigma_n$  = irrelevant  
 c. O of  $\sigma_n$  = /?w/  
 \*

However, /w/ cannot precede /u/ so that it is not syllabified, the onset then consisting only of /?/.

Case d.i. is illustrated by the form /ko?moy-i?/ ("he is heard"). This is rather more complex than the preceding two cases.

- (28) a. N of  $\sigma_1$  = /i/  
 b. C of  $\sigma_1$  = /?/  
 c. O of  $\sigma_1$  = /y/  
 \*

As soon as we have reached this stage we have performed created a disallowed structure. In the previous two cases the part of the algorithm involved at the moment the disallowed structure was created introduced a sequence comprising a glottal stop and a semivowel. The minimal CVCV patterning of Yurok could therefore be preserved if the offending sequence is reduced by leaving the semivowel unsyllabified. In this case, however, we do not have a cluster, the relevant part of the form being /..oyi?/. There are obviously two possible options - leaving either the semivowel or the vowel unsyllabified. Let us examine these options.

If as in the previous cases we leave the semivowel unsyllabified, we get an ungrammatical sequence of two vowels - /oi/. This is clearly not what we want. Adopting the other option means that the nuclear element of the syllable is not syllabified, so that we have to find a new nucleus to the left. We are attempting to syllabify /ko?moyi?/.

- (29) a. N of  $\sigma_1$  = /o/  
 b. C of  $\sigma_1$  = /y?/  
 c. O of  $\sigma_1$  = /m/

The result is thus that a vowel - /i/ - is left unsyllabified.

Case e. is illustrated by /maaw-u?w/ ("he pays a fine"). This is in fact a combination of case b/c. and case d. which we have just dealt with.

- (30) a. N of  $\sigma_1$  = /u/  
 b. C of  $\sigma_1$  = /?w/  
 \*

As before the coda is "reduced" so that the constraint is no longer contravened, giving /..u?/.

- (31) b. C of  $\sigma_1$  = /?/  
 c. O of  $\sigma_1$  = /w/  
 \*

Once again we have an illegitimate structure. This time things work exactly as with /ko?moyi?/ - we have to look for a new nucleus to the left.

- (32) a. N of  $\sigma_1$  = /aa/  
 b. C of  $\sigma_1$  = /w?/  
 c. O of  $\sigma_1$  = /m/

Note that once we have decided not to syllabify a particular segment it apparently is no longer a candidate for resyllabification.

Lastly we have case f. This case is illustrated by /?oolek<sup>w</sup>-u?w/ which we are interpreting as /?oolekw-u?w/ (underlying /?oolekw-ew'/).

- (33) a. N of  $\sigma_1$  = /u/  
 b. C of  $\sigma_1$  = /?w/  
 \*

This, by now familiar, case is resolved as before - by reducing the coda to /?/.

- (34) b. C of  $\sigma_1$  = /?/  
 c. O of  $\sigma_1$  = /kw/  
 \*

Now we have a similar situation to that we encountered in case g. above. The difference is that case g. concerned a word-initial onset, whereas this case involves a preceding vowel. Since we have a cluster here, however, the basic CVCV patterning is not affected by reducing the cluster by not syllabifying the offending semivowel - /..k(w)u?(w)/. If we were to consider not syllabifying the vowel /u/ in this case we would get the following result:

- (35) ?oolekw(u)?(w) > ?oolekw? > ?oolek'w > ?oolek'w

In other words, Yurok is clearly a language which tries as far as possible to retain vowels. However since Yurok does not have epenthesis rules available - although it is clear which segments would be inserted if it had such rules - we cannot avoid retaining singleton intervocalic nonsyllabic elements. In such a case if a CV-sequence is disallowed the vowel is not syllabified.

#### 4. Retroflex Harmony: Introduction

In this section we will treat a phenomenon that is very rare in the languages of the world: retroflex harmony. Robins 1958 forms the source of all the examples utilized here.

Retroflex vowels are on the whole fairly uncommon, at least as phonological entities. Phonetically retroflex-tinted vowels will of course occur in most or all languages incorporating retroflex consonants.

Retroflex harmony will be treated in terms of the single-valued feature hypothesis as defined in v/d Hulst 1988, Ewen and v/d Hulst 1988, and v/d Hulst and Smith 1988. For the application of these ideas to Yurok itself see section 1.

### 5. The Characterization of the Yurok Vowel System

Robins describes the Yurok vowels in terms of the following vowel diagram:

(36)

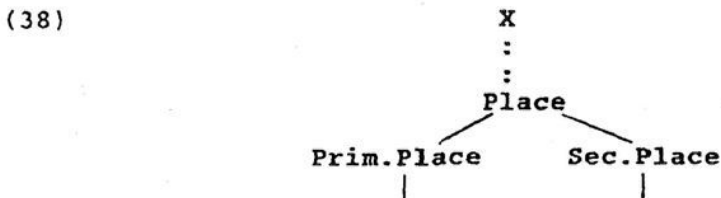
/i/		/u/
	/j/	
/e/		/o/
	/a/	

In section 1 these vowels are assigned the following feature specifications:

(37)

<u>Vowel</u>	<u>Primary Place Feature</u>	<u>Secondary Place Feature</u>
/i/	I	I
/u/	I	U
/j/	A	IU
/e/	A	I
/o/	A	U
/a/	A	-

These features are located with respect to the main place feature in the segmental hierarchy in the following fashion as we have seen above:



### 6. The Data concerning Retroflex Harmony

Robins 1958 remarks about retroflex harmony that forms displaying this are more frequent in connected speech, while those not displaying retroflex harmony are more common in the pronunciation of words in isolation.

a. Nouns

In nouns retroflex harmony appears principally in "pronominal prefix forms":

- (39)            (?)ne-ljhpjyeL    or    (?)nj-ljhpjyeL    "saliva"  
                   (?)ne-?wjyL        or    (?)nj-?wjyL        "egg"  
                   (?)ne-?jgjjc        or    (?)nj-?jgjjc        "sweathouse"

b. Verbs

Retroflex Harmony is more pervasive in the verbal system of Yurok because of the greater possibilities for affixation with verbs. There are two main conjugations of verbs in Yurok - the **e-class** and the **o-class**. Both exhibit the effects of retroflex harmony. We will employ the **indicative active** paradigm as our first illustration:

- (40) a.            e-class:    sjmjt-    "to kill, beat"
- |       |           |    |           |
|-------|-----------|----|-----------|
| 1 sg. | sjmjt-ek' | or | sjmjt-jk' |
| 2 sg. | sjmjt-e?m | or | sjmjt-j?m |
| 3 sg. | sjmjt'    |    |           |
| 1 pl. | sjmjt-eh  | or | sjmjt-jh  |
| 2 pl. | sjmjt-u?  |    |           |
| 3 pl. | sjmjt-eL  | or | sjmjt-jL  |
- (41) b.            o-class:    njgjyk-    "to help"
- |       |             |    |             |
|-------|-------------|----|-------------|
| 1 sg. | njgjyk-ok'  | or | njgjyk-jk'  |
| 2 sg. | njgjyk-oo?m | or | njgjyk-jj?m |
| 3 sg. | njgjyk-o?m  | or | njgjyk-j?m  |
| 1 pl. | njgjyk-oh   | or | njgjyk-jh   |
| 2 pl. | njgjyk-o?w  | or | njgjyk-j?w  |
| 3 pl. | njgjyk-oL   | or | njgjyk-jL   |

Another example involving one suffix would be the imperative inflection:

- (42)            Stem            Imp.Sg.            Imp.Pl.
- |         |            |                        |
|---------|------------|------------------------|
| sjmjt-  | sjmjt-'es  | sjmjt-ek <sup>v</sup>  |
|         | sjmjt-'js  | sjmjt-jk <sup>v</sup>  |
| njgjyk- | njgjyk-'os | njgjyk-ek <sup>v</sup> |
|         | njgjyk-'js | njgjyk-jk <sup>v</sup> |

Note that retroflex modification of suffixes is not completely restricted to stems containing retroflex vowels. Two exceptional cases **hum-** "to sweat in a bathhouse", and **nur?urnc-** "to climb" display retroflex harmony in their affixes:

- (43)            Stem            1st Sq. Indic. Active
- |           |              |    |              |
|-----------|--------------|----|--------------|
| hum-      | hum-ok'      | or | hum-jk'      |
| nur?urnc- | nur?urnc-ok' | or | nur?urnc-jk' |

According to Robins (p.51) verbs that are subject to retroflex harmony are either harmonized throughout or not at all. What Robins apparently means here is that if a verb has a prefix and a (single) suffix, either both or neither is harmonized. It is however not the case that

a series of suffixes necessarily displays retroflex harmony right through as we shall shortly see.

(44)	<u>Stem</u>	<u>Prefixed &amp; Suffixed Form</u>	
	sjmjt-	(?)ne-sjmjt-ek'	"I beat"
		(?)nj-sjmjt-jk'	

There are three types of suffixation involving partial retroflex harmony. The first involves series of suffixes which are all subject to retroflex harmony. However the optionality of retroflex harmony means that the fact that one suffix displays harmony does not necessarily mean that the following suffix harmonizes.

(45)	<u>Stem</u>	<u>1st Sq. Indic. Passive</u>	
	njgjyk-	njgjyk-oy-(e)k'	"I am helped"
		njgjyk-jy-(e)k'	
		njgjyk-jy-j	

The passive suffix -ey- or -oy- is as we see optionally subject to retroflexion. If the passive suffix is retroflexivized, however, this does not mean that the personal suffix has to be retroflexivized. It may or it may not.

The second type of suffixation involving partial retroflex harmony involves sequences of suffixes which taking the nature of their vocalic structure into account ought to be retroflexivizable. In these cases however only the first suffix is subject to retroflex harmony while the second is not.

(46)	<u>Stem</u>	<u>3rd Sq. 1st Sq. Bipersonal Indic.</u>	
	sjmjt-	sjmjt-ep-e?n	"he beats me"
		sjmjt-jp-e?n	
		*sjmjt-jp-j?n	
	njgjyk-	njgjyk-op-e?n	"he helps me"
		njgjyk-jp-e?n	
		*njgjyk-jp-j?n	

(47)	<u>Stem</u>	<u>Reciprocal</u>	
	njgjyk-	njgjyk-ep-ew	"to help one another"
		njgjyk-jp-ew	
		*njgjyk-jp-jw	

The third type of incomplete suffix retroflexion involves vowels which are *never* subject to retroflex harmony. These are the high vowels /i/ and /u/.

(48)	<u>Stem</u>	<u>3rd Person Attributive</u>	
	njgjyk-	njgjyk-omin	
		njgjyk-jmin	
		*njgjyk-jmjn	

c. Infixation

Infixation seems to differ in nature from suffixation or prefixation inasmuch as retroflex harmony is obligatory in this case.

(49)	<u>Stem</u>	<u>Intensive</u>	
	laay-	l-eg-aay-	"to pass"
	Lkyork*-	Lky-eg-ork*-	"watch"
	but kjtk-	*k-eg-jtk-	"to fish for trout"
		k-jg-jtk-	
	sJJLjp-	*s-eg-JJLjp-	"to do"
		s-jg-JJLjp-	

d. Retroflex Suffixes

There are a small number of suffixes containing retroflex vowels. These appear as class markers with adjectives and numerals.

(50)	<u>Stem</u>	<u>Animal/Bird Class</u>	
	koht-	kjht-J?J?y	"one"
	na?-	nj?-J?J?y	"two"
	co?on-	cj?Jn-J?J?y	"four"

Although this system of class markers appears to be breaking down, they provide us with a number of such retroflex suffixes

7. Retroflex Harmony: Triggers and Undergoers

The trigger of retroflex harmony is as we have seen the retroflex vowel /j/. This acts as trigger wherever it is located. That is, either in a stem as in 2) a/b., a suffix as in 2) c., an infix as in 2) d., or as a kind of ablaut effect as in 2) e.

Undergoers are V - the default vowel - as we have seen in 2) a., and /o/ as we have seen in 2) b. We leave undetermined the question of whether the /e/ to be found in verbal suffixes, which is also subject to retroflex harmony, is in fact /e/ or is V. In 2) c. where stems are retroflexed we find examples of /a/ as undergoer.

A clear case of /e/ undergoing retroflex harmony is provided by the following examples involving the affix /-j?jy/ - a variant of /-j?J?y/ illustrated in (50):

(51)	pekoy + j?jy	>	pjkjy-j?jy	"red (animals/birds)"
	cey(k) + j?jy	>	cjyk-j?jy	"small (animals/birds)"

In other words all vowels that do not possess the feature [I] are potential undergoers. Compare (48) for a case of a suffix whose second vowel - /i/ - remains inviolate under retroflex harmony. For a case involving /u/ compare (52):

(52)	(?)wV-?wJLkJ?	>	?u-?wJLkJ?	"his-egg"
		>	*?j-?wJLkJ?	
	(?)wV-mjm	>	?u-mjm	"his-son"
		>	*?j-mjm	



Normally a mixture of retroflex and nonretroflex vowels will only be possible if a retroflex stretch is bounded by /i/ or /u/:

(53) a.	hinkjh	"small acorn"
	ckip'jL	"snowdrop"
	kjtjksin-	"to put a lid on"
	kjjnit	"falcon"
	kyjnikjt	"to sprain"
	sjs?ikoy-	"to be shallow"
b.	curp'jy	"to comb"
	tumjL	"sea duck"
	cjjnun	"sprout"
	tjkjku	"quail"

There are a very few exceptions to this rule, involving other vowels such as /e/.

We have seen above that there are also a few suffixes which contain /e/ but do not undergo retroflex harmony. This is the case with the subject marker in series of two personal suffixes in verbs (cf. (46), (47)). Cases like this, and the cases just referred to involving stems must be marked as exceptional in the lexicon. Note that we cannot utilize the strata of the lexical phonological model to provide an explanation for this since some at least of the inflectional suffixes that do not retroflexivize as the second of two suffixes, do precisely that if they follow the verb stem directly.

(54)	sjmjt-ek'/sjmjt-jk'	"I beat"
		(beat-I)
<u>but</u>	sjmjt-es-ek'/sjmjt-js-ek'	"I beat him"
		(beat-him-I)

## 8. Analysis

Our analysis falls into two portions - a treatment of retroflex harmony itself, and a discussion of the domain of application and the optionality of this process.

### a. Retroflex Harmony in General

The task we have to perform here is to ensure that the features marking retroflexion - [IU] - are spread across a sequence of vowels containing no high vowels. Retroflex harmony is restricted to vowels bearing the feature [A]. It is in other words a case of **parasitic** harmony. Mester 1986 has proposed that such cases of harmony be analysed with the help of the **Obligatory Contour Principle** or OCP.

His analysis makes use of vocalic place features piled up on top of each other. We will, however, reject this view of feature geometry in favour of an appeal to the **Likeness Condition** (van der Hulst & Smith (ms)).

### (55) Likeness Condition

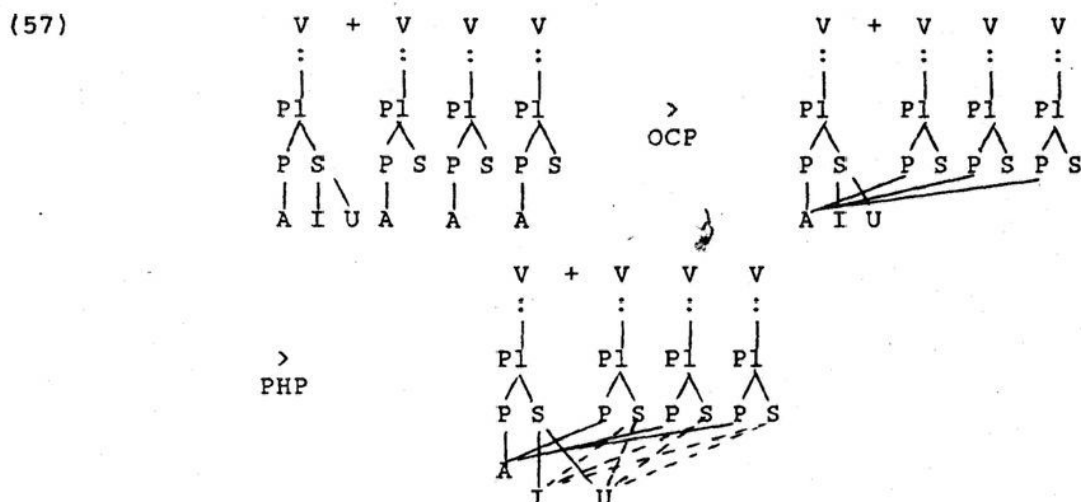
Harmony for some feature F is favoured by **likeness**, where colinking is the best form of likeness.

In other words we follow Mester as regards his use of the OCP, but achieve harmony by other means. We reformulate the Likeness Condition as the Parasitic Harmony Principle.

(56) **Parasitic Harmony Principle**

If segments are colinked for some primary feature P with respect to some domain, then colinking must also apply with respect to certain specific secondary features  $S_1 \dots S_n$  with respect to the same domain.

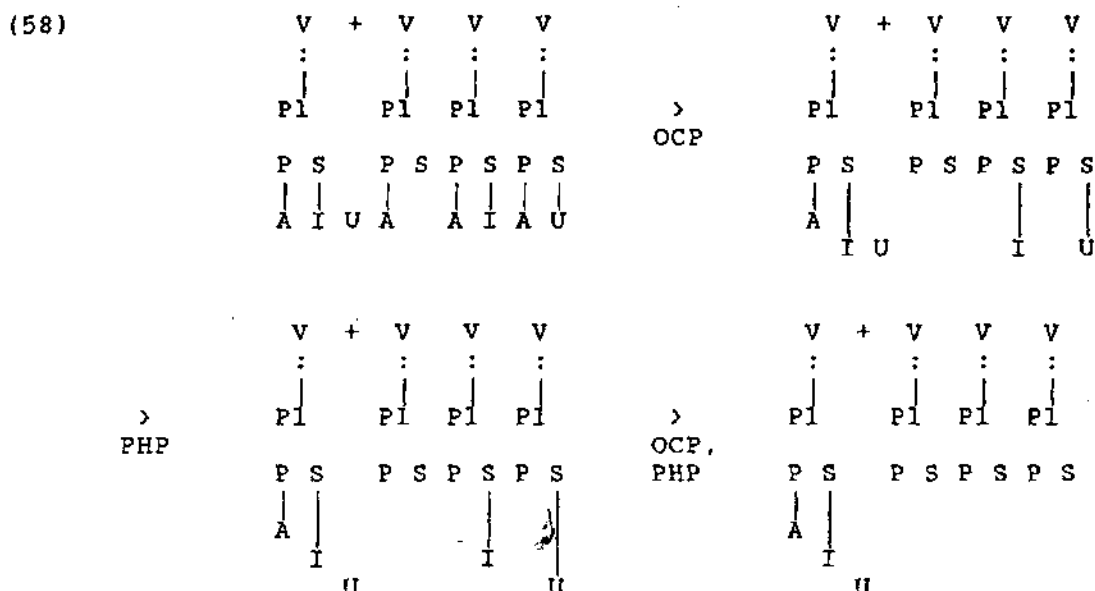
If the OCP applies to all sequences of vowels containing the primary feature [A], then the Parasitic Harmony Principle (PHP) will ensure that all the vowels in such a sequence also share all their secondary features. Let us first examine how this will apply in some abstract cases. Firstly we will examine the case of a retroflex vowel that becomes adjacent to a sequence of /a/'s:



The obvious question that now arises is what precisely happens if the sequence of low vowels that is subject to retroflex harmony contains one or more vowels that is specified for a particular secondary place feature. In fact this is not so problematic. The problem is similar to that of transparent vowels. For general (nonparasitic) harmony van der Hulst and Smith 1986 describe transparency as follows. A floating harmonic feature - which is still assumed to be involved in cases of nonparasitic harmony - attaches to all suitable sites simultaneously. A transparent vowel is assumed to involve an association to the harmonic feature. The combination of floating and attached features gives rise to an automatic operation of the OCP, which results in the survival of a single, floating, instance of the harmonic autosegment.

The present case is of course not identical to the case of transparency in nonparasitic harmony - although we shall see that there are cases like this present - but we would like to assume a similar treatment here. The PHP ensures that spreading of secondary features will take place. What happens when the spread feature comes up against an association involving the same feature? Here of course we are spreading two secondary features simultaneously. We assume that in fact a more general operation of the OCP is involved, which will be

applicable to both parasitic and nonparasitic harmony. If in a stretch of segments which provide landing sites for a particular harmonic feature, the harmony process comes across a prior association with the same feature, then we assume automatic operation of the OCP.



This explains the "obliterating" effect of Retroflex Harmony in Yurok - an effect, note, that is unknown in other languages with retroflex harmony. It has the effect of supplementing the feature characterization of low vowels ([A]) with the features [I] and/or [U] so that they all appear as [A, I, U]. Any unspecified vowel in a relevant context will of course have [A] spread from the neighbouring vowel first. We will provide some examples of the "obliterating" effect of Retroflex Harmony here for convenience.

(?)woogey	"white man"	(?)wjjgy-]s	"fair-skinned person"
co?on-	"four"	c]n-]y?y	"do. (animal/bird)"
pontet	"ashes"	p]nc]c	"dust"
pahtek*s	"store basket"	p]hc]k*s	"small absket"

The last two cases are illustrative of diminutive sound-symbolism, one aspect of which is retroflexivization.

### 9. The Mode of Application of Retroflex Harmony

The question of the mode of application of Retroflex Harmony is of relevance for several reasons. Firstly the operation of this process in the direction from stem to affix is clearly optional-cyclic. We reproduce (9) here for convenience.

(60)	<u>Stem</u>	<u>1st Sq. Indic. Passive</u>	
	n]g]yk-	n]g]yk-oy-ek'	"I am helped"
		n]g]yk-]y-ek'	
		n]g]yk-]y-]k'	

As we can see from the first option that is available to express the First Person Singular Indicative Passive it is not necessary to have Retroflex Harmony at all. The second option tells us that it is possible to have the first suffix subject to Retroflex Harmony as well, while the third option tells us that the second suffix too may be subject to Harmony.

In order to demonstrate that we don't have the option of extending retroflexion by one syllable at a time we have to consider disyllabic suffixes.

(61)	<u>Stem</u>	<u>2nd Sq./Pl. Attributive</u>	
	njgjyk-	njgjyk-oomon	"(that) you help"
		njgjyk-JJmJn	
		*njgjyk-JJmon	

In other words the option whereby we retroflexivize the first suffixial syllable but not the second is disallowed. This confirms the cyclic and noniterative nature of the phenomenon.

We saw above in (10) that there are cases in Yurok where a suffix appears to be exceptional with respect to Retroflex Harmony. This was the case with respect to the so-called Bipersonal conjugation, and with respect to the Reciprocal forms. This phenomenon deserves closer examination.

(62) a. Bipersonal Suffix Combinations

	<u>Nonretro. (e-conj.)</u>	<u>(o-conj.)</u>	<u>Retro.</u>
1) 2s/1s:	-a?	-op-a?	-jp-a?
2) 3s/1s:	-(ep-)e?n	-op-e?n	-jp-e?n
3) 3p/1s:	-ep-aaL	-op-aaL	-jp-aaL
4) 1s/2s:	irr.	-oc-ek'	-jc-ek'
5) 1s/3s:	-es-ek'	-os-ek'	-js-ek'
6) 2s/3s:	-es-e?m	-os-e?m	-js-e?m
7) 1p/3s:	-es-oh	-os-oh	-js-oh
8) 2s/1p:	-ey-ogoh	-oy-ogoh	-jy-ogoh
9) 1s/2p:	irr.	-oc-'-o?	-jc-'-o?
10) 1s/3p:	-es?-o?	-os?-o?	-js?-o?

b. Reciprocal Suffix

	<u>Nonretro. (e-conj.)</u>	<u>(o-conj.)</u>	<u>Retro</u>
	-ep-ew	-op-ew	-jp-ew

It is not completely certain whether the suffix /-ep-/ occurring in the bipersonal conjugation (with 1st Singular Object forms) is the same as the suffix /-ep-/ occurring as a part of the reciprocal marker, and additionally as the reflexive marker. At least the latter two would seem likely to be related.

Leaving the question of the reflexive use of /-ep-/ aside for the moment, there are two explanations for the incomplete nature of the application of Retroflex Harmony which are on the face of it reasonable.

Firstly we could claim that the second suffixes here (and the first suffixes in cases (62) a. 1/2)) are all exceptional with respect to Retroflex Harmony. This does not seem satisfactory for at least two reasons. Firstly, with such a variety of suffixes, it seems at least rather coincidental that precisely all these suffixes referring to subjects should be exceptional precisely following object suffixes.

Secondly, these at least some of these suffixes occur elsewhere, and then do not behave exceptionally with regard to Retroflex Harmony. For instance /-ek', -e?m, -oh/ are respectively the normal terminations representing 1st Sg. Subject, 2nd Sg. Subject, and 1st Pl. Subject, and are otherwise subject to Retroflexion.

A third conceivable explanation turns out not to be available either. This is that the first of the two suffixes while undergoing Retroflex Harmony itself, prevents the harmony process from proceeding further. We observed above however that the reciprocal marker /-ep-ew/ was partly segmentally identical with the reflexive marker /-ep-/, and that presumably the grammatical function of these two is close enough to guarantee lexical identity as well. However, the reflexive marker does not prevent Retroflex Harmony from proceeding further in the word.

(63)	<u>Stem</u>	<u>Reflexive Stem</u>	<u>3rd Sg. Refl.</u>
	n g jyk-	n g jyk-ep-	%n g jyk-ep-ek' "I help myself"
		n g jyk-jp-	%n g jyk-jp-ek'
			%n g jyk-jp-jk'

(% = forms constructed on the basis of Robins, p.78)

In addition the morpheme /-ey-/ occurring in (62) a. 8) is identified by Robins with the passive morpheme /-ey-/. This too does not affect the progress of Retroflex Harmony.

These facts make an explanation in terms of lexical strata most unlikely. In that case one would expect differentiated but consistent phonological behaviour in respect of morphemes. Here we have inconsistent behaviour. If we assumed Retroflex Harmony to be a solely cyclic process, then we could assume that it did not operate at the word level, or last (post-cyclic) lexical stratum. This does not help us much since these cases displaying incomplete retroflexion are specifically not possible words in the majority of cases.

In addition insofar as certain of the suffixes which follow /-ep-/ etc. would under these assumptions have to be located in a cyclic stratum, eg. /-ek'/ etc., we would require use of a loop (Mohanani 1986), which would mean that Retroflex Harmony could operate in any case.

In other words the exceptionality in respect of Retroflex Harmony in the cases in question requires to be stated over combinations of suffixes, not a very tidy state of affairs.

### c. The Optionality Question

We have basically three types of operation of Retroflex Harmony from a morphological point of view.

(63)	<u>Source</u>	<u>Target</u>	<u>Oblig./Opt.</u>
	1) Stem	Affix	Optional
	2) Affix	Stem	Obligatory
	3) Stem	Infix	Obligatory
	4) Floating	Stem	Obligatory

We can ignore the last type of Retroflex Harmony as being completely unproductive. Here a floating feature of retroflexion is spread over the stem as one of the ways of indicating diminutive Sound Symbolism, but this is apparently no longer a living process in Yurok.

The third type is also comparatively easy to explain. Since there is a restriction in stems that no sequence of vowels involving the feature [A] can occur where a mixture of retroflex ([A<sup>l</sup>]) and nonretroflex ([A<sup>h</sup>, A<sup>u</sup>, A]) is involved, we require a constraint forbidding such combinations within stems. As infixes are inserted within stems any infix containing a low vowel will automatically have this retroflexivized in a retroflex environment.

It remains then to explain the distinction between the optionality of the first case, and the obligatoriness of the second case. As we remarked above when we were discussing the cases of retroflexion operating from a suffix to a stem (see page 13) these cases appear to represent a system in decay. The question is then whether we have anything to explain, or whether these cases are all lexicalized.

This situation could be connected to the situation whereby affixes form the head of the resultant structure of stem plus affix. Note that in vowel harmony systems we usually have two possibilities -stem dominance, or no particular dominance. However in this respect Yurok Retroflex Harmony is more akin to Umlaut systems, where in fact stems never have any effect on suffixes. The unidirectional effect of Umlaut processes - whether bounded as in the case of the more familiar types like German, or unbounded as in the case of Djingili (see van der Hulst & Smith 1985) - is perhaps best explained by assigning these processes the status of cyclic processes. Yurok Retroflex Harmony would then be a rather exceptional (i.e. bidirectional) case of an Umlaut process, but one which retained the general asymmetry of such processes.

## 9. Conclusion

We have attempted to accomplish two things in this report. Firstly to characterize the Yurok vowel system in terms of features; to describe consonant-vowel interactions involving features; and the effect of these on syllabification.

Secondly we have attempted to give an account of the operation of the most notable vocalic phenomenon in Yurok - Retroflex Harmony. We have reached the unusual conclusion that Retroflex Harmony in Yurok is in fact rather to be characterized as an Umlaut process. We therefore have drawn a novel distinction between Vowel Harmony and Umlaut, whereby the basic distinction is that Vowel Harmony takes place at the Word Level, i.e. is a postcyclic lexical phenomenon, while Umlaut is a cyclic (and lexical) phenomenon.

Bibliography

- Clements, NG, 1985  
The geometry of phonological features in CJ Ewen & JM Anderson (eds.) Phonology Yearbook 2 CUP, 225-252.
- Ewen, CJ, & H van der Hulst, 1988  
[High], [Low] and [Back] or [I], [A] and [U]? TIN lecture.
- van der Hulst, H, 1988  
On the dual nature of [I], [A] and [U] NELS lecture.
- van der Hulst, H, & NSH Smith, 1985  
Vowel features and Umlaut in Djingili, Nyangumarda and Warlpiri in CJ Ewen & JM Anderson (eds.) Phonology Yearbook 2 CUP, 277-303.
- van der Hulst, H, & NSH Smith, 1986  
On neutral vowels in K Bogers, H van der Hulst and M Mous (eds.) The phonological representation of suprasegmentals Dordrecht, Foris Publications, 233-279.
- van der Hulst, H, & NSH Smith, 1988  
Tungusic and Mongolian vowel harmony: a minimal pair TIN lecture.
- van der Hulst, H, & NSH Smith, ms.  
Vowel harmony systems
- Mester, A, 1986  
Studies in tier structure diss. University of Massachusetts.
- Mohanan, KP, 1986  
The theory of lexical phonology Dordrecht, Reidel.
- Robins, RH, 1958  
The Yurok language: grammar, texts, lexicon Berkeley, University of California Press.
- Sagey, EC, 1986  
The representation of features and relations in nonlinear phonology diss. MIT.
- Smith, NSH, 1988  
The hierarchical representation of consonant features TIN lecture.