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NASALITY IN OGBERIA

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A study of nasality in Ogberia[1] leads to the proposal of an autosegmental analysis that is shown to have significant advantages over a (linear theory) segmental analysis within standard generative phonology. In particular, the autosegmental analysis involves one nasality mapping rule that assigns and spreads nasality to nasality-bearing units, in a principled and predictable manner, as against (at least) two rules required by the segmental analysis. Furthermore, the nasality mapping rule encodes a unidirectional left-to-right nasality spread, thus providing a natural explanation for apparent exceptions to nasalization within a linear theory phonological process. Although Ogberia and Gokana (Hyman, 1982) are fundamentally quite different in terms of (underlying) phonological representation of nasality when viewed from the segmental perspective, the two languages are nevertheless quite similar from the perspective of the autosegmental analysis. We are thus led to the conclusion that significant universal properties of nasality may be missed when languages with inherently suprasegmental nasality are forced into a linear theory straightjacket.

Une étude des faits de la nasalité en ogbéria nous mène à proposer une analyse autosegmentale qui est plus avantageuse que l'analyse (liniaire) segmentale de la perspective générative. Plus précisement, l'analyse autosegmentale envisage une seule règle d'association qui assigne la nasalité et l'étend de manière prédictable aux éléments nasalisables au lieu de deux règles (au moins) requises par l'analyse segmentale générativiste. De plus, cette règle d'association préconise un mouvement unidirectionnel de nasalité de gauche à droite, ce qui explique, de façon toute naturelle, les exceptions à la règle phonologique de la nasalization selon la perspective segmentale. Bien que l'ogbéria et le gokana (Hyman, 1982) soient fondamentalement différentes du point de vue de la structure phonologique sous-jacente de nasalité, ils sont cependant très similaires du point de vue de l'analyse autosegmentale. Nous sommes donc amenés à la conclusion que certains caractéristiques universels de la nasalité se perdent quand une langue dont la nasalité est essentiellement suprasegmentale est figée dans un paradigm de l'analyse segmentale.

1. INTRODUCTION

It is now fairly well established that nasality in a number of languages is better viewed as a suprasegmental rather than a segmental feature. Thus, in languages like Terena (Bendor-Samuel, 1960), Desano (Kaye, 1971), Guarani (Lunt, 1973), Gokana (Hyman,

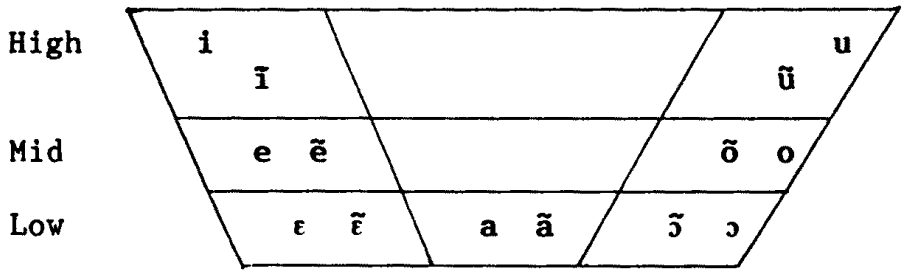
1982) it has been shown that nasality is a 'prosody' on the same level as the well known bona fide prosodies or suprasegmentals like tone and stress. In particular, it is argued that in such languages a [+nasal] specification covers a domain larger than a segment. The advent of Autosegmental Phonology (Goldsmith, 1976) which allows a multi-tiered representation of phonological structure in terms of autonomous and independent levels such that tone, for instance, is represented on a separate and autonomous tier from the vowels and other syllabic elements with which it is identified, has led to autosegmental treatment of nasality as well (e.g. McCarthy, 1981, and Hyman, 1982).

The literature on Autosegmental and Metrical Phonology however, readily shows that there are relatively fewer attempts to autosegmentalize nasality than there are for tone and stress. In this paper, a study of nasals and nasalization in Ogberia leads to an autosegmental analysis which is shown to have significant advantages over a segmental treatment within a linear theory of Phonology (the standard generative phonology of Chomsky and Halle (1968).

2. PHONETIC INVENTORY OF OGBERIA SOUNDS

The surface sound segments attested in Ogberia are summarized in the consonant and vowel charts below.

2.1 PHONETIC VOWEL CHART



2.2 PHONETIC CONSONANT CHART

	Bilabial	Labiodental	Alveolar	Alveopalatal	Palatal	Velar	Labiovelar	Glottal
STOP	p b		t d			k g k^w g^w	kp gb	
NASAL	m		n	ɲ		ŋ		
						$ŋ^w$		
FRICATIVE		f	s z	š				h
								h^w
AFFRICATE			ts dz	ts dz				
LATERAL APPROXIMANT			l					
CENTRAL APPROXIMANT					j		w	
TRILL			r					

2.3 NASAL AND NASALIZED SEGMENTS:

There are four nasal consonants in the language: bilabial [m], alveolar [n], palatal [ɲ], and velar [ŋ] as evidenced in 2.2. There are seven oral and seven nasalized vowels in the language as shown in 2.1 but vowels [ẽ] and [õ] are restricted in distribution (as discussed with exemplification below.)

3. DISTRIBUTION OF NASALITY

With respect to nasality there are three types of lexical morphemes in Ogberia.

(1) lexical morphemes with no nasal segments.

kɔ	grind	lɛb	bite	àbɔ́rɔ̀	tongue
zì	steal	gɔ̀b	choose	òkwòrè	mountain
dži	kill	para	unite	kpòlabo	vulture
wé^2	that	rìbè	kolanut	ìsisab	toad
jé^2	that	òzi	thief	òkpákúrú	table

(2) lexical morphemes with nasal consonants but not nasalized (or nasal) in vowels. These are relatively few in number.

(a)			(b)		
	ǹdā	tray		èbìém ~ [ebʲem]	heap
	ŋ́kà	I take		ídžen	your
	ndžè	I go		tíèn ~ [tʲen]	refuse
	ḿbè	I come		rítém	heart

(3) lexical morphemes with both nasal consonants and nasalized vowels.

(a)			(b)		
	bḯn	break steak		ènɛ̀	mother
	nûŋ	smell		èmõ	water
	lɔ̀m	bite		oɲẽ	wife
	ògǔn	wall		òɲì̩ɲẽ	woman
	ɔ̄tām	goat		ònì̩džé	person
	inɛ́m	heavy			
	ikwɛ̄n	firewood	(d)	ǹda	tray
	mɔ̃rɔ	swallow		ŋ́kwikwáŋ	plantain
	ɲɛ̀bɛ̀ɛ̀	urinate		ŋ̀kánàŋ	bed
	ɲèbu	defecate		ŋ̀kpɔ́kín	shoe
	bìdán	fire		ḿbiń	I break
				ḿmé	I run
(c)	tìrì̩mɔ̀	weep		ńnò	I dance
	ùgbàmà	town		ńtɔ̃m	I bite
	rɪ̀kɔ́ɲ̩ɔ́	corpse		ŋ́kûŋ	I carry
	ùfûmìpó	blow of wind			
	džɪ̄ɲ̩ɔ̃	drink	(e)	inẽn	your
	gúnì̩ríbu	gather		ìkɔ̃mómén	his/her navels
	ùkāmɪ̄ɲã	horse		ómén	his/her
				ikɔ̃m	navels
				rìdžínómẽn	his/her nose

Notice that the restriction on nasalized vowels in (2) are of two types:

(i) In the morphemes in (2a) (where the nasal consonant is homorganic with an adjacent oral consonant), the oral consonant, not being a nasality-bearing unit in this language, does not take up the nasality of the preceding homorganic nasal and consequently also insulates the following vowel(s) from the effect of nasality.[3]

(ii) In the morphemes in (2b) the vowels **e**, **o** preceding a nasal consonant do not get nasalized (but are nasalized when they are preceded by a nasal consonant as evidenced in (3b) where post nasal **e** and **o** in the forms for 'wife', 'water', etc. are nasalized).[4]

In (3), the nasalized vowels are invariably preceded or followed by nasal consonants. However, whereas all vowels are nasalized when preceded or followed by a nasal consonant, vowels **e** and **o** are nasalized only when preceded by a nasal consonant and surface as oral vowels when followed by a nasal consonant as already mentioned above (see the forms in (3b)).

4. OVERVIEW OF NASALITY

The relevant facts of nasality (i.e. nasals and nasalization) in Ogberia can be summarized as follows:

(4a) Words in the language may consist entirely of oral segments.

(4b) The language also has words with nasal consonants and nasalized vowels.

(4c) Nasalized vowels occur only contiguous with nasal consonants, such that words with nasalized vowels predictably also have nasal consonants.

(4d) Not all vowels in the vicinity of a nasal consonant are automatically nasalized however. Vowels **e**, **o** when preceding a nasal consonant are not nasalized.

(4e) There are generally no consonant clusters in the language. The only case of two adjacent consonants is where the first consonant is a syllabic nasal homorganic with the succeeding consonant.[5]

5. NASALITY WITHIN MORPHEMES

From the data 1 - 3, in section 3, it is evident that <u>verbs</u> in Ogberia have the following canonical shape:

\+ CV (C(V))(CV)

(5a)	**kɔ**	'grind'	**nɔ̀**	'dance'	**tsù**	'pull'	CV
	gòb	'choose'	**nùŋ**	'smell'	**bín**	'break'	CVC
	bérè	'climb'	**džĭmɔ̃**	'think'			CVCV
	ɲẽbèsè	'urinate'	**tìrìmɔ̀**	'weep'	CVCVCV		

<u>Nouns</u> have the following shape:

V-CV(C(V))((CV)C)

(5b) (i)

òzi	'thief'	**ènɛ̀**	'mother'	V-CV
àsãm	'matchet'	**ɔtãm**	'goat'	V-CVC
òɲìɲẽ	'woman'	**ofãm**	'town'	V-CVCV
ùkàmíɲã	'horse'	**ufùmĭpo**	'wind'	V-CVCVCV
ɔ̀tùrukãŋ	'lantern'			V-CVCVCVC

CV-V(C(V))

(5b) (ii)

ríbè	'kolanut'	**bènɔ̀**	'salt'	CV-CV
rítém	'heart'	**ri-dšĭn**	'nose'	CV-CVC
rìfènɛ̀	'lie'	**rìkàmà**	'crab'	CV-CVCV

The initial V and CV in 5b(i) and 5b(ii) are noun class prefixes and function as separate morphemes from the noun stem in that, among other things, they are normally not nasalized in the vicinity of a nasal consonant.

The morphemic shape of adjectives and adverbs is similar to that of nouns, with respect to morpheme initial vowels. However, whereas the initial vowel of the noun is not nasalized because it is a noun class morpheme, it is nasalized for the other grammatical categories, because such initial vowels constitute an intergral part of the stem or lexical morpheme. Consider the data in (5c).

(5c)

(i)		(ii)	
ịnɛ́m	'heavy'	**ịɲãm**	'meat'
ịɲimī	'like'	**òɲìɲè**	'woman'
inẽ́n	'your'	**aɲīn**	'bird'
+VCVC(V)		V + CVC(V)	

The initial vowels in 5c(ii) are separate (noun class) morphemes whereas the initial vowel in 5c(i) belongs to the root or base morpheme.

Now that the shape of morphemes in the language has been reviewed, it is possible to take a look at the general properties of nasality in the language as outlined in 4 above with a view to seeing what the distributional constraints of nasality are and their implication for the analysis of nasality and nasalization in the language.

(4a) stipulates that words of the language may consist entirely of oral segments

(4b) and (4c) stipulate that nasalized vowels occur only contiguous with nasal consonants.

(4d) observes that not all vowels in the vicinity of nasal consonants are automatically nasalized. In particular vowels **e and o** when preceding a nasal consonant are not nasalized.

The facts in (4b, c and d) can be captured by the sequence structure constraints in (6) and (7).

(6) If $+([+seg]_0)$ $\begin{bmatrix} +syll \\ -cons \end{bmatrix}$ $\begin{bmatrix} +cons \\ +nas \end{bmatrix}$ $\begin{bmatrix} +syll \\ -cons \end{bmatrix}$ $([+seg]_0)+$

Then $[+nas]$ $[+nas]$

Condition 6 stipulates that within a morpheme, if a vowel precedes or follows a nasal consonant, then that vowel is expected to be a nasal vowel (irrespective of the number of segments preceding (or following) the vowel.

(7) If $\begin{bmatrix} +syll \\ -cons \\ -high \\ -low \end{bmatrix}$ $\begin{bmatrix} +cons \\ +nas \end{bmatrix}$

Then $[-nas]$

Condition (7) stipulates that if the vowel that precedes a nasal consonant is either **e** or **o**, then the vowel remains unnasalized.

Condition (6 and (7) would together account for most of the data in (2) and (3). Condition (7) will account for data of the type exemplified in (2b), while condition (6) will account for all other cases.

There is, however, another generalization made in (4e) that deserves consideration. (4e) is an observation with respect to permissible consonant clusters in the language and this can be captured by condition (8).

(8) If [+cons] (+) [+cons]

Then [+nas]
[+syll]

Condition 8, stipulates that the first of any contiguous consonants must be a syllabic nasal.

The only consonant cluster attested in the language is, in fact, a sequence of syllabic nasal /N/ followed by a consonant as evidenced in data (2a) and (3d) above. The nasal consonant which may or may not be an independent morpheme is usually homorganic with the adjacent consonant.

6. NASALITY ACROSS MORPHEME AND WORD BOUNDARIES

The facts of nasality outlined above are true not only of lexical morphemes but also of all forms larger than the lexical morpheme i.e., they are applicable to lexical morphemes in isolation or in collocation. A few illuminating examples are presented in (9) below.

(9a)	**ko**	#	**ŋ́kwíkwáŋ**	--->	**koŋ́kwíkwáŋ**
	grind		plantain		'grind plantain'
	ke	#	**ǹdá**	--->	**keǹda**
	give		tray		'give tray'
	só	#	**ŋ̀káŋáŋ**	--->	**sóŋ̀ǩŋáŋ**
	wash		bed		'wash bed'
(9b)	**ìdũŋ**	#	**ìken**	--->	**ìdũŋ̀ìken**
	lizard		your		'your lizard'
	ikɔ̃m	#	**ómém**	--->	**ìkɔ̃mómén**
	navel		his/her		'his/her navel(s)'
	bèn̆ɔ̃	#	**ibí**	--->	**bèǹ̀ibí**
	sal		my		'my salt'
	òtãm	#	**ítén**	--->	**òtàḿ̀iteń**
	goat		our		'our goat'
	bìnãŋ	#	**ínén**	--->	**binãŋ̀ìnẽn**
	chairs		your		'your chairs'
(9c)	**ìnãŋ**	#	**kì + nũŋ**	--->	**inãŋkìnũŋ**
	chair		conc. good		'good chair'
	òkwènẽ	#	**wò + nũŋ**	--->	**òkwènẽ̀wònũ̀ŋ**
	fish		conc. good		'good fish'
	òšáŋ	#	**ogwí**	--->	**òšáŋõgwí**
	tooth		my		'my tooth'

	itũŋ	#	**íkí**	--->	**ìtũŋi kí**
	neck		my		'my neck'
	òŋẽ	#	**ítén**	--->	**òŋĩtén**
	wife		our		'our wife'
	rìdžín	#	**dzí**	--->	**rìdzínídží**
	name		my		'my name'
(9d)	**bù**	#	**èmõ**	--->	**bwèmõ**
	pour		water		'pour water'
	tsù	#	**ìnàŋ**	--->	**tswìnãŋ**
	pull		chair		'pull chair'
	ãŋúáò	#	**ìkwénẽ**	--->	**áŋwókwénẽ**
	small		fish		'small fish'
	èbìáŋ	#	**jén**	--->	**èbjĩãŋén**
	bush		this		'this bush'

It can be observed from the forms in (9b) and (9c) that vowels preceding and following nasal consonants are generally nasalized irrespective of whether or not the vowel and the putatively conditioning nasal are separated by morpheme or word boundaries. The only exceptions are predictably the cases of vowel **e** and **o** when preceding nasal consonants as in (4d).[6] This restriction on the distribution of nasality across word boundary in the case of **e, o** is precisely the same restriction observed for the distribution of nasality within words.

Consider the following items extracted from (9b):

A				B
òtãm	#	**ítén**	--->	**òtãmítén**
goat		our		'our goat'
rikɔ́mó	#	**ènɛ̀**	--->	**rikɔ́ménɛ̀**
corpse		mother		'mother of the dead'
rìdžín	#	**omẽn**	--->	**ridžĩnõmẽn**
nose		his/her		'his/her nose'

It can be seen that **o** and **e** followed by nasal consonants are nasalized in the B forms contrary to condition (7) which requires that these vowels remain oral (as in their citation forms in A). It is obvious from these facts that the vowels **e** and **o** are nasalized not by the nasal segment they precede but by the nasal segment they follow (i.e. the nasal consonants) across morpheme or word boundary in the preceding words. This establishes the fact of nasality spread across morpheme and word boundaires in Ogberia.

7. SEGMENTAL ANALYSIS

It is clear from the above facts that the Morpheme Structure conditions (6), (7), and (8) are not sufficient to account for the facts of nasality in Ogberia within the standard generative phonology theory (or, indeed, within any known theory of

phonology), because nasality spreads beyond morphemes, which alone constitute the domain and scope of morpheme structure constraints.

However, since much of the nasalization (including nasality across morpheme and word boundaries) is redundant, phonological rules can be used to introduce nasalization.

The fundamental question in determining the nature of the phonological process of nasalization in Ogberia is the determination of the underlying representation of nasality. It is crucial to determine which of the surface nasal segments (consonants or vowels) are basic and which are derived.

It could be assumed that the nasal vowels are basic and should be underlyingly represented. A priori, this is fairly natural for there are, indeed, languages such as Ebrie, (Bole-Richard, 1980), Gbe, (Capo, 1981), Gokana, (Hyman, 1982) etc. where the facts of nasality warrant assuming underlying nasal vowels to derive surface nasal consonants. In most of such languages, however, nasal consonants do not occur in the vicinity of both oral vowels and their nasal counterparts.[7] Thus, for instance, the consonants **m, n, ɲ, ŋ** would be derived from underlying **/b, l, j, g/** respectively because the pairs **b ~ m, l ~ n, j ~ ɲ** and **g ~ ŋ** maintain a consistently parallel relationship, such that the second member of the pair consistently occurs in the vicinity of nasal vowels while the first member consistently occurs in the vicinity of oral vowels.

In Ogberia, such a consistent parallel does not exist between nasal consonants and their oral counterparts. There is evidence of contrast between oral and nasal consonants in the postnasal vowel position but not in the prenasal vowel position. Thus, forms like:

(1)	**lɔ̃m**	'bite'	**nūŋ**	'smell' and
(2)	**be**	'come'	**bĩn**	'break'

(among others) cannot be readily accounted for, since in (1) **l** and **n** both occur before nasal vowels and in (2), **b** occurs before both oral and nasal vowels.

Furthermore, assuming underlying nasal vowels for Ogberia will lead to problems of predictability for the resulting rule of nasalization. Recall that nasal vowels occur only in the vicinity of nasal consonants (4c); and the converse is not true (i.e. all nasal consonants do not occur only next to nasal vowels). Nasal consonants occur in the vicinity of oral vowels as well and some occur before oral consonants and therefore cannot be said to be conditioned by a neighbouring nasal vowel. This is evidenced by words like **rítem, tèbjem, ewóm** etc. (2b) and **ǹda ŋ́kwikwáŋ, ńtɔ̃m ḿbĩn** etc. (3b). Thus, assuming underlying nasal vowels, it would be impossible to predict all nasal consonants attested in Ogberia.

These problems do not arise, however, if nasal consonants are assumed to be phonemic and nasal vowels derived by phonological rules.

With this assumption, two rules (R1 and R2) would be required to derive all the nasal vowels from underlying nasal consonants.

R1 Progressive Nasalization

$$\begin{bmatrix} +\text{syll} \\ -\text{cons} \end{bmatrix} \quad \text{---} > \quad [+\text{nas}] \; / \; \begin{bmatrix} +\text{cons} \\ +\text{nas} \end{bmatrix} \; \underline{\quad\quad}$$

A vowel is nasalized when it is preceded by a nasal consonant.

R2 Regressive Nasal Assimilation

$$\begin{bmatrix} +\text{syll} \\ -\text{cons} \\ +\text{high} \\ +\text{low} \end{bmatrix} \quad \text{---} > \quad [+\text{nas}] \quad \underline{\quad\quad} \quad \begin{bmatrix} +\text{nas} \\ +\text{cons} \end{bmatrix}$$

A vowel which is either high or low is nasalized when it precedes a nasal consonant.

The two rules concern vowel nasalization and a linguistically significant generalization would be missed if they are considered as two different processes. One is therefore led to undertake a conflation and collapsing of R1 and R2 to achieve a unified process. The angled bracket and brace notations are the only devices relevant to the conflation and collapsing of R1 and R2 and the resulting rule is R3 below.

R3

$$\begin{bmatrix} +\text{syll} \\ -\text{cons} \\ \langle \{ +\text{high} \\ +\text{low} \} \rangle \end{bmatrix} \quad \text{---} > \quad [+\text{nas}] \; / \; \left\{ \begin{bmatrix} +\text{cons} \\ +\text{nas} \end{bmatrix} \; \underline{\quad\quad} \;\; \underline{\quad\quad} \; \langle \begin{bmatrix} +\text{cons} \\ +\text{nas} \end{bmatrix} \rangle \right\}$$

The angled bracket notation that is allowed to enclose and relate two discontinuous dependencies 'permits' us to conflate and collapse R1 and R2. But R3, because of the peculiar nature of the restriction on nasality, turns out to be a rather 'monstrous' rule which is not readily amenable to the usual interpretation of angled brackets.

The normal (permissable) interpretation of R3 with particular reference to the angled bracket is as follows:

(10) 'A vowel is nasalized when it is preceded by a nasal consonant but <u>if</u> the vowel is either high or low <u>then</u> it should precede the nasal consonant.'

(10) is the logical prose rendering of R3 that ensures that, according to convention, the <u>if</u>-Clause refers to the dependency to left while the <u>then</u>-clause refers to the dependency to the right. However, what does this logical prose interpretation of R3 really mean? It actually leads to a semantic confusion.

However, consider the non-logical and unconventional interpretation of the angled bracket in R3 as rendered in (11) below:

(11) A vowel is nasalized when it is preceded by a nasal consonant; but if the nasal consonant follows the vowel <u>then</u> the vowel must be either [+high] or [+low].

Neither of the possible interpretations of R3 in (10) and (11) is satisfactory in that none of them logically reflects the claims of the original rules R1 and R2.

The angled bracket was intended to capture discontinuous dependencies essentially within the structural description and the structural change and not between the structural description and the context or environment (Chomsky and Halle, 1968; Howard, 1972; Chumbow, 1975 and Kenstowicz and Kisseberth, 1979). It is therefore understandable if it cannot be extended to capture the type of dependencies that the Ogberia data 'compels' us to capture. In the face of this impasse, we are forced to conclude that R3 is not the required rule for predicting nasalization in Ogberia; for the theoretical machinery of Generative Phonology rules out such an amalgamation as a natural rule.

It may then be justified to consider R1 and R2 as two separate but related processes. The two rules will account for the data both in morphemes and across morpheme and word boundaries without recourse to the Morpheme Structure Conditions, in the manner exemplified in (12).

(12)

				1 1	
ìtsen	**#**	**èmo**	**--->**	**ìtsenẽmõ**	(R1 applies twice)
beans		water			
				2 1	
ìduŋ	**#**	**ìken**	**--->**	**idùŋìken**	(R2 and R1 apply)
lizard		your		'your lizard'	
				2 1 1	
òtam	**#**	**ómén**	**--->**	**otãmõmẽn**	(R2 applies and Rule 1
goat		his		'his goat'	applies twice)
				1 1	
ìɲam	**#**	**ologo**	**--->**	**iɲãmõlogo**	(R1 applies twice)
animal		cassava		'animal cassava'	
				2 1 1	
ìkɔm	**#**	**íneń**	**--->**	**ikɔ̃mĩnẽn**	(R1 applies
navels		their		'their navels'	twice and R2 once)

The segmental analysis proposed here will derive the correct output for all items involving nasality with the rules of progressive and regressive nasalization applying whenever their structural description is met.

However the solution is unsatisfactory in a number of significant respects. Firstly, in some words, like the word for 'animal cassava' (**iɲam**), the initial vowel is not nasalized even though it satisfies the condition for the application of R2. With the information given earlier, to the effect that the initial vowels in this and similar cases are noun class morphemes, R2 could be modified to include a morpheme boundary in the appropriate context and will thus make the segmental analysis observationally adequate. It will, however, still not explain why there is need for the restriction of R2 from applying across

morpheme boundary when R1 does apply across all boundaries. As will be seen later, nasality in Ogberia is basically a characteristic of the morpheme and nasality spread is sensitive to directionality. These facts do not receive due cognisance and direct expression in the segmental analysis (which is putatively the most optimal linear analysis compatible with the data) and that is why it fails to explain the facts of (what is perceived as) regressive nasalization.

A second weakness is the fact that the R1 has to be constrained to apply iteratively to its own output (as in (12)) while R2 does not have to be so constrained.

Thirdly, although the fact that the two rules are subject to different conditions of rule application supports the decisions to consider them as two separate processes, there is something intuitively wrong with the recourse to two rules to account for what is apparently a unified process of nasalization (characterized by nasality spread).

As Hyman (1982) rightly observed for a similar problem in Gokana,

> 'the need for two rules to capture the automatic spreading of naslity is unfortunate and due to our decision to 'segmentalize' the nasal feature...'

Note that an attempt to remedy the situation by maintaining only one phonological rule, R1, along with one of the Morpheme Structure conditions, MSC 7 as proposed for Vowel Harmony (e.g. Vago, 1973) will not do. Such a solution will be observationally adequate in that the MSC would account for regressive nasal assimilation in the roots prior to the application of the phonological rule, but it still does not resolve the problem of using two separate devices to account for what is apparently a unified process. The weakness of using both the MSC and phonological rules to account for vowel harmony have been adequately articulated in the literature (e.g. Clements, 1977, and Jenson, 1977). In Chumbow (1982) it was observed that the bifurcation of vowel harmony into root harmony (to be accounted for by the MSC) and affix harmony (to be accounted for by phonological rules) amounts to claiming that two different processes are involved contrary to the evidence. To the extent that nasality spread is similar to vowel harmony, the arguments against the use of both MSC and phonological rules to account for vowel harmony must apply to automatic nasality spread as well.

These problems of the lack of a unified account for nasality in Ogberia arise ostensibly from the fact that whereas nasality has properties and characteristics of a suprasegmental feature in this language, it is being forced into the confines of segments. An autosegmental analysis, that assumes an autonomous level of representation for nasality in Ogberia will now be examined.

8. AUTOSEGMENTAL ANALYSIS

Goldsmith (1976) and Hyman (1982) have shown that the essential characteristics of nasality in some languages (like Guarani and Gokana) can be most insightfully captured within the now well-

known theoretical framework of autosegmental phonology. Basically, the feature [+nas] is autosegmentalized onto a separate tier from the remaining segmental features and appropriate association rules subsequently apply to derive the right output. This in effect means that once the feature [+nas] is abstracted, none of the remaining features can be [+nasal].

8.1 DOMAIN OF NASALITY

Languages generally situate nasality syntagmatically within an established sequential domain within which a single [+nas] specification may reside (Hyman, 1982). In some languages, this basic domain of nasality may be the segment or a syllable; but in Ogberia (as shown in (2) and (3), there is at most one [+nasal] specification per morpheme. The qualification 'at most' is used partly because no morpheme may have more than one [+nas] specification but also because there are morphemes (and words) with no [+nasal] specifications (i.e. they have no underlying nasal specification and so all segments surface as oral. This will account for the class of words with no nasal segments mentioned above and exemplified in (2).

Although the basic domain of nasality is the morpheme, the [+nas] feature spreads not only to all relevant segments within the morpheme but also across morphemes and words under specific conditions. We will return to this aspect later, but it is relevant to the autosegmental analysis.

8.2 NASALITY-BEARING UNITS

With respect to nasality, languages have to designate a set of features (segments) which may occur with the specification [+nasal]. Such segments that must be specified as allowing an opposition in nasality have been called 'nasality-bearing units' (NBU's) by Hyman (1982). The nasality-bearing units in Ogberia include all vowels (since all oral vowels have nasal counterparts). They also include phonetic nasal consonants [**m, n, ɲ, ŋ**]. However, since within the autosegmental perspective, nasality is abstracted and placed on a separate tier, the nasality-bearing consonants would naturally be the oral counterparts of these nasal consonants (i.e. **/b, l, j, g/**). Besides being the natural choice in view of the high degree of phonetic similarity between the two sets, the choice is further facilitated by the fact that there is contrast between the pairs **l ~ n, g ~ ŋ, b ~ m,** and **j ~ ɲ** in postnasal vowel position. Thus, both consonants in the pair do not occur after nasal vowels, only the nasal consonants occur. However, as mentioned earlier, both consonants may occur before nasal vowels, but this can be readily accounted for as will be shown later. Before illustrative examples of the autosegmental analysis are given, it will be useful to consider the principles guiding the association of the [+nas] segment to the nasality-bearing units on the other tier.

8.3 ASSOCIATION CONDITIONS

The data analysis above leads to some significant observations with respect to the relation of an independent [+nas] segment to nasality-bearing units:

1. Some morphemes are completely oral and therefore are not associated with [+nas] segments.
2. Some surface nasal consonants do not affect vowels preceding them (e.g. **ewom, iten**).
3. Some morphemes lack the contrast between oral and nasal consonants (e.g. **bĩn, mẽ**).

All three cases are fairly limited statistically and therefore constitute the exception rather than the rule.

Whereas the (underlying) phonological representation of morphemes and words is such that the [+nas] segment is generally not associated to the NBU, the behaviour of these exceptional cases can be attributed to the fact that they are exceptionally associated to the [+nasal] autosegment underlyingly. This is illustrated in (13).

(13)(a) +N +N

i + j a b ---> i+jab ---> iɲãm 'animal'

(b) +N +N

r i + t e b ---> ri+teb ---> ritem 'heart'

Thus, the nasality of **a** in (13a) versus the lack of nasality on **e** in (13b) (and all such differences) is attributable to the difference in the phonological representations where [+N] is not linked in (13a) but linked in (13b). All the data in (2b) can be accounted for by this principle of lexically linked or opaque segments.[8] Implicit in this principle is the claim that nasality spread is unidirectional and goes from left to right. This claim will be examined in detail later when more relevant data has been analysed.

We may now examine the principle that governs the association of [+N] segments in the majority of cases. In this respect, it can be observed that the nasality-bearing consonants **b, g** systematically do not carry nasality in morpheme initial position (e.g. **bĩn, gũnĩribu, a-gũn, o-gãnĩ**). There is therefore a need for an Initial Nasal Association rule and a mapping rule that will continue to associate successive contiguous nasality-bearing units.

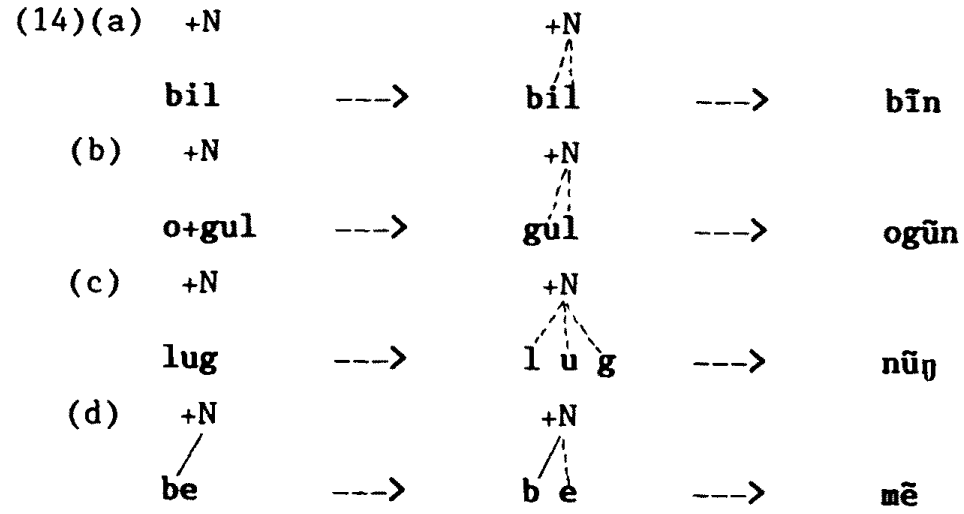
R4 (a) Initial Nasal Association Rule

$$+\left(\left\{\begin{bmatrix}+\text{ant}\\-\text{cor}\end{bmatrix}\right\}\right)\quad \begin{matrix}[+N]\\ .\\ .\\ .\\ ..\\ [+seg]\end{matrix}$$

Assign nasality to the first nasality-bearing unit in the morpheme except morpheme initial **[b]** and **[g]**.

Condition: [+seg] = NBU

The rule skips over any morpheme initial **[b]** or **[g]** (if any) and assigns nasality to the first nasality-bearing unit. This can be illustrated as in (14) below.



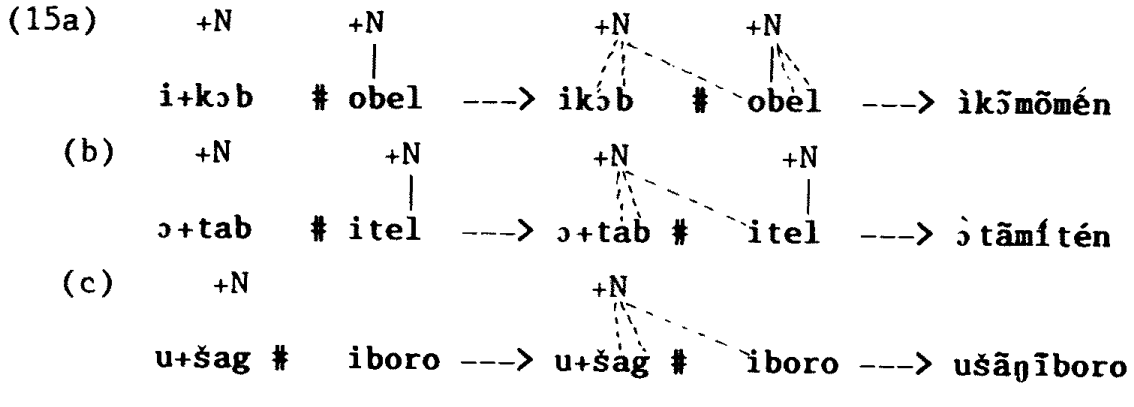
In (14a), the phonological representation has a [+nasal] autosegment and therefore the initial Nasal Association rule applies, it skips **[b]** and assigns nasality to the first NBU (vowel **i**). The nasality automatically spreads to the next NBU (**l**) and the surface output in **bĩn.**

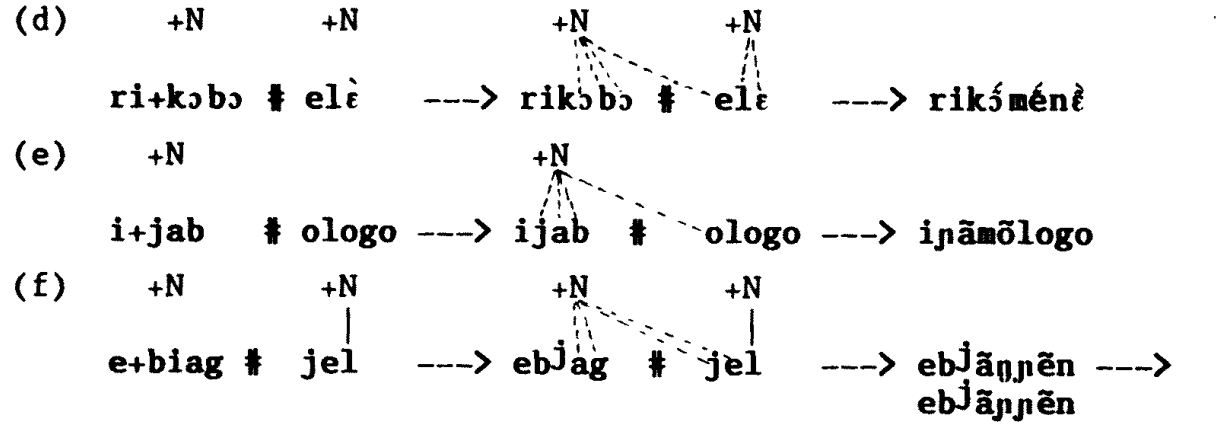
In (14b), **o**, is a morpheme with no underlying [+N] autosegment; so it surfaces as oral; **[g]** is skipped by R4(a) and nasality assigned to vowel **u** and then spreads to the next NBU **l** to yield **ogũn.**

In (14c), the initial segment is a NBU which is neither **b** nor **g**, so it is not skipped but is associated with the [+nas] autosegment. Nasality then spreads rightwards to all contiguous nasality-bearing units and the result is **nũŋ.**

In (14d) [+N] is underlyingly linked to **[b]**, therefore the Nasal Association rule does not apply but the rightward spreading of nasality to all contiguous NBU's takes place and the output is **mẽ.**

It is evident from the above data that the Initial Nasality Association rule R4(a) does not provide the complete picture of nasality since once nasality is assigned, it automatically spreads to the right. To determine the scope of the relevant association processes or mapping rule that spread nasality, it is pertinent to look at the relevant facts of nasality across word boundaries discussed earlier in (9). The autosegmental treatment is presented in (15).





In (15a), Nasality Association R4(a) assigns nasality to ɔ after skipping the non-NBU segment **k**. But note, that [+N] segment is lexically linked to **[b]** in the next word. The nasality assigned to the first word spreads right to succeeding NBU even across a word boundary, till it hits the already attached [+N]. The latter spreads right to all successive NBU.

In (15b), nasality is lexically assigned to the last segment in the second word of the collocation whereas the first word has a non-attached [+N] which is assigned by R4a to **a**, the first NBU after the morpheme boundary. Nasality spreads right from this point to all NBU (even across a word boundary) till it reaches a non-NBU **(t)**.

(15c) exemplifies collocations where the first word has a {+N} autosegment while the second does not.

In (15c), nasality is assigned by R4(a) and spreads across morpheme boundary until it hits a consonant and then stops. Thus, nasality spreading across word boundary does not effect consonants in the next word whether or not such consonants are NBUs.

In (15d), nasality is assigned to the first NBU and spreads right to all NBUs until it reaches a NBU of the next word that has already been assigned nasality by R4(a). Note that Vowel Elision rule applies to delete the first of two contiguous vowels across word boundary. Such deletion does not prevent the nasality of the deleted segment from spreading to the NBU across word boundary.

In (15e), the second word in the collocation is completely oral and thus constitutes another good test case of nasality spread across word boundaries. Nasality assigned to the first word by R4(a) spreads across to the initial vowel of the next word but stops at the first consonant even though the consonant **/l/** and vowel **/o/** (successive segments) are NBUs.

In (15f), the second word has a [+N] autosegment underlyingly attached to **/l/**. Nasality assigned to the first word by R4(a) spreads right across the semi-vowel **j** and the vowel **e** until it comes to an already associated segment.

The mapping rule that emerges from the above facts is summarized in R4(b) below.

---> R4(b) 'Let the [+N] continue associating with successive nasality-bearing units until it hits the word boundary; beyond the word boundary it should associate with successive vowels and glides only until it hits a consonant or an attached nasal'. R4(a) and R4(b) can be left as separate aspects of the same process or collapsed as one rule R4.[9]

R4

$$[+N] \quad \vdots \quad n$$

$$+ \left(\left\{ \begin{bmatrix} -ant \\ -cor \end{bmatrix} \right) \right) \quad [+seg]_1 \quad \# \quad \begin{bmatrix} +seg \\ -cons \end{bmatrix}^n_1$$

$$\left. \begin{bmatrix} -ant \\ -cor \end{bmatrix} \right\} \right)$$

Condition: [+seg] = NBU

Prose Statement of R4:

Skip over any morpheme-initial **[b]** or **[g]** (if any) and assign nasality to the first nasality-bearing unit; let nasality spread to any successive number of nasality-bearing units until it hits word boundary, then continue to associate all successive non-consonantal NBUs (vowels and semi-vowels) in the next word.

R4 can adequately account for all aspects of nasality as exemplified in (15) above.

It is pertinent at this point to show how the data with homorganic nasals would be accounted for under this analysis. This is exemplified in (16) below:

(16)(a) +N +N +N +N
b + t ɔ b ---> b t ɔ b ---> mtɔ̃m ---> ǹtɔ̀m

(b) +N +N +N +N
b + kug ---> b kug ---> mkũŋ ---> ŋkùŋ

(c) +N +N +N +N
b + bil ---> b bil ---> mbìn ---> mbìn

(d) +N +N +N +N
b + kalag ---> b + kálag ---> mkãnãŋ ---> ŋkãnãŋ

(e) +N +N +N +N
b + b e ---> b + be ---> mmẽ ---> mmẽ

(f) +N +N +N +N
b + kpɔkil ---> b + kpɔkil ---> mkpɔkin ---> ŋkpɔkin

Incidentally, all syllabic nasals in the language are separate morphemes (for first person singular and noun class marker etc.)

Since the syllabic nasals usually occur at word initial position and are homorganic with the following consonant, any of the consonant NBUs can potentially be the underlying syllabic nasal.

However, recall that earlier it was shown that two consonants have to be lexically associated with [+N] to account for some exceptional data. **l** has to be lexically associated in morpheme final position to derive (**omen, iten,** etc.) while **b** has to be lexically linked to account for **mẽ** (as opposed to **bĩn**). Since syllabic nasals have to be underlyingly associated, these two consonants are most suitable candidates by reason of economy. However, lexically associated **l** is restricted so far to morpheme final position while lexically associated **b** occurs morpheme initially in the residual cases mentioned earlier. Since syllabic nasals occur word initially, **b** is therefore the most appropriate choice since one can then make the generalisation that lexically associated **b** occurs only morpheme initially and morpheme finally while lexically associated **l** (in all the exceptional data) occurs only word finally.

The derivation of the homorganic syllabic nasals in (16) is straightforward, (in the manner illustrated earlier in (15) except that a homorganic nasal assimilation rule is required to make **[m]** hormorganic with the consonant it precedes. The required rule R5 is independently motivated.

R5. $\begin{bmatrix} +\text{cons} \\ +\text{nas} \end{bmatrix} \text{ ---> } \begin{bmatrix} \alpha\text{ant} \\ \beta\text{cor} \end{bmatrix} \; / \; \underline{\quad} \; \begin{bmatrix} \alpha\text{ant} \\ \beta\text{cor} \end{bmatrix}$

The rule would be independently required to account for data of the type in (17).

(17)(a) **ŋkpɔ́kín** **#** **bìén** **---> ŋkpɔ́kímbʲèn**
shoe this this shoe

n ---> m/____b

(b) **èbìáŋ** **#** **jen** **---> ebjãɲɲẽn**
bush this this bush

ŋ ---> ɲ /____ɲ

9. CONCLUSION

Having examined the facts of nasality in Ogberia it has been shown that the most optimal segmental analysis within the standard generative phonology framework compatible with the data proves problematic and unsatisfactory for a number of reasons, including the following:

1 (a) Two rules are required to account for nasality which in the language actually constitutes a unified process.

(b) One of the rules, R1, must be extrinsically constrained to apply iteratively.

(c) The effect of the two rules is the claim that nasality spreads both ways (left and right).

2 The segmental analysis does not give a principled and explanatory account of a number of apparently exceptional data in Ogberia.

(a) The absence of nasality in some pre-nasal vowels like **iɲãm** versus the presence of nasality in others like **bĩn** cannot be explained; the rule of anticipatory nasalization, R2, which accounts for the nasality of the vowel **i** in **bĩn**, is expected to nasalize **i** in **iɲãm** as well since the latter satisfies the condition for the application of R2.

(b) There is no explanation from the two nasalization rules why vowels **e** and **o** should be nasalized in some contexts but not in others.

Within the autosegmental analysis, a more adequate and satisfactory account is achieved in that all the problems and unsatisfactory aspects of the segmental analysis are eliminated.

Firstly, there is only one nasality mapping rule, R4, that assigns nasality in a principled and predictable manner and spreads it in an equally principled and predictable manner. This principle of nasality captures and encodes a left-to-right direction for nasality spread (ruling out anticipatory assimilation of the type in R2).

Secondly, the issues raised in 2 above find a straightforward explanation within the autosegmental analysis in that:

(a) The absence of nasality in segments like the initial vowel of **ĩɲãm**, follows from the fact that the basic domain of nasality is not the segment or the word, but the morpheme, and such words consist of two morphemes: the noun class morpheme + the root noun (**i+ɲãm**). Furthermore some morphemes are inherently nasal while others are inherently oral and the class (and concord) markers belong to the second category.

(b) The fact that some vowels are not nasalized follows from the left-to-right directionality explicit in the mapping rule. It can readily be seen that all vowels including **e** and **o** are nasalized if the nasal autosegment is associated first to the left of the vowel, so that it can eventually spread to these vowels. Where the nasal autosegment is either lexically or predictably assigned to a segment to the right of the vowel, it cannot spread to the left.

Thus, the vowels that are not nasalized are those that are ruled out in principle by the nature of nasality spread. (i.e. the nasality mapping rule R4).

The left-to-right directionality is not an artifact of our analysis but one that is natural and evident in the language. Recall that **o** is not nasalized in **omẽn** while **e** is. This accords with the left-to-right direction. However, the same **o** is

nasalized in **ikɔm # omen** ---> **ikɔ̃mõmẽn**, again in accordance with the left-to-right spread of nasality from the segment to the left of the vowel (the **m** of **ikom**).

Indeed, left-to-right directionality appears to be fairly universal for suprasegmentals. It is required for tones (Clements and Ford, 1979), for vowel Harmony (Chumbow, 1982) and apparently for nasality as evidenced here (see also Hyman, 1982). This fact is obscured in the segmental analysis.

Finally, languages that appear to differ considerably in many significant respects in the way they process nasality when viewed from the perspective of a linear theory, appear to be quite similar with respect to nasality when viewed from the perspective of autosegmental phonology (or any non-linear multitiered theory of phonology). For instance, in Gokana (Hyman, 1982) the optimal segmental analysis requires postulating underlying nasal vowels from which nasal consonants are derived by appropriate rules; in Ogberia the optimal segmental analysis claims that nasal consonants are basic and nasal vowels derived from the nasal consonants by appropriate rules. Yet despite this fundamental difference in claims with respect to the underlying representation of nasality, the two languages are quite similar when nasality is viewed as a suprasegmental feature in an autosegmental analysis.[1] This suggests that some significant universal characteristics of nasality may be missed if languages whose nasality is inherently suprasegmental are confined to a linear theory straightjacket.

NOTES

[1]Ogberia is one of (about) ten languages that make up the Mbe (Mbube) cluster spoken in Ogoja local government area of Nigeria. It is therefore a Benue-Cross language of the Niger Congo family. The author wishes to acknowledge the contribution of Unegbu (1984) to the data source of this paper. My thanks also go to Names Ogar, my language helper and to John Bendor-Samuel for valuable comments on an earlier draft of the paper, which was presented at the 17th Congress of West African Linguistics Society, at Ibadan, March 1986.

[2]The **je/we** alternation is determined by the class of noun with which the deitic 'that' occurs.

[3]Most of the forms in (2a) involve more than one morpheme but the word for 'tray', for instance, indicates that nasal homorganicity is not attested only across lexical morphemes as in the form 'I break'. The non-monomorphemic examples of homorganic nasals are given here as well because, as will be seen later, as far as nasality is concerned, the distributional constraints that hold within morphemes also hold across morpheme and word boundaries in a predictable manner.

[4]Note that although pre-nasal e and o are generally not nasalized they may be nasalized if they are in turn preceded by a nasal segment and thus wedged in between two nasal segments, as in the (3e) forms: **ínẽn** 'your', **ómẽn** 'his/her' etc. This is frequently the case at word boundary also as in the word for 'his nose': **ridzɪ̌n # ōmẽ́n** (in 3e).

[5]The syllabic nasal may be hormoganic with nasal consonants as well in which case the nasality of the second nasal affects succeeding vowels as in the following forms (3d): ńnɔ̀ 'I dance', m̀mé 'I run'.

[6]There are few other apparent exceptions but these are the V- and CV- noun class markers which function as independent morphemes. Other apparent exceptions in collocations like those in (9a) can be explained when the directionality of nasality spread is considered (see the Section on Autosegmental Analysis).

[7]There are other grounds for the justification of 'languages without (underlying) nasal consonants'. For further information, see Bole-Richard (1980) and Capo (1981).

[8]The use of the device of underlyingly linked segments in autosegmental phonology may not appear satisfactory to some, but the segments involved are generally very few and constitute a class of exceptions. There is therefore nothing wrong in using an exceptional device (like underlyingly linked segments) to account for exceptions. No theory has yet found a better way of dealing with exceptions than recourse to an exceptional device. Recall the 'rule features' of Chomsky and Halle (1968) (among other such exceptional devices).

[9]Hyman (1982) formulates one mapping rule to account for nasality assignment and spread, although he allows for the possibility of having two rules (nasality assignment and nasality spread). Clements and Ford (1979) keep the Initial Tone Association rule separate from the association condition, (although it is understood that these are basically related processes.).

[10]This basic similarity between different Kwa languages with respect to nasality was quite evident when I compared nasality from recent studies with which I have been associated, e.g. Ihionu (1984), Abiodun (1986) and Oyebade (forthcoming).

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