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CONDITIONING FACTORS FOR PROGRESSIVE AND REGRESSIVE NASAL HARMONY*

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The results of a survey of nasal harmonies triggered by nasal consonants argue for independent conditioning factors for progressive and regressive nasal harmony. Specifically, the only condition on a consonantal trigger of progressive nasal harmony is that it be released into a vowel, while triggers of regressive harmony should mark the right edge of a boundary. Schourup's 1973 survey of local nasal to vowel assimilation suggests that similar conditioning factors govern local perseverative and anticipatory nasal assimilation. Several motivations for the conditioning factors are considered, and tentative phonetic reasons are outlined.

1. Introduction

This paper explores the relation between the context of a nasal consonant, and the direction of the nasal harmony it triggers. Specifically this paper considers whether the consonantal triggers of progressive and regressive nasal harmony favor different contexts, and if they do, whether the same correlations can be observed in local nasal to vowel assimilation.

Previous generalizations about the directionality of nasal assimilation do not suggest a connection between local assimilation and long distance harmony. In her survey of the feature nasal, Cohn (1993:159) makes the following observation:

> ...it is less common for long distance spreading to occur with anticipatory thanprogressive nasalization. Only four cases out of the 61 cases of anticipatory nasalization invole spreading in a domain larger than a segment: whereas 11 of the 30 cases of progressive nasalization involve such spreading.

Not only do the numbers that Cohn gives suggest that there are more progressive harmonies than regressive harmonies total, but they also indicate that the percentage of progressive assimilations that are long distance is higher, especially as the total number of anticipatory assimilations is twice that of progressive assimilations. Therefore, long distance harmony appears to favor the progressive direction.

For local assimilation, Cohn's numbers suggest that anticipatory nasal to vowel assimilation is more common than progressive nasal to vowel assimilation. This coincides with Ferguson's (1975:181) statement: 'Nasality may spread either

regressively or progressively from a nasal consonant to a neighboring vowel, but regressive spread is more common.'

A preliminary conclusion might be that local nasal to vowel assimilation and long distance nasal harmony have nothing in common with respect to their likely directionality: without considering any other factor, local nasal to vowel assimilation is more likely to be anticipatory while nasal harmony triggered by a consonant is more likely to be progressive. However, there are other factors to consider, namely the context of the triggering nasal. When this factor is considered, common generalizations about directionality in local nasal to vowel assimilation and nasal harmony emerge.

The first generalization is that in both local and long distance nasal assimilation processes, a nasal consonant that is released into a vowel is more likely to trigger progressive assimilation than regressive assimilation, and that this is equally true regardless of the position within the word this prevocalic nasal occupies. For example, being in word initial position does not appear to increase the likelihood of triggering progressive harmony. One result of this is that intervocalic triggers which might be expected to trigger either progressive or regressive harmony, usually trigger progressive harmony.

The second generalization is that for both local and long distance nasal assimilation, the likelihood that a nasal consonant will trigger regressive assimilation is increased when that triggering consonant is at the right edge of some kind of boundary (e.g., at the end of a syllable, a morpheme, or a word). For example, a nasal in coda position is more likely to trigger regressive assimilation by virtue of marking the right edge of a syllable.

The first goal of this paper is to establish the generalizations stated above by comparing a survey of nasal harmonies to a survey of local nasal to vowel assimilations. Section 2 describes the results of a survey of nasal harmonies with consonantal triggers which I conducted, while section 3 reviews Schourup's 1973 survey of local nasal to vowel assimilation. Both surveys confirm the described generalizations. For both regressive nasal harmony and anticipatory nasal to vowel assimilation, there is an implicational hierarchy of contextual restrictions on triggers: intervocalic triggers in a regressive assimilation imply the presence of syllable final and word final triggers, but syllable and word final triggers do not imply the presence of intervocalic triggers in regressive nasal assimilation. This suggests that the act of marking the right edge of a syllable or word boundary somehow promotes regressive nasal assimilation from a consonantal trigger. No similar hierarchy is observed for the contextual restrictions on triggers of progressive nasal harmony and perseverative nasal assimilation. This suggests that the condition of being released into a vowel is the only factor which induces a nasal consonant to trigger progressive assimilation.

The second goal of this paper is to consider possible explanations for the two generalizations. Section 4 considers and rejects phonological-representational accounts. The autosegmental treatment of feature harmony (exemplified in Piggott 1992) does not predict a correlation between the context of a trigger and

the direction of harmony. Although the Optimal Domains Theory treatment of feature harmony (described in Cole & Kisseberth 1994, 1995 a and b) allows expression of the correlation, it also allows the expression of correlations which don't exist so the observed correlation must be stipulated. Section 5 explores the possibility that the correlation logically follows from the nature of nasal harmony itself, but no simple logical explanation is found. Finally Section 6 looks to the phonetic aspects of nasalization for an explanation. Tentative articulatory and acoustic motivations are outlined for the generalizations established in this paper.

2. Survey of Nasal Harmonies

The appendix contains data from nine languages which display nasal harmony triggered by a consonant. For convenience, the results are summarized in table (1). For each nasal harmony in the survey, the table indicates whether triggers are found in a particular context, those contexts being word final, before another consonant, intervocalic, word initial, and after another consonant.[1]

(1) Summary of Survey Results:

		Context of trigger					
Language	Direction	N#	NC	VNV	#N	CN	examples
Capanahua	regressive	✔	✔	✔			cipõnki , bĭmi
English	regressive	✔	✔				rãĩm , hɛ̃lən
Ijo	regressive	✔	✔				kɔ̃rɔ̃ŋmbɔ
Maxakali	regressive	✔	✔				ʃõwən , ãmbĭk
Arabela	progressive			✔	✔		nɛ̃ɛ̃nũʔ ,kanããgeʔ
Land	progressive			✔	✔		mãlu , umɔ̃
Malay	progressive			✔	✔		nãhũ , enãʔ
Sundanese	progressive			✔	✔		ŋhãk , gumədə
Warao	progressive			✔	✔		nãõ , inãwãhã

The most striking result from the summary in (1) is that intervocalic triggers are predominantly found in progressive harmonies. In fact every progressive harmony exhibits intervocalic triggers, but only the regressive harmony in Capanahua has intervocalic triggers, and even in this language the numbers of word final and preconsonantal triggers are much higher. In other words, a regressive harmony might have intervocalic triggers, but only if it also has word final and preconsonantal triggers, while regressive harmonies can have word final and preconsonantal triggers without having intervocalic triggers. No parallel restrictions or implications are found among progressive harmonies.[2]

My interpretation of these observations is that there is something about nasal consonants that are released into a vowel which makes them good triggers for progressive harmony, and that whatever this quality is, it applies equally to

all prevocalic consonants regardless of their position in a word. This would explain why there is no implicational hierarchy among the contextual restrictions on triggers of progressive harmony. Every prevocalic nasal consonant carries the progressive harmony promoting characteristic to an equivalent degree, so no prevocalic nasal consonant is more likely to trigger progressive harmony than any other prevocalic nasal consonant.

Some independent characteristic of nasal consonants which mark the right edge of a boundary make them good triggers for regressive harmony. I propose that if other nasal consonants trigger regressive harmony, they do so only to achieve phonological symmetry as discussed by Hayes 1996. This proposal predicts the implicational restrictions on triggers of regressive harmony, and the overall rarity of intervocalic regressive harmony triggers.

3. Survey of Local Assimilation

Similar generalizations can be made about local nasal to vowel assimilation if we consider the results of Schourup's 1973 survey. The inventory Schourup gives of the contexts for vowels undergoing local nasal assimilation is shown in (2).

(2) **environments for regressive nasalization:**
__N# just word final (3 languages)
__N$ just syllable final (1 language)
__NC(spec) before a specific class of consonants (3 languages.)
__N#, __NC(spec.) word final or before a specific class of consonants (2 languages)
__N#, __NC word final or before all consonants (5 languages.)
__N before all nasals (4 languages)

BUT NEVER
__NV just before prevocalic nasals

environments for progressive nasalization:
N__ after all nasals (11 languages)
N(spec)__after a specific nasal (2 languages)
N(spec)__# after a specific nasal word finally (3 languages)

An examination of the contexts for regressive assimilation shows implicational restrictions on the trigger which are similar to those found in triggers for long distance harmony. Namely, a regressive assimilation may have intervocalic triggers but only if it also has word final and syllable final triggers. In fact regressive assimilations that have only word final or syllable final triggers are much more common. For progressive assimilation on the other hand, there is no preference for word initial triggers. The only cases where a prevocalic trigger of progressive harmony is in any way restricted is when the trigger must have a certain place, or where the target vowel must be word final, but not where the trigger must be in a certain position.

Articulatory data from Krakow 1993 support the generalizations made about anticipatory nasal to vowel assimilation. In a study comparing the relative timing

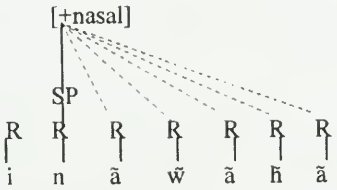
of lip movements and velum movements during the production of intervocalic nasal bilabial consonants, Krakow 1993 found that when the consonant is a coda (e.g., the [m] in 'home E'), velic lowering begins as the lip starts to rise for the bilabial closure. In contrast, when the nasal consonant is in an onset (like the [m] in 'hoe me'), the velic lowering begins as the lip completes its rise. This confirms that at least in English, anticipatory nasalization is greater if the trigger consonant marks the end of a syllable boundary.

To summarize, both the survey of long distance nasal harmony and Schourup's 1973 survey of local nasal to vowel assimilation find similar conditioning factors on consonantal triggers. On the one hand, all prevocalic nasal consonants are equally likely to trigger progressive assimilation, indicating that the only conditioning factor for a trigger of progressive assimilation is that it be released into a vowel. On the other hand, triggers of regressive assimilation fall into an implicational hierarchy: nasal consonants which mark the right edge of boundary, trigger regressive assimilation before other nasal consonants. This indicates that the conditioning factor for triggers of regressive assimilation is that they mark the right edge of a boundary. At this point the question arises as to why these two factors should condition progressive and regressive nasal assimilation respectively. The next three sections explore possible answers to this question.

4. Phonological-Representational Accounts

Current phonological-representational treatments of feature harmony can't account for the generalizations in a satisfactory way. The autosegmental analysis of feature harmony as spread of association lines from an underlying feature specification on the trigger has no account for the tendency for intervocalic nasals to trigger progressive harmony. There is nothing in the representation which would predict that it should be more preferable to spread in one direction over the other. The diagram in (3) shows progressive nasal harmony in Warao as resulting from the spread of association lines from a [+nasal] specification on an intervocalic nasal consonant to the right, but given the representation in (3), the association lines could just as easily have spread to the left. The fact that they don't must be stipulated.

(3) Autosegmental account of nasal spread in Warao as seen in Piggott 1992.



In contrast, the Optimal Domains Theory of feature harmony can at least express the correlation. Optimal Domains Theory (as described in Cole & Kisseberth 1994, 1995a, b) treats feature harmony as occuring when feature domains

have wide scope, which in turn results when alignment constraints require the edges of feature domains to be aligned with the edges of prosodic or morphological domains. So for example, progressive nasal harmony would result if alignment constraints requiring the right edge of a nasal domain to be aligned to the right edge of a word outranked the constraints requiring it to be aligned to the right edge of the triggering segment. Therefore Optimal Domains Theory could express the correlation between trigger context and the direction of harmony by positing constraints requiring the edge of the trigger aligned to the feature domain to also be aligned with a syllable boundary. This is shown in (4) where the tendency for intervocalic nasal consonants to trigger progressive harmony is expressed by a constraint requiring that the left edge of a Nasal Domain be aligned to the left edge of a syllable boundary.

(4) Constraint: Align (Nasal Domain, left, syllable, left)

(i) [(nã)(w̃ã)(ñã)] : '[ ]' mark the Nasal Doman, '( )' mark syllables.

However, the fact that progressive harmony shows no preference for word initial triggers while regressive harmony does would have to be stipulated. Furthermore, any similar patterning in local nasal assimilation would be accidental because Optimal Domains Theory doesn't address local assimilation. Finally, it might not be appropriate to approach these generalizations with any Optimality Theoretic account as the generalizations describe cross-linguistics tendencies. Optimality Theory (Prince & Smolensky 1993) handles crosslinguistic variation by changing constraint rankings, so to handle a crosslinguistic tendency, one must make statements about preferred rankings. This could be done, but the question as to why the ranking is preferred would still be left unanswered.

5. Possible Logical Explanation

It might be the case that the tendency for intervocalic nasal consonants to trigger progressive harmony follows logically from the very nature of nasal harmony. Homer 1998 argues that nasal harmony is non-neutralizing. It follows that nasal harmony from a consonantal trigger should spread in the direction of a compatible segment which, if it were to undergo nasalization, would not have to change so much as to neutralize a contrast. This predicts that the most likely target would be a vowel because vowels can nasalize easily with a minimal impact on their contrastive properties.[3] Given the assumption that harmony should spread towards a vowel, it follows logically that a trigger preceded by a consonant will spread progressively, a trigger followed by a consonant would spread regressively, but an intervocalic trigger could still spread either way. These conclusions are summarized in (5).

(5) Logical conclusions assuming that nasal harmony spreads towards vowel:

- CN triggers will spread rightward.
- NC triggers will spread leftward.
- VNV triggers can spread either way.

The prevalence of intervocalic nasals triggering progressive harmony is not explained by this line of reasoning. Another option is to propose the functional argument that in order to be detected, harmony should spread into the word.

This predicts that word initial triggers should spread progressively, and that word final triggers should spread regressively, but predicts nothing about word medial triggers. These conclusions are summarized in (6).

(6) Logical conclusions assuming that nasal harmony spreads into the word:

- #N triggers will spread rightward.
- N# triggers will spread leftward.
- # ... N... # triggers can spread either way.

One might argue that word medial triggers just pattern after the more default word initial or word final triggers to achieve phonological symmetry, but in this case one should expect some harmonies that have only word initial consonantal triggers. None are found among the nine nasal harmonies surveyed in this paper.

6. Phonetic Reasons

There are possible articulatory reasons for the connection between syllable final triggers and anticipatory nasalization. According to Bell-Berti 1993, it's likely that raising the velum involves active muscular contraction, while lowering the velum results from passive muscular relaxation, so one might expect the nasal to oral transition to be quicker than the oral to nasal transition.[4] This predicts that in general, anticipatory nasalization is more common. Krakow 1989, cited in Bell-Berti (1993:80) finds that coda nasals achieve a lower velic position than onsets. This might predict that codas in general make better triggers for nasalization than onsets. Putting these two pieces together, one might reach the conclusion that codas are better triggers for nasal assimilation, and that they're more likely to assimilate regressively.

The articulatory evidence presented thus far makes no prediction about progressive nasal assimilation. However there may be perceptual reasons for prevocalic nasals to trigger progressive assimilation. In a perceptual test involving synthesized vowels, Stevens 1985 found that the nasal consonant in a nasal-vowel sequence where nasality was extended 100 msec into the vowel was more readily identified as nasal than when nasality was only extended 50 msec into the vowel. Hence it appears that extending nasalization into the following vowel aids in the identification of the consonant as nasal, as opposed to an obstruent.

7. Conclusion

In conclusion, there appear to be independent factors which condition progressive assimilation and regressive assimilation from a nasal consonant. Being released into a vowel conditions progressive assimilation from a nasal consonant, while marking the right edge of a boundary conditions regressive assimilation from a nasal consonant. These conditioning factors are active in both local and long distance assimilation, and result in different contextual restrictions for the triggers of progressive and regressive nasal assimilation. These conditioning factors are not accounted for by phonological-representational treatments of feature harmony, nor do they logically follow from any inherent properties of nasal harmony. There are articulatory reasons to expect regressive assimilation in general to be more prevalent, and for coda nasals to be better triggers. There are per-

ceptual reasons for nasal consonants released into a vowel to trigger progressive assimilation. However, it is still not clear why regressive harmony should be conditioned when a nasal consonant marks the right edge of a boundary: the articulatory evidence presented here suggests that codas make better triggers for both regressive and progressive assimilation.

One other question that remains is why the progressive direction is preferred for long distance harmony, while the regressive direction is preferred for local assimilation. To answer this question requires a more complete understanding of the different natures of local and long distance assimilation than is currently within our grasp. However if we assume that long distance harmony is a higher level, or more 'phonologized' phenomenon than local assimilation, then the beginning of an answer can be found in the results of experiments described in Kawasaki 1986. Kawasaki 1986 finds that nasal vowels are more easily perceived as nasal when in a context where they would not typically receive contextual nasalization. If anticipatory local nasalization is more common, perhaps vowels following nasals are more easily identified as being nasal so phonologization into harmony from local progressive assimilation is more likely. This assumes that a crucial step in the development of a long distance nasal harmony from local nasal assimilation is that the speaker-hearer actually recognizes the vowel as being nasal.

NOTES

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[1] Although I've included included Capanahua and Ijo as languages with word final consonantal triggers, an examination of the data shows that none of the forms in either language actually surface with a nasal consonant at the end of the word. Descriptions of both languages propose underlying word final consonants that trigger anticipatory nasalization, and then delete. While stated in synchronic terms, these descriptions are probably accurate reflections of historical developments in both languages, so even though the word final consonantal triggers have since disappeared, they were the original source of harmony emanating from the end of the word.

[2] The absence of triggers preceded by a consonant (i.e., in the CN context) most likely is not significant. It might be the case that the CN sequence itself is rare, so there just aren't any CN nasals around that can trigger harmony.

[3] Homer 1998 discusses an apparent exception to this statement: in Applecross Gaelic, nasalization reduces the number of height contrasts among vowels, so mid-high vowels block nasal harmony in order to preserve height contrasts. However, when compared to consonants, it is easier to preserve contrasts on vowels under nasalization.

[4] Using auditory reasons, Bladon 1986 reaches the same conclusion. Bladon argues that the vowel to nasal consonant transition is less salient than the nasal consonant to vowel transition because the first type of transition involves 'spectral offset'. As a result, the vowel to nasal consonant is more susceptible to 'auditory temporal smear' and therefore anticipatory assimilation is more likely.

REFERENCES

ANDERSON, Stephen.1972. On nasalization in Sundanese. *Linguistic Inquiry 3*. 253-68.

BEDDOR, Patrice. 1983. Phonological and phonetic effects of nasalization on vowel height. University of Minnesota Doctoral dissertation.

——. 1993. The perception of nasal vowels. *Phonetics andPhonology V: Nasals, Nasalization, and the Velum*, ed. by Huffman & Krakow, 171-96. San Diego: Academic Press.

BELL-BERTI, Fredericka. 1993. Understanding velic motor control: Studies of segmental context. *Phonetics and Phonology V: Nasals, Nasalization, and the Velum*, ed. by Huffman and Krakow, 63-85. San Diego: Academic Press.

BLADON, Anthony. 1986. Phonetics for hearers. *Language for Hearers*, ed. by Graham McGregor, 1-24. New York: Pergamon Press.

COHN, Abigail. 1993. A survey of the phonology of the feature [+/- nasal]. *Working Papers of the Cornell Phonetics Laboratory*. 8.141-203.

——. 1990. Phonetic and phonological rules of nasalization. University of California at Los Angeles, Ph. D. dissertation in Linguistics.

COLE, Jennifer S., & Charles KISSEBERTH. 1994. An optimal domains theory of harmony. *Studies in the Linguistic Sciences* 24:2.101-14.

——.1995a. Pardoxical strength conditions in harmony systems. *Proceedings of the North-East Linguistic Society* 25:1.17-29. Philadelphia: University of Pennsylvania.

---. 1995b. Nasal harmony in optimal domains theory. *Proceedings of the Western Conference on Linguistics* 7.44-58. Fresno: California State University Fresno, Department of Linguistics.

FERGUSON, Charles. 1975. Universal tendencies and 'normal' nasality. *Nasálfest. Papers from a Symposium on Nasals and Nasalization*, ed. by C. Ferguson, L. Hyman, & J. Ohala, 175-96. Stanford: Stanford University Language Universals Project.

GUDSCHINSKY, Sarah, Harold POPOVICH, & Frances POPOVICH, 1970. Native reaction and phonetic similarity in Maxakali phonology. *Language* 46.77-88.

HAYES, Bruce. 1996. Phonetically driven phonology: The role of Optimality Theory and inductive grounding. MS, Rutgers Optimality Archive. Rutgers, NJ: Rutgers University.

HOMER, Molly. 1998. The role of contrast in nasal harmony. University of Illinois at Urbana-Champaign, Ph. D. dissertation in Linguistics.

VAN DER HULST, Harry, & Norval SMITH. 1982. Prosodic domains and opaque segments in autosegmental theory. *The Structure of Phonological Representations*, part I, ed. by van der Hulst & Smith 1.311-36.

KAWASAKI, Haruko. 1986. Phonetic explanation for phonological universals: The case of distinctive vowel nasalization. *Experimental Phonology*, ed. by J. Ohala & J. Jaeger, 81-103. Orlando: Academic Press. 81-103.

KENSTOWICZ, Michael, & Charles KISSEBERTH. 1979. *Generative Phonology: Description and Theory*. New York: Academic Press.

KRAKOW, Rena. 1993. Nonsegmental influences on velum movement patterns: Syllables, sentences, stress and speaking rate. *Phonetics and Phonology V: Nasals, Nasalization, and the Velum*, ed. by Huffman & Krakow, 87-116. San Diego: Academic Press.

LOOS, Eugene E. 1969. *The Phonology of Capanahua and its Grammatical Basis*. Norman, OK: Summer Institute of Linguistics.

OSBORN, Henry. 1966. Warao: phonology and morphophonemics. *International Journal of American Linguistics* 32:2.108-23.

PIGGOTT, G.L. 1992. Variability in feature dependency: The case of nasality. *Natural Language and Linguistic Theory* 10.33-77.

PRINCE, A., & P. SMOLENSKY. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. Cambridge, MA: MIT Press [forthcoming].

RICH, Furne.1963. Arabela phonemes and high level phonology. *Studies in Peruvian Indian Languages* I, ed. by B. Elson, 193-206. Norman, OK: Summer Institute of Linguistics.

SAFIR, Ken. 1982. Nasal spreading in Capanahua. *Linguistic Inquiry* 13:4.689-694.

SCHOURUP, Lawrence. 1973. A cross-language study of vowel nasalization. Columbus, OH: *Ohio State Working Papers in Linguistics* 15.

STEVENS, Kenneth. 1985. Evidence for the role of acoustic boundaries in the perception of speech sounds. *Phonetic Linguistics: Essays in Honor of Peter Ladefoged*, ed. by V. Fromkin, 243-55. New York: Academic Press.

TEOH, Boon-Seong. 1989. Aspects of Malay phonology revisited — A Non-linear approach. University of Illinois at Urbana-Champaign, Ph. D. dissertation in Linguistics.

WALKER, Rachel. 1994. Hierarchical opacity effects in nasal harmony: An optimality theoretic account. *Proceedings of the Eastern States Conference on Linguistics-ESCOL* 11.318-29.

WILLIAMSON, Kay. 1987. Nasality in Ijo. *Current Approaches to African Linguistics* IV, ed. by D. Odden, 397-407. Dordrecht: Foris.

APPENDIX

A. Data from Capanahua (Loos 1969, Piggott 1992, van der Hulst & Smith 1982, Safir 1982, Walker 1994):

From word final nasal that deletes:

/waran/	[warã]	'squash'	/poyan/	[põỹã]	'arm'
/bawin/	[bãwĩ]	'catfish'	/ciʔin/	[cĩʔĩ]	'by fire'
/boon/	[bõõ]	'hair'			

From word medial nasal before a glide that deletes, then nasal spreads right:

/wiranẅi/	[wirãw̃ĩ]	'push it over'
/hisyaʃaʔnẅi/	[hisaʃãʔw̃ĩ]	'see sometime'

From word medial nasal that remains:

cipõnki	'downriver'	kĩnča	'bowl'	kãncĩ(n)	'banana'
bĩmi	'fruit'	bãnawi	'plant it'	ñãmawi	'step on it'
ñãmãʔõna	'coming stepping'			wirãnai	'I pushed it'

B. Data from English (Schourup 1973):

r̃ãim	'rhyme'	fjũm	'fume'	ñɛ̃lən	'Helen'
ñãlĩŋ	'hollering'	klɛ̃r̃ɔ̃ts	'Clarence'	riw̃ãĩr̃iŋ	'rewiring'

C. Data from Ijo (Williamson 1987, Piggott 1992):

(Piggott (1992:42-43) proposes an underlying word final nasal that deletes for Ijo and for another Nigerian language, Urhobo.)

bɛ̃i	'be full'	õw̃ɛ̃i	'bite'	õỹãỹã	'horse'
ỹãr̃i	'shake'	ɛ̃r̃ɛ̃i	'day'		
kɔ̃r̃ɔ̃ŋmbɔ:	'thin'	ĩndaa	'how many'		
ãnda	'wrestle'	õmgbɔ	'seed'		
ũmbu	'navel'	õŋgɔ	'riches'		

D. Data from Maxakali (Gudschinsky, Popovich, & Popovich 1970)

(It appears that Maxakali also exhibits progressive nasal harmony. The data shown here are selected to demonstrate the regressive harmony only) :

pʲiitʲnãŋ	'frog species'	ʃõw̃ãn'to open'	kõmɛ̃ˌn 'city'
tõmããn	'tomato'	mãỹõw̃ãn 'sun'	pĩŋən 'noise made by jumping'
mĩhĩɛ̃m	'wood, tree'	ʔɛ̃ʔɛ̃ɛ̃m'who'	
ʔãmbiʷi	'needle'	ʔãmbik'cook'	ʔãmbĩi 'wind' hãɛ̃mpʃoëbay 'a good thing'

E. Data from Arabela (Rich 1963):

nãxeʔ	'his father'	nããnᵈriʔ	'type of demon'
nãĩʔ	'stinging ant'	nĩnỹũʔ	'to come'
nũwãʔ	'partridge'	nỹæ̃æ̃riʔ	'he laid it down'
nãsexeritiʔ	'did he say it'	nĩtyænũʔ	'to carry on the back'
nĩỹẽnõʔ	'he is coming'	nẽẽnũʔ	'to turn over'
nẽỹætuʔ	'daughter'	nũnũnũʔ	'light beaming'
mỹæ̃nũ	'swallow'	mwĩræt:tyenũʔ	'cause to be seen'
mãn:teʔ	'moth'	mãũʔ	'mushroom'
mõnũʔ	'to kill'	mããnũʔ	'woodpecker'
ɦãnũʔ	'to fly'	ɦỹũũʃ:ʃænõʔ	'where I fished'
ɦũwãʔ	'a yellow bird'	ɦĩỹæ̃nĩʔ	'old woman'

kanããgeʔ	'our father'	pokonãgiʔ	'yellow'
papanʌ̃ɦãʔ	'hollow'	keronĩʔ	'deep'
komʌ̃ɦĩʔ	'over there'	karʌ̃k:koɦwãʔ	'type of owl'
tinỹãkariʔ	'afternoon'	rupoɦõnũʔ	'to stick together'

F. Data from Land Dayak (Schourup 1973, Kenstowicz & Kisseberth 1979):

nĩɦĩn	'place'	nãɦãn	'bear'	nãjũn	'swing'
nũwãŋ	'pour'	nãbur	'sow'	nũʔã:n	'open'
ɲĩjũm	'kiss'	mãlu	'strike'	mẽʔãn	'eat'
ənãk	'child'	siŋãũ	'cat'	kiñãm	'feeling'
pəmĩŋ	'dizzy'	simĩɦĩŋ	'ten'	umõ	'water'
pimãjĩn	'a game'				
ntakadn	'taste'	mpahit	'send'	sunɔk	'in need of'
suŋkoi	'cooked rice'	sampɛ:	'extending to'		

G. Data from Malay (Teoh 1988, Piggott 1992):

ñãwãh 'soul, spirit'	nãhũ 'grammar'	nĩyõ: 'coconut'
nĩyãt 'wish'	ñãñĩ 'to sing'	nãʔẽʔ 'to ascend'
nãŋkë 'jack fruit'	nãmpaʔ 'to see'	ŋãŋã 'agape'
nãnti 'to wait'	mãhãl 'expensive'	mĩnõm 'to drink'
mãwãs 'type of monkey'	mĩnõmãn 'drinks'	mãʔẽn 'to play'
mãhãsiswa'undergraduate'	mãkan 'to eat'	mãkanãn 'food'
mẽŋãyãʔ 'to sift'	mãʔãp 'forgive'	mãti 'to die'
mẽwãh 'prosperous'	mãyãŋ 'stalk (palm)'	mãyãt 'corpse'
mãmpu 'affordable'	mãndi 'to bathe'	mĩŋgu 'week'
mẽŋkuaŋ 'a species of grass'		mẽndoŋ 'overcast'

këñsuñĩyãn'stillness'	bënũã 'continent'	istanẽ 'palace'
binãsë 'destruction'	binãtaŋ 'animal'	enãʔ 'delightful'
sëmpurnẽ 'complete'	baŋõn 'to rise'	suŋãĩ 'river'
uŋũ 'purple'	këbi:mbaŋãn 'anxiety'	
pësamãmãʔãn 'the same'	ramãĩ 'numerous'	kemõt 'crumpled'

ëmãʔ 'mother' elmũ 'knowledge' laksëmãnẽ' admiral'
ilmĩyãh 'scientific' sëmũẽ 'all'

guri:ndam'type of poetry' to:mbaŋ 'to fall'
ba:ŋgë 'to be proud'

H. Data from Sundanese (Anderson 1972, Piggott 1992, Cohn 1990):

ɲĩãr 'seek' ɲãũr 'say' ɲãĩãn 'wet'
ɲãhõ 'know' ɲãʃãtkin 'dry' nũhũrkin 'dry'
nuʃũs 'dry' ŋãtur 'arrange' nĩʃĩs 'relax in a cool place'
ŋũdag 'pursue' ŋĩsər 'displace' ŋũliat 'stretch'
ŋĩwat 'elope' ŋãjak 'sift' ŋãluhuran 'to be in a high position'
ŋõbah 'change' mĩʃãsih 'love' mãro 'to halve'
mãhãl 'expensive' mãrios 'examine' mĩhãk 'take sides'

biŋhãr 'to be rich' kumãhã 'how?' gumə̃de 'to be big'
dumĩhĩs 'to approach' pinãŋgih 'to find'

I. Data from Warao (Osborn 1966, Piggott 1992):

nãõ 'come' mõãũ 'give it to him'
mõyõ 'cormorant' mẽhõkohi 'shadow'

inãwãhã 'summer' honĩwãku 'turtle'

no codas allowed (Osborn 1966)