NEZ PERCE VOWEL HARMONY:
AN AFRICANIST EXPLANATION
AND SOME THEORETICAL QUESTIONS

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1. *Introduction*. The question of the proper description of the vowel harmony system of Nez Perce[1] has already engaged the attention of a number of linguists: Aoki (1966, 1970), Rigsby (1965), Jacobsen (1968), Rigsby and Silverstein (1969), Chomsky and Halle (1968:377f.), Kiparsky (1968), Zwicky (1971), Kim (1978). There is no disagreement about either the phonetic facts or about the working of the vowel harmony process; however, there has been considerable debate about the question of the natural relationship between any possible underlying phonological system which can be derived from these phonetic facts and a principled explanation for the operation of the vowel harmony rules. We have decided to enter this debate because we believe that a simple and unitary explanation is possible from a different perspective, that of tongue-root position based vowel harmony systems.

In Nez Perce there are five surface vowels: [i], [ɐ], [a], [o], [ɯ]~[u], all of which may occur either long or

short. For the purposes of the vowel harmony rule they are divided into two sets:

(1)

DOMINANT	RECESSIVE
i	ɯ ~ u
o	
ɑ	æ

The vowel harmony rule states that if any morpheme in a word has a vowel of the Dominant series, then all Recessive vowels in the word become Dominant. If no morpheme containing a Dominant vowel is present then, naturally, all vowels in the word are Recessive. Morphemes whose vowels are inherently Dominant can occur as either roots, or as suffixes.[2] [i] is a member of both series in that some [i]'s cause harmonic shift, while others do not, and [i] thus co-occurs with both sets of vowels.

An example[3] of a root with a Recessive vowel is

(2) mæq 'paternal uncle'.

When affixes with Recessive vowels are added, there is no vowel harmony change. For example, the first person possessive prefix *næ?-* added to this root yields

(2a) næ?mæx 'my paternal uncle'.

The vocative suffix -æ? yields

(2b) mæqæ? 'paternal uncle!'.

However, if *næ?-* is prefixed or -æ? is suffixed to a root with a Dominant vowel, as, for example,

(3) to·t 'father',

the affix vowel changes to its Dominant counterpart, yielding

(3a) nɑ?to·t 'my father'
(3b) to·tɑ? 'father!'.

Harmony can be caused by a dominant suffix, e.g. *-?ayn* 'for', which, when suffixed to

(4) cæqæ·ɨ 'raspberry'

causes harmonic shift, yielding

(4a) caqa·ɨ?ayn 'for a raspberry'.

Harmonic shift can also result from compounding. For example, if to

(5) wæ·yik + s + æ + næ
go across stem formant 1st person long ago

yielding, by itself,

(5a) wæ·yiksænæ '(I) went across long ago'

is prefixed *wat-* 'to wade', one gets

(5b) watwa·yiksana '(I) waded across long ago'.

That [ɨ] is a member of both series is shown by the examples in (6),

(6) ?ɨ·c 'mother'
(6a) næ?ɨ·c 'my mother'
(6b) ?ɨ·cæ? 'mother!'

where the [ɨ] is non-Dominant, and in (7),

(7) cɨ·c 'paternal aunt'
(7a) na?cɨ·c 'my paternal aunt'
(7b) cɨ·ca? 'paternal aunt!'

where the [ɨ] is Dominant.

Previous linguists who have treated this question have seen three major, interrelated problems in the description of this phonological system:

1) the problem of the two [ɨ]'s and the best strategy for handling the fact that in the morphophonemic representation they must be kept distinct even though phonetically there seems to be no clue which distinguishes Dominant [ɨ] from Recessive [ɨ].[4]

2) the fact that "the sets of vowels in the two classes of words -- [ɪ ɑ o] and [ɪ ə u] -- are not natural classes in any reasonable phonetic framework." (Chomsky and Halle 1968:377).[5]

3) the difficulty of integrating Nez Perce vowel harmony into any universal theory of vowel harmony processes.

It is, we believe, this last point which has led previous investigators astray: in comparisons of the Nez Perce vowel harmony system with other systems of vowel harmony they have, by and large, tried to draw parallels with systems found in the Uralic and Altaic languages. However, there are several major differences between Uralic and Altaic systems and that of Nez Perce, and there is another model available, that to be found in a large number of African languages.[6]

2. *Voice-Quality Based Vowel Harmony Systems.* In Africa today there are two major areas, one in West Africa, the other in East Africa, where many languages exhibit vowel harmony systems of what has been termed the "horizontal" or "cross-height" type. These vowel harmony systems have been rather extensively studied for West African languages such as Akan (i.e. Fante-Twi), Igbo, and Ịjọ (all Niger-Kordofanian)[7] and for East African languages such as Luo, Bari, Maasai, and Kalenjin (all Nilotic languages of the Eastern Sudanic branch of Nilo-Saharan).[8] In spite of some language-particular idiosyncracies, there is surprising uniformity in the way in which the vowel-harmony process is realized in all of these languages and, as we have tried to show elsewhere (Hall et al, 1974), in the basic principle which underlies its operation.

In an ideal language of this sort there are two sets of five vowels each:

(8)

Set 1		Set 2	
i	u	i	u
e	o	e	o
a		a	

Words normally contain vowels only of Set 1 or only of Set 2. In West African languages, typically, roots may contain either Set 1 or Set 2 vowels and affixes always harmonize with the root. In East African languages, as in Nez Perce, there are also affixes which contain Dominant vowels and which cause the vowels of the other set to harmonize with them. The following verb forms from the Elgeyo dialect of Kalenjin (a Southern Nilotic language) illustrate this process:

(9)

ke:r	'see/look at (it)!'	ker	'shut (it)!'
ki-a-ke:r	'I saw (it)'	ki-a-ker	'I shut (it)'
ki-a-ke:r-e	'I was looking at (it)'	ki-a-ker-e	'I was shutting (it)'

The progressive tense suffix *-e* is Dominant and it causes all of the non-Dominant vowels of the word to which it is attached to become Dominant.

In descriptions of African languages (e.g. Tucker and Bryan 1966, Stewart 1971) the vowels of Set 1 are conventionally symbolized as /i,e,u,o/ and either /ä/, ([ɜ]), /ö/, or /æ / for the low vowel and those of Set 2 as /ɪ,ɛ,ʊ,ɔ,ə/. This symbolization is at best misleading because the distinction between the vowels of the two sets is frequently not accompanied by the distinctions in tongue-body placement which are implied by the IPA symbols [i] vs. [ɪ], [u] vs. [ʊ], etc. The primary distinction in every language of this type which we have investigated personally lies rather in what has been termed 'voice quality', that is, in variations in some part of the vocal tract below the oral cavity.

Typically, the vowels of Set 1 have a 'bright' quality which is often accompanied by breathiness. The vowels of Set 2 typically have a 'flat', 'hard', or 'dull' quality which is sometimes accompanied by a slight degree of creakiness. In the languages of this type with which we have worked intensively (Elgeyo, Bari, Toposa, Lotuko, Mabaan), the voice quality distinction in the non-high vowels had as a concomitant a noticeable distinction in tongue body position. In the high vowels voice quality was at times the only auditory cue. In Bari the distinction between /ʊ/ and /u̱/ was also clearly visually marked: the /u̱/ was articulated with moderate lip rounding, very much like the [u] of English; the /ʊ/, however, was articulated with the jaw noticeably thrust forward and the lips markedly pursed. In Bari for all of the Set 1 vowels the forward movement of the jaw was noticeable and the genioglossus muscle could be felt moving forward and swelling transversely toward the tip of the chin. (Note: there was no such lateral swelling as is found with the long, tense vowels of English.)

There is another fact that should be noted about languages like Bari: the speakers with whom we worked were, by and large, university graduates whose English was extremely fluent and very nearly within the phonetic norms expected of native speakers. Nonetheless, we noted occasional errors which resulted from the confusion of English /e/ and /ɛ/, /o/ and /ɔ/. This can only mean that the differences in tongue-body position which we noted between Sets 1 and 2 in their languages were secondary and not available to them for transfer to English.

The primary gesture involved in distinguishing Set 1 from Set 2 seems to be movement of the tongue root. Phonologically, it is easy to view the process as one of simply

a binary opposition between a plus category, Advanced Tongue Root, and a neutral or unmarked category, Non-Advanced (or normally positioned) Tongue Root. (This is the rather simplistic proposal which we made in Hall et al, 1974.) Phonetically, however, the situation can be much more complex because not only can the genioglossus muscle pull the tongue root forward, but also the glossopharyngeus muscle can retract the tongue root, and the hyoglossus can lower the tongue root and, with it, the larynx. (See figure 8 in Lindau 1975:31.)

Thus, in any language with a two way opposition, we may have as the phonetic gestures:

(10) Set 1 vs. Set 2

(a) advanced tongue root vs. retracted tongue root
(b) advanced tongue root vs. neutral tongue root
(c) neutral tongue root vs. retracted tongue root

That is, since the articulatory cue is variation in pharyngeal size, any combination of oppositions of the movements of the genioglossus and glossopharyngeus muscles will result in the same effect. Needless to say, as the tongue root is moved forward, the tongue body is compressed and therefore raised. Conversely, as the tongue root is retracted, the tongue body is pulled down and therefore lowered. Either, or both, gestures, therefore, may result in some difference in the position of the tongue body during the articulation of the two vowel sets. Since it is not uniformly the case that there is a clear difference in tongue body position (which the European-trained phonetician would perceive as the difference between [i] and [ɪ], etc.) between the vowels of the two sets, it follows that tongue body position, whether achieved by jaw opening or by raising the tongue alone, is a secondary gesture which results from the primary one (or ones) of altering the

position of the tongue root.

There have been two extensive acoustic and radiographic studies of some African languages which exhibit the kind of vowel harmony we have just discussed (Lindau 1975 and Jacobson 1978). Both of these studies give the impression of having been extremely sophisticated in their use of the instruments and in their analytic techniques and extremely careful throughout. And yet both studies are, we feel, inconclusive. Lindau found that for the West African languages she studied, Akan (4 speakers), Ịjọ (1 speaker) and Igbo (1 speaker), all of the speakers used tongue root advancement (with resultant pharyngeal expansion) and concomitant lowering of the larynx to produce the vowels of Set 1. She also found that the four non-low vowels of Set 1 had a lower first formant than did any of the vowels of Set 2. For Akan and Ịjọ she found that the vowels of Set 2 were produced with the tongue root in neutral position; for Igbo the tongue root was retracted. However, in Akan, which was studied in most detail, she found (p.41) that the formant separation between /e/ and /ɪ/ was only 25 Hz. (within the range of measurement error) and that between /ɛ/ and /ɜ/ it was only 50 Hz.; trained phoneticians, who had no knowledge of Akan, in her listening test in fact heard these vowel pairs as identical (p.39). Jacobson (1978:80) reports that for Luo

> ...an expansion of the pharynx does not necessarily involve a depression of the larynx... Behavior in Dho-Luo is not so uniform as that reported for the West African languages: one Dho-Luo speaker may distinguish the vowel harmony categories almost exclusively by means of tongue height while another speaker uses width of pharynx and a third speaker uses both.

Since all three of these speakers of Luo can understand one another, there must be something which unites these phonetic variations to yield a clear phonological distinction.

Lindau (1975:41) reports that she played the randomized listening tape back to her Akan informant twice,

> ...once after a three week interval and once after a four week interval since the recording session. He was able to identify the vowels as those in words he had been asked to produce. It is highly unlikely that he remembered the order of vowels in the recording after so long a time. The most plausible explanation is that he actually *heard* the vowels as different, and that he as a native speaker hears something that a non-native is not trained to use as a cue, and that that something is a physical property.

Jacobson (1978:4ff) also reports that when he played back a tape his Luo informant was able to identify the vowels of 187 bisyllabic verbs "without any difficulty or hesitation", separating the vowels into their two harmony category sets.

It has been our experience that a speaker of one Nilotic language which uses this vowel harmony type can not only uniquely identify the vowels of his own language, but he can with equal ease and lack of hesitation identify the set membership of vowels in Nilotic languages not his own, which are not mutually intelligible with his, and of which he had no prior knowledge.

What emerges from Lindau's study and, particularly, from Jacobson's, is that there is an articulatory and acoustic event which is not being measured unambiguously by either the spectograms or the x-ray measurements. Jacobson states (1978:80):

> ...the articulatory freedom permitted among speakers of Dho-Luo would be understandable if some aspect of the speech signal other than articulatory vowel quality were distinctive. I would suggest that this is the case and that the distinctive aspect is one of voice quality.

Jacobson goes on to point out (p.81) that in Twi (i.e. Akan) Stewart (1967) says "that breathiness is associated

with the raised vowels [i.e. those of Set 1] but it is not considered distinctive."

Nonetheless, in spite of the inconclusiveness of both of these studies, it is clear that the major articulatory gesture which can be measured and which is present for most speakers when the vowels of Set 1 are articulated and absent when those of Set 2 are articulated is an expansion of the pharyngeal cavity achieved by advancement of the tongue root and, for the West African languages reported on by Lindau, concomitant lowering of the larynx. Since the West African languages, like Luo, only involve a two-way opposition, within the terms of a binary distinctive feature phonological description, clearly one feature will suffice. Lindau proposes that 'Expanded' be used to designate this feature since, in the West African languages she studied, a lowered larynx co-occurs with the advanced tongue root, yielding both a horizontal and vertical expansion of the pharynx. However, the East African data clearly show that larynx movement is secondary and not a necessary concomitant of tongue root advancement or, conversely, that tongue root advancement is the primary gesture. Therefore, in our opinion it is completely appropriate to continue the use of the phonological feature Advanced Tongue Root ([ATR]) to describe the articulatory gesture which differentiates the vowels of Set 1 from those of Set 2.

Although vowel harmony systems of this type have been best studied for West African languages of the Kwa family, for Ịjọ, and for the Nilotic languages in Eastern Africa, as we showed in Hall et al (1974),[9] they are actually much more widespread, and many languages in both the Nilo-Saharan and Niger-Kordofanian families which today do not have vowel harmony as an active principle nevertheless

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still have traces of it. In addition, vowel harmony of this type has been reported from languages in two families of Afro-Asiatic: Somali (Armstrong 1934, and Tucker 1971) and Bilin (Palmer 1957 and 1958) (both Cushitic), and Tangale (Jungraithmayr 1971) (Chaddic).

Thus, vowel harmony systems based on tongue root position are found in languages from three of the major African families. As Aoki (1968:143) pointed out, it is also found in the Lhasa dialect of Tibetan and in Paleo-Siberian languages such as Koryak and Gilyak (cf. also Jakobson 1942: 610 and 1971:82). Therefore tongue root position as a basis for vowel harmony is something which has, one must assume, come into being more or less spontaneously in a variety of languages and therefore can provide a possible model for the analysis of the Nez Perce data.[10]

3. *A Reanalysis of the Nez Perce Data.* In the analysis of the Nez Perce vocalic system the first thing to be remarked is its basic surface assymetry:

(11)

i		u
		o
æ		ɑ

Not only do the sets of vowels which form the two harmonic series not form natural classes by conventional phonological criteria (as Chomsky and Halle remark in the quotation given earlier), but a vocalic system which contains a low front and a high front vowel but no mid-front vowel, as Nez Perce does, is strangely unbalanced and anomalous. It is, however, precisely this surface anomaly which gives us a clue to the kind of vocalic system with which we are dealing. Universal phonological theory predicts that one should not find more front/back low vowels distinguished than one finds at any one given non-low position. That is, the theory would predict that if /æ/

is found, then either one must be dealing with the canonical six-vowel system in (12),

(12) i u
e o
æ ɑ

as Rigsby and Silverstein (1969) postulate, or, alternatively, one can postulate, as Aoki, Jacobsen, and Kiparsky did, that surface [æ][11] is merely the result of some low-level phonetic rule operating on the expected front mid vowel and that one has the canonical five-vowel system in (13),

(13) i u
e o
ɑ

with an extra underlying vowel (/ə/ or /ɨ/) to account for the participation of /i/ in both harmonic sets.

Both of these systems, which have been logically deduced on the basis of expected universal phonological properties, have as an unstated assumption the belief that Nez Perce has an underlying vocalic system which distinguishes three tongue heights. However, there is another possibility which is also suggested by universal theory: if [æ] is found but not [e], one may be dealing with only *two* tongue heights. In this case, the anomalous vowel is not [æ], but surface [o].

We postulate that what we have in Nez Perce is the underlying canonical three-vowel system in (14)

(14) i u
ɑ

and tongue root position, yielding the following matrix:

(15)

	I_1	I_2	U_1	U_2	A_1	A_2
high	+	+	+	+	-	-
back	-	-	+	+		
ATR	+	-	+	-	+	-

Note: In this chart we have deliberately not used specific phonetic symbols (e.g. [i] vs. [ɪ]) for the underlying segments which are differentiated only by tongue-root position

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because any further specification would be misleading. More detailed specification of the vocalic segments is a property of the systematic phonetic level and not of the underlying representation.

With the above feature specification, the Nez Perce vowel harmony rule[12] of course becomes simplicity itself:

(16) [+ATR] → [-ATR] / [-ATR]

Our postulation of a three vowel system with tongue root position as the feature which differentiates the two harmonic sets has more to recommend it than simply the neatness which it permits in the statement of the vowel harmony rule. As well as providing physiological correlates for the phonological feature [±Dominant], the mechanics of tongue root movement and the concomitant movement of the body of the tongue also provide a phonetically natural explanation of why it is that just these two sets of vowels ([i,ɐ,u] and [ɪ,ɑ,o]) form the harmonic classes. Furthermore, an understanding of these same mechanics of tongue root and resultant tongue body movement allows a simple statement to be made of the phonetic realizations of [+ATR, -high] as [ɐ] and of [-ATR, +high, +back] as [o], as well as of the surface neutralization of the feature [ATR] in the case of the high front vowels.

With the tongue in low position, as the tongue root is advanced the body of the tongue can either rise slightly and more forward, yielding [ɜ], which is found in many African languages, or it can maintain backness while rising,[13] or it can move forward while maintaining low position, yielding [ɐ], as in the case of Nez Perce and also Somali (which also is underlyingly a three-vowel language). That the option taken in Nez Perce was forward movement follows from the large amount of phonetic space available in a three vowel position language.

According to Aoki's descriptions, the sound which he phonemicizes as /u/ has three phonetic realizations: [ʉ], [ʊ] and [ɯ]. [ʉ] occurs when there is length and [ʊ] elsewhere. Although Aoki is not as specific on this point as one could wish ("in general, rounding is non-distinctive" (1970:19) and "there is considerable individual variation in the degree of rounding of /u/" (1966:759)), it appears that [ɯ] can occur both long and short. That [ɯ] is an allophonic variant would follow naturally if the tongue root is in advanced position when /u/ is articulated. With the tongue root advanced, the body of the tongue moves forward; since rounding is non-distinctive in Nez Perce, there is no constraint on the vowel to remain in a position where automatic rounding occurs.

When the tongue root is retracted, the dorsum of the tongue is lowered. Since the area [ɯ,ʉ,ʊ] is already filled by the [+ATR, +high, +back] vowel, and since there is still phonetic space left, the tongue lowers to [o] for the articulation of the [-ATR, +high, +back] vowel. That the back of the tongue does lower all the way to [o] is at least partially due to the fact that /u/ is, according to Aoki (1970:19), normally realized as [ʊ] except when long. It is to be noted that the normal articulation of Nez Perce vowels seems to tend toward 'laxness'.

It is, we believe, the general 'lax' pronunciation of vowels (i.e. [ɪ,ɯ,ɑ,oˇ,ʊ]), as described by Aoki, which accounts for the surface neutralization of the plus and minus ATR /i/. In the languages which we know which have tongue root position harmony, the [+ATR] vowel tends to be [i], the [-ATR] vowel [iˇ] or [ɪ], this somewhat lower articulation being a result of the less forward position of the tongue root. Since, however, the normal realization of the high, front vowel in Nez Perce is [ɪ] (except before

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length), and less forward position of the tongue root does not cause the front of the tongue to lower to the same degree as it does the back of the tongue, what we have is normal [-ATR, +high, -back] [ɪ˃] falling together with the less-high pronunciation of [+ATR, +high, -back] /i/ as [ɪ] and a resultant neutralization of the distinctions in pronunciation of these two sounds (that is, one would expect the [-ATR] vowel to be slightly less front than the [+ATR] vowel). Such surface neutralizations of underlying distinctions, while not widespread, are by no means unknown in other languages exhibiting this kind of harmony.[14]

If our hypothesis is correct, then the surface composition of the two harmonic series is in fact accounted for in a phonetically natural way: That is, [i,ɐ,u] are /i,ɑ,u/ plus advanced tongue root and [ɪ ɑ o] are /ɪ ɑ u/ plus retracted tongue root position. The actual surface realizations of the underlying segments not only cannot, but should not, be subsumed in some sort of curly brace rule; we believe the reason why no one has been successful in writing such a rule which is convincing is because the rules involved are low-level adjustment rules (required by every grammar), needed for describing the surface realization of each individual segment. These are not necessarily interrelated phenomena and should not be lumped together.

The major surface adjustment rules which are needed are the following, all of which are, of course, ordered *after* the vowel harmony rule:

(17) $\begin{bmatrix} -\text{high} \\ \alpha\text{ATR} \end{bmatrix} \rightarrow [-\alpha\text{back}]$

(18) $\begin{bmatrix} +\text{high} \\ +\text{back} \\ -\text{ATR} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{high} \\ -\text{low} \end{bmatrix}$

(19) $\begin{bmatrix} +\text{high} \\ -\text{back} \\ \alpha\text{ATR} \\ \beta\text{long} \end{bmatrix} \rightarrow [\beta\text{ATR}]$

These rules have the following effects: rule (17) causes the low vowel to be realized as [ɑ] if [-ATR] and [æ] if [+ATR]; rule (18) lowers the [-ATR] high back vowel to [o]. Rule (19) has the effect of neutralizing tongue root position as an independent variable for the high front vowel and making it dependent on length. Thus, the long vowel will be realized as the expected [+ATR] vowel ([i·]) and the short vowel as the expected [-ATR] vowel ([ɪ]).

(20) $\begin{bmatrix} +\text{back} \\ -\text{low} \\ -\text{long} \end{bmatrix} \rightarrow [-\text{tense}]$

(21) $\begin{bmatrix} +\text{high} \\ +\text{back} \\ +\text{ATR} \end{bmatrix} \rightarrow [-\text{round}]$ / under certain conditions

Rule (20) obviously must be ordered after rule (18), which added a surface feature of lowness to the underlying three-vowel system. This later rule has the effect of realizing non-long non-low back vowels as somewhat lower in articulation,[15] that is, the [+ATR] as [ʊ] and the [-ATR] as [oˇ]. Rule (20) thus produces an effect which, on the surface, looks like the same phenomenon as that found for the high front vowel. However, the temptation to subsume these disparate phenomena into one rule such as

(22) $^{*}\begin{bmatrix} -\text{low} \\ -\text{long} \end{bmatrix} \rightarrow [-\text{tense}]$

would completely mask the important fact of the neutralization of tongue-root position in the high front vowel.

Rule (21) unrounds the [+ATR] high back vowel. This rule would appear to be a 'variable' rule; whether the variation is a completely free one or is constrained by

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tempo of speech or by sociological factors (age, propriety, etc.) would require further investigation.

Thus, the feature of [ATR] which we have postulated will permit a natural and unitary explanation not only of the vowel harmony alternations but also of the surface phonetic alternation which Aoki (1970) reports: [i·, ɪ, ɯ(.), ɑ(.), o·, oˇ, u·∿ɯ, ʊ∿ɯ].

4. *Sahaptin*. The only language related to Nez Perce is Sahaptin, which, with it, forms the Sahaptian family. Sahaptin has one dialect, Palouse, which has the same vocalic inventory and surface vowel harmony as Nez Perce (Rigsby and Silverstein, 1969:48ff). There are a number of other dialects which, according to Rigsby and Silverstein's analysis, have a surface three-vowel system:

(23) i u
ɑ

In these dialects vowel harmony, as it is reported, is not manifested by overt alternations of the surface vowels. However, Rigsby and Silverstein postulate that Sahaptin does have underlying vowel harmony because /k/ and /k̟/, in the environment of *some* /i/'s and /ɑ/'s (but not others) become palatalized to [č] and [c̆]. They cite at least some comparative evidence (1969:50 fn.12) showing that the morphemes involved have in the Palouse dialect (as well as in Nez Perce) overt recessive harmony in just those places where this palatalization occurs. Palatalization in the environment of [+ATR] vowels is readily explicable: with the tongue root advanced, the body of the tongue is moved forward and thus the classic condition for palatalization is met. It is noteworthy here that for palatalization to occur not simply the body of the tongue but also the tongue root must be advanced since we can have both [-kɑn] and [-čɑn] and both [-kni] and [-čni] as the allitive and

ablative case suffixes:

(24) a. yipáxšikan 'downriverward'
b. yipáxsikni 'from downriver'
c. túnišikan 'upriverward'
d. túnišikni 'from upriver'
e. atínačan 'westward'
f. atínačni 'from the west'
g. mítičan 'downward'
h. mítični 'from below' (Rigsby & Silverstein 1969:49)

If, as Rigsby and Silverstein postulate, there is absolute surface neutralization of vowel harmony by a rule ordered after the rule of palatalization, then for the child learning Sahaptin the palatalization is part of the morphology, not the phonology; but this doesn't seem at all likely. In languages exhibiting vowel harmony, the harmony is grammatically non-significant; it is simply a constraint on the surface vowel output. While it is of course possible for vowel harmony to become grammatically siginificant (as *i*-umlaut has in modern West Germanic languages), all the evidence in Sahaptin points against this. The sole trace of vowel harmony reported by Rigsby and Silverstein, palatalization, is completely productive, although it remains grammatically non-essential. That is, there seems to be no place in the data which Rigsby and Silverstein have given on Sahaptin where the meaning of a form is dependent on the presence or absence of palatalization.

That there is absolute surface neutralization of vowel harmony is further thrown into doubt by the facts presented by Jacobs (1931) and Aoki (1962) who show a surface vocalic inventory of a great deal more than three vowels: most significant is Jacobs' report that /a/ alternates with [ä] (= [æ]). In fact, he lists (p. 100, with symbols changed to our system) the surface inventory given in (25), where [i ~ ɪ ~ ɛ], [a ~ æ], [u ~ ʊ ~ ɔ]:

(25)

i		u
ɪ		ʊ
ɛ	ə	ɔ
æ	ɑ	

Since [ə] alternates with other vowels, Jacobs phonemicized /i,ɑ,u,ə/. He did not attempt to account for this wealth of surface vowels nor for the alternations which he noted. However, combined with Rigsby and Silverstein's facts about palatalization, the whole picture looks like one which is typical of a language exhibiting tongue root based harmony. Jacobs (p.99) further remarks that the language has a "predominantly breathy content". He attributes this to the absence of voiced stops and voiced continuants; however, since in fact Sahaptin has a consonant inventory very much like that found in other languages in its area, it seems more probable to us that the breathiness Jacobs observed is actually a property of the vowels. Certainly in Africa [+ATR] vowels are very commonly breathy; if there still is surface vowel harmony in Sahaptin, then the recessive [+ATR] vowels predominate as the unmarked category and this could account for the reported breathiness.

While our hypothesis about Nez Perce is probably not instrumentally verifiable, in Sahaptin our hypothesis that [ATR] harmony is acoustically marked by a breathy/hard distinction[15] can perhaps be instrumentally tested (although see the discussion in Section 2).

Even if it should be the case that instrumental measurements of the vowels of present day Sahaptin prove inconclusive, nevertheless we believe that a phonological feature of [ATR] is the most likely candidate for offering a unitary explanation of the vowel harmony processes in the Sahaptian languages.

5. *Feature-Switching vs. Feature-Specifying Vowel Harmony Systems*. Previous linguists who have discussed the vowel harmony system of Nez Perce have made reference to vowel harmony of the sort found in the Uralic and Altaic languages. However, the Uralic and Altaic system of vowel harmony is different in kind from that found in Nez Perce. In Uralic and Altaic there is no Dominant-versus-Recessive dichotomy. Rather, harmony is stem-determined, which, by the suffixal nature of Uralic and Altaic morphology, means that harmony is always determined by the right-most non-neutral root vowel. To cite a Uralic or Altaic affix in any particular form (e.g. the Turkish plural as /-lɛr/ or /-lɑr/ rather than as $l \quad V \quad r$) would be purely arbitrary.[17]

$$[^{-\text{high}}_{\alpha\text{back}}]$$

In Nez Perce, however (as in the Nilo-Saharan languages), every Recessive vowel must be fully specified since, after all, a word can contain only Recessive vowels. Thus, tongue-root position based vowel harmony such as that found in Nez Perce and African languages is a feature-switching system whereas harmony systems based on front/back or round/unround dichotomies such as that found in the Uralic and Altaic languages are feature-specifying.

There are two properties of tongue root position based harmony not found in any feature-specifying system where harmonization is to a feature such as labiality or backness:

1. a Dominant/Recessive dichotomy
2. at least potentially, harmonic shift triggered as readily by a Dominant vowel in an affix as by a Dominant stem vowel.

6. *Toweett's Paradox*. There is however an interesting difference between the tongue root position based harmony systems found in Africa and that found in Nez Perce. In all of the African languages the Dominant class is uni-

formly [+ATR] whereas in Nez Perce it is [-ATR].[18]

In our discussion so far of Nez Perce vowel harmony and of the feature of tongue-root position on which it is based, we have simply taken over from Africanist practice the feature [+ATR] to describe the more forward position of articulation. In Nez Perce, however, the Dominant phonological series and therefore, we assume, the marked one, is that series which is produced with the tongue-root relatively non-forward. Using [ATR] as the relevant feature, we therefore have a seeming contradiction in the notation in which the marked member of the opposition is designated by the minus feature. However, this seeming contradiction is not just an artifact of the notation. If there is any validity to Jacobs' observation cited above that Sahaptin has a "predominantly breathy content", then this, coupled with the fact of palatalization in Sahaptin in the environment of Recessive vowels, argues that in these languages the basic set of the throat is one in which the tongue root is advanced. That is to say, the marked physiological gesture is one in which the tongue root is retracted from advanced position. This might suggest that the appropriate feature for Sahaptian is [RTR] (i.e. Retracted Tongue Root), but this begs the question of how the tongue root became advanced in the first place. Furthermore, we have no evidence that in the Dominant series the tongue root *is* physiologically retracted, rather than in some neutral position, while the fact of palatalization is positive evidence that the tongue root is physically advanced.

In various African languages having this type of harmony we have reports not only of breathiness (a clear mark of tongue root advancement), but also of hardness and, in some cases, creakiness, both clear indications of

actively retracted tongue root and constricted pharynx. The paradox here is even greater. This paradox was first actively pointed out to us by the Honorable Dr. Taita Toweett (personal communication[19] in reaction to Hall et al (1974)), who stated that, as a native speaker of Kipsigis (one of the Kalenjin languages), he felt that when he was producing the Dominant (i.e. [+ATR]) vowels of his language, his tongue root and throat were essentially at rest but that when he was producing the Recessive (i.e. [-ATR] and hence phonologically unmarked) vowels, he was making the active gesture of retracting his tongue root. That this feeling that the minus phonological feature corresponds to the marked physiological gesture is not a peculiar property of either Toweett or of Kipsigis is shown by Welmer's report (personal communication) that his Fante informants, when criticizing his pronunciation of the Recessive set of vowels, consistently told him to "pull his throat back"; they were willing to accept his normal English (that is to say, neutral) pronunciation of the Dominant vowels. For many languages in both East and West Africa not only are the Dominant vowels described as being breathy, the Recessive vowels are also described as being hard or creaky and as having greater tension of the vocal tract (thus Stewart 1971:198f. and Welmers 1946:15).

The preceding suggests that what we may be dealing with is the kind of multi-valued feature system which Peter Ladefoged and his students have proposed. For example, Lindau (1975:79) proposes that the feature [Expanded] has the following five[20] phonetic values,

(26) 2 = Advanced tongue root plus lowered larynx
1 = Advanced tongue root, but no lowered larynx
0 = Neutral pharynx
-1 = Retracted tongue root, plus raised larynx
-2 = Pharyngealization

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Language	Set 1 [+Expanded]	Set 2 [-Expanded]
Akan	+2	0
Igbo	+2	-1
Ateso	+1	0
Luo	+1	0
Arabic (pharyngealized vowels)	0	-2

In these terms, Kipsigis, as reported by Toweett, is 0 and -1 and Toweett's paradox, since we have devised labels for it, would seem to be no paradox at all.

In actual fact, of course, Toweett's paradox remains. Also, the five phonetic values for the feature [Expanded] seem excessive for any one language with only a binary opposition.[21]

In both Kipsigis and Sahaptin the paradox is that the tongue root seems to have shifted its phonologically unmarked position in the direction opposite to the marked member of the pair. Thus in Kipsigis, where the marked member is [+ATR], the neutral member has receded to the point of active retraction; in Sahaptin (as in Nez Perce) where the marked member would seem to be [-ATR] (or [+RTR]), the neutral member has fronted to the point of active advancement.

Historically we believe that in both of these cases we are dealing with a kind of drift. That is, at some point, using Lindau's range of values for [Expanded] (where [-Expanded] = [+Contracted]), Sahaptian had 0 for its Recessive series vs. -1 for its Dominant series; Proto-Kalenjin had 0 for its Recessive series, vs. +1 for its Dominant series. At this point in both of these languages articulation matched phonology and there was no paradox. With the passage of time, what must have occured was that the unmarked member drifted further in the direction of

increasing the pharyngeal size distinction between itself and its marked opposite, in reaction to which the marked member in its turn drifted to maintain the original distance. Thus, in Sahaptin Recessive 0 Dominant -1 shifted to Recessive +1 Dominant 0; in Kipsigis Recessive 0 Dominant +1 shifted to Recessive -1, Dominant 0. In this way in both languages 0 or neutral position is maintained and the distance between the members of the opposition has been maintained, but 0 has changed its markedness, thus giving rise to Toweett's paradox. That this particular paradoxical situation need not necessarily have arisen is shown by languages such as Igbo where the same sort of drift has resulted in the Recessive series being -1 and the Dominant series being +1. (See Lindau's chart, reproduced in (26) above.)

7. *Conclusions*. One further theoretical question remains: the exact nature of the realtionship between tongue root position, vocalic length, and what has traditionally been termed the tense/lax opposition. In the case of Nez Perce /I/ we have seen that the result of the neutralization of [ATR] is to assign the expected phonetic realization of the [+ATR] vowel to the long member of the opposition, [I·], and the [-ATR] one to the short member [ɪ]. In the Somali dialect which Armstrong (1934) describes, there is a neutralization identical to that of Nez Perce but with [ɪ] as the only surface vowel. Here there is a correlation of [ɪ·] with the [+ATR] harmonic series and [ɪ] with the [-ATR] series. This would suggest that vocalic length and advanced tongue root position can come to be interdependent. However, since all of the other vowels, both [+ATR] and [-ATR], in Somali and Nez Perce can occur either long or short, it is obviously necessary to maintain [long] as an independent feature.

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It might be claimed that tenseness and Advanced Tongue Root are interdependent and therefore that no feature of tenseness is necessary. Again, the Nez Perce realizations of /i/ would seem to bear this out. However, this leaves unexplained the fact noted by Welmers (1946:15) and Stewart (1971:198f) that [-ATR] vowels in West African languages are rather more tense than the [+ATR] ones are, since such a formulation requires that [+ATR] = [+tense]. Nez Perce also poses another problem for this equation. According to such a theory one would predict that [u] is [+ATR] and [ʊ] is [-ATR]. However, in Nez Perce both [u] and [ʊ] are [+ATR]. In rule (20) above we introduced [tense] as an independent feature in order to account for what Aoki describes as the somewhat lower and laxer articulations of systematic phonetic [u] and [o] as [ʊ] and [oˇ] when short. We have used [tense] for lack of a more precise term to indicate somewhat lowered articulation, since this is the term traditionally used to differentiate [u] from [ʊ] in languages such as English and German. One could, of course, simply use [ATR] in these latter languages but this feature cannot be used in Nez Perce since it is actively needed elsewhere in the phonological framework. On this basis we feel that tenseness (whatever this feature may mean; that it refers in some direct sense to muscular tension would seem to be dubious), vocalic length and Advanced Tongue Root must be maintained in the theory as independent features. This does not, of course, preclude the possibility that in individual languages any two of them, or even all three, may become mutually interdependent.

In the above pages we have tried to show that seeing Nez Perce as a language with tongue root/voice quality based vowel harmony will provide a simple and unitary explanation for its vowel harmony process. From this

point of view, the vowels of the two sets do indeed fall into natural classes in a reasonable phonetic framework.

The Americanist who remains unconvinced by our attempt to interpret Nez Perce within the terms of this seemingly exotic framework will remain with the problem of producing an equally natural explanation.[22] To him we can only say that it seems to us to be at least of some significance that, among vowel harmony languages, Nez Perce and Nilotic share the rather unusual structural trait of not only having a Dominant/Recessive opposition but also in having harmonic shift triggered by afffixes as well as roots.

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N O T E S

1 This paper is an essay in re-analysis based solely on the published descriptions of Nez Perce listed in the bibliography; we have never heard the language spoken. It was originally written during the summer of 1973 as an offshoot of our work surveying African vowel harmony systems (Hall et al 1974), and it was privately circulated to various of our friends and colleagues, and to everyone (Aoki through Zwicky) who had previously written on the question.

We would like to thank Charles Cairns, Mark Feinstein, John Moyne, Amy Myers, and Martin Pam for their dicussion of the problem with us as the paper was coming into being. Bruce Rigsby and Michael Silverstein wrote us detailed responses to the draft version which we sent them and for which we here wish to express our thanks; they remained unconvinced by our arguments, preferring their original analysis. We also wish to thank Eric Hamp for his most encouraging response to the draft version.

We wish to express our gratitude to our friend and colleague Robert Vago for the interest which he showed in our analysis. It is due to his urging that we have decided finally to publish this paper. We also wish to thank him for his many helpful comments and suggestions.

The version of the paper which appears here has been rather extensively revised and expanded from that which we wrote in 1973. Our revision has benefited considerably from the experimental work of Lindau (1975) and Jacobson (1978). It has also been informed by our own ongoing work on the phonetics and phonology of the Nilotic languages as well as that of our students, friends, and colleagues, especially B.F. Wallace-Gadsden (1980), Eluzai Moga Yokwe (1978), Edward B.G. Ayom (Hall, Hall, and Ayom 1977), and Telar Deng (Hall, Hall, and Deng 1980).

Our work on the Nilotic languages was supported by sabbatical leaves from our respective institutions for the year 1976/77; an NEH Fellowship for 1976/77; UAC/JAC grants-in-aid to B.L.H. for 1976/77, and 1978/79; and a FRAP Grant for 1976/77 and a PSC/BHE Grant for 1978/79 to R.M.R.H. We wish to express our gratitude to these granting agencies. Without the confidence which they showed in us, our work would not have been possible.

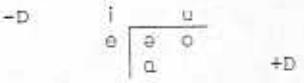
2 It is interesting to note that in Nez Perce, as in the African languages we report on below, there seem to be no true cases of Dominant grammatical prefixes which cause harmony to themselves. Apparent counterexamples like *watwa·yiksana* 'I waded across long ago' are clearly compounds of *wat-* 'to wade' and *wæ·yik* 'to go across'. Aoki (1970:84ff) calls these "compound verb stems which consist of an adverbial prefix and a verb root". However, an examination of the semantics of these "adverbial prefixes" which contain Dominant vowels

leaves little doubt in our minds that they are all either denominal or deverbative in origin. Of the 167 members of the class which he cites, the only ones with Dominant vowels are: *c'ɑw* 'with shell- or bead-like object'; *ɬâʔw* 'in speech'; *nî* (Dominant) 'leave behind'; *tôxpîl* 'with leg'; *waqi* 'in arms'; *wat* 'wade'; and *waʔwa* 'fish'. The four nominal prefixes which have Dominant vowels are: *tali·* 'short'; *tam* 'throw'; *waʔ* 'with hand'; and *wiwaqi* 'old'. These are, as Aoki says (1970:57) "generally attributive" and the resulting forms can also certainly be seen as compounds with adjectival, deverbative, or denominal first members.

[3] All of the Nez Perce data which we cite are from Aoki (1966:759f and 762f). For reasons which will become clear in Section 3 below, we have changed his phonemic /e/ to the actual occurring surface vowel /æ/, which he himself reports (1966:759 and 1979:2).

[4] The possibility of positing some other vowel, [ɨ], [ə], or [e] which would be a member of the Dominant series and which would be merged with the Recessive [ɨ] by a rule which would apply after the vowel harmony rule occurred to Aoki (who rejected this solution in favor of a prosodic one), to Jacobsen and Kiparsky, who opted for schwa as the sixth vowel, and to Rigsby and Silverstein, who opted for [e]. Jacobsen, Kiparsky, and Rigsby and Silverstein all invoke criteria of naturalness in support of their proposed underlying systems.

[5] For this reason Chomsky and Halle, following Aoki, propose the use of a morpheme feature [±H] (for harmony). Jacobsen's purely phonological solution (1968:822) (which Zwicky seconded) of a vowel system that is divided as



has the advantage of grouping the Dominant and Recessive vowels into adjacent quadrants and making the changes of Recessive to Dominant unidirectional: ɨ→ə, ə→ɑ, and u→o. However, there are still major objections:
a) The vowel which Jacobsen, following Aoki, symbolizes as /e/ (for purposes of pattern symmetry) is phonetically [æ], a fact which is treated as irrelevant and disguised by this analysis.
b) Granted that a certain symmetry has been gained by grouping the Recessive and Dominant vowels into two quadrants, the fact remains that, in universal phonetic terms, the classes thus obtained are still highly unnatural and, in features required, the vowel harmony shift still necessitates an extremely complex specification -- much more complex than is required for the specification of vowel harmony elsewhere in the world's languages.

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[6] In his article on the typology of vowel harmony systems (1968), Aoki shows that he is aware of these systems which he, following Jakobson (1942:610), terms HORIZONTAL harmony, and which he states "involve harmonization in height, tenseness, or position of tongue root." However, Aoki does not seem to have seen the analogy which we are proposing here between such systems and that of Nez Perce.

[7] Throughout this discussion we shall refer to the family membership of African languages according to the Greenberg classification as given in Greenberg (1971) for the Nilo-Saharan languages and Greenberg (1963) for all others.

[8] Akan has been studied by Welmers (1946), Stewart (1967); Igbo by Green and Igwe (1963), and Battistella (1978); Ịjọ by Williamson (1965). The state of the art is summarized in Stewart (1971). Lindau (1975) reports on an acoustic and radiographic investigation and summarizes the literature to date with extensive bibliography. Spagnolo (1933) and Yokwe (1978) have studied Bari vowel harmony; Luo has been studied by Tucker (1975 and forthcoming) and by Jacobson (1978). Kalenjin has been studied by Tucker (1964). Maasai has been studied by Tucker and Mpaayei (1955) and Wallace-Gadsden (1980).

Vowel harmony relationships for the Nilotic languages are surveyed in Tucker and Bryan (1966) which also gives some data on vowel harmony in the other non-Nilotic (and non-Bantu) languages of North-Eastern Africa. Hall et al (1974) (of which Antell et al, 1974, is a preliminary version) offers a survey of African vowel harmony systems in general.

[9] To the bibliography cited there should be added Herbert (1975/6) for Ganda; Stewart and van Leynseele (1979) for Nen (Bantu A.44); Bender and Ayre (1980) for Gaam [Ingessanã] (Eastern Sudanic); and Sakraan (1977 ms.) for Kwashii (Hill Nubian, Eastern Sudanic).

[10] It might be objected that vowel harmony systems which make use of distinctions in tongue root position are nowhere else attested in native America. This is not a compelling argument against our analysis for three reasons:
a) There is no real reason why a given language cannot innovate to create for itself a vowel harmony system of this type without any outside influence or model.
b) In Africa where such vowel harmony systems abound it is only quite recently that their nature has been recognized (Welmers (1946) in his description of Fante being perhaps the first to state the relationships systemmatically). Many of the older grammars which are otherwise exemplary for their time and quite detailed either ignore vowel harmony or treat it as a sporadic and unexplained alternation. We may suggest that if other native American languages are looked at

from this point of view, vowel harmony alternations based on tongue root position may well be found. In this regard, cf. Jacobsen's reference to Washo (1968:822).

c) The distinctions between the vowels of the two harmonic sets are often subtle, and even European-trained ears that are listening for a distinction often fail to recognize the significant cue. Thus, the fact that none of the linguists working on the Sahaptian languages have reported hearing systematic voice quality distinctions, which they were not even listening for, does not constitute prima facie evidence that the distinction is not present.

[11] The phonetic value of this vowel is clearly stated to be [ɐ] in Aoki (1966:759) and in Phinney (1934:x). It was, we believe, Aoki's phonemicization of this vowel as /e/ (e.g. 1962:172 and 1970:19) which has prevented previous linguists from focusing on the proper explanation of the relationship of the phonetic realities to the underlying system.

[12] In this rule no directionality of environment is specified under a convention similar to that which Bach (1968) terms a 'neighborhood' convention or Langacker (1969:858f) a 'mirror image' convention.

[13] This is what occurs in Kalenjin, yielding the sound which Tucker and Bryan (1966) symbolize as [æ̈], and which some linguists have found hard to distinguish from [ɔ] of the [-ATR] series. A similar result is found in Bari, yielding as the [+ATR] equivalent of [ɑ] the sound which is symbolized in the orthography as <ö>, a [ʌ] which is produced with the vocal tract in a "long tube" configuration (see Yokwe 1978 for discussion).

[14] For example, in Maasai, a Nilo-Saharan language, the surface distinction between the /+ATR/ and the /-ATR/ low vowel is neutralized (except after /wu-/); however that this is only a surface neutralization is shown by the fact that some /ɑ/'s trigger vowel harmony while others do not. For example, the marker of one verbal class is /ɪ/ (a recessive vowel in Maasai). Before some verb roots with surface /ɑ/, it occurs as [ɪ], e.g. *ɑ-*Iɡɑɲ 'to fill', while before others it occurs as [ɨ], e.g. *ɑ-*ɨpɑŋ 'to buy from' (data from Tucker and Mpaayei 1955:xiv, 52). This neutralization is discussed in detail in Wallace-Gadsden (1980).

[15] We shall turn to a discussion of the need for an independent feature [tense] in the conclusion of this paper.

[16] In Maasai (A.N. Tucker: personal communication) while [±ATR] /ɑ/ have fallen together, cf. fn. 14 above, as far as tongue body position is concerned and in this respect are phonetically identical,

they are maintained acoustically distinct by the feature of breathiness which is present in the [+ATR] ɑ but absent in the [-ATR] one.

[17] Robert Vago has pointed out to us that, in his view, we are here committing ourselves to an archiphonemic analysis of Uralic and Altaic.

[18] Nez Perce is unusual but not unique in this regard. According to Jakobson (1942:610), Koryak and Gilyak also have vowel harmony systems much like that of Nez Perce. They have six surface vowels, divided into two sets, where Set (2) is Dominant:

(1)	(2)
i u	e o
ə	a

If one uses the feature [ATR] then Set (2) is [-ATR] and, unlike Nez Perce, fulfills Stewart's (1971:199f) prediction that the [+ATR] low vowel will rise while retaining its centralized character.

[19] Dr. Toweett's comment to us was in a letter in 1974 in which he sent us some draft pages of what became his 1975 University of London Master's Dissertation on Kipsigis nominals. Unfortunately, we have never seen the finished dissertation, and therefore are unable to cite it with its proper title. We understand that this dissertation has recently been formally published in Kenya.

[20] In her discussion of the feature [Expanded] in her 1978 article (552f. and the chart on 559), Lindau presents this feature in terms of a simple 1,0,-1 opposition. Whether she chose to abandon her previous position because none of the examples which she cites show more than a binary phonological opposition, or whether the simplification is just an example of the kind of condensation which is inevitable when the content of a monograph is squeezed into a journal article, we do not know. However, we think that her earlier proposal is the more interesting one and so we have chosen to reproduce it here.

[21] There exist a complex of six Western Nilotic languages (on four of which we have worked intensively), Dinka, Nuer, Atuot, Shilluk, Jur, and Anyuak, which have not merely a binary voice quality opposition but rather a four-way one. In these languages laryngeal movement is clearly distinct from advanced tongue root, despite Lindau's claims that lowered larynx is simply a variable in her feature [Expanded]. The four qualities, to which we have given impressionistic labels are: normal voice, which is produced with the tongue root, pharynx, and larynx in neutral position; hard voice, which is produced with the tongue root retracted, the pharynx constricted, and the larynx somewhat raised; breathy voice, which is produced with the tongue root advanced, and the pharynx and the larynx in neutral position;

and hollow voice, which is produced with the tongue root advanced, the pharynx constricted, and the larynx lowered. Since, as Jacobson (1978:81, see also his paper in this volume) points out on the basis of his radiographic work, for Shilluk and Dinka "...the width of the pharynx is independent of the height of the tongue or the depth of the larynx...", we cannot adopt Lindau's term [Expanded], with its multiple values, because, given the independence of laryngeal and tongue root movement, the term 'Expanded' becomes just a notational variant of 'Advanced Tongue Root' and insufficient to explain the gestures involved. We have discussed the function of the four-way voice quality variation in greater detail in Hall, Hall and Ayom (1977) and Hall, Hall, and Deng (1980).

[22] The scholar with a commitment to Nez Perce or Sahaptian who wishes to show that our conclusions are wrong does have yet another alternative: to conduct his own spectrographic and radiographic investigations of the language. According to Aoki (1970:v) "time is running short for the Nez Perce language...only a small fraction [of the 2,097 tribal members] have a productive knowledge of the language." It is astounding that so few native American languages have been the objects of detailed experimental phonetic investigations. For many other groups besides the Nez Perce, time is also running out and soon it will be no longer possible to make this detailed part of the linguistic record.

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