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ON SEGMENT COUNTING, OCP, AND HEAVY SEGMENTS

Aim and scope of the paper

Both McCarthy and Prince 1986 and 1990 (implicitly only) argue in favor of counting prosodic elements, moras, syllables, or feet, and against counting segments in order to explain phonological structures and processes. Their argument against counting segments is based mainly on assertion that "no language process, ... is known to depend on the raw number of segments in a form" (McCarthy and Prince 1986). I will present data and analyses to show that counting segments on a melodic plane allows for predictions that are not obtained if one counts only moras, syllables, or feet. I will argue that in Migama (Migaama in some studies), an East Chadic language, certain phonological processes are sensitive to the number of segments on the consonantal plane and others are sensitive to the number of moras; therefore at least one language requires counting segments as well as counting prosodic elements.

The importance of the Obligatory Contour Principle, originally proposed in Leben 1973 (cf. also Goldsmith 1976), rests on the possibility of its being one of the fundamental organizing principles of phonological systems. Such a possibility is envisioned or defended in McCarthy 1986 and supported in Steriade and Schein 1986, Hayes 1986, Yip 1988, McCarthy 1989, Goldsmith 1990, and Paradis and Prunet 1990, Rose 2000, among many others. Rubach 1986 has shown some problematic aspects of the OCP when applied to Polish, and Odden 1986 and 1988 argues against the universality of the OCP. McCarthy 1986:256 states that "the strongest argument for the absolute prohibition expressed by the OCP is the absence of languages contrasting tautomorphemic one-to-many associations with tautomorphemic one-to-one associations of identical segments. Such a contrast could have straightforward phonetic, phonological, and morphological consequences, yet it is simply not exploited by the languages analyzed thus far". The second aim of the present paper is to show that there are indeed cases of

tautomorphic one-to-many and one-to-one associations of identical segments, and that such associations have phonological and morphological consequences. I will show that an analysis that accepts the OCP produces less-desirable results than one that rejects it. As the result of this analysis, the OCP would have to be taken as a language specific rather than a universal constraint on morpheme structures. Migama, as a Chadic language, is remotely related to Semitic languages, another group within Afroasiatic.¹ The data in Migama are particularly interesting in view of the fact that much of the evidence for the segmental OCP in McCarthy 1986 comes from the analysis of various Semitic languages.

Ewen 1982, Anderson and Ewen 1987, and with a different theoretical approach Clements 1985, Sagey 1986, and Ladefoged and Halle 1988 have postulated that phonetic segments may have hierarchical and sequential organization. The final aim of the present paper is to show that within a specific language certain sequential characteristics of segments have phonological consequences, while others do not. Those segments whose sequential complexity has phonological consequences are called here heavy segments, in analogy with the widely accepted notion of heavy syllable. Thus not only syllable weight but also segment weight must be taken into consideration in explaining phonological constraints and processes.

Data

The verbal stem in Migama, especially its imperfective form, has already been a subject of considerable discussion in the literature, viz. Jungraithmayr 1974 and 1975, Newman 1977, Wolff 1977, Frajzyngier 1981, Voigt 1989. All those studies were based on a rather limited body of data (218 verbs) presented in Jungraithmayr 1974 and 1975. The present paper is based mainly on 1,241 verbs in Migama as published in Semur et al. 1983, where all verbs are given in two aspectual forms, perfective (*accompli*) and imperfective (*inaccompli*), and the form of the verbal noun. In addition Semur et al. 1983 provide examples of several other forms, including an anterior past form, a tense form used in embedded clauses (33 verbs in total have the additional forms quoted). Given the limited number of items of the anterior past form, my discussion will be based on the forms of perfective and imperfective, and although I will also propose the first explicit description of the formation of the anterior past, I will not concentrate on this form. As a by-product of the present study I will propose new analyses of the verbal structures in Migama, which I believe supersede the previous ones, including some elements of my own analyses.

The following classification, which I will use further in the paper as reference, is based on segmental rather than tonal properties and represents all

types of imperfective forms and most types of perfective forms in the Semur et al corpus:²

(1)

Type	Perfective	Imperfective	Gloss	No. of examples
Class A adds the suffix -ww- in imperfective				
A	màanǰé	màanǰwwá	'climb'	218
Class B inserts -k- and geminates the final consonant				
B	gèemé	gèkèmmá	'measure'	31
Class C adds the suffix -kk- in imperfective				
C	kámé	kàmàkká	'hunt mice'	115
Classes D through M geminate the final consonant				
D	lékké	lékékká	'have'	298
E	nàmbé	nàbàkká	'rest'	3
F	wàtiyé	wàtàyyá	'warm up'	93
G	tàwád`dé	tàwàd`dá	'hunt'	55
H	gàrté	gàràttá	'become sweet'	75
I	kúdfisé	kódfóssá	'heat up'	56
J	sáadfiyé	sàadfiyyá	'winnow'	53
K	dyáalkiyé	dyàlkàyyá	'woo'	136
L	dfóppinyé	dfóppònnyá	'stew'	47
M	gònyól`gùwé	gònyòlgòwwá	'become an idiot'	75

All these classes contain verbs that Semur et al. spell with an initial vowel, with all vowels being represented in that position. However, Jungraithmayr 1974 and 1975, who postulates that the glottal stop is phonemic in Migama, has no vowels in word initial position in his corpus. Vowel initial verbs from the corpus of Semur's et al. are transcribed in Jungraithmayr's papers with an initial glottal stop followed by a vowel. Such a transcription has also been accepted in studies based on Jungraithmayr's data, e.g. Wolff 1977 and Voigt 1989. Assuming Jungraithmayr's transcription to be correct, we nevertheless must bear in mind that glottal stops occur mainly in word initial position, and in word medial position only

between vowels, e.g. *dyóo'iré* 'bellow'. The limited distribution of the glottal stop could be used as an argument for its being a product of epenthesis and, hence, not a part of the underlying representation. There are, however, two arguments in favor of treating the glottal stop as underlying. The first one has to do with its occurrence in word medial position in words like *dyóo'iré* 'bellow'. I will show below that the vowel *i* in such a word is epenthetic, inserted between consonants in a very specific phonological environment. Hence if the vowel is epenthetic, then the consonant before it is not. The second argument in support of the phonemic status of the glottal stop is that with respect to phonological properties to be described later in the present paper, all verbs transcribed with an initial vowel by Semur et al. behave as if they actually had an initial consonant. In the present paper, therefore, I accept Jungraithmayr's transcription and assume that vowel initial verbs in Semur et al. begin in fact with a glottal stop.

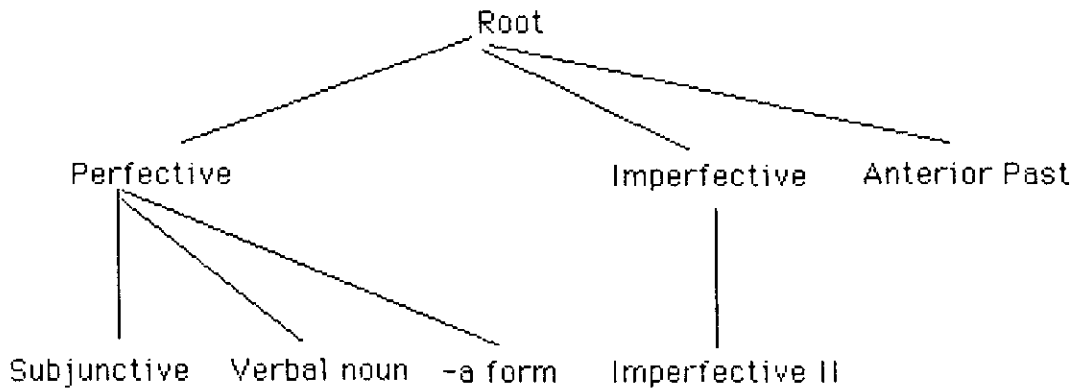
The underlying form of the verbal root

I will propose in this section the structure of the underlying form of the verbal root, and then postulate the derivation of the perfective form of the verb from the underlying structure. The successful derivation will constitute partial evidence for the direction of derivation. The derivation of the imperfective and the anterior past forms will be provided later in the paper.

The verbal paradigm of Migama

In addition to the perfective and imperfective forms given above, Migama also has other verbal forms; an 'anterior past' form ending in *dž*, a subjunctive form ending in *-u*, a form ending in *-a* (the function of this form is not stated in Semur et al.), a verbal noun ending in either *-aw* or *-o* (the two variants are phonologically predictable), and a second imperfective ending in *-e*. All surface structure verbal forms in Migama end in a vowel or a vowel followed by a glide. The final vowel in the verb is always a tense or aspect marker or is a part of such a marker. The perfective, imperfective, and the anterior past derive from the verbal base consisting of the root and a thematic vowel, whereas the other elements of paradigm derive from either the perfective or the imperfective forms. Only elements that are unpredictable are part of the underlying representation, and only they constitute the verbal root. The derivation of the major elements of the partial verbal paradigm in Migama is therefore as follows:

The verbal paradigm of Migama



The perfective form in Migama consists of a stem, the final vowel *e* and a tonal pattern. The last tone is high. (Since tones do not affect the segmental structure, I will not discuss them in this paper, and I will not represent them on the tonal plane, but cf. Wolff 1977. A thorough study of rules affecting tone in Migama has yet to be made.) The first vowel may be long (indicated by (V₁)) and there may be more than two consonants following the first consonant, indicated by (C), representing any number of consonants. The following linear pattern illustrates the formation of the perfective form (only underlying segments are shown).

$$(1) \quad C \quad V_1(V_1) \quad (C) \quad + \acute{e}$$

The *-a* form is derived from the above stem by substituting *á* for the final *é*. The subjunctive is derived by substituting *ú* for the final *é* of the perfective form. The verbal noun is derived from the perfective form by the addition of the sequence *áw* to the stem for the perfective forms that do not have a heavy syllable, and the addition of the vowel *o* to the forms that contain a heavy syllable; therefore we have the first piece of evidence for the role played by prosodic elements in the derivation of verbal forms, e.g.

(2)

Type	Perfective	Verbal noun	Gloss
A	màaŋé	màŋò	'climb'
B	rúùmé	rúumó	'cook in water'
C	kámé	kámáw	'hunt mice'
D	lékké	lékkó	'have'
E	nàmbé	nàmbò	'rest'
F	wàtìyé	wàtìyò	'warm up'
G	tàwáf`dé	tàwàdfò	'hunt'
H	gàrté	gàrtò	'become sweet'
I	kúdfísé	kúdfísó	'heat up'
J	sáadìyé	sáadìyò	'winnow'
K	dyáلكiyé	dyáلكiyò	'woo'
L	dóppìnyé	dóppìnyò	'stew'
M	gònyól`gùwé	gònyól`gùwò	'become an idiot'

I will not return to the derivation of the subjunctive, verbal noun, and the *-a* form, as these forms do not affect any of the theoretical issues or argumentation in the present paper.

The underlying consonants

There exist verbs that display different segmental structures in various elements of the paradigm. Therefore, for the discovery of the underlying form I extrapolate the root of the verb from more than one stem.³ The perfective form, whose derivation involves only the addition of a vocalic suffix *-e* bearing a high tone, displays the unaltered underlying vowel.

All consonants of the perfective are part of the underlying structure. There are two processes that may alter the consonantal structure of the root: gemination and reduplication (the latter to be discussed in a separate section). Only the second or third consonant of the root can be geminated, e.g. *gell-* 'laugh', *wagg-* 'pound with a pestle', *dàbál`lé* 'cheat', *gòmós`sùwé* 'rejuvenate (about women)'. More than half the verbs with a geminated second consonant are glossed as having some kind of plural meaning, such as affecting many objects or an action done many times, e.g. *baage* 'embank' and *bagge* 'embank many times'; *geemo* 'measure' and *gemmo*

'count' (both forms given in the functional equivalent of the infinitive). Not all verbs with a geminated second or third consonant have non-geminated counterparts. In some cases the surface gemination may be a result of assimilation rules. Assuming that such verbs could be identified, I take the remaining verbs with geminate consonants to originate as derived at some stage in the history of the language, even if in the contemporary language they may be the only forms available (for the functions of gemination in Chadic and other Afroasiatic languages, cf. Frajzyngier 1965, 1977, 1979, Wolff 1977, Newman 1990). I will represent the geminated consonants by the familiar one-to-many association with C elements on the CV tier.

The underlying vowel

I postulate that part of the lexical form of the verb is one vowel, which always occurs in the first syllable, following a consonant. This vowel may be short or long, and there is no indication that the difference in length carries a semantic or grammatical function. In Frajzyngier and Ross (1996) we show that some underlying vowels carry a grammatical function. Therefore, they represent a separate morpheme from the consonantal segments, to a certain degree resembling the properties of verbs (but not necessarily nouns) in Semitic languages. The study of the functions of different vowels in Migama indicates that the great majority of verbs with the vowel *a* are intransitives, and verbs with *i* or *u* are overwhelmingly transitive. Moreover, whenever /a/ or /e/ in the first syllable is opposed to /i/ with the same consonantal skeleton, /a/ and /e/ indicate an intransitive verb while /i/ indicates a transitive verb, e.g. (all verbs quoted in the perfective, tones omitted):

(3)

tatide	'be lost'	titide	'eliminate, lose'
wesinye	'be spread'	wisinye	'spread'
tyalliye	'be said openly'	tyilliye	'say openly'
batte	'extinguish' (intr.)	bitte	'extinguish' (tr.)
nanje	'spoil' (intr.)	ninje	'spoil' (tr.)

Vowel /e/ indicates a transitive verb when contrasted with /a/ with the same consonantal elements:

(4)

dámalmile	'roll'	démelmile	'make (smth) round'
sáâpé	'advance' (intr.)	séèpé	'stretch smth'

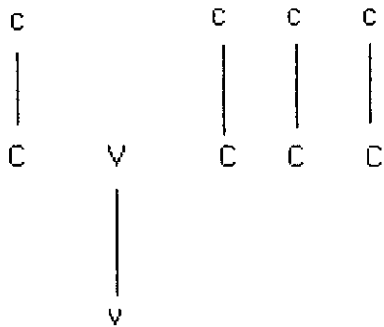
I have no information regarding the productivity of the low vowel-high vowel contrast in Migama. Note, however, that one can find different values with respect to transitivity and other syntactic or semantic properties attached to the same vowel, e.g. transitive with the vowel *a*: *baam* 'catch, hold', *dyale* 'prepare food'; intransitive with the vowel *i*: *migise* 'get used'. In Frajzyngier and Ross we postulate that *a* is the default vowel of the verb, and that the verb with this vowel was inherently intransitive. A systematic syntactic study of the correlation between the underlying vowel of the stem and semantic/syntactic properties of the verb has yet to be made. I will use the functions of the underlying vowel as an argument for the separation of consonantal and vocalic planes. Further in this study the consonantal root, simple, geminated, or reduplicated, supplemented by the thematic vowel, will be referred to as the 'base'.

The skeleton and the epenthetic vowels

It is a common but seldom explicitly stated practice to postulate a skeleton (or timing tier) to reflect exactly the segments or the timing units of the actual form of a word. Association lines then connect the elements of an autosegmental tier with elements on the skeleton. Such an approach does not allow a distinction between the elements of the skeleton that are there by virtue of being elements of the underlying structure and the elements that are fully predictable, such as products of phonologically motivated epenthesis. In order to indicate the distinction between the underlying and epenthetic segments, I postulate a two-stage representation for the skeleton. The first stage reflects only the quantity of C and V elements on the autosegmental tiers, or planes, of both independent and affixal morphemes. Let's call this an initial skeleton. The second stage reflects the products of epenthesis, elision, or another morphophonological process. I will call this the final skeleton. The final skeleton is in fact identical to the commonly practiced way of representing the skeleton. In the case of Migama, the verbal stem, for which I postulate one vowel and an undetermined number of consonants between one and five (five is simply the largest number of consonants encountered), the initial skeleton will have the following form (I have chosen as

an example a verb with four underlying consonants, each of them linked to only one element on the skeletal tier):

(5)



If there are only two consonants in the root, there are no further changes to the skeleton. The interesting question is, given only one underlying vowel, what happens when the number of underlying consonants is greater than two.

Two constraints on consonant clusters and one constraint on syllable structure are responsible for the changes in the CV configurations in the initial skeleton. The constraint on syllable structures does not allow syllables of the structure *CVVC. The evidence for this constraint is provided by biconsonantal verbs with long vowels, which undergo gemination. The vowel in such verbs is shortened, e.g. (all examples in perfective):

(6)

bàagé	'embank'	bàggé	'embank many times'
geemo	'measure'	gemmo	'count' (verbal noun)
bèéré	'descend'	bèrré	'descend many times'
bòoré	'stoop, bend'	bòrré	'stoop, bend many times'
làaté	'stretch'	làtté	'stretch many times'

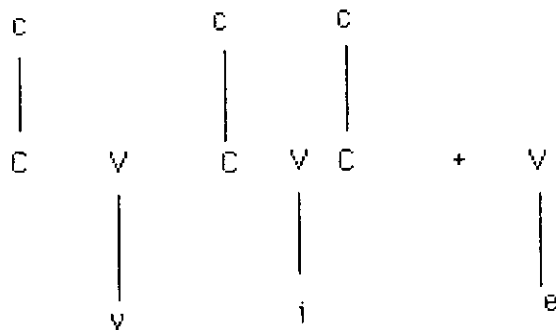
The first constraint on consonant clusters allows only two consonants in a sequence, hence *CCC(C). The first piece of evidence for this constraint is provided by the absence of such sequences in the data. Additional evidence is provided by the rules of epenthesis, to be described shortly. This constraint can be formulated in terms of syllabic structures. Only the following types of syllables are allowed: CV, CVV, and CVC. Accordingly, the following types of syllables are disallowed: *CVVC, *CVCC, *CCV(C).

The second constraint on consonant clusters allows only some consonantal sequences, viz. all geminates including geminate sonorants, and clusters whose first component is a sonorant, viz. *w*, *y*, *r*, *l*, *m*, and *ŋ* (but no clusters of a nasal followed by another sonorant, thus **mn*, **nr*, **mw*, **ny*, etc.). There are 75 verbs (group H) having a skeleton of the form C₁VC₂C₃V, where the C₂C₃ cluster has an initial sonorant: *bòys-é* 'become angry', *gàld-é* 'ruminate', *gàwn-é* 'cultivate', *'èrty-é* 'cry', *gàyd-é* 'have a hoarse voice', *làmd-é* 'soften', etc.

Exempted from this constraint are consonant clusters that result from a derivational process, such as affixation or reduplication. Thus there is a class of four-consonantal verbs derived through the reduplication of the underlying consonants, with the configuration C₁VC₂C₁VC₂V. There are no restrictions on the type of clusters so generated. One can thus find a fricative followed by a stop, a stop followed by a liquid or a continuant, and even a stop followed by another stop: *kóskìs-é* 'woo a woman', *zébzìb-é* 'slacken a cord', *zégzìg-é* 'build a big fire', *tyéptyìp-é* 'split, cut', *kàdàg`dìg-é* 'have too much play', *pàtág`tìg-é* 'catch and tie down (a dog)'. If we take the reduplicated part as constituting another morpheme, we can state that there are no constraints on type of clusters if the morpheme boundary occurs between the consonants. The hypothesis about the morpheme boundary allowing clusters disallowed within the morpheme is further supported by the anterior past, which is formed by addition of the suffix *čé*. As the result of the suffixation process, the following clusters can be found: *sč*, *pč*. The facts described above indicate the need to recognize morpheme boundary as a factor in phonological structure of the language. At the morpheme boundary clusters are allowed that are disallowed in morpheme internal position.

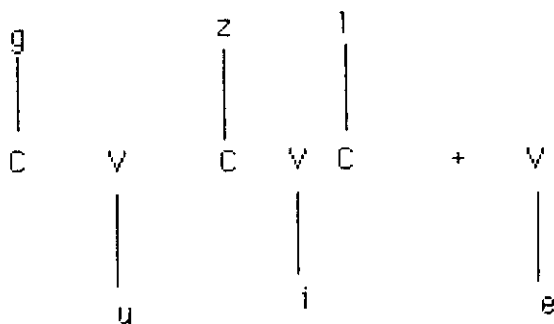
The initial skeleton together with suffixes that have been added is scanned from left to right for the process of syllabification. When a disallowed sequence is encountered, a vowel is inserted. There are two sources for the epenthetic vowel in Migama. The default epenthetic vowel is *i*. It is inserted to break a disallowed consonantal cluster or to generate a new syllable when there is only one consonant to follow the epenthetic vowel. The following diagram of the formation of the perfective form illustrates such an epenthesis for perfective stems and verbal nouns in Groups F, I, J, K, L, and M (third vowel):

(7)

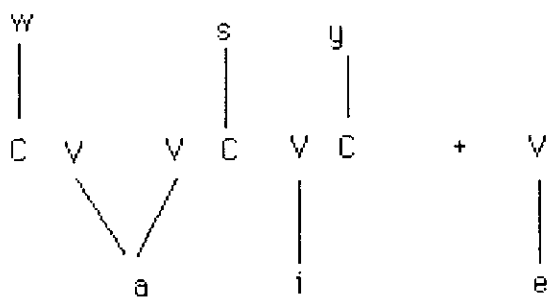


The following are examples of the derivation of a specific verbs:

(8) *gùzilé* 'inflate, as in edema'



(9) *wáasiyé* 'equalize'



There are no exceptions among perfective and the verbal noun forms of the 55 Group G verbs nor among the 75 Group M verbs, where the second vowel is epenthetic and is always followed by the cluster of consonants. Examples:

(12)

bènéy`y-é	'talk, say'
'òzób`b-é	'heat up until the object becomes red'
kòtóp`p-é	'thrust'
tyàlál`l-é	'fail'

Out of the 55 examples of verbs with a cluster of consonants there are three exceptions to the vowel copying rule, all involving the initial *i*. This vowel is not copied and instead an epenthetic *a* is inserted:

(13)

pidáw`w-é	'pass a rainy season'
riđyáw`w-é	'whine'
riábább-é	'pass the harvest season'

Note that although the above forms are exceptions to the vowel copying rule, they do prevent the default epenthetic vowel *i* from occurring in the position in which it is not supposed to occur.

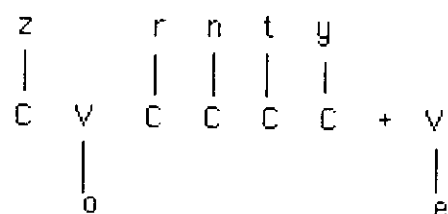
In quadrisyllabic verbs of Group M, all of which have an internal consonant cluster, there are two epenthetic vowels. One, a copy of the preceding, i.e. thematic, vowel occurs before a consonant cluster, and the other, *i* or its variant *u*, occurs before a single consonant:

(14)

dyèdénj`kìl-é	'be unstable'
mìgírìm-é	'become a patriarch'
gòdóm`bìl-é	'become round'
'ògól`lùm-é	'become dense, thick'
bàbáj`gùw-è	'age'

I will illustrate the process of epenthesis on the root *z-f-u-t-y* 'be sad'. The thematic vowel of this verb is *o*, hence the initial skeleton for the perfective stem is as follows:

(15)



The vowel epenthesis processes proceed as follows: During the scan of the initial skeleton from left to right, a disallowed sequence of consonants is encountered, *r-n-t-y*. Within this sequence, there are two more disallowed sub-sequences, *r-n-t-* and *n-t-y*. There is only one sub-sequence that is allowed, *n-t*. Hence there are two places into which a vowel must be inserted if the underlying structure is to be preserved: *r_n-t* and *t_y*. In the first environment the epenthetic vowel is followed by a consonant cluster, hence the vowel is a copy of the preceding vowel, in this case *o*. In the second environment, the epenthetic vowel is followed by only one consonant, hence the epenthetic vowel is *i*, and the resulting form is *zòr-ó-n`t-ì-y-é*. If a verb has a three-consonant cluster with the first CC sequence allowed, the epenthetic vowel is inserted at the CC_C position: *sórd-ì-l-é* 'fight with force'. The importance of the rules of epenthesis is that they operate in different verbal forms, and they fully account for the internal structure of verbal templates.

Two arguments for counting segments: Reduplication

I have not found any semantic or syntactic function associated with the reduplicated stems. And although I cannot formulate the syntactic, semantic, or pragmatic motivations for a root to be reduplicated, I can predict the form a verb will have, once the reduplication process has been applied. There are two types of verbal stems in Migama. In both types of reduplication what is counted are consonantal segments, rather than moras or syllables. The rules for reduplication are as follows: Reduplicate the first two segments if the verb has two underlying consonants. Reduplicate the second and third segment if the verb has three underlying consonants. The importance of this hypothesis is that segment counting applies twice, once in the selection of the type of reduplication process and the other in the selection of the sequence to be reduplicated. The following is a formalized statement for the rules of reduplication: If the root is C_1C_2 then the reduplicated form is $C_1C_2C_1C_2$. If the root is $C_1C_2C_3$ then the reduplicated

form is $C_1C_2C_3C_2C_3$. After the root has been reduplicated, the thematic vowel is inserted after the first consonant and the epenthetic vowels are inserted as provided by the rules of epenthesis discussed earlier with respect to three-consonant clusters. As stated earlier, the reduplicated, derived stems differ from non-derived stems in that they have no restrictions on two-consonantal clusters. Here is an illustration of the first type of reduplication, where only one epenthetic vowel *i* is inserted in a predictable environment (tones omitted):

(16)

Root	Reduplicated	Thematic vowel	Epenthesis	Gloss
sm	smsm	semsm	semsim	'whisper'
sw	sww	sawsw	sawsiw	'gather in hands'
pt	ptpt	petpt	petpit	'glean (leaves)'
ky	kyky	koyky	koykiy	'tickle'
zr	zrzr	zerzr	zerzir	'reanimate'
ty-r	tyrtyr	tyartyr	tyartyir	'feel sharp pain'

The reduplication rules cannot be formulated in terms of prosodic elements. The above forms could not be derived through reduplication of a syllable, or of two or three moras. Let us assume that the first syllable, consisting of one mora or two moras, is to be reduplicated. In order to make such an assumption, we have first to assume that the reduplication does not take place at the level of the root, which has no vowel, hence no syllables, but rather at the level of the stem, after the thematic vowel has been inserted. As an example of difficulties involved, I will try to derive the verb *bórbiré* 'pour'. The product of the collapse of the initial skeleton, vocalic, consonantal, and tonal planes and the addition of the aspectual suffix *-é* gives us *bór-é*. The reduplication of the first mora or the first syllable (first two moras) will produce respectively **bóbóré* and **bórbór-é*, both ungrammatical forms. One could conceivably postulate that indeed the first two moras are reduplicated, and that subsequently *o* is replaced by *i*. We would have to postulate a rule saying that no matter what vowel occurs in the reduplicated segment, it is always replaced by *i*. But this will be an ad hoc solution whose only purpose would be to eliminate the possibility of reduplicating segments.

Even stronger evidence for segment counting is presented by the second type of reduplication, where the second and third consonants are reduplicated. This reduplication triggers the epenthesis of two vowels, the first, a copy of the thematic vowel, and the second, the default vowel *i*:

(17)

Root	Reduplicated	Thematic vowel	Epenthesis	Gloss
dkɔ	dkɔkɔ	dekɔkɔ	dekedkɔ	'tickle'
ɔml	ɔmlml	ɔemlml	ɔemelmil	'roll up'
gdɪ	gdɪdɪ	godɪdɪ	godoldɪ	'walk in a bent position'

For these verbs, there is no vowel in the reduplicated portion either at the level of the root or at the level of the product of the collapsing of the consonantal and vocalic planes. Here are some additional examples, from a total of 71 items having this structure (all examples quoted in the perfective form):

(18)

'áláy`liy-é	'push continuously'
'áwál`wíl-é	'agitate frantically'
gèdér`dir-é	'vibrate'

Arguments for separate consonantal and vocalic planes

Since the internal structure of tiers is not of primary concern in this paper, I have accepted Archangeli's 1985 division into planes and tiers and I will be using the notion of plane in this paper. The hypothesis about the OCP crucially involves the notion of segregation of melodic planes, already introduced in McCarthy 1979, and a CV tier, or skeleton. The decision about monoplanar or multiplanar representation of consonants and vowels is important for the discussion of the tautomorphic identical consonants and vowels that are not adjacent on the skeleton. If consonants and vowels were postulated to occur on the same plane, then identical consonants separated by vowels and identical vowels separated by consonants would not constitute an argument against the universality of the OCP. This type of argument is used in Paradis and Prunet 1990.

The decision as to whether vowels and consonants are to be represented on the same plane or on different planes is as much theory dependent as dictated by the facts of language. The first argument stemming from the facts in Migama has to do with the formation of reduplicated forms described above. The reduplication process is sensitive only to the elements on the consonantal plane and affects only those elements. The thematic vowel is not affected by reduplication (i.e., it is not reduplicated itself), nor does it affect the choice of one of the two types of the reduplication processes to be applied.

In addition facts of Migama do not differ drastically from facts in other languages, e.g. Semitic, where vowels and consonants are represented on different planes. In fact Migama meets more than one of the conditions that McCarthy 1989 postulates to be sufficient to represent vowels and consonants on separate planes. McCarthy 1989:74 states: 'we shall accept planar V/C segregation as morphologically justified if there is at least some evidence that vowels and consonants constitute separate morphemes in the Bloomfieldian sense, even if not all cases are analyzable in that way'. In Frajzyngier and Ross (1996) we have shown that consonants in Migama carry the semantic characterization of verbs, and the vowels contribute the syntactic properties. Furthermore McCarthy 1989:88 states that 'templatic morphological system alone is sufficient to require planar V/C segregation'. In the following section I will describe the templatic properties of the imperfective aspect and the anterior past formation.

The imperfective and the anterior past templates

All verbal templates have the initial sequence CV. The limited data indicate that it may well be a characteristic of all words, verbal and non-verbal, in Migama. The importance of such characterization for the verbal templates is that it allows for the correct configuration of the first two segments when the vocalic and consonantal planes are collapsed. The first consonant from the consonantal plane is always followed by the vowel from the vocalic plane, and then the consonants follow in the order of the consonantal plane, to produce the initial skeleton. Tones on the penultimate (epenthetic) vowel of the imperfective (but not of the perfective) are always identical with tones of the first vowel. That indicates that the first tone on the tonal plane attaches to two syllables on the skeleton.

In terms of CV elements there are six types of imperfective templates, viz.:

CVCVCCV This is by far the most frequent (946 verbs) imperfective template.

CVCCVCCV This template provides the imperfective for verbs with four consonants, including stems derived through the reduplication of the first and second consonant.

CVVCVCCV This template is reserved for verbs with three consonants on the consonantal plane, and a long thematic vowel.

CVCVCCVCCV This template provides the imperfective form for verbs with five consonants, including those derived through the reduplication of the second and third consonant, and those four-consonant verbs whose third consonant is geminated.

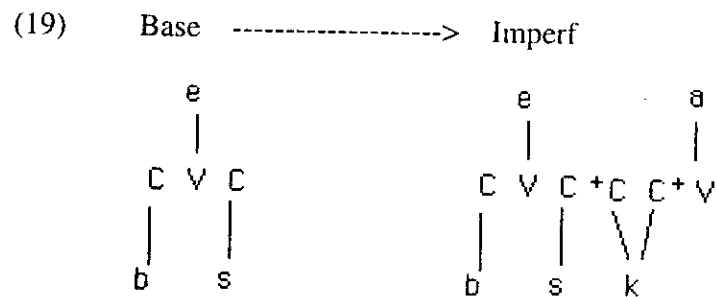
CVVCV (template for the seven verbs having the structure CVV-ro in the perfective)

CVCVCVCCV This template is represented by only two verbs.⁵

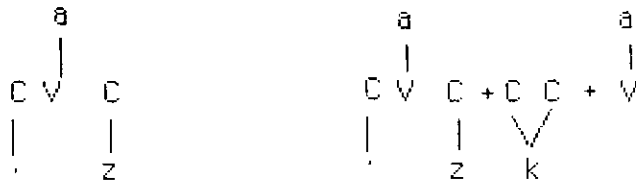
In addition to the above templatic characteristics, the final two consonants must have the form $-C_iC_i-$, i.e., they must be identical. Taking the first segments and the last three segments of the template as constant, viz. CV- and $-C_iC_i-a$ respectively, the configuration of the remaining, i.e. internal, elements of the template is predictable from the number of underlying consonants, the length of the thematic vowel, and the rules of epenthesis described earlier. Since there is a cluster of consonants, the epenthetic vowel preceding this cluster is always a copy of the preceding vowel, in accordance with the rules of epenthesis. What remains to be described is the nature of the final consonant cluster of the imperfective template and the role of the long thematic vowels.

Additional arguments for segment counting: The choice of the $-C_iC_i-$ sequence

The choice of the segments forming the final cluster of consonants in the imperfective template depends solely on the underlying form of the verb, and more specifically on its segmental structure. Verbs with long or geminated vowels apart, the consonantal ending of the imperfective of the remaining verbs depends on the number of segments on the consonantal plane rather than on the skeleton. Stems that have two consonants add the suffix $-kk-$ to the root, as in the following diagrams for the verbs *bes* Imperf. *bese-kk-a* 'save' and *'az* Imperf. *'aza-kk-a* 'boast'). The epenthetic vowels are subsequently inserted into the initial skeleton in accordance with the epenthesis rules.



(20)



Additional examples with the epenthetic vowel in place (tone omitted):

(21)

Base	Imperfective	Gloss
bes	bes-e-kk-a	'save'
bit-	bet-e-kk-a	'pull out' ⁶
kaβ	kaβ-a-kk-a	'pull in stomach'
wál	wàlà-kk-á	'pass the night'
'az	'aza-kk-a	'boast'
'ab	'aba-kk-a	'not to have enough'
'ar	'ara-kk-a	'suffer'

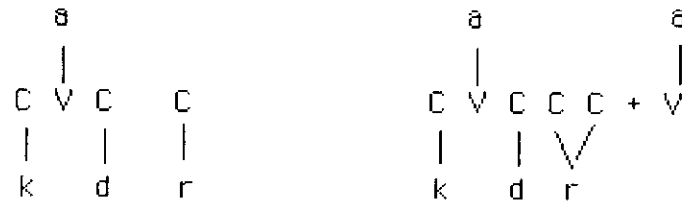
The anterior past marker for biconsonantal verbs is *-dǎǎ*, i.e., the consonant of the suffix is geminated:

(22)

dyàl	dyàlá-dǎǎ	'prepare mush'
sím	sémé-dǎǎ	'copulate'
wál	wálá-dǎǎ	'pass the night'

For the verbs that have three or more consonants, i.e. that have C₁-C₂-C₃ in the underlying structure, the final consonant of the imperfective stem is the final consonant of the root, which is geminated in the imperfective, as in the following diagram illustrated for the verb *kadr* Imperf. *kadarra* 'outline':

(23) Base -----> Imperf



Additional examples with the epenthetic vowel in place:

(24)

Base	Imperfective	Gloss
kudʃ	kodoss-a	'warm up'
kalp	kalapp-a	'mount'
sawl	sawall-a	'metamorphose'
migs	megess-a	'get used to'
gadp	gadappa	'reveal a secret'
ɖakl	ɖakalla	'have an erection'
dabr	dabarra	'rest (about animals)'
'abr	'abarra	'deter'
maɖ-y	maɖayy-a	'be pregnant'
gomssw	gomossowwa	'rejuvenate (about woman)'
ɖibllw	ɖèbèllèwwá	'rejuvenate'

Note that the reduplicated roots are treated as if they contain more than two consonants:

(25)

Base	Imperfective	Gloss
zebzb	zebzebba	'slacken the tension of a cord'
gezrZR	gèzèzèrrá	'secure'
sémism	sèmsèmmá	'whisper'

There is a class of verbs that in the perfective have the structure CV₁V₁C-e and that in the imperfective have their last consonant geminated and a consonant *-k-* inserted between the two vowels. The same verbs have the consonant *-k-* also inserted in the anterior past form:

(26)

Base	Imperfective	Anterior past	Gloss
dyàaw	dyàkâww-á	dyàkâw`-dé	'gather'
rùum	rókómm-á	rókòm-dé	'cook'
nyàaw	nyàkâww-á	nyàkâw-dé	'rain'
zòòŋ	zókóŋŋá	?	'be caught'

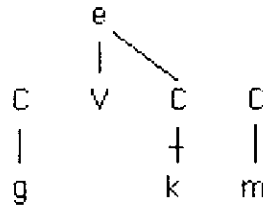
Superficially, these verbs could constitute counterevidence to the claim that the necessary condition for the forming of the imperfective through the gemination of the last consonant of the verb is for the verb to have three underlying consonants.

The role of the consonant [k] in this class of verbs constitutes an interesting issue. Wolff 1977:169 postulates /k/ to be an 'imperfective base formative'. One problem with this solution is that /k/ is used in only one subset of a class of verbs that have a long vowel. Another, equally serious, problem is that *k* appears also in the anterior past forms of exactly the same class of verbs.

The simplest solution is to postulate that *-k-* in these verbs actually constitutes part of the root, and that consequently the form in the imperfective rather than the form in the perfective should be taken as more fully representing the underlying segments, and that subsequently a rule deleting /k/ in the perfective should be postulated. The chief evidence for the claim that [k] must be a part of the root is the fact, noted already in Wolff 1977, that the class of verbs that have [k] in the imperfective behaves like triconsonantal verbs in having the last consonant of the root geminated in the imperfective. Jungraithmayr 1983 reconstructs this class of verbs as having historically an intervocalic velar consonant.

The derivation of these verbs indicates that their roots have actually the form *CkC*. In the perfective the consonant *-k-* is replaced by the preceding vowel on the skeleton ('assimilates to the preceding vowel'). This rule operates in a very specific environment, because the third consonant in these verbs is either *m*, *w*, or *ŋ*. The following rule accounts for vowel lengthening: $k \rightarrow V_1/V_1 \text{ ______ } C$ [+sonorant, -coronal]. The following would represent the derivation of the perfective form (illustrated for the verb *gem* Imperf. *gekemma* 'measure'):

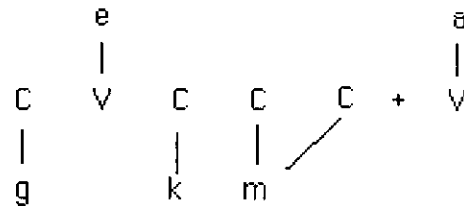
(27)



At this point one could ask why the rule of assimilation has applied rather than the vowel epenthesis rule, which would produce the ungrammatical form **gèkìmé* rather than the grammatical *gème*. The only answer that I can provide is that the base is first scanned for possible assimilation. Only when assimilation cannot apply are the rules of epenthesis invoked. As support for the proposed derivation one should note that in the available data there are no clusters consisting of *km*, *kŋ*, or *kw*.

The imperfective is formed on the same root. This being a triconsonantal root, the final consonant is geminated, producing the following initial skeleton:

(28)



There is thus a cluster of three consonants at the skeleton. The rule of epenthesis inserts a copy of the first vowel to break the disallowed consonantal cluster, producing the imperfective form *gekemma*.

At this point one could ask whether it is possible to predict when epenthesis would apply rather than assimilation, in other words, why not the form **gèemmá* or **gèmmá* for the imperfective? There are two possible answers to this question. The first is that all imperfective templates have at least three syllables, and neither of the two ungrammatical forms conforms with this templatic requirement. In addition the first form **gèemmá* is ungrammatical because it violates the syllable structure constraint *CVVC described earlier.

If the root contains three consonants and the final consonant is geminated, then there are no consonantal changes in the imperfective stem:

(32)

Base	Imperfective	Gloss
taww-	tawa-kk-a	'feed, take to pasture'
'abb-	'aba-kk-a	'catch'
baɸɸ-	baɸa-kk-a	'stumble, trip'
bagg-	baga-kk-a	'embank many times'
cf.		
sim-	seme-kk-a	'copulate'

One could conceivably claim that the suffix *-kk-* has nothing to do with the number of consonants involved but rather is determined by the number of syllables or moras. There is, however, a strong counterargument to such a claim. There is a large group of disyllabic verbs that have the structure CVC₁C₂-, e.g. *surd* 'shave', *'alm* 'act quickly', *boŋs* 'become angry', etc., i.e., the syllabic or moraic structure of these verbs is exactly the same as the structure of the verbs with the geminated second consonant. And yet, these verbs form the imperfective through the gemination of the last consonant (i.e. like all other triconsonantal verbs) rather than through the addition of the suffix *-kk-*:

(33)

Base	Imperfective	Gloss
'ams	'amassa	'mix'
barm	baramma	'enlarge'
'els	'elessa	'boil'
boŋs	boŋossa	'become angry'

The CV characteristics of anterior past templates are identical to those of imperfective templates for all groups except for the monosyllabic verbs, where the anterior past has the form CVCCV rather than CVVCV. In addition, the final cluster of consonants in the anterior past does not have to contain geminated consonants. The anterior past suffix is *dé*. When it is added to triconsonantal verbs, the last consonant of the verb precedes the consonant of the suffix, thus satisfying the templatic requirement:

(34)

Base	Anterior past	Gloss
kálp	kálàp-dé	'climb'
mígs	mígís-dé	'get used to'
sùrd	sòród-dé	'shave'

Arguments against the OCP

The crucial argument against the OCP comes from the condition about the formation of the imperfective stem. Now that we have established at what level the consonants are counted, we can proceed to show how an analysis that accepts the OCP produces ungrammatical results. The arguments against the universality of the OCP are based on analyses of the following phenomena:

Triconsonantal verbs with the structure $C_1-C_1-C_2$: The C_1-C_1 sequence is treated as two segments.

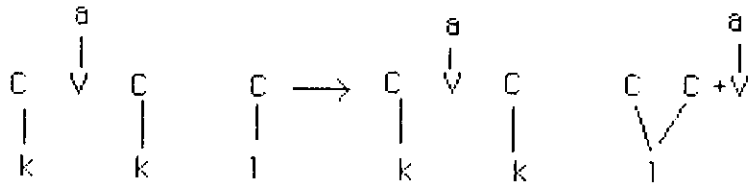
Triconsonantal verbs with the structure $C_1-C_2-C_2$: The $C_1-C_2-C_2$ sequence is treated as two segments. These verbs should be contrasted with the verbs with two different consonants in the root, those having the structure $C_1-C_2C_2$. The C_2C_2 sequence is treated as one segment.

These verbs have been analyzed in the preceding section.

Each of the first two structures represents a potential instance of the operation of the OCP. For each of these structures I will show that the analysis accepting the OCP is less desirable than the one rejecting the OCP.

Verbs with the first two consonants identical, viz. $C_1-C_1-C_2$: If one assumes plane separation and the OCP, one would have to consider these verbs as containing two consonants, and consequently their imperfective form would have the suffix *-kk-a*. That, however, is not the case. All verbs with the consonantal structure $C_1-C_1-C_2$ form the imperfective through the gemination of the last consonant and the addition of the vocalic suffix *-a* only, according to the following scheme (illustrated for *kakl* Imperf. *kakall-a* 'extract'):

(35)



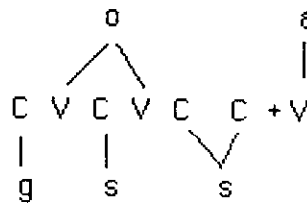
Here are some additional examples:

(36)

Base	Imperfective	Gloss
sus-y	sosoyy-a	'wipe'
ɖaɖɖ	ɖaɖaɖɖ-a	'courir les dos rentré'
gugr	gogorra	'donner des tubercules'
susm	sosoma	'itch'
noony	noonoyya	'hum'
waawy	waawayya	'to help a sick person'
tóotl	tòotòllá	'deduce'

Verbs with the second and third consonant identical, having the structure C1-C2-C2C2: Just like the C1C1C2 verbs, the C1C2C2C2 are treated for the derivation of imperfective as triconsonantal rather than biconsonantal as stipulated by the OCP. If these verbs were biconsonantal, one would expect the imperfective to be formed with the suffix *-kk-a*. But instead, the imperfective adds just the vowel *-a*, since the last consonant of the base is already geminated. The imperfective form for this class of verbs has the following structure (illustrated on the verb *gosss* Imperf. *gosossa* 'augment by swelling'; the epenthetic vowel is included in the skeleton and attached to the underlying segment on the vowel plane).

(37)



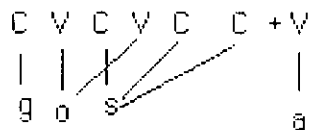
(38) (additional examples)

Base	Imperfective	Gloss
lok-kk	lokokka	'drivel'
zol-ll	zololl-a	'escape through one's own cunning'
tyàl-ll	tyàlàllá	'fail'

The analyses of the C₁-C₁-C₂ and C₁-C₂-C₂ verbs constitute the evidence that it is the number of consonants on the consonantal plane that determines the form of the imperfective and, moreover, that the identical adjacent consonants on the plane must be counted separately. Were the above verbs considered as having only two consonants at the consonantal plane, they would have had the suffix *-kk-* added. Hence we have two identical, adjacent, tautomorphic segments, and the structure of the language compels each of the segments to be attached to a different element on the skeleton. This is exactly the case that McCarthy 1986 considered to be an argument against the universality of the OCP.

Note here an additional argument for the plane segregation and against attaching all identical consonants on the skeleton to one consonant on the melodic plane. As in all imperfective forms, the vowel preceding the final C_iC_i-*a* sequence is epenthetic, and moreover it is a copy of the preceding vowel because it is followed by a sequence of consonants rather than a single consonant. Hence the first vowel and the second vowel on the skeleton **must** be attached to the same vowel. If the consonants on the skeleton were all attached to the same consonant on the melodic plane, we would get line crossing, as in the following diagram:

(39)



Although line crossing is defended in McCarthy and Prince 1986 as allowable in certain conditions, allowing line crossing as in the diagram above would be very much an ad hoc solution. Because the above diagram has two consonants on melodic plane, the suffix *-kk-* would also be required, producing ungrammatical form.

Prosodic factors

The problem

An attentive reader must have noticed that in several groups of verbs, e.g. Group A (218 verbs) and Group D (298 verbs), the segmental structure of the base in the imperfective differs from the segmental structure in the perfective. More specifically, biconsonantal verbs with the first vowel geminated in the perfective have the first vowel short in the imperfective. In addition to scattered examples in the text, compare the following:

(40)

Base	Imperfective	Gloss
kiil	kelewwa	'hide'
laat	latawwa	'stretch'
meel	melewwa	'renounce'
baag	baga-ww-a	'embank'
boob	bobo-ww-a	'pour in large quantities'
naas	nasa-ww-a	'breathe'

Biconsonantal verbs with the second consonant geminated in the initial skeleton of the perfective have a non-geminated consonant in the imperfective:

(41)

Base	Imperfective	Gloss
yebb	yebekka	'drink voraciously'
werr	werekka	'vomit (many times)'
wanj	wajakka	'be in a delicate situation'
wagg	wagakka	'crush'

The interesting questions are the following: Why are the long vowels and the geminated consonants reduced in Groups A and D? Because the conditions responsible for the reduction in the vowel length in Group A and the reduction of the geminated consonants in Group D are instances of the same process of syllable reduction from heavy to light.

The solution

If the reduction represents the operation of some rule, why doesn't this rule operate in Groups J (53 verbs) and L (47 verbs), where the long vowels and geminated consonants in the first syllable are not reduced? In verbs with the first vowel long and three underlying consonants, or with three consonants but the second consonant geminated, the first long vowel (and the geminated consonant) has no effect on the choice of the final consonantal cluster of the imperfective because as in the triconsonantal verbs described earlier, the last consonant is geminated in the imperfective, e.g. (all perfective forms of these verbs have the epenthetic *-i-* in accordance with the epenthesis rules described earlier):

(42) (Group J)

Base	Imperfective	Gloss
'áan-y	'aanàyyá	'go toward'
káaw-y	kàawàyyá	'brand (with iron)'
sáad-y	sàadàyyá	'sift lightly'
hóokl	hòokòllá	'bray'

(43) (Group L)

Base	Imperfective	Gloss
ǎóppny-	ǎóppònnyá	'stew'
lólík	lòllòkká	'beg humbly'
káatm	kàttàmmá	'pass in front of somebody'
wé'kk	wèkkèllá	'bricoler'

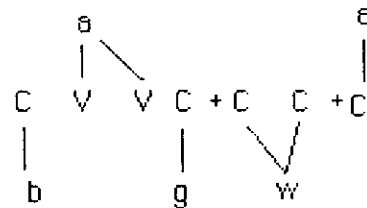
An obvious answer to the question asked above must involve one of the structures above the level of the segment, such as syllables, feet, or words. In what follows I will consider the higher level structures to find whether or not they can effect the syllable length reduction described above.

Syllable and word structure constraints

In this section I shall show that neither the syllable structure constraints nor word structure constraints could be responsible for the syllable reduction in groups A and D. I assume that *-w-* in addition to *-a* is a marker of

the imperfective of Group A.⁷ The initial skeleton of the imperfective has the following form (illustrated on the verb: *baag-* Imperf. *baga-ww-a* 'embank').

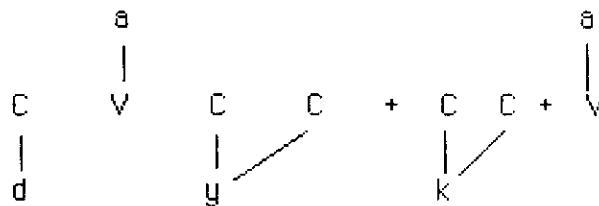
(44)



I have shown earlier in this paper the existence of a syllable structure constraint that does not allow syllables of the type *CVVC. Note, however, that this constraint is monomorphemic only. If a morpheme boundary is involved, there are in fact long vowels occurring in a closed syllable, and moreover, there exist long vowels followed by a consonantal cluster. Thus the addition of the third person singular feminine possessive suffix *-tí* to the word *páato* 'sun' produces *páattí* 'her sun' and not **pattí*. Compare also *'aatti* 'her stomach' rather than **'attí*, and *páàttí* 'in the sun(shine)' rather than **páttí*. For these forms I postulate the derivation: *paat + tí*, and *'aat + tí*. Consider also: *déènnè* 'let them be for us' vs. *dèènnè* 'let us be'. Hence the syllable structure constraint cannot be responsible for the vowel shortening in the imperfective of Group A.

Group D verbs have the initial imperfective skeleton as follows (illustrated on *dàyy* – Imperf. *dàyàkká* 'sift'):

(45)



Instead of the consonant reduction, one could envisage here vowel epenthesis to produce the form: **dayy akka*, whose CV configuration would be identical with the CV configuration of Group L verbs, such as *mòmmòdíá* 'inflamm spontaneously'. Hence the consonant reduction does not follow as a necessary outcome from syllable structure conditions. We are therefore left with two higher

level units potentially responsible for the vowel and geminate reductions in Groups A and D respectively. The ungrammaticality of words of the type **dayy akka*, and grammaticality of words of exactly the same type as represented by *mòm mòddá* (and 46 other verbs of this type, i.e. trisyllabic verbs with the first and second syllable heavy, and with the second consonant geminated), argues against constraints on the structure of the word being responsible for vowel shortening in Group A and geminate reduction in Group D.

Syllable, foot and word

The differences in behavior of Groups A and D verbs when compared with Group J and L verbs are due to a set of conditions involving the structure of the word, the structure of the foot, and the structure of the syllable, combined.

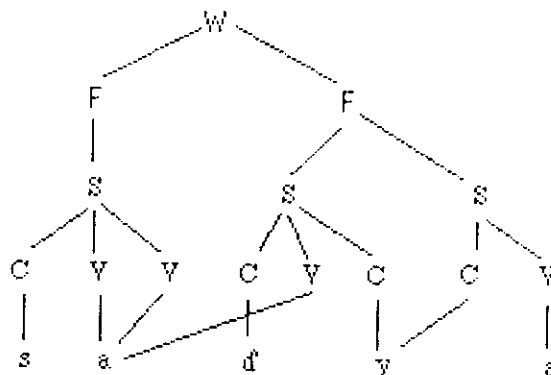
The above formulation begs the question about the notion of foot, in view of the fact that there is no information on stress in Migama, if any, nor are there samples of metrically organized texts, allowing one to determine the structures of feet in this language. Hence, there is no independent evidence that the phonological unit 'foot' even exists in Migama. I am nevertheless going to postulate the existence of foot as a phonological unit, and this decision will be justified by its ability to explain the existing data. The ultimate confirmation or falsification of the existence and the nature of foot may come from different analyses or, even better, from the study of metrically organized speech fragments when those become available.

I assume that a word may consist of one or more feet. Let 's assume that a foot may not have more than one heavy syllable. The following rule governs the organization of the imperfective form: If the base of the verb has the potential of producing four or more moras, the imperfective form of the verb will consist of two feet. If the base consists of less than four moras, the imperfective form will consist of one foot. The moras of the base are counted in the following way: The first consonant with the thematic short vowel is counted as one mora. The long vowel adds one more mora. Each subsequent consonant of the skeleton counts as one mora because, given the syllable structure conditions of Migama, it will either serve as an onset of a syllable or as a coda of a syllable. Here are a few examples of derivation of imperfective forms for five groups of verbs that are going to be affected by the rule. We start with bases having four moras:

Group J. Verb *sáad'-y* 'winnow'. The first mora is *sa*. The second is *a*. The third mora will be built on the basis of *d'* and the fourth on the basis of *y*. Hence the resulting word must contain two feet. The following is the hierarchical structure of the imperfective form *sáad'áyyá* (not having a possibility of three-dimensional graphics I am showing consonants and vowels on the same plane,

hence the association lines between the epenthetic vowel and the second consonant cross):

(46)



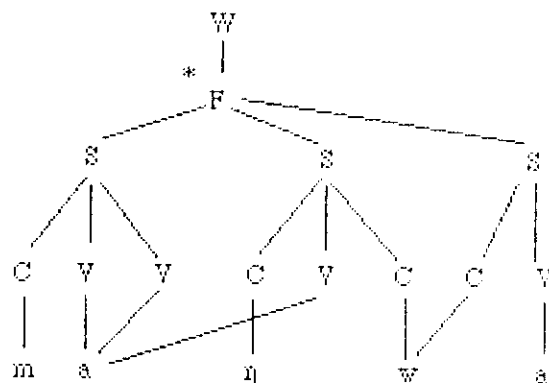
The verbs from the Groups K, L, and M, which all have at least four potential moras in the base, form their imperfective forms with two feet. Here are examples of the counting procedure for one verb from each group: *dōppny* Imperf. *dōppōnyá* 'stew': *dō* first mora, *p*, second mora, *p*, third mora, *ny*, fourth mora; *dyálky* Imperf. *dyàlkàyyá* 'woo': *dyá* first mora, *l* second mora, *k* third mora, and *y* fourth mora; *gònylgw* Imperf. *gònyòlgòwwá* 'become an idiot': *gò* first mora, *ny* second mora, *l* third mora, *g* fourth mora, *w* fifth mora. No verbs from these groups undergo heavy syllable reduction in the imperfective.

Here are examples of the mora-counting procedures for some of the remaining groups of verbs: *kàm* Imperf. *kàmàkká* 'hunt mice': *ka* first mora, *m* second mora; *wàt-y* Imperf. *wàtàyá* 'warm up': *wà* first mora, *t* second mora, *y* third mora; *gàrt* Imperf. *gàràttá* 'become sweet' *gà* first mora, *r* second mora, *t* third mora; *kúds* Imperf. *kódóssá* 'heat up' *ku* first mora, *d'* second mora, *s* third mora. All these verbs have the imperfective formed with one foot only. There are no changes to the base of these verbs.

Let us now consider those verbs that undergo changes in the segmental structure of the imperfective, viz. verbs with long vowels and geminated consonants. Group A verbs are illustrated with the derivation of *mànyé* Imperf. *mànyàvwá* 'climb'. The first mora is *ma*, the second mora is *a*, the third mora is *y*. Therefore the imperfective form is formed with one foot only. We have seen that the obligatory element of the imperfective form is a heavy syllable followed by a light syllable. In derivation of the imperfective form of this verb, we will end up with two heavy syllables in one foot, violating the foot structure condition described earlier. The following would be the form obtained after addition of

the suffix *ww-a* to the base (association line crossing is an artifact of two-dimensional graphics only):

(47)



In order to prevent the violations of the foot structure, one of the two heavy syllables must be reduced, either *maa* or *naw*. The latter contains *w* as part of the grammatical morpheme at this level of derivation. In Migama the reduction at the level of derivation cannot affect the derivational morpheme of that level, hence only the first heavy syllable is available for reduction (cf. Blevins /in press/ for similar view with respect to other languages).

The derivation of the imperfective from the base having geminated consonants is very similar. Illustrated on the verb *bábĕ* Imperf. *bábĕkká* 'not to get involved, stay on the side': The first mora is *ba*, the second mora is the first element of the geminate *b*, the third mora is the second element of the geminate *b*. Trimoraic verb will have only one foot in the imperfective. The verb is biconsonantal, hence it takes the suffix *-kk-* in the imperfective. We end up with two heavy syllables in one foot. The suffix *-kk-* cannot be reduced, because it is a grammatical morpheme. Hence the first heavy syllable is the only one that can be reduced. The diagram for the word structure of this verb is essentially the same as the preceding diagram for the verb *māḡāwwá* 'climb' except for the structure of the first syllable and the types of segments involved.

On the nature of prenasalized stops

Kenstowicz and Pyle 1973 noted that geminates may not be separated, and this observation has been subsequently confirmed by other studies (cf. Hayes 1986). The data in Migama fully support this observation, because when the copy

of the preceding vowel of the stem is inserted to break a disallowed consonant cluster, it is never inserted between the two components of the geminate. The other property of geminates proposed by Kenstowicz and Pyle 1973 and most recently supported in Steriade and Schein 1986, and Hayes 1986 (but see for contrary evidence Rubach 1986), viz. that there could be no rule affecting only one of the geminates, is contradicted by the reduction rules of Migama, where heavy syllables composed of long vowels or geminate consonants are reduced through the deletion of one of the elements of the geminate segment. The interesting property of Migama is that prenasalized stops share the two properties of geminated consonants and vowels, viz., they cannot be separated by insertion rules and one of their components can be deleted in the process of syllable reduction.

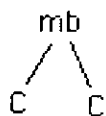
The existence of the class of prenasalized stops can be shown using the criteria that determine the formation of the imperfective stem. There are stems that apart from their initial consonant also have a sequence of a nasal followed by a stop in their surface structure. Although these verbs may appear to have three consonants in their surface structure, they are treated as if they had only two consonants in their consonantal plane. They take the suffix *-kk-* in the imperfective instead of the gemination of the last consonant, as is the case with verbs having three consonants in their consonantal plane:

(48)

Base	Imperfective	Gloss
nambe	nabakka	'rest'
nange	nagakka	'spoil' (intr.)
niŋge	negekka	'spoil' (tr.)

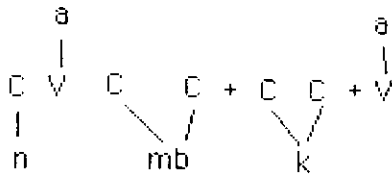
The prenasalized stops are therefore consonants that have one segment on the consonantal plane attached to two segments on the skeleton. Each of the components of the prenasalized stop is attached to a different segment on the skeleton, as already proposed in Sagey 1986, viz.:

(49)



Segments that have this representation and only this representation are prenasalized stops. The initial imperfective skeleton for verbs with the prenasalized stops has the following form (illustrated on the verb *nàmb* Imperf. *nàbàkká* 'rest'):

(50)



The prenasalized stop is treated as a sequence of consonants on the skeleton. But underlyingly it is a biconsonantal verb that allows only one foot in the imperfective. Hence the first heavy syllable *nam* must be reduced and the syllabic coda [m] is deleted. Then a copy of the first vowel is inserted between *b* and *k* to break a disallowed consonant sequence. The prenasalized stops behave thus exactly like geminate consonants in two ways: Although in the surface structure they are realized as two segments, in the underlying structure they are considered as only one segment. Neither prenasalized stops nor geminates can be separated by another segment. In the process of syllabification, both geminate consonants and prenasalized stops have one of their components deleted. Interestingly, it appears that rules of deletion in Migama are exceedingly rare otherwise, and no other segments within the verbal system may undergo reduction. This argues for a hypothesis that heavy or long segments are in fact less resistant to change than simple segments. A functional explanation for that fact may be sought in the fact that the deletion of a portion of the geminate still leaves the other portion, allowing for identification of the underlying segment. Since geminate consonants, long vowels, and prenasalized stops share a common property, they are called here 'heavy segments', in analogy with heavy syllables. They all could be represented by the obligatory multiattachment of one element on the segmental plane to two elements on the skeleton.

Note now that not all sequences of a nasal and a stop in the surface structure derive from the underlying prenasalized stops. Sequences of a non-homorganic nasals followed by a stop such as *md*, and of homorganic nasal followed by a voiceless stop such as *ɲk*, are not derived from one underlying segment. The evidence for this is provided by the fact that disyllabic verbs with the above sequences of consonants are considered to have three consonants in the underlying structure, because their imperfective is formed through the gemination of the last consonant:

(51)

Base	Imperfective	Gloss
'ajk	'ajakka	'want'
'amdy	'amadfy	'achieve (badly)'

In addition, as the examples above indicate, the sequences *md'* and *ɲk* can be separated by another segment.

The notion of heavy segment as described in the present paper refers to the phonological rather than the phonetic properties of segments. Segments that are phonetically complex according to Ewen 1982 and Anderson and Ewen 1987 may or may not be phonologically complex. Thus in Migama there is a series of palatalized alveolar stops [ty], [ɲy], and [ny]. According to Anderson and Ewen 1987, these are segments with internal sequential structure by virtue of their phonetic properties. In Migama they behave like single segments at both the consonantal plane and at the skeleton. The evidence that they behave like a single segment at the consonantal plane is provided by the fact that disyllabic verbs with the sequence *Cy* are treated as two-consonantal and have the suffix *-kk* in the imperfective:

(52)

Base	Imperfective	Gloss
any	anya-kk-a	'take a bath'
lony	lonyo-kk-a	'tear meat with teeth'
katy	katya-kk-a	'make an opening'
keɲy	kedye-kk-a	'take down, unhook'

The evidence that palatalized consonants are considered simple at the skeleton comes from syllabification processes. The palatal component of the consonant is never separated from the stop component. Compare the examples above, where the palatal is never separated, with the following examples of words with consonant clusters whose components are separated in the process of syllabification:

(53)

Base	Imperfective	Gloss
surd-e	sorodf-a	'shave'
kalpe	kalappa	'climb'

Conclusions

The following are the main results of the paper. With respect to what elements should be counted I have shown that for some processes one ought to count segments and for others one ought to count prosodic elements, more specifically moras.

The organization of phonological system in Migama provides support for the plane segregation as proposed in McCarthy 1979 and subsequent work.

I have also shown that syllable weight within the stem also plays a role in the determination of the form of the suffix. This seems to be a frequent phenomenon in Chadic (cf. Frajzyngier 1976).

Morpheme boundary in Migama is an important element in phonological structure in that it allows types of consonant clusters that are disallowed within morphemes.

The data in Migama indicate an interesting hierarchy with respect to structure preservation. At each level morphological markers of that level are preserved in their entirety. But products of derivation at a previous stage may be obliterated at a subsequent stage. More specifically, the gemination as the marker of plurality may be reduced and hence lost at some stages of derivation. On the other hand elements that contribute to the lexical information, viz. elements of the underlying structure, are not reduced.

I have shown that the acceptance of the OCP in the analysis of Migama verbs has no phonological or morphological consequences and does not yield results enabling prediction of various verbal forms. Its rejection has important phonological and morphological consequences. I have provided thus an argument against the universality of the OCP.

I have also shown that it may be necessary to recognize the existence of a class of phonologically heavy segments. One of their properties, their resistance to separation, has already been noted in Kenstowicz and Pyle 1973 and subsequent works. Heavy segments in Migama have in addition the property of having a rule apply to one portion of the segment but not to another. One of the most interesting results of the study is the demonstration that prenasalized stops, but not other segments with sequential organization, behave like geminated segments.

Notes

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(1) The name of the language is most often spelled in published literature with a short vowel, viz. Migama. I am adopting the spelling with the long vowel in deference to the spelling in Semur et al. 1983 and Abbakar et al. 1975, both works written with participation of a large number of Migama speakers. The language is spoken in Prefecture Guéra in Chad. The 1963 census gave the number of speakers of Migama as 12,000 (Jungraithmayr 1975). East Chadic is one of the three branches of the Chadic group of Afroasiatic languages. The transcription convention used in Semur et al. is also used in the present paper to avoid any further confusion. In this transcription ' stands for glottal stop, *ty*, *dy*, *ny*, for palatal stops. This is a rather unfortunate convention, as there are clusters of stops with palatal glide *y*, which Semur et al. also represent as *ty*, *dy*, etc. Whenever it is important, I will represent such clusters by *t-y*, *d-y*, etc. Long vowels and geminated consonants are represented by digraphs, e.g. *aa*, *tt*, etc. In those cases when the French gloss for a Migama verb is ambiguous, I will give the gloss in French rather than in translation.

(2) There is one group that differs significantly from the rest. First, these verbs have the structure *CVVro* in the perfective. Note that they have the final vowel *-o* rather than *-e* in the perfective. The consonant *-r-*, which occurs in the perfective, does not occur in the imperfective form of these verbs. Some of these verbs are *deero* 'become', *weero* 'give birth', *neero* 'die', *reero* 'sing', *leelo* 'make, hope'. Wolff 1977 postulates that verbs in this class have actually a monoconsonantal root. Jungraithmayr 1983 and earlier writings postulates that these verbs have a polyconsonantal root. These verbs are also unique in having in the imperfective non-geminated /w/ preceding the suffix *-a*:

Perfective	Imperfective	Gloss
deero	deewa	'become'
teero	teewa	'eat'
weero	weewa	'give birth'

The formation of the imperfective form of these verbs resembles the formation of imperfective for verbs with first geminated vowels. But this has no bearing on the question of the number of consonants in the root.

On Segment Counting, OCP, and Heavy Segments

The verbs from this group behave differently from all other verbs in other fragments of the verbal paradigm. Thus in cases when other verbs have the form CVC-u the verbs from the -o group have the form CVV:

dee	'become'	cf.	sim-u	'copulate'
tee	'eat'	cf.	gell-u	'laugh'
wee	'give birth'	cf.	migis-u	'get used to'

Whatever may be the explanation for the unusual behavior of the -o verbs, it does not affect the central issues of this paper.

(3) As illustration of just such a case, consider verbs 'last' and 'hit'. The consonantal structures of their perfective forms are quite similar, respectively *dämmé* and *tám'mé*. Yet their imperfective forms are quite different, viz. *dòmòkká* and *támánná*. For the verb 'last' I postulate that its consonants are *dm*, but for the verb 'hit' I postulate its consonants to be *im* with an assimilation rule where *m* replaces *n* when the two consonants are abutting.

(4) It appears that in a very few cases the i/u alternation among epenthetic vowels has been exploited for morphological purposes, as illustrated in the following example where it is the second, epenthetic, vowel of the stem that carries the function of transitive/intransitive distinction: *teeriwe* 'keep one's balance' *teerawe* 'balance an object'.

(5) The template for monosyllabic verbs (cf. footnote 2) will be excluded from discussion here, as its description must be done in conjunction with the description of this class of verbs.

(6) The vowel lowering manifested in the imperfective form of this and other verbs is described in Frajzyngier 1981. The vowel lowering rule as formulated in Frajzyngier 1981 is as follows: The final low vowel *a* causes lowering of all preceding high vowels by one step within the vocalic system of Migama. That means that /i/ and /u/ become /e/ and /o/ respectively. The rule is non-iterative. The formation of the verbal form ending in -*a* and the formation of the anterior past tense ending in -*á*, none of them available to me at the time Frajzyngier 1981 was being prepared, indicate that the above rule must be modified. In particular it appears that the vowel -*a* alone does not cause the lowering, but that it must be preceded by a consonant belonging to the suffix. Second, the vowel -*e* in exactly the same conditions (i.e. when preceded by a consonant forming part of the suffix) can also lower the preceding vowel, as indicated by the formation of the anterior past.

(7) The additional evidence that -*ww*- is a grammatical marker (rather than a part of the underlying structure of the verb) whose choice is determined by the phonological properties of the verb is provided by verbs that have a single vowel and a sequence of geminated liquids. These verbs behave as if they had a long, rather than a short, vowel. These verbs take in the imperfective the suffix -*ww-a*, rather than -*kk*-. Compare the following forms: *gell* Imperf. *geleww-a* 'laugh', *kóll* Imperf. *kólóww-á* 'call'. Since only liquids trigger this phenomenon, it is clear that a feature common to liquids and vowels

occurring in a sequence corresponds to the long vowel. Migama, thus, is one of the languages in which liquids are [+cons] and [+voc].

An alternative analysis of Group A verbs would be to postulate *w* as a part of the underlying representation, thus the root for the verb 'embank' would be **bwg*. As there are no consonant clusters with an initial *w*, we can hypothesize that *w* assimilated to the preceding vowel or was replaced by the preceding vowel, in a way similar to the process that affected *k* in the same position. While this process would explain the structure of the perfective template, it would not explain the imperfective template, where *w* occurs after the second consonant. A metathesis rule would have to be invoked in order to explain the imperfective form. In addition postulating *w* as part of the underlying structure for these verbs will not account for the occurrence of *w* in the imperfective of the verbs having CVll sequence described earlier.

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