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THE CASE OF CONSONANTAL HARMONY IN BAKAIRI LANGUAGE (CARIB)[1]

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ABSTRACT: O objetivo deste trabalho é focalizar o caso de harmonia consonantal do Bakairi sob a luz da teoria Autossegmental. É nossa intenção verificar se as estratégias oferecidas pela Autossegmental dão conta dos fatos arrolados no Bakairi. Será discutida, também, a real necessidade de se postular um nível fonêmico para o Bakairi: é o fenômeno da harmonia que condiciona os traços surdo/sonoro das oclusivas e fricativas no bojo das palavras. Assim, o contraste fonêmico parece desaparecer. Finalmente, será mostrado como a harmonia consonantal se desenvolveu na língua.

INTRODUCTION

The Bakairis - allocated in two indigenous posts, created by old Indian Protection Service: Indigenous Post Simões Lopes and Indigenous Post Santana - speak a language known by the same name and classified within the South branch of the Carib family.

They constitute a group of about 600 members, whose majority masters portuguese along with their native tongue.

Research with the language has been restricted to the Indigenous Post Simões Lopes situated on the banks of Paranatinga river, 520 km Northeast of Cuiabá, Brazil.

We have already carried out some research on four

field trips[2] working with a total of eight native speakers of diferent ages. Data have been registered in eletromagnetic tape in a UHER recorder, 4000 Report model.

One of the aims of the present work is to focus on a case of consonantal harmony under the light of the Autosegmental theory and to verify to what extent will the strategies offered by this theory account for the inventoried facts in the Bakairi language.

The harmony phenomenon in Bakairi has the function of determining the distribution of the stops and fricative consonants concerning the voiceless/ voiced features. This distribution, nevertheless, is not tied to some roots or to certain word themes.

As opposed to other languages, harmony in Bakairi comprises the entire consonantal system of the language which makes it difficult to define the phonemes and allophones in Bakairi.

So, also among our aims we intend to raise the discussion about the different concepts of phoneme having as background the behavior of phones in Bakairi.

Finally, we will show when and why consonantal harmony develops in the language. Our starting point are registers made by Von den Steinen from 1887 and, in the time line, we will try to point out the reasons that caused the phenomenon.

CONSONANTAL SEGMENTS IN BAKAIRI

There are 33 consonantal segments in Bakairi:

p b ^{m}p ^{m}b t d t͡ʃ d͡ʒ ^{n}t ^{n}d k g k͡g ^{ŋ}k ^{ŋ}g
β ɯ ɥ ɥ̃ m n l ɾ ɾ̃ s z ʃ ʒ x ɣ t͡ʃ d͡ʒ

Let us observe some facts about these sounds.

In the stop series there is no doubt that the complex stops[3], labialized and pre-nasalized, are

allophones of the corresponding single stops.

The alveolar stops [t] and [d] are palatalized before front high vowels and they are realized as [tʃ] and [dʒ] only in word junctures: [tʃ - ɥã - 'tɔ̃ɰ] 'for him to eat'; [adʒ - ixu - ʃʁʒ] 'in order to roast'.

The approximant [w] and the labial fricative [β], when in internal juncture, occur in complementary distribution: the fricative before [i] and [e] - [iβe'pɨɛ] 'my canoe'; [ɥeβi'pɨ̃ẽ] 'sharp' - and the approximant in the other enviroments - [i'waɾgɔ] 'my brother', etc.

These two segments - [w] and [β] - seem to be expressions of one bilabial consonant, specifically, *p*. When the root begins with *p*, this one will be voiced in the process of word-formation, changing to [β] and [w] according to the distribution described above. So, [β] and [w] are results of internal juncture. In the case of suffixation, however, the formatives initiated by *p* will be kept as [p] - [ɥepi-'pɨ̃ẽ] 'sharp' or change to [b] - [saguʁɔ'bɨɛe] 'old' - under the rule of consonantal harmony; *p* can also be manifested as [p] or [b] in the interior of the root; [nekɔbɨze'agɛ] 'he sweated'; [kʊ'dupɛ] 'bowl'[4].

The bilabial nasal is also realized as [w] in juncture, but it nasalizes the adjacent vowels: [tã'wĩze] 'to be hungry'; ['tãwĩ] 'tobbacco'.

The alveolar and velar fricatives are distributed complementarily as follows:

- The voiceless alveolar fricative s is palatalized before a front or back vowel in word initial position: [ʃe͡ʊ] 'quati'; [ʃɾ'ɡase] 'making'; [ʃu'tune] 'person who knows'. It is also palatalized and voiced before a front high vowel in medial position: [pa'ʃika] 'aut-eater'; ['tɔʒɾ] 'people'.

- The voiceless alveolar fricative [s̲] occurs before [a] and [e] anywhere in the word: [nesage'agɛ] 'he dug'; [sa'wãkɔ] 'flower'; [ʃi'gase] 'he made'; [se] 'tree' - or the voiced z, restrained to medial position - [a'zage] 'two'; [sape'zĕ͡ɛ͡ɔ̃] 'wind'.
- The velar fricative is manifested either as the voiceless one [x] or as the voiced one [ɣ] in medial positions before [ɔ], [ɑ] and [u]: [ɑ'xɔxɑ] 'bosom'; [ɑ'xusɑ] 'foot'; [sagɑɣɔ'bɨɛe] 'old'.
- The velar fricative [ɣ] has yet an unexpected distribution before [a] in words like [neɣatu'taɾ] 'he narrated'; [niɣatu'taɾ] 'he ran'; [eɣase] 'to get out'; [aɣaɾ'tĩɔ̃] 'old person'; [ʃ̃ã'ɣaxɔ] 'head'; where the voiced alveolar fricative would be expected.

The explanation for this unexpected behavior of [ɣ] can be supported by a historical statement which we would consider appropriate to explain, parenthetically, at this point.

In XIX century Bakairi (VON DEN STEINEN, 1892) there was a certain sound - represented by ɣ -, "near gutural r": [eɣawo] 'to run'; [ynaɣaxo] 'head'. There was still another sound, "aspirated h", that took turns with Ø, s, s̄, z, z̄ - hina ~ sina ~ s̄ina ~ ina 'we'; haɣaitiõ ~zaɣaitiõ 'old person'; hego ~ ego 'crusher' (ibidem: 253-255).

Nowadays it is possible to rescue that the fricative which breaks the rule - the voiced velar [ɣ] - corresponds to that historical sound realized near "gutural r". About the alternation of the "aspirated h" with the other sounds, it is verified that this alternation happens according to the distribution of the fricatives mentioned above. The voiced velar

fricative under this distribution is, consequently, a result of the derivational process in the language, while the other fricative - that one which is realized only before[a]in certain words - is previous to the derivational process.

Recovering the remarks we were making on the sound system in Bakairi, we can conclude at first that the realization of the consonantal phones is linked to two facts: the complementary distribution that manages the presence of the variants and the distribution of the stops and fricatives with relation to the voiceless/voiced polarity.

Since the harmony prescribes the alternation between voiceless/voiced features in the stop and fricative series,a possible delimitation of the phonemes in Bakairi will only be successful by leaving the harmony aside as a criterion and dealing with a syntagmatic axis: the prediction of some variants is easily described under a restricted segmental phonological context.

On the other hand, in a paradigmatic axix, the definition of the voiceless/voiced polarity becomes opaque. In Bakairi, the distribution of the stop and fricative series does not necessarily constitute a phonemic opposition with relation to the voiceless/voiced polarity. The stops like the fricatives happen in turns in the word body according to those features.

So, a word with a succession of syllable begun by stop consonants, for instance, must reflect an alternation of the voiceless/voiced features as the one shown in

(1) tɔdɛ'kage 'to have *bow*'
Vd VlVd

This distribution of voiceless and voiced consonants - that summarizes the harmony case that will be taken later in this paper - will make the

delimitation of the Bakairi phonemes difficult.

We can not claim, for instance, that the voiced ones are allophones of their voiceless equivalent because the environments are not complementary. So, it is impossible to deal with a whole set of phonological rules.

Besides, a sole sequential constraint rule, according to which no Bakairi word can begin by a voiced consonant [ɔ], associated with a morphophonemic rule, that voices every initial consonant of the word formation processes, makes clear that the minimal pair category in Bakairi is not relevant to the determinantion of the phonemes.

This premise is corroborated when one observes, for instance, what happens with a word as ['tɸkɣ] 'bow', that can be in a derived word - [tɔdɸ'kage] 'to have *bow*', or inflected word [idɸ'kaʂ] 'my *bow*' where [t] and [d] do not contrast phonemically into a same phonological segmental environment. The change of the voiceless feature by the voiced one does not cause a change in meaning.

As it can be seen, the alternance of the voiceless /voiced features in Bakairi seems not to happen as a means of determining meaning, which turns the establishment of Bakairi phonemes into a relevant question. It also points out the possibility of questioning the concept of phoneme offered by the different schools. This makes us revisit such concepts confronting them with Bakairi data.

THE PHONEME IN BAKAIRI

Summarizing what we said earlier about the distribution of consonantal sounds in Bakairi, it seems at first that there is no problem with the prediction of the occurrence of certain phones into a segmental distribution.

At the syntagmatic axis, [tʃ], [dʒ], [ʃ], [ʒ], [β],

[w] behave as segmentally conditioned variants (cf.: distribution of the consonantal sounds presented in the previous section). Nevertheless, the question becomes complex due to the necessity of relating such variants to the respective phonemes.

At first, it seems possible to associate [tʃ] with /t/, [dʒ] with /d/, [ʃ] with /s/ and [ʒ] with /z/ having only the segmental phonological context in mind. But it seems impossible, though, to associate [β] and [w] with /b/ - having as support the phonetic proximity among [b], [β] and [w] - since [β] and [w] are expressions of a sound *p* in word-formation processes as in ['paɪgɔ] 'brother'/[i'waɪgɔ] 'my brother' and ['petɔ] 'fire'/[i'βetɔ] 'my fire'. So, there is no reason to consider [β] and [w] allophones of /b/.

If, at another time, we enlarge our scope and look upon the consonantal sound pattern as a whole, we will be under the possibility of denying that [dʒ] and [ʒ] could be the variants of /d/ and /z/, respectively. In some instances, [d] and [z], and also [b], cannot be treated as phonemes, for their occurrence is conditioned by the consonantal harmony phenomenon. What we want to say is that the phones marked by the [voiced] feature do not contrast phonemically with the respective phones marked by the [voiceless] feature. This also corroborates the finding that [β] and [w] are expressions of [p] which in their turn also alternate with [b] within word roots and in suffixation processes according to consonantal harmony[6].

All the observations made above permit us to predict the degree of complexity that will cover the definition of phoneme in Bakairi if we take the notions of phonemes offered by theory as premises.

In the interplay of voiced and voiceless consonants, for instance, two paradoxical facts come on the scene:

- the distribution of voiceless and voiced phones is not complementary;

- although not being complementary, the distribution can sometimes be contrastive.

So, in any segmental phonological environment - except for word initial position that constrains the occurrence of voiced consonants - there will be voiceless and voiced consonants as in the following examples

(2) nekɔgeze'agi	3p.-*tire*-immediate past 'he was tired'
(3) nigɔke'aki	3p.-*wash*-immediate past 'he washed'
(4) neka'daʒ	3p.-*ask*-immediate past 'he asked'
(5) niga'taʒ	3p.-*make*-immediate past 'he made'
(6) 'ɤtɔ	'house'
(7) ɔ'edɔ	'hammock'

which show that, in spite of the non-existence of minimal pairs[7], we could inventory the phonemes of the language dividing them into voiceless and voiced if we take into account the segmental structure of the words. The dichotomy voiceless/voiced could be seen here as phonemic.

But if we analyse other examples alongside with those above it is possible to verify that the stops

and fricatives are variants of their homorganic voiceless that are combined in series in the structure of the words alternatively showing either the voiceless or the voiced feature:

(2) n-ekɔze-'agi 'he was tired'

Vl Vd

(3) n-igɔke-'aki 'he washed'

VdVl Vl

(4) n-eka-'daʒ 'he asked'

Vl Vd

(5) n-iga-'taʒ 'he made'

Vd Vl

(8) ad -ixɔ-'ʌʒ 'in order to roast'

Vl Vd

(9) e'ʌa-se 'to get out'

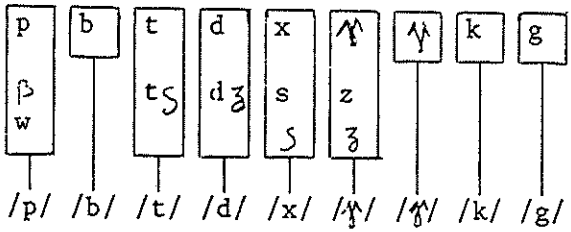
Vd Vl

The two sets of examples above seem to confirm that in certain instances we can think of phonological contrasts, but the contrast may be accidental: the distribution of voiceless and voiced is an imposition of the harmony that conditions the alternance of the features, as it can be seen in the second set of examples above. The accidental contrast may be the reason why those pairs do not help in the determination of phonemes in Bakairi.

So all the mutations Bakairi phones go through turn the strategies offered for the definition of phoneme opaque.

For several reasons it would be an impropriety to say that the Bakairi phoneme is a class of sounds that shares similar phonetic characteristics.

Besides the distribution being unproductive there are other relevant facts. From what was described here up to now, we can verify that the consonantal segments in Bakairi fill two different distributions. Leaving the harmony phenomenon out we can take the behavior of some variants as basic and propose the distribution below for the stops and fricatives in Bakairi [8].



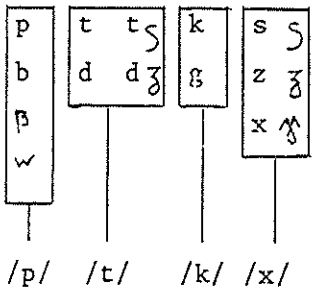
The occurrence of similar phonetic sounds derived from distinct entities, namely the case of the voiced velar fricative, is incompatible with the notion of phoneme as a phonetic class. Yet this same fact would not be inconvenient to the analysis that is supported by the phoneme as a phonological concept.

Other problematic data to the definition of phoneme as a phonetic class are the alophones [β] and [w] associated to *p* rather than to the voiced labial consonant *b*.

The frame above still raises discussion about the symmetry in the pattern: to consider that [p] is phonemically opposed to [b] would lead us to the expectation of finding the voiceless counterpart of [β], the voiceless labial fricative [ɸ], in the

pattern and would also lead us to the possibility of associating the homorgenic voiceless and voiced segments to each other, that is, the segment /p/ would be associated to [ɸ] and to [b], [β] and [w].

Now if we do not wish to leave the harmony phenomenon out, we are compelled to take into account that every voiced counterpart of the above segments is conditioned by this phenomenon. This corresponds to stating that the voiced segments themselves would be realizations of a voiceless entity and we would have to present another chart:



where the symmetry in the pattern would be solved. But the prediction of the phonic variants would go on as problematic ones.

In relation to this last frame we still have to observe that the voiced velar fricative [ɣ] realized before [a] was not included in that chart since this voiced consonant already existed before the development of harmony in a determined list of words.

The impossibility of foreseeing both the voiceless phones and the voiced ones within a segmental context represents one more contradictory fact to the definition that has the distribution as corollary; it also represents a statement against the functional criterion: the phonological contrast would be neutralized in all and any sequential contexts.

Besides, the second frame above, in which the display of sounds according to harmony is reflected, allows us to foresee a very problematic fact from the theoretical point of view: a possible phonemic entity in Bakairi could only be characterized by taking into account the point and manner of articulation. Whereas languages make use of the distintictive feature system to deal with the phoneme, in Bakairi this resource does not seem expressive.

Based on the mentalistic position, the conception of phoneme as psychological reality - or as an abstract one - also does not find support in Bakairi data.

To adopt the employment of basic forms as strategy and, by derivation, to get the phonic alternative forms, does not seem to be a feasible procedure.

First, because the facts are circular: there is no way to foresee the occurrence of these forms via sequential rules. This accounts for the fact that no feature system can be fed by segmental environments.

Second, the Bakairi phonic oppositions, besides not being related to the distribution of meaning, do not reflect grammatical facts. We are not dealing with problems about morphophonemics.

Summarizing, in Bakairi, the realization of voiceless and voiced consonants cannot be predicted by phonological rules; also there are no segmental environments which describe such realizations. Bakairi phones can even be contrastive at a segmental level - as we have already shown before (cf: (2) - (7))- but the contrast is not, strictly, phonemic: it has sprung from the distribution of sounds according to consonantal harmony. The outline of the Bakairi word is a result of this distribution that does not seem to fill up all the prediction in the phonological context: the voiceless/voiced contrast is, as a matter of fact, a contrast provided by the lexicon.

This being so, the discussion about those sounds

to be labelled as phonemes can extrapolate the sphere of autonomy, taxonomy or even the psychological reality of the phoneme.

In the case of Bakairi the question becomes a complex one because harmony is not a partial phenomenon, that is, it does not apply to some grammatical paradigms. It permeates the entire phonological system of the language, dominating sound distribution.

Despite all the theoretical treatment the phoneme has received, the definition of phonemes and allophones in Bakairi does not hold water.

We believe that to describe the sounds functioning in Bakairi safely we do not need the phoneme category. This category seems to us unnecessary for its different theoretical approaches do not find echo in Bakairi data.

In Bakairi the distribution of voiceless and voiced consonants evolves around a larger phenomenon - consonantal harmony - which despite being comprised and reflected within the word also seems to be settled at another level. And so the comprehension of harmony seems more relevant than the search for phonemic entities. In Bakairi the sounds give up assuming a strict phonological identity because their characterization in terms of features guarantees the word structure in Bakairi, displacing the question of meaning.

CONSONANTAL HARMONY IN BAKAIRI

Generally speaking, works on vocalic and consonantal harmony have shown that this kind of phenomenon has not been adequately treated when the strategy adopted is the search for explanation on the segmental level.

With the advent of autosegmental phonology, new horizons were opened for harmony studies.

From an autosegmental perspective, phonological

representation may be extended for several tiers which make up a non-linear arrangement of the segments. Segments belonging to different tiers are interconnected by association lines which indicate how they articulate with each other. This new approach to phonological structure contributes to more satisfactory solutions for familiar problems, such as the phenomenon of harmony.

The point of departure of autosegmental phonology (Goldsmith, 1976) is the difference between feature and suprasegment, the latter being identified with the autosegment. Whereas autosegments are subject to automatic spreading within possible domains, the feature itself does not expand: rather, it merely contributes to the identification of the segment. On the other hand, a given autosegment's association domain spreads almost automatically.

Another characteristic of the autosegmental approach is the fact that phonological rules are not called for.

In sum, this is a theory about how the various resources of the articulatory apparatus are coordinated. Parallel sequences of segments are proposed in which no segment depends on or is superimposed upon another. Each is independent, so that an autosegmental level is employed.

The new approach offered by autosegmental phonology led us to consider our data within the context of this theory.

What particularly interested us was the proposal to distinguish between features and autosegments. Our two findings concerning Bakairi - the fact that the system of oppositions does not necessarily imply phonemic opposition and the fact that the occurrence of a voiceless or an unvoiced feature is determined by harmony - suggested to us the possibility of treating the voiceless/voiced polarity not in terms of the notion of features, but rather in terms of the concept

of autosegment .

The particular case of harmony we are concerned with does not allow the assimilation of features. In Bakairi, harmony occurs as a function of the dissimilation of the voiceless or voiced feature. There seems to be a certain degree of incompatibility among certain similar features at a syllabic chain made up of consonants all of which belong to the same series.

The possibility of incompatibility of similar features invests the phenomenon of Bakairi harmony with a different aspect.

First, what is involved is feature dissimilation, not assimilation; dissimilation determines the specific feature - voiceless or voiced - of each consonant at the syllabic chain. This phenomenon is repeated at each series of consonants within the domain of a word; that is, harmony spreads throughout the word, but this spreading does not generate copies of features.

On the other hand, Bakairi harmony is not predictable on terms of segmental phonological rules, and since the voiceless/voiced alternance does not imply phonemic contrast, we are led to consider the possibility that the chain in which this alternance is reflected may be independent of the segment. In this way we can avoid the traditional approach to harmony, since the peculiar facts about Bakairi harmony suggest an autosegmental perspective.

Let us now turn the detailed description of the particular case we are concerned with.

Initially, we might expect harmony to occur among elements of a chain made up of syllables with consonants belonging to the same series. In this case, harmony is obligatory, in Bakairi, either among stops or among fricatives. Any segment other than a stop or a fricative interposed between segments of either series will break up the harmony.

The existence of incompatibility among certain features within a given series is confirmed by examination of the syllabic structure of a word such as

(10) nekɔbɨze'agi 'he sweated'
VlVdVd Vl

where voiceless/voiced alternance occurs only between the first two syllables formed by stops. The voiced fricative interrupts the alternance that had been taking place, and the impression is that harmony has been broken.

However, this generalization does not seem to hold for all cases.

In the case of a word such as

(11) adakɔba'dɨle 'to hunt'
VlVd Vd

the consonants at the chain *-akɔba'dɨle* make up a series of three stops, in which the expected harmony does not occur. Here the succession of the voiced stops *b* and *d* does not seem to involve any incompatibility.

Thus any explanation of the phenomenon of harmony will focus on the problem: why does harmony sometimes lead to alternance of the voiceless/voiced features and sometimes to assimilation of one of them?

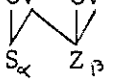
Let us look at other facts that are relevant to the description of the kind of harmony we are dealing with here.

The first fact to take into account is directionality. Harmony is triggered by the leftmost [+consonantal] element in the root or word, that is, the base-word. The movement is from left to right. It

is a one-way process.

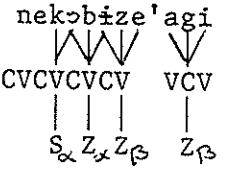
As to syllabic patterns, it has been mentioned that in Bakairi no word begins with a voiced consonant. Thus we may set off from a CV position restricted to voiceless consonants, whereas succeeding positions are regarded as free. Voiced consonants, on the other hand, appear solely in intervocalic position.

To translate these facts into autosegmental terms, the phenomenon of Bakairi harmony must be described in terms of a skeleton of the type

(12) 

through which we associate voiceless consonants, represented by the symbols S, with CV chains, and voiced consonants, represented as Z, with VCV chains. We add to the symbols S and Z either α or β, which stand for different series.

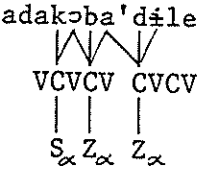
This skeleton will also describe the harmony that occurs in

(13) 

'he sweated'

where the voiceless/voiced alternance seems restricted to the chain formed by stops *k* and *b*.

This same skeleton, however, may not be able to account for the facts presented in

(11) 

'to hunt'

since harmony should be observed in the series of stops.

If we observe the morphological structure of examples (13) and (11), we find that in

(13) n- ekɔbɨze -'agi 3p.- to sweat - immediate past
'he sweated'

harmony was interrupted within the root of the word by the presence of a segment which does not belong to the series of stops - *k* and *b* - namely, the fricative z. In example

(11) ad- akɔba -'dɨle intrans. marker- to hunt - aspect
'to hunt'

we notice that, although the consonants *k*, *b* and *d* form a series of stops, harmony apparently has not occured: there is no voiceless/voiced alternance within the series. Here harmony was broken not by the interposing of an extraneous element, but rather in function of the morphological boundary.

Therefore, due to the possibility of harmony blocking by morphological boundaries, we are forced to indicate the presence of such boundaries in our syllabic skeleton using the symbol [+].

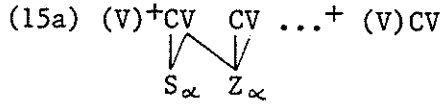
The proposed skeleton is then

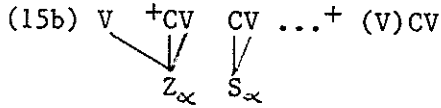
(14) $^{+}$CV CV ...$^{+}$
S_{α} Z_{α}

where the possibility of harmony in terms of a successive alternance of the voiceless/voiced features in a given series of consonants is restricted to roots and base-words.

The restriction of harmony to roots and base-words suggests that the process of suffixation in Bakairi should not alter the harmony present at the root or base-word. In this case, the skeleton shown in (14) would be enough to describe the phenomenon.

The final representation of the skeleton could then be

(15a) 

(15b) 

The above considerations sum up, in rather general terms, part of the phenomenon of consonantal harmony in Bakairi.

Assuming that they suffice to describe the entire process of Bakairi harmony, it would be easy to proceed to formalize the facts in autosegmental terms:

(i) The voiceless or voiced feature is not copied by the segment in a continuous series of α segments.

(ii) Alternance in a series is interrupted by segments extraneous to the series or by morphological boundaries.

(iii) The process is always repeated following a left-to-right orientation every time a new series is formed.

The phenomenon of harmony, as formalized above, would not raise any problems for an approach based on the theoretical guidelines we have been following so

far if Bakairi harmony contained only the facts presented up to now. However, since further data will come up, we believe that premises (i)-(iii) present certain problems.

The need of grammatical information, for example - the morphological boundary - implies that the above approach must restrict harmony to the segmental level.

On the other hand, this same set of premises may lead to the conclusion that harmony is restricted to roots or base-words, since we have made no predictions concerning processes of suffixation. If, however, we analyze the following examples

(16) n- ekɔze -'agi 3p.- tire -immediate past 'he was tired'

(17) n- igɔke -'aki 3p.- wash -immediate past 'he washed'

we find that (1) the process of suffixation in Bakairi is not unrelated to harmony: the same tense-aspect marker comes in two forms, *-agi* ~ *-aki*, and (2) if suffixation is also subjected to harmony, predications (i)-(iii) - which restrict harmony to roots or base-words - are untenable.

Besides, if we take into account example (17) *nigɔke'aki* 'he washed', we see that the series formed by the stops *g* and *k*, interrupted by the morphological boundary, is not reestablished - as far as alternance is concerned - with the voiceless stop in the suffix *-aki*. However, example (16) *nekɔze'agi* 'he tired' suggests precisely this assumption: the choice of the form *-agi* might represent the reestablishment of a series with the stop which is closest in regard to harmony.

This fact raises a further complication: which factor conditions the use of *-aki* or *-agi*, or any other formative, since almost all formatives in Bakairi

come in pairs?

The answer to this question requires an explanation of much greater complexity than the one we presented above, in (i)-(iii).

Let us return to some of the examples we have seen before - (13) *nekɔbɨ́ze'agɨ́* 'he sweated' and (16) *nekɔze'agɨ́* 'he was tired' - in which we can see that the voiced fricative consonant z, the element which breaks up a series of stops in (13), contains the feature which is opposite to the element that triggers the harmony, the stop *k*; as to the voiced stop *q* in the morpheme *-agɨ́*, the same observation is pertinent: again there is a feature which is opposite to the first consonant in the root.

Analogous considerations apply to

(18) ad- akɔba -'dɨ́le 'to hunt'

Vl Vd

(19) n- igɔke -'aki

Vd Vl

where the first consonantal segment of the suffixed element contains the feature opposite to the segment where harmony begins - the first consonant in the root.

This leads to the conclusion that the phenomenon of harmony takes place in successive movements: every time the process is interrupted, harmony begins once again from the starting point. And, in this case, harmony does not involve solely elements within a given series: alternance is maintained at another level.

It is clear, than, that Bakairi harmony is a rather elaborate phenomenon and the facts involved are complex: suffixation is not unrelated to harmony:

nevertheless, it does not imply the redistribution of the voiceless/voiced features present in the root or base-word. Thus the syllabic skeleton proposed in (15a) and (15b) will not be able to account for the entire process of harmony in Bakairi.

An initial possibility would be to attempt the establishment of an affix skeleton specially for suffixal formatives, through which formulations (i)-(iii) would be reiterated. In this case, the grammatical information included in (ii) might be disregarded, but on the other hand it would be necessary to create a readjustment rule for the association of lines at the juncture between the root skeleton (or base-word skeleton) and the affix skeleton.

The predictions are now as follows:

(i) the voiceless or voiced feature is not copied by the segment in a continuous series of segments.

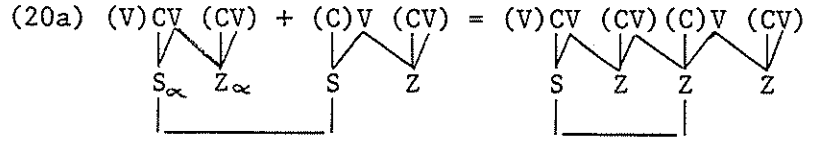
(ii) Alternance in a series is interrupted by segments extraneous to the series.

(iii) premises (i) and (ii) are always repeated following a left-to-right orientation every time a new series is formed.

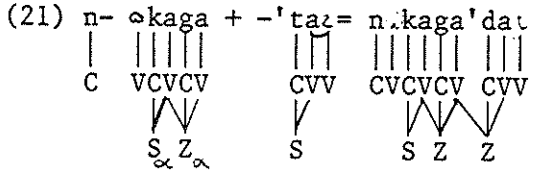
and will apply at different stages both to harmony in the root (or base-word) and to harmony reflected in suffixes. Thus Bakairi harmony applies in stages: at the root level (or base-word level), at the suffix level and, finally, at the level of the root-formative juncture.

At the juncture of the two propposed skeletons, readjustment of lines may proceed as previously established: at the suffix, the first voiceless segment is associated only with the CV position, and

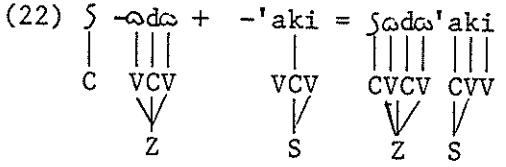
the first voiced segment is associated only with the VCV position. This generalization covers the two combinatory possibilities of the language with two kinds of syllabic skeleton in Bakairi:



in order to account for the facts observed in



-where, after the readjustment rule is applied, the association lines relative to the suffix -*daɾ* must be linked to the position VCV - and in



- where the association lines of the suffix -*aki* will remain linked to the CV position, expressing the feature: which is opposite to the first consonant in the root.

These two proposed skeletons allow us to see

harmony as a whole process dimensioned in terms of the syllabic chain. But this solution does not seem to describe Bakairi harmony in full.

The two skeletons belong to a static plane and do not reflect the successive movements of harmony, which is always repeated beginning from the same element - the first consonant in the root or base-word. The skeletons describe only the final result of the process of harmony, but not the process itself. Thus, if we want to capture the entire scope of Bakairi harmony, we might have to add a further premise to assumptions (i)-(iii):

> (iv) the feature of each segment which is extraneous to the first established series and the feature of the first consonant in the suffix must be opposite to the feature of the segment which triggers harmony: the first consonantal segment in the root or base-word.

which becomes feasible to determine every step of the process of harmony in Bakairi. However, it must be observed that these steps are to be followed in separate moments, that is, during the formation of the root or base-word and during the formation of the suffixes.

Thus the final form of the skeleton will depend on all of the information contained in the set of premises, and grammatical information will certainly be included.

At this point, it would be relevant to consider the possibility of such a skeleton being understood as an independent chain at the autosegmental level.

It is clear that the skeleton is not the result of a set of segmental rules: rather, its constitution directely depends on the arrangement of the segments within the word as a whole and on the way the associations are set up. That is, it is necessary to

establish - depending on the harmony offered by the word - how the segment chains are to be articulated with each other. This is not, then, a predicted process, but rather one to be programmed a posteriori so that the data may be accounted for. The skeleton reproduces only the facts that arise from the composition of the word, but offers no way to predict how the process will take place during the composition.

As to the association between the skeleton and the syllabic chain, it seems that this association is not established in an autonomous and independent way. Positions CV and VCV are established a posteriori, in function of the very structure of the word. These positions, in turn, seem suspect in that the only position satisfactorily filled in is the initial one in a #CV word: this position is clearly restricted to voiceless consonants. The other positions arise from the need to determine the association lines in the composition of the syllabic skeletons.

Besides the problems arising from the examination of the possibility of approaching Bakairi harmony from an autosegmental perspective, some inherent aspects of Bakairi harmony may be seen as problematic given the formulations presented so far.

The fact that Bakairi harmony does not copy features is not reason enough to conclude that the choice of feature contrast rather than feature copying is the differentiating factor in Bakairi harmony.

In Bakairi, harmony does not proceed in chain-reaction fashion. It is not the triggering of one element that determines the triggering of the others. If we were dealing with a chain reaction, feature dissimilation would not be a problem.

This characteristic of Bakairi harmony - the fact that the process takes place through a series of segments but is not a serial phenomenon proper - is

one of the reasons why the autosegmental proposals are insufficient to describe the phenomenon.

In fact, we are dealing with a multidimensional phenomenon, which takes place in stages and at various levels, and not as a linear chain reaction or as complementarity. The reaction is interrupted and reestablished at levels other than those predicted by the theory, such as the syllable, the foot, the word, the juncture, etc. The levels are set up according to the scope of a given characteristic - occlusion or friction - and in this domain, which is not theoretically predictable, harmonization of the voiceless/voiced features takes place.

Not even at the root or base-word level is the phenomenon linear: there is no simple alternation of voiceless and voiced features making up a syllabic structure, and the conditioning element of this alternance does not act in function of syllabic patterns. The hierarchy of levels is established in function of the various segments, serial or otherwise, which arise within the domain of harmony.

Nevertheless, it should be observed that the processing of harmony is entirely predicted in the lexicon; so that the roots and base-words, as well as the suffixes, contain the segments arranged in function of the harmonization process. That is why the first consonant in every root, base-word and suffix contains the voiceless feature: at the moment when juncture takes place, these initial segments accomodate to harmony.

The conclusion that follows from this observation is that the processing of the phenomenon as a whole does not take place at the word level, in the case of derived and inflected words. The phenomenon is completed at the word level, but the point at which completion is reached does not mark the end of the word, but only the boundary between root or base-word and suffix[9]. This can be seen in a word such as

(23) ɔpa -izaʒᶻ farm-to
V1 VdVd 'to the farm'

where, if harmony took place at the level of the whole word, one would expect the last consonant to be voiceless fricative ʃ rather than voiced ʒ since the two consonants would form a series.

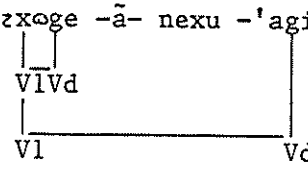
This fact is a further argument in favor of the statement that harmony is inherent to lexical formation, rather than the result of word-forming processes. Thus morphological boundaries do not block harmony, as they might seem to at first sight. The juncture simply readjusts two elements- root or base-word and suffix - each of which already contains harmonized segments.

In turn, harmonization of these segments takes place in stages and not at hierarchical levels. It is as if harmonization had to proceed along various steps formed by spatially arranged consonants, thus forming a three-dimensional structure such as

(24) n- ɷxɷdɷ -ge -'agi 3p.-feather-verb marker-past
V1Vd 'pulled out the feather'
V1 Vd
V1 Vd

(25) ad- ɷkaga -dɨ'bĩe intrans. marker-break-aspect
V1Vd 'broken'
V1 Vd

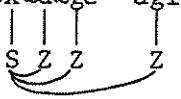
(26) n- ɛxɑge -ã- nexu -'agi[10] 3p.-fall-trans. marker-causative-past 'he upset'



Confronted with this perspective, the possibility of a prosodic skeleton would seem in such cases, on one hand, ad hoc, since the skeleton would indicate only the serialization of the segments and the morphological boundary.

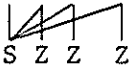
On the other hand, the fact that Bakairi harmony takes place through stages and not chains implies that autosegmental projection rule cannot be satisfied. If we combine in a single skeleton the projections triggered by the first consonant in the root - the triggering element - in example

(27) nɑxɑdɑge 'agi 'pulled out the feather'



we will get crossing association lines, as in

(28) *CVCVCVCVVCV



since the leftmost consonantal segment in the root - and not the positions in the syllabic skeleton - is the catalyzing element of harmony.

Given this fact, it is clear that if the phenomenon of harmony is restricted to a syllabic skeleton its three-dimensional quality will not be captured and it will be impossible to express the fact that harmony, at the level of root and formatives, occurs in separate stages: Bakairi harmony is not a function of morphophonemic changes.

The reason why we attempted an autosegmental approach was the a priori perception that the intrinsic complexity of Bakairi harmony would lead to problems if we adopted a traditional treatment, not only because Bakairi harmony is predictable on the basis of the lexicon - which certainly precludes a set of iterative rules - but also because it is not a chain-type phenomenon.

However, it seems unfeasible to replace a set of cyclical and iterative rules by the proposal of an auto-segmental chain that would allow description of the phenomenon in a simpler and more objective way than allowed by segmental rules. This replacement cannot be made: the case of Bakairi harmony precludes, a priori, rules of any kind, and the setting up of a skeleton is no more than a way of formalizing the relevant facts, since their prediction is given by the lexicon.

Besides, Bakairi harmony cannot be seen as a spreading of associated features up to a morphologically defined point. Rather, what happens is an inverted irradiation of a feature of a single element, which is responsible for the features of the other segments at the root or base-word level. This irradiation ceases when it runs into the irradiating element of another level - the first consonant in the element to be suffixed.

Thus the target element of harmony will be related to various other elements, and this causes the crossing of the association lines. The result is that the harmony rules we are concerned with are projected on an angle which is contrary to what autosegmental theory predicts.

This projection is in conflict with autosegmental theory: in Bakairi, although the feature does not imply the phonemic characterization of the segment - which makes us consider the voiceless/voiced

specification outside the domain of phonemics - neither does it reproduce an autosegment-type behavior. This raises the question: could it be that consonantal harmony in Bakairi cannot be treated by an autosegment approach?

It seems that autosegmental theory can account only for harmony among linearly concatenated elements, with no feature specification. However, in Bakairi, feature specification not only establishes the series but also feeds into harmony.

On the other hand, Bakairi harmony cannot be seen as a strictly sequential phenomenon because there are no sequential restrictions - except for word-initial position - concerning the occurrence of sounds. What does exist is a combination of sounds which results in the characterization of the segment in terms of the features voiceless or voiced.

This characterization lends a certain melody to the syllabic chain. It is not a tonal kind of melody, but nevertheless it is a specific kind of sound arrangement involving voiceless and voiced sounds. This arrangement depends on the first consonant in the root which, acting as a time signature, ensures the harmony of Bakairi words.

CONSONANTAL HARMONY IN BAKAIRI: A DIACHRONIC PROBLEM

In the late nineteenth century, when the voyager Von den Steinen undertook a detailed study of Bakairi language, the phenomenon of consonantal harmony had not yet arisen.

It seems that Bakairi at the time was suffering a series of changes, which came to affect the basic set of sounds in the language.

Concerning the Bakairi consonantal sounds reported by Von den Steinen (1892) - w y p b t d ɲ k(g) kχ ɣχ s̄ z̄ s z dz h r (λ) l m n ŋ - the relevant observations are:

- "p and b are freely used as medial sounds"

- "p is actualized as w when it is the initial sound of word stems and preceded by a pronominal prefix"

- "t and d are not often differentiated in the middle of a word"

- "k and kχ are clearly distinguished in initial position. In medial position they are often undistinguishable and are replaced by ɣ (a sound close to the sonant g heard in Westphalia)"

- "aspirate h alternates with Ø, s, z, š, ž"

- "ɣ and y are very difficult to differentiate"

These observations show that, according to Von den Steinen, there was much "oscilation" among Bakairi sounds, a fact which often seemed to be due to "the informant's casual way to speaking" [*ibidem*: 256]. Von den Steinen saw sound variation in Bakairi as free variation, and found that the occurrence of voiced variants such as *b*, *d* and *g*, for instance, could either occur or fail to occur in speech of a given informant. As to the alternation between *h* and Ø, ś, z. š and ž, a similar point is made: it depends on the speaker's free choice.

The prediction of certain sounds seemed then to be impossible to systematize, so that Von den Steinen was reduced to registering all the existing actualizations, without, however, giving up on the attempt to define and describe the facts.

Von den Steinen then proceeds to classify the sounds, based on phonetic criteria, and to compare

words of various Carib languages, in order to try to arrive at a proto-Carib language. In this way he managed to determine the probable basic sounds of Bakairi, concluding that the consonantal sounds of Bakairi had suffered changes.

In the proto-language, there are no voiced variants. The alveolar fricatives ś and z and the palato-alveolars š and ž of Bakairi were, in turn, related to the consonant *t* of the proto-language; the "aspirate *h*" was associated with ś and z, which were identified with the *t* of the proto-language. On the other hand, there was a sound, represented as  , which generated much confusion; this sound was sometimes related to a *k* in the proto-language, sometimes to a gutural *ʀ*.

Our immediate conclusion is that the basic consonantal sounds in Bakairi were the series of voiceless stops[11]. As to the series of fricatives, it seems that these sounds were derived from the basic series, specifically from *t* and "aspirate h". That is, the language was apparently in a stage of acquisition of sounds, which were not yet well defined.

Besides the mutation of the basic sounds - which probably resulted in the acquisition of the series of fricative consonants[12] - Von den Steinen already reported the "softening of the hard initial sound of stems when they received a pronominal preffix" [*ibidem* 260]. Voicing by prefixation was extended to the process of suffixation, so that the first consonant in the suffix was also voiced.

If we admit, following Von den Steinen, that the basic sounds in Bakairi were the voiceless variants, we may conclude that the weakening process which affected these sounds, solely in word formation, eventually had the effect of making the language acquire the voiced variants in a random fashion, that is, without being conditioned by cases of internal

juncture. Thus the voiced segments appeared in the body of word stems and root words in an irregular and unpredictable manner, up to the moment when these sounds were settled in such a way as to generate the phenomenon of consonantal harmony.

The series of fricatives, after it was defined, also became subject to harmony.

Thus consonantal harmony seems to have developed in order to meet the need of ordering the chaotic situation of the language. It provided the language with a way to deal with those sounds that did not belong to its original phonetic repertory.

This phonetic repertory, in turn, since it contained no voiced phones, could not offer the language the option of contrasting the features voiceless and voiced so as to establish meaning. This, then, is the reason for the constant neutralization of features found in Bakairi today. This fact also supports our previous statement that the few analogous and minimal pairs found in the language today are accidental.

Finally, it should be observed that, if Bakairi contained no voiced sounds, their acquisition could not possibly be used to establish meaning, since the meaning of Bakairi words had already been established without the use of feature opposition. This conclusion seems to explain fully why consonantal harmony in Bakairi is lexically predictable.

CONCLUSION

The peculiar facts concerning consonantal harmony in Bakairi point to a consideration of the setting up of so called language universals, in that such facts may either support or question specific would-be universals.

It is both elucidative and contradictory to realize that voiceless stops actually seem to be

primary sounds. However, the secondary acquisition of sound variants by the language, together with the asystematic use of such sounds, has resulted in the phenomenon of consonantal harmony in Bakairi. This phenomenon, in turn, organizing as it does the use of voiceless and voiced sounds, demolishes the premise that the voiceless/voiced dichotomy is necessarily a phonemic opposition.

On the other hand, the very existence of Bakairi harmony leads us to challenge the power claimed by theories with the setting up of universals. Autosegmental theory, for instance, when it universalises well-formedness conditions for the formation of a prosodic skeleton for natural languages, may perhaps be founded on some principle that establishes that if a given phenomenon has been found to recur in natural languages, then the way in which the phenomenon is manifested will also be found to be recurrent. Thus, to the extent that theories claim comprehensiveness, they restrict the universality of the phenomena themselves, denying languages the possibility of diversifying a given phenomenon.

If the above-mentioned principle is in fact relevant, the supposedly universal theoretical premises practically always predict a single manifestation of the phenomena, so that object and method reflect each other. In the end, theory shapes the evidence. Thus, in favor of major universals, facts such as Bakairi consonantal harmony are often supressed or reinterpreted.

As we showed before, there is a whole series of facts in connection with Bakairi consonantal harmony which make it plain that not all cases of harmony in natural language fit the universal theoretical molds of autosegmental theory.

The array of contradictions we have seen bring, once again, a consideration of the power of theories, and seem to hammer home the need for approaches

effective in dealing with both universal and specific facts, which will undoubtedly contribute to the development of linguistic science.

NOTES

1. Paper presented at the SIXTH INTERNATIONAL PHONOLOGY MEETING, Krems, Áustria, 1988.
2. Research undertaken in January 1984, February 1985, July 1985 and July 1986, supported by CNPQ and FAPESP. The study of the Bakairi language is directly related to the doctoral dissertation project titled "Da Organização do Discurso na Língua Bakairi" ("On the organization of discourse in Bakairi language"), at the Linguistics Graduate Studies Program of UNICAMP, under the supervision of Dr. Eni Orlandi.
3. The study of complex segments [t], [d], [k], [g], [^{m}p], [^{m}b], [^{n}t], [^{n}d], [^{ŋ}k] and [^{ŋ}g] is part of an ongoing study of the prosodic structure of Bakairi. We shall not go into this matter at present.
4. Thus word formation in Bakairi takes place differently in prefixation and suffixation. In prefixation, morphophonemic rules - a result of sequencial restriction - are at work; in suffixation, juncture is defined in terms of consonantal harmony.
5. Except for the words *Bakairi* 'name of the people' and *bacururu* 'type of ritual dance', which etymologically seem extraneous to the language.
6. The voiceless bilabial stop behaves differently from other consonants. Whereas the other stops, as well as fricatives, have only their homorganic counterparts as variants, occlusive *p* may alternate with the voiced bilabial stop [b] or the voiced bilabial fricative [β] or the approximant [w]. This fact seems to be related to the labialization of stops, which, among bilabials, may manifest as [w] and [β].
7. Not only are minimal pairs inexistent, but analogous

pairs are also quite few.
8. We leave out consideration of complex, labialized and prenasalized stops, due to the reasons mentioned in note 3.
9. The formalization of an approach to Bakairi harmony is close to the proposal offered by generative phonology of a morphophonemic level made up of abstract phonic entities, on and through which basic forms for Bakairi suffixes would be postulated. The only difference would be the lack of sequential rules, since surface forms would be a result of the articulation between the association lines and the syllabic chain.
On the other hand, we always represent initial segments as their voiceless variants, when dealing with affixes, because of the rule of sequential restriction, which predicts the non-occurrence of voiced segments in initial position.
10. Notice that at the sentence level - that is, between words - harmony does not occur. This fact helps to determine the grammatical status of Bakairi formatives. Evidence such as example (23) ɔ*pa*-izaʒɨ 'to the *farm*' show that Bakairi "postpositions" are in fact bound forms: the first consonant in the "postpositions" harmonizes with the source element of the harmony occurring in the word.
11. This example once again shows that harmony in Bakairi is not the result of word-formation processes, and the harmony takes place at separate stages within roots, base-words and suffixes. Notice that in (26) n-ʒɣɷge -ã- nexɷ - 'agi the voiceless velar fricative *x* present in - *nex*ɷ - 'causative morpheme' does not submit to harmony at the stage of word derivation: the consonant retains its voiceless feature. This is due to the consonant of the causative morpheme.
12. There was also a nasal sound, close to dental *r*, which freely alternated with *l*. Von den Steinen, 1892: 255 .
13. A more accurate study based on articulatory possibilities should explain the acquisition of fricative consonants with greater precision.

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