SUPRASEGMENTAL PHONOLOGY *

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1. *Introduction*

With SPE and the theses of Nancy Woo (1969) and Will Leben (1973), MIT contributed in a major way to solving problems of prosodic analysis. There remains, however, one fundamental uncertainty, which can be phrased in the following way: *Is prosodic information stored in the segments, like all other phonic information, or in a different way?*

This uncertainty might be related to the different functions of pitch in language. We all agree intuitively that intonation patterns cannot be constructed by a concatenation of the individual frequencies of segments, but are in some way superimposed on meaningful units. Linguists with first-hand experience of 'normal' tone languages agree in the same intuitive way that the total pitch contour of a sentence in a tone language cannot be constructed in any other way than by a concatenation of segmental frequencies. In the pre-generative age we might have been quite happy to leave this problem unsolved and treat each language as a different universe. Modern linguists all suffer from universalitis, which sometimes means that they want to explain identical surface phenomena in identical ways: wherever contrastive pitch is found, the same universal explanation should be used.

The recent work of Leben is very attractive to universalists, because he offers a synthesis of segmental and suprasegmental treatment of prosodic phenomena. Leben claims that in some languages prosodic information is stored not in individual segments, but in the morpheme as a unit. A morpheme may be marked by prosodic patterns like L, HL, or LHL. This means that every morpheme of the language is spelled out in two matrices:

- a segmental one which contains all the phonic information,
- a suprasegmental one which contains all the prosidic information.

As soon as morphemes are combined in a sentence, one has to apply first the suprasegmental rules which change the prosodic matrices of the morphemes. Then the prosodic information is mapped on individual segments (vowels, syllabic nasals, etc.). Finally the segmental prosodic rules (or normal tone rules) are applied, which may alter the segmental prosodemes.

This is a strong theory, because:

a. it predicts and explains an order of prosodic rules (suprasegmental rules precede segmental ones),

b. it predicts and explains restrictions in prosodic patterns (one expects, e.g., no difference between LHH and LLH in morphemes. According to Leben such a difference could only be produced by the mapping rules.)

c. it predicts and explains the existence of 'floating tones' (which should be expected wherever the prosodic matrix is bigger than the number of tone-bearing segments of a morpheme).

Moreover, the theory allows for the possibility of leaving the supra-segmental or the segmental component empty. If there are no suprasegmental prosodic rules, as might be the case in 'normal' tone languages, one could as well mark the segments in the lexicon and dispense with prosodic patterns on morphemes. If there are no segmental prosodic rules, as might be the case in 'normal' stress languages, the mapping rules are no longer necessary. Pitch Accent systems might be crucial to test this theory, but the theory seems so strong that it is hardly possible to falsify it as a theory. One can only criticise the way it is used in individual languages. Leben assumes that a suprasegmental component is necessary in languages like Tiv and Mende. In a private communication he told me that he had to give up his Tiv-position. I shall try to show that his Mende material does not offer strong support for his theory either.

I shall organize the material under three different headings:

a. Leben's theory does not offer conclusive arguments to explain rule ordering in Bambara (Section 2),

b. Leben's theory does not explain restrictions in the prosodic patterns of Mende (Section 3),

c. Vowel contraction in Mankon offers evidence that not only tone may float, but also an unquestionable vocalic feature like [closure] (Section 4).

2. *Rule Ordering in Bambara*

It seems clear to me that phonological rules are partly ordered by conventions. A rule can only apply if its input or environment has been produced by a preceding rule or if an underlying form provides an input to the rule. One could devise other ordering conventions, like: a more complex environment (in features or markings) precedes a simpler one. This convention has already been accepted in abbreviations. Why should it not be generalized? Let us assume, however, that explicit ordering is inevitable. In that case a theory which predicts the order is stronger than one which does not.

Leben calls his L-spreading rule suprasegmental. This rule runs as follows:

(1) H ⟶ L / L —— H.

This rule has been found in a number of Mande languages, but also in Hausa. The rule applies from left to right. Leben argues in the following way for its suprasegmental nature:

All Mande languages have a compounding rule with the effect that all following elements in nominal compounds lose their tonal distinctions. The resulting compound has the tonal pattern of the first element:

(2) Bambara

jírí	(tree)	jírí-fínmán-nyímán	(good black tree)
musó	(woman)	muso-finman-nyímán	(good black woman)

N.B. L tone is left unmarked.

One could state informally that the whole compound is H if the first noun is H, and that all elements except the last one are L, if the first noun is LH. This rule can be generalized, if the L-spreading rule is incorporated. The rule (after compounding) should then become:

a. copy the last tone of the first element on all following vowels,

b. apply L-spreading.

These two rules produce incorrect results, as shown in:

(3) musó-finman-nyiman (after compounding)

musó-fínmán-nyímán (after a)

*muso-finman-nyimán (after b)

But if L-spreading applies in the suprasegmental component, the correct result is produced:

(4) ^{LH}muso-finman-nyiman (after compounding)

^{LH}muso-^{H}finman-^{H}nyiman (after a)

^{L}muso-^{L}finman-^{H}nyiman (after b)

muso-finman-nyímán (after the mapping rules)

If L-spreading is supra-segmental, then so are the preceding copying and compounding rules.

This illustrates a weak point in Leben's analysis. His copying rule has a strong segmental flavour. If, on the suprasegmental level, a morpheme is characterized by the pattern ^{LH}, how can one on this level analyse the pattern in two different pitch levels, $^{L + H}$, and copy only the last one? One would rather expect that either the whole compound falls under the domain of the pattern of its first element, or that the pattern ^{LH} would be copied.

A segmental treatment is possible, based on the concept of reduced tone systems. Imagine a general rule which states that all prosodic segmental information is neutralized to H, except immediately after word boundary. Every word, compound or simple, would only permit a tonal distinction on the first syllable, all other syllables would be indiscriminately H. This would mean an important generalization. Leben's compound and copying rules would no longer be necessary, but the natural result of the compounding process, given the general constraint (tonal reduction). L-spreading produces the same incorrect result as in (3), unless it is blocked by the last morpheme boundary. The weak point here is that a general phonological rule (like L-spreading seems to be) is sensitive to the last morpheme boundary (thus to syntactic information). The Mende material will show, however, that L-spreading is apparently not so general.

3. *Restrictions in the Tone Patterns of Mende*

In Bambara, only two tone patterns were possible. Mende is more complicated and shows 6 more or less frequent tone patterns in nouns and verbs. Leben only studied the nominal tone and found the following possibilities (Leben's patterns between brackets):

(5) Mende nouns

L L	(L)	bɛlɛ	'trousers'
L H	$(LH)_1$	navó	'money'
H L	(HL)	kálí	'hoe'
H H	(H)	tɔ́kpɔ́	'palmtree'
L HL	(LHL)	nyahâ	'woman'
L LH	$(LH)_2$	mahá	'chief'

Leben's theory cannot permit a distinction between L H and L LH, which have been marked LH_1 and LH_2. Both categories show a ^{LH} pattern in isolation. The difference becomes clear, when the locative postposition *-ma* is added:

(6) navómá 'on the money'

mahamá 'on the chief'

Leben explains the difference by applying L-spreading only to the last category $(LH)_2$. This means that $(LH)_1$ should be marked in the lexicon with a negative rule feature [- L-spreading]. This is supported by a word count by Dwyer, who found LH_1 in 5% and LH_2 in 25% of all morphemes counted. I repeated this count under controlled conditions, counting all disyllabic nouns and verbs on every sixth page of Innes' Mende dictionary until 100 nouns and 100 verbs had been obtained. The results were the following:

(7) Count of Mende Nouns and Verbs

Tone Group	Dwyer's Count	Own Count	
		Nouns	Verbs
L L	4	19	8
L H	5	13	6
H L	10	16	9
H H	37	41	36
L HL	18	3	13
L LH	25	4	27
H LH	0	1	1
H HL	1	1	0
LH L	0	2	0

Dwyer's count (not distinguishing nouns from verbs) had L L and L H as exceptions. My count has L L and L H as verbal exceptions, but L HL and L LH as nominal ones, I cannot explain this difference (unless Dwyer happened to count more verbs), but it seems highly unlikely that the category *navó* (LH_1 with 13% of occurrences) could be treated as exceptional, while *mahá* (LH_2 with 4% of occurrences) would be normal.

Leben only talks about nouns. This seems to be a dangerous restriction. He proposes general tone rules for Mende and wants to prove that a suprasegmental treatment fits the data better than a segmental one. Alternative rules are always possible and difficult to evaluate in phonology. One should at least survey other parts of the grammar to

see if the rules can be applied elsewhere. I briefly scanned the verbal tenses to look for confirmation of the Leben rules. The tone groups of verbs are:

(8) Mende verbs

tone groups	transitive	intransitive	meaning
L L	kɔndɔ	gɔndɔ	starve
L H	kpanjá	gbanjá	reverse
H L	kɔ́i	gɔ́i	find
H H	gɛ́ɛ́	yɛ́ɛ́	break
L HL	fogbà	vogbà	whip
L LH	paá	haá	kill/die

Transitive and intransitive verbs follow different tone rules, so I had to distinguish these two (formally related) categories. The necessary tone rules can be illustrated by citing the surface forms of future (in 9) and negative imperfect (in 10):

(9) Future	transitive		intransitive
L L	ekɔndɔmaá		egɔndɔmaá
L H	ekpanjá'máá	≠	egbanjámá'á
H L	ekɔ́'ímáá		egɔ́'ímáá
H H	egɛ́ɛ́'máá	≠	eyɛ́ɛ́má'á
L HL	efogbá'máá		evogbá'máá
L LH	epaá'máá	≠	ehaamá'á

(10) Negative imperfect	transitive		intransitive
L L	ikɔndɔni		igɔndɔni
L H	ikpanjáni	≠	igbanjani
H L	ikɔ́ini		igɔ́ini
H H	igɛ́ɛ́ini	≠	iyɛini
L HL	ifogbáni		ivogbáni

L LH ípaáni ≠ ihaani

N.B. A downstep is symbolized by apostrophe before H. I am not quite sure whether a final series of H's after downstep is not rather realized as L.

A brief survey shows that the rules for nominal compounds and nouns do not work:

ekɔndɔmaá shows that the compound rule does not work here,

eyɛ́ímá'á shows that L-spreading does not work here.

H-copying seems to operate in a restricted way, over one syllable only, cf. egbanjámá'á

Lyɛini demonstrates that the H of the verbstem can be lost.

The tone rules seem to be much more complicated and less general. I assume that the verbal suffixes are found in their underlying forms after L L verbstems. Then the future suffix should be *-maá*, and the negative imperfect suffix *-ní*. One should have a rule which assimilates all L tones between a H tone in the stem and the first H in a suffix to the level of this later H. This rule follows downdrift and therefore produces downstep. This rule (L assimilation) is exemplified in

(11) e - gɔ́i - maá

e - gɔ́'í - máá

There are, however, exceptions in the intransitive verb-forms ending on a H tone. The final H of a stem seems to copy itself, but only in the intransitive. I do not accept a rule which is sensitive both to phonetic conditions (final H tone), and to grammar (intransitive stem). I should like to convert such mixed conditions into purely phonetic ones. This is possible if one accepts a floating L tone as a morpheme marking transitivity. In that case one could devise two successive rules:

a. a rule which copies the final H tone of a verb-stem onto the following tone (final-H copying),

b. a rule which assimilates L tones between a H tone of the stem and one in the suffix (L assimilation).

If the verb stem ends on H, the floating L tone in the transitive is affected by final-H copying, but in the intransitive the first L of the suffix is affected. This is illustrated in

(12) e - kpanjá - ` - maá e - gbanjá - maá

final-H copying

L assimilation

e - kpanjá -'máá e - gbanjá - má'á

The same floating low should also be found in the negative imperfect. The floating L prevents final-H copying to apply to the transitive of the future. In the negative imperfect a rule lowers all H tones immediately preceding *-ni*, except again in the transitive, where the floating L prevents H tones from preceding *-ni* immediately. So *i-yέí-ni* changes into *iyεini*, but *i-gέí-ˋ-ni* is not changed.

A completely different set of tone rules is necessary to account for the tonal shape of verb tenses. There is no evidence whatsoever for the existence of a L-spreading rule. This might force us to reanalyze the Mende material. Two preliminary conclusions can be drawn from the evidence presented here:

a. Leben's theory does not explain restrictions in the tone patterns of Mende morphemes,

b. the Mende evidence should be reanalyzed before one can determine whether a suprasegmental treatment offers other advantages.

4. *Floating Vowel Features in Mankon*

The concept of floating tones (as used in the analysis of Mende verb tenses above) has proved its value in African linguistics. If one does not wish to accept long paradigms with little or no explanatory value, to give the tonal output, one has to accept these very abstract devices. But the concept is a dangerous one, which can easily be misused. One would be glad to find a criterion to restrict its use in some way. Till now I have explained floating tones by using the diachronic concept of vowel reduction. If CVCV morphemes lose their final vowel, one often observes that the original tonal contrasts remain intact. This can only be explained if one accepts the possibility of incomplete vocalic reduction, which deletes all vocalic features except tone. Leben's theory offers a much more natural explanation. Vowel deletion changes e.g. ^{LH}CVCV into ^{LH}CVC. The deletion of a final tone support produces a floating tone. Leben might be disturbed by the deletion of a vocalic morpheme, in which case ^{LH}V changes into $^{LH}\emptyset$. But he accepts the consequences: morphemes which consist of a suprasegmental matrix only (cf. his treatment of Tiv tense-markers). Zero-morphemes with a suprasegmental matrix are less dangerous than zero-vowels with tone, because they have a meaning correlate. Leben's strongest argument can therefore be phrased in the following way: *If tone is the only vocalic feature which can lead a floating existence, there is reason to believe that it is linked to vocalic segments in a way different from other vocalic features.*

This summer I had the opportunity of working with a Western Bamileke language, Mankon. The phenomena of vowel contraction in this language may lead us to the conclusion that the feature specifying closure may also lead a floating existence. The material comes from a

student of mine, Jacqueline Warnier, who completed her studies at the Federal University of Cameroun. We shall present a full report later. Here I shall present only a general outline.

Nouns in Mankon have the structure CV(C)v, in which the last vowel /v/ is reduced, which means that its quality can be predicted entirely by rules. In isolation it is / ə / after consonants other than /?/, regardless of the preceding vowel. After /?/, or if the second consonant is absent, /v/ is /ə / if the preceding vowel is close, but identical to the preceding vowel if it is open.

Nouns are characterized by a nominal prefix indicating the nominal class, and all dependent pronouns, adjectives, verb-forms, etc. have to agree with the class of the noun. The following classes were distinguished (numbered according to the Bantu numbering system), each number followed by first the nominal prefix (NP), then the concord of 'other' (O), the associative concord (A) and the subject concord (S):

	NP	O	A	S
1	Ø, ǹ	wù	ɨ̀	à
2	bɨ̀	bǎ	bɨ́	ɨ́
3	ɨ̀,ǹ	wù	ɨ́	ɨ́
5	nɨ̀	nǎ	nɨ́	ɨ́
6	mɨ̀	mǎ	mɨ́	ɨ́
7	à	zǎ	á	á
8	ɨ̀	tsǎ	ɨ́	ɨ́
9	ǹ	zɨ̀	ɨ̀	ɨ̀
10	ǹ	tsǎ	ɨ́	ɨ́
19	fɨ̀	fǎ	fɨ́	ɨ́

Most variation is found in O, where only the concords of 8 and 10 cannot be distinguished. Classes 1, 3, 9 and 10 do not always show a distinction in NP. For A there is no distinction between classes 1 and 9 on the one hand, and between classes 3, 8 and 10 on the other. S does not show a distinction between classes 2, 3, 5, 6, 8, 10, and 19. I should mention here that the vocalic prefixes of concords A and S are always found after a noun, and this noun always ends with a reduced vowel. Sequences of vowels are contracted in Mankon. So the quality of these vocalic concords can never be heard as such.

I shall try to explain this by treating the associative construction in more detail. The associative construction consists of two nouns, separated by an associative marker which agrees with the first noun. This associative marker may have the structure CV (as e.g. in class 2 *bɨ́*), but can also be vocalic (as e.g. in class 1 *ɨ̀*). If the associative marker is

vocalic, it always contracts with the reduced final vowel of the preceding noun and the vocalic prefix of the following noun, if this noun has a vocalic prefix:

(13)

/ mɨ-soŋə + mɨ́ + bɨ-ləmə / [mɨsɔŋ mɨ́ bɨ̂ləmə] 'the teeth of the witches'

/ ɨ-fɨŋə + ɨ́ + ɨ-bərə / [ɨfɨ̂ŋ bərə] 'the locks of the idiots'

/ ɨ-fɨŋə + ɨ + a-bərə / [ɨfɨŋə́ bərə] 'the locks of the idiot'

N.B. To explain the phonetic output in (13) I must mention briefly some contraction rules. The reduced vowel /v/ is realized as /ɨ/ if preceding a consonant in the underlying representation. /ɨ/ is deleted after a nasal consonant. We have used examples with nasal consonants to maximize the difference in the effect between a [+ close] vowel (disappearing after a nasal consonant), and a [- close] vowel (resulting in the final vowel [ə] after nasal consonant).

The last two examples of (13) demonstrate that the closure of the last vowel of a series of contracted vowels decides the closure feature of the contracted vowel. This becomes even more evident in associative constructions with a zero prefix in the second noun:

(14)

/ ɨ-fɨŋə + ɨ́ + Ø-kaŋə / [ɨfɨŋ káŋə] 'the locks of the squirrel'

/ a-fɨŋə + á + Ø-kaŋə / [afɨŋə́ káŋə] 'the lock of the squirrel'

The problem is to find out how a Mankon speaker has stored his concords. Has he access to a list such as the one presented above, and if so, how did he decide about the vowel quality of the vocalic concords which never surface in the language. He has of course access to data by analogy. In the examples in (14) he may find support in analogy with the vowel quality of the nominal prefix of the first noun. This, however, will not help him if the first noun belongs to classes 1, 3, 9 and 10, where the nominal prefix is often a homorganic nasal or zero:

(15)

cl.1 [kaŋ kaŋə] 'the squirrel of the squirrel'

cl.3 [mbǎŋ káŋə] 'the nut of the squirrel'

cl.9 [ndzǎm kaŋə] 'the axe of the squirrel'

cl.10 [ndzǎm káŋə] 'the axes of the squirrel'

By applying the vowel contraction rules, we know of course that the contracted associative was [+ close] in all these cases, with L tone in classes 1 and 9, and H tone in classes 3 and 10. But which one of the three close vowels of Mankon should be chosen, /i/, /ɨ/, or /u/?

By analogy with other vocalic concords of the same classes which can surface (because they may appear phrase initially), a Mankon speaker may have some idea about the vowel quality. Class 1 however shows suppletive concords: *à-* [- close, - H] as subject concord or subject pronoun, *á-* [- close, + H] as a kind of concord preceding a class 1 object, *ɨ̀-* [+ close, - H] as associative marker, *wù-* as concord for 'other', *w-* as demonstrative concord, etc. The only things a Mankon speaker has to know are the features [tone] and [close] of the vocalic concords which never surface, so it may as well be that he stores these concords as underspecified vowels, as e.g. [+ close], without making any decision about the features [back] or [anterior], because they are irrelevant in his grammar. Thus the Associative concord for classes 1, 3, 7, 9, 10 should be represented not as the vowels /ɨ́/, /ɨ̀/ or /á/, but simply as the underspecified feature bundles [+ close, + H], [+ close, -H], and [- close, + H] respectively. I would therefore like to consider the possibility of accepting underspecified (or reduced) vowels which have preserved only the features [close] and [tone] in the underlying representation. If this is true, the feature [tone] is not the only 'floating' feature.

FOOTNOTE

* I am much obliged to my colleague, Mr. T.L. Cook, for correcting the English and for giving me the benefit of his critical reading at the same time.

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