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# Two Notes on Igbo Vowels*


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In this paper we document and discuss two generalizations in the phonology of Igbo vowels that to the best of our knowledge have not been noticed before. They bear on issues in feature geometry (in particular homologous place features for consonants and vowels) and structure preserving constraints and associated repair operations. Our discussion focuses on two Igbo constructions--CVCV reduplications and V#V clusters.

We begin by tabulating the phonemes (from Green & Igwe 1963). The vowels are distinguished by the feature [constricted pharynx] rather than [ATR] because it better reflects the intuition that the [ị,ụ,ọ,a] set is marked in comparison to [i,u,e,o]. Also, the vowel system is not symmetric: [e] lacks a [+constr ph] counterpart in the mid front region while [a] lacks a low vowel [-constr ph] partner. We return to these gaps and the appropriate constraints later.

(1) <u>vowels</u> [-constricted pharynx] [+constricted pharynx]

| | | | | | |
|---|---|---|---|---|---|
| i | u | | ị | | ụ |
| e | o | | | | ọ |
| | | | | a | |

<u>consonants</u>

| | | | | |
|---|---|---|---|---|
| p | t, ṭ | c | k, $k^w$ | |
| $p^h$ | $t^h$ | | $k^h$, $k^{hw}$ | |
| b, ɓ | d | | g, $g^w$ | |
| $b^h$, $ɓ^h$ | $d^h$ | | $g^h$, $g^{hw}$ | |
| f | s | | | |
| v | z | | ɣ | h, $h^w$ |
| m | n | | ŋ, $ŋ^w$ | |
| | r,l | | | |
| w | | y | | |


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## 1. Gerundive Reduplication

The gerundive is marked by reduplication for CV verb roots. Longer verbs form the gerundive without reduplication. When verbal, the gerundive takes an [i] prefix; nominal forms are prefixed with [o]. Both prefixes assimilate their [constricted ph] specification from the following root and are low in tone. The CVCV gerundive stem itself is characterized by a number of descriptive generalizations which we first enumerate and then discuss.

The first generalization is that when the root vowel is high, then the two syllables of the CVCV gerundive are identical. In (2) we illustrate this point with examples of CV roots chosen from each of the major consonantal places of articulation.

(2)

| | infinitive | gerundive | |
|---|---|---|---|
| | ị́-pʰ!ị́ | pʰị́pʰị | 'whittle' |
| | í-pì | pìpì | 'hit on head with knuckle' |
| | í-fù | fùfù | 'get lost' |
| | í-zì | zìzì | 'send' |
| | ị́-z!ụ́ | zụ́zụ́ | 'buy' |
| | í-c!ú | cúcú | 'fetch liquid' |
| | ị́-gʰ!ụ́ | gʰụ́gʰụ́ | 'sing, read, count' |

Second, when root vowel is nonhigh then there is never complete identity between the root and the reduplicant because the first syllable of the CVCV gerundive stem must contain a high vowel: e.g. í-sè, sìsè 'stir, draw water'. Since the second syllable of the gerundive stem is always identical with the root, we take the first syllable to be the reduplicant. Its [±constr ph] value as [i,ị] vs. [u,ụ] mirrors the root (as does its tone). The interesting problem presented by the reduplicants concerns the variation between front [i,ị] versus back [u,ụ]. This is determined by the surrounding consonantal and vocalic context. Let us survey the cases one by one.

First, if the root consonant is a coronal obstruent, the reduplicant's vowel is always front /i/ or /ị/.

(3)

| | infinitive | gerundive | |
|---|---|---|---|
| | í-sè | sìsè | 'stir, draw water' |
| | í-s̃!ó | s̃ís̃ó | 'prick' s̃ũs̃ọ |
| | ị́-ṭ!á | ṭị́ṭá | 'bite' |
| | ị́-d!ọ́ | dị́dọ́ | 'pull' |

| | | | |
|---|---|---|---|
| ị́-ṭ!ọ́ | ṭị́ṭọ́ | 'loosen' | ṭụṭọ not too bad/ [illegible] |
| ị́-j!ọ́ | jị́jọ́ | 'be ugly' | jujo ? |
| ị́-c!ọ́ | cị́cọ́ | 'want' | cucọ ? |
| ị́-zọ̀ | zị̀zọ̀ | 'trample' | zuzo |

Note in particular the contrast between í-zù, zùzù 'meet' vs. í-š!ó, šíšó 'prick': the high-vowelled root [zù] copies the back rounded vowel while the nonhigh root [šó] does not. This generalization is systematic: roots with a high vowel always reduplicate completely while those with nonhigh vowels never do-- precisely because the reduplicant's vowel is always [+high].

When the root consonant is a labial, the reduplicant's vowel is [u] or [ụ]. (We follow the orthography and represent the implosive [ɓ] with the digraph gb.)

(4)

| infinitive | gerundive | | |
|---|---|---|---|
| í-m!é | múmé | 'make' | *í-mimi |
| í-m!á | múmá | 'know' | |
| ị́-wè | wùwè | 'take' | |
| í-f!ó | fúfó | 'uproot' | |
| ị́-f!ọ́ | fụ́fọ́ | 'remain' | |
| ị́-f!á | fụ́fá | 'stuff' | |
| í-gb!ê | gbúgbé | 'crawl' | *, jhi-jhe |

Once again high-vowel roots are stable and show a front vowel [i] or [ị] if the root is [i], respectively [ị]. Compare í-b!í, bíbí 'cut' and í-pì, pìpì 'hit on head' vs. fá, fụ́fá 'stuff'. It is clear that there must be a rule spreading labiality from the consonant to the high vowel of the reduplicant--but only when that vowel arises from a nonhigh root vowel.

The labialized dorsals [kʷ] and [gʷ] also spread their labiality demonstrating that the status of labiality as a primary versus secondary articulation does not matter for the rule.

(5)

| infinitive | gerundive | |
|---|---|---|
| í-kʷ!é | kʷúkʷé | 'believe' |
| ị́-kʷà | kʷùkʷà | 'push' |
| ị́-kʷá | kʷụ́kʷá | 'spread out' |
| ị́-gʷ!á | gʷụ́gʷá | 'tell' |
| ị́-ŋʷà | ŋʷùŋʷà | 'tempt' |
| í-k!wọ́ | kʷụ́kʷọ́ | grind |

Finally, the table in (6) shows the behavior of the dorsal and laryngeal consonants under reduplication.

(6)

| | infinitive | gerundive | |
|---|---|---|---|
| | í-k$^{h!}$ó | k$^{h}$úk$^{h}$ó | 'offer' |
| | ị́-k$^{!}$ọ́ | kụ́kọ́ | 'narrate' |
| | ị́-kà | kị̀kà | 'say' |
| | í-kè | kìkè | 'share' |
| | ị́-gá | gị́gá | 'go' |
| | ị́-g$^{!}$ọ́ | gụ́gọ́ | 'deny' |
| | ị́-g$^{h}$á | g$^{h}$ị́g$^{h}$á | 'grow' |
| | í-ŋ$^{!}$é | ŋíŋé | 'pass over' |
| | í-ŋ$^{!}$ó | ŋúŋó | 'be tired' |
| | ị́-họ̀ | hụ̀họ̀ | 'choose' |
| | ị́-hà | hị̀hà | 'release' |

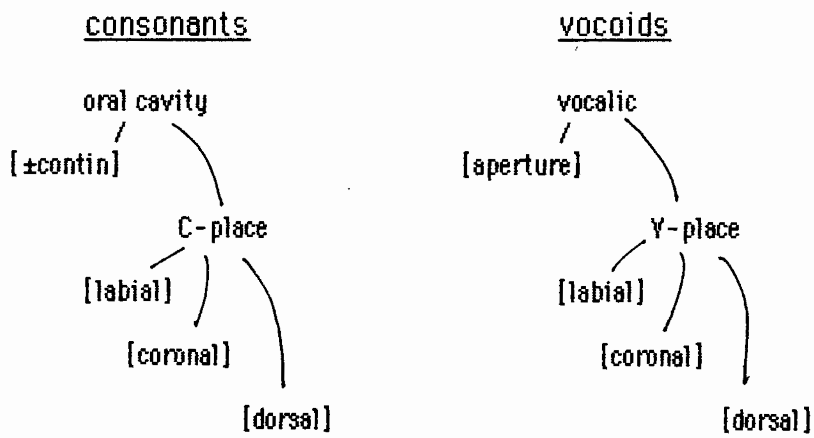
Here we also find spread of labiality when the root vowel is a back round vowel: e.g. kụ́kọ́ 'narrate'.

The Igbo data reviewed so far make a number of points bearing on feature theory that are worthy of note. First, they replicate the labialization paradigm from Tulu (Bright 1972) discussed by Clements (1990) as support for a feature [labial] that comprehends both labial consonants and round vowels. Indeed, the Igbo data are richer showing that labialized consonants serve as the source of the spreading as well. In effect, any labial segment (consonantal or vocalic) in the local environment initiates labialization. Second, if the vocalic cases in (6) are properly grouped with those in (4) and (5), they suggest that labial assimilation is a right-to-left regressive process in Igbo.

We must now confront the asymmetry in the behavior of the velar and coronal obstruents. The coronals (3) systematically block the spread of labialization while the velars (6) do not: cf. dị́dọ́ 'pull' vs. kụ́kọ́ 'narrate'. This asymmetry is puzzling under the traditional generative model in which front vowels are characterized by the feature [-back] as a dependent of the Dorsal articulator. Why should coronal obstruents block the spread of [+back, +round] while velars remain permeable? Such blocking behavior is expected from secondary articulations on consonants (palatalization, labialization, velarization) which are defined in the traditional model by the [±back, ±round] features that mark vocalic articulations. But in the Igbo gerundive the coronal versus dorsal contrast of (3) vs. (6) concerns the primary consonantal articulator.

Hume (1992,1994) interprets a parallel asymmetry from Maltese Arabic as evidence for grouping front vowels and coronal consonants under the common feature [coronal]--part of a more general enterprise (Clements 1990, Clements & Hume1993) to unify place of articulation for consonants and vowels under the common schema illustrated in (7).

(7)




Hume's discussion centers on the Maltese measure-I imperfects from Brame (1972) where the CV prefix assimilates the labialization of the following [o] (8a). But when the first radical is a coronal obstruent, the prefixal vowel remains as [i] (8b).

| | | | |
|---|---|---|---|
| (8) | a. | no-bzo? | 'I spit' |
| | | no-fto? | 'I unstitch' |
| | | no-krob | 'I groan' |
| | | no-ħlom | 'I dream' |
| | | no-?tol | 'I kill' |
| | | no-mšot | 'I comb' |
| | b. | ni-tlob | 'I pray' |
| | | ni-dħol | 'I enter' |
| | | ni-skot | 'I become silent' |
| | | ni-zlo? | 'I slip' |
| | | ni-šrob | 'I drink' |
| | | ni-ǰbor | 'I pick up' |

Brame (1972) formulates the linear rule in (9).

(9) $$[i] \rightarrow [o] \;/\; \underline{\quad} \begin{bmatrix} \text{+cons} \\ \{\text{+sonor}\} \\ \{\text{-coron}\} \end{bmatrix} C_0\,[o]$$

When the Maltese labialization process is translated into an autosegmental rule of spreading, the behavior of the coronal obstruents becomes especially puzzling. They block labialization when they immediately follow the prefixal vowel (e.g. ni-tlob 'I pray', ni-šrob 'I drink') but not when they immediately precede the source [o] (cf. no+?tol 'I kill', no-mšot 'I comb'). The blocking behavior is puzzling enough in itself but its dependence on the initial versus terminal position in the intervening consonant cluster only compounds the mystery.

Hume (1992,94) proposes an analysis along the following lines. The imperfect prefix is an empty V-slot that receives V-Place specifications from the local environment. Two rules are assumed: the first (10a) spreads [coronal] from an obstruent to the immediately preceding empty V-slot. This rule precedes a more general rule spreading [labial] (10b).

```
                       [-sonor]
                          |
(10)  a.    V-Pl        C-Pl          (feature filling)
               `  .       |
                    ` .   |
                       ` [coronal]


      b.    V-Pl  C0    V-Pl          (feature filling)
               `  .       |
                    ` .   |
                       ` [labial]
```

If the front vowel [i] and the consonants [t,d,s,z,š,ǰ] are defined by the same place feature [coronal] as proposed in (7), then the Maltese paradigm has a natural explanation: the empty prefixal vowel assimilates its V-Place specification from a following coronal obstruent. This process precedes (and bleeds) a more general rule spreading labialization from [o]. Under this analysis the peculiar wrinkle in Brame's rule (9) is factored into a separate process of feature spreading that is on a par with the labialization rule itself--both are processes of V-Place assimilation.[1]

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[1] The labial specification on the intervening consonant in [no-bsot] does not block spreading on the assumption of Clements (1990) that the V-Pl node is embedded under C-Pl and so eludes a crossing violation.

[n] [o] [b] [s] [o] [t]

Hume's Maltese analysis translates more or less point for point to the Igbo reduplicative structures. Let us assume that after complete reduplication a rule delinks the features depending from the vocalic node of the reduplicant when it dominates a nonhigh vowel. The resultant empty V-Place node then receives a [coronal] specification from the following obstruent by (10a). Just in case this rule has not applied, then [labial] is assimilated from the local context by the rule in (11) that very much resembles (10b).

```
                          [±cons]
                             |
(11)        V-Pl          V/C-Pl       (feature filling)
              \              |
               \             |
                 \           |
                   `      [labial]
```

Our analysis requires two additional subsidiary rules. First, the feature [dorsal] must be added to [labial] in vowels by an enhancement process that couples [labial] with [dorsal] in order to lower the second formant; the addition of [dorsal] localizes the labial vowel in the rear of the oral cavity. Second, there is essentially just one situation in which the reduplicant's vowel escapes the rules of coronalization (10a) or labialization (11)--when the root contains a dorsal consonant followed by a nonlabial vowel: e.g. kịka.

---

```
  C    V    C    C    V    C
  |    |    |    |    |    |
 CPl  CPl  CPl  CPl  CPl  CPl
  |    |    |    |    |    |
 cor   |   lab  cor   |   cor
      VPl            VPl
         \            |
           \          |
             `       lab
```

This allows the vocalic place feature to spread over the same consonantal feature unless the latter marks a secondary articulation which is represented at the V-Pl level and thus accounts for the well-known blocking of palatal consonants in Barra Gaelic. It is also designed to explain an asymmetry between consonant and vowels: while vowels may spread place features across a consonant, a consonant does not spread its place features across a vowel. So-called "consonant harmony" in child language would appear to be a counterexample to the ban on consonantal place spreading. However, see Levelt (1994) for evidence that apparent cases of consonant harmony are really spreading from the intervening vowel.

It is worth observing that the price for introducing the C-Pl vs. V-Pl distinction is that the difference between consonants and vowels is expressed at more than a single location in the feature tree--at the root node and at V-Pl vs. C-Pl. Also, embedding the V-Pl node under C-Pl is formally quite similar to Government Phonology's notion of "nucleus projection" (see e.g. Charette 1990).

In this case the reduplicant's front vowel [coronal] specification must be defined by a context-free default rule (12).

(12) V-Pl → V-Pl (feature filling)

$$
\begin{array}{c}
\text{V-Pl} \\
| \\
| \\
\text{[coronal]}
\end{array}
$$

We have so far been silent about reduplicants with a coronal sonorant. Here there is another interesting parallel with the Maltese Arabic paradigm discussed by Hume. As the following Maltese data from Brame (1972) indicate, coronal sonorants show labialization of the prefixal vowel--hence the wrinkle in rule (9) is limited to obstruents. This restriction is translated into Hume's autosegmental analysis by limiting (10a) to coronal consonants whose root node is marked by [-sonorant].

| | | |
|---|---|---|
| (13) | nó-rbot | 'I tie' |
| | nó-nfo? | 'I spend' |
| | nó-l?ot | 'I hit' |

Turning to the Igbo CVCV gerundives, we find that both [i] and [u] are possible when C is [n], [l], [r], or [y] with an apparent preference for [u] when the prefix is the nominal [o] and for [i] when prefix is the verbal [i].

?i nuno
*i nuno

| (14) | infinitive | gerundive | | |
|---|---|---|---|---|
| | ị́-nọ̀ | ị̀-nị̀nọ̀, ọ̀-nụ̀nọ̀ | 'stay' | possible |
| | í-l!ó | ì-lílò, ó-lúló | 'swallow' | ililo o lilo ~ o lulo preferable |
| | í-rò | ì-rùrò, ò-rùrò | 'settle' (sediment) | |
| | ị́-rọ̀ | ị̀-rị̀rọ̀, ọ̀-rụ̀rọ̀ | 'bend' | |

On the unified place theory of (7), the spreading of the coronal articulator to the adjacent vowel must be optionally extended to sonorants in Igbo. If it fails to apply then the labialization rule steps in to round the vowel of the reduplicant.

While this analysis is an improvement over the traditional one based on [±back], there are still certain gaps in our understanding of how just how homogeneous consonantal and vocalic place features are. Two points in particular remain unanswered. First, if the reduplicant's empty vowel assimilates its place features from the following consonant, we might ask why velar consonants such as [k] do not induce a back vowel [ụ] instead of the front vowel [ị] observed in kịka. Is this a simple descriptive gap in Igbo? Or does it reflect a more general disparity between labials and coronals on the one hand, where the evidence for uniting [p,f, etc.] with round vowels and [t,s, etc.] with front vowels is rather strong, and dorsals on the other hand, where the connection between (plain) velar consonants and back vowels is less secure? Clements & Hume (1993) support the back vowel-velar consonant connection with reference to Traill's (1985) analysis of Buru where there is a constraint requiring back vowels in the context of velars and uvulars. A similar distribution is displayed by the imperfect root vowel of Palestinian Arabic (Herzallah 1990) where [u] is found in the context of back velars and uvulars (but not the plain velar [k], which requires default [i]!). Clearly, more support is needed for this point. Cases in which the connection runs from vowel to consonant seem more secure: e.g. Dell (1993) points to the realization of /N/ as [ŋ] in the context of back vowels and as [n] in the context of front vowels in the Chinese dialect Yongding; he also mentions the Tibeto-Burman language Hayu (Michailovsky (1988:58) where /h/ is realized as the dorsal fricative [x] after [a,o,u,U] and as the palatal [ç] after [i,I,e]. See also Levelt (1994:63) for cases from child language phonology in which dorsal consonants are produced in the context of back vowels.

Second, the relative weakness of the sonorants in comparison to the obstruents as a source of spreading [coronal] remains a mystery. The fact that the same asymmetry shows up in Igbo suggests that something deeper is at work that the proposal to unify front vowels and coronal consonants is failing to capture. Additional data from another Arabic dialect indicates that the special behavior of the coronal sonorants is not properly characterized as being a relatively suboptimal source for spreading [coronal]; indeed, the asymmetry should go in the opposite direction if shared constriction features such as [sonorant] are an inducement to participate in place assimilation in the first place. In many Bedouin dialects (Irshied & Kenstowicz 1984, McCarthy 1990) short [a] is raised to [i] in a open syllable (15a). The rule is inhibited by an adjacent guttural consonant (15b). Raising is also blocked in CaCaC roots with a medial coronal sonorant (15c). Apparently, the open ([pharyngeal]?) vowel of the second syllable is able to penetrate through the medial [l,r,n] to block raising just like an adjacent guttural. Other sonorants (e.g. [m] (15d) do not inhibit the reduction rule.

| | | | | | |
|---|---|---|---|---|---|
| (15) | a. | /katab/ | → | kitab | 'he wrote' |
| | | /kasar/ | | kisar | 'he broke' |
| | | /dafan/ | | difan | 'he buried' |
| | | /lagam/ | | ligam | 'he punched' |
| | | /laban/ | | liban | 'milk' |
| | b. | /saħab/ | | saħab | 'he pulled' |

| | | | |
|---|---|---|---|
| | /ħamal/ | ħamal | 'he carried' |
| | /xadam/ | xadam | 'he served' |
| c. | /balas/ | balas | 'he denounced' |
| | /sarag/ | sarag | 'he stole' |
| | /šanag/ | šanag | 'he beheaded' |
| d. | /jama9/ | jima9 | 'he collected' |

Why [l,r,n] have this property while [t,d,s,š, etc.] do not remains mysterious.

A nonsystematic survey of the coronal "transparency" literature suggests a hierarchy in which sonorants are more permeable than obstruents. For example, Paradis & Prunet (1989) report vowel copy in Fula that crosses the sonorant [r] as well as the obstruent [t] and [ɗ]; in Guere there is copy across [l] and [ɗ]; but in Mau the process is apparently restricted to [l,r]. Marotta & Savoia (1991) discuss a vowel copy process in certain Calabrese dialects of Italian that crosses the sonorants [r,l,n,ḍ<*ll]. Indeed, in Igbo itself the -rV perfective suffix copies the preceding vowel: sì-rì 'cooked', sị̀-rị̀ 'told a lie', sè-rè 'quarreled', s̃à-r̃à 'wash'. We know of no cases of transconsonantal vowel copy that crosses obstruents to the exclusion of sonorants. The articulatory/perceptual basis for this asymmetry is unclear. In any case, it suggests that the paradigms in (13) and (14) may reflect a competing process of vowel copy across coronal sonorants that preempts an unrestricted version of rule (10a) as well as (11) and (12).

Let us close this section with a brief comparison of the cognate reduplication structure in Yoruba.[2]

| | | | |
|---|---|---|---|
| (16) | bí | bíbí | 'to give birth' |
| | pín | pípín ≈ pínpín | 'to divide' |
| | yìn | yíyìn ≈ yínyìn | 'to praise' |
| | bù | bíbù ≈ búbù | 'to scoop' |
| | dù | dídù ≈ dúdù | 'to scramble for' |
| | dùn | dídùn ≈ dúndùn | 'to be sweet' |
| | kù | kíkù ≈ kúkù | 'to remain' |
| | rù | rírù ≈ rúrù | 'to carry on the head' |
| | lù | lílù ≈ lúlù | 'to beat' |
| | tú | títú ≈ tútú | 'to unravel' |
| | gùn | gígùn ≈ gúngùn | 'to be long' |

[2]Thanks to Yetunde Laniran for data and discussion. We follow Yoruba orthography by representing nasal vowels with the consonant [n].

| | | |
|---|---|---|
| fẹ́ | fífẹ́ | 'to love' |
| tọ́ | títọ́ | 'to take care of' |
| fò | fífò | 'to jump' |
| kó | kíkó | 'to gather' |
| lò | lílò | 'to use' |
| pọ́n | pípọ́n | 'to be ripe' |
| fọ́n | fífọ́n | 'to scatter' |
| rá | rírá | 'to crawl' |
| tàn | títàn | 'to shine' |

There are a number of similarities to as well as differences from the Igbo situation worthy of note. While the consonant of the CV reduplicant copies the root, the features of the vowel are more stable than in Igbo. Specifically, the vowel is always high-toned; and since there is no tongue root contrast among the high vowels in Yoruba, it fails to harmonize with the root for [ATR] or [RTR]. As in Igbo, the Yoruba reduplicant vowel shows the default value [i]--but in a greater range of contexts. In fact, the vowel is always [i]--with the option of complete reduplication and no reduction when the root vowel is high. As we have seen, complete reduplication of high vowels is obligatory in Igbo. When viewed from the Igbo perspective, we can say that the Yoruba reduplication arises from complete reduplication followed by delinking at the level of the root node. The delinking is obligatory for nonhigh vowels and optional for high vowels. If delinking applies, the root node is filled by the features defining the default vowel [i] (Pulleyblank 1988). Unlike in Igbo, there is no rule assimilating labiality from the local context. Finally, since the prefix is uniformly high toned, a separate rule must either delete (or fail to copy) the tone of the root and replace it with [high]. The independent behavior of tone from the remaining features recalls the Igbo situation in which the tone of the root is preserved in nonhigh vowels which otherwise shed their vocalic features. Finally, we recall Igbo í-s̃!ó, s̃ís̃ó 'prick' showing that vowel nasality (marked by the tilde on "s") is preserved even in roots whose vowel is nonhigh. The delinking process in Igbo thus takes place at a lower level in the feature tree--the vocalic node. Since both prefixes and suffixes harmonize for [RTR] in Igbo, we cannot tell if the [RTR] specification of the reduplicant's vowel is spread from the root vowel or if it is rather a residue of the copying under reduplication that survives delinking. In the next section we turn to evidence that vocalic place features may spread independent of [RTR].[3]

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[3]Igbo has a rule spreading nasality from left to right through a string of sonorants; the nasality of the reduplicant in s̃ís̃ó cannot be due to this rule but rather must be a survivor of delinking.

## 2. V*V assimilation

Like many other languages of Africa, Igbo sharply reduces the range of vowel clusters that arise from combining words into sentences. The assimilations we study here seem to have no particular phrasing requirements and operate freely so long as there is no "pause" between words. Given the language's eight underlying vowels, there are 64 possible combinations that can arise in the V*V construction. If nasality and tone are factored in then the number of possible combinations is much larger. We illustrate some of the sequences and their resolution below. First a word about the data. Our transcriptions are based on careful listening and comparison with cases in which the underlying vowel*vowel combinations appear to remain unchanged. That is to say, when spoken at a normal rate of speech underlying /rá ị̀kpà/ 'lick an ikpa' becomes homophonous with /rị́ ị̀kpà/ 'climb an ikpa'; and each differs from /ré ị̀kpà/ 'sell an ikpa' and /rí ị̀kpà/ 'eat an ikpa', which in turn are homophonous with one another.[4]

The basic generalization is that when the first member of the V*V cluster is nonhigh, it assimilates the height and quality of the following vowel but preserves its own tone, nasality, and where possible [constricted pharynx] specification. The paradigm in (17a) shows that high vowels remain unchanged before another vowel while (17b) samples cases where a nonhigh vowel assimilates the quality of the following vowel.

| | | | | |
|---|---|---|---|---|
| (17) | a. | zụ́ èŋwè | [ụ́+è] | 'buy a monkey' |
| | | zụ́ òké | [ụ́+!ó] | 'buy a rat' |
| | | zụ́ ícé | [ụ́+í] | 'buy a parrot' |
| | | zụ́ úzè | [ụ́+ú] | 'buy a squirrel' |
| | | zí èŋwè | [í+è] | 'send Mr. Monkey' |
| | | zí òké | [í+!ó] | 'send Mr. Rat' |
| | | pị́ èŋwè | [ị̀+è] | 'castrate monkey' |
| | | | | |
| | | ré ìkó | [í+!í] | 'sell a cup' |
| | | cọ́ ákwà | [á+á] | 'seek a cloth' |
| | | rá ọ́bà | [ọ́+ọ́] | 'lick a gourd' |
| | | rọ̀ ụ̀tá | [ụ̀+ụ́] | 'bend a bow' |
| | | kè ófé | [ò+ó] | 'share out soup' |
| | | sa̰ ụ́lọ̀ | [ṵ +ụ́] | 'wash house' |

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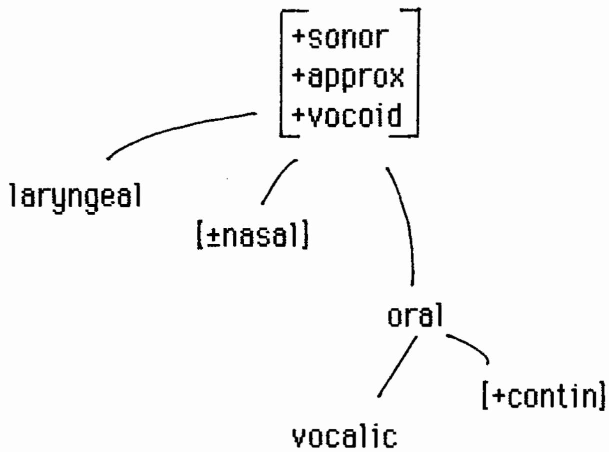
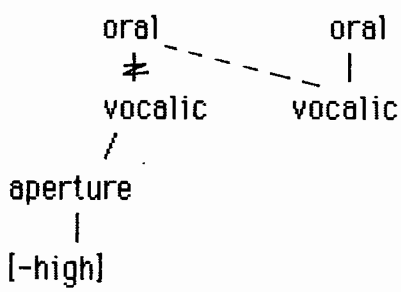
[4] See Zsiga (1993) for a different view of Igbo hiatus resolution as a gradient phonetic process that compresses the temporal duration of $V_1$ to give the perception of assimilation.

Given the feature organization for vocoids in (18a) (based on Clements & Hume 1993), the assimilation can be expressed as the rule in (18b) that spreads the vocalic node leftwards delinking a [-high] vowel. In this model the stability of nasality, tone, and [constricted pharynx] makes sense. The spreading and delinking operates at the level of the oral cavity node and so the tone, nasality, and pharyngeal specifications of both the spreading $V_2$ and recipient $V_1$ remain unaffected.

(18) a.




b.




The stability of the high vowels (17a) recalls the pattern seen in reduplication. In both the Igbo gerundive CVCV and the V#V constructions, it is the more sonorant nonhigh vowels that are blocked from appearing in the "governed" position on the left (unless they simultaneously appear at the right edge of this domain) .

Finally, there are cases in which the pharyngeal constriction specification of $V_1$ must be adjusted with respect to the V-Place and aperture specification of the spreading $V_2$ vowel. On the assumption that segmental inventories arise from the free combination of designated features, we posit the filters in (19) to characterize the absence of [ẹ] and [ạ].

(19) $* \begin{bmatrix} +\text{constr ph} \\ +\text{coronal} \\ -\text{high} \end{bmatrix} \quad \begin{bmatrix} * & -\text{constr ph} \\ & +\text{low} \end{bmatrix}$

If spreading the vocalic node of $V_2$ leads to a violation of these constraints, then the [constr ph] specification of $V_1$ gives way. Let us survey these cases systematically.

The paradigms in (20) show cases in which the [±constr ph] specification of $V_1$ is preserved because $V_2$ is a vowel that is compatible with both values of [±constr ph].

| | | | |
|---|---|---|---|
| (20) | kọ̀ ị̀kpà | [ị̀+ị̀] | 'scoop an ịkpa' |
| | $\mathrm{k^h}$ó ị̀kpà | [í+ị̀] | 'present an ịkpa' |
| | | | |
| | kọ̀ ụ́kpà | [ụ̀+ụ́] | 'scoop nuts' |
| | $\mathrm{k^h}$ó ụ́kpà | [ú+ụ́] | 'present nuts' |
| | $\mathrm{k^h}$ụ́ ụ́kpà | [ụ́+ụ́] | 'sew nuts' |

When $V_1$ is the [-constr ph] [e], then [-constr ph] will be preserved so long as $V_2$ is a vowel that is compatible with [-constr ph]--essentially any vowel but [a].

| | | | |
|---|---|---|---|
| (21) | ré ọ́bà | [ó+ọ́] | 'sell a gourd' |
| | rọ́ ọ́bà | [ọ́+ọ́] | 'rub a gourd' |
| | | | |
| | ré ị̀kpà | [í+ị̀] | 'sell an ikpa' |
| | rị́ ị̀kpà | [ị́+ị̀] | 'climb an ikpa' |

Similarly, [a] groups with the [+constr ph] vowels in the sense that when it assimilates to a following vowel, the initial portion of the resultant cluster is systematically [+constr ph]. There is just one case where this is not true--when the second vowel is [e]. In this case the result is [e+e].

| | | | |
|---|---|---|---|
| (22) | rá ìkó | [ị́+!í] | 'lick a cup' |
| | rị́ ìkó | [ị́+!í] | 'climb a cup' |
| | rí ìkó | [í+!í] | 'eat a cup' |
| | ré ìkó | [í+!í] | 'sell a cup' |
| | | | |
| | rá ésó | [ẹ́+é] | 'lick an eso fruit' |
| | ré ésó | [ẹ́+é] | 'sell an eso fruit' |

More generally, when $V_2$ is [e], then [+constr ph] is not preserved on $V_1$.

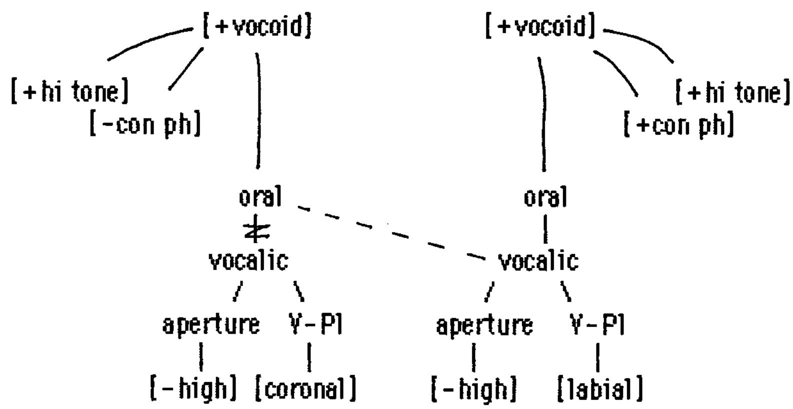
(23) cọ́ és!ó [ė+ė] 'seek an eso fruit'
cé és!ó [é+é] 'preserve an eso fruit

Similarly, when $V_2$ is [a] then [-constr ph] is not preserved on $V_1$.

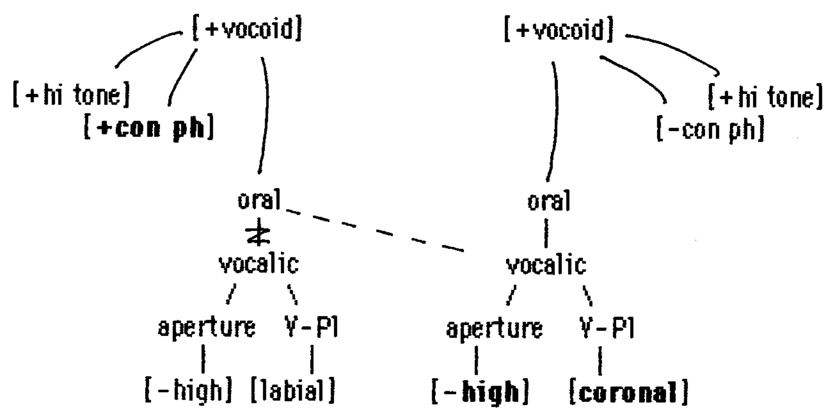
(24) kʰó àkpà [á+à] 'present a bag'
kọ̀ àkpà [à+à] 'scoop a bag'

To show how our analysis works, we give two derivations: [é+ọ́] → [ó+ọ́] and [ọ́+é] → [é+é]. In the first case (25a), the [-constr ph] of $V_1$ is compatible with [o] vowel quality. But in the second case (25b) the [+constr ph] of $V_1$ [ọ] violates the constraint in (19) that prevents this feature from combining with nonhigh coronal (front) vowels. We highlight the conflicting features. The violation is repaired through delinking the [+constr ph] specification and replacing it with [-constr ph].

(25) a.




b.



As we have just seen, if the spreading vowel features create an output that violates the filter, then it is the [±constr ph] specification of $V_1$ that is delinked. This behavior contrasts with that found under vowel harmony. As shown by the paradigm in (26), affixal [e] and [a] alternate as a function of the [constr ph] of the root in parallel with [i] versus [ị] and [o] vs. [ọ].

| | | |
|---|---|---|
| (26) | é r!í-rí mụ́ ánụ́ | 'I ate meat |
| | í r!í-rí ánụ́ | 'you ate meat' |
| | ó r!í-rí ánụ́ | 'he ate meat' |
| | | |
| | á c!ọ̀-rọ̀ mụ́ ánụ́ | 'I want meat' |
| | ị́ c!ọ̀-rọ̀ ánụ́ | 'you want meat' |
| | ọ́ c!ọ̀-rọ̀ ánụ́ | 'he wants meat' |

This alternation also reflects the filters in (19) in the sense that the height of the vowel is adjusted to accommodate the spreading [±constr ph]. Thus, in both (21-24) and (26) the same filters are controlling the outputs--but in different ways. Under V*V hiatus resolution, it is the height feature of $V_2$ that is preserved at the expense of the [±constr ph] in $V_1$. In vowel harmony on the other hand the V-Place features are adjusted to accommodate [±constr ph]. In both cases, however, it is the spreading feature that is maintained at the expense of a feature on the segment that is targeted by the rule. This may reflect a kind of economy of derivation. Given the constraints in (19), it would make no sense for vowel harmony to spread [constr ph] to the prefix and then have the filter remove it to produce a result that is no different from the input. Similarly, it would make no sense to delink the vocalic node in hiatus resolution in order to resolve the clash of [+constricted ph] with [-high, coronal] in (25b) since the result would make application of the spreading rule vacuous. See Calabrese 1994 for recent discussion of this sense of economy of derivation.

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