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“Nasal vowel patterns in West Africa”¹
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1. INTRODUCTION

Nasal vowels are a common feature of West African phonologies, and have received a significant amount of attention concerning their (suprasegmental) representation, their interaction with nasal consonants, and their phonetic realization. Numerous authors have presented surveys of varying degrees of (targeted) depth which address the distribution of contrastive nasal vowels in (West) Africa, including Hyman (1972), Williamson (1973), Ruhlen (1978), Maddieson (1984, 2007), Clements (2000), Clements & Rialland (2006), and Hajek (2011). Building on this literature, this present study provides a more extensive survey on contrastive nasal vowels in West Africa, and specifically studies the types of systematic gaps found. For example, the language Togo-Remnant language Bowili has a 7 oral vowel inventory canonical of West Africa /i e ε a ɔ o u/, as well as a full set of nasal counterparts /ĩ ẽ ẽ̃ ã õ õ̃ ù/ (Williamson 1973). In contrast, the Gur language Bariba has the same 7 oral vowel inventory, though a more limited nasal set /ĩ ẽ ã õ ù/, missing mid-high vowels */ẽ̃ õ̃/ (Hyman 1972:201).

Using this as a starting point, this paper addresses the following questions:

- What are the recurring patterns one finds in West African nasal vowel systems and inventories?
 - What restrictions are there on mid vowels in the nasal inventory?
- In which families/areal zones do we find these patterns?
- To which factors can we attribute these patterns?
 - Genetic – Vertical inheritance
 - Areal – Horizontal spread
 - Universal Phonetic – Parallel Developments
- How do these patterns manifest in the phonologies of these languages
 - E.g. Restrictions of (co-)occurrences
- Are these patterns anomalous or expected when viewed in a cross-linguistic perspective?

This paper presents a survey of 168 languages and language clusters, incorporating previous studies on nasal vowels cross-linguistically, and nasal vowels in (West) Africa. This study finds that nasality is pervasive across the region, and does not align well with genetic classification. Both the presence and absence of contrastive nasal vowels is shown in Atlantic groups, Gur groups, Mande, Kru, Kwa/Gbe groups, and Benue-Congo groups, including Igboid, Defoid, Edoid, Plateau/Kainji, Nupoid, Cross River, etc. This strongly suggests [1] areal spread introducing/initiating contrastive nasal vowels or nasal loss, [2] independent innovation/loss of contrastive nasal vowels, or [3] both.

In addition, this present survey is unique in coding for the presence/absence of high-mid nasal vowels /ẽ̃ õ̃/, which have been described by many authors as rare in West Africa. This

¹ This paper is a working draft stemming from a large-scale project on nasal vowels cross-linguistically. Initial thanks to Larry Hyman, Matt Faytak, Florian Lionnet, Lev Michael, Zachary O'Hagan, Roger Blench, Stuart McGill, and Otelemate Harry. All comments very much welcome!

survey confirms this, and shows that restrictions against these phones cut across families and regions too. Even among those languages without contrastive nasal vowels, there may be a restriction against even contextual [ẽ õ]. I situate both the distribution of contrastive nasality and the lack of /ẽ õ/ within a phonetic perspective, a West African genetic/areal perspective, and a cross-linguistic perspective. When taken together, this shows that although the lack of /ẽ õ/ is phonetically motivated, cross linguistic evidence shows that it is not subject to similar cross-linguistic restrictions in other nasal vowel zones. I present a small survey of South American languages to support this claim. In total, this study shows the robustness of nasal vowels in the West African phonological profile, and understands them as an areal affect which has its roots in phonetic “naturalness” and genetic inheritance.

2. SURVEY

This section presents a survey of West African nasal vowel inventories. I first provide some background information on vowel systems in West Africa in general, and nasal vowels in particular. Within this section, I also present an overview of previous large-scale surveys of nasal vowels in (West) Africa, and what has previously been said. I then present this paper’s current survey of nasal vowels, which have been culled from a number of sources, and graphically displayed on a Google Maps format (open access).

2.1. Relevant background

The vowel systems of West Africa display remarkable uniformity. Typical vowel systems contain 5-10 vowels, even distributed, with a common +/-ATR harmony system operating, often transcribed as /i ɪ e ε a ɜ,ə o ɔ u ʊ/. If certain values are absent and/or a merger takes place, the most common cases are for /a/ to be present rather than /ɜ,ə/, then /i u/ to be present over /ɪ ʊ/. It is much less common for a distinction between oral /e ε/ and /o ɔ/ to be neutralized. Certain larger vowel systems occur in Dan [Mande], and certain Kru languages (e.g. Tepo Kru).

Nasal vowels are also very common in West Africa, and perhaps can be understood as a prototypical phonological feature (Clements & Rialland 2006: 8). These occur both as contextual variants of oral vowels when adjacent to a nasal consonant (phonetic [Ṽ]), and as non-contextual phonemes which are not conditioned by an environment (phonemic /Ṽ/). This study mainly focuses on phonemic nasal vowels, which I will call “contrastive nasal vowels” throughout, where the nasal vowel is not conditioned².

It is very rare for a West African language to have a full set of nasal vowel counterparts to its oral vowel inventory, as previously noted by a number of researchers. Hyman (1972:167) was one of the first to notice that in numerous New-Kwa and New-Benue Congo languages, the following observations can be made:

² Certain borderline cases occur in which it remains a matter of interpretation whether or not a language is interpreted as having contrastive nasal vowels. For example, Williamson notes Elugbe’s (1969) study of Ika Igbo, in which it is not clear whether the nasalized vowels should be treated as /Ṽ/ or /CnV/. For the most part in this paper, I take on faith the authors representation of nasal vowels as contrastive or predictable. A fuller study would need to scrutinize this assumption carefully for each case.

1. Kwa/Benue-Congo restrictions on nasal vowels – Hyman (1972)

- Mid-high nasal vowel counterparts to oral vowels do not occur: */ẽ/, */õ/
- [n] (and sometimes [m]) does not occur before mid vowels: *[ne] ~*[nẽ], *[no] ~*[nõ]

Hyman puts forward the idea that the restrictions of nasal vowels relates to the origins of these nasal vowels, most specifically that they have developed from *CNV sequences in the languages he studied. In particular, he notes that *[ẽ, õ] “characterizes the Kana, Yoruba, Edo and Niger-Kaduna clusters...[and] a similar restriction in Grebo, a Kru language” (1972:175).

Williamson (1973) takes up the ideas proposed in Hyman (1972), and presents additional diachronic paths to contrastive nasal vowels across West Africa (specifically Nigerian languages). Williamson (1973:132) also notes the relative infrequency of /ẽ/ and /õ/ (as compared with /ẽ/ and /õ/, which she does *not* warrant as sufficiently infrequent), but understands this as a merger of /ẽ õ/ and /ẽ ã/, rather than posit a structural restriction against one (or both) mid nasal vowels in a proto-language. She quotes Ansre (1961:82), noting that phonemes /ẽ/ and /õ/ do not exist in Ewe, and that when /e/ and /o/ are contextually nasalized, they “tend to become [ẽ] and [õ]”. Igbo dialects also show a similar situation in which phonemic /ẽ/ and /õ/ surface as [ẽ] and [õ], e.g. in Ika Igbo (Williamson 1973: 132-133, citing Elugbe 1969). This paper shows that a restriction against */ẽ õ/ is very strong across West Africa, to a greater extent than perhaps Williamson originally understood. Further, later works also commented on the lack of /ẽ õ/ across West Africa, e.g. Creissels (1994), Clements (2000:139), Clements & Rialland (2006), and Güldemann (2010)³.

A number of studies have discussed the distribution of contrastive nasal vowels in Africa. Ruhlen (1978), Maddieson (1984 [i.e. UPSID], 2007), and Hajek (2011a) [i.e. WALS] are larger cross-linguistic surveys which either directly or incidentally document the distribution of contrastive nasal vowels as presently holds in the world’s languages [these surveys are further discussed in section 4. Situating the West African nasal vowel patterns - Cross-linguistic comparison]. Two other studies are Clements & Rialland (2006) and Hajek (2011b) [i.e. WALS] which specifically target nasal vowels in Africa. These studies are summarized in ex. (2), showing the number of languages surveyed, and the proportion which had nasal vowels.

³ What I am calling “West Africa” here (or more specifically sub-Saharan West Africa), Clements & Rialland (2006: 8) refers to as the “Sudanic belt”, and Güldemann (2010) refers to as the “Macro-Sudan Belt”.

2. Previous surveys/studies of nasal vowels cross-linguistically and in (West) Africa

	Study	# of languages	# with contrastive nasal vowels	Percentage
Cross-Linguistic	Ruhlen (1978)	700	150	21.4%
	Maddieson (1984) - UPSID ⁴	317	71	22.4% ⁵
	Maddieson (2007)	670	138	20.1%
	Hajek 2011a - WALS	244	64	26.2%
(West) Africa	Clements & Rialland 2006	150	African languages with nasal vowels	26.7%
			West African languages with nasal vowels	34%
	Hajek 2011b - WALS	40	20	50%

The cross-linguistic studies show that nasal vowels occur in approximately ¼ to 1/5 of the world’s languages, and are therefore a rare feature, but not uncommon. In contrast, we see from the African studies that in West Africa, they occur to a greater degree, 34% in Clements & Rialland (2006), and 50% in Hajek (2011b)⁶.

In Hajek’s (2011a,b) surveys, he shows that the occurrence of contrastive nasal vowels has a clear areal skew. There are 5 zones in which nasal vowels occur to a disproportionate amount compared to other areas, provided in (3)⁷. A WALS map with these areal zones highlighted is in example (4), on page 5.

3. Areal zones of contrastive nasal vowels

- a. Zone 1: Middle Belt of North America
- b. Zone 2: North and Central South America
- c. Zone 3: West African Sub-Saharan Belt**
- d. Zone 4: Northern India
- e. Zone 5: Southern Mexico

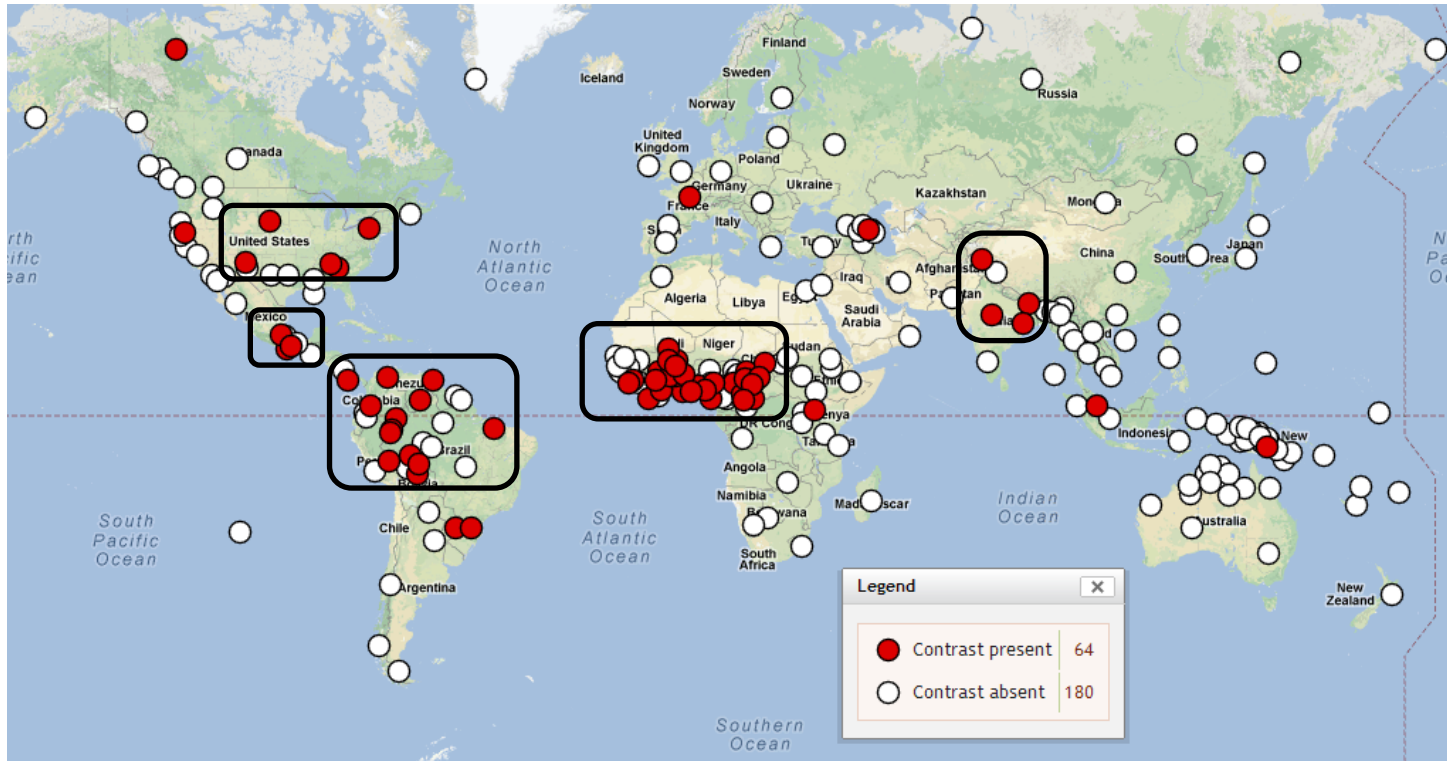
⁴ This intercepts with Ruhlen (1976,1978) but they are not identical.

⁵ This database was later updated to include 451 languages, as shown at <http://www.linguistics.ucla.edu/faciliti/sales/software.htm#upsid>. Of these 451 languages, 102 were described as having contrastive nasal vowels, roughly 22.62%. This proportion is almost identical to the original 317 language sample, shown above.

⁶ The sampling techniques are not available.

⁷ This areal distribution is also noted in Ruhlen (1978:205), Clements & Rialland (2006: 9), and Maddieson (2007).

4. WALS Map – Zone of contrastive nasal vowels

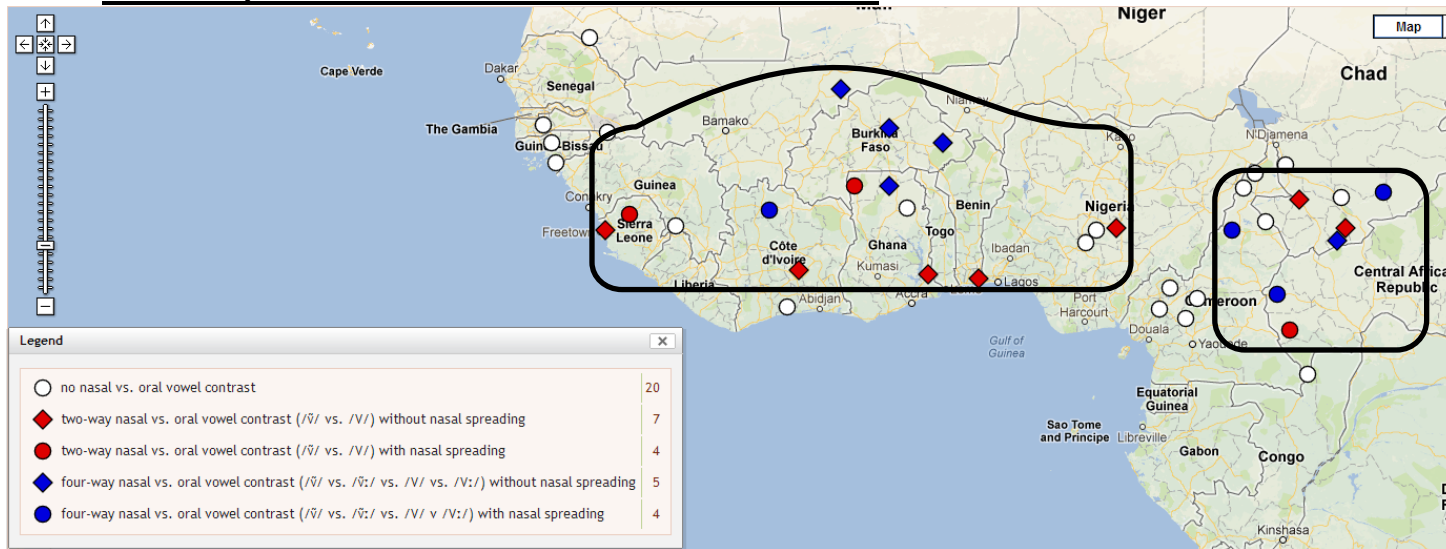


Further, Hajek (2011b) presents a map of West Africa, showing a small sample distribution of contrastive nasal vowels, shown in (6). This map can be broken down tentatively into two major zones, as in (5).

5. **Two Potential Nasal Vowel Zones**

- a. Zone 1: Sub Saharan/Sahel West Africa: Guinea to Nigeria
- b. Zone 2: Southern Chad-Eastern Cameroon-Western CAR

6. **Small sample distribution of Nasal vowels in West Africa**

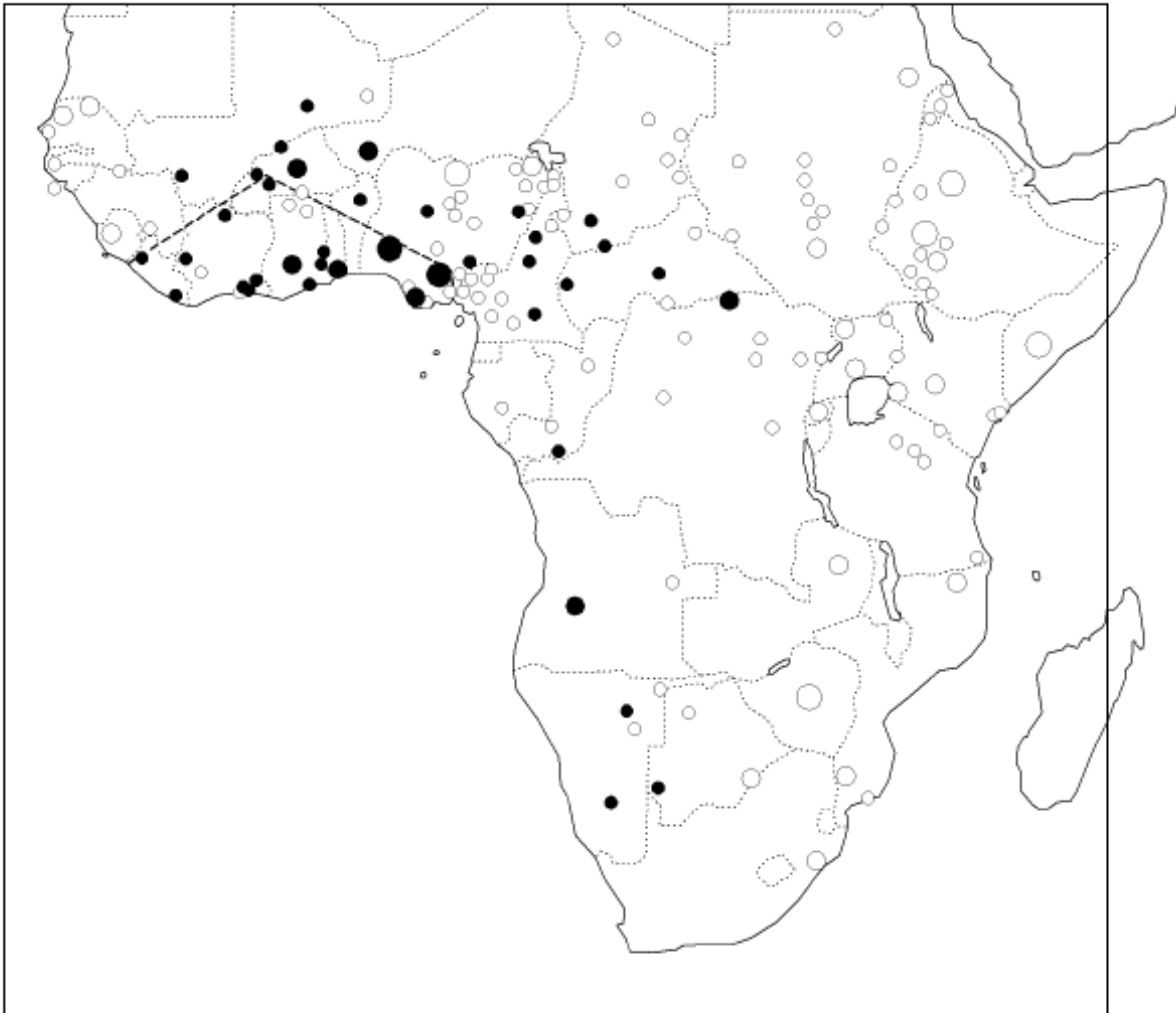


Further, Clements & Rialland’s (2006) survey shows an even clearly areal effect of contrastive nasal vowels. A map taken from this paper showing the distribution of nasal vowels is provided in (7). This map consists of 150 languages, 100 of which occur in sub-Saharan West Africa (their Sudanic belt)⁸. They note that of these 100 languages, 34 have contrastive nasal vowels. This figure is both higher than the percentage of African languages outside of the Sudanic Belt which have nasal vowels (~6%)⁹, as well as the proportion they find of non-African languages with contrastive nasal vowels (21.2%).

⁸ 66 from Niger-Congo, 23 from Nilo-Saharan, and 11 from Afro-asiatic (Chadic).

⁹ They find that the only other area in Africa where nasal vowels are common is among the Khoisan languages in SW Africa (Clements & Rialland 2006:8).

7. Distribution of contrastive nasal vowels in C&R's 2006 a sample of 150 African languages (100 in Sudanic belt)



Within this map, the area enclosed under the dashed line contains languages which have been reported to lack distinctive nasal consonants, i.e. in languages where nasal consonants such as /m n/ are analyzed as contextual variants of /b d/ in the context of a nasal vowel. This type of contextual nasal consonants cuts across linguistic families, and is found in Mande (e.g. Kpelle, Dan), Kru (e.g. Klao), Gur (e.g. Bwamu, Sanadi), Kwa (e.g. Abure), and Igboid (e.g. Ikwerre). As we will see in the present survey, this also cuts across nasal vowel inventory types.

2.2. Present Survey – With attention to mid nasal vowels

Both of these maps are excellent at showing the broad distribution of the presence and absence of contrastive nasal vowels in West Africa. However, these two distribution studies have certain shortcomings. Both of these studies have the goal of macro-regional/continental breadth, rather than rather than micro-regional depth, and therefore sacrifice understanding how nasalization is distributed within (1) individual families, and (2) regional cross-ethnic networks. Further, both of these surveys merely note the existence of contrastive nasalization in the vocalic system as a whole, and do not survey common patterns of nasal vowel inventory profiles.





This current survey seeks to build upon these previous studies by understanding not only the distribution of nasal vowels, but also which which nasal vowels are absent. Based on the discussion above, a natural starting point is surveying for the absence of /ẽ õ/. To this end, I compiled 168 languages and language clusters, and mapped them onto 187 data points on a Google Maps platform. The list of 168 languages and language clusters is available in Appendix 1 on page 31, listing their genetic affiliation, and gaps in their nasal vowel inventory. The reason why these numbers do not match is that in certain cases, a language cluster was described by a researcher as having a uniform contrastive nasal vowel profile across all of the individual languages. For example, Marchese Zogbo (2012) describes Eastern Kru as a whole as lacking nasal vowels, referring to languages Neyo, Godie, Dida, Bete, and Koouya; each of these individual languages was placed as a separate point on the Google map. This entire map is available at <

<https://maps.google.com/maps/ms?msid=202237073215306702997.0004dc823171d98b7362d&msa=0&ll=6.620957,1.274414&spn=35.233721,39.506836>

>¹⁰.

Examples (8-9) provides the codes used for this map; the maps themselves are provided in examples (10-13) on pages 10-12; refer to the public link above for easier navigation. Primary codes are provided in (8). The main difference is between red, blue, green, purple drops which indicate a contrastive nasal vowel system, vs. the yellow drop which indicates no contrastive nasal vowels. Red drops indicate a system with full nasal counterparts to all oral vowels, e.g. Bambara oral /i e ε a ɔ o u/ and nasal /ĩ ẽ ẽ ã ã õ ù/ (Maddieson 1984). Dark blue drops indicate those systems which are missing /ẽ õ/, which we are specifically targeting. A green drop indicates those systems which are missing all mid nasal vowels, e.g. Akan /i ɪ e ε a ə ɔ o u/ and nasal /ĩ ĩ ã ã õ ù/ (Williamson 1973). A purple drop indicates a system which does not fit into either one of these patterns, and is areally atypical, e.g. the Mande language Yaure which has no nasal counterparts to its [-ATR] vowels in general (*/ĩ ẽ ã õ/ (Vydrine 2004). Finally, a light blue drop indicates a system which is said to have nasal vowels, but it is not known which vowel qualities are nasalized at this point.

8. Codes for map – Primary codes for nasal vowel distribution

- a. Red drop with dot: 
 - i. Has nasal vowels – is missing **no** nasal counterpart
- b. Dark Blue drop with dot: 
 - i. Has contrastive nasal vowels – missing /ẽ õ/
- c. Green drop with dot: 
 - i. Has nasal vowels – is missing **all** mid nasal vowels /ẽ ẽ ã õ/
- d. Purple drop with dot: 
 - i. Has nasal vowels – is missing some other nasal vowel – atypical pattern

¹⁰ The Google Map format was chosen because it is publically available, and the information is exportable in a .kml extension (i.e. a “Keyhole Markup Language”), used for geographic coordination, annotation, and visualization within a number of software. This should allow this data to be transferred and manipulated at more advanced stages of a potential project.



- e. Light blue drop:
- i. Has contrastive nasal vowels – inventory not yet determined



- f. Yellow drop with dot:
- i. Has **no** contrastive nasal vowels

The next set of codes require more explanation. These secondary codes constitute a very small number of tokens, though have interesting implications (discussed later in [3. Interpretation](#)). A blue pin refers to a language which has contrastive nasal vowels, and can be analyzed as having phonological /ẽ õ/ phonemes (e.g. from vowel harmony /restrictions), though these phonemes are always realized as [ẽ ɔ̃] (i.e. phonetically but not phonologically merged), e.g. Fon (Capo 1985:21). A red pin indicates a language which has contrastive /ẽ õ/, though these are restricted in their distribution, e.g. only in ideophones. A yellow pin refers to languages which lack contrastive nasal vowels, though show some phonetic restriction against [ẽ õ] regardless, e.g. Ogberia, in which automatic contextual nasalization occurs on vowels before nasal consonants for all vowel qualities except /e/ and /o/ (Chumbow 1987).

9. Secondary codes for nasal vowel distribution



- a. Blue Pin:
- i. Has contrastive nasal vowels
 - ii. A language has /ẽ õ/ phonemically, but phonetically realized as [ẽ ɔ̃]



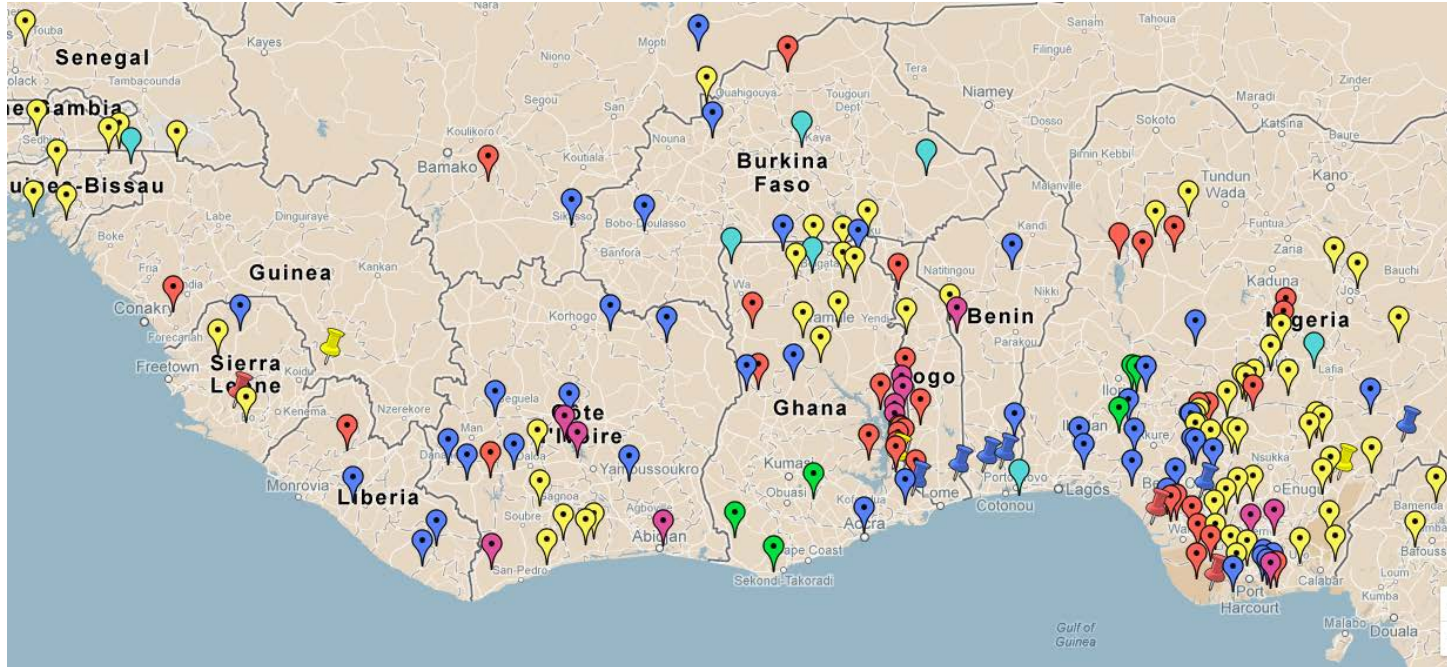
- b. Red Pin:
- i. Has contrastive nasal vowels
 - ii. /ẽ õ/ exist, but very limited distribution (ideophones, borrowings, etc.)



- c. Yellow Pin:
- i. Does **not** have contrastive nasal vowels
 - ii. Limited occurrence of contextual [ẽ õ]

A macro-view of the distribution of nasal vowels types is provided in the map in (0), taken from the Google Map. We can notice a number of broad trends. First, the existence of nasality is extremely widespread, as has been previously documented (the blue, purple, red, and green drops). It occurs almost uniformly from SE Nigeria into Eastern Cote D'Ivoire, up into Burkina Faso, and in the Liberia/ Cote D'Ivoire area. Further, the absence of contrastive nasal vowels (the yellow drops) occur in four major regions: the Senegal/Guinea area (mostly "Atlantic"), the southern area of Cote D'Ivoire (mostly Eastern Kru), the northern area of Ghana/Togo (mostly Gur), and the eastern Regions of Nigeria, extending into Cameroon and the Bantoid/Bantu area.

10. Macro-view of distribution

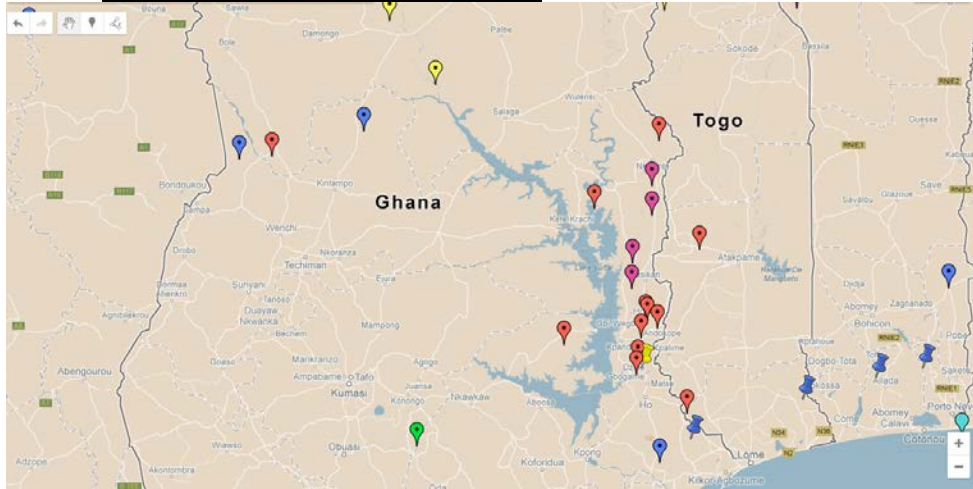


Of those languages which have contrastive nasal vowels, there are also regional trends, but not as clear. A strong belt of blue indicating a gap of /ẽ õ/ occurs in Western Nigeria moving west, covering the Nupoid, Edoid, Defoid, Gbe/Kwa groups. Mixed in with this region are languages lacking all mid nasal vowels (the green drops), e.g. Akan, but also Anyi in Western Ghana, and certain Northern Yoruba dialects (e.g. Oro). The lack of green supports Williamson's (1973:132) original claim, that an absence of all mid nasal vowels is idiosyncratic within West Africa.

Further, other pockets of blue drops occur. One particular region stretches from Liberia, into Cote D'Ivoire, and into Mali/Burkina Faso/Ghana, where Gur, Kru, Mande, and Kwa language families meet. Another smaller pocket occurs in southern Nigeria among the Cross River Ogoni group. Other languages which lack /ẽ õ/ but do not fit into a "belt" include Etulo in eastern Nigeria, Bariba in northern Benin, Kusaal and Kasem in northern Ghana, and Loko in Sierra Leone.

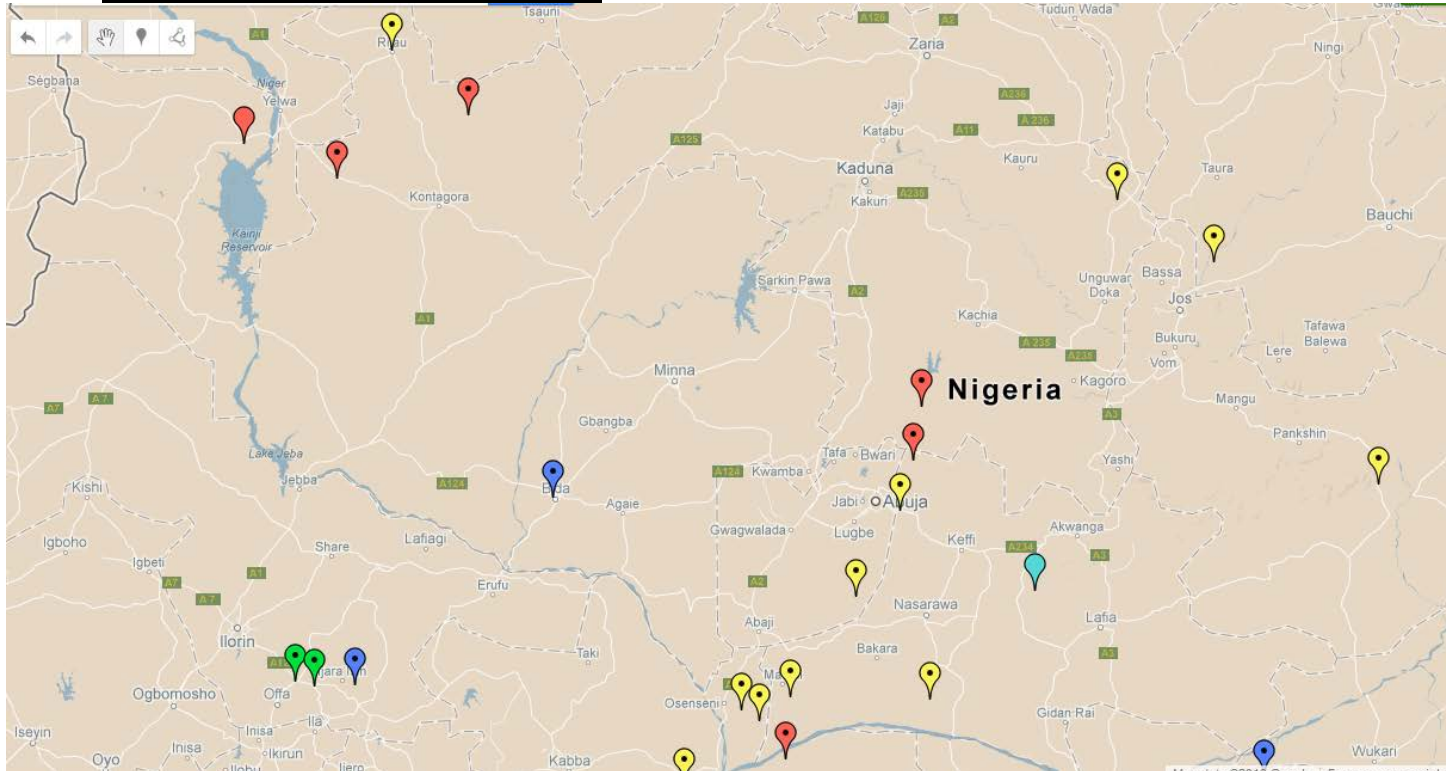
We should also note the occurrence of large belts where red drops occur, indicating languages which have all nasal counterparts to their oral set, and therefore have /ẽ õ/. This occurs in the Ghana-Togo area (among the Ghana-Togo Mountain Kwa group), where many are said to have full counterparts, or if they are missing one, it is one other than /ẽ õ/. A zoom in of this area is provided in (11).

11. Micro-view of Ghana-Togo area

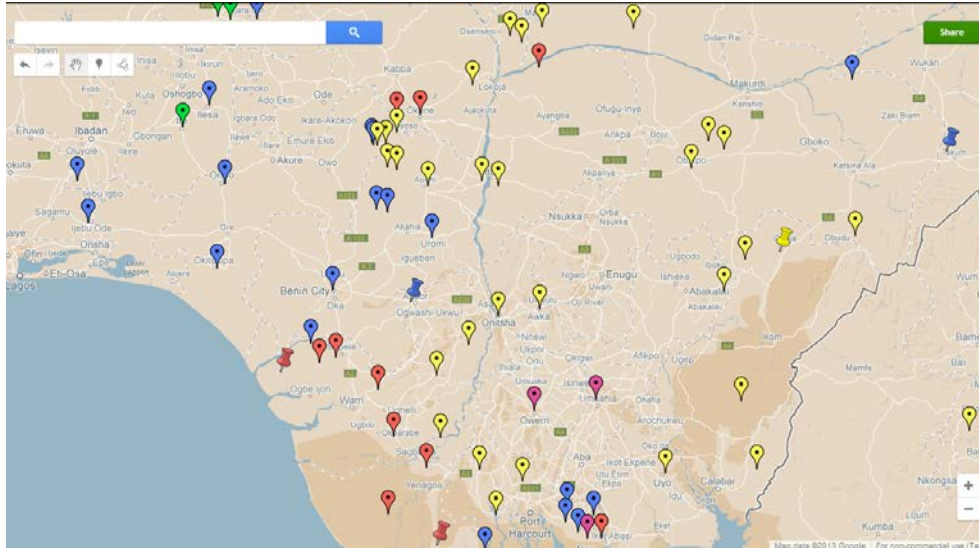


Two other areas in Nigeria show a disproportionate number of red drops. One is in northern Nigeria among the Kainji/Plateau area (but also moving into West Benue-Congo groups, e.g. Oko and Ikaan near the Benue and Niger rivers confluence); this is shown in the map in (12). Another is in Southern Nigeria, among the Ijoid and Edoid groups (e.g. Urhobo), which also have /ē ð/ [the limited distribution of /ē ð/ in some Ijoid languages will be discussed in the next section]. This is shown in the map in (13).

12. Micro-view of Central Nigerian area



13. Micro-view of Southern Nigerian area



Red drops are also scattered in the western countries, such as in Guinea, Mali, and Cote D'Ivoire; see in the macro-view map above.

3. INTERPRETATION

Having established the types of systems which exist, their geographic locations, and their genetic affiliations (provided in Appendix 1), we can now begin to interpret the data more finely. I will approach this from a number of angles. The first is understanding these trends from a view of phonetic naturalness, in which it is predicted that / \tilde{e} / and / \tilde{o} / would be rare. The second is understanding these data from a genetic and areal perspective. Finally, in the next section in section 4, I situate these nasals vowel patterns within a cross-linguistic comparison.

3.1. Phonetic perspective

In Clements & Rialland's (2006:12) survey of West African nasal systems, they conclude that "it is not clear to us whether nasal systems of this type have been inherited from a common source, whether they result from diffusion, or whether they have evolved independently in different languages". This last possibility of independent evolution rests on the assumption that the changes these systems would have undergone are "natural" sound changes which do not necessarily require a strong areal or genetic inheritance. Much work has been done in the field in the last half century to understand in precise terms what makes one sound change more "natural" than another. This is typically couched in terms of phonetics, either in articulatory or perceptual ease. Therefore, given that a gap of / \tilde{e} \tilde{o} / is so widespread in West Africa across numerous families and geographical regions, we can ask is it natural for a language to have such a gap/restriction?

The majority of sources point that this indeed can be understood as "phonetically natural", and therefore increasing its likelihood as independent innovation. Nasal vowels may result in the perceptual "blurring" of different vowel qualities (Ohala 1975). Johnson (2012:198) notes that nasal vowels are one of the "most complicated configuration[s] of the vocal tract", in which two resonant systems operate at once, and that there is nothing articulatory complex about

producing nasalization with different vowel qualities (Johnson 2012:201), but they are difficult to perceive. In general, many phoneticians have pointed to an acoustic effect of nasality which results in the F1 of high vowels being interpreted as lower, as compared to oral vowels without nasal coupling, and the F1 of low vowels as being interpreted as higher. This can therefore result in /i u/ being interpreted as lower variants in the vowel space (e.g. [ɪ]), and /a/ being interpreted as a high variant in the vowel space (i.e. [ɐ]). We can understand this as a Height Centralization Effect of Nasalization.

More technically, Kingston (2007: 417) notes that with nasal vowels, “what’s probably more important perceptually is that a broader bandwidth makes it harder to detect this prominence’s center of gravity and thus to determine the vowel’s height”, leading to reinterpretation of vowel categories, a notion also echoed in Schwartz et al (1997:237). Wright (1975:373) notes that (higher) nasal vowels tend to lower due to the coupling of nasalization, citing Ohala (1974) that large degrees of velopharyngeal opening correlate with a rise in F1 (and hence a lower sounding vowel), which lead to a reinterpretation of the vowel as targeting an articulation lower in the vowel space. Thus, because of the acoustics of nasal vowels being filtered through two resonances, vowels tend to diachronically converge on a target which is a stable region for nasal coupling¹¹. This then can be understood as a mechanism for language change in which the articulatory plan for these same nasal vowels alters to a lower location in the vowel space, e.g. the well known French example of $\text{ĩ} > \tilde{\text{e}}$.

This change in F1 perception effects $[\tilde{\text{e}} \tilde{\text{o}}]$ as well, which is also subject to a Height Centralization Effect of Nasalization. A phonological distinction therefore between $[\tilde{\text{e}} \tilde{\text{o}}]$ and $[\tilde{\text{e}} \tilde{\text{o}}]$ is unstable perceptually, and primed to undergo diachronic sound change (discussed in Foley 1975, Wright 1980, Maddisison 1984). This also predicts that if a language has only one mid height, the nasal counterpart may be lower than the oral one, i.e. having phones $[\text{e} \tilde{\text{e}} \text{o} \tilde{\text{o}}]$. Specific cases have been noted which bear this out (outside of West Africa, to which we will return). For example, in Ruhlen’s (1978:221) cross-linguistic phonological survey, he notes that in 10 languages where there exists only one oral mid vowel, the nasal mid vowel is always the same height or lower, e.g. Chipewyan below:

14. Chipewyan System – mid nasal lower than mid oral

Front		Central		Back	
O	N	O	N	O	N
i	ĩ			u	ũ
e				o	
	ẽ				õ
		a	ã		

¹¹ Hajek & Maeda (2000: 4) cite experimental results (based on fibroscopic and X-ray studies of English, Hindi and Chinese) (e.g. Chen & Wang 1975 and Bell-Berti 1993), which report that “the relative degree of velic opening in a vowel in nasal contexts is inversely related to increased vowel height”. If this is true, then higher $[\tilde{\text{e}}]$ has less velic opening and hence less nasalization than $[\tilde{\text{e}}]$, therefore priming $[\tilde{\text{e}}]$ to either (1) lose nasalization, or (2) merge/lower to $[\tilde{\text{e}}]$. They do not, however, see this as the complete story. Further, Beddor et al (1986) point to an effect of nasalization on vowel height perception as also conditioned by the phonetic/phonological status of the vowel, as well as the degree of nasalization (either reduced or excessive). Further discussion is required, but is outside of the scope of this immediate paper.

Other languages which show this include Kamauni, Siona, Sango, Polish, Yuchi, Seneca, and Mezquital Otomi. In contrast, he finds no instance of the reverse in which a sole oral mid vowel is *lower* than the sole nasal mid vowel, e.g. a system [ɛ ẽ].

3.2. Genetic and areal perspective

These phonetic studies provide an initial explanation for the gap of */ẽ õ/. However, I argue that this provides only one component to understanding the pervasiveness of contrastive nasal vowels in West Africa. We also need to complement this phonetic study with an understanding of the genetic and areal conditions of these languages¹².

To begin, the genetic perspective would suggest that the absence or presence of contrastive nasal vowels, the type of nasal system a language displays, and the widespread gap of /ẽ õ/ across West Africa can be understood as a consequence of inheriting such a feature from a common proto-language. This could either be a constraint against /ẽ õ/ directly in the proto-language, a constraint against /e o/ in general, or a constraint against /e o/ occurring in a specific structural position, e.g. not being allowed in proto */CVN/ structures, which lead to /CṼ/ reflexes. In contrast, the areal perspective suggests that languages either adopt contrastive nasal vowels, or develop it (via sound change) based on areal alignment with speech communities with whom they form networks.

I will present a number of language groups, and present a genetic and areal perspective in tandem. It is often very difficult to distinguish between areal and genetic features in specific situations, discussed at length in the African perspective in Dimmendaal (2001)¹³. One group to discuss is Mande. In Mande, most languages have contrastive nasal vowels, shown in Appendix 1 (and easily searchable in the attached excel database). Vydrine (2004:117) notes that in most West Mande languages, there is a full set of nasal counterparts to the oral vowels, including /ẽ/ and /õ/, e.g. in Susu which has /ẽ õ/. However, in West Mande languages (Bamana, Guinean dialects of Maninka, Vai, Mende, Soso, Jallonke), these typically have an absence (or a strong rarity) of /me, mo, ne, no, ɲe, ɲo/ (Vydrine 2004:118), showing a restriction against [ẽ õ] to some degree. He takes this as evidence that despite current systems which have /ẽ õ/, /e o/ were incompatible in the Proto-Language with an onset nasal. Further, many other Mande languages lack /ẽ õ/ altogether (e.g. Dan, Bobo, Samo, Toura, and Wan), or restrict them to ideophones (Loko)¹⁴.

Further, Vydrine (2004:124) also points to the role of areal alignment in his assessment of the phonological inventory and activity profiles of Mande, claiming that “the phonological type of a language is shown to depend much more on areal than genetic factors”. As an example, he points to previous accounts which attribute phonological forms in Mande to influence from neighboring Kru and Kwa languages, particularly on the development of vowel inventories and harmony in the southern Mande-speaking regions (Vydrine 2004:117, citing Dwyer 1989). Further, three Mande languages surveyed did not have contrastive nasal vowels: Bisa, Mandinka,

¹² Further, it is not the case that we can invoke a universal principle which states that /ẽ õ/ and /ẽ ɔ̃/ will always merge to /ẽ ɔ̃/, as there are cases in which the opposite has taken place, for example, Portuguese *ẽ ɔ̃ > ẽ õ (Schourup 1972: 21), and Scottish Irish *ɔ̃ > õ (Schourup 1972: 21, citing O’rahilly 1932). These cases show that it is possible for languages to undergo an “unnatural” sound change with respect to nasal vowels, though much more rarely.

¹³ For example, Dimmendaal (2001:358) notes that the conflation of genetic features vs. areal features was one of the reasons (Old) Kwa and (Old) Benue-Congo were originally posited, having since been redefined based on more stringent criteria.

¹⁴ Further research is required to confirm this understanding of Mande.

and Soninke. We can understand this too as areal alignment. Bisa is a Mande island in Northern Ghana, and occurs in a non-nasal region (as shown in the map in 0 above). Mandinka and Soninke are both spoken in a non-nasal zone as well, in contact with Atlantic languages in the far West of West Africa¹⁵.

Next to Mande are the Kru languages. Marchese Zogbo (2012:5) states that contrastive vowel nasalization is found robustly in Western Kru area (e.g. Nyabwa, Wobe, Klao), though is almost entirely absent from the Eastern side (e.g. Godie, Dida). No conclusion can be made as to why there is this divide, and what possible areal features may have induced a gain or loss of contrastive nasal vowels. Regardless, he notes that even in those Western Kru languages with contrastive nasalization (e.g. Nyabwa, Wobe, Guere, Klao, Bassa), nasalized /ẽ õ/ do not occur¹⁶. He therefore posits a reconstruction of Proto-Western Kru having oral */i e ε a ɔ o u/ and nasal */ĩ õ ẽ õ ã/, but no /ẽ õ/, pointing to a genetic explanation as to the lack of these nasal counterparts.

Further, in Kwa and Gbe language areas, certain patterns emerge. Stewart (1983) posits */ĩ ỹ õ ẽ õ/ for his Proto-Volta-Congo but not [ẽ õ ã]. He also provides the vowel inventory in (15) for his Proto-Tano-Congo, where mid nasal counterparts have not been reconstructed (Stewart 1983:23-24; see also Capo 1989:284-285).

15. Vowels of Proto-Tano-Congo

		-nasal		+nasal	
		-round	+round	-round	+round
+high	+advanced	i	u	ĩ	ỹ
-low	-advanced	ɪ	ʊ	ĩ	õ
-high	+advanced	e	o		
-low	-advanced	ε	ɔ		
-high	- advanced	a		ã	

Capo (1985:20), citing Capo (1981b), posits a 7 quality proto-Gbe system /i e ε a ɔ o u/ with all nasal counterparts. However, he notes that there (must have been) a phonetic rule mapping /ẽ õ/ to [ẽ õ], reflecting the fact that a number of modern Gbe dialects have /ẽ õ/ (seen in harmony rules), but that these are realized as as [ẽ õ] (e.g. Fon). The only exception he shows is a dialect Awlan, in which /õ/ is realized as [õ] after oral consonants, but [õ] after nasal ones. To back his claim, he shows a number of sound changes which took place in the Gbe dialects to warrant positing a 7 quality proto-system with full oral and nasal counterparts.

Looking at Kwa as a whole, however, there is not complete uniformity as to the nasal vowel profiles. Spanning across southern Ghana and up into Togo, a large number of Ghana-Togo Mountain Languages, as well as Potou-Tano Guang languages, do not easily fit into a

¹⁵ I will not discuss the Atlantic languages here as areal trends have not been established, and the genetic classification of Atlantic as a single unit is highly doubtful. It should be noted, however, that nasal vowels are not common in Atlantic, although Bullom So (also called Mmani or Mani) are said to have nasalized vowels, and in general is said to sound “very nasal” in pronunciation (Kropp Dakubu 1980; contributor Walter J. Pichl). Kisi is of particular interest here, because even though it lacks nasal vowels, Childs (1991:31) notes that a process of perservatory nasalization after nasal consonants “has partially neutralized the contrast between e:ε and o:ɔ after nasals in favor of the lower vowels”, and also notes that “few words in Kisi begin with a nasal followed by either e or o”. Both these facts suggest a constraint against contextual phones [ẽ õ].

¹⁶ It should be noted that other sources note that Wobe *does* have /ẽ õ/, e.g. Bearth & Link (1980).

profile of lacking /ẽ õ/. Many are said to have complete sets of nasal counterparts which include /ẽ õ/, such as Ghana-Togo Mountain languages Ahlo, Akpafu, Bowili, Kebu, Lelemi, Likpe, among others. Others of the area have restrictions which do not easily fit patterns seen elsewhere in West Africa, e.g. Adele and Animere have /ẽ õ/ but lack /ã/, while Basila has /ẽ õ/, but lacks nasal counterparts /ĩ ẽ õ¹⁷ ã¹⁸. If we move farther West, the Cote D'Ivoire Kwa language Ebric also has an atypical system as well, /i e ɛ a ɔ u/, but only /ẽ ã õ/ (Ruhlen 1976:191, citing Vogler 1968).

Certain Kwa languages lack contrastive nasal vowels, e.g. Logba, Gonja, and Ega (if Ega is understood as Kwa, which is controversial¹⁹). In the map above in example (11) on page 11, Logba is the lone yellow marker in the area, and even this language has restrictions on contextual [ẽ õ] (see Dorvlo 2004). Ega is spoken in Cote D'Ivoire and is like its Eastern Kru neighbors in lacking nasal vowels. Gonja is spoken in central Ghana in the vicinity of Dagbani and other Gur languages, which lack contrastive nasal vowels, as well. Therefore, taking the Kwa/Gbe group as a whole, there are clear trends within regions and within genetic branches, but specific large-scale statements are more difficult to make.

Further, the Gur family presents another situation where it is difficult to understand the distribution of nasal vowels as due primarily to genetic inheritance. A total of 22 Gur languages/language clusters were studied. 12 have contrastive nasal vowels, while 10 do not, most of whom occur in the northern Ghana region, shown on the Google map (e.g. Dagbani, Frafra, and Hanga). Naden (1989:154) notes that contrastive nasal vowels are “found a) in the southwest [Gur] languages, which may or may not be Gur, adjacent to Kwa, and b) in Gurma languages of the Ghana-Togo border”, though the distribution seems wider than this statement (e.g. nasal vowels occur in Dagaare, as cited in Hajek 2011b²⁰). If a Gur language does have contrastive nasal vowels, most have a reduced system without /ẽ õ/. This is true of the Senoufo languages of Cote D'Ivoire, and of a Bariba, a Gur language of northern Benin. Naden (1989) leaves open the possibility of reconstructing proto-Gur nasal vowels as a contextual or contrastive nasal vowel.

Perhaps the area where areal alignment should be invoked the most is Nigeria. Dimmendaal (2001: 374-377) comments on this fact discussing nasal vowels in Niger-Congo as

¹⁷ I assume this is what the transcription symbol <ö> represents, as documented in Williamson (1973). Also, this language has [-ATR] /ã/.

¹⁸ Despite these claims, there is reason to suspect that some Ghana-Togo Mountain languages may conform to a regional pattern of lacking /ẽ õ/. For example, although Williamson (1973) cites that Santrokofi (aka Sele) has nasal inventory /ĩ ẽ ẽ ã õ ù/, Kropp-Dakubu (1980; contributor Christine Allen) notes this languages does not have /ẽ õ/ nasal counterparts, and further questions the contrastiveness of certain nasal vowels, noting only /ĩ ù/ occur after non-nasal consonants. All other nasal vowels occur after nasal consonants only. Further, Schuh (1995) notes that in Avatime, ẽ and õ are rare, and that in general among the modern generation, nasalization has all but disappeared, the nasal vowels collapsing with their oral counterparts. This is particularly interesting, as Avatime is spoken within a couple miles of Logba, which lacks contrastive nasal vowels, atypical for the region.

Moreover, some proposals exist concerning the development of contrastive nasal vowels in Ghana-Togo Mountain languages, e.g. the reconstruction in (i) below, taken from Heine [1968]'s work on Proto-Togo-Remnant (cited in Hyman 1972:192-193), in which *CVNV > /CṼ/

i. Proto-Togo-Remnant *kane ‘to go’ > Balemi, Likpe kẽ

Much more research is needed on these languages before more statements can be made.

¹⁹ See for example <http://www.rogerblench.info/Language/Niger-Congo/Kwa/Ega.pdf>.

²⁰ See Bodomo (1997), and earlier Kropp Dakubu (1976:114; contributor E. Hall) who notes that /Ṽ/ might actually be /Vm/.

an areal feature, noting that Cross-River languages as a whole lack contrastive nasal vowels (backed by this survey as well), though a single low-level group Ogoni does have them. He further notes that within Bantoid, nasalized vowels are somewhat common in this NW Bantu/Bantoid zone, though extremely rare in Bantu as a whole.

From the Google map, in western Nigeria and moving west one can see a strong blue and green belt of drops which indicate the lack of /ẽ õ/ and /ẽ ẽ õ õ/ respectively. This line roughly aligns with the coverage of coastal and mildly inland Kingdoms before 1900, which influenced one another, e.g. among the Akan/Gbe/Ewe peoples, the Yoruba people, and the Edo (i.e. the Benin/Bini Kingdom from the 15th Century to late 19th). A strong areal spread zone here is therefore not surprising. In the north of Nigeria, we see a mixture of types, which cut across families. Some Kainji/Plateau languages have contrastive nasal vowels (e.g. Reshe, TsuVadi, Cicipu, Ashe, and Gwara), while others do not (e.g. Duka, Tarok, and East Kainji languages as a whole)²¹. Further, as mentioned above, Eastern Nigeria is a zone of intense lack of nasal vowels, though this is not categorical, as many languages within this area are describe as having contrastive nasal vowels, e.g. Basa Benue, Mada, Etulo, Jukun, and Vute. In general, however, we can see that in Southern Nigeria, there is a sharp East/West divide in the absence vs. presence of nasal vowels. This is also touched upon in Williamson (1989), who provides reconstructions tying the various families. A reconstruction is taken from Williamson (1989:259), shown in (16). This show Westerly located Edoid, Igbooid, and Nupe as having a nasal vowel reflex (or in the case of Edoid, a nasal feature of some sort which was later realized as a nasal vowel), whereas in more easterly located languages Proto-Jukunoid and Bantoid, the reflexes are nasal stops.

16. Reflexes of nasality in small Nigerian language group sample

Language		Form	Reflex
Proto-Edoid		*tɔN	Ambiguous
Igbooid	Proto Igbooid	*'tõ	Nasal vowel
Nupe		tsã	Nasal vowel
Proto Jukunoid		ton-a	Nasal stop
Bantoid	Jarawan	#tono	Nasal stop
	PEG	*-tòn	Nasal stop
	PB	*-tùm̩b	Nasal stop
Among others			

This data suggests that the Eastern languages are more conservative w/r/t nasal consonants, and the westerly languages underwent nasalization. This leads one to conclude that the Eastern Nigerian region without contrastive nasalization is conservative, whereas West Nigerian languages innovated nasalization, perhaps due to areal influence.

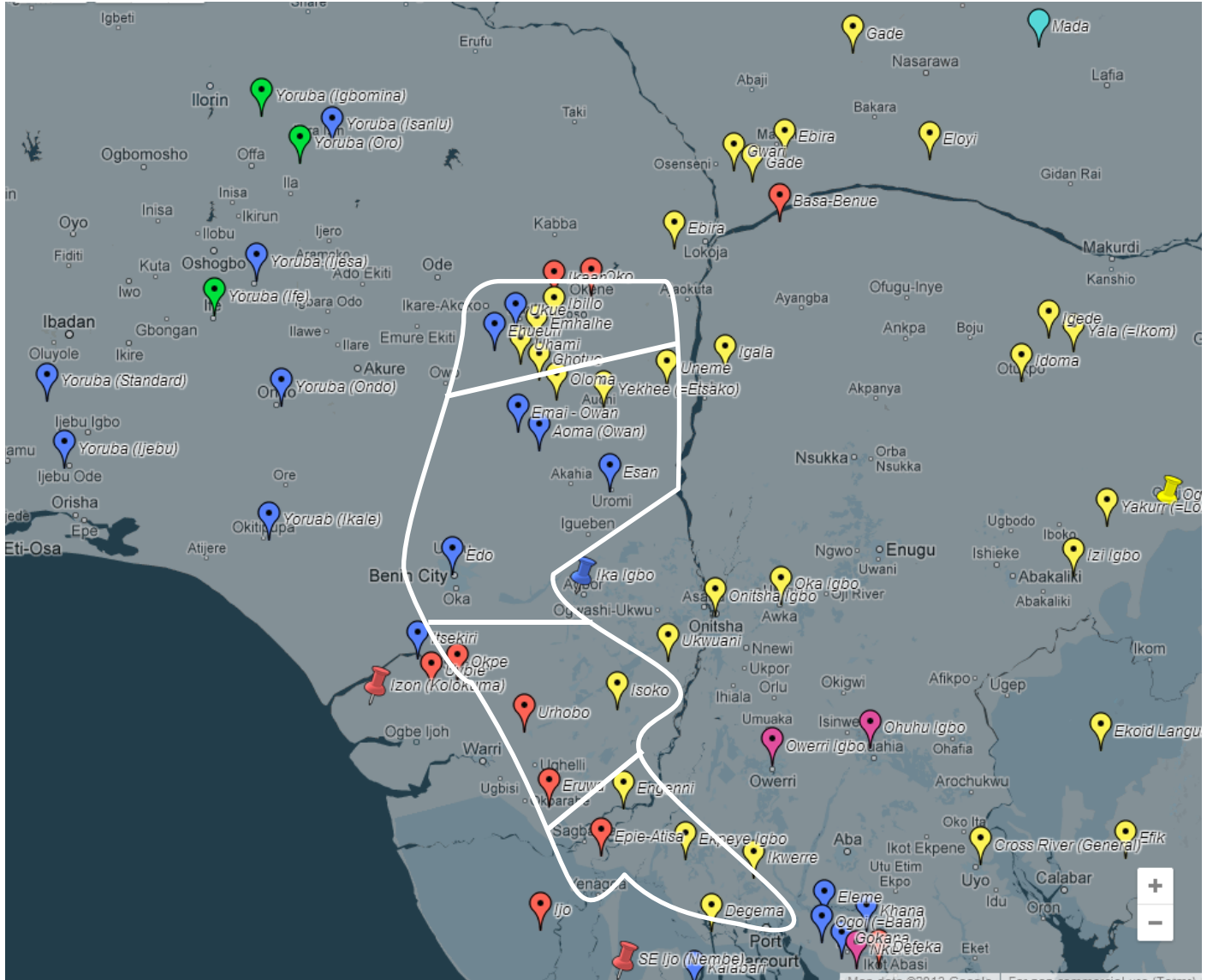
One family in which the areal alignment effect of nasal vowel systems is particularly strong is Edoid. Elugbe (1989:40) notes that nasalization on vowels is a feature of all Edoid language, though only contrastively in some; in others it is conditioned by a neighboring nasal consonant. Geographically, Edoid is situated between Defoid and Igbooid languages, mainly occurring to the West of the Niger River, and situated between three-micro Zones. To the West is

²¹ Many of the Kainji/Plateau languages surveyed in this paper are based on tentative descriptions drawn by Roger Blench in various online manuscripts. I have attempted to contact Roger to ask permission to cite these and gauge his confidence in these sketches, though have received no response. I cite them here as tentative proposals for this course paper only, and await his reply.

an almost categorical Nasal Vowel zone in which /ẽ õ/ are absent, e.g. in Yoruba, Itsekiri, among others. To the south are Ijo languages which typically have contrastive nasal vowels; two nearby languages Kolokuma Izon and SE Ijo (Nembe) have a full set of nasal counterparts including /ẽ õ/, albeit only in a limited context, e.g. in ideophones (Williamson 1973, Jenewari 1989:110). To the east across the Niger River is a strong non-nasal vowel zone.

We see that the distribution of nasal vowels in Edoid is more determined by areal proximity than it is by genetic affiliation, shown in (17) below. Edoid is divided into four branches, North-West, North-Central, South-West, and Delta (the further south) (Elugbe 1989). In the North-West and North Central groups, those languages which butt against Yoruba have contrastive nasal vowels, e.g. Ehueun and Edo (=Bini), whereas those which are located more easterly do not have contrastive nasal vowels, e.g. Ghotuo, Yekhee (=Etsako), and Uneme. Further, in the SE and Delta branches, we see that westerly located Okpe, Eruwa, and Urhobo have a full set of nasal counterparts including /ẽ õ/, and are also located against Ijo languages with a similar inventory. In contrast, languages to the east such as Isoko and Engenni do *not* have nasal vowels, and butt against the non-nasal zone of Nigeria. This distribution suggests a strong areal alignment effect across different language families.

17. Distribution of nasal vowel systems in Edoid – 4 genetic subgroups divided



If we look at the set of words from Edoid in example (18), we see that within those North Central Edoid languages which lack /ẽ õ/, a word with /ẽ/ often maps to a South West Edoid language's /ẽ/, which suggest */ẽ/ has merged with /ẽ/ in these North Central Edoid languages. For example, the Edo word /èwǣ/ corresponds to Urhobo /èvjè/.

18. Correspondences in Edoid

	Urhobo	Edo	Uromi Esan	Okpe (SW)	Proto-Edoid	Correspondence
water	<amen> [àmè]	<àmèn> [àmě]	<àmèn> [àmě]	?	*A-mɪN	ẽ ↔ ẽ
sand	<ékpén> [ékpé] ?	<èkèn> [èk ^h ě]	<èkèn> [èkě]	?	*I-kɛN “earth (soil)”	
eight	[ěřě+řě]	<èrérèn> [èřěřě]	<èléénlèn> [èlé:ľě]	?	*nhɪNanhɪ	
breast	[èvjè]	<èwén> [èwě]	<ínyèn> [ĩně]	?	?	
fly	<úyé> [újé]	<ikian> [ikjá]	<íkhièn> /íxjě/	/újě/ [ùjé]	*A-khiNə	ẽ ↔ ǎ ↔ ẽ
Source:	Rolle Field notes; Ukere 2005 [1986]	Rolle Field notes, Agheyisi 1986	Rolle Field notes	Elugbe 1989	Elugbe 1989	

Future work is needed to understand these diachronic developments further, as well as nasalization as a whole within Edoid²².

4. SITUATING THE WEST AFRICAN NASAL VOWEL PATTERNS - CROSS-LINGUISTIC COMPARISON

While exact genetic and areal details cannot firmly be established in a holistic fashion at this point, what we can do is understand this situation within a cross-linguistic context and comparison. In particular, I start by asking if the pervasive constraint against /ẽ õ/ ~ [ẽ õ] is common elsewhere in the world. In this section, I find that such a constraint is not found, and that in systems in which there is a mid-height contrast in the oral series /e ɛ o ɔ/, there does not seem to be a strong cross-linguistic preferences for nasal mid-low vowels /ẽ õ/ over mid-high vowels /ẽ õ/. I first present a summary of previous cross-linguistic surveys, and then present a case study of a similar area with widespread contrastive nasal vowels, looking at the Amazon linguistic area within South America.

4.1. Cross-linguistic comparison

As shown above in example (2) on page 4, previous studies which have discussed the cross-linguistic distribution of nasal vowels include Ruhlen (1976,1978), Maddieson’s (1984) UPSID, Maddieson (2007), and Hajek’s (2011a) WALS entry. In discussing patterns in his work, Ruhlen (1978:222) notes that the most common situation (“the most natural system”) is one in

²² Elugbe notes that the proto */-N-/ in this table has “no segmental reflex in any known Edoid language...[and] may never have been realized except as nasalization of surrounding vowels” (Elugbe 1989: 115), speculating this may have been a velar nasal in some works. He also shows that nasalization in the NC branch can come from CVnhV sequences, and CVNV sequences (Elugbe 1989: 117), where <nh> is a lenis coronal nasal stop.

which all nasal vowels equal the number of oral vowels. The next most common is one in which there is a neutralization of mid vowels, or if more than one mid height, one of these mid heights. Ruhlen's study shows that if a language lacks a nasal vowel counterpart, a mid-vowel will be the most common missing one. Of the 73 languages which he found with reduced nasal vowel inventories, 33 lacked a mid nasal counterpart (cf. high vowels, of which only 19 languages lacked a high vowel counterpart). He also notes that in larger vowel inventories ($n > 5$), the tendency to have fewer nasal contrasts than oral contrasts becomes much more frequent. This is largely backed up by Maddieson (2007), who notes that of the 138 languages surveyed, 68 (or 49.3%) had a full inventory of nasal counterparts to the oral vowels; the second most common system is one in which the nasal vowel inventory to be two less than the oral vowel inventory.

We can also look at Ruhlen's (1978) study to analyze which mid height is more often missing a nasal counterpart. As shown in Ruhlen (1978:220), of the 73 languages with nasal vowels, 28 have two oral mid vowel heights which correspond to only 1 nasal mid height, showing a mid-nasal gap. He shows that / $\tilde{\epsilon}$ $\tilde{\delta}$ / are likely to be the sole phonemes present as opposed to / $\tilde{\epsilon}$ $\tilde{\delta}$ /. However, this table includes a number of West African languages which may skew these findings. If we take out these languages, we are left with 14 languages, shown in the table in example (19)²³.

19. Ruhlen 1978 – Languages with Two Oral Mid Heights – Missing Nasal Counterparts

Language	Family	Oral Mid Vowels	Nasal Mid Vowels	Nasal vowels Counterpart	Number
Sara	Central Sudanic, Nilo-Saharan	e o ɔ	$\tilde{\epsilon}$ $\tilde{\delta}$	Mid-Hi	5
Marathi	Indic	e ə ɐ o ɔ	$\tilde{\epsilon}$ $\tilde{\delta}$ $\tilde{\delta}$		
Lisbon Portuguese	Romance	e ε o ɔ	$\tilde{\epsilon}$ $\tilde{\delta}$		
Mazahua	Oto-Manguean	e ε ə o ɔ ʌ	$\tilde{\epsilon}$ $\tilde{\delta}$ $\tilde{\delta}$		
Yaruro	? [Venezuela]	e ε o ɾ ɔ	$\tilde{\epsilon}$ $\tilde{\delta}$		
Gbeya	Eastern Adamawa	e/e: ε/ε: o/o: ɔ/ɔ:	$\tilde{\delta}$ / $\tilde{\delta}$:	Md-Lo	6
Dowayayo	Eastern Adamawa	e/e: ε/ε: o/o: ɔ/ɔ:	$\tilde{\epsilon}$ / $\tilde{\epsilon}$: $\tilde{\delta}$ / $\tilde{\delta}$:		
Haitian Creole (Fort) Chipewyan	Romance creole Athabaskan	e ε o ɔ e ε/ε: o	$\tilde{\epsilon}$ $\tilde{\delta}$ $\tilde{\epsilon}$ / $\tilde{\epsilon}$:		
Biloxi	Macro-Siouan	e: ε/ε: ə o/o: ɔ/ɔ:	$\tilde{\delta}$ / $\tilde{\delta}$:		
Tewa	Kiowa-Tanoan	e/e: ε/ε: o/o:	$\tilde{\epsilon}$ / $\tilde{\epsilon}$:		

²³ I do not include in this table “repetitions” of languages which are included in his survey. For example, Ruhlen includes both Rio Portuguese and Lisbon Portuguese. I also do not include his French dialects. Further, because I do not survey the Adamawa languages in this study, I leave them in the table in (19).

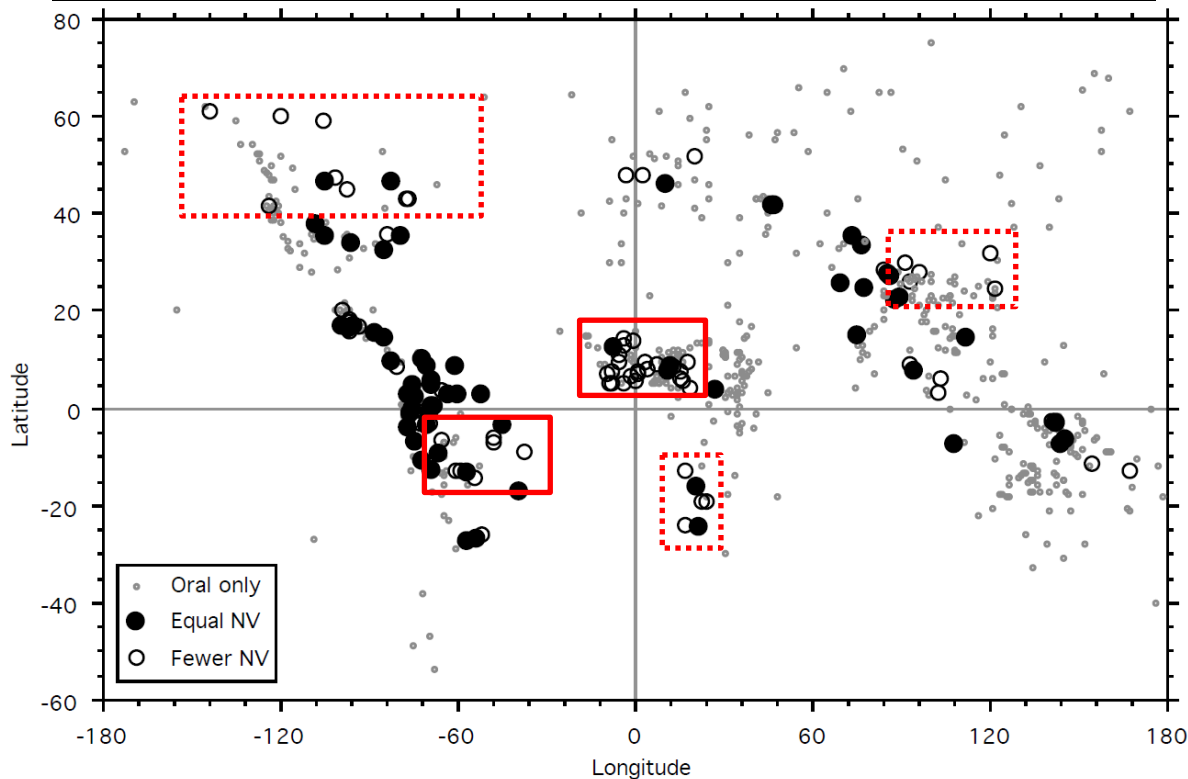
Language	Family	Oral Mid Vowels	Nasal Mid Vowels	Nasal vowels Counterpart	Number
Otomi (Mezquital)	Oto-Manguean	e ε ə o	ẽ õ	Mixed	3
Apinaye	Macro-Ge	e ε o ɾ ɔ ʌ	ẽ õ ʌ̃		
Cayapo	Macro-Ge	e ε ə o ɔ ʌ	ẽ õ ʌ̃		

This table shows 5 instances of the sole mid nasal height being **mid-high** /ẽ/ and/or /õ/, 6 instances of the sole mid nasal height being **mid-low** /ẽ/ and/or /õ/, and 3 instances of a mixed system. Although this sample from Ruhlen is very small, we can see from this table that there is no one clear preference for converging on a single mid nasal vowel inventory if we do not include westerly West Africa. Further, although Maddieson's (1984) UPSID database shows that 11 languages have /ẽ(:)/ whereas 22 have /õ(:)/, the same proportions do not hold for back vowels. Here, 21 languages have /õ(:)/, whereas only 19 have /ẽ(:)/.

All of these studies show a strong areal skewing of the occurrence of nasal vowels, found in 5 major regions: [1] Middle Belt of North America, [2] North and Central South America, [3] **West African Sub-Saharan Belt**, [4] Northern India²⁴, and [5] Southern Mexico. Nasal vowels are not a feature of entire vast regions, e.g. Australia (Dixon 2004:547). Within these different regions, however, the distribution of languages with nasal vowel gaps is not uniform. Maddieson (2007:1384) presents a ghost map visualizing the approximate geographic locations of his 670 languages surveyed, shown below in (20). This specifies [1] which languages have no nasal vowels (the small grey circles), [2] languages which have full oral and nasal counterparts (the solid black circles), and [3] languages which have a reduced number of nasal counterparts (the white-filled circles). We can see from this map that areas in which a nasal counterpart is missing are in West Africa, Central South America, and to a less extent South-Eastern Africa, Northern North America, and a belt in Northern South Asia. In other places, it is more likely the case there is a full nasal vowel set.

²⁴ In India, there may be a strong areal alignment as well. Masica (1991: 117-118) notes that nasal vowels are a prominent feature of (New) Indo-Aryan (NIA). She qualifies this, however, by noting Nasalization appears to play a prominent role in the phonology of Western NIA languages (e.g. Hindi, Punjabi, Gujarati, Rajasthani, Sindhi, "Lahnda" and Siraiki, Nepali, and Konkani), far more than in the Eastern NIA area.

20. ‘Ghost map’ of world-wide distribution of languages with and without nasalized vowels (Maddieson 2007: 1384) – Red squares over which indicate relevant zones



Of these four regions, only the West Africa and central Amazon regions (in solid red) appear to not include a disproportionately large number of languages within their zone which do not have nasal vowels, i.e. they do not have disproportionately large number of grey dots within the region.

4.2. Case Study - SAPHON

This data suggests that South America may be a good location to explore if there are systematic restrictions against mid-high nasal vowels /ẽ õ/~[ẽ õ]. To this end, I ran a survey of nasal vowel systems as found in South American Phonological Inventory Database (SAPhon v1.1.2)²⁵. This database surveys 359 languages of South America, drawing from a number of independent sources, often of hard to find material and in languages other than English. Using their advanced search tools, I conducted a systematic survey of nasal vowel inventories; the results are shown in the table in (21). Of the 359 languages, 158 are described as having contrastive nasal vowels, of which 68% have a full set of nasal counterparts. If a language was missing an oral counterpart, the majority case was one where a mid vowel was missing.

²⁵ This is Available at <http://linguistics.berkeley.edu/~saphon/en/>. There are some complications with using this database. It is not confirmed that the works cited in this database systematically determined whether a nasal vowel was contrastive or conditioned. Second in many South American languages, the nasalization feature itself may be understood as a property of the syllable, or the word, in which case nasal vowels have to be reinterpreted somehow. This is, of course, also an issue in Africa. For example, in the Adamawa-Ubangi family in general Boyd (1989:198) notes that “nasality is associated with morpheme structure, rather than individual segments”.

21. SAPHON Database - Stats

Total languages of SAPHON	Languages with nasal vowels	Languages with full nasal counterpart set	Languages missing a nasal counterpart		
359	158/359 (44%)	98/158 (62%)	60/158 (38%)	Missing a high vowel	22/60 (37%)
				Missing a mid vowel	40/60 (67%)
				Missing a low vowel	10/60 (17%)

Further, we can compare the types of nasal vowels which occur in the mid vowel range and notice some striking differences when compared to West Africa. Of the 158 languages which had nasal vowels, 26 languages had more than one mid height in either the nasal or oral inventory. As expected, reductions in the nasal inventory of mid vowels were the norm, shown in (22). However, I found that there were more cases where only a **mid-high** nasal vowel occurred (i.e. /ẽ õ/ but not */ẽ ã/), compared to those instances in which only a **mid-low** nasal vowel occurred (i.e. /ẽ ã/ but not /ẽ õ/).

22. Types of mid nasal-vowel gaps in SAPHON²⁶

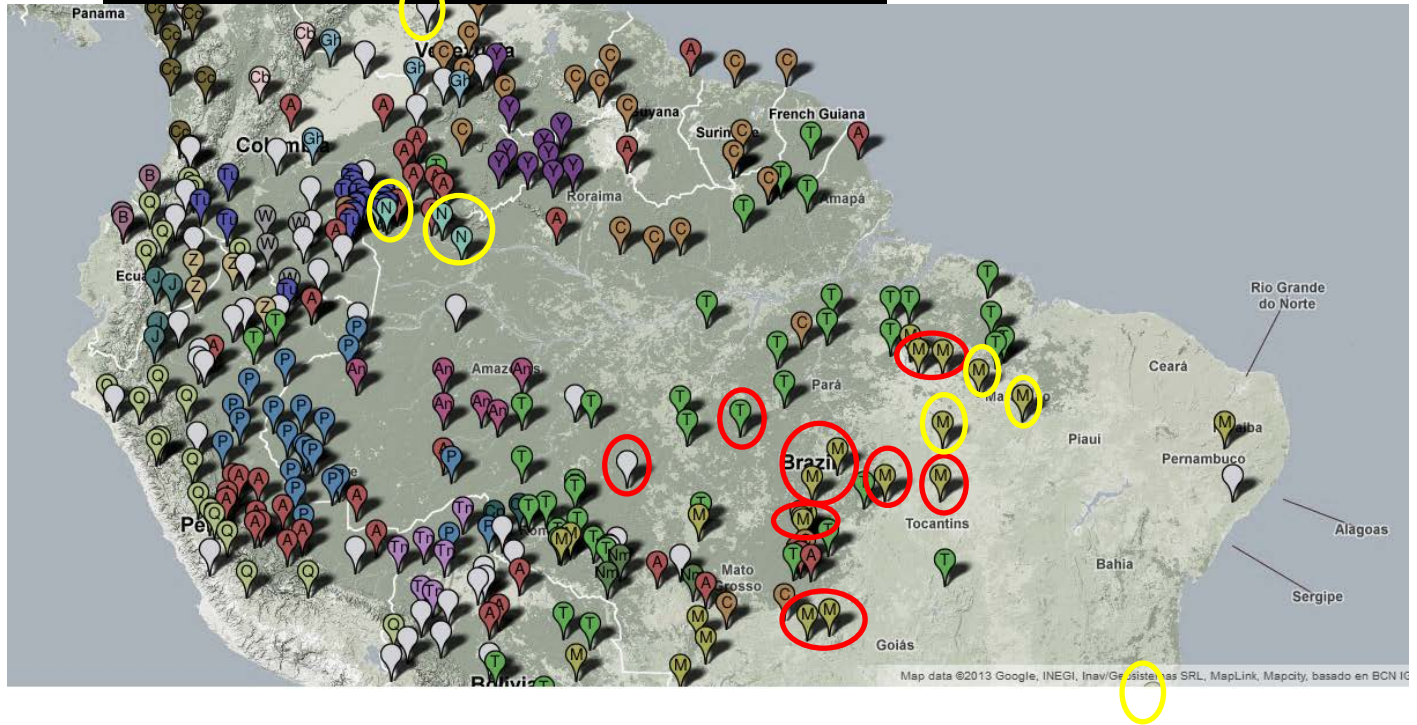
Missing mid-low ẽ/ã Has mid-high ẽ/õ	Missing mid-high ẽ/õ Has mid-low ẽ/ã	Mixed (*ẽ *ã, ẽ õ)	Missing only /ə/	Nothing missing
Apinayé	Canela	Kaingáng, São Paulo	Hoti	Cayubaba
Arára do Mato Grosso	Dâw			Kwaza
Karajá ²⁷	Hup			Xokleng
Kuruáya	Krahô			
Mebengokre	Krenak			
Ofayé	Krinkati-Timbira			
Panárá	Nadëb			
Parkateje	Pumé			
Suyá	Yuhup			
Tapayuna				
Xavánte				
Xerénte				
12/26	9/26	1/26	1/26	3/26

²⁶ Pressing Ctrl+Left Click over a language name, this goes to the SAPHON webpage providing the phonological inventory.

²⁷ This has /õ/, but is missing */ẽ ã/.

These data show us a reverse pattern from what we see in West Africa. If we plot these languages onto the SAPHON map (also created with Google Maps, but in an advanced program), we notice both a genetic and areal skewing of this distribution. A map and table is provided in (23); red circles indicate languages having mid-high nasal vowels, whereas yellow circles indicate those with mid-low.

23. Map of nasal vowel languages with a mid nasal vowel gap



Mid-High languages		Mid-Low languages	
Missing mid-low $\tilde{\epsilon}/\tilde{\text{õ}}$	Family	Missing mid-high $\tilde{\epsilon}/\tilde{\text{õ}}$	Family
Has mid-high $\tilde{\epsilon}/\tilde{\text{õ}}$		Has mid-low $\tilde{\epsilon}/\tilde{\text{õ}}$	
Apinayé	Macro-Ge	Canela	Macro-Ge
Arára do Mato Grosso	Isolate	Dâw	Nadahup
Karajá	Macro-Ge	Hup	Nadahup
Kuruáya	Tupí	Krahô	Macro-Ge
Mebengokre	Macro-Ge	Krenak	Macro-Ge
Ofayé	Macro-Ge	Krinkati-Timbira	Macro-Ge
Panárá	Macro-Ge	Nadëb	Nadahup
Parkateje	Macro-Ge	Pumé	Isolate
Suyá	Macro-Ge	Yuhup	Nadahup
Tapayuna	Macro-Ge		
Xavánte	Macro-Ge		
Xerénte	Macro-Ge		
12/26		9/26	
Red Circles		Yellow Circles	

We can notice two main things about this distribution. One is that there is clear genetic skewing. Macro-Ge languages (not-Eastern ones) tend to have /ẽ õ/, but not */ẽ õ/. This contrasts with [1] other Macro-Ge languages which have /ẽ õ/, and [2] all of the Nadahup languages of NW Brazil which also have /ẽ õ/. Finer genetic classifications of the languages in these families have not been researched at this time. Further, there is also a clear asymmetrical areal distribution between these two types of languages. Mid-high languages occur in the central regions of the Brazil among the Macro-Ge languages. Noteworthy are two non-Macro Ge languages Kuruáya (Tupí-Guaraní) and Aráta do Mato Grosso (Isolate) which appear in the areal vicinity of the Mid-High zone, and also show that same pattern as the Macro-Ge languages. In contrast, mid-low languages occur in the eastern and southern part of the Macro-Ge region.

Although the number of languages surveyed is small, it does show that there is not a comparable large-scale areal constraint against /ẽ õ/ operating in South America. This may be due to the different types of nasal systems which exist in the two regions. Aikhenvald notes that in many Amazonian languages nasalization is a feature of the syllable (Hup [Makú]) or phonological word (Warao [Isolate]). This is also summarized in Ruhlen (1978:218), who speculates that the prosodic use of nasalization in South America may explain why it is common for there to be an equal number of nasal and oral vowels. This is statistically confirmed in Maddieson (2007), who notes that the average number of vowel quality distinctions in South America vs. Africa is statistically significant, with there being more on average in Africa. What is most important to take away from this study though is that the typological profile which emerges from West Africa is not repeated in other large-scale nasal vowel zones of the world, showing the uniqueness of these patterns, in particular the constraint against /ẽ õ/ ~ [ẽ õ].

5. CONCLUSION AND OUTSTANDING ISSUES

In conclusion, this study has shown the pervasiveness of nasal vowels in the West African phonological profile, and understands them as best able to be best explained as an areal affect which has its roots in phonetic “naturalness” and genetic inheritance. The following points were established:

- The presence/absence of contrastive nasal vowels cuts across language groups and is a strong areal feature of West Africa
- A restriction against phones */ẽ õ/ as well as *[ẽ õ] is perhaps more robust than previously understood
- A restriction against these phones is disproportionately present in West Africa compared with other languages of the world, e.g. S. America
- Although a restriction against /ẽ õ/ is phonetically natural, this alone cannot explain the widespread distribution in West Africa

This constraint against [ẽ õ] appears to be so great that even in languages which do not have contrastive nasalization at all, there appear to be restraints on the occurrence of [ẽ õ], for example in the far West in Kisi, and the far east in Ogberia.

There are a number of additional areas which require further research. One is filling out the areas on the map currently lacking, e.g. in Northern Benin, Northern Togo, Central Ghana, Northern Cote D’Ivoire, Guinea in general, Southern Mali, the Middle Belt of Nigeria, and south-western Niger. Further, this paper has dealt almost entirely with the zone which stretches from Guinea-Bissau to Nigeria, roughly south of the Sahel. Another potential nasal vowel zone

includes Southern Chad, Eastern Cameroon, and Western Central African Republic. This is shown by Hajek (2011b), who notes the following languages with nasal vowels in this second zone area:

24. Potential Central Africa Nasal Zone

Language with nasal vowels	Family
Mbodomo	Gbaya, Ubangian?
Gbaya	Gbaya,
Kara	Ubangian?
Doyayo	Adamawa
Mbay	Bongo– Bagirmi
Day	Adamawa
Kosop	Mbum
Gula Iro	Bua, Mbum

Some of these languages, too, have a constraint against /ẽ õ/, e.g. Doyayo has /e ε o ɔ/ but only /ẽ õ/ (Wiering 1974), and Gbeya in general is also noted as having /e ε o ɔ/ but only /ã ã/ nasal counterparts (Maddieson 1984). Further, the Bantu language Beembe (H11) is also noted as having contrastive nasalization, which is spoken near the Teke languages in Congo-Brazzaville which also have nasal vowels, e.g. Eboo-Nzikou /e o ε ɔ/ /ẽ õ/ (Raharimanantsoa 2012).

Finally, some further questions include the following:

25. Other outstanding questions

- [1] How can the distribution of nasal vowel patterns shed light on specific proposals positing nasal vowels in a Proto-Bantu or a pre-Proto Bantu stage (e.g. Stewart 1999)?
- [2] How have restrictions against /ẽ õ/ and [ẽ õ] been realized diachronically? Merger with /ẽ õ/ only? Instances of denasalization (e.g. to /e o/ or /eN oN/?)
- [3] Building on Clements & Rialland's (2006) map of nasal vowel distribution, can we isolate a more exact linguistic boundary between those languages with **contrastive** nasal consonants, and those with **contextual** nasal consonants?
- [4] If the areal perspective on the lack of /ẽ õ/ proves most fruitful, where are the hubs of this areal spread? Are there more than one?

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APPENDICES

Appendix 1 – West African languages surveyed

This appendix provides the 168 languages and language clusters which form the basis of this survey. For reasons of space and cleanliness, this is a reduced database of the larger one; references for data of these languages are available upon request. The most important column here is the 5th, “Which nasal counterparts are missing”, which denotes the gaps in the nasal vowel inventory compared to the oral inventory. A “0” indicates that there were a complete set of nasal counterparts, usually meaning that /ẽ õ/ were present. A “1” indicates no contrastive nasal vowels. An excel file accompanies this paper for easier navigation.

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
1	Adangbe Ewe	Gbe	yes	o?	md-hi
2	adele	Ghana–Togo Mountain, Kwa	yes	ə	md-lo
3	Ahanta	Tano, Potou-Tano, Kwa	yes	e ε o ɔ	md-hi,md-lo
4	Ahlo	Ghana–Togo Mountain, Kwa	yes	0	
5	Akan	Potou-Tano, Kwa	yes	e o ε ɔ	md-hi, md-lo
6	Akpafu	Ghana–Togo Mountain, Kwa	yes	0	
7	Amo	East Kainji		1	
8	animere	Ghana–Togo Mountain, Kwa	yes	ə	

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
9	Anyi	Potou-Tano, Kwa	yes	e ε o ɔ	md-hi,md-lo
10	Aoma Owan	Edoid	yes	e o	md-hi
11	avatime	Ghana–Togo Mountain, Kwa	yes	0/(1)	
12	bafia	Bantoid		1	
13	balanta	atlantic		1	
14	bambara	Western Mandé, Mandé	yes	0	
15	baoulé	Akan, Potou-Tano, Kwa	no	e o	md-hi
16	bariba	Gur	yes	e o	md-hi
17	basa-Benue	kainji, east benue congo	yes	0	
18	basari	Gur		1	
19	Basila	Ghana–Togo Mountain, Kwa	yes	ɪ ö ε ɔ	nr-md, md-lo
20	Biafada	atlantic		1	
21	bijago	Atlantic		1	
22	bisa	Mandé		1	
23	Bobo	Mandé	yes	e o	md-hi
24	Bowili	Ghana–Togo Mountain, Kwa	yes	0	

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
25	cicipu	kainji, east benue congo	yes	0	
26	Cross River Family	Cross River		1	
27	dagbani	gur		1	
28	dan blossomé	mande	yes	e ɾ o	md-hi
29	Defeka	Ijoid?	?	0	
30	Deg	Gurunsi, Gur	yes	i e o u	high, mid (+ATR) vowels
31	Degema	Edoid	yes	1	
32	Dogon	Dogon	yes	e o	md-hi
33	Duka	Kainji, East Benue Congo	yes	1	
34	East Kainji family	kainji, east benue congo	yes	1	
35	Eastern Kru	Eastern Kru, Kru	yes	1	
36	Ebira	nupoid	yes	1	
37	Ebrie	kwa	yes	i ɛ u ɔ	high, md-lo
38	edo	edoid	yes	e o	md-hi
39	efik	Cross River		1	
40	Ega	Kwa?		1	

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
41	Egene	Edoid	yes	1	
42	Ehueun	Edoid	yes	e o	md-hi
43	Ekoid Family	Ekoid		1	
44	Ekpeye	Igboid		1	
45	Eloyi	Plateau	yes	1	
46	Emai Owan	Edoid	yes	e o	md-hi
47	Emhalhe	Edoid	yes	1	
48	epie-atisa	Edoid	yes	0	
49	Eruwa	Edoid	yes	0	
50	Esan	Edoid	yes	e o	md-hi
51	Etsako	Edoid	yes	1	
52	Etulo	Idomoid	yes	e ə a u o	high, md-hi, low
53	ewe	Gbe	yes	e o	
54	Fon	Gbe	yes	[e o]	md-hi
55	Foodo	Guang, Potou-Tano, Kwa	yes	1	
56	Frafra	More, Gur	yes	1	
57	Gã	Kwa	yes	e o	md-hi
58	gade	nupoid		1	
59	Gen Ewe	Gbe	yes	e o	md-hi
60	Ghotuo	Edoid	yes	1	

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
61	Gikyode	Guang, Potou-Tano, Kwa	yes	0	
62	Godie	Eastern Kru, Kru	yes	1	
63	gonja	Potou-Tano, Kwa	yes	1	
64	grebo	kru	yes	e o	md-hi
65	Grusi Family	gur		1	
66	guro	South Mande, Mande	yes	i ε ɔ u	high, md-lo
67	gwara	Plateau?	yes	0	
68	gwari	nupoid	no	1	
69	Hanga	More, Gur	yes	1	
70	Ibilo	edoid	yes	1	
71	Idoma	Idomoid		1	
72	Ife Yoruba	defoid	yes	e o ε ɔ	md-hi, md-lo
73	Igala	defoid	yes	1	
74	Igbomina Yoruba	defoid	yes	e o ε ɔ	md-hi, md-lo
75	Igede	Idomoid		1	
76	Ijebu Yoruba	defoid	yes	e o a	md-hi, low

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
77	Ijesa Yoruba	defoid	yes	e o a ε	md-hi, md-lo, low
78	Ijo	Ijoid	?	0	
79	Ika igbo	Igboid	yes	ɔ	md-lo
80	Ikaan	West Benue Congo?	yes	0	
81	Ikale Yoruba	defoid	yes	e o	
82	Ikwerre Igbo	Igboid		[ɔ]	md-lo
83	Isanlu Yoruba	defoid	yes	e o a ε	md-hi, md-lo, low
84	Isoko	Edoid	yes	1	
85	Itoo Ashe	koro, plateau	yes	0	
86	Itsekiri	defoid	yes	e o	
87	Izi	Igboid	yes	1	
88	jukun	Jukunoid	no	0	
89	Kalabari Ijo	Ijoid	yes	[e] o	md-hi
90	Kalamse	Gur	yes	1	
91	kanuri	Saharan		1	
92	Kasem	Grusi, Gur	yes	e o	md-hi
93	kebu	Ghana-Togo Mountain, Kwa	yes	0	
94	Ketu Yoruba	defoid	yes	e o	

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
95	kisi	West Atlantic, Atlantic	yes	1	
96	Klao	Kru	yes	e o	md-hi
97	Kolokuma Izon	Ijoid	yes	e o	md-hi
98	Konni	gur	yes	1	
99	koromfe	gur	yes	0	
100	Kposo	Ghana–Togo Mountain, Kwa	yes	i e ε a	
101	Krache	Guang, Potou-Tano, Kwa	yes	0	
102	Krim	Mel, Atlantic	yes	0	
103	Kusaal	More, Gur	yes	ɪ ʊ e o	nr-hi, md-hi
104	lelemi	Ghana–Togo Mountain, Kwa	yes	ε o ɔ	md-hi, md-lo
105	Liberian Kpelle	western mande, mande	yes	0	
106	Ligbi	Mande	yes	0	
107	Likpe	Ghana–Togo Mountain, Kwa	yes	0	
108	logba	Ghana–Togo Mountain, Kwa	yes	1	
109	loko	mande	yes	e o	md-hi
110	Mampruli	More, Gur	yes	1	

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
111	Mandinka	Mande		1	
112	Mende	Mande	yes	0	
113	Nafaanra	Senúfo, Gur	yes	e o	md-hi
114	Ncham	Gur	yes	1	
115	Nembe SE Ijo	Ijoid	yes	e o	md-hi
116	Ngangam	Guang, Potou-Tano, Kwa	yes	0	
117	Nkoroo	Ijoid	yes	ẽ õ	md-hi,md-lo,mixed
118	nupe	nupoid	yes	e o	md-hi
119	Nyangbo	Ghana–Togo Mountain, Kwa	yes	0	
120	Nyankpa	koro, plateau	yes	y	
121	ogberia	Mbe, Bantoid	yes	0/1 ?	
122	Ogoni Group	Cross River	yes	e o	md-hi
123	Ohuhu Igbo	Igboid		[ɔ]	md-lo
124	Oko	West Benue Congo	yes	(1)/0	
125	Okpe	Edoid	yes	0	
126	oku	Grassfields, Bantoid		1	
127	Oloma	Edoid	yes	1	
128	Ondo Yoruba	defoid	yes	e o	md-hi
129	Onitsha Igbo	Igboid		1	

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
130	Owerri Igbo	Igboid		[ɔ]	md-lo
131	Owka Igbo	Igboid		1	
132	Phla-Pherá group	Gbe	yes	e o	md-hi
133	reshe	kainji, east benue congo	no	0	
134	Samo	mande	yes	e o	md-hi
135	santrokofi	Ghana–Togo Mountain, Kwa	yes	#	
136	santrokofi	Ghana–Togo Mountain, Kwa	yes	#	
137	sara	Central sudanic	yes	ε	md-lo
138	senadi	Gur	yes	e o	md-hi
139	Senufo group	Senufo, Gur	yes	e o	md-hi
140	Siwu	Ghana–Togo Mountain, Kwa	yes	0	
141	soninke	mande		1	
142	Standard Yoruba	defoid	yes	e o a	md-hi, low
143	Supyire	senufo, gur	yes	e o	md-hi
144	susu	mande	yes	0	
145	Tamprusi	Gur		1	
146	Tarok	Plateau		1	
147	temne	Atlantic		1	

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
148	Tepo Kru	Kru	yes	è ò	mid
149	tikar	Bantoid		1	
150	Tiv	Southern Bantoid, Bantoid		1	
151	Toura	Mande	yes	ɪ ʊ e o	md- hi,nr-hi
152	TsuVadi	kambara, kainji, east benue congo	yes	0	
153	uhami	edoid	yes	1	
154	Ukue	Edoid	yes	e o	md-hi
155	Ukwuani	Igboid	yes	1	
156	Uneme	Edoid	yes	1	
157	Urhobo	Edoid	yes	0	
158	Uvwie	Edoid	yes	0	
159	Vagla	Gurunsi, Gur	yes	0	
160	Vute	Northern Bantoid, Bantoid	yes	ɔ	md-lo
161	Wan	mande	yes	e o	md-hi
162	Western Kru	Western Kru, Kru	yes	e o	md-hi
163	Wobe	Kru		0	
164	wolof	Atlantic		1	

Reference Number	Language	Family	Has more than one mid height	Which nasal counterparts are missing {0 =none (complete set of nasal counterparts); 1 = all (i.e. No nasal vowels); [?]/[#] means it is controversial}	Which height
165	Yakurr	Upper Cross, Cross River	yes	1	
166	Yala Ikom	Idomoid		1	
167	yaure	South Mande, Mande	yes	ɪ ɛ ɔ u	high, md-lo
168	yemba	Grassfields, Bantoid		1	

Appendix 2 – ATR and nasality

One potential articulatory explanation involves the fact that numerous languages of West Africa employ a phonological distinction between Advanced Tongue Root vowels [ATR]/[+ATR] and Retracted Tongue Root vowels [RTR]/[-ATR]. One possibility is that we can understand the restriction against /ẽ õ/ (rather than against /ẽ ð/) as stemming from the fact that they are [+ATR]. I do not adopt this here. If this were the explanation, we might expect nasal vowels to be realized as [-ATR] vowels in general. For example, we might expect a language in which [+ATR] /i/ when nasalized is consistently realized as -ATR [ĩ] (<[ĩ]>). Further, we might also expect that in cases where both /ĩ/~i/ /ũ/~u/ and /ĩ/~i/ /ũ/~u/ occur in an inventory, if one were to not have a nasal counterpart, it would be the +ATR version, analogous to the mid vowel situation. However, this is not the case. For example, Basila (=Giseda) [Ghana Togo Mountain], Kpelle [Mande]²⁸, and Dan (Santa) [Mande] have nasal counterparts for +ATR high vowels, though not for -ATR high vowels. The only language which fits this prediction is Deg, a Grusi Gur language of Ghana, in which /ɪ ɛ ɔ ʊ/ can be nasalized, but [+ATR] /i e o u/ cannot.

²⁸ According to Maddieson (1984), Kpelle has -ATR /ĩ/ but not /ũ/. However, a fairly different phonological inventory is given for Liberian Kpelle in Leidenfrost and McKay's (2007) *Kpelle English Dictionary*.