Issues in African language phonology

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1. Introduction

In this section I discuss some of the major phonological properties of African languages that are of particular significance for general linguistics. The historical relation between African and general phonology has been a mutually beneficial one: the languages of the African continent provide some of the most interesting and, at times, unusual phonological phenomena, which have contributed to the development of phonology in quite central ways. This has been made possible by the careful descriptive work that has been done on African languages, by linguists and non-linguistics, and by Africanists and non-Africans who have peeked in from time to time. Except for the click consonants of the Khoisan languages (which spill over into some neighboring Bantu languages that have "borrowed" them), the phonological phenomena found in African languages are usually duplicated elsewhere on the globe, though not always in as concentrated a fashion. The vast majority of African languages are tonal, and many also have vowel harmony (especially the types known as ATR- and vowel-height harmony). Not surprisingly, then, African languages have figured disproportionately in theoretical treatments of these two phenomena. On the other hand, if there is a phonological property where African languages are underrepresented, it would have to be stress systems—which rarely, if ever, achieve the complexity found in other (mostly non-tonal) languages. However, it should be noted that African languages have contributed significantly to virtually every other aspect of general phonology.

Given the considerable diversity of the properties found in different parts of the continent, as well as in different genetic groups or areas, it will not be possible to provide a comprehensive account of the phonological phenomena found in African languages, overviews of which are available in such works as Creissels (1994) and Clements (2000). Most recently, Clements & Rialland (2008) treat African phonology from an areal perspective. Drawing from a database of 150 African languages, they address a range of phonological properties which have significant African distributions as compared with a non-African database of 345 languages. They begin with three consonant types which are characteristic of languages within their "Sudanic belt", a vast area which stretches from Senegal in the West, "bounded roughly by the Sahel to the north and the equatorial rain forest to the south" (p.38):

(i) Labial flaps are found "in at least seventy African languages, heavily concentrated in the center of the Sudanic belt in an area encompassing northern Cameroon, the Central African Republic (CAR), and adjoining parts of Nigeria, Chad, Sudan, and the Democratic Republic of the Congo (DRC)" (p.41).

(ii) The labiovelar stops /kp/ and /gb/ which have 54 attestations each, followed by /Ngb/ (13) and /ŋm/ (7).

(iii) Implosives, especially /ɓ/ and /ɗ/, which in this area "are about twelves times commoner than elsewhere in the world" (p.55).

Among other consonants, languages of Clements & Rialland's South area attest ejectives and aspirated (and murmured) consonants more than languages outside Africa, and phonemic exploitation of click consonants is found virtually only in this part of the world. A negative consonant property is that African languages are much more likely to lack the phoneme /p/ than languages outside Africa: 21.3% of their 150 African languages vs. 8.1% of the 345 non-African languages.

Clements & Rialland also demonstrate that African languages exploit certain vowel features more than other languages: (i) 34% of the languages in the Sudanic belt and 26.7% of the 150 African languages within their database contrast nasalized and oral vowels vs. 21.2% of the 345 non-African languages. (ii) 28% of the Sudanic languages contrast two degrees of high vowels, often transcribed /i, u/ vs. /ɪ, ʊ/, vs. only 2% of the languages outside Africa. Both these languages, as well as those which instead or additionally contrast /e, o/ vs. /ɛ, ɔ/, are also more likely to exhibit what either Advanced Tongue Root (ATR) or vowel height harmony than languages outside Africa.

Finally, African languages have also figured prominently in the area of tone. The vast majority of Sub-Saharan African languages are tonal, often involving multiple heights of up to five contrasting pitch levels and multiple combinations or contours. Africa has provided the textbook cases of tonal melodies, floating tones, and tonal morphophonemics at both the word and phrase levels. While African languages provide some of the greatest tonal complexities found anywhere, some languages which contrast /H/ vs. /Ø/ have the kind of restricted tone system that some refer to as pitch- or tonal accent.

Rather than surveying all of the above (and perhaps other) phonological properties of African languages, I will focus in this chapter on the following issues which have been important both to Africanists and to phonologists in general: 1) tone; 2) vowel harmony; 3) nasals and nasalization; 4) labial and palatal prosodies; 5) slots and moras; 6) reduplication; 7) the syntax-phonology interface. Since African tone is particularly widespread and has had the most impact on general linguistics, it will be discussed in somewhat greater detail than the other six issues. The concluding section argues for a comparative approach to theoretical, descriptive, and historical work in Africa as a strategy for addressing the most important issues which are yet to be resolved.[1]

2. Tone

Of all of the phonological properties to be discussed, Africa has contributed the most to our understanding of tone. Drawing disproportionately from African tone systems, Leben (1973), Goldsmith (1976), Williams (1976), and others showed up the inadequacies of classical (segmental) generative phonology, as encoded in Chomsky & Halle (1968), henceforth *SPE*. The resulting autosegmental "revolution" then spread from tone to other aspects of phonology.[2] The dominant view within structuralist and early generative phonology was that

[1] Sections 2-8 represent a slight revision of Hyman (2003a).

[2] In fact, Goldsmith's tier metaphor, based originally on African tone, also spread from phonology to morphology, and ultimately to syntax and semantics, e.g. Sadock (1991), Yip et al (1987), etc.

phonological strings could be subdivided into a succession of discrete segments. Each segment, in turn, consisted of a matrix of simultaneous "distinctive features", generally claimed to be binary, in the Jakobson-Halle tradition. These features had both a classificatory and phonetic function, being designed to capture the phonological oppositions found in languages as well as their output realizations. While not yet receiving very much attention, the assumption in the 1960s was that tone could be characterized with additional features on vowels, as in (1).

(1) Segmental representation of H and HL falling tone

a. [á] = $\begin{bmatrix} +\text{syll} \\ -\text{cons} \\ -\text{high} \\ +\text{low} \\ +\text{back} \\ -\text{round} \\ +\text{HIGH} \end{bmatrix}$ b. [â] = $\begin{bmatrix} +\text{syll} \\ -\text{cons} \\ -\text{high} \\ +\text{low} \\ +\text{back} \\ -\text{round} \\ +\text{FALLING} \end{bmatrix}$

In feature systems such as Wang (1967), based largely on Chinese dialects, high (H) tone could be indicated as [+HIGH], as in (1a), while a high-to-low (HL) falling tone would be [+FALLING], as in (1b). Pike (1948) had split tone systems into what we can refer to as a Chinese- vs. African-type: Whereas Chinese dialects have an abundance of contour tones, which Sinologists viewed as indivisible units, contours seem quite secondary in African tone languages, where they were typically viewed as combinations of the level tones independently attested in the respective language.

Tonal representations such as the above were shown to run into a number of problems. In many African languages, a falling tone such as in (1b) shows "edge effects": It appears to be a H tone from the point of view of what precedes it, but a L tone from the point of view of what follows. Thus, if a L is raised to a mid (M) tone before a H tone, we expect also that it will be raised before a HL falling tone. The feature specification [+FALLING] does not capture this fact, and any attempt to represent the fall as a sequencing of [+HIGH][-HIGH] squeezed into a single matrix below the segmental features would be incoherent in a formal framework which otherwise views segments (here, vowels) as a single vertical array of distinctive features.

In establishing autosegmental phonology, Goldsmith's (1976) proposal was that an /a/ with high- or falling-tone should be represented roughly as in (2).

(2) Autosegmental representation of H and HL falling tone

a. [á] = $\begin{bmatrix} +\text{syll} \\ -\text{cons} \\ -\text{high} \\ +\text{low} \\ +\text{back} \\ -\text{round} \end{bmatrix}$ H b. [â] = $\begin{bmatrix} +\text{syll} \\ -\text{cons} \\ -\text{high} \\ +\text{low} \\ +\text{back} \\ -\text{round} \end{bmatrix}$ H L

As seen, Goldsmith proposed a distinction between a segmental tier vs. a tonal tier, which are semi-autonomous in the sense that they are separate, but linked by association lines. Among the familiar arguments for a two-tier representation are the three listed in (3).

(3) Three arguments for two tiers (segmental vs. tonal):

a. *non-isomorphism:* features of one tier do not line up/synchronize with features of the other tier, i.e. overlapping of segmental vs. tonal features

b. *stability:* features of one tier may be deleted without affecting (deleting) features of the other tier

c. *zero representation:* features may be specified on one tier but partially/totally lacking on the other tier

By non-isomorphism is meant that associations of tones to tone-bearing units (TBUs) are often not one-to-one. Two tones may link to a single TBU, as in (2b). In addition, a single tone may link to two TBUs. As a result, a potential contrast may arise as in (4a) in the Bantu language Kukuya (Paulian 1975, Hyman 1987):

(4) a. Medial

má-bá	wátá
| |	\ /
H H	H

b. Prepausal

má-bā	wātā
| |	\ /
H M	M

Both *má-bá* 'they are oil palms' and *wátá* 'bell' are pronounced H-H in medial position. Before pause, however, there is a rule that lowers a H to M. As seen in (4b), the H → M rule affects the last H feature, not just the last TBU. The contrasting representations in (4a), which had no equivalent in pre-autosegmental tonology, provide the structural difference that results in the surface opposition of H-M vs. M-M before pause. These and other facts from Kukuya showed that at least in some cases we must be able to talk about tones in terms of abstract melodies, rather than concrete features on syllables, moras, or vowels.[3] The formal recognition of tonal melodies inspired analogous non-linear analyses of Semitic templatic morphology (McCarthy 1981) and partial reduplication (Marantz's 1982).

The argument for a tonal tier is what is known as stability effects: a tone may survive even when its TBU is deleted, as the following dialectal realizations of /mé + ɔ̀bó/ 'my stone' in Twi (Stewart 1965, Schachter & Fromkin 1968):

(5) a.

/me ɔbo/	→	me bo	→	me bo	[mê bó]
| | |		| |		|⋱ |	
H L H		H L H		H L H	

b.

/me ɔbo/	→	me bo	[mé ↓bó]
| | |		| |	

[3]Rather than viewing tone as a segmental property, Paulian (1975) recognizes five "schèmes tonals" (tonal melodies) in Kukuya which can be predictably mapped onto stems of different lengths: L, H, LH, HL, LHL. Leben (1973) had proposed exactly the same for Mende, although not without complications and challenges (Leben 1978, Dwyer 1978, Conteh et al 1983).

H L H H L H

As seen in the first step of the derivation, when the vowel of the noun prefix /ɔ-/ is deleted, its L appears unlinked on its tier. In (5a) it reassociates to the preceding vowel, creating a HL falling tone. In (5b) it remains unlinked and conditions a following downstep (↓). As Clements & Ford (1979) originally demonstrated from Kikuyu, downstep most canonically occurs when an associated L tone is wedged between two linked H tones as in the output of (5b).

The third argument for autosegmental tiers is the possibility of a zero representation on one or the other tier. On the one hand, there are toneless morphemes such as the postpositions *-hu* 'in' and *-ma* 'on' (Leben 1978), which are unspecified on the tonal tier. On the other hand, there are tonal morphemes such as the H associative tone of Igbo, which are unspecified on the segmental tier: /àgbà + ´+ èŋwè/ → *àgbá èŋwè* 'jaw of monkey'. While there had been early descriptions of tonal morphemes, studies in the 1970s showed that floating tones could also be lexical. A particularly persuasive case comes from Aghem (Grassfields Bantu). Although the two nouns *kɨ́-fú* 'rat' and *kɨ́-wó* 'hand' are both pronounced H-H in isolation, the phrases in (6) show that they exhibit quite different tonal behaviors in the following contexts (where the the noun class prefix kɨ́- deletes in the presence of the following modifiers):

(6) Floating lexical tone, e.g. Aghem /-fú/ 'rat' vs. /-wó`/ 'hand'

a.	fú kɨ́à	'your (sg.) rat'		fú kɨ́n	'this rat'
	H L			H H	
b.	wó kɨ̀à	'your (sg.) hand'		wó ↓kɨ́n	'this hand'
	H L L			H L H	

In the forms on the left, each noun is followed by the L tone second person singular possessive pronoun /kìà/. As seen in (6a), the H of *-fú* 'rat' spreads onto the pronoun to derive a HL falling tone realization. H tone spreading does not occur after *-wó* 'hand' in (6b). The reason is that the root /-wó `/ carries a lexical floating L tone which is absent on the root /-fú/. That the floating tone is not simply an ad hoc device put in for the sole purpose of blocking H tone spreading is seen from the forms on the right, where each root is followed by the H demonstrative /kɨ́n/ 'this'. As seen, the floating L tone conditions a downstep on the demonstrative in (6b), but not in (6a), where the floating L tone is absent. In other words, the posited "abstract" floating L tone does exactly what we expect a L tone to do: (i) block a H from spreading onto a following L; (ii) condition a downstep when wedged between H tones. As discussed in some detail in Hyman (2003a), the floating tone hypothesis provides an analytic framework that both accounts for the observed facts as well as accounting in a direct way for the insight that roots such as /-wó `/ act "as if" they have a L tone following them. In contrast, a diacritic approach which might set up the arbitrary tone classes H_1 vs. H_2 for 'rat' and 'hand', respectively, are not only uninteresting, but make the prediction that the properties could have aligned in an unattested way, e.g. with H_1 triggering both H tone spreading AND downstep and H_2 conditioning neither.

The above and other arguments thereby justify the basic premise of autosegmental tonology stated in (7).

(7) Tones (T's) must be represented as semi-autonomous from the tone-bearing units (TBUs) on which they are realized

In fact, the conceptualization of tone as "semi-autonomous" from other vowel features was the traditional view which pre-autosegmental phonologists were hard-put to formalize. Consider, for example, the question of how the H tone spreading in (6a) should be represented. In pre-autosegmental phonology, Hyman & Schuh (1974) expressed such a rule roughly as in (8a).

(8) a. H-L → H-H͡L

b. V C V
| ⋯⋯ |
H L

Goldsmith's (1976) autosegmental representation, on the other hand, is shown in (8b). Whereas Goldsmith's representation clearly indicates that there is a single H feature involved in tone spreading, Hyman & Schuh's formulation implies that a H feature is being copied onto the following vowel as in the *SPE* conception of assimilation.[4] However, consider Hyman & Schuh's (1974) prose statement about what they feel is going on:

> "Spreading is an assimilatory process of the progressive or perseverative type, rather than of the regressive or anticipatory type. That is, the earlier tone appears to last too long, rather than the later tone starting too early. This in fact is the way that we should like to view this phenomenon. There is no process of tone copying or tone addition in the second syllable. Rather, the earlier tone simply enlarges its domain." (p.88)

Clearly Hyman & Schuh had something in mind that they could not formalize, but which is conceptually identical to the autosegmental representation of tone spreading in (8b).

As a second example, consider Leben's (1973) proposal that tone is suprasegmental in Mende. Rather than being a property of (syllabic) segments, both Leben and Goldsmith developed models in which Mende words of varying sizes could be characterized in terms of five tonal melodies: L, H, LH, HL, LHL. In note 3 I mentioned Paulian's (1975) independent and converging research on Kukuya, in which stems of one, two or three syllables clearly are restricted to one of these same tonal melodies. However, one can go back at least as far as Welmers (1962) to find the same insight, this time concerning Kpelle, a Southwest Mande language closely related to Mende: "tonemes must be analyzed in terms of segments between two open transitions" (p.85). Welmers describes "the five types of forms" in Kpelle as follows (presented with his transcriptions):

[4]Actually, Hyman & Schuh's formulations are even worse, since they use F and R instead of H͡L and L͡H. Their formulation /ábà/ → [ábâ] is at best ambiguous between the two interpretations. It should be clear, however, that marking tone via accents on vowels cannot distinguish between the two types of Kukuya H-H words in (4).

(9) Five tonal melodies of Kpelle (Welmers 1962:86)

a. High throughout

pá	'come'	ɓóa	'knife'
láa	'lie down'	píli	'jump'

b. Mid throughout

kpɔŋ	'help'	sua	'animal'
see	'sit down'	kali	'snake'

c. High followed by low (low begins on the next vowel if there is one)

yɛ̂	'for you'	tôa	'pygmy antelope'
kpôŋ	'door'	kâli	'hoe'

d. Mid with first vowel, then high followed by low

tɛɛ̂	'black duiker'	konâ	'mortar'
yuɔ̂	'axe'	kpanâŋ	'village'

a. Low throughout

kpòo	'padlock'	kpàki	'loom'
tɔ̀nɔ	'chisel'	tòloŋ	'dove'

Note, first, that Welmers uses only one tone mark per word. He thus writes /kâli/ for what is pronounced [kálì] 'hoe', i.e. H-L. Second, there is no difficulty reducing Kpelle to an underlying two-level system: The M that occurs in the MHL melody in (9d) can be analyzed as a L which is raised before H, and the "M throughout" melody in (9b) is underlyingly /L-H/, as is seen when two "Mid throughout" words occur in sequence:

> "In mid-mid, for the dialect being described here, the first mid has a slightly rising allotone.... In some areas, the first mid is level, but the second mid begins a little higher and drops quickly to the level of the first. In still other areas, both phenomena occur: the first mid ends a little higher, and the second begins a little higher. In all cases, the conjunction of two mids is accompanied by an upward pressure." (p.87, note 2)

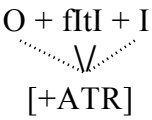
Welmers goes to considerable trouble to justify his suprasegmental analysis, with one tonal melody per word, or, in his terminology "one toneme between two open transitions" (p.86). What is clear is that he had the same insight as Leben, Goldsmith, and Paulian concerning the semi-autonomy of the five tonal patterns. Like Hyman & Schuh, he did not have an adequate framework such as autosegmental phonology to express this insight.

It would be interesting to speculate on the form the subsequent autosegmental revolution might have taken without the impetus of African tone. Would present-day phonologists be talking as readily about autosegmentalized H(igh) and L(ow) features for Chinese tonal contours if it were not for the input from Hausa, Igbo and Mende? Would Pierrehumbert (1980) and subsequent scholars have developed an analogous approach to intonational systems such as in English? And what would our view be of other phonological phenomena to be discussed below, which also have autosegmental properties?

3. Vowel harmony

After tone, African languages are well known for providing vast numbers of phonological systems with vowel harmony (VH), particularly of the advanced tongue root (ATR) variety. Stewart (1967), cited in *SPE*, and Schachter and Fromkin (1968) educated early generations of generative phonologists as to the intricacies of Akan (Kwa) ATR harmony. However, it was Clements (1977a, 1981) who applied the new autosegmental framework both to Akan and to VH in general. Although the existence of transparent neutral vowels had been known from Finnish and Hungarian, Clements provided an autosegmental account of opaque neutral vowels, based on Akan. Since this language has both prefixal and suffixal harmony, as seen in (10), he also was able to establish the general property of "root-control":

(10) ATR harmony in Akan



[o-fiti-i] 'he punctured (it)'

For Clements this meant that the directionality of assimilation in VH need not be stipulated, but rather followed from convention: the root features [+ATR] and [-ATR] spread left and/or right, as needed, so that no vowel would lack a specification and, hence, be ill-formed. For some theorists, root-control is a necessary, definitional property of VH systems. In this case, vowel alternations which are referred to as metaphony, umlaut, or stem ablaut, and which are often triggered by suffixes, would not be identified as VH.

Since Clements, Niger-Congo and Nilo-Saharan ATR harmony systems have figured prominently in the theoretical study of VH. At the same time, they have contributed to theories of vowel features and feature geometry. Government- or dependency-theories involving the vowel elements {i}, {u}, {a} are developed by Kaye, Lowenstamm & Vergnaud (1985) and Rennison (1986) based on Kpokolo (Kru) and Koromfe (Gur), respectively. African ATR systems also provide the fuel for Archangeli & Pulleyblank's (1994) grounded phonology and a number of subsequent optimality theoretic works, including Bakovic (2000) and Krämer (2003). For extensive documentation and typological generalizations concerning such African vowel harmony systems, see Casali (2003).

As in the case of tone, African ATR harmony has not only contributed to linguistic theory, but also to the way VH is described in other languages. Hall & Hall (1980), for example, are explicit in applying their Africanist insights to Nez Perce, whose unusual harmony, they suggest, should be analyzed in terms of ATR. There are striking resemblances between the VH found in the Pacific Northwest and that found on much of the Asian land mass. It is thus not surprising that ATR/RTR has also been recognized in Tungusic languages (Li 1996, Zhang 1996), and may very well be implicated in languages extending from Tibetan to Chukchee.

While African languages have provided the model for VH based on ATR, or its retracted counterpart, RTR, they also provide the world's greatest supply of VH systems based on tongue height (F1). Best known are those found in Bantu, exemplified below from Luganda:

(11) Height harmony in Luganda

	plain stem	stem + causative	stem + applicative	
a.	lim-a	lim-is-a	lim-ir-a	'cultivate'
	túm-a	túm-is-a	túm-ir-a	'send'
	land-a	land-is-a	land-ir-a	'climb'
b.	sek-a	sek-es-a	sek-er-a	'laugh'
	kól-a	kól-es-a	kól-es-a	'work'

As seen, the causative and applicative suffixes surface with the vowel [i] when preceded by /i, u, a/, but with [e] when preceded by /e/ or /o/. Sometimes called "mid harmony", variants of height harmony are found in most Bantu languages (Hyman 1999). The relation to ATR has not been missed by Africanists or theoreticians such as Clements (1991), who provides a geometric model of vowel aperture designed to capture both types of VH.[5] Finally, within optimality theory, Beckman's (1997) notion of positional faithfulness is based on Shona height harmony, which has the same properties as in Luganda, Swahili, Chichewa, Cibemba, and so forth.

4. Nasals and nasalization

African languages have contributed to our understanding of nasals and nasalization in several ways. Nasality is of course another feature that often takes on suprasegmental or prosodic character. A large number of West African languages have nasalized vowels, and in many of these nasal consonants are in total or near complementary distribution with voiced oral counterparts. Thus, quite early in generative phonology, Schachter & Fromkin (1968) had proposed derivations such as following for their dialects of Akan:

(12) No underlying nasal consonants in Akan

a.	/bã/	→	[mã]	'give'
b.	/dã/	→	[nã]	'and'
c.	/yã/	→	[ỹã]	'receive'
d.	/wãdĩ/	→	[w̃ãnĩ]	'scrape'
e.	/hũ/	→	[h̃ũ]	'fear'

Rather than representing nasality on vowels, where it is contrastive, they also could quite easily have abstracted the feature away as a prosody, [+NAS], in keeping with the Firthian tradition. This was subsequently proposed by Leben (1973) for Terena and Goldsmith (1976) for Guarani, two Amazonian languages, and by Hyman (1982) for the Lower Cross language, Gokana. For recent work on African systems which lack a nasal contrast on consonants, see Clements & Osu (2003, 2005). [6]

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[5]Other views of aperture and its relation to other vowel features also draw heavily from African languages, e.g. Hyman (1988), Odden (1991). See also Pulleyblank (1988) for an important contribution to vowel underspecification, based on Yoruba.

[6]A further area of nasality of theoretical significance concerns the treatment of long-distant nasal consonant harmony, e.g. Yaka /miituk-idi/ → [miituk-ini] 'pout + perfective', found also

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5. Labial and palatal prosodies

Another feature which received early attention in autosegmental phonology was palatalization. Once again Clements (1977b) was there drawing from African examples: Chimwiini (Bantu), Fe'fe'-Bamileke (Grassfields Bantu), Ewe (Kwa). The real African contribution, however, occurred a few years later, when McCarthy (1983) introduced Afro-Asiatic prosodies into current phonology. Autosegmentalists had become accustomed to tonal morphemes, but had not yet appreciated the type of labial and palatal morphemes found in Chaha (Ethiopian Semitic):

(13) Perfective 3 m. sg. in Chaha

	Without object	With 3 m.sg. object	
a.	dænæg	dænæg^{w}	'hit'
	nædæf	nædæf^{w}	'sting'
	nækæb	nækæb^{w}	'find'
b.	s^{y}æfær	s^{y}æf^{w}ær	'cover'
	nækæs	næk^{w}æs	'bite'
	kæfæt	kæf^{w}æt	'open'
c.	qæṭær	q^{w}æṭ ær	'kill'
	mæsær	m^{w}æsær	'seem'
	mæk^{y}ær	m^{w}æk^{y}ær	'burn'

As seen, the third person masculine singular object is marked by a labialization feature which links to the right-most labializable consonant—which means a non-coronal. Although this phenomenon is known mostly from Ethiopian Semitic, there are comparable cases found in Chadic languages as well as templatic phenomena reminiscent of Arabic.[7]

6. Slots and moras

In the early 1980s, African languages provided important contributions to the development both of skeletal (CV) and moraic phonology. A good case in point is Luganda compensatory lengthening, by which sequences such as /Cia/ and /Cua/ are realized [Cya:] and [Cwa:], respectfully. Clements' (1986) insight was that the high vowel reassociates to the preceding C slot, delinking from its V slot, which is in turn filled by spreading of the following vowel, as in (14).

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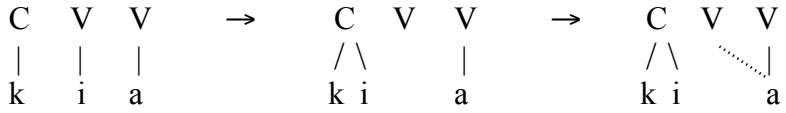
in Kikongo and other Western Bantu languages (Ao 1991, Hyman 1995, Piggott 1996, Rose & Walker 2003, Walker 2000, Hansson 2001).

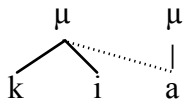
[7]For further theoretical work on "featural affixes" involving African languages see especially Akinlabi (1996), Zoll (1998), and Ettlinger (to appear). For evidence of templaticity in Somali, a Cushitic language, see Barillot (2002).

(14) CV account of Luganda compensatory lengthening



In the moraic account (Hyman 1985), the /a/ spreads right to left onto the first mora:

(15) Moraic account of Luganda compensatory lengthening



Clements also considers the lengthening of a vowel before a NC sequence, e.g. /genda/ → [ge:nda] 'go!'. This time, if the nasal leaves its V to join the following C slot, the preceding vowel can lengthen to take its place. Numerous Bantuists have worked on the problem of NC clusters (see Downing 2005 for a recent statement and references).[8] Finally, most of the arguments in favor of moras developed in Hyman (1985) were based on African languages, particularly Gokana (Lower Cross), where there is no evidence for syllable structure above the moras.[9]

7. Reduplication

The vast majority of African languages belong to the Niger-Congo family, and virtually all of these exploit partial reduplication as a morphological process. In West African languages such as Akan (Kwa) (Schachter & Fromkin 1968), the reduplicant consists of a CV copy of the base verb, except that the vowel must be [+high]. I cite examples from Nupe in (14).

(16) CV reduplication in Nupe

a.	/gí/	'eat'	→	gi-gí	'eating'
	/ge/	'be good'	→	gi-ge	'goodness'
	/gà/	'separate'	→	gi-gà	'separating'
b.	/gú/	'puncture'	→	gu-gú	'puncturing'

[8]On a related nasal front, African languages figured prominently in Herbert's (1986) work on prenasalization and N+C sequencing. Many if not most African languages allow NC segments or clusters of some type, and it is not surprising to see African cases contributing to their analysis: Are they one or two segments? If one, what is their feature geometry? If two, is the nasal moraic or not?

[9]One of the major successes of a "slot" approach to segmental length was its ability to characterize geminates and their "inalterabilty". Among the major examples were two Afroasiatic languages: Hausa (Chadic) (Hayes 1986) and Tigrinya (Ethiopian Semitic) (Schein & Steriade 1986, Kenstowicz 1982). Readers will also be familiar with the contribution of another Afro-Asiatic language, Imdlawn Tashlhiyt (Berber), to the study of syllabification, particularly of consonantal nuclei (Dell & Elmedlaoui 1985, 1988), which provided one of the centerpieces in the development of optimality theory (Prince & Smolensky 1993).

/gò/ 'receive' → gu-gò 'receiving'

The Nupe data comes up in the context of an argument in favor of abstract phonological representations (Hyman 1970), whereas corresponding Akan forms are cited both by Wilbur (1974) and Marantz (1982) for their "overapplication" property. Again, this can be illustrated from Nupe, where underlying /ts, dz, s, z/ are palatalized to [č, ǰ, š, ž] before front vowels. The issue is that a verb like /tsà/ 'choose' reduplicates as *tsi-tsà*, not as **či-tsà*. The above-cited authors revert to rule ordering (palatalization precedes reduplication), whereas others have used this kind of African data to argue for a global "identity constraint" (Wilbur 1974), which is easily implemented as a base-reduplicant identity correspondence within optimality theory (McCarthy & Prince 1999).

While the above gives some idea of how West African CV reduplication has contributed to phonology, Bantu CVCV verb stem-reduplication has also contributed to the development of prosodic morphology. The verb stem is a constituent consisting of a root plus one or more suffixes. In a number of Bantu languages, but not all, the preposed reduplicant may or must be exactly two syllables in length. Thus, in Kinande, tU@m-Ir-an-a 'send to each other' (root-applicative-reciprocal-final vowel) obligatorily reduplicates as tU@m-a + tUm-Ir-an-a 'send to each other here and there' (Mutaka & Hyman 1990). Interestingly, sw-a 'grind' reduplicates as *sw-a-sw-a + swa* 'grind here and there', where the bisyllabic reduplicant, created by double reduplication, is actually longer than the base verb stem. Odden (1996) shows that in Kerewe there is some choice in how long the reduplicant can be. Hence, *lim-il-an-a* 'cultivate for each other' (applicative *-il-*, reciprical *-an-*) may reduplicate as *lim-il-an-a.lim-il-an-a*, l*im-il-a.lim-il-an-a*, or *lim-a.lim-il-an-a*. The comparisions in (15), which show how Proto-Bantu **gu-a* 'fall' and **dim-ɪd-a* 'cultivate for/at' are reduplicated in three different Bantu languages, reveal that bisyllabicity can be imposed as a minimum (Sukuma), maximum (Kinyarwanda) or exact (Ndebele) requirement on the reduplicant:

(17)	(i) RED ≥ σ-σ	(ii) RED ≤ σ-σ	(iii) RED = σ-σ
	e.g. Sukuma	e.g. Kinyarwanda	e.g. Ndebele
	gw-a-gw-a + gw-a	gw-aa + gw-aan-a	w-a-yi + w-a
	lɪm-ɪl-a + lɪm-ɪl-a	rim-aa + rim-ir-a	lim-a + lim-el-a
	(Matondo 2003)	(Fidèle Mpiranya, p.c.)	(Hyman, Inkelas & Sibanda 1998

As seen, Sukuma double reduplicates a monosyllabic stem, like Kinande, while Kinyarwanda accepts a monosyllabic reduplicant, but appears to augment the base from *gw-a* to *gw-aan-a* to provide an extra syllable. Ndebele inserts a dummy syllable [yi] to fill out the bisyllabic template. While the applicative suffix -ɪl- is obligatorily truncated in both Kinyarwanda and Ndebele, it optionally appears in Sukuma, which has no upper limit on the size of the reduplicant, there is no upper limit on the size of RED in Sukuma, e.g. *leembeel-el-nij-iw-a + leembeel-el-nij-iw-a* ('be calm' + APPLICATIVE + SIMULTANEOUS + PASSIVE). However, when a verb stem contains only one productive suffix, it may optionally be truncated, e.g. *lɪm-ɪl-a + lɪm-ɪl-a ~ lɪm-a + lɪm-ɪl-a* 'cultivate for here & there' (Matondo 2003:129-130, 154).

The apparent truncation observed in reduplicated forms such as Kinande *lɪm-a + lɪm-ɪl-a* and *túm-a + tum-ir-an-a* have also raised interesting morphological questions. Downing (1999ab, 2000) sees the final *-a* as an indicator that the reduplicant is a morphological

constituent, while Hyman, Inkelas & Sibanda (1998) present evidence from Ndebele that the reduplicant is obtained by morphosyntactic doubling, but is subject to additional prosodic restrictions (cf. Inkelas & Zoll 2005)

8. Syntax-phonology interface

The preceding subsection indicates the importance of African languages in the study of the morphology-phonology interface.[10] From early generative phonology to the present, African languages have also been central in the study of the syntax-phonology interface. Among the earliest and most informative documentations of this interaction are Kisseberth & Abasheikh's (1974) treatment of syntactically conditioned vowel length alternations in Chimwiini and Clement's (1978) analysis of syntactically conditioned tonal alternations in Ewe. Studies such as these informed Chen's (1987) approach to Xiamen tone sandhi, from which Selkirk (1986) generalized her end-based theory of derived domains, based largely on Chimwiini. Several of the contributions in *Phonology Yearbook* 4 (1987) and Inkelas & Zec (1990) deal with the syntax-phonology interface in African languages. Both Kaisse (1985) and Hayes (1987) cite earlier manuscript versions of Odden (1987) on the phrasal phonology of Kimatuumbi to support their views on this interface. Subsequent work by Kanerva (1990ab), Truckenbrodt (1995, 1999), Serbian (2007), Downing (2008), and others have provided important advances in our understanding interactions between phonological phrasing, syntactic representation, and focus based on Bantu languages such as Chichewa, Chimwiini, Kimatuumbi, Chitumbuka, Northern Sotho and Zulu.

This completes my brief survey of phonological issues to which African languages have contributed in a significant way. There are doubtless others, and perhaps some phonologists or Africanists will take issue with the choice of issues or specific omissions. As stated in the outset, it is hard to cover the diverse phonological properties of African languages in a short article.[11] From the sampling just seen, it is safe to say that African languages have been prominent in almost all of the major phonological developments over the past half century, with the notable exception of metrical stress theory.

9. Outstanding issues and strategies for future research

In the preceding sections I have outlined some of the major phonological properties of African languages, most which have had some impact on general linguistics and are well-known. The questions I would like to consider in this final section are: (i) What is the state of our understanding of these issues? (ii) How should students of African phonology proceed from here? The easy answer to (ii) might be "continue as our predecessors have done", but which predecessors? While African phonology has definitely benefitted from its alliance with general linguistics, in this final section I would like to emphasize the Africanist side of the equation: The extraordinary progress on the issues raised in sections 2-8 were only possible because of

[10]See also Pulleyblank (1986) for extensive treatment of Africantone within the framework of lexical morphology and phonology and Myers (1987) for original contributions on integrating morphology, phonology and syntax, based on Shona.

[11]For a recent survey of the phonology of African languages, see Clements (2000); for a monograph-length treatment, see Creissels (1994).

the careful and brilliant work undertaken by scholars deeply committed to Africa. Students of my generation had the benefit of learning first-hand from such greats as Joseph Greenberg, A.E. Meeussen, John Stewart, William Welmers, and Kay Williamson, who shaped our field. Whether describing, reconstructing, classifying, or formalizing, such scholars were concerned with what African languages tell us about language and languages in general. Perhaps this has been the strength of African linguistics, but how should we proceed in addressing issues such as those in sections 2-8? I suggest that we try to follow in their footsteps.

While deep descriptive work is still lacking for many (most?) of the 2,000 languages of Africa, my proposal for making progress at this point is to focus inward on Africa and address the African phonological phenomena from an historical and comparative perspective. While we have a basic understanding of the issues in African phonology, the field is still shrouded in mystery once we adopt a diachronic perspective. Questions such as the following have yet to be answered:

(i) Where does tone come from in Niger-Congo, Nilo-Saharan, and Khoisan? How did languages of the Chadic, Omotic, and Cushitic branches of non-tonal Proto-Afro-Asiatic develop their tonal systems?

(ii) Where does ATR vowel harmony come from in Niger-Congo and Nilo-Saharan? While cases of ATR harmony spreading through contact are suspects (e.g. from Central Sudanic to neighboring Bantu languages such as Kinande), we don't fully understand how it originates. Does it have a monogenesis or has it developed separately in different places on the continent? Correlating with the high concentration of ATR systems is the fact that a number of African languages including Kpelle (Mande), Jomang (Kordofanian) and Kukuya (Bantu) contrast two degrees of high vowels /i, u/ vs. /ɪ, ʊ/ without having a corresponding contrast of /e, o/ vs. /ɛ, ɔ/. Since such a vowel system is highly unusual outside Africa, the natural question that should be addressed is where such systems come from. There is a likely relationship between their development and that of ATR harmony systems, which would account for why both are so much more prevalent in Africa than elsewhere.

(iii) How do labial and palatal prosodies arise, as was seen in Chaha in (13) (McCarthy 1983, Rose 1994)? Such prosodies occur elsewhere in Africa, e.g. in the Chadic language Mafa (Barreteau and le Bleis 1987, 1990; Ettlinger 2004):

(18)	Stem	Imperfective /^{y}/	Perfective /^{w}/	Gloss
a.	tə́v	tív	túv	'scale'
	ngəh	ngih	nguh^{w}	'hide'
	kərɗ	kirɗ	kurɗ	'grind'
b.	pán	pén	pón	'wash'
	saf	šef	sof	'breathe'
	zám	žém	zóm	'spit out'
	tsák	čék	tsók	'take a little'
	ndzáv	ǹjév	ndzóv	'raise'
c.	ndzá	ndzáy	ndzáw	'stay'
	ndá	ndáy	ndáw	'eat'
	gudza	gudzay	gudzaw	'tremble'
	sa	sáy	sáw	'drink'

As seen in (18a,b), when the root ends in a consonant, the imperfective and perfective aspects are marked by labial vs. palatal prosodies, respectively. It thus is possible to analyze the two aspectual realizations of /pán/ 'wash' as /pán/^{y} [pén] and /pán/^{w} [pón]. The assumption is that these prosodies must have come from earlier suffixes which have become fused into the roots. Evidence for this comes from verbs ending in /a/, which, as seen in (18c), mark their imperfective and perfect by adding *-y* and *-w*, respectively. The same "fusion" is of course rampant in tonal morphology, the stability effect allows tones to survive the historical loss of their TBUs. By such fusion, quite complex systems have developed in Africa, such as the one in Dinka, whose resultant polymorphemic monosyllabic words contrast three degrees of length, three tones, and three voice qualities. Thus, "...for many transitive verbs there are at least six stem types, each of which has a distinct derivational status: a simple stem, a centrifugal stem, a centripetal stem, a benefactive stem, a benefactive-antipassive stem, and an antipassive stem" (Andersen 1992-1994:12).

While such featural and durational fusions are relatively straightforard, other templatic developments can be quite mysterious. Unlike more canonical Bantu languages, Tiene restricts stems (consisting of a root + possible suffixes) as in (19) (Ellington 1977):

(19) The "prosodic stem" in Tiene

a. Five shapes: CV, CVV, CVCV, CVVCV, CVCVCV

b. In case of $C_1VC_2V_2C_3V_3$:

i. C_2 must be coronal
ii. C_3 must be non-coronal
iii. C_2 and C_3 must agree in nasality
iv. V_2 is predictable (with few exceptions)

As seen, the Tiene stem may consist of up to three syllables. When trisyllabic, there are severe restrictions on the distribution of the second and third consonants: coronals must precede labials and velars. When a coronal suffix such as causative -Vs- or applicative -Vl- threatens to produce the reverse order, the /s/ or /l/ appears to metathesize with the final labial or velar consonant:

(20)	a.	lab-a	'walk'	→	lasab-a	'cause to walk'
		lók-a	'vomit'	→	lósek-ɛ	'cause to vomit'
	b.	dím-a	'become extinguished'	→	díseb-ɛ	'extinguish (tr.)'
		yóm-a	'become dry'	→	yóseb-ɛ	'make dry'
(21)	a.	yɔb-ɔ	'bathe'	→	yɔlɔb-ɔ	'bathe for'
		bák-a	'reach'	→	bálak-a	'reach for'
	b.	dum-a	'run fast'	→	dunem-ɛ	'run fast for'
		lɔŋ-ɔ	'load'	→	lɔnɔŋ-ɔ	'load for'

The examples in (20b) and (21b) show that C2 and C3 must agree in nasality. Thus, stem- /m/ denasalizes in the presence of causative -Vs-, and /l/ nasalizes in the presence of room /m/. While there are a number of ways one might account for the CVTV{P,K}- template (cf. Hyman & Inkelas 1997), it is not at all obvious what the historical motivation was for the

observed place-driven metathesis. Based on the limited documentation available, Hyman (to appear) shows that there is considerable variation in the templatic properties of CVCVCV stems in the Teke group to which Tiene most likely belongs. What is clearly called for is a comparative study of the group, first to establish what is vs. is not attested, and then to resolve the question of how and why such requirements are placed on trisyllabic stems. (There are no corresponding restrictions on the C_2 of bisyllabic stems.)

The Tiene example points to two conclusions. First, there are interesting and important discoveries still to be made in African phonology and morphology. Second, when such phenomena are identified, it is important to pursue them in their genetic and geographic setting. If we are to understand how and why such systems arise, we will need first to establish the full range of possibilities, in this case, what the different constraints are that neighboring languages place on their C_2 and C_3 in trisyllabic stems. While such an approach has been applied to certain subgroups or areas with respect to tone, vowel harmony, question markers (Rialland 2007, Clements & Rialland 2008), and a few other issues, e.g. , there is much more waiting to be done.

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