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Affixation by Place of Articulation: Rare AND Mysterious

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1. Introduction

As is well known, certain phonological, morphological and syntactic properties occur with great frequency in the world's languages, while others are quite rare. To account for this difference, linguists have generally assumed that properties will be frequent if they have a "natural" motivation in terms of production, processing, communication etc., whereas properties which lack such a functional basis are "unnatural" and hence expected to be rare. Qualitative differences between frequent vs. rare properties may be attributed to diachrony: Widely attested synchronic properties tend to resemble each other in terms of substance, as they often arise transparently from universal processes of phonologization and grammaticalization. More restricted properties, on the other hand, often have an unmotivated or arbitrary character requiring a history involving multiple such processes and/or restructuring (cf. Bach & Harms' 1968 notion of "crazy rules"). What would be striking is a property which appears to be motivated, but still is rare.

In this paper I consider one such case from the verb morphology of Tiene, a Bantu language of the Teke subgroup spoken in the Democratic Republic of the Congo, which is not only rare, but as we shall also see, mysterious. In order, first, to appreciate how unique the Tiene facts to be presented are within Bantu, consider in (1) the derived verb forms from Ikalanga, a Southern Bantu language spoken in Botswana:

(1) Derivational suffixes ("verb extensions") in Ikalanga (Mathangwane 2001)

a. Productive extensions (cf. dabíl-a 'answer')

i.	Causative:	dabíl-ís-a	'cause to answer'	< PB *-ɪc-
ii.	Applicative:	dabíl-íl-a	'answer for/at'	< PB *-ɪd-
iii.	Reciprocal:	dabíl-án-a	'answer each other'	< PB *-an-
iv.	Stative/Neuter:	dabíl-ík-a	'be answerable'	< PB *-ɪk-
v.	Passive:	dabíl-w-a	'be answered' (→ [dabig-w-])	< PB *-ʊ-

b. Non-productive extensions (*amb-, *fum- are bound roots)

i.	Extensive:	amb-al-a	'dress, put on (clothes)'	< PB *-ad-
ii.	Reversive tr.:	amb-ul-a	'take off (clothes)'	< PB *-ʊd-
iii.	Reversive intr.:	amb-uk-a	'come off (clothes)'	< PB *-ʊk-
iv.	Impositive:	fum-ik-a	'cover up (sth.)'	< PB *-ɪk-

c. Multiple extensions: dabil-is-an-il-a 'cause to answer each other for/at'

The productive derivational suffixes or "verb extensions" are illustrated in (1a), where the verb base is /dábil-/ 'answer' and -a is a final vowel (FV) inflectional morpheme. With the exception of the passive (which is not attested in Tiene), these extensions all have the shape -VC-, corresponding with the Proto-Bantu (PB) reconstructions given to the right (Meeussen 1967, Schadeberg 2003). The data in (1b) illustrate some typically non-productive suffixes which also have analogues in Tiene. Although there are constraints, the form in (1c) shows that extensions typically can be combined with each other to form quite long derived verb stems, here six syllables.

If we now compare the Tiene data in (2), we see a quite striking difference (the corresponding Ikalanga suffixes are shown in parentheses to the right):

(2) Verb infixes in Tiene (Ellington 1977)

a.	i.	Causative:	lók-a	'vomit'	→	lósek-ɛ	'cause to vomit'	(cf. -is)
	ii.	Applicative:	yók-a	'hear'	→	yólek-ɛ	'listen to'	(cf. -il-)
b.	i.	Extensive:	kab-a	'divide'	→	kalab-a	'be divided'	(cf. -al-)
	ii.	Reversive tr.:	sook-ɛ	'put in'	→	solek-ɛ	'take out'	(cf. -ul-)

As in Ikalanga, the causative and applicative suffixes are productive in Tiene, while the extensive and reversive are not. While Ikalanga (and Bantu in general) has -VC- verb suffixes, the (underlined) consonant of the corresponding suffix appears to be infixed in Tiene. (Other differences, e.g. in the vowels, will be addressed below.) The question is why? What has caused Tiene to change the pan-Bantu suffixes into infixes?

Such questions are addressed in the following sections. In order to answer the above questions I first take a fuller look at Tiene verb morphology in §2. As we shall see, the exact realization of the above and other verb extensions depend on the phonological properties of the verb base. In §3 I show that these properties follow from restrictions on the "prosodic stem" in Tiene, which is then compared with other Bantu languages in §4. §5 seeks diachronic and external evidence for the unusual Tiene properties, which are shown to have parallels in other Teke languages (§6) and a Nigerian Plateau language, Izere (§7). A speculative account of the rare and mysterious distributions and affixation by place of articulation is presented in §8 followed by a brief summary in §9.

2. Tiene verb extensions

In this section we shall examine the realization of the verb extensions in Tiene. Except where indicated, all of the data are taken from Ellington (1977) to whom I owe an additional debt for personal communications.

In (3) we begin by considering the two ways in which the language forms a causative:

(3) Causative formation (PB *-ɪc-i- > -es-)

a. C_2 = coronal (alveolar or palatal)

mat-a	'go away'	maas-a	'cause to go away'
bót-a	'give birth'	bóos-ɛ	'deliver (child)'
tiit-a	'grow'	tiis-ɛ	'cause to grow'
kɔl-ɔ	'become tired'	kɔɔs-ɔ	'tire (tr.)'
pal-a	'arrive'	paas-a	'cause to arrive'

		kal-a	'be'	kaas-a	'cause to be/become'
		lil-a	'cry'	liis-ɛ	'cause to cry' (< Guthrie 1960)
		taan-a	'get thin'	taas-a	'cause to get thin' (< Guthrie 1960)
		píín-a	'be black'	píís-ɛ	'blacken'
		bany-a	'be judged'	baas-a	'caused to be judged'

b. C_2 = non-coronal (labial or velar)

i.	lab-a	'walk'	lasab-a	'cause to walk'
	lók-a	'vomit'	lósek-ɛ	'cause to vomit'
	bik-a	'become cured	bisek-ɛ	'cure' (< Guthrie 1953)
	kuk-a	'be sufficient	kusik-ɛ	'make sufficient' (< Guthrie 1960)
ii.	dím-a	'become extinguished'	díseb-ɛ	'extinguish (tr.)'
	yóm-a	'become dry'	yóseb-ɛ	'make dry'
	tóm-a	'send'	tóseb-ɛ	'cause to send'
	suɔm-ɔ	'borrow'	sɔsɔb-ɔ	'lend'

c. $C_2 = Ø$

lɛ	'eat'	lees-ɛ	'feed'
vu	'fall'	vuus-ɛ	'cause to fall'

As seen in (3a,b), most roots in Tiene, as in Bantu in general, consist of a $C_1V(V)C_2$- structure, where VV = a long vowel. As can now also be seen, the realization of the causative depends on the place of articulation of the root C_2. In (3a), where C_2 = coronal, the /s/ of the causative suffix replaces the C_2, and the vowel lengthens, if it is not already long. (In these and other forms, the FV of a derived verb stem is /-ɛ/, which assimilates to a preceding /ɔ/ or /a/.) In (3b.i.), where C_2 = non-coronal, the /s/ of the causative is infixed, with the root C_2 now being realized as C_3. The same is observed in (3b.ii), with the addition that root C_2 /m/ is denasalized to [b]. The two verbs in (3c) show that when there is no root C_2, the causative suffix takes the expected -Vs- shape.

Turning to the applicative suffix, the data in (4) show the same skewing on the basis of the place of articulation of the root C_2:

(4) Applicative formation (PB *-ɪd- > -el-)

a. C_2 = coronal (alveolar or palatal)

bót-a	'give birth'	bóot-ɛ	'give birth for'
bel-a	'speak'	beel-ɛ	'speak to'
sal-a	'work'	saal-a	'work for' (< Guthrie 1953)
yal-a	'spread'	yaal-a	'spread for'
kas-a	'fight for'	kaas-a	'fight on behalf of'
kón-a	'plant'	kóon-a	'plant for'
sɔ́n-ɔ	'write'	sɔ́ɔn-ɔ	'write for'
kony-a	'nibble'	koony-ɛ	'nibble for'

b. C_2 = non-coronal (labial or velar)

i.	yɔb-ɔ	'bathe'	yɔlɔb-ɔ	'bathe for'	
	bák-a	'reach'	bálak-a	'reach for'	
	yók-a	'hear'	yólek-ɛ	'listen to'	
ii.	dum-a	'run fast'	dunem-ɛ	'run fast for'	(NB: l → [n])
	súɔm-ɔ	'buy'	sónem-ɛ	'buy for'	
	tim-a	'dig'	tinem-ɛ	'dig for' (< Guthrie 1953)	
	lɔŋ-ɔ	'load'	lɔnɔŋ-ɔ	'load for'	

c. C_2 = Ø

tá	'throw, strike'	téel-ɛ	'throw to/for'
día	'wrap'	díil-ɛ	'wrap for'
síɛ	'whittle'	síil-ɛ	'whittle for'

In (4a), where the root C_2 is coronal, the /l/ of the applicative suffix /-el-/ is lost, the only reflex of the applicative being the observed vowel lengthening.[1] In (4b.i.), the /l/ is infixed exactly like the /s/ of the causative in (3b.i.). The same infixation is observed in (3.b.ii), but since the root C_2 is nasal, the /l/ is nasalized to [n]. The three verbs in (4c) which lack a C_2 form their applicative by suffixing -Vl-.

Tiene stative formation is shown in (5).

(5) Stative formation (PB *-ɪk- > -ek-)

a. C_2 = coronal (alveolar or palatal)

i.	yaat-a	'split'	yatak-a	'be split'
	ból-a	'break'	bólek-ɛ	'be broken'
	faas-a	'drive through'	fasak-a	'be driven through'
ii.	sɔ́n-ɔ	'write'	sɔ́nɔŋ-ɔ	'be written'
	vwuny-a	'mix'	vwunyeŋ-ɛ	'be mixed'

b. C_2 = non-coronal (labial or velar) (? < PB *-ad- > -al-)

i.	kab-a	'divide'	kalab-a	'be divided'
	nyak-a	'tear'	nyalak-a	'be torn'
ii.	kam-a	'twist'	kanam-a	'be turned over'

c. C_2 = Ø

kaa	'fasten'	kaal-a	'be fastened'

The forms in (5a.i.) show that when the root C_2 is coronal the stative is derived by the historical -Vk- suffix, which becomes -Vŋ- in (5a.ii.), where the root C_2 is nasal. However, when the root C_2 is non-coronal, as in (5b.i.), an -l- is infixed, which again becomes -n- when the root C_2 is nasal, as in (5.b.ii). In this case it appears necessary to recognize two allomorphs: a suffix -Vk- which occurs after coronals vs. an infix with -l- which occurs before non-coronals (and is,

[1] This process of fusion is reminiscent of a widespread process of root-suffix fusion in Bantu known as "imbrication", most frequently involving the PB **id-ɛ* perfective ending (Bastin 1983). Since imbrication sometimes extends to applicatives and causatives, it could be that the Tiene forms derive from this process.

therefore, identical to the applicative). The one example Ellington cites without a root C_2 takes the -l- allomorph, as seen in (5c).

There are fewer examples of reversives in the materials, all of which are reproduced in (6).

(6) Reversive formation in Tiene (PB ‘reversive’ *-ʊk-, *-ʊd- > -ok-, -ol-)

a. C_2 = coronal (alveolar or palatal) (PB ‘reversive transitive’ *-ʊd- > -ol-)

kót-a	‘tie’	kóót-ɛ	‘untie’
yal-a	‘spread’	yaal-a	‘roll up’

b. C_2 = non-coronal (labial or velar) (PB ‘reversive transitive’ *-ʊd- > -ol-)

sook-ɛ	‘put in’	solek-ɛ	‘take out’
sum-a	‘stick in ground’	sunem-ɛ	‘pull out of ground’

c. C_2 = coronal (alveolar or palatal) (PB ‘reversive intransitive’ *-ʊk- > -ok-)

kót-a	‘tie’	kótek-ɛ	‘be untied’

d. Coronal/non-coronal alternation

vuol-a	‘open’	vuok-a	‘close’ (< impositive *-ɪk- ?)

(6a,b) show the same realizations as the applicative: vowel lengthening if the root C_2 is coronal vs. -l- infixation if it is non-coronal. The one form in (6c) shows a -Vk- suffix being added to a coronal root C_2 (as in the stative), while (6d) shows an alternation between /l/ and /k/, where the latter is perhaps related to the PB impositive suffix *-ɪk- illustrated in Ikalanga in (1.b.iv).

While we shall be primarily interested in why affixal -s- or -l- appears before non-coronal root C_2, let us first note the types of phonological analyses one might consider to account for the above alternations. Working within the framework of Chomsky & Halle (1968), Ellington (1977) proposes a solution involving metathesis:

(7) Metathesis: : CVPVT, CVKVT → CVTVP, CVTVK

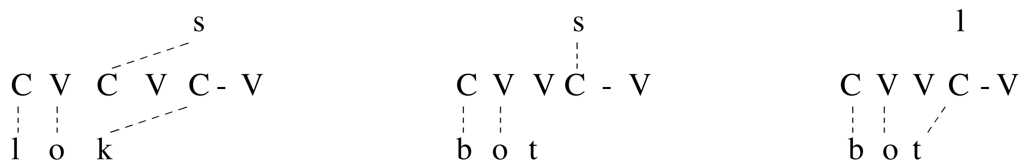
(a)	(b)	(c)	(d)	
/lók-es-/	/yók-el-/	/kab-el-/	/sook-el-/	Underlying representations
			sok-el-	Vowel shortening
lós-ek-	yól-ek-	kal-eb-	sol-ek-	Metathesis

Whenever there is an input where root C2 = labial or velar and suffixal C3 = coronal, the two consonants are metathesized. In addition, (7d) shows that a long root vowel must be shortened.

Had Ellington been working a few years later, Tiene metathesis or infixation could have been neatly represented in the non-linear framework of McCarthy (1981). With the CV template in (8a), the effect of metathesis could be achieved by having the suffixal /s/ of the causative associate to the second C just in case the root ends in a non-coronal:

(8) Multiple tier analysis with CV templates à la McCarthy (1981)

a. /lók-/ + /-es-/ → lósek- b. /bót + es/ → bóos- c. /bót+el/ → bóot-



When the root C_2 is coronal, as in (8b), it is overriden by suffixal /s/, which links to the second C, while the coronal root C_2 overrides suffixal /l/ in (8c).

Finally, as summarized in (9), a constraint-based analysis within the framework of McCarthy & Prince (1999) is also possible (cf. Hyman & Inkelas 1997):

(9) Metathesis/fusion can also be driven by OT-style output constraints

a. T ⊃ P, K
b. MAX(s) >> MAX(Root) >> MAX(l)

(9a) directly encodes that coronals should precede non-coronals, while the ranked constraints in (9b) say that input /s/ should be preserved over other consonants of the root, which in turn should be preserved over affixal /l/.

The three approaches in (7)-(9) of course assume that the realization of affixal /s/ and /l/ as the C_2 of CVCVC-V verb stems should be accounted for in phonological terms. The alternative would be to set up allomorphs (as is required for the stative, in any case): The causative and applicative would have the infixal allomorphs /-se-/ and /-le-/ when the root C_2 is non-coronal, otherwise the allomorphs would be suffixal /-es-/ and /-el-/, which fuse with a coronal C_2 but are transparently suffixed to a CV- root (see §3 concerning the realization of the underlying vowel /e/).

Considering the above (and perhaps other) solutions, we can conclude that the Tiene data are easy to describe, but raise a number of questions: Why doesn't Tiene have only derivational suffixes as elsewhere in Bantu? Why does the derivational morphology show such sensitivity to place of articulation ("fusion" vs. "infixation"; *-Vk-* vs. *-lV-* allomorphy)? Why do affixal *-l-* and *-k-* nasalize to [n] and [ŋ], respectively, and the root C_2 /m/ denasalize to [b] (e.g. *tóm-a* 'send' → *tóseb̲-ɛ* 'cause to send')? Why does the vowel of a CVVC- root shorten when appearing in a trisyllabic verb stem (e.g. *yaata* 'split' → yataka 'be split')? As discussed in §3, all of these properties are the result of phonological restrictions on the "prosodic stem" in Tiene.

3. The prosodic stem in Tiene

As summarized in (10), there are severe restrictions on the size and distribution of consonants and vowels within the stem in Tiene:

(10) 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 in (10a), in Tiene stems can be monosyllabic, bisyllabic or trisyllabic, with vowel length being limited to monosyllables and the first syllable of bisyllabic stems. In addition, trisyllabic stems are subject to the conditions indicated in (10b). We have mostly focused on the first two, which have to do with place of articulation. In addition, C_2 and C_3 must agree in nasality: This causes infixal *-l-* and suffixal *-k-* to nasalize to [n] and [ŋ] when the root C_2 is nasal. When the infix is *-s-*, root C_2 /m/ denasalizes (since it is difficult, perhaps impossible to nasalize an [s]).[2] With few exceptions, the V_2 is limited to /e/, which is realized [e] after /i, u, e, o/, but is identical to a preceding /ɛ, ɔ, a/.[3] These phonological conditions define what may be referred to as the “prosodic stem” in Tiene.

Further evidence that the prosodic stem is subject to a maximum of three syllables is seen from the definitive aspect forms in (11).

(11) Definitive aspect formation (cf. PB *-ɪdɪd- > -elel- ‘completive’)

a.	kaa	‘fasten’	kalal-a	‘fasten permanently’
	nɔ́ɔ	‘look at’	nɔ́lɔl-ɔ	‘fix gaze on’
	bɛɛ	‘become ripe’	bɛlɛl-ɛ	‘ripen once and for all’
	sía	‘hate’	sílel-ɛ	‘hate definitively’
	twa	‘crush’	túlel-ɛ	‘crush definitively’
	fuɛ	‘become violent’	fuɛlɛl-ɛ	‘become permanently violent’
	suɔ	‘show’	suɔlɔl-ɔ	‘show once and for all’
b.	yɔb-ɔ	‘bathe’	yɔbɔb-ɔ	‘bathe thoroughly’
	mat-a	‘go away’	matat-a	‘go away once and for all’
	yak-a	‘believe’	yakak-a	‘believe once and for all’
	kén-a	‘dance’	kénen-a	‘dance once and for all’
	lɔŋ-ɔ	‘load’	lɔŋɔŋ-ɔ	‘load once and for all’
c.	kɔ́ɔ́m-ɔ	‘sweep’	kɔ́mɔm-ɔ	‘sweep once and for all’
	maas-a	‘cause to go away’	masas-a	‘cause to go away for good’

The forms on the right show that the definitive aspect is characterized by a $C_1VC_2VC_3$-V template, where $C_2 = C_3$. If a verb root lacks a C_2, as in (11a), the C_2 and C_3 of the template are filled with a /-lel-/ sequence, whose /e/ assimilates to the root vowel as expected. As seen in (11b), if the root has a C_2, the definitive is formed by adding /e/ + a copy of the C_2. (11c) shows that if the root vowel is long, it must shorten, as expected. Since the C_2 and C_3 are identical, these

[2] Note that C_2 /ŋ/ is extremely rare, occurring mostly (only?) in borrowings, e.g. *lɔŋ-ɔ* ‘load’, *lɔnɔŋ-ɔ* ‘load for’. While it does not occur in Ellington’s materials, the expected causative form would be *lɔsɔk-ɔ*, with denasalization of /ŋ/.

[3] Compare the FV morpheme which is /-ɛ/ after “extended” verbs, otherwise /-a/. /-ɛ/ assimilates to a preceding [ɛ] or [ɔ], while /-a/ assimilates to a preceding [ɛ] or [ɔ].

forms are obviously exceptions to the distribution of coronal + non-coronal indicated in (10b). The requirement of the definitive that $C_2 = C_3$ thus overrides the otherwise general place restrictions on the two consonant positions. Now consider what happens if the verb base already has a C_3: "...verbs having the canonical shape -CVCVC- (including extended radicals)... do not accept the Definitive Aspect Morpheme. For such verbs, this aspect must be rendered by adding the expression *nkó mɔ́te* to the conjugated verb in the Neutral Aspect" (Ellington 1977:93). The morphological definitive is blocked just in case the condition $C_2 = C_3$ cannot be met without either truncating part of the base or exceeding the maximum trisyllabic size constraint on stems.

Further evidence for a trisyllabic maximum is seen from the vestiges of the reciprocal extension in (12).

(12) Reciprocal "vestiges" (PB *-a(n)g-an- > -ŋena > -neŋa)

a.	lɛ	'eat'	b.	lé-neŋa	'eat with each other
	nwa	'drink'		nú-neŋa	'drink each other'
	pa	'give'		pé-neŋa	'give each other'
	ta	'throw, strike'		té-neŋa	'injure each other'

As seen, the above four C(V)- roots occur with traces of the reciprocal extension *-neŋ-* inherited from the Proto-Bantu plural+reciprocal sequence **-a(n)g-an-* found in a number of daughter languages (cf. Haya *-angan-*, Luganda *-agan-*). In the Tiene reflex, the velar+coronal sequence is metathesized to coronal+velar, in conformity with the place restrictions on prosodic stems. Significantly, there are no vestiges of the reciprocal with CVC- or CVCVC- verb bases, precisely because *-neŋ-* would require a fourth syllable. It is again clear that derived stems are maximally trisyllabic in Tiene.

The same is true of the non-derived verb stems I have been able to extract from Ellington (1977). As seen in (13a), verbs consisting of a synchronically non-derived CVCVC- base + FV observe all of the constraints in (10):[4]

(13) "Non-derived" CVCVCV stems in Ellington (1977)

a.	kótob-a	'chase'	C-t-b	
	kótok-a	'gnaw'	C-t-k-	GCB *kókot-
	vútek-ɛ	'come back'	C-t-k-	GCB *bútok-
	pálab-a	'sprout'	C-l-b-	
	pɛlɛb-ɛ	'fly'	C-l-b-	
	tóleb-ɛ	'pierce'	C-l-b-	GCB *tóbod-
	sɛ́lɛk-ɛ	'tease'	C-l-k-	GCB *cɛ́k-ed- 'laugh' (+app)
	sɔlɔk-ɔ	'go out'	C-l-k-	GCB *cɔkod- 'pull out'
	binem-a	'sleep'	C-n-m-	
	dínem-a	'get lost'	C-n-m-	GCB *dímed-
	kanam-a	'turn over (sth.)'	C-n-m-	GCB *kámod- 'wring'

[4] Ellington does not report a corresponding root for any of the CVCVC- verbs in (13a). However, because their FV is *-ɛ* rather than *-a*, (cf. note 2) the forms *vútek-ɛ* 'come back' and *tóleb-ɛ* 'pierce' suggest that they may have been morphologically complex at one time.

	kɔnɔm-ɔ	'crawl'	C-n-m-	
	panam-a	'frighten'	C-n-m-	
b.	m-pítiba	'darkness', 9?	C-t-b-	"REGULAR"
	le-bóboki	'bird (sp.)', 11/10	(pl. m-bómboki)	REDUPLICATION
	ke-lélébe	'lip', 7/8	(pl. be-lélébe)	REDUPLICATION
	le-sásálá	'eyelash', 11/10	(pl. n-sánsálá)	REDUPLICATION
	m-fúmfálá	'armpit', 9		REDUPLICATION
	síkule	'school'		BORROWING
	n-gwánkete	'enemy', 9	(~ n-gbánkete)	COMPOUND?

The schemas given to the right these forms show that C_2 = coronal and C_3 = non-coronal, as expected. Several of these are reflexes of reconstructed PB forms. Ellington cites from Guthrie's (1967-1971) Common Bantu, which I abbreviate as GCB. As seen, all but **-bútok-* 'comeback' require the metathesis of the GCB C_2 and C_3 consonants. Most interesting is **kókot-* 'gnaw', which, although possibly an archaic reduplication **kó-kot-*, becomes *kótok-a* in Tiene. Since such forms cannot be interpreted as infixation, it is clear that metathesis occurred as historical process in the language.

Except for the first form, the trisyllabic noun stems in (13b) all violate one or another of the conditions in (10). It looks, however, like four are reduplications, one a borrowing, and one a possible compound. (The number(s) following each gloss indicates the Bantu noun sg./pl. noun class.) It is safe to say that there are very few trisyllabic noun stems.

Up to this point nothing has been said about possible constraints on the C_2 of bisyllabic verb stems. As seen in (14), both coronals and non-coronals appear in this position:

(14) Underlying consonants found in C_1 position and in C_2 position of $C_1V(V)C_2V$ stems

	Labials	**Alveolars**	**Proto-Palatals**	**Velars**	
C_1 = 13:	p b m	t l n	s z ɲ	k g ŋ	(PB *c, *j > s, z)
C_2 = 10:	b m	t l n	s ɲ	k ŋ	

The main restriction is the merger of /p, b/, /s, z/ and /k, g/ in C_2 position. In addition, there are exactly two constraints on C_1 + C_2 combinations: First, after C_1 /p/, we find [p] instead of [b], e.g. *kab-a* 'divide', *lɔ́b-ɔ* 'fish with a line' vs. *píp-a* 'suck', *m-pɛɛpɛ* 'wind'. Second, when C_1 is a nasal consonant, C_2 cannot be [b] or [l]. There is one interesting exception to this generalization: *nyalak-a* 'be torn'. Deriving from earlier **nyakal-a*, the [l] escapes nasalization because it originates in C_3 position separated from the [+nasal] C_1 by a full syllable; cf. *nyak-a* 'tear'. This form not only provides further evidence for metathesis, but also reveals that if we start with the pre-metathesis order, nasal agreement is both left-to-right and strictly local. Differing from nasal agreement between C_2 and C_3, a C_2 [k] may follow a C_1 nasal, e.g. *nɔ́k-ɔ* 'to rain'. On the other hand, just as we saw that a (metathesized) C_2 [s] may not co-occur with a C_3 nasal, Ellington cites no forms where [s] follows a C_1 nasal.

4. Comparision with the prosodic stem in other Bantu languages

The Tiene facts presented in the preceding sections raise a number of questions: Why does Tiene have such a restrictive prosodic stem template? How did the prosodic stem template arise? Is

Tiene unique, or can we relate these facts to what happens in other languages? In this section we compare Tiene with other Northwest (NW) Bantu languages spoken in the same vicinity.

The properties of the Tiene prosodic stem template can be subdivided as in (15a,b).

(15) The properties of the Tiene prosodic stem template can be subdivided into those which are

a. not so unusual
   i. prosodic maximality
   ii. decreasing # of oppositions from C_1 to C_2 to C_3
   iii. stronger realization of consonants in C_1 vs. C_2 and C_3 positions

b. very unusual
   i. coronal-noncoronal limitation on C_2-C_3 sequences
   ii. regular, nonlocal metathesis based on place of articulation

The properties in (15a) are duplicated in neighboring languages. As seen in (16), whereas "canonical" Central, Eastern, and Southern Bantu languages do not place an upper limit on how many syllables can appear within the stem (recall Ikalanga from (1c)), stem-maximality conditions are very common in NW Bantu, as indicated in (16).

(16) Maximal size limitations on the stem in certain NW Bantu languages and further West

a.	four (~five) syllable maximum	Yaka (Hyman 1998), Bobangi (Whitehead 1899) Punu (Fontaney 1980, Blanchon 1995)
b.	three (~four) syllable maximum	Koyo (Hyman 2004)
c.	three-syllable maximum	Tiene (Ellington 1977), Basaa (Lemb & Degastines) 1973, Hyman 2003), Kukuya (Paulian 1975)
d.	two (~three) syllable maximum	Mankon [Grassfields Bantu] (Leroy 1982)
e.	one (~two) syllable maximum	Ewe [Kwa] (Westermann 1930)

Some of the languages are transitional, with the additional syllable (indicated in parentheses) typically being restricted to a single morpheme or construction.

As an illustration, consider in (17) the possible stem shapes in Koyo, a NW Bantu language spoken in nearby Congo (Hyman 2004):

(17) Possible stem shapes in Koyo (Congo-Brazzaville) (Hyman 2004)

CV	:	dz-a	'be, exist'	my-a	'swallow'
CVV	:	dzá-a	'eat'	sá-a	'cultivate'
CVCV	:	kór-a	'attach'	bom-a	'kill'
CVCVCV	:	sέlum-a	'slip'	ñɔbir-a	'tickle'
CVCVCVgV	:	sέlum-ag-a	'slip + DUR'	ñɔbir-ag-a	'tickle + DUR'

In this language stems are maximally trisyllabic, although a fourth syllable is made possible only by the durative -Vg- suffix. That such a maximality condition is in effect is seen in (18).

(18) Maximum trisyllabic stem: verb extensions can be added only if there is room!

a.	kór-a	'to tie'	bar-a	'to bite'
	kór-is-a	'to cause to tie'	bar-is-a	'to cause to bite'
	kór-in-a	'to tie each other'	bar-in-a	'to bite each other'
b.	*kór-is-in-a	'to cause each other to tie'	*bar-is-in-a	'to cause each other to bite'
	*kór-in-is-a	'to cause to tie each other'	*bar-in-is-a	'to cause to bit each other'
c.	dzá-a	'to eat'	/dzé-a/	tá-a 'to see'
	dzé-s-a	'to cause to eat, feed'	tá-s-a	'to cause to see, show'
	dzé-n-a	'to eat each other'	tá-n-a	'to see each other'
	dzé-s-in-a	'to feed each other'	tá-s-an-a	'to show each other'
d.	yigin-a	'to get accustomed to'	súndzin-a	'to decrease, shorten'
	yig-is-a	'to cause to be accustomed'	súndz-is-a	'to cause to decrease'

Causative *-is-* and reciprocal *-in-* are illustrated in (18a). As seen in (18b), they cannot both be present after a CVC- root, because that would result in four syllables. The do co-occur in the order causative+reciprocal after a CV- root in (18c), where they can be fit into the trisyllabic maximal template. The examples in (18d) show exceptional cases where the causative replaces the [in] of a monomorphemic CVCin- verb.

Another property of NW Bantu accompanying stem maximality is the decrease in the number of consonant oppositions as one goes from left-to-right . In (19) we see that the drop is precipitous in Koyo:

(19) Decrease in the number of consonant oppositions in each of the four stem syllables

	Labials	**Alveolars**	**Proto-Palatals**	**Velars**
C_1 = 18:	p b w m mb	t l s n nd	ts dz y ɲ ndz	k h ŋg
C_2 = 12:	b m mb	r l s n nd	y ɲ ndz	g
C_3 = 6:	m	r l s n		g
C_4 = 1:				g

This contrasts with Proto-Bantu and present-day canonical Bantu languages, where there is a near-free distribution of consonants in the different stem positions (cf. Hyman 2004, Teil-D'Autrey 2002, to appear). (Concerning vowels, /i, e, ɛ, u, o, ɔ, a/ contrast in V_1 position, while only /i, u, a/ contrast as V_2, V_3 and V_4 in Koyo.)

In addition to the decrease in contrasts by position, (25) also shows that a stem-internal stop must be voiced. As a result, /p/ contrasts with /b/ only in C_1 position (as in Tiene). The examples in (20) show that /t/ and /k/ are realized [t, k] in C_1 position vs. [r, g] in C_2, C_3 and C_4 positions:

(20) Realization of /t/ and /k/ in Koyo

C_1:	/tón-a/	[tóna]	'refuse'	/kúl-a/	[kúla]	'abandon'
C_2:	/bát-a/	[bára]	'keep'	/mék-a/	[méga]	'dare'
C_3:	/tsikit-a/	[tsigira]	'tremble'	/pítak-a/	[píraga]	'smear'
C_4:				/pítak-Vk-a/	[píragaga]	(+DUR)

As seen, however, there are no significant place restrictions in Koyo, aside from the restriction of the historical palatals /ts/ and /dz/ to C_1 position. In fact, place restrictions seem to be found only in the Teke subgroup to which Tiene belongs (see §6).

The question is whether the place restrictions in Tiene are synchronically grounded, i.e. due to a linguistic tendancy of some sort, or are synchronically accidental, i.e. attributable to specific historical factors which gave rise to it? Addressing this latter possibility first, it is easy to show that T ⊃ P, K is not inherited from PB, nor is it typical of Bantu languages in general, where non-coronals statistically PRECEDE coronals.

Consider in this context the PB extension system, which is impressively uniform throughout most of Bantu:[5]

(21) PB verb extensions (Meeussen 1967, Schadeberg 2003)

a. frozen, mostly unidentifiable -VC- "expansions" (9/11 = non-coronal)

i.	*-im-, *-un-, *-ing-	iii.	*-ɪm-, *-ɔm-, *-ɔng- (only after CV-)
ii.	*-ang-, *-ab-, *-ag-, *-ak-	iv.	*-ʊt-

b. unproductive extensions often restricted to post-radical position (4/7 = non-coronal)

i.	*-ɪk-	'impositive'	iv.	*-ad-	'extensive'
ii.	*-am-	'positional'	v.	*-at-	'tentive' (contactive)
iii.	*-a(n)g-	'repetitive'	vi.	*-ʊd-/*-ʊk-	'reversive/separative' (tr/intr)

c. productive extensions (3/4 clear cases = coronal)

i.	*-i-	'causative'	iv.	*-ɪk-	'neuter/stative'
ii.	*-ɪc-i-	'causative'	v.	*-an-	'reciprocal/associative'
iii.	*-ɪd-	'applicative'	vi.	*(-ɪC-)-ʊ-	'passive'

In (21) the reconstructions are presented in the order in which they are expected to occur: frozen "expansions", unproductive extensions, productive extensions. As seen, as one moves out from the verb root the suffixal consonants become more coronal. The preponderance of (productive) coronal suffixes appears to be characteristic of Niger-Congo in general, and is particularly striking in the Atlantic subgroup (cf. the table in Becher 2000:31). Although less impressive in this respect, for completeness, the PB inflectional endings are given in (22).

(22) PB final inflectional endings (Meeussen 1967; see also Grégoire 1979, Bastin 1983)

a.	*-ɪ (past)	c.	*-id-ɛ (perfective)	e.	*-a ("default")
b.	*-ɛ (subjunctive)	d.	*-ag-a (imperfective)		

Since PB did not provide the source, the Tiene place restrictions must be an innovation. We might therefore expect nearby NW Bantu languages to show at least a statistical tendency for coronals to come earlier among post-root consonants. In (23) we see that both Koyo and Bobangi instead show a preponderance of coronals in later verb stem positions:

[5] The following discussion is restricted to verbs, since noun stems are typically limited to two syllables unless they are derived (e.g. from verbs), reduplicated, or borrowed.

(23) Distribution of consonants by place in two nearby NW Bantu languages

a. Koyo (Hyman 1996): Max = CVCVCV (fourth CV must be durative -gV)

	Total	P	K	T	Y	h	{T, Y} %	CV$\underline{C}_2$-V	CV$\underline{C}_2$VC-V
C_1	1536	419	316	613	118	70	47.6%		
C_2	1308	324	409	549	24	2	43.8%	47.4%	38.5%
C_3	192	11	31	148	1	1	77.6%		

b. Bobangi (Whitehead 1899) : Max = CVCVCVCV; 3/3,324 verbs have fifth CV

	Total	P	K	T	Y	{T, Y} %	CVCV$\underline{C}_3$-V	CVCV$\underline{C}_3$VC-V
C_1	7619	2055	1502	3048	1012	55.3%		
C_2	7246	1508	2289	3257	192	47.6%		
C_3	2930	395	470	1955	110	70.5%	81.5%	43.6%
C_4	852	65	112	634	41	79.2%		

In both Koyo and Bobangi coronals range from 43.8% to 55.3% in the two root positions, C_1 and C_2. The percentage rises dramatically to 70.5-79.2% in C_3 and C_4 positions. The last two columns show that the C_2 in Koyo and the C_3 in Bobangi are even more likely to be coronal if they are the last consonant of the verb stem. Since coronals cannot occur in C_3 position, Tiene appears to have exactly the opposite distribution from its neighbors outside the Teke group.

5. In search of an explanation

Having eliminated the possibility that Tiene inherited a skewed distribution of consonants by place, we must now seek an account of how and why Tiene innovated as it did. There are two aspects of the Tiene situation which require an explanation. First, why can't $C_2 = C_3$ in place of articulation? Second, why can't C_2-C_3 = non-coronal + coronal?

The first question seems appropriately answered by relating Tiene to the avoidance of sequences of homorganic consonants in lexical items, well-known from the study of Arabic roots (cf. Frisch et al 2004). Pozdniakov & Segerer (to appear) have recently shown that there is, universally, an avoidance of successive homorganic consonants within words, even when such consonants are separated by a vowel. They calculate the expected vs. attested number of consonant combinations by place of articulation. Some of their results are reproduced in (24).

(24) Similar Place Avoidance (SPA) (Pozdniakov & Segerer, to appear)

Fula (n=672)

	P	K	T	Y
P	– –	– –	+	
K	– –	– –		+ +
T	+ +	+ +	–	–
C	+	+ +		– –

Malagasy (n=1944)

	P	K	T	Y
P	– –		+	+
K		– –		+
T	++		–	–
C		++	–	– –

Basque, Euskara (n=3140)

	P	K	T	Y
P	– –			
K	– –	– –	+	
T	+	++	–	+
C	++			– –

Pidgin English, Port-Moresby (n=2215)

	P	K	T	Y
P	– –		+	
K		– –		
T	+ +	+	–	
C		+		

Quechua (n=2245)

	P	K	T	Y
P	– –			+
K	++	– –		
T	+	+		–
C				

Classical Mongolian (n=66,407)

	P	K	T	Y
P	– –	–	+	+ +
K		– –	+ +	
T		+ +	– –	
C	+			–

Bantu Reconstructions (n=12,426)

	P	K	T	Y
P	–		+	
K		– –	+	
T	+	+		– –
C	+	+	– –	+ +

Swahili (n=1481)

	P	K	T	Y
P	– –	+		
K		– –	+ +	+
T	+		–	–
C	+		– –	

In the above tables P = labial, K = velar, T = dental-alveolar, and Y = palatal. A single + or - indicates that the attested number of lexical entries is 15-30% off from the number that would be expected if there were no co-occurrence restrictions. A double ++ or -- means that the discrepancy is over 30%. As seen, the bulk of minutes occurs along the descending grey diagonal, i.e. where the consonant combinations involve an identical place of articulation. Besides the underrepresentation of consonants of identical place, the upper left and lower right quadrants of the above tables show a statistical avoidance of successive consonants from the same superclass: P+K (= peripheral/grave) and T+Y (= medial/acute).

Pozdiakov & Segerer show that their statistical universal is also in force within Bantu. While we expect the productive suffixes to combine freely with bases ending in all places of articulation, I have found that unproductive suffixes avoid homorganic bases, at least in Chichewa:[6]

(25) Distribution of unproductive suffixes *-am-, *-ʊk-, *-Vt- and *-ʊd- in Chichewa

		P	K	T	
		-Vm-	-uk-/-ok-	-Vt-	-ul-/-ol-
C_2	P	-77%	+23%	+52%	+12%
	K	-25%	-78%	+150%	+17%
	T	+43%	+17%	-77%	-11%
	C	-7%	+15%	-11%	-3%

[6] The calcuatlions in (22) are based on 1,412 trisyllabic or longer verbs extracted from Sanderson (1954) as adapted by Al Mtenje for the Comparative Bantu On-Line Dictionary project.

I will therefore assume that the statistical universal of Similar Place Avoidance (SPA) is responsible for the categorical prohibition of the coronal/non-coronal superclasses in Tiene.

Having provided a possible motivation for why C_2-C_3 consonants cannot be [αcoronal], the remaining question we must address is why they cannot occur in the order non-coronal + coronal (*P-T, *K-T). As indicated in (26), there are three logical possibilities for ruling out such sequences (henceforth, T stands for all coronals):

(26) Three logical possibilities for ruling out non-coronal C_2 + coronal C_3

a.	a restriction on non-coronals:	*P, *K in C_2 position
b.	a restriction on coronals:	*T in C_3 position
c.	a restriction on sequences:	*P-T, *K-T in C_2-C_3 positions

Having limited stems to a maximum of three syllables, the innovative prohibition may have been against medial non-coronals, final coronals, or non-coronal + coronal sequences (cf. Hyman & Inkelas 1997). The Tiene data thus do not point to a clear interpretation.

One possibility is that the coronal + non-coronal order is related to the special "unmarked" status of coronals in inventories, processes, language acquisition, and performance. It is often pointed out that coronals have greater frequency, assimilability, transparency, and distribution (Paradis & Prunet 1991a,b). But why should unmarked T precede marked P and K? Perhaps there is a phonetic motivation: If it could be shown that coronals tend to be shorter in duration than coronals, perhaps Tiene phonologized "fast before slow"? As reported by Maddieson (1997:630), however, available data are not consistent on this point:

(27) Two studies of English stop consonant closure duration (in ms) by place of articulation

P > T > K (Strathopoulos & Weismer 1983)

p : 96	t : 82	k : 72
b : 92	d : 76	g : 68

P > K > T (Byrd 1993)

p : 69	t : 53	k : 60
b : 64	d : 52	g : 54

While these studies measured stop closure, we would also want to know how the durations compare between nasals, but of oral sonorants, affricates and fricatives. It seems unlikely that Tiene intervocalic [s] and [l] are shorter in duration than [b] and [k] or were so at the time of phonologization.

In §3 it was demonstrated that the historical process in developing the place constraints was one of metathesis: {P, K} V T > T V {P, K}. However, this metathesis goes against claims which have been made concerning the direction of historical metathesis or speech errors. As an example of long distance metathesis, Grammont (1933:348) cites the example *beaucoup* > *copou* as producing a sequence reflecting the "expiratory order": K ⊃ T ⊃ P. Concerning contiguous CC metathesis, Blevins & Garrett's (2004) generalizations in (28), taken together, produce the favored linear ordering: K ⊃ P ⊃ T.

(28) Generalizations of Blevins & Garrett (2004) concerning CC metathesis as sound changes

a.	PK > KP	not: *KP > PK
b.	*T{P,K} > {P,K}T	not: *{P,K}T > T{P,K}

Data from child language phonology also seems to be of little help in understanding Tiene (Macken 1996, Pater & Werle 2001, Fikkert & Levelt 2006, etc.) First, there is the well-known fact that "consonant harmony predominates", e.g. *duck* → [gʌk], [dʌt] (Rose 2001). Second, as the examples in (29) show, metatheses often result in coronals being realized later:

(29) Non-coronal + coronal metatheses in child language (examples from Smith 1971)

a.	[rikt]	'risk'	b.	[mizbərəl]	'miserable'
	[ɛplin]	'helping'		[gæpəlin]	'galloping'

The examples in (29a) are cases of local CC metathesis, whereas those in (29b) involve consonant metathesis across a vowel. Concerning these latter, the generalization seems to go against Tiene: "[cor] Cs metathesize to C_2 position in [ˈCV.CV] and [CVC] words and to C_3 position in [ˈCVCVCV], and to the right of string-adjacent [-cor]" (Macken 1996:166). What Tiene does have in common with child language phonology is that the latter is often templatic (Macken 1992, 1996; Vihman 2002). Macken distinguishes two kinds of learners (harmonic vs. templatic) who are both sensitive to coronality: "...in the harmony systems... coronals undergo harmony, particularly when they precede non-coronals; in melody templates, coronals are sequenced to the right of non-coronals" (Macken 1992:350). Macken considers non-coronals dominant and coronals non-dominant and adds: "Nondominant features occur in prosodically nondominant positions, such as in codas or foot-internally, or in positions of neutralization; dominant features occur in prosodically dominant positions, such as foot initial and onsets generally" (Macken 1996:166).

There is reason to think that this property of child language phonology extends to adult phonology as well. As the first of two examples, consider the realization of pluractional *-ta* in Kashaya:

(30) Pluractional -ta- in Kashaya (Buckley 2000:16)

a. suffixation after T

i.	dahqot̜ol-	→	dahqot̜ol-**ta**-	'fail (to do)'	
ii.	dit̜'an-	→	dit̜'an-**ta**-	'bruise by dropping'	

b. infixation before P, K

i.	bilaq^{h}am-	→	bilaq^{h}a-**ta**-m-	'feed'	*bi.la.q^{h}am.ta
ii.	sima:q	→	sima-**ta**-q-	'go to sleep''	*si.ma:.q.ta

Whereas *-ta* is suffixed after a base which ends in a coronal in (30a), it is infixed in (30b), where the base ends in a non-coronal consonant. Buckley explains that *-ta* is infixed in order to avoid non-coronal codas (as suffixation would produce in the starred forms to the right in (30b)). Following Macken, Kashaya *-ta* affixation avoids producing dominant {P, K} in a non-dominant (i.e. coda) position.

The second example concerns the distribution of root-internal consonants in Mathimathi. As seen from the lexical counts made by Gahl (1996) in (31a), both consonants of CVC roots can be coronal or non-coronal:

(31) Root-internal C must be coronal in Mathimathi (Gahl 1996; data from Hercus 1969, 1986)

a. CVC roots

	C_1	C_2
T	66	79
P, K	110	97

b. CVCVC roots

	C_1	C_2	C_3
T	25	104	30
P, K	79	0	74

In (31b), however, we see that there are no non-coronal consonants in the C_2 position of CVCVC roots. This is indeed very reminiscent of Tiene. Using the term "weak" in place of Macken's "non-dominant", the facts seen thus far can be united as in (32).

(32) Tendency to align coronals with weak prosodic positions

a. Kashaya: coda vs. onset
b. Bantu in general: late vs. early (roughly, root vs. post-root)
c. Tiene and Mathimathi: medial vs. peripheral

As was seen in §4, Koyo, Bobangi, and most Bantu show more coronality in later consonant positions within the stem, especially those following the initial CV(V)C- root. The prosodic structure of such languages is therefore strong (root) vs. weak (post-root). In Tiene (and apparently Mathimathi), there is instead a weak medial CV or "nadir" (Hyman & Inkelas 1997). As schematized in (33), the PROSODIC TROUGH (τ), introduced for Yaka (Hyman 1998), consists of the middle C_2V_2 sequence of a CVCVCV stem in Tiene, where C_2 = T and V_2 is predictable from V_1:

(33) The prosodic trough in Tiene

If we are correct in extending Macken's observations on child language phonology in this way, we can summarize the account reached for Tiene consonant place restrictions as follows: (i) [αcoronal] C_2-C_3 sequences are prohibited by a categorical version of the statistical universal of SPA (Pozdniakov & Segerer, to appear). (ii) Non-coronals are restricted from the prosodic trough. Taken together, this account perhaps represents a bit of an overkill in the sense that a non-coronal C_2-C_3 sequence would be ruled out by either constraint. It also may not be as fine-tuned as needed, since it lumps together all coronals vs. all non-coronals. In order to get more perspective on both of these issues, the next sections briefly describes three other languages that have Tiene-like properties.

6. Other Teke

In the preceding sections reference has been made to the Teke subgroup of Bantu to which Tiene has sometimes been claimed to belong. It should not be surprising that other languages of this subgroup have at least some of the same properties found in Tiene. In this section I will briefly describe two Teke languages for which we have data and then turn in §7 to a quite distant language, Izere, spoken in Nigeria.

The prosodic stem has been described in great detail for Kukuya by Paulian (1975). The relevant properties of Kukuya prosodic stem are summarized in (34).

(34) The prosodic stem in Kukuya (Paulian 1975; cf. Hyman 1987)

a. Five syllable shapes: CV, CV.V, CV.CV, CVV.CV, CV.CV.CV
b. Six C_2 or C_3 consonants: /p, t, k, l, m, n/ (vs. large inventory of C_1 consonants)
c. Six C_2-C_3 combinations: C-n-m, C-t-k, C-l-k, C-l-p, C-t-p, C-k-p
d. Weak C_2, C_3 realizations: /p, t, k/ are realized [b ~ β], [r] and [k ~ g ~ ɣ], respectively.
e. V_2 of CVCVCV is almost totally predictable and is subject to reduction or deletion
f. Five tonal "melodies": L, H, LH, HL, LHL

As seen, Kukuya stems are limited to the same five shapes as in Tiene, with a maximum of three syllables. In terms of consonant distribution it has gone beyond Tiene in two ways. First, only six consonants appear as C_2 or C_3, even in CV(V)CV stems. (We saw in (14) that Tiene allows 10 out of its 13 consonants in this position.) Second, there are only six combinations of C_2-C_3 in trisyllabic stems, exemplified in (35).

(35) Among CVCVCV stems, "ne sont attestées que" (C_2-C_3): (Paulian 1975)

a.	C - n - m :	/ (kì-) .púnumà/	'accidentally knock over'	34.57%
	C - t - k :	/ (kì-) .bítikà /	'be numerous'	26.33%
	C - l - k :	/ (kì-) .bólokò/	'break'	19.15%
	C - l - p :	/ (kì-) .lèlèpè/	'slow down'	9.84%
	C - t - p :	/ (kì-) nàtàpà /	'be fixed, stuck'	3.19%
b.	C - k - p :	/ (kì-) .pákapà/	'crack, be torn (intr.)'	6.92%

The six combinations agree in nasality and respect the prohibition against [αcoronal]. Those in (45a) mirror the coronal + non-coronal sequencing found in Tiene. Unlike Tiene, however, the velar+labial combination is allowed in (35b) is allowed. On the other hand, Kukuya has gotten labials out of C_2, possibly by metathesis: PB **papʊk-a* 'become torn' > *pákapà* 'crack, be torn', PB **tʊmbʊk-a* 'burst open' > *ókopò* 'burst open' (abcess). Verb extensions are not productive in the language (Christiane Paulian, personal communication).

The second language is a variant of Teke spoken in Gabon whose properties in (46) are drawn from a lexicon of 1466 items (Hombert 1993):

(36) The prosodic stem in Teke-Gabon

a. Five syllable shapes: CV, CV.V, CV.CV, CVV.CV, CV.CV.CV
b. Seven C_2 + C_3 consonants: b, r, g, l, m, n, ŋ (vs. large inventory of C_1 consonants)
c. Five C_2-C_3 combinations: C-b-g C-m-ŋ, C-l-g C-r-g, C-n-ŋ

Again we see the same five stem shapes and a maximum of three syllables in (36a). While Teke-Gabon allows a wide array of C_2 consonants in CV(V)CV stems (including prenasalized /mb, nd, nj, ŋg/), the seven consonants in (36b) form the five C_2-C_3 combinations in (36c). As seen, velars are excluded from C_2, while only velars can occur in C_3 (cf. Koyo's C_4 in (19)). Again, C_2 and C_3 must agree in nasality. Given the seven consonants in (36b), which may be derived from /p, t, k, l, m, n, ŋ/, and the bidirectional constraint "if C_3, then velar; if velar, then C_3", exactly the five combinations in (36d) will be well-formed.

The facts from Tiene, Kukuya and Teke-Gabon suffice to show that the languages of this area exhibit variations on a theme, as summarized in (37).

(37) Heterorganic C_2-C_3 combinations ranked in terms of most to least prohibitions

	C_3 = T		C_2 & C_3 = P, K		C_2 = T, C_3 = P, K	
	CVPVT	CVKVT	CVKVP	CVPVK	CVTVP	CVTVK
Tiene	*	*	*	*		
Kukuya	*	*		*		
Teke-Gabon	*	*	*		*	
Izere	*	*	*			

In (37) I have added Izere, which will be discussed next. As seen, all four languages prohibit non-coronal + non-coronal C_2-C_3. They also all allow CVTVK. Beyond this they differ: Kukuya allows CVKVP (but not CVPVK), while Teke-Gabon and Izere allow CVPVK (but not CVKVP). Finally, Teke-Gabon alone disallows CVTVP, since C_3 must be velar.

What this means is that slightly different constraints have been imposed in the languages for which we have information. It is tempting to say that the initial trigger of the above variations was getting coronals out of C_3. However, this does not quite work for Izere, as we shall now see.

7. Izere

Izere (a.k.a. Afuzare and Zarek) is a Northern Nigerian language belonging to the Plateau subbranch of Niger-Congo whose relevant phonological and morphological properties have been studied by Wolff & Meyer-Bahlburg (1979), Gerhardt (1984), and Blench (2001). Although distantly related to Bantu, Izere is geographically quite far from Tiene and its close relatives. Still, as seen in (38), based on 2,178 entries from Blench & Kaze (2000), the maximum CVCVC stem shows remarkable similarities with the Teke languages:

(38) Maximum stem = CVCVC

C_2/C_3	P	K	T
P	*	**CVbVk** **CVmVŋ**	*
K	*	*	*
T	CVrVp CVrVm CVsVp CVsVm	CVrVk CVrVŋ CVnVŋ CVsVk CVsVŋ	**CVrVs**

Izere is like Tiene except for the two bolded cells: Like Teke-Gabon, it allows C_2-C_3 to be CVPVK. Unlike any of the Teke languages, however, it allows one CVTVT shape, CVrVs, occurring only in pluractional forms (see below). In addition, nasal agreement is unidirectional in Izere: If C_2 = nasal, then C_3 = nasal, but if C_3 = nasal, C_2 may or may not be. All 12 acceptable sequences are illustrated in the verbs in (39), where it should also be noted that Izere does not require an inflectional FV:

(39) CVCVC verb stems

CVTVP	CVTVK	CVPVK	CVTVT
tíríp 'rub'	burúk 'stir'	túbùk 'stab'	sáràs 'tear+PL'
kurúm 'coax'	káráŋ 'pay'	rómóŋ 'bite'	
gesèp 'stammer'	kánáŋ 'fry'		
kósóm 'cough'			

While Izere contrasts approximately 25 consonants in C_1 position, (40) shows severely restricted inventories in C_2 and C_3 positions:

(40) C_2 & C_3 consonants (no verbs are CVVp; two verbs are CVVk)

CVC			CVCVC		CVCVC			CVVC		
p	r	k	b	r	p		k	(p)	r	(k)
m	n	ŋ	m	n	m		ŋ	m	n	
	s			s		s			s	

Again, coronals are missing from C_3 position, except for /s/, which must be preceded by [r].

Besides the striking distributional similiarities, Izere has in common with Tiene that verb pluractional (~ habitual) formation may involve either suffixation or infixation:

(41) Suffix vs. infix -s-(~ -r-) in pluractional formation

a. CV → CVs (12)

bɔ́	→	bɔ́s	'fetch'	dí	→	dís	'see'
kpà	→	kpàs	'fall'	sɛ	→	sɛs	'locate, find'

b. CVP, CVK → CVVs (14)

rɛ́p	→	rɛ́ɛ́s	'sell'	nɔk	→	nɔ́ɔ́s	'build'
káp	→	káás	'farm'	fók	→	fóòs	'hear'
tóm	→	tóós	'send'	gaŋ	→	gáás	'finish'
nyim	→	nyíís	'meet'	tseŋ	→	tséés	'walk, go'

d. CVn → CVrVŋ (9), CVsVŋ (4)

men	→	mérèŋ	'lie down'	bún	→	búsúŋ	'break (wood, bones)'
kon	→	koroŋ	'rub'	tɛ́n	→	tɛ́sɛ́ŋ	'cut'
tún	→	túrúŋ	'remove'	shán	→	sháshàŋ	'buy' (+ sibilant harmony)

e. CVr → CVsVk (10)

gor	→	gósók	'pass'	tár	→	tásák	'shout, yell'
nár	→	násàk	'surpass'	tsɛ́r	→	tsɛ́sɛ́k	'look for, want'

f. CVs → irregular (4)

mas	→	manaŋ	'laugh'	rús	→	tsór	'hit, beat, strike'
shésh	→	shíshék	'save (s.o.)'	rus	→	tsor	'groan in pain'

Within the data base there are 539 verbs of which 181 (or 34%) have a derived pluractional form. (The number of examples of each pattern is given in parentheses.) In (41a) we see that CV verbs take an *-s* suffix. The same appears to be true in (41b) when a CVC verb ends in a non-coronal. As seen, the labial or velar consonant drops out. Thus compare Izere *nɔk* → *nɔ́ɔ́s* 'build+PL' with its analogue in nearby Berom: *lɔk* → *lɔgɔs* 'build+PL' (Blench 2005). The forms in (41c) show infixation of either -r- or -s-. In addition, the /n/ of the root becomes [ŋ] in accordance with the requirement that C_3 be non-coronal. The same interpretation is possible in (41d), if we assume that C_2 [r], which reconstructs as *t (Wolff & Meyer-Bahlburg 1979, Gerhardt 1984) is underlyingly /t/ (cf. Izere *nɔ́ɔ́k*, Berom *nɔt* 'give'). Starting with /got/ 'pass', we first derive *gosot*, which then becomes *gosok* 'pass+PL' since C_3 must be non-coronal.

That infixation is required is clearly seen in the following derivations:

(42) CVPVK → CVsVP unambiguously requires infixation (and loss of velar C_3)

a. CVbVk → CVsVp (7), CVsVm (1)

fúbúk	→	fúsùp	'sip'	nabak	→	násap	'lift up, stretch'
túbùk	→	túsùp	'stab'	kɔ́bɔ́k	→	kɔ́sɔ́p	'loan, borrow'
kábák	→	kasàp	'share out'	fɛ́bɛ́k	→	fɛ́sɛ̀m	'blow'

b. CVmVŋ → CVsVp (3), CVsVm (1)

rímíŋ	→	rísìp	'kick'	bɔmɔ́ŋ	→	bɔsɔ̀p	'learn, try, teach'
shímíŋ	→	shíshìp	'wake up, rise'	tɔ́mɔ́ŋ	→	túsɔ́m	'push'

When the verb has the shape CVPVK, the plural form is derived by infixing *-s-* into the C_2 position. [7] In (42a) the labial C_2 of the singular form appears as C_3, where it is devoiced, and the C_3 velar of the singular is deleted. Also reminiscent of Tiene, three of the four pluractional forms in (42b) involve denasalization of /m/ as C_3. The last example of each set shows that there is some irregularity concerning nasality.

As seen in the table in (43), when the base verb has the shape CVTVK, the corresponding pluractional forms show considerable variation:

[7] There are four exceptions: *rómóŋ* → *rós* 'bite-PL', *tsíbík* → *tsip* 'twist-PL', *tɛ́mɛ́ŋ* → *tɛ́m* 'cut-PL, chop down-pl', *zímíŋ* → *zim* 'fling-PL, swing-PL'. Forms like the first three motivate Wolff & Meyer-Bahlburg (1979) and Gerhardt (1984) to propose a singular suffix *-k* (~ -ŋ) which is missing in the plural. Blench's (2005) reconstruction of singulative *-tV in Berom suggests that this *-k* may have originally been **-t* in Izere as well.

(43) CVTVK → multiple forms in the plural

	# sg.	# pl.	CVrVs	CVrVk	CVsVk	CVsVŋ	CVs	CVr	CVk	CV
CVrVk	40	26	13	4	2		1	1	1	4
CVrVŋ	20	1	1							
CVnVŋ	24	12	2	2	1	4	2			
CVsVk	12	6					6			
CVsVŋ	9	2				1	1			

First note that the three shapes whose C_2 and C_3 agree in nasality (CVrVk, CVnVŋ, CVsVk) have the highest percentage of pluractional forms (cf. only one out of 20 CVrVŋ verbs). Examples of some of the patterns are given in (44).

(44) Different patterns when singular = CVTVK

a. CVrVk → CVrVs (13)

kárák → káràs 'open' wórók → woros 'throw, fling'
kórók → kóròs 'pour' yírìk → yírìs 'destroy, demolish'

b. CVrVk → CVrVk (with tone change) (5)

burúk → burùk 'stir' shiríḱ → shirik 'frighten, scare'
berék → bèrek 'support' biríḱ → bírik 'cancel, erase'

c. CVsVk → CVs (all 6)

basák → bás 'seal, paste' bísík → bís 'untie, unfold'
fósók → fós 'peel' (tree bark) kpísík → kpís 'split chuck off larger part'
tásák → tás 'pierce, winnow' mísík → mís 'sprinkle, pour away'

d. CVrVk, CVnVŋ → CVrVs ~ CVrVk, CVsVŋ

bárák → bárás ~ barak 'throw' fíníŋ → fírìs ~ fírìk 'sun-dry'
dorók → dóròs ~ dorok 'leave' tónòŋ → tóròs ~ túsòŋ 'show'
fúrúk → fúrùs ~ furuk 'jump'
tárák → táràs ~ tàràk 'spread out'

Most significantly, all 16 CVrVs verbs derive from CVTVK, either from CVrVk (13), CVrVŋ (1) or CVnVŋ (2), suggesting that in just this one case it was hard to avoid a CVTVT output. Still, as seen in (44d), six of the 16 CVrVs pluractionals have a variant of the shape CVTVK. It is hard to determine whether one variant is older than the other.

The following summarizes the aspects of Izere which resemble the Teke languages:

(45) Special properties of Izere verb stems

a. five stem shapes: CV (100), CVC (165), CVVC (72), CVCV (9), CVCVC (183)[8]
b. limited inventory of C_2 and C_3 consonants in (40) (cf. especially Kukuya in (34b))
c. C_2-C_3 is limited to CVTVP (27), CVTVK (109), CVPVK (36) and CVrVs (16PL)
d. $V_1 = V_2$ in 167/183 or 91% of CVCVC stems
e. -s suffix overrides root non-coronal C_2 (vs. coronal C_2 in Tiene)l;
f. -s- and -r- infixes precede non-coronal C_3 (cf. -s- in Tiene)

Recall that we have had some difficulty finding support for restricting coronals to internal position. It also is rare for a suffix to be infixed because of its place of articulation. Given that such a distant language has so much in common with the Teke languages, we confidently conclude that they must share a common motivation.

8. Towards an account

I suggest that the precondition that allowed for these languages to progress as they did was the limitation of the prosodic stem (root + suffixes) to a maximal triconsonantal structure: CVCVC-V in Tiene, CVCVC in Izere. With this established it meant that there are exactly three positions: initial, medial and final. Since these same languages show stem-initial prominence (e.g. more oppositions in the first CV of the stem), only the C_2 and C_3 were available to be identified with specific places of articulation. Languages which impose a greater maximum or no maximum are not likely to reorganize the system by place of articulation.

With prosodic maximality as a backdrop, I speculate that the Teke and Izere facts were initially triggered by the codification of SPA, followed by different restructurings. Using T to stand for all coronals, *CVPVP-, *CVTVT- and *CVKVK- became prohibited in various stages. It is known that the fusion or "imbrication" of perfective *-id-ɛ, applicative *-ɪd- and causative *-ɪc-i- suffixes which is widely attested in Bantu (Bastin 1983) first applied to bases which ended in coronals. The prohibition against *CVTVT- may therefore have predated the others in Teke. It certainly predated the develop of the non-coronal constraints *CVPVK-, *CVKVP-, which are differentially observed within the Teke languages (and Izere).

Given the relative non-productivity of non-coronal suffixes in Bantu seen in (21), the effect of these prohibitions may have been to marginalize or lose P and K suffixes. Since coronal suffixes were more productive, some kind of accommodation would have had to be made for *CVT-VT-. As we saw in (3a) and (4a), causative -Vs- and applicative -Vl- avoid *CVTVT- by fusing with a CV(V)T- root. Izere relies on the dissimilation of C_3 T to K and metathesis. This produces the derivations in (46).

(46) Infixation and velarization in Izere

a.	*got	[gor]	'pass'	*got-Vs	>	gotos	>	gosot	>	gosok	'pass+PL'
b.	*tɛ́n	[tɛ́n]	'cut'	*tɛ́n+Vs	>	tɛ́nɛ́s	>	tɛ́sɛ́n	>	tɛ́sɛ́ŋ	'cut+PL'
c.	*kon	[kon]	'rub'	*kon+Vt	>	konot	>	koton	>	koroŋ	'rub+PL'

[8] The numbers do not add up to 539 because of exceptional verbs. For example, two verbs have the shape CVCVVC with exceptional C_2-C_3 sequences: *kutáám* 'lose direction', *témɔ̀ɔ̀r* 'throw (piece of food) into mouth at once'.

In (46a,b) the pluractional suffix is *-Vs-*, while in (46c) it is *-Vt-*. In each case the suffixal consonant metathesizes with the coronal C_2 of the root. **t* is realized [r] as C_2, but [k] as C_3. The metathesis in (46a,b) appears to be motivated by the fact that velarization of C_3 *s would have produced [x], which does not otherwise exist in the language. This, however, cannot explain why metathesis is required in (46c). There we note that a non-metathesized output *[konok] would violate the Izere constraint that if C_2 is nasal, then C_3 must also be. One might try to fix this up by producing *[konoŋ], which may be avoided for morphological reasons: Of the 84 CVCVC pluractional verbs in Blench & Kaze (2000), only two irregular verbs have nasal C_2 and C_3: *mas* → *manaŋ* 'laugh+PL', *tsɛ́ɛ́m* → *tsɛ́mɛ́ŋ* 'sift+PL'. Given that pluractionality is marked by [s] and [r] (< **t*), *[konoŋ] may just sound too singular.[9]

The suggestion made here is that once a language both limits its maximal prosodic stem to CVCVC- and introduces severe constraints on C_2-C_3 homorganicity, it invites other restructurings. For example, Tiene speakers would be justified in interpreting CVT-Vs- > CVVs- as a coronal C_3 becoming C_2. If this can serve as the basis of analogy, it might be extended to shift other coronals to C_2, i.e. CVP-Vs-, CVK-Vs- > CVsVP-, CVsVK-. On the other hand, from the other end of the stem, the C_3 velar of the once productive durative/imperfective suffix *-*a(n)g-* may have served as the model for the requirement that C_3 = velar in Teke-Gabon.

There are, however, at least two problems in applying this account to Izere: (i) If CVPVT, CVKVT > CVVT by intervocalic P-/K-deletion, how or why do labials survive in CVPVK? (ii) If CVTVT is prohibited, how does (pluractional) CVrVs survive? Concerning the first question, considerably less is known about pre-Izere than pre-Tiene, which derives from PB. It is possible that we should reconstruct *CVCs and perhaps other clusters in pre-Izere. In this case *CVPs and *CVKs would become CVVs by cluster simplification. *CVPK, on the other hand might have escaped cluster simplification because the second consonant is not coronal or because an epenthetic vowel was inserted to produce CVPVK. Similarly, it is possible that *CVrs escaped cluster simplification and only later became CVrVs. Perhaps there was a contrast in pre-Izere between CVCC and CVCVC. Since I have argued that C_3 *T > K, there also are possible complications deriving from the neutralization of C_3 *T and *K. Finally, it should be noted that some of the C_3 consonants may have been suffixes even on singulars, and that there may even have been a possibility of multiple suffixation (Wolff & Meyer-Bahlburg 1979, Gerhardt 1984).

While the above account is admittedly speculative, and leaves open a number of questions, one can feel at least confident about SPA as a trigger in paring down the number of consonant combinations in a CVCVC- stem. Compare in (47) the possible CVCVC verb stems shapes in Izere vs. nearby Berom (based on Blench et al 2006):

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[9] A few verbs form their pluractional by denasalization, or by -s- affixation + denasalization, e.g. *fíníŋ* → *fírìk* ~ *fírìs* 'sun dry-PL].

(47) Comparison of CVCVC in Izere vs. Berom verbs

a. Izere (9/12 = CVTVP, CVTVK)

C_2/C_3	P	K	T
P	*	**CVbVk** **CVmVŋ**	*
K	*	*	*
T	CVrVp CVrVm CVsVp CVsVm	CVrVk CVrVŋ CVnVŋ CVsVk CVsVŋ	**CVrVs**

b. Berom (12/30 = CVTVP, CVTVK)

C_2/C_3	P	K	T
P	*	**CVmVŋ**	**CVbVt** **CVbVs** **CVmVt** **CVmVl** **CVmVs**
K	**CVgVm**	*	**CVgVt** **CVgVs** **CVŋVt** **CVŋVl** **CVŋVs**
T	CVrVp CVrVm CVlVm CVsVp CVsVm	CVrVk CVrVŋ CVlVk CVlVŋ CVnVŋ CVsVk CVsVŋ	**CVrVs** **CVlVt** **CVlVs** **CVnVt** **CVnVs** **CVsVl**

While 9 out of12 Izere CVCVC forms have coronal + non-coronal C_2-C_3, only 12 out of 30 Berom conform to this template. In fact, even though C_3 may not be /n/, this still allows 16 different CVTVT shapes. What we see from Berom, however, is that the constraints are severest on combinations of non-coronals : there are no CVPVP or CVKVK forms and only one each of CVKVP and CVPVK, the ordering being predictable based on the nasality of the velar. Pozdniakov & Segerer (to appear) not only point out that labials and velars work together as a non-coronal superclass, but also that they show greater SPA effects than the coronal superclass (dental-alveolars and palatals). Whether Berom will develop further in the direction of Izere is not clear. What we can say about the above distributions in Berom is that with two exceptions, a CVCVC stem must contain at least one coronal.[10]

9. Summary

In the preceding sections we have seen that two separate groups of Niger-Congo languages have independently introduced place of articulation constraints on consonant positions within the prosodic stem, which in turn determine whether derivations will involve suffixation or affixation. Although many languages and most of the external evidence from language acquisition and language change suggest that coronals should be realized after non-coronals, these languages have a preference for placing coronals before non-coronals, i.e. CVTVP and CVTVK. Historically, these systems result from the interaction of a number of changes, including

[10] Space limitations preclude a full discussion of pluractional marking in Berom, studied by Bouquiaux (1970) and Blench (2005). Suffice it to say that Berom has both -s- suffixation and infixation, e.g. *yí* → *yís* 'come from-PL', *wùl* → *wùlus* 'arrive-PL', sila → silsa 'fill-PL', *raŋal* → *raŋsal* 'ask-PL'. As the last two examples show, Berom differs from the other languages in allowing CVCCV(C) pluractional stems.

metathesis of the C_2 and C_3 of inherited CVPVT and CVKVT sequences. The fact that this happens independently in the Teke Bantu region and on the Jos Plateau of Nigeria suggests that such sequencing is not isolated or accidental. Based on additional evidence from Kashaya and Mathimathi, it was suggested that the most likely synchronic motivation is that coronals gravitate to "weak" positions. While it appears more common that a language will define strong vs. weak in terms of early vs. late positions within a prosodic domain, in these languages, the weakest position is the medial prosodic trough. Tiene speakers appear to have given an [s-w-s] interpretation to the maximal CVCVC-V stem vs. the more usual [s-w-w] interpretation of Koyo speakers in (19). Interestingly, C_2-C_3 [w-s] appears to be particularly sensitive to place of articulation while C_2-C_3 [w-w] shows a gradual weakening along the traditional strength hierarchies (voiceless → voiced; non-continuant → continuant) (cf. Williamson 1979). In other words, it is [s-w-s] structure that accounts for the relative rarity of Tiene and Izere affixation by place of articulation. That being the case, we would learn a lot more if the rare and (perhaps) mysterious variations in the Teke and Plateau areas were studied in greater comparative detail.

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