THE PHONOLOGICAL DERIVATION AND BEHAVIOR OF NASAL GLIDES

by

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This thesis presents a unified phonological approach to the emergence of nasal vowels from the reduction of vowel plus nasal consonant sequences (in our terms nasal "absorption") in a number of unrelated languages. Nasal "absorption" is studied in the context of other phenomena which play a role in this process: the appearance of optional weakly articulated velar nasals after nasalized vowels, the appearance of nasalized "transitions" or of nasal stops between nasal vowels and certain consonants, the exceptional susceptibility to "absorption" processes and to processes which neutralize a consonant's point of articulation which certain nasal consonants have, depending on their position in the word.

I claim that nasal "absorption" occurs when the oral occlusion of a nasal stop is removed or weakened considerably to the point where it is a glide. A nasal without any place features, [N], is shown to derive by a process which simultaneously reduces obstruent stops to glottal stops in Japanese. Material from Chinese, Caribbean Spanish and Choctaw are used to provide supporting evidence for the role of [N] in nasal "absorption". The nasals which are most susceptible to "absorption" are shown to be those which are most susceptible to weakening processes that diminish the magnitude of their oral occlusion or remove that occlusion altogether.

I show that the reduction of nasal stops to [N] causes spreading of nasalization from the nasal onto neighboring vowels and need not be accompanied by the deletion of the nasal segment, though it often is. When [N] is not deleted, it is often taken for a weakly articulated velar nasal, either because it is actually velarized in surface representation or because of a systematic transcription error. I argue that in many languages nasals in homorganic NC stop clusters do not undergo "absorption" because "absorption" targets [N] in these languages. Place assimilation is shown to be a potentially feature changing operation which may occur before or after the creation of [N].

The analysis of nasal "absorption" which posits an intermediate stage with a floating [+nasal] autosegment leads to undesirable predictions. I question the basis upon which "floating" nasal features have been assumed to exist in Coatzospan Mixtec and Terena where the domain of nasalization is predictable on the assumption that the trigger of nasalization is properly ordered with respect to the rest of the segments in the word at all stages in the derivation. Certain facts of Aguaruna provide the basis for an argument in favor of representing derivationally ambiguous forms as having more than one underlying form. Thus, the fact that in certain cases the exact ordering of a nasal element in the word cannot be known does not constitute sufficient evidence for the existence of a "floating" nasal feature.

I establish the existence of vocalic nasal glides and continuants derived from nasal stops in Basari. The possibility that vocalic nasal glides may participate in "absorption" processes is also considered.

Thesis Supervisor: Morris Halle

Title: Institute Professor

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As is the case with most doctoral theses, this thesis could not have been completed had it not been for the support of many people. I would like to take this opportunity to express my gratitude to them.

I owe the better part of the thesis to my teachers, Morris Halle and Donca Steriade: I could not have written anything resembling this four years ago.

I am indebted to Morris Halle for his constant support and encouragement and for pages and pages of red ink. From Morris I learned what it means to be a theoretician and a teacher. By listening to my ideas with serious interest and by arguing with me on almost every available occasion he taught me that the only way to make progress in theoretical work is by sticking to a radical position until proven wrong. By being infinitely patient with my agony of doubts, trusting my abilities when I myself did not trust them, he taught me courage.

Donca Steriade's influence on this study will be visible to the naked eye simply from the references to her work. I have tried to emulate her in not believing something has been proved until every imaginable alternative has been disproved and I wrote every draft anticipating her objections, playing both parts. Most important, I thank her for encouraging me to read in the area of phonetics and for her combination of open-minded and rigorous scholarship. Finally, many ideas which the reader will be happy to have been spared were eliminated in response to her criticism. To the extent that this thesis is readable and coherent, the reader should probably thank Donca.

Other M.I.T. faculty have played a less direct, but no less significant role in my general education. I am grateful to Ken Stevens for his spring 1988 seminar on acoustic phonetics which proved invaluable to the ideas developed in this thesis and for hours of discussion on the acoustic correlate of the feature [ATR]. To Jim Harris I owe an interest in the phonology of my own language, Spanish, which I had neglected. He provided me with many valuable comments and references which enriched my research in this area considerably. Ken Hale has never failed to show interest in any fact concerning language and his own detailed knowledge of what seem to be hundreds of languages has never ceased to inspire me and elicit my admiration.

I would like to thank my fellow graduate students for four years of intellectual discoveries, debates and moral support. I am thinking of

Jennifer Cole, for the many hours spent with me discussing harmony processes, Carol Tenny for her wisdom and her sympathetic ear, Ewa Higgins, for her encouragement during difficult moments. In addition to these people, many others at M.I.T. and outside have contributed invaluably to my education (both linguistic and otherwise)--my classmates, John Lumsden, Michelle Sigler, Dough Saddy, Steven Abney, Ur Shlonsky, Hyon-Sook Choe; from other classes, Janis Melvold, Betsy Ritter, Andrea Calabrese, Chris Tancredi; now to be counted among the M.I.T. alumni, Diana Archangeli, Juliette Levin, Betsy Sagey, Peggy Speas, Mark Baker; from 20D-219, Maggie Carracino and Nancy Peters; my friends and family in Boston, Morito, Carlos and Florence Ferré, Efrain Kristal, Ariel Ferdman, Mary Ann Nelson.

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Chapter 1

FRAMEWORK

This thesis deals with the interaction between processes that weaken the occlusion of nasal consonants and the emergence of nasal vowels. As I will give explicit phonological formulations of these weakening processes, I will begin by introducing the reader to the phonological notation and terminology used in the rest of the thesis. A blueprint of the argument of the thesis is given in (§1.3).

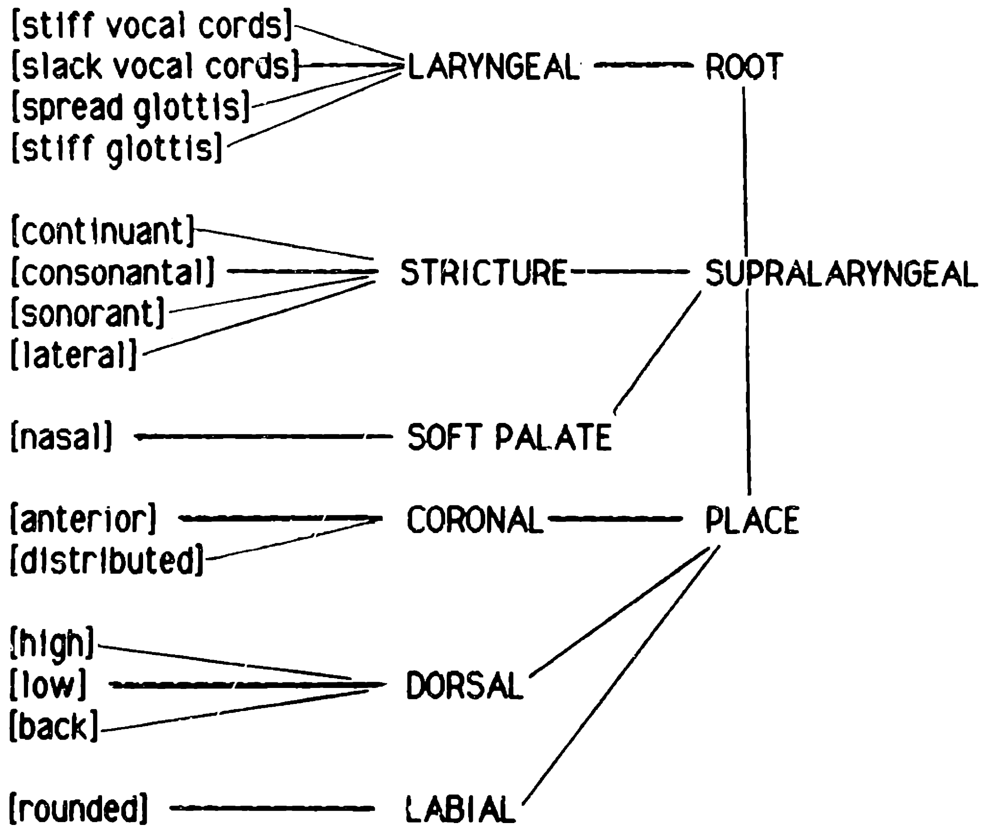
1.1 Feature Geometry

Because of our present relative lack of understanding of the significance of acoustic/auditory data, the discussion below is limited to the articulatory aspect of speech. The anatomical structures involved in the production of speech are the glottis, the soft palate, the lips, the tongue blade, the tongue body and the tongue root and I shall refer to these six structures as the articulators following the terms of Halle(1983) and Sagey(1986). In producing speech each of the six articulators executes a limited set of behaviors, generally referred to as features. For example the feature [+round] is executed by the LABIAL articulator. Each articulator is independently controlled so that in general the features executed by a given articulator are freely combinable with those executed by any of the five other articulators. With respect to most features it is true that only a single articulator is capable of executing the prescribed behavior. Thus only the SOFT PALATE articulator executes the feature [+nasal]. There are, however, a number of features, among them the feature [continuant], that can be executed by a number of distinct articulators. These features are called stricture features and they differ from the rest in that the articulator which is to actualize them must be stipulated in each case. The distinctive speech sounds in languages are called phonemes and formally construed as lists of features. Following proposals by Clements(1985) and Sagey(1986) I will assume that feature sets functioning as units in phonological processes are formally captured by imposing on the phonemic feature list a tree structure where each subtree defines a feature set that functions as a unit and each division of a branch into two or more branches is called a node. The tree structure I will assume here is quite similar to Sagey's(1986):[1]

---

[1]**These annotations may be abbreviated as follows: [stiff vocal cords] = [stiff], [slack vocal cords] =[slack] [spread glottis] = [spread], [stiff glottis] = [stiff], [continuant] = [cont], [consonantal] = [cons], [sonorant] = [son] [lateral] = [lat], [nasal] = [N], [anterior] = [ant] , [distributed] = [distr] , [high] = [hi], [low] = [low], [back] = [back] , [rounded] = [round], LARYNGEAL = l., SOFT PALATE = sp, CORONAL = CORONAL, LABIAL = LABIAL, DORSAL = DORSAL, ROOT = r., SUPRALARYNGEAL = sl., PLACE = pl.. Often the intermediate structure of a tree is not written in, in which case dotted lines are used instead of continuous lines.**

1)



A few comments regarding the tree structure in (1) are in order. I follow Harris(1988) in placing the stricture features and SOFT PALATE articulator above the root node. Harris shows that in Cuban Spanish gemination the place node, the stricture node and the SOFT PALATE articulator can be assimilated as a group to the exclusion of the LARYNGEAL articulator; I assume the group of assimilated features in Cuban Spanish is the supra-laryngeal node.

As noted above, the stricture features require us to stipulate the articulator(s) by means of which these features are implemented in each sound. Extending the terminology of Sagey(1986) and following Halle(1988) I shall call the articulator(s) so indicated the major articulator(s). I will also assume, following Halle(1988) that since it is necessary to specify for every sound the stricture feature [consonantal], it is also necessary to stipulate the major articulator for every sound. While a major articulator is thus activated in the production of every sound, it does not follow that no other articulator must be involved, nor that there can only be one major articulator.

Finally, I will assume that the SOFT PALATE and LARYNGEAL articulators cannot be used to make stricture distinctions. Only the articulators dominated by the place node are capable of implementing stricture distinctions: the LABIAL, CORONAL and DORSAL articulators. If a segment loses its place node it automatically becomes [-consonantal] (Chomsky&Halle(1968 p.303) consider [h ʔ] to be [-consonantal] segments). This stricture feature is implemented by whatever articulator is left behind as the major articulator of the segment. Following McCarthy(1988) I call debuccalization the process of removing the place node of a segment, for instance, the change of $[p^h]$ --> [h] can be represented as in (2):

2)

```
   [-son ]  lab
   [-cont]   |
   [+cons]  place [+spread glottis]      [-cons] [+spread glottis]
       \ /          |                        |       |
supra-laryngeal  laryngeal        supra-laryngeal  laryngeal
          \   /                                \ /
          root              --->               root
           |            debuccalization          |
           x                                     x

          [pʰ]                                  [h]
```

Similarly, if a segment is nasal to begin with, the deletion of the place node produces a place-less nasal glide:

3)

```
          ⌒↘
    [+son ]  lab
    [-cont]   |                                          ⌒↘
    [+cons]  place  [+nasal]                  [-cons] [+nasal]
        \ /            |                          |       |
supra-laryngeal  soft palate        supra-laryngeal  soft palate
            \    /                                 \ /
             root               --->              root
              |            debuccalization         |
              x                                    x

             [m]                                  [N]
```

The evidence for these assumptions involves the phonological behavior of segments after they have undergone debuccalization in a number of languages where [h ? N] derived from [+consonantal] segments pattern after [-consonantal] segments. For example in Japanese (S2.0) all word-final [+consonantal] segments trigger a rule of epenthesis except [? N] derived via debuccalization. It is not uncommon for [h] to surface as a glide by assimilation to a neighboring vowel, exactly as predicted if [h] can only be [-consonantal]. For example, in Choctaw(Nicklas 1975) there is a rule of assimilation whereby an [h] optionally becomes [w or y] after [o or i] if the following vowel is unstressed. For example [**ni:ha**] --> [**ni:ya**] 'fat' [**ačaffoha**] --> [**ačaffowa**] 'few' . [h] in such forms behaves like a glide, though there is reason to believe that [h] is underlyingly /x/ in Choctaw ([h] patterns with [k] in triggering a rule of epenthesis (S2.0)). In Oriya (S 4.1.1) [h] becomes obligatorily [w, y] by assimilation to [u, i] and otherwise deletes. Oriya [h] is derived by debuccalizing stops which function as glides upon losing their place and stricture features. If [ʔ h] could ever be [+consonantal] one would expect [ʔ h] to become consonants upon acquiring the place features of a neighboring vowel:

4) [ʔ h] --> [c ç] / ___ [i]
[ʔ h] --> [k x] / ___ [u]

I am not aware that such precesses ever occur. Therefore, I will rule out the existence of two types of [h ʔ N], [+consonantal] [h ʔ N] and [-consonantal] [h ʔ N]. That is, I rule out distinguishing various types of [h ʔ N] on the basis of stricture: all [h ʔ N] are [-consonantal].[2]

Debuccalization is only one of the various processes of "weakening" that consonants can undergo. There are two others:

5) Spirantization: [-continuant] --> [+continuant]
6) Gliding: [+consonantal] --> [-consonantal]

When a stop becomes a glide, it automatically becomes [+continuant] as glides cannot be [-continuant]: gliding [t n] yields [+continuant] [y ỹ]. Alternatively, we could assume that the conflict between the features [-consonantal -continuant] can be resolved in two ways: by spirantization (as I have just proposed) or by debuccalization. But I have no evidence that debuccalization ever takes place in this way rather than directly. Note that the glottal stop is never subject to spirantization; that is, [ʔ] never

---

[2]**Alternatively, [h ʔ N] are simply unspecified for stricture.**

spirantizes to [h], nor does [h] ever become [ʔ] by stopping. I take this as evidence that [ʔ] and [h] are not distinguished in terms of the feature [continuant].

It is tempting to consider spirantization, gliding and debuccalization as processes that yield progressively weaker values along a numerical stricture scale such as the one given in (7):

7)

6	5	4	3	2	1
|	|	|	|	|	|
p	f	ɸ	w	h	ø

However, the existence of such a stricture scale would make it possible to express non-existing phonological changes in terms of the addition and subtraction of absolute quantities e.g. a change involving rising one "step" in the stricture scale would cause glides to become consonants (3 +1 = 4) simultaneously as continuants become stops (5 + 1 = 6). This approach is highly controversial as it is not supported by any phonological analysis of which I am aware; it will not be endorsed here. Rather, if spirantization, gliding and debuccalization are "steps" in a scale, for example the sonority scale, that scale is not used for processes of addition/subtraction of "steps" but is an object constructed from phonological features (see Steriade1982). One might speculate that spirantization, gliding and debuccalization increase the sonority of segments and apply typically to coda segments in obedience to a univeral tendency to maximize the sonority of syllable codas (Clements 1987).[3] I do not rule out the possibility that articulatory or acoustic factors independent of syllable structure are relevant to the above "weakening" processes. In (§ 5.1) I note that the typology and distribution of segments undergoing debuccalization suggests that debuccalization typically targets segments in contexts where their point of articulation is hard to distinguish, perhaps because their release is not heard clearly. These additional articulatory or acoustic factors predict the existence of asymmetries in the "weakening" processes that are independent of syllable structure; for example, that obstruent stops in coda position should debuccalize to [ʔ or h] more readily than liquids in coda position or that pre-consonantal coda segments debuccalize more readily than pre-pausal coda segments. However, the task of establishing the existence of such asymmetries lies beyond the scope of this thesis, so I must leave the question open.

---

[3]Clements(1987) asserts that the feature [continuant] is irrelevant to the sonority hierarchy, hence he predicts that the tendency to increase the sonority of syllable codas will not cause coda segments to spirantize.

1.2 Phonological Rules

There are two types of phonological rules: feature filling and feature changing rules. Feature filling phonological rules are rules which provide segments with the missing value of a feature. Such rules cannot target segments which are already specified for a value of the feature in question. For example a place assimilation rule that targets only [**h**] (to the exclusion of [**w y**] or other consonants) must be formulated as a feature filling rule:

8)

```
    place
     |`-.
    sl1   `sl2          condition:  sl2 is not linked to a place node
```

An example of such a rule occurs in Choctaw(Nicklas 1975), where an [**h**] optionally becomes [**w** or **y**] after [**o** or **i**] if the following vowel is unstressed. Nicklas does not say that this rule applies to [**w**] or [**y**] although these glides can be found in the relevant context. It is reasonable to assume that this is not an oversight and that Nicklas intentionally restricts the rule to [**h**]:

9) [**ni:ha**] --> [**ni:ya**] 'fat' [**ačaffoha**] --> [**ačaffowa**] 'few'
but [**ohoyo**] --> [**owoyo**] not *[**owowo**] 'woman'.

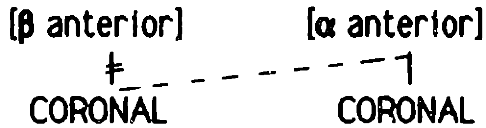
Unlike feature filling rules, feature changing rules may substitute one feature value for another. An example of a feature changing rule is anterior harmony in Chumash (Poser 1982). This rule turns a sequence [..š..s..] to [..s..s..] and a sequence [...s..š..] to [..š..š..]:

10)

k-su-šoyim --> **k-šu-šoyim** 'I darken it'
s-api-tšho-lus --> **s-api-tsho-lus** 'he has good luck'

The rule may be formulated as:[4]

11)



Another feature changing rule that has been proposed in the literature is Hungarian [back] harmony (Steriade 1987a, Farkas&Beddor 1987).

Among the rules that we shall encounter in the following chapters there are a number of rules of nasalization. These rules may target a single segment or they may target many segments in a sequence up to the end of the word or up to the first "blocker". A "blocker" is a segment which interrupts the spreading of a feature. In the nasalization process shown below, [t] is a "blocker":

12) **anayarataya** --> **anãỹãr̃ãtaya**

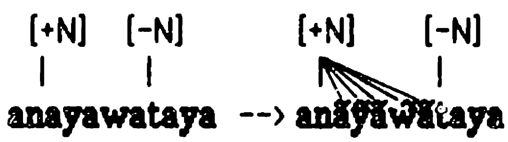
I will not attempt to establish the how "blocking" takes place. I will only note that there are at least three ways of viewing this process. One is to

---

[4]The rule cannot apply to a sibilant in SC clusters where C is a coronal stop. This can be accounted for in terms of inalterability (see further in the text): the rule requires the target to be a [+continuant] consonant and the SC clusters share a single place node. This means that the rule cannot affect S without also affecting (incorrectly) C, so it cannot affect S at all.

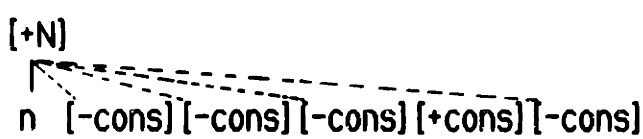
assume that the spreading process applies in a feature filling manner. Then the spreading will be interrupted by the first segment which is specified for some value of the spreading feature (assuming that association lines cannot be crossed):

13)



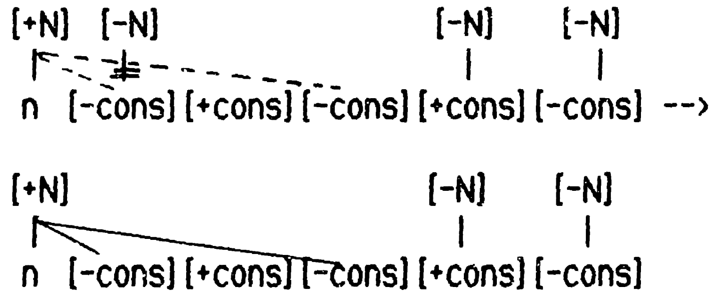
Alternatively, we may assume that the spreading process is restricted to apply to a continuous sequence of undergoers. If the rule requires that the undergoers be [-consonantal], then the first [+consonantal] segment will interrupt the spreading process because it cannot be either affected or skipped:

14)



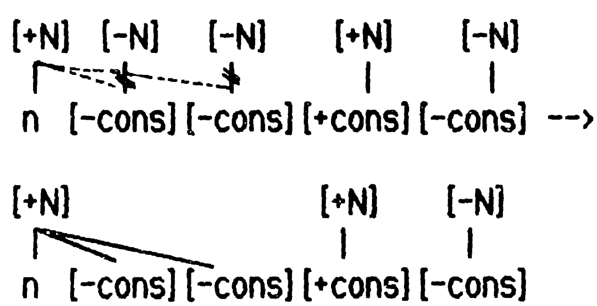
The third way of looking at "blocking" is to assume that the rule is neither feature filling nor does it apply to a continuous set of undergoers. Rather, the rule simply restricts its set of undergoers to some set e.g. the set of [-consonantal] segments. Then any [+consonantal] segment that is specified for some value of the spreading feature will act as "blocker" (assuming that association lines cannot be crossed):

15)



This latter model provides the best account of the behavior of segments which are specified for the same value as the spreading value. I know of four nasalization systems where nasal consonants do not "block" nasalization and two where they "block" it. Nasal consonants do not "block" nasalization in Scottish Gaelic (Ternes 1973), Tucanoan (§ 3.2.1) and Coatzospan Mixtec (§ 6.2.1) and Terena (§ 6.2.2) even though there is reason to believe that the nasal consonants are underlyingly [+nasal] in at least some of these languages.[5] Nasal consonants "block" nasalization in Capanahua (§ 4.2.2) and Aguaruna (§ 4.1.2, 4.2.1). In the latter two systems the class of undergoers of nasalization can be identified as [-consonantal]:

16) "Blocking" by nasal consonants:



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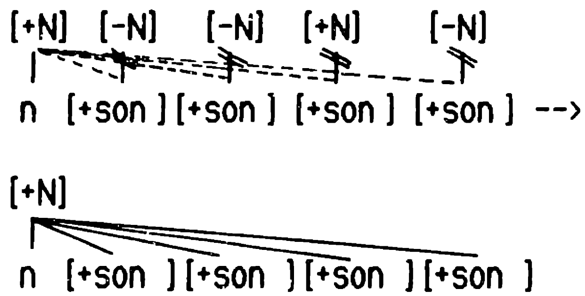
[5]**In Scottish Gaelic and Coatzospan Mixtec nasal stops contrast with voiced stops and oral sonorants at the same point of articulation.**

By contrast, the nasalization systems where nasals are transparent do not restrict the set of undergoers to the class of [-consonantal] segments, but to some set which includes the nasal consonants (e.g. the set of [+sonorant] segments):

17) No "blocking" by nasal consonants:



This suggests that a nasal will not interrupt the spreading of nasality unless it is excluded from the set of undergoers. The same is true of round vowels in round harmony systems (e.g. Mongolian cf. Steriade 1987a).

To determine which segments are the potential "blockers" of a spreading process we must know two things: (1) the set of undergoers of the process and (2) the set of segments which are underlyingly specified for some value of the spreading feature. Regarding the second question I will follow Steriade's(1987a) hypothesis that a segment A must be underlyingly marked for a given feature [F] if there is a segment B that contrasts with A on the basis of [F] alone. I will also follow Steriade(1987a) in assuming that if a feature plays no contrastive role at all in distinguishing A from any other segment, then it is redundant for A and should not be underlyingly marked on A. For example, fricative obstruents are redundantly [-nasal] in languages that have no nasal fricatives (that is, the vast majority of languages) and specifying them as underlyingly [-nasal] is incorrect. When I say that there is no independent evidence in favor of specifying a certain class of segments as [-nasal] in underlying representation what I mean is that the feature [-nasal] is redundant for that class of segments.

Finally, I assume that rule application is subject to geminate blockage as defined in Schein&Steriade(1986):

18) Uniform Applicability Principle (Schein &Steriade 1986):

Given a node n, a set S consisting of all nodes linked to n on some tier T, and a rule R which alters the contents of n: a condition in the structural description of R on any member of S is a condition on every member of S.

In particular I assume that a rule that deletes the place node of nasals in coda position will not be able to apply to a nasal that shares the place node with the following onset consonant as shown in (19):

```
     [+N]
      :
19) place --> ø   / ___ ]σ

            place
            /  \
           m] [p     rule (19) does not apply to [m].
         coda  onset
```

1.3 Guide to thesis

The purpose of this thesis is to establish the exact formulation of nasal "absorption", a process whereby a vowel + nasal sequence becomes a nasalized vowel. I formalize this process as in (20) where [N] stands for a debuccalized nasal (a nasal with no place features). However, I will use the term nasal "absorption" as a pre-theoretical term that means "whatever process causes vowel + nasal sequences to reduce to a nasal vowel".

20) Nasal "absorption": $v + N]_\sigma \dashrightarrow \tilde{v}\ N]_\sigma$

$\tilde{v} + N]_\sigma \dashrightarrow \tilde{v}\ \emptyset$

This section should be read as a blueprint of the complete argument of the thesis and as a directory to the demonstration of individual steps in the argument as worked out in subsequent chapters.

DeChene&Anderson(1979) stated that nasal "absorption" can be viewed as involving "the loss of oral articulation altogether in pre-consonantal nasals, with transfer of the nasalization gesture onto the preceding vowel" (p.530). However, DeChene&Anderson provide no evidence in support of this claim other than a reference to the phonetic value of the Sanskrit anusvara (post-vocalic pre-consonantal nasal element):

21)

"It seems certain...that some of the ancient writers had perceived something other than a simple nasalization of the vowel...in the present state of our knowledge it would perhaps be unwise to say more than these authorities had observed some form of nasalized glide in the transition from the vowel to the consonant"(p. 516 footnote 13).

It will be my task to provide fresh evidence in favor of the view that nasal "absorption" involves the creation of a nasal glide at some point in the derivation. In particular, I argue that in most instances of nasal "absorption" the nasal glide in question is place-less. I offer five arguments to support this claim, [I] - [V]:

[I] Glide-like transitional elements similar to Sanskrit *anusvara* have been described in languages which have developed or seem to be developing nasal vowels; namely, Caribbean Spanish, Chinese and Choctaw (§ 2.0). The phonetic description of these *anusvara* indicates that they lack an oral point of articulation. Based on evidence from Chinese and Japanese (§ 2.0), I demonstrate that the correct *phonological* representation of *anusvara* lacks a place component and is a glide. Specifically I propose to represent *anusvara* as in (22):

```
                  [+nasal]
22)                   |
          SOFT PALATE [-consonantal]
                      \ /
                       sl                  transcribed [N]
                       |
                       r
                       |
                       x
```

From the above mentioned data, we can conclude that a number of languages exhibit debuccalized (that is, place-less) nasals after nasalized vowels. This suggests that nasal "absorption" and nasal debuccalization occur in the same contexts.

[II] I show the existence of a correlation between the typology and distribution of nasals undergoing "absorption" and those undergoing debuccalization: labial nasals tend not to undergo "absorption" or debuccalization, whereas coronal and velar nasals appear to be more susceptible to either process. Thus with respect to debuccalization, we see that in the loanword vocabulary of Japanese (§ 3.1), word-final [n] debuccalizes to [N] but word-final [m] does not debuccalize and triggers epenthesis instead. The same asymmetry can be observed in the behavior of labial vs. coronal nasals in "absorption" processes: In Chickasaw (§ 3.1) [v-n*] undergoes "absorption" while [v-m*] fails to undergo either process. Similarly, Chen(1975:114) reconstructs the emergence of nasal vowels in the dialects of Chinese as taking place only after Middle Chinese *[m] had coronalized to [n]. Coronal and velar nasals also react asymmetrically to the debuccalization and "absorption". Intervocalic velar nasals debuccalize to the exclusion of coronal nasals in Aguaruna (§ 3.1) and the development of nasal vowels in Caribbean Spanish and Mandarin Chinese (§ 3.1) suggests that they are also "absorbed" more promptly than coronal nasals in similar contexts. Such data suggests that the hierarchy of nasal debuccalization corresponds to the hierarchy of nasal "absorption"; namely:

23)

(i) [n] [ŋ] debuccalize more promptly than [m]; they also undergo "absorption" more promptly than [m].
(ii) [ŋ] debuccalizes more promptly than [n]; it also undergoes "absorption" more promptly than [n].

The identification of [ŋ] as a preferred target of debuccalization and "absorption" may have to be restricted to intervocalic [ŋ] and may follow from a tendency to "weaken" velars in intervocalic contexts (a tendency which is clearly visible in the historical development of intervocalic stop lenition processes: Wanner&Cravens(1979)). Chen(1975) indicates that word-final [n] is more susceptible to "absorption" than word-final [ŋ] in the majority of Chinese dialects. A major obstacle in comparing the susceptibility of coronal and velar nasals to debuccalization and "absorption" is that velar nasals are acoustically quite similar to place-less nasals. This acoustic similarity has led to possibly incorrect transcriptions of [N] as [ŋ] (§ 3.3). Moreover, it is quite possible that there exist velarization processes whereby [N] becomes [ŋ], since other place-less glides i.e. [h ʔ] velarize to [x k] in a number of languages (§ 3.3.1-5). This means that it is not always possible to determine if the velar nasals which alternate with vowel nasalization (vŋ ~ ṽ) are underlyingly [ŋ] or [N]. With these provisos in mind, we can nevertheless conclude that (a) nasal consonants are not all equally susceptible to debuccalization nor are they all equally susceptible to "aborption" ; (b) labial nasals resist both debuccalization and "absorption" and (c) except for the cases of intervocalic [ŋ] both debuccalization and nasal "absorption" typically target nasals in coda position (Chen 1973, § 2.0). (a) (b) and (c) suggest that nasal debuccalization and nasal "absorption" share a set of necessary or sufficient conditions.

[I] [II] show that nasal "absorption" and debuccalization have quite similar if not identical distributions cross-linguistically. Arguments for the ordering Debuccalization --> "Absorption" are given below:

[III] Nasal consonants in Oriya (§ 4.1.1) and Aguaruna (§ 4.4.2) spread their nasality onto neighboring vowels only when they debuccalize (i.e. lose their point of articulation) and become place-less nasal glides: [h̃] in Aguaruna, [N] in Oriya. In Oriya, the weakening of the nasal consonant's occlusion is not itself caused by the fact that the neighboring vowel(s) have become nasalized; rather, nasals debuccalize by a rule which targets all intervocalic stops, nasal and oral. Similarly, in Aguaruna a nasal may be surrounded by nasal vowels and remain [+consonantal]. This means that debuccalization is a necessary condition for vowel nasalization in these languages. Since vowel nasalization is part of the nasal "absorption" process, the Oriya and Aguaruna data suggest that debuccalization is a necessary condition for nasal "absorption" at least in some languages.

[IV] The assimilation of a nasal to the point of articulation of a following consonant prevents the nasal from undergoing "absorption" in a number of languages including Aguaruna (§ 4.2.1) , Capanahua (§ 4.2.2) and Western Muskogean (§ 4.2.3). That this bleeding relation holds cross-linguistically can be deduced from the typology of the segments which follow "absorbed" nasals which are those that are less likely to spread their point of articulation and stricture onto the preceding nasal (§ 4.2.0). Such data can be explained on the assumption that only debuccalized nasals undergo "absorption" (this statement may need modification as discussed below).

[V] Assuming that nasal debuccalization occurs <u>before</u> (not after) nasal "absorption" is formally advantageous in languages where nasal "absorption" does not cause vowels to assimilate the place features of nasal consonants.

We need not stipulate that the vowels do not assimilate the place features of the "absorbed" nasal along with the nasality because we can assume that the place features of the nasal are no longer present when "absorption" takes place.

It is my contention that the derivation in (24):

24) **vn** --> **vN** --> **ṽ**

is a natural one in the sense that each step is (acoustically or articulatorily) motivated and cross-linguistically attested. The derivation could not be a natural one in this sense if it could be shown that a great many languages compute derivationally intermediate [N]'s that do not undergo the "absorption" process in (24) but that behave in such a way that there is no way of predicting what will happen to [N] in a particular context. Mascaro's(1987) theory of place assimilation is a challenge to our theory because Mascaro would derive all homorganic NC clusters by debuccalizing nasals first despite the lack of (articulatory or acoustic) motivation for this derivation. I agree with Mascaro that feature filling place assimilations exist; however, I dispute the validity of generalizing feature filling place assimilation to all cases on the basis of the following three arguments.

[VI] If place-less segments are preferred targets of place assimilation then the fact that continuant obstruents debuccalize (e.i. [**s**] --> [**h**]) much more frequently than they assimilate in place to a following consonant is left without explanation unless one assumes that the [h]'s which derive from continuant obstruents (by debuccalization) resist place assimilation (for whatever reasons). But this assumption is not necessarily valid. Since underlying [h] assimilates place features with relative ease, Mascaro must distinguish [+consonantal] [h] (derived from /f s x/) which resists place assimilation from underlying [-consonantal] [h] which does not resist it. But there is no independent evidence to distinguish two types of [h] (see § 1.1), it seems best to attribute the peculiar behavior of fricatives to their intrinsic articulatory or acoustic properties.

[VII] The feature filling approach to place assimilation cannot explain the markedness facts determining the asymmetrical behavior of the triggers of place assimilation. Labials tend to spread their place features onto a preceding nasal more often than velars (English and Polish place assimilation § 5.2). A possible explanation of this fact is that the assimilation by a nasal to a following velar is discouraged because it gives rise to angma, a linguistically marked segment. This explanation cannot be translated in terms of a strictly feature filling approach to place assimilation which predicts that nasals which fail to assimilate to velars will surface as place-less [N] contrary to fact.

[VIII] Coronal nasals in English and Polish undergo optional place assimilation processes. Since these nasals surface as [n] (not as place-less [N]) whenever they happen not to assimilate, the feature filling theory of place assimilation must assume that the surfacing [n]'s acquire their point of articulation by default after place assimilation has applied: [np] --> (debuccalization) [Np] -->(place assimilation did not apply) [Np] -->

(coronalization) [np]. However, a default rule introducing the coronal point of articulation is not supported by independent evidence. If place assimilation is feature filling and coronals are underlyingly unspecified for point of articulation, one cannot derive the cross-linguistic distribution and typology of segments undergoing and triggering place assimilation. Moreover, there is no evidence that place-less segments [? h N] ever become coronal; if anything, they tend to become velar as argued in [II].

The model of nasal "absorption" presented above stands in contrast to a popular model of nasal "absorption" proposed by Halle&Vergnaud(1981), Safir(1984), and lately by Piggot(1987). According to these authors, nasal "absorption" occurs when some process sets the [+nasal] feature of the nasal consonant "afloat". The "floating" [+nasal] feature then links to neighboring segments as shown in (25). Let us call this the "floating" nasal analysis:

25)

```
[+N]                [+N]                 [+N]
 |                                         |
v ŋ  -->(deletion) v ø C --> (relinking) ṽ C
```

I offer four arguments against the "floating" nasal analysis schematized in (25):

[IX] The derivation in (25) assumes that the deletion of the timing slot of the nasal consonant somehow sets the [+nasal] feature "afloat" but does not explain why only this feature and not some other feature is set "afloat". Dorsal features can float (cf. Ito 1984). Why is it that the dorsal features of an "absorbed" [ŋ] do not "float" and re-link along with the nasality?

[**X**] The derivation in (25) does not account for the nasalization facts in Mandarin Chinese (§ 6.1) or Choctaw (§ 2.0, 4.2.3, 6.1). The derivation in (25) assumes that the nasality of a deleted (=disappearing) nasal segment spreads onto a preceding vowel. Mandarin Chinese is a problem for this analysis because both [**n**] and [**ŋ**] are deleted (=disappear) before the diminutive suffix but only [**ŋ**] leaves behind the trace of nasality. The derivation in (25) also assumes that a vowel is nasalized only if the following nasal consonant deletes. But in Choctaw, a [**v+n**]$_\sigma$] sequence surfaces as a long nasalized vowel [**ṽ:**], which means that the timing slot of the nasal consonant has not deleted. I also show that we cannot derive the Choctaw data on the assumption that the [+nasal] feature of the nasal consonant is set "afloat" leaving its segmental content behind. This means that the Choctaw nasal "absorption" data does not involve "floating" a [+nasal] feature at all.

[**XI**] The derivation in (25) does not explain cases where place assimilation bleeds nasal "absorption" (that is, the cases discussed in [IV] above). To derive such data along the lines of (25) we must assume that rules deleting the timing slot of a nasal consonant are restricted to applying to nasals that do not share a place node with anything else. But this restriction lacks motivation. Long vowels and geminate consonants can shorten even though they share place features (e.g. $v_i v_i$ --> $ø v_i$; $c_i c_i$ --> $ø c_i$) so it cannot be the case that the sharing of place features in principle prevents the deletion of half of a geminate. Rather if the deletion rule is restricted to apply to a place-less glide, then place-assimilation will bleed it.

[XII] The "floating" nasal analysis makes a prediction which is not documented in the nasal "absorption" data; namely, that the [+nasal] feature of the deleted nasal can in principle link up arbitrarily far away from the site of the deleted nasal. I am not aware of cases where nasal "absorption" results in the nasalization of a vowel that is not next to the site of nasal deletion as shown in (26):

26)

```
   [+N]                         [+N]                                [+N]
    |                                                                 |
cv cvn cv cv -->(deletion) cv cvø cv cv -->(re-linking) cv cvø cv cṽ
```

To rule out this derivation we must assume that the intervening segments are always already specified as [-nasal] before the nasal feature is set "afloat" (even if these intervening segments are redundantly [-nasal] as e.g. fricatives). But there is no independent evidence in support of such a proposition. Of course the derivation in (26) is a possible phonological derivation in the sense that it is allowed by the notation. However the fact that we have found no instances of the derivation suggests that it does not reflect the natural chain of events that underlies the process of nasal "absorption". If we do not rule out the derivation in (26) as a matter of principle we should at least reserve it for the realm of the idiosyncratic rather than for a familiar process such as nasal "absorption". The nasal prosodies of Coatzospan Mixtec (§ 6.2.1) and Terena (§ 6.2.2) which have been analyzed as involving "floating" [+nasal] features can be re-analyzed involving nasal glides. Based on data from Aguaruna (§ 6.3) I argue that we should not set up "floating" [+nasal] autosegments simply because we do not know the exact underlying ordering of a nasal segment with respect to the other segments of the word. Thus we have no convincing evidence that the feature [nasal] can "float" at all. Ruling out "floating" [nasal] features explains why we never encounter the derivation in (26).

The arguments given below concern the possibility that the nasals undergoing "absorption" may not necessarily be place-less nasal glides, but may be vocalic nasal glides with place features in the same group with the oral glides [**w y**].

[**XIII**] Vocalic nasal glides [**w̃ ỹ**] exist and can be created by gliding nasal stops. Based on facts from Basari (§ 7.1) I show that nasals in coda position are not only subject to processes of debuccalization, but may undergo various other "weakening" processes such as spirantization and gliding. Chen(1975) and DeChene&Anderson(1979) have reconstructed similar developments in Chinese, Greek and Polish, but their reconstructions are historical or distributional and do not involve alternations.

[**XIV**] Certain facts in Coatzospan Mixtec (§ 7.2) can be viewed as indicating that when a palatal nasal becomes [**ỹ**] it spreads its nasality onto surrounding vowels. If this is true then it is not the place-less condition of [**ỹ**] which prompts the spreading of nasality (since [**ỹ**] has place features) but the fact that it is a glide. This suggests that nasal "absorption" may be fed by nasal gliding: **vn** --> **vỹ** --> **ṽ**.

It is attractive to speculate why nasal consonants spread nasality to neighboring vowels upon becoming glides. All nasal consonants nasalize neighboring vowels to some extent at the phonetic level. The issue is when this nasalization is perceived by naive speakers as being well entrenched in the vowel and when it is perceived as being only in the consonant. One might hypothesize that in a sequence Ṽ+m the nasality of the vowel can be traced back as originating in the consonant and is easily ignored for this reason, but in a sequence Ṽ+N the nasality of the vowel is not so easily separated from the vowel because the [N] is acoustically similar to a continuation of the vowel. Alternatively it may be the case that the perceptual saliency of nasality in a vowel increases as the perceived consonantality of the neighboring nasal stop decreases (i.e. if the nasal stop becomes a glide).[6] I am not aware that this hypothesis has ever been tested experimentally; however, the description of the effect which nasal consonants have on neighboring nasalized vowels in some languages suggests it. For example, Capo (1981:9) describes Gbe nasal vowels as follows: "after the nasal stops we have slightly rather than heavily nasalized vowels; whereas after nasalized liquids and approximants as well as ...oral consonants...the vowels are heavily nasalized" (the nasalized vowels in question derive from historic or underlying *[v+N] sequences). Such data suggests that the perceptual saliency of nasalization in a vowel increases as the perceived consonantality of a neighboring nasal segment decreases. However, it is not altogether clear how the variation in the saliency of nasality affects the phonological statement of vowel nasalization. In Gbe both heavily nasalized and slightly nasalized vowels

[6]I am concerned only with cases in which nasal "absorption" takes place irrespective of the quality of the preceding vowel. Nasal "absorption" can be influenced by the quality of the preceding vowel, since low vowels "absorb" following nasal consonants more frequently than high vowels(Chen 1975). It is not clear why low vowels should have this influence since nasalization disturbs the spectra of high vowels more and hence, one would have expected nasalization to be more noticeable on high vowels than on low ones (Ohala 1975). If nasal "absorption" is typically initiated by a weakening of a nasal consonant's occlusion then we must assume that nasals tend to weaken in position following a low vowel. However, the effect of vowel height on nasal "absorption" is outside the scope of this thesis, so I will leave the issue open.

behave identically with respect to rules targeting nasal vowels, that is both types of vowels are phonologically nasal. A purely formal explanation of the change from $V+N$ to $\tilde{V}$ is to attribute the "absorption" to a shift in the position of the nasal glide within the syllable from coda position to a position inside the syllabic nucleus which causes the vowel and the [N] to monophthongize (see DeChene&Anderson 1979).

Chapter 2

[N]: PHONETIC DESCRIPTION & DERIVATION

Glide-like transitional elements similar to Sanskrit anusvara transcribed here as [N] have been described in languages which have developed or seem to be developing nasal vowels. The phonetic description of these nasals varies because their point of articulation and stricture is indeterminate. In fact, the phonetic descriptions of [N] suggest that it lacks a point of articulation and that it is not a stop, but a glide in the same group with [h] and [?].

In certain dialects of Spanish called "velarizing" because they velarize nasals in coda position, nasals in pre-consonantal position have become [N]:

1)

The [pre-consonantal variant of [ŋ]] is a consonantal nasal sound that occurs when the tongue moves from the articulation of the preceding vowel in transition to that of the following consonant...the nasal condition of the segment is perceptible, though not its point of articulation, which does not assimilate [to the following consonant]). ... one can say that this variant has no point of articulation (D'Introno&Sosa 1984: 3).

Before vowels and before pause, [ŋ] exhibits two variants:

2)
The first variant of /ŋ/ is...articulated with the dorsum of the tongue in contact with the soft palate. The second variant is a relaxed [-tense] velar consonant. In this relaxed production the articulatory gesture of the tongue is weakened and it is possible that in some cases there is no real closure between the articulators but rather an approximation. The relaxed nasal can be produced with a minimum of articulatory movement, as when a nasal is produced begining from the neutral position of the articulatory organs when the mouth is closed. The relaxed nasal is equivalent to a continuant velarized nasal sonorant, which can also be transcribed as [γ̃] (D'Introno&Sosa1984:2-3)

D'Introno&Sosa(1984) and Guitart(1981) note that [N] sometimes disappears leaving behind a nasalized vowel: [ṼN] --> [Ṽ]. Some standard ("non-velarizing") Spanish dialects also develop nasal glides before spirants, but not before pause. For example, in Highland Mexican dialects, nasal consonants become "pure nasalized voice" in position before spirants; that is, they are almost indistinguishable from vowel nasalization (Harris p.c.).

The above data can be summarized as follows:

3) (a) Nasalized vowels alternate between [Ṽ] and [ṼN].
(b) The phonetic value of [N] indicates that it lacks a place node.
(c) [N] is sometimes transcribed as [ŋ].

(3)(c) is probably due to the fact that [N] and [ŋ] are acoustically very similar. However, it may be that transcriptions are no mistake and that [N] is actually becoming a velar nasal in surface representation (for a detailed discussion of this issue see § 3.3). In what follows I shall concentrate on (3)(a) and (b).

Another striking case of anusvara has been described in Choctaw (Nicklas 1975). The phonemic inventory of this language is: labial /**p b f w**/ coronal /**t d[l] č s š l ɬ y**/ velar /**k x[h]**/ vowels /**a i o a: i: o:**/. In this language, pre-consonantal nasals "disappear" and leave behind a trace of nasality according to the following rules given by Nicklas(1975):[1]

4)	a.	v: (m, n) C]σ	-->	ṽ: ø C]σ
		v (m, n) C]σ		ṽ ø C]σ
	b.	v (m, n)]σ C	-->	ṽ:]σ C

am-issi	'my dear'	**o-n-na** [**õ:na**]	'to arrive n-grade'
ã:-pala	'my lamp'	**ta-n-kči** [**tã:kči**]	'to tie n-grade'
ã:-tabi	'my cane'	**ši:-n-pli** [**šĩ:bli**]	'to stretch n-grade'
ã:-čokka	'my house'	**nokšo:-npli** [**nokšõ:bli**]	'to scare n-grade'
ã:-kofi	'my guinea fowl'		
ã:-bina	'my camphouse'		
ã:-mi:ko	'my chief'		
ã:-lowak	'my fire'		

The processes in (4)(a)&(b) involve the creation of a velar nasal [**ŋ**] which patterns with [**x**] and [**k**] in triggering a rule of "weak" epenthesis, as Nicklas himself notes. The epenthesis rule is given in (5). [**b**] and [**d**] are the only oral voiced stops in Choctaw. Choctaw has four fricatives corresponding to four stops: [**p t č k f s š x**]. [**x**] surfaces as [**h**], [**d**] **surfaces as** [**l**] **before** [**l**].[2]

---

[1]**Munro&Ulrich(1985) describe a dialect with no compensatory lengthening:**
4b. v (m, n)]σ C --> ṽ]σ C.
Nicklas gives the rules as:
4 a. v: (m, n) CC --> ṽ: ø CC ; v (m, n) CC --> ṽ ø CC
b. v (m, n) C --> ṽ: C
But Ulrich(1987) shows that all CC clusters (including C+liquid clusters) are hetero-syllabic in Choctaw, hence the condition on 4a. can be reduced from CC to C]σ as in the text. The C condition on 4b. cannot be straightforwardly eliminated because [n] can occur word-finally in certain Choctaw nouns: cholhkan 'spider', nishkin 'eye'.
[2]**Thus /ši:p-li/ --> [ši:b-li] 'to stretch' and /bičot-li/ --> bičod-li --> [bičol-li) 'to bend'.**

In examples (6) we see that the epenthetic vowel becomes a copy of the preceding vowel.

5) Choktaw epenthesis: ø --> v / (k, x) ___ (b l (-/d/?))

6) examples:

hokli --> kok^{o}li 'to catch', taxli --> tah^{a}li 'to finish', ikbi --> ik^{i}bi 'to make'

After nasal vowels, we do not get a copy of the preceding vowel, instead we get what Nicklas describes as "simple voicing and nasalization"(p. 247). Given this description, Nicklas' transcription of this "simple voicing and nasalization" as an [ŋ] is somewhat perplexing: [ĩ ŋbi] 'to make n-grade' [hõŋli] 'to catch n-grade'. I hypothesize Nicklas is using the symbol [ŋ] because [ŋ] is acoustically closest to the sound he actually wants to transcribe. The following derivation suggests itself:

7) derivation of nasal consonants before [l]:

v (m, n) l-->(velarization&spirantization)v γ̃ l -->(epenthesis) v γ̃ v l -->
--> (formation of a syllabic nasal) v γ̃ l --> (debuccalizaton)v N̩ l.

The fact that the asnuvara patterns with [x] and [k] in triggering a rule of epenthesis suggests that [N] is underlyingly velar. In fact, we can assume that it is [γ̃] and that [γ̃] becomes [N] (on analogy to the change from [x] to [h]).

Regarding the rules in (4)(a) and (b), I note that in the Oklahoma dialect of Choctaw (**Ulrich 1987**) the glottal stop infixed by the ?-grade after the penultimate vowel of the verb stem undergoes processes (4)(a) and (b):

8)

rule (4)(a): **ik-koba?ffi-o-h --> ikkobaffoh** 'she did not break it'
rule (4)(b): ik-pato?li-o-h --> ikpatoolioh 'he did not touch it'

Such data suggest that nasal vowels develop via the creation of a place-less nasal glide [N] that patterns with [?]:

9)

rule (4)(a):	**vNc.cv --> ṽc.cv**	**v?c.cv --> vc.cv**
rule (4)(b):	**vN.cv --> ṽṽ.cv**	**v?.cv --> vv.cv**

One of the most enlightening descriptions of nasal glides and their relation to nasal stops and vowel nasalization is in Chen's(1973) cross dialectal comparison of the attrition of syllable endings in Chinese. Throughout its recent history, the sound pattern of Chinese has consistently obeyed fairly strict phonotactic rules. There are three major types of syllable structures, depending on whether the syllable ends in (a) a vowel or a glide; (b) one of the nasals [**m, n, ŋ**]; or (c) a stop which may be [**p t** or **k**]. Chen(1973) notes that since Middle Chinese [hereafter MC], the evolution of the Chinese language can be characterized as a continuous process of merging and simplification of syllable types. Specifically, the nasal and stop endings have undergone varying degrees of neutralization, weakening and loss. This means that the CVC or closed syllables have been evolving in the direction of CV or open syllables. This direction of development is in line with the principle of universally preferred syllable structure.

Chen(1973) concludes that the major changes that have taken place with reference to MC finals of the CVC and CVN forms are:

CVC forms

(1) the merging of [**p, t, k**] endings first to two and then to one single consonant and finally to a glottal stop; (2) the eventual disappearence of the glottal stop; while preceding vowel becomes distinctively shortened and acquires a rising pitch contour (in Chen's terminology, these vowels acquire an "entering" tone transcribed [v̆]); (3) with vowel length neutralization the last trace of the consonantal ending in the MC form is obliterated.

CVN forms

Parallel to the developments affecting the CVC endings, the CVN forms have gone through a series of changes which can be characterized as (1) the merging of [**m n ŋ**] to two and then to one single nasal ending (2) the weakening of the syllable ending to a "weakly articulated nasal", usually symbolized by a raised N as in [V^N]--this is our nasal glide, (3) the loss of nasal ending with compensatory nasalization of the vowel.

Although most of Chen's evidence is based on cross-dialectal comparisons, Chen claims that the consonant attrition processes acting in the various Chinese dialects have the specific order of development outlined above. He provides evidence form chronological surveys from MC down to Pekinese records to establish the sound change from MC */**k**/ to [ʔ]. He also cites recent surveys of Taiwanese spaced over several decades, attesting to the gradual disappearence of the glottal stop. The sucessive stages of change are schematized in (10)(a) and (b); relevant dialects are indicated in brackets to the right of each stage:

10)a

	a.				**b.**			
I	p	t	k	[a.b.c.]	m	n	ŋ	[a.b.c.]
IIa.	p	|	k	[d.]	m	|	ŋ	[d.]
IIb.		t	k	[e.]		n	ŋ	[n.o.p.q.r.g.i.t.u.e.]
III			k	[f.]			ŋ	[s.h.j.k.]
IV			?	[g.h.i.j.(k).]			v^N	[v.]
V			v̆	[l.m.]			ṽ	[w.x.]
VI			v	[n.o.p.q.r.s.t.u.]			v	[y.z.]

a. Guangzhou, b. Xiamen, c. Meixian, d. Chaozhou, e. Nanchang, f. Fuzhou, g. Yangshou, h. Tauyuan, i. Suzhou, j. Shanghai, k. Fuzhou, l. Handan, m. Shijiazhuang, n. Peking, o. Jinan, p. Xian, q. Hankou, r. Chengdu, s. Wenzhou, t. Changsha, u. Shuangfeng, v. Changshou, w. Jinggu, x. Shuangjiang, y. Fengyi, z. Lijiang.

Countering the objection that the above mentioned syllable attrition processes may be restricted to China as a linguistic area, Chen provides the following examples of attrition in other languages:

Indo.European.	Lat. **lupum**	:	Gk.**lukon**
	Skt. **abharam**	:	Gk. **epheron**
Common Germanic:	**Lat. tum**	:	Goth. **þan**
Modern German:	Eng. **bosom**	:	Germ. **busen**
French:	Lat.**rem**	:	Fr. **rien**
Afrikaans:	Dutch. **hoorn**	:	A. **horəŋ**
Ripuarian dialects:	Germ. **hund, zeit**	:	R. **huŋk, t͡sik**

The development of nasals in Spanish shows almost all the stages of attrition:

Spanish:	Lat. **adam**	:	Sp. **adan**
	Sp. **adan**	:	C-1.Sp. **adaŋ**
	C-1.Sp **adaŋ**	:	C-2.Sp. **ada**^{N}

C-1 Sp: Caribbean Spanish
C-2 Sp: Caribbean Spanish: Venezuelan

The point by point parallelism indicates that the directionality of merging of the stop endings is virtually a replica of that of the nasal endings. For our purposes, the most important parallelism between the two kinds of endings is the following: "the weakening of a full fledged consonant ending to a glottal stop parallels the weakening of [VN] to [V^{N}], a transitional stage on the way to full nasalization and the loss of the nasal ending (Step IV)(Chen, 1973:42)". This parallelism is not obvious because there is a systematic difference in the relative chronology of changes in the development of nasal and oral endings:

11)

The stop endings typically show reflexes of more advanced stages of change than their nasal counterparts within a given dialect; in some cases both sets of endings have reached an equivalent stage of development; but in no case do we find nasal endings clearly outpace their stop endings in their progression toward eventual deletion along parallel directions.(p.44)...As compared with their nasal counterparts, final stops (especially when unreleased) provide much less distinct perceptual cues for the discrimination of the place of articulation. This perceptual factor accounts, in part, for the greater propensity of final stops to reduction (to a glottal stop) and eventual loss. (p.55).

An example of the typical asynchronism in the development of nasal and oral endings is observed in the dialects with [V^{N}] (e.g. Changshou dialect). This dialect is representative of 13 Wu dialects characterized by a modern reflex of the "weakened" nasal ending [V^{N}]. The dialect is typical of a great number of Wu dialects in yet another sense: although the [p, t, k] stops have been dropped, the 'entering' tone [V̆] is preserved as a distinct phonological category, characterized by a contrastive vowel shortness and by a rising pitch contour. In other words, while the oral stops have reached stage V the nasal endings have only reached stage IV. Nevertheless, it is possible for oral and nasal endings to pattern together as Chen himself notes. Finally Chen notes that the development of vowel nasalization or shortening is accompanied by the deletion of a nasal or oral place-less glide respectively:

12)

Just as the nasal ending is deleted after leaving the trace of nasality in the vocalic nucleus, the stop ending did not disappear without transferring its contrastive vowel shortening to the vocalic portion of the syllable (Step V). In both changes the underlying process is identical, namely, 'rephonologisation' (Jakobson 1931) in the sense of the transfer of a phonemic contrast from the primary to a secondary cue or carrier: in one case it is the nasality that is transferred from the nasal ending to the vowel; in the other case, the characteristic shortening of a vowel before a voiceless consonant--originally an intrinsic and purely automatic variation without any contrastive function--now becomes phonemic after the loss of the glottal stop (p.42).

Chen's findings confirm observations (3)(a)(b) and (c). Other languages where vowel nasalization is accompanied by the appearence of [N] (or of a "weakly articulated velar nasal") are Yucatec Maya and Acatlan Mixtec. For example, in Maya(Stewart 1976), attrition processes in pre-pause position also lead to velarization, gliding, deletion and nasalization:

13)

The effects of these rules [affecting phrase-final nasals] include labializing or velarizing a nonlabial or nonvelar nasal (but never alveolarizing a labial or a velar) and devoicing any one of them (with or without a concurrent change in point of articulation). Sometimes, this phrase-final degeneration of nasals proceeds beyond these effects to the point of complete loss of obstruence, with the only indication of nasality being the nasalization induced on a preceding vowel...such nasalization of vowels followed by syllable-final nasals is absolutely normal (Straight:1976:69).

According to Straight, children learning Maya pronounce phrase-final nasals as freely alternating [m] ~ [m̥] ~ [ŋ] ~ [ŋ̊] ~ [ṼH̃].[3] The Maya facts suggest a close connection between [ŋ], [H̃] and vowel nasalization. In Acatlan(Pike&Wistrand 1974) "word final nasalized vowels are optionally followed by a lenis velar closure" [ĩ]~[ĩŋ] 'nine'.

The behavior of [N] in Japanese (Martin 1954, McCawley 1968, Poser 1983[4] 1988, Haraguchi 1984, Ito 1986) shows that it is place-less at some point in the derivation. The Japanese data also illustrates the tendency to transcribe [N] as [ŋ]. The following are some descriptions of Japanese [N]:

14)

...a uvular nasal consonant, ranging from stop to approximant in manner of articulation. Elsewhere /N/ assimilates in point and manner of articulation to the following consonant. (Poser:1983:7-8).

---

[3]The derivation of [H̃] is unclear: phrase-finally, voiceless liquids and nasals appear to become [h] and [H̃] respectively. But it may be the case that these voiceless liquids and nasals are undergoing total deletion. We cannot know because phrase-final vowels always add [h] anyway.

[4]A version of this paper was given at the Minifestival on Compensatory Lengthening at Harvard University in 1986.

15)

The mora nasal is phonetically either a nasal consonant homorganic with the following consonant or (if there is no following consonant) something which has been variously described as a nasalized transition to the following vowel... or a nasalized continuation of the preceding vowel ...or a velar nasal consonant ...or a velar nasal consonant with incomplete closure. What every one agrees on is that when no consonant follows...the mora nasal is a nasalized segment colored by the surrounding segments and with the back of the tongue close to the back of the mouth. My own auditory impression is that it is a nasalized prolongation of the preceding vowel which colors a following /ʔ/ by making it a (possibly nasalized) [**w**] or [**y**] if the following vowel is **u/o** or **i/e** respectively.(McCawley:1968:84)

16)

The basic part of this sound is just nasalization...If you like, you may think of this as N WITH THE TONGUE NOT QUITE TOUCHING THE TOP OF THE MOUTH ANYWHERE. This sound is heard most distinctly at the end of a word... it is also heard before **s, sh, z, h, f, r**. (Martin:1954:25)

Though [N] is transcribed as [ŋ], it is a place-less nasal glide at some point in the derivation because:

(i) [N] fails to pattern with [+consonantal] segments in that it fails to trigger epenthesis; therefore, [N] is [-consonantal].

(ii) [N] is the output of deleting the place features of a nasal consonant (Kagoshima dialect); therefore, [N] is place-less.

The phonemic inventory of Japanese is the following: labials/**p p͡y b b͡y m m͡y**/ coronals /**t d t͡ʃ d͡ʒ s ʃ z n n͡y r r͡y y**/ dorsals /**k k͡y g g͡y ŋ w**/ and laryngeals /h N/. Unlike a true nasal or oral consonant, [N] does not trigger epenthesis in Japanese.[5] Consider the following loanwords from English:

17)

waʃintoN	'Washington-F'	/n/
simputomu	'symptom-F'	/m/
kooto	'coat-F'	/t/

Words cannot end in [+consonantal] segments in Japanese; no word may end in an obstruent nor in a continuant sonorant such as [r]. Word final rhymes can only be: V?, VV(including Vy) and VN. The examples in (17) show that epenthesis (shown in bold) applies if the word final nasal is labial but not if it is [N].[6] This suggests that the [N] in [waʃintoN] is not a consonant. This exceptional behavior of [N] is not limited to the loanword vocabulary of Japanese. The following examples show that final [N] does not trigger epenthesis in the Sino-Japanese vocabulary, unlike true consonants such as [r, t, g, k or t͡s]. I follow Ito(1986) in assuming that palatalization is distinctive for consonants in Japanese and that in the Sino-Japanese vocabulary, the backness of the epenthetic vowel derives from the preceding consonant.[7] Hence CʸV --> Ci; CV --> Cu:

[5] My analysis of Japanese syllable structure relies heavily on Poser(1983) and Ito(1986). Following McCawley(1968) I assume that Japanese phonology applies differently to different vocabularies; namely Yamato (Y) or native, Sino-Japanese (SJ), Foreign (F) and Ideophonic (I). All the Japanese data cited here comes from Poser(1983), Haraguchi(1984), Ito(1986), McCawley(1968) Martin(1954) and Haraguchi(personal communication). I am gratefult to Shosuke Haraguchi for his insightful coments and suggestions on the issues discussed in this section.

[6] Words ending in a velar nasal in English are borrowed in accordance with the spelling: soŋgu 'song'.

[7] In the verbal derivation (Yamato vocabulary) the epenthetic vowel is always [i]: see Poser (1983).

18)

mori	'a leak-Y'	**/mor/**
oyoŋi	'a swim-Y'	**/oyog/**[8]
dai-gaku	'university-SJ'	**/dai-gak/**
gaku-batsu	'academic clique-SJ'	**/gak-bat/**
gaku-moN	'learning-SJ'	**/gak-moN/**

The examples suggest that the [N] in [**gaku-moN**] 'learning' is not a consonant, because it does not trigger epenthesis.

Further confirmation for this position can be gathered from the Kagoshima dialect of Japanese (Haraguchi 1984 and p.c.). In the Kagoshima dialect high vowels are systematically dropped in word final (or morpheme final) position after a non-strident consonant. After vowel deletion, the remaining consonant is syllabified into coda position, where it surfaces as [?] if oral and as [N] if nasal. Examples from the verbal and nominal paradigms are shown below:

19) nouns

obi	-->	**ob**	-->	o?	'belt'
matu	-->	**mat**	-->	ma?	'pine tree'
doku	-->	**dok**	-->	do?	'poison'
kagi	-->	**kag**	-->	ka?	'key'
hidži	-->	**hidž**	-->	**hi?**	'elbow'
kami	-->	**kam**	-->	**kaN**	'god'
inu	-->	**in**	-->	**iN**	'dog'
tuyu	-->	**tuyu**	-->	**tuyu**	'dew'
kasu	-->	**kasu**	-->	kasu	'draft'
kiži	-->	**kiži**	-->	**kiži**	'bell'

---

[8]The change from [g] to [ŋ] is due to a rule that changes intervocalic [g] to [ŋ].

20) verbs:

oku	-->	**ok**	-->	**o?**		'to put'
katu	-->	**kat**	-->	**ka?**		'to win'
karu	-->	**kar**	-->	**ka?**		'to cut'
umu	-->	**um**	-->	**uN**		'to give birth'
osu	-->	**osu**	-->	**osu**		'to push'

The behavior of oral and nasal consonants can be unified if we assume that [N] is a place-less glide in the same category with [?]. The fact that [N] and [?] are derived by a single process in Japanese confirms the parallelism between [N] and [?] proposed by Chen(1973) in his analysis of syllable final attrition processes in Chinese.

I propose that the process that creates [N] and [?] in the Kagoshima dialect of Japanese consists in a deletion of the point of articulation of word-final consonants (i.e. debuccalization):

21) Debuccalization: place --> ø / ___ #

Debuccalization is accompanied by an independent process which inserts the feature [+constricted glottis] if the segment is [-nasal]. This explains the emergence of a final glottal stop in (19) and (20). Note that the insertion of the glottal stop is independent of the continuancy value of the original consonant: [+continuant] [**r**] and [-continuant] [**t**] are both replaced by [?] in the verbal paradigm. I point this out as evidence that [?] does not in any way "inherit" the continuacy value of the debuccalized segment.[9,10]

In addition to debucalization[11,12] various other rules in Japanese appear to conspire to prevent the surfacing of word-final [+consonantal] segments. Epenthesis, shown in (17) and (18), is one of these rules; another

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[9]The fact that the debuccalization of fricative obstruents such as [s] derives [h] rather than [?] in Spanish, Sanskrit, Desano and other languages may have more to do with the aerodynamic requirements of these segments rather than with the continuacy per se. That is, fricative obstruents are phonetically aspirated during the occlusion, so they leave behind an [h]; [r] is not phonetically aspirated during the occlusion, so it need not leave behind an [h].

[10]?-insertion is not restricted to the Kagoshima dialect. Japanese geminate clusters are often described as preglottalized (p.c. S.Haraguchi, W.Poser). One tradition writes the first half of a geminate with a special phoneme, simbolized as Q, which is referred to as glottal closure. The following is a description of the first half of oral geminates given by Martin(1954): "Another characteristic of Japanese double consonants --including ss, ssh, as well as pp, tt, tch, kk --is the special TENSENESS with which they are pronounced. It's as if the Japanese *tightened up his throat* in order to hold on and get in that extra syllable represented by the first of the consonants. (p 15; italics are mine) Regarding Martin's reference to an "extra syllable" see footnote (12) this chapter.

[11]Debuccalization also applies in standard Japanese: the final high vowel of negative verb forms drops in position after a nasal consonant. As a result the nasal winds up in word-final position and looses place, surfacing as [N]: [komu] 'will come' vs [koN] 'come not'.

[12]An interesting aspect of Martin's(1984) description relevant to the derivation of [N] in Japanese concerns the length of [N] and the length of homorganic nasal and oral clusters. Martin calls [N] a syllabic nasal because "The pronunciation of the syllabic nasal varies according to its surroundings, but it is always pronounced with the nasal passage open and it ALWAYS TAKES A FULL SYLLABLE'S TIME (sic.)...The combination nk is pronounced about as in banker but the ng sound is held for a full syllable." (pp. 23-24). According to Martin, the first part of an NC or CC cluster is as long as a syllable: "Listen to the difference between the single and double consonants in the following examples, then imitate them, being very careful to hold the first of the double consonants for a full syllable's duration and then release it tight and clear with no puff of air"(p15). Martin's description suggests that Japanese CC and NC clusters are not double but triple in length: not CC and NC but CCC and NNC where the bold consonant plays the role of a vowel. It is well known that syllabic consonants may develop from underlying CV sequences. Triple clusters in Japanese may have developped from CVC and NVC sequences created by the insertion of an empty epenthetic vowel between consonants. The derivation would be as follows: /C_1C_2/ -->(epenthesis) /C_1VC_2/ -->(place assimilation-creation of a syllabic consonant) [$C_2C_2C_2$]. On this analysis the derivation of word-final [N] ([NN] in Martin's description) is as follows: /n#/ -->(epenthesis)/nV#/ -->(creation of a syllabic consonant)/nn#/ -->(debuccalization) [NN]. I have not followed this analysis here for lack of evidence corroborating Martin's description.

is sonorant gliding, also applying in the Kagoshima dialect. Sonorant gliding turns a word final [r] to [y] in the nominal paradigm (but not in the verbal paradigm, where [r] becomes [ʔ]):

22) Sonorant gliding : [+consonantal] --> [-consonantal] / x #
[+sonorant]

turu --> **tur** --> **tuy** 'vine, runner'

2.1 Conclusion

We can conclude (1) that Japanese [N] is place-less, like [N] in Spanish, Choctaw and Chinese; (2) that [N] is closely related to nasal "absorption"; that is, to the creation of nasal vowels in Spanish, Choctaw and Chinese and (3) that [N] is frequently transcribed as [ŋ]. In the next chapter I will provide further evidence in favor of the hypothesis that nasal "absorption" and nasal debuccalization are related. I will also address the question of the relation between [N] and [ŋ].

Chapter 3

DEBUCCALIZED AND "ABSORBED" NASALS

In this chapter I show the existence of a correlation between the typology and distribution of nasals undergoing "absorption" and those undergoing debuccalization. I conclude that nasal "absorption" and nasal debuccalization share a set of necessary or sufficient conditions.

3.1 Typology and distribution

According to Ruhlen(1978) two factors play a role in the "absorption" of nasal consonants: the position of the nasal consonant in the word and the nature of the segment following the nasal consonant. The positions in the word where "absorption" is observed are (in order of preference):

1) Positions of "absorption":

i) pre-consonantal
ii) word-final followed by a consonant
iii) word-final
iv) inter-vocalic

This means that the contexts in which nasal consonants undergo "absorption" are contexts where consonants tend to debuccalize (see § 5.1 for further discussion of this issue).

Labial nasals tend not to undergo "absorption" or debuccalization, whereas coronal and velar nasals appear to be the more susceptible to either process. Thus with respect to debuccalization, we see that in the loanword vocabulary of Japanese, word-final **[n]** debuccalizes to [N] but word-final **[m]** does not debuccalize and triggers epenthesis instead:

2)

waʃintoN	**'Washington-F'**	**/n/**
simputomu	**'symptom-F'**	**/m/**
kooto	**'coat-F'**	**/t/**

For an additional example of a debuccalization rule that targets **[n]** to the exclusion of **[m]** see (§ 3.3.4).

The same asymmetry between **[m]** and **[n]** in debuccalization rules can be observed in the behavior of **[m]** and **[n]** in "absorption" processes: In Chickasaw (Munro&Ulrich 1985) **[v-n#]** undergoes absorption while **[v-m#]** fails to undergo either process:

2)

Chickasaw:	**apa-ta-m**	'eat-Q-past'
	cholhkan-a-n --> **cholhkan-ã**	'spider-object'
	fammi-ka-n --> **fammi-kã**	'that he whips him-diff subj'

Similarly, Chen(1975:114) reconstructs the emergence of nasal vowels in the dialects of Chinese as taking place only after Middle Chinese coda *[**m**] had coronalized to [**n**]. Only coda [**n**] and coda [**ŋ**] underwent "absorption" in Chinese, [**m**] did not.

To discover why [**n**] is more susceptible to debuccalization than [**m**] might require studying the acoustic and perceptual consequences of overlapping vocal tract constriction movements. Browman&Goldstein(1987) note that (oral and nasal) coronal stops in pre-consonantal position tend to undergo processes of gestural reduction and overlap in casual speech (see § 5.2). Browman&Goldstein hypothesize that higher susceptibility of coronal stops to gestural reduction and overlap accounts for their higher susceptibility to place assimilation and deletion: coronals are "hidden" more easily than other consonants because they are pronounced with the tongue tip and tongue tip movements show higher velocities that do either tongue dorsum or lip movements (which are about equivalent to each other). The answer to the question of why [**n**] is prone to "absorption" is that the debuccalization of nasals feeds nasal "absorption" but I have yet provided no arguments to this effect. Here I only take note of the fact that debuccalization and "absorption" tend to happen in the same environments and to target the same segments.

Coronal and velar nasals also react asymmetrically to debuccalization and "absorption". Velar nasals debuccalize to the exclusion of coronal nasals in Aguaruna. In Aguaruna (D.L.Payne 1974) [ŋ] surfaces as nasalized breath [h̃] pre-vocalically before tense high vowels [i] and [u] and as [ŋ] elsewhere.[1] The labial and velar nasals do not undergo this process. The phonemic inventory of Aguaruna is labials: /p w m/, coronals: /t t͡s s n/, palatals: /t͡ʃ ʃ y/, velars: /k ɣ ŋ/[2], laryngeals: /h ʔ/, and vowels:/i ɨ a u/ . The examples in (3) show the behavior of [ŋ] in intervocalic position, (which I assume is identical to that of [ŋ] in word-initial position because [ŋ] never surfaces in word-initial position):

3) prevocalically:

ãh̃ũm	'later'
t͡sũh̃ĩ	'fish'
sũh̃ĩk	'beads'
isãh̃ĩ	'ridge of roof'
sakãh̃ũ	'skeleton'

4) syllable finally:

asiŋ	'spark'
suŋkuŋ	'cough'
wiaŋ	'father in law'
tantaŋ	'shield'
suntaŋ	'soldier'

---

[1] /h/ is a phoneme separate from /ŋ/ in Aguaruna. Aguaruna /ŋ/ corresponds to [r̃] in the related language Huambisa; Aguaruna /h/ corresponds to Huambisa [h]: A: [t͡sɨhiŋ] H:[t͡sɨhir̃]; A: [humaŋ] H: [himir̃]. Oral [h]'s appearing before tense high vowels in Aguaruna are underlying /h/'s.

[2] /m/ and /n/ may become prenasalized or oralized completely: Onset [m] and [n] vary freely with [ᵐb] and [ⁿd] (with any degree of prenasalization) if the immediately following rhyme contains a tense high vowel (/i/ or /u/) or if the next syllable begins in an oral consonant. According to Payne, monolingual speakers cannot distinguish [b] and [d] from [m] and [n]. [b] and [d] never occur before a nasalized vowel.

t͡sat͡saŋ 'mother in law'

The rule changing [ŋ] to [h̃] is now limited to a particular morphological environment in Aguaruna. The morpheme /-ŋu/ 'possessive-aspectual' has two realizations: [-h̃ũ] and [-ŋ] which are conditioned by a rule of vowel deletion whose environment is not well understood:

5) with no vowel deletion:

duha-h̃ũ-t 'rise-asp-inf'
kumpa-h̃ũ 'friend-poss-vocative'

6) with vowel deletion:

duwɨ-ŋ 'clay-poss'
duha-ŋ-tinu 'rise-asp-fut'

The change from [ŋ] to [h̃] requires the removal of the place of the original nasal while preserving nasality.[3] That the change targets only [ŋ] suggests that [ŋ] is more susceptible to debuccalization than [m] and [n], at least in intervocalic and pre-vocalic contexts.

The development of nasal vowels in Mandarin Chinese and Panamanian Spanish suggests that they are also "absorbed" more promptly than coronal nasals, at least in pre-vocalic contexts. Mandarin Chinese (Cheng1973) has two nasals [m] and [n] that can appear in onset position and two nasals [n] and [ŋ] that can appear in coda position to the exclusion of all other consonants. According to Chen(1973) some coda [n]'s in Mandarin Chinese

---

[3]**The nasalization caused by a debuccalized velar nasal is always bi-directional. The reason why it does not appear to be bi-directional when the suffix [h̃ũ] (</-ŋu/ 'possessive-aspectual') is added has to do with a peculiar property of this suffix: this suffix oralizes all preceding segments up to the first obstruent stop: /nuwɨ-ŋu/ --> [duwɨ-ŋ] 'clay-poss' vs /kumpa-ŋu/--> [kumpa-ŋ] 'friend-poss'.**

are the reflex of a rule coronalizing labial nasals. Both coda [n] and [ŋ] delete before the diminutive suffix /-ɤr/. However only [ŋ] nasalizes a previous vowel upon deletion:[4]

7)

ian-ɤr —> ian-r —> iar	'seal'
kuɤn-ɤr —> kuɤn-r —> kuɤr —> kuər	'roll'
iaŋ-ɤr —> iaŋ-r —> iãr	'sheep'
k'uɤŋ-ɤr —> k'uɤŋ-r —> k'uɤ̃r —> kuə̃r	'free time'

Similarly, [ŋ] appears to be more susceptible to "absorption" in Spanish. Cedergren&Sankoff(1976) argue that the development of nasal "absorption" in Panamanian Spanish follows the pathway m > n > ŋ > Ṽø because nasalized vowels alternate with vowel + [ŋ] sequences: Lat. adam --> Standard Spanish: adan --> Caribbean Spanish: adaŋ --> Panamanian Spanish: adã~ adaŋ "Adam". Such data suggests that the hierarchy of nasal debuccalization corresponds to the hierarchy of nasal "absorption"; namely:

[4]Speakers of Mandarin Chinese vary as to the degree to which they nasalize vowels before nasal consonants in word-final position. Yefei Li, who speaks Peking Mandarin, nasalizes vowels equally before [n] and [ŋ], but Bao Zhiming (p.c.) tells me that in some dialects of Mandarin Chinese nasalization before [ŋ] is stronger than nasalization before [n]. Cheng(1973) does not discuss these facts. All dialects agree as to the data in (7). Coda [n] and [y] trigger a rule that fronts a preceding [a] to [æ]: /tan/[tæn] 'candy', /lya/ --> /lyay-t͡sya/-->(fronting) /lyæy-t͡sya/ 'two' (May-ka secret language formation) vs /taŋ/ [taŋ] 'talk'. Fronting feeds a rule that raises [æ] to [ɛ] in position after [y]: /tyan/ -->(fronting) /tyæn/ --> (raising)[tyɛn]; /lyay-t͡sya/-->(fronting)/lyæy-t͡sya/ -->(raising) /lyɛy-t͡sya/--> [lyɛ-t͡sya] 'two'. There is no need to specify [ŋ] as [+back] to derive these facts; it is only necessary to assume that [n] and [y] are [-back]. Thus, fronting need not be ordered with respect to debuccalization.

8)

(i) [n] [ŋ] debuccalize more promptly than [m]; they also undergo "absorption" more promptly than [m].
(ii) [ŋ] debuccalizes more promptly than [n]; it also undergoes "absorption" more promptly than [n].

From these data we can conclude that (a) nasal consonants are not all equally susceptible to debuccalization nor are they all equally susceptible to "aborption" ; (b) labial nasals resist both debuccalization and "absorption" and (c) except for the cases of intervocalic [ŋ] both debuccalization and nasal "absorption" typically target nasals in coda position. (a) (b) and (c) suggest that nasal debuccalization and nasal "absorption" share a set of necessary or sufficient conditions.

3.2 The behavior of intervocalic [ŋ]

The identification of [ŋ] as a preferred target of debuccalization or "absorption" may have to be restricted to pre-vocalic or intervocalic [ŋ]. Chen(1975) indicates that word-final [n] is more susceptible to "absorption" than word-final [ŋ] in the majority of Chinese dialects, whereas the instances where [ŋ] debuccalizes or is "absorbed" more promptly than [n] are cases where [ŋ] is in pre-vocalic position. The tendency to debuccalize pre-vocalic or intervocalic [ŋ] may be a reflex of a tendency to weaken the occlusion of velar stops (oral or nasal) in these contexts. Processes of spirantization/voicing of stops in intervocalic position tend to affect [k] before they affect [p t] (e.g. see the historical development of stop lenition in Tuscan: Wanner&Cravens(1979)). But the hypothesis that intervocalic [ŋ] undergoes the same weakening processes that affect oral velars cross-linguistically may be very difficult to prove due to the acoustic nature of [ŋ].

There are reasons to suspect that stricture distinctions are hard to hear in the case of the velar nasal. According to Ohala(1975) nasality weakens the perceptual cues that help distinguish the point of articulation and stop occlusion of a velar. The point of articulation and stop occlusion become more salient if the release of the velar nasal is oralized. For example, a study of the acquisition of Maya phonology by Straight(1976) indicates that children learning Maya (a language lacking [ŋ] in the underlying inventory) imitate intervocalic [ŋ] as [ŋg] or (less frequently) change the place of articulation. The change to [ŋg] suggests a tendency to make the release of the segment more salient. If no oralization takes place, the distinction between the velar stop [ŋ] and the nasal glide [N] (pure nasalized voice) is acoustically minimal. The acoustic pattern of the velar nasal is more like that of a nasalized vowel than are those of any other nasal consonant. According to Ohala(1975) nasal consonants' spectra are characterized by both resonances of the combined pharyngeal and nasal tract and one anti-resonance of the oral side cavity. The resonances are relatively stable no matter what the consonantal point of articulation, but the frequency of the anti-resonance varies inversely with the length of the oral cavity. There is evidence that formant transitions in adjoining vowels are less effective cues for differentiating place of articulation of nasals than are the formant transitions of oral obstruents. This suggests that listeners might tend to rely on the frequency of the anti-resonance of the oral cavity to distinguish point of articulations among nasal consonants.

9)

"the anti-resonance for the velar nasal is generally so high in frecuency that it is perceptually less evident (since high frecuencies are severely attenuated in nasal consonants). Thus the acoustic pattern of the velar nasal is more like that of a nasalized vowel than are those of any other nasal consonant" (Ohala 1975:297).

If Ohala is correct it will be very easy to write [ŋ] for what should have been transcribed as an unrounded velar nasal glide [ɰ̃] or a place-less glide [N]. In this context Gudschinsky&Popovich's(1970) transcription of the nasalized counterpart of [ɣ] as [ŋ] in Maxakali may reflect a systematic transcription error due to acoustic similarity. In this language a continuant segment may develop between certain vowels and [ə ə̃ ɨ ɨ̃] (which are the syllabic variants of [t n c ɲ] respectively):

10)

"The quality of the continuant is determined by the preceding vowel: voiced velar fricative [ɣ] after [a ɨ], velar nasal [ŋ] after [ɨ̃], palatal semivowel [y] after [i], nasalized palatal semivowel [ỹ] after [ĩ], labial semivowel [w] after [o] and nasalized labial semivowel [w̃] after [õ]" (p.83)

A possible explanation for Gudschinsky&Popovich's transcription of [ɣ̃] as [ŋ] is that the air which causes turbulence at the oral constriction in the case of a [ɣ] is going out the nose in the case of [ɣ̃]. Thus even though [ɣ̃] is [+continuant] phonologically, it will tend to be produced as a stop and to be re-phonologized as one. Alternatively, these authors have failed to hear the distinction between [ɣ̃] and [ŋ].

Despite the difficulties involved in the study of [ŋ] I have found a number of languages (see below) where [ŋ] patterns with continuants even though it is transcribed as a stop. I take this as evidence for the hypothesis that [ŋ] undergoes the same weakening processes that affect pre-vocalic or intervocalic oral velars cross-linguistically (assuming that these processes have been ignored in the case of [ŋ] because of a systematic transcription error). On the basis of these cases we can attribute the behavior of [ŋ] in Aguaruna and Mandarin Chinese to the tendency to weaken velar stops (oral and nasal) in intervocalic or pre-vocalic position. The languages where [ŋ] patterns after continuant sonorants are Tucanoan, Gokana and Gbe described below.

3.2.1 Tucanoan [ŋ]

In Barasano(Stolte1980) and Tucano(Welch1967 & p.c) [ŋ] fails to pattern with the stop sonorants [m] and [n] in terms of rule application and distribution suggesting that [ŋ] is a continuant at some point in the derivation (although it is transcribed as a stop). Barasano and Tucano are closely related languages in the same language family as Desano. The segment inventory of Barasano and Tucano is: labials /p m~b w/, coronals /t s n~d r~l y/, dorsals /k ŋ~g /, vowels / i ĩ ɨ ɨ̃ u ũ e ẽ a ã o õ/ and laryngeals /ʔ h/[5]. The syllabic template is simple (C)V(L) --C, V and L stand respectively for consonant, vowel and laryngeal glide-- and the morphemes are usually harmonic in that they have only oral vowels or only nasal vowels (disharmonic morphemes exist; see below):

11) Barasano: oral morphemes[6] nasal morphemes

paa	'to cut with an axe'	pãã	'to turn over'
tuu	'to hit'	tũũ	'to close'
m͡baa	'to eat'	mãkã	'earth'
m͡bar̃ia	'Maria'	tẽñã	'basket'
		ɲã	'to look'

12) Tucano: oral morphemes nasal morphemes

---

[5] Kaye(1965) believes that [r] is not an underlying phoneme of Desano, but an allophone of [n~d]. The evidence that [n~d] and [r] are distinct in Tucano is the following: [r] becomes [r̃] before or after a nasal vowel [pũr̃ĩ] 'leaf', whereas [n~d] surfaces as [n] before a nasal vowel: [pũ-nĩʔmõ] 'hammock rope' as [n͡d] before an oral vowel: [kĩʔã-n͡d-akĩ] 'thin' [mãn͡du] 'Manuel' [n͡diare] 'river'. Finally, there are a pair of intrinsically nasal suffixes which exhibit the opposition between [r] and [n~d]: [-nõ] 'change of focus' and [-r̃ã] 'imperative'. Similar arguments for a distinction between [r] and [n~d] in Barasano are given in Stolte(1980).

[6]Stolte does not mention any word-initial prenasalized stops in Barasano though he does mention the word-internal ones. As this word-initial prenasalization is slight and optional in the Tucanoan languages that have it, it may have been lost in Barasano, or is simply not mentioned in my source. I have assumed the existence of prenasalized stops in Barasano to simplify the exposition. The existence of word-initial prenasalized stops in Barasano is irrelevant to the argument of this section.

wa?a	'go'	**wĩ?r̃õ**	'wind'
paga	'stomach'	**pũr̃ĩ**	'hammock'
yuka	'vulture'	**sũkũã**	'small of back'
n͡di?	'meat'	**nũnĩã**	'ash'
m͡basa	'to sing'	**mĩsĩ**	'vine'
ya	'my'	**ỹãmĩ**	'deer'

Although most morphemes fall into one of these two classes, Tucano exhibits a few disharmonic morphemes. Stolte(1980) does not mention any disharmonic roots in Barasano:

13) Tucano: **kõpe** 'left'
wehẽ 'fish'
n͡diakĩ 'straight'
mãn͡du 'Manuel'
?ãŋ͡gara 'angels'

In Barasano and Tucano all consonants except [**p, t, k, s**] alternate in nasality as follows:[7]

14)

Before nasal vowels we get [**m n ŋ r̃~l̃ ỹ~ɲ**].
Between oral vowels we find [**b d g w r~l y**].
Between a nasal vowel and an oral vowel we find [**m͡b n͡d ŋ͡g**].
Word-initially, before oral vowels we find [**m͡b n͡d ŋ͡g w r~l y**].

The distribution of prenasalized stops in Tucanoan is derived most easily on the assumption that [**m~b n~d ŋ~g**] are underlyingly [+nasal]. All we need to assume is the following two rules:

15) Consonant nasalization (mirror image):

---

[7] **Tucano [p t k] become [m͡p n͡t ŋ͡k] in position after a voiceless consonant plus nasalized vowel bearing high tone.**

```
[+son][αN][βN]       [βN]
    \|  |            / |
     sl sl          sl sl
     |  |           |  |
     C  V    --> C  V
```

16)

```
 [-N]                    [+N][+N]               [+N][-N]
  /|                      /|  |                  |\/|
m͡b aa      'to eat'     mãkã     'earth'        mãn͡du     'Manuel'
```

As shown in (16) this rule spreads the nasality/orality of a vowel to the immediately preceding and following sonorant consonant (the rule is mirror image). Since the rule spreads both values of the feature [nasal] I am assuming that vowels are specified [+nasal] or [-nasal] at the point in the derivation when consonant nasalization applies. Consonant nasalization derives homogeneously nasal or oral consonants if the surrounding vowels are both nasal or both oral. If the surrounding vowels do not agree in nasality, this rule creates prenasalized consonants [N͡C] in the context ṽ___v and postnasalized consonants [C͡N] in the context v___ṽ. However, postnasalized consonants never surface as such, hence, I will assume that the following rule simplifies postnasalized consonants to simple nasal consonants:

17) Simplification:

```
[-N][+N]        [+N]
   \/             |
   |              :
   C      -->     C
```

18)

```
[-N] [+N]      [-N] [+N]
  |\  /|          |  /|
-sa-ᵐbĩ --> -sa- m  ĩ  as in   ᵐbu?e-gɨ-sa-mĩ  'study-msc.sg-indef-3
```

In Tucanoan, [m~b n~d] pattern together as stops whereas the nasal [ŋ~g] patterns with [r] in two respects: (1) No Barasano or Tucano word can begin in [r ~ r̃ g ~ ŋ]. (2) In Barasano and Tucano a rule spreads the nasality of a vowel onto following vowels, glides and liquids. Stolte(1980) reports that progressive nasalization applies across morpheme boundaries and is "blocked" by [p t s k m~b n~d] but not by [g ~ ŋ]. He also states that when [m n] "block" progressive nasalization and the vowel following them is oral, [m n] become prenasalized, which is to be expected given the rule in (15). Examples (19)-(25) below show progressive nasalization going through [g w y r] (which become [ŋ w̃ ỹ r̃]). Examples (19)(b) and (23)(b) show nasalization going through [g ~ ŋ]. Examples (19)(b), (25)(b) and (c) show blocking by [s, k, t]:

Tucano:

19) (a) ᵐbu?e-gɨ-sa-mĩ 'study-msc.sg-indef-3'
    (b) ĩ?ã-ŋɨ̃-sa-mĩ 'look-msc.sg-indef-3'

20) (a) ᵐbasa-wɨ 'sing-1rst pers visual past'
    (b) nĩ-w̃ĩ 'be-1rst pers visual past'

21) (a) soo-ya 'rest-imperative'
    (b) ĩ?ã-ỹã 'look-imperative'

22) (a) ⁿdia-re 'river-specifier'
    (b) sẽr̃ã-r̃ẽ 'pineapples-specifier'

Barasano:

23) (a) ɲãpi-ga 'to advance-round object'

(b) ʔitã-ŋã 'rock-round object'

24) (a) m̂baa-ya 'eat-imperative'
(b) kãnĩ-ỹã 'sleep-imperative'

25) (a) kĩ-kãnĩ-r̃ĩ 'he-sleep-question marker'
(b) kãnĩ-r̃ũku 'sleep-continuous action-adj.-nom.'
(c) kĩ-kãnĩ-ti-ri 'he-sleep-neg-question marker'

Unfortunately I have no Barasano or Tucano examples that show blocking of progressive nasalization by [b~m d~n]; these must be deduced from Stolte's description of progressive nasalization in Barasano and from the following categorization of suffixes provided by Welch(p.c). The list of suffixes that block nasalization includes the suffix /-mo/ 'conditional'. This means that [b~m] blocks progressive nasalization:[8]

26)

Tucano:

undergoers of nasalization		blockers of nasalization	
-a	'noun plural'	-kãti	'1 emphatic pst'
-wi	'1st pers visual past'	-ti	'negation'
-ya	'imperative'	-toya	'completive'
-re	'specifier'	-m̂bo	'conditional'
-ŋi	'msc.sg'	-sa	'indefinite'
-ŋo	'fem.sg'	-ti	'pres interrogative'
		-pari	'report interrotative'
		-pi	'1rst pers pst'
		-si	'1 recent emphatic pst'
		-pi	'3 msc report pst'
		-po	'3 fem pst'
		-paro	'1&2 inanimate report pst'

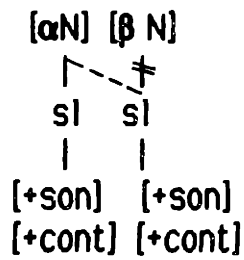
[8]A number of suffixes have underlying nasal vowels so they cannot be categorized as undergoers or blockers of nasalization e.g. -w̃ã '3 plur remote pst' -m̃ĩ '3 masc pres'. These suffixes may be added without any changes to an oral morpheme or to themselves: [tu?ti-m̃ĩ] 'scold-3 masc pres.' One suffix begining with a vowel is classed with the suffixes that do not nasalize: -apa 'future imperative'.

-ti	'definite future'
-ku	'msc formal'
-ko	'fem formal'

It is clear from the list in (26) that a suffix undergoes progressive nasalization only if it begins with a vowel, a glide, a liquid or [**g** ~ **ŋ**].
The behavior of [**g**~ **ŋ**] shows that it patterns with the [+continuant] sonorants in undergoing nasalization. I hypothesize that underlyingly [**ŋ**~**g**] is in fact continuant [**γ̃** ~ **γ**]. As a continuant [**γ̃**~**γ**] undergoes the deletion rule in (27) and the progressive nasalization rule shown in (28):

27) Deletion: [**γ̃** & **r**] [+sonorant, +continuant] --> ø /#__

28) Progressive nasalization:



At a later point in the derivation [**γ̃** ~ **γ**] becomes a stop, and this is the version which is transcribed: [**ŋ**] if nasal and [**g**] if oral. Alternatively, what we have been transcribing as [**γ̃** ~ **γ**] is not exactly a continuant sonorant but some sort of weakened sonorant stop; however, given that the feature [lenis] or [tense] is poorly documented and not yet understood, I have adopted the more conservative account in terms of the feature [continuant]. I note that it is not clear whether the weakened version of [**ŋ**] is a glide. If [**w**] and [**y**] are underlying phonemes, we must assume that the weakened version of [**ŋ**] is [+consonantal]. The reason is that unlike the weakened version of [**ŋ**], [**w**] and [**y**] can occur in word-initial position, so the deletion rule in (27) must be restricted to [+consonantal] segments. Welch&Welch(1967) assume without argument that [w] and [y] are phonemic. I do not have enough evidence about Tucano to determine whether the glides are phonemic or whether they derive from [u] and [i]. The glides [w] and [y] vary in pronunciation from no friction to light friction to (in the case of [y]) pre-stopped realizations.

3.2.2 Gokana [ŋ]

Like Tucanoan, Gokana (Ogoni) (Hyman (1982) Brosnahan(1964)) has [ŋ] and [r] in intervocalic and postvocalic position but not in initial position. Like Tucanoan [ŋ] Gokana [ŋ] fails to pattern with the stop sonorants [m] and [n] because [m] and [n] can appear in initial position and [ŋ] cannot. I hypothesize that this distribution indicates that [ŋ] is a continuant in Gokana. The segment inventory of Gokana is the following: labials /p, b, f, b~m, w/, coronals /t, d, s, l~n , y/, velars /k, ky, kp, g~ŋ, g, g͡y, g͡b, ŋ /, and vowels/ i, ĩ, u, ũ, ɛ, ɛ̃, ɔ, ɔ̃, a, ã, e, o/. The distribution of oral and nasal consonants is predictable from the distribution of oral and nasal vowels. Root initially, the following pattern holds:

29)

Before	oral vowels	nasal vowels	underlying form

b	**m**	**m**
l	**n**	**n**
g	**ŋ**	**ŋ**
v	**ŋ̃**	**w**
z	**ɲ**	**y**

The consonants in the first column cannot precede nasal vowels though other oral consonants may do so. The consonants in the second column cannot precede oral vowels. I will assume that the underlying phonemes are [**m n ŋ w y**], which become or remain oral before an oral vowel and become or remain nasal before a nasal vowel. The reason for this assumption is that it allows me to simplify the statement of a morpheme-structure condition that requires [**m~b n~l n~g**] to occupy the C_2 position of the cannonical root pattern $C_1V(V)(C_2(V))$ to the exclusion of all other consonants. --In this C_2 position we get [**b l g**] after oral vowels ([**v**, **ɣ̃**, **γ**] if a vowel follows) and [**m n ŋ**] after nasal vowels.[9] -- The condition simply states that C_2 must be underlyingly [+nasal]. Moreover, it can be shown that [**b d g**] are independent phonemes from [**m n ŋ**]. [**b**] can be followed by oral or nasal vowels:

30)

ba	'arm'
bã	'pot'
mã	'breast'

This means that [**m**] cannot be underlying [**b**]. Similarly, [**d**] and [**n**] can be shown to contrast in the following forms:

31)

[9]The realization of intervocalic [g~ŋ] varies. Hyman gives [g] between oral vowels; Brosnahan(1964) gives [γ].

dɛ̃m 'tongue'
nɜ̃m 'animal'

This means that [n] cannot be underlyingly [d]. Finally [ŋ] is not derived from [g] because [g] belongs to a series which does not alternate in nasality; namely, the series [g g͡y g͡b]. Thus, I conclude that underlyingly, the consonants [m~b n~l ŋ~g] are [m n ŋ].

Despite the fact that [m~b n~l ŋ~g] behave as a class in one instance, they do not pattern together word-initially: [m~b n~l] can be word-initial, but [ŋ~g] cannot. All word-initial [+consonantal +voiced] segments in Gokana are stops. Gokana has [ŋ] and [r] in intervocalic or postvocalic position but not in initial position. This distribution indicates that [ŋ~g] is a continuant (by contrast to underlying [g] which can appear in word-initial position: [gɑ̃nɑ̃gɑ̃] 'shoulder'). We can derive the distribution of [ŋ~g] as follows:

Gokana [ŋ~g] is underlyingly continuant [ɣ̃]. As a continuant [ɣ̃] is deleted in word-initial position by the rule in (32); it becomes a stop [ŋ] by the rule given in (33):

32) Deletion: [ɣ̃] [+continuant +voiced +consonantal]--> ø /#__

33) Stopping: [ɣ̃] [+continuant +back]--> [-continuant] [ŋ] /__ #

3.2.3 Gbe [ŋ]

[ŋ] patterns with continuants in Gbe(Ewe)(Westermann 1907, Capo 1981). The segmental inventory of Gbe(Ewe) is the following: labials /f v **b**~**m** w~w̃~ŋw̃/, coronals /t d **ɖ**~r̃~**n** c~ʃ ɟ~ʒ s z l r y~ỹ~ɲ/, dorsals /k͡p g͡b, χ ʁ χ͡w~ɸ~p ʁ͡w~β ɣ~ŋ / and vowels / i e ə ɛ a ɔ o u ũ ɔ̃ ɜ̃ ã ɛ̃ ə̃ ẽ ĩ/-- the consonants in bold script are so-called lenis and are poorly described.[10] I will be conservative and assume that they are underlyingly [+nasal] [**m** **n** ŋ]. According to Capo(1981) nasal consonants in Gbe derive when an oral consonant acquires the nasality of a following nasal vowel. This generalization is based on inter-dialectal evidence such as the following:

34)

súmɔ̃́	(Waci)	**súbɔ́**	(XOXOI)	'worship'
àɲĩ́	(Awlon)	**àyí**	(Fon)	'earth'
nĩ́nĩ́	(XOXOI)	**ɖìɖì**	(Waci)	'to slip'
ŋɔ̃́	(Gen)	**wɔ́**	(Agbome)	'to detect'
dã̀	(Gen)	**dà**	(Awlon)	'snake'
gbɔ̃̀	(Gen)	**gbɔ̀**	(Waci)	'to breathe'

That is, nasal consonants [**m** **n** ŋ w̃~ŋw̃ ỹ~ɲ r̃ l̃] occur only before nasalized vowels, and nasalized vowels do not occur after the oral consonants [**b** **ɖ**~r̃

[10] **Capo cites Dabuku(1977) as noting that Common Potou (lenis) /b/ generally develops to [b]~[m] in Gbe, but (fortis) /b/ develops to [g͡b]; Common Potou lenis /b/ also corresponds to Modern Potou [v]. Dabuku argues that Common Potou had a lenis/non-lenis opposition for three voiced and three voiceless stop articulations of which she discusses only the voiced and alveolar ones.**

ɣ w y r l] but may occur after other oral consonants. It is possible to set up a correspondence between the nasal consonants and those oral consonants that are not followed by nasalized vowels, namely:

35)

nasal	oral
m	ɓ
n	ɖ~r̆
ŋ	ɣ
w̃~ŋw̃	w
ỹ ~ ɲ	y
r̃	r
l̃	l

This correspondence is not accidental but shows a phonological peculiarity of the dialect cluster: the consonants under the nasal column and those under the oral column are in complementary distribution. Since the distribution of nasal consonants is entirely predictable from the distribution of nasal vowels, two solutions are possible: (1) nasal consonants are derived when the oral consonants in (35) acquire nasality from a following vowel. This implies that Gbe has no underlying nasal consonants (only vowels have a nasal vs oral contrast) and that the consonants that alternate in nasality are unified by an obscure feature [lenis] which is not well documented.[11] However, I will be conservative and

[11]This account appears to be contradicted by the fact that Gbe exhibits syllabic nasals [m̩ n̩ ŋ̩]. But syllabic nasals in Gbe can be argued to be underlying sequences of "lenis" /ɓ ɖ~r̆ ɣ/ plus /ə̃/ or /ɯ̃/. According to Capo, syllabic nasals arise in the following way (p.38): "Regularly in the phonology of Gbe, /ə/ or /e/ and their nasal counterparts are often elided when in contact with another vowel and may be properly called schwa, the function of which is tone bearing. Since any nasal consonant is potentially tone bearing, the schwa may be elided and the tone transferred to the nasal. In the case of /ɯ̃/, since it assimilates first the "created" nasal to the velar [ŋ], both segments have similar resonance and one of them may be elided. This is precisely what explains the

assume that (2) the alternating consonants are underlyingly [m n ŋ w y r l] and that oral vowels are capable of oralizing [m n ŋ] to [b ɖ ɣ] while nasal vowels are capable of nasalizing [w y r l] to [w̃ ỹ r̃ l̃]. Note that whereas the oral counterparts of [m n] are stops [b ɖ] the oral counterpart of [ŋ] is a continuant [ɣ]. This is to be expected if [ŋ] is phonologically a continuant in Gbe.

I hypothesize that the extraordinary behavior of [ŋ] in Tucanoan, Gokana, and Gbe is due to the tendency to weaken the occlusion of velars (oral and nasal) in intervocalic position, a tendency which has been generalized to include velars in pre-vocalic position as well. The fact that Aguaruna [ŋ] undergoes debuccalization more promptly than [n] and that Mandarin Chinese [ŋ] undergoes "absorption" more promptly than [n] may be attributed to the fact that the velar nasal is in intervocalic position and hence, prone to weakening processes which target velar consonants first.

---

free variation we sometimes get between [ŋũ] ~ (syllabic)[ŋ] ~ [wũ] ~ [ũ]." Capo's derivation of syllabic nasals is given below (C = oral consonant, N = nasal consonant; superscript indicates tone):

1: underlying representation α^{T}(CṼ)

2: regressive nasal assimilation α^{T}(NṼ)

ex: /ɖṹ/ 'thing' --> [nṹ]

3: velar assimilation when V is ũ α^{T}(ŋũ)

ex: /nṹ/ 'thing' --> [ŋṹ]

4: vowel deletion, syllabic nasal α^{T} (N)

ex: /ɔ̃/ deletes: /mɔ̃̀gbé/ 'back' --> /m̀gbé/

ex: /ũ/ deletes: /ŋũ̀ lé kɔ̀ / 'I turned back' --> [ŋ̍ lé kɔ̀] (~ [ũ̀ lé kɔ̀] ~ [wũ̀ lé kɔ̀])

5: homorganicity with the consonant of the following syllable

ex: /m̀gbé/ 'back' --> [ŋ̀gbé]

Normally /ɔ̃/ and /ɛ̃/ are the only nasal vowels that can delete to create syllabic nasals. But the stop occlusion of [ŋ] is acoustically weak and like [u] [ŋ] is [+high] [+back]; hence, the acoustic distinction between [ŋũ] and [ŋ] or between [ŋũ] and [ũ] is minimal. This similarity makes it possible for [ũ] to delete in position after [ŋ] or for [ŋ] to delete in position before [ũ]. In the former case, deletion derives a syllabic nasal; in the latter it derives a nasal vowel.

3.3 On the possibility that [N] might become [ŋ]

As I noted in the previous section, a major obstacle in comparing the susceptibility of coronal and velar nasals to debuccalization and "absorption" is the fact that velar nasals are acoustically quite similar to place-less nasals. This acoustic similarity might have led to incorrect transcriptions of [N] as [ŋ]. On the basis of this acoustic similarity, Guitart(1981) argues that there probably exist velarization processes whereby [N] becomes [ŋ]. This means that it is not always possible to determine if the velar nasals which alternate with vowel nasalization (**Vŋ** ~ **Ṽ**) are underlyingly [ŋ] or [N]. The fact that in certain "velarizing" dialects of Spanish (Guitart 1981) [ŋ] and [N] are in free variation: **[aNsia]** ~ **[aŋsia]** **/ansia/** does not necessarily mean that [ŋ] is debuccalizing to [N]. Recall that it has often been assumed (e.g. Cedergren&Sankoff(1976)) that the development of nasal "absorption" in Spanish follows the pathway **m** > **n** > **ŋ** > **Ṽø** because nasalized vowels alternate with vowel + [ŋ] sequences: Lat. adam --> Standard Spanish: adan --> Caribbean Spanish: **adaŋ** --> Panamanian Spanish: **adã**~ **adaŋ** "Adam" (S 4.2.3). However, if velarization is not necessarily a step towards deletion this derivation is called into question. Perhaps the derivation is as in (36):

36)

```
          ∅
        ↗
m > n > N
        ↘
          ŋ
```

Despite the ambiguity between [ŋ] and [N] there is no question that nasal "absorption" and debuccalization in Mandarin Chinese and Aguaruna involve underlying [ŋ], not underlying [N]. Aguaruna [ŋ̃] is underlyingly [+consonantal] [ŋ] (not [ɰ̃] or [N]) because it blocks the spread of nasalization like any other [+consonantal] nasal (see § 4.2.1). Mandarin Chinese [ŋ] is also underlyingly [ŋ] and not [N]. Chen(1973) reconstructs Middle Chinese as having oral and nasal morpheme-final stops at the labial, coronal and velar points of articulation and Mandarin Chinese [ŋ] corresponds to [ŋ] in other dialects of Chinese.

In the following sections I will discuss a number of languages where place-less segments undergo velarization, in confirmation of Guitart's(1981) hypothesis. Velarization can be analyzed as a two step process involving debuccalization and velar-insertion. The argument for this two step analysis is that velar insertion is a context-free redundancy rule which place-less segments tend to undergo irrespective of their position in the syllable. By contrast debuccalization is typically undergone by segments in coda position as discussed in (§ 5.1).

3.3.1 Uradhi

An example of a velarized laryngeal occurs in Uradhi (Hale 1976). Uradhi has a rule of coronalization and a rule of velarization applying to distinct utterance-final segments. Coronalization applies to utterance-final (and word-final) consonants; velarization applies to utterance-final laryngeal glides. The consonants and vowels of modern Uradhi are as follows: labials /p b m w/, coronals /t t͡h d͡h t͡j n n͡h n͡j l r ṛ y/, dorsal /k g ŋ/, and vowels /i u e a/--the letter /j/ indicates centro-domal articulation; the letter /h/ indicates lamino dental articulation; the symbols /b dh g/ represent voiced fricatives, not voiced stops; /e/ represents a schwa-vowel, which may or may not be phonologically distinct from /a/ in Uradhi.

Uradhi has a rule that coronalizes word-final consonants. This rule is inferred from distribution, as there are no alternations: word-final [+consonantal] segments are predictably coronal [t~n] --as for [-consonantal] segments, final Paman [*l *r] have become [w y] respectively and final rolled [*r] has become flapped [ṛ] or [t] in Uradhi. Final [t] appears if the first consonant to the left is oral and [n] appears it the first consonant to the left is nasal. The symbol ' after a segment indicates lack of release:

37)

ute-n --> utét' 'cut-past'
un͡je-n --> uɲYén 'eat-past'
ante-n --> andét' 'put-past'
aɲe-n --> aɲen 'dig-past'

In addition to coronalization, Uradhi exhibits velarization: utterance final vowels and glides are terminated rather energetically with a constriction in the velar region; this constriction is oral if the first consonant to the left is also oral, and nasal if the first consonant to the left is nasal:

38)

yuku --> yukuk' 'tree'
ipi --> ipik' 'water'
ama --> amaŋ 'person'
ani --> aniŋ 'what'

The mystery to be explained is why utterance-final vowels add [**k'**] and not [**t'**], since it is clear that coronal consonants are favored in final position. A possible account is that utterance final [**k'**] is a velarized laryngeal glide [? or **h**]. On this view Uradhi has a rule which adds a laryngeal glide after utterance-final vowels, a rule which is frequently attested in other languages. For example, in Yucatec Mayan utterance-final vowels receive a final laryngeal spirant [**h**]:

39) Laryngeal Insertion (Straight:1976:71):

v --> v**h** / ___ $]_{utterance}$

ʔu k'áat u kaŋ kàasteyàano --> **ʔu k'áat u kaŋ kàasteyàanoh**
'he wants to learn Spanish'

A similar rule adds [**h**] to utterance final vowels in the Tucanoan languages (see Welch&Welch(1967:18)). By analogy it is plausible to assume that Uradhi adds [ʔ] in the same environment; this [ʔ] velarizes and becomes [**k'**]:

40) **ipi** --> **ipiʔ** --> **ipik'** 'water'

Since [ʔ] is a glide, I assume that the velar-insertion inserts appropriate stricture features in this and similar cases presented below. Although the output of velarization often agrees with the original consonant in terms of stricture, this is not always the case (e.g. velarization in Polish produces glides).

The velarization of laryngeals is not an unusual phenomenon. Russian or Castilian Spanish speakers replace English [**h**] by dorsal [**x**] or [**χ**](velar or uvular): **[xamilton] /hamilton/** ; **[xam] /ham/**. Guitart(1981) has suggested that the replacement of laryngeals [**ʔ h**] by velar [**k x**] is triggered by an acoustic similarity between laryngeal and dorsal segments (the speakers that replace English [**h**] by [**x**] speak languages whose phonemic inventories lack [**h**] but have [**x**]). This is a clear instance of velarization of a place-less segment because laryngeal glides lack place features. I should note that unlike velar insertion, coronalization processes appear never to target place-less segments such as laryngeals [**ʔ** or **h**]. Cross-linguistically, the unmarked point of articulation for [+consonantal] segments is coronal: CORONAL is the universally unmarked stop and fricative ("A language with any nasals has [n]" : Maddieson(1986:69); "If a language has [p] then it has [k], and if it has [k] then it has [t]" : Maddieson(1986:40); "...in languages which have one fricative, it is overwhelmingly probable that that single fricative will be a voiceless dental or alveolar sibilant" : (Maddieson(1986:52)). We may therefore hypothesize that coronalization is motivated by considerations of markedness (i.e. articulatory simplicity or perhaps maximal acoustic efficiency). An example of coronalization occurs in the Taiwanese secret language reduplication (Yen-hwei Lin 1988, Jen-kuei Li 1985). The examples in (a-d) show coronalization of labials and velars [**m ŋ p k**] to coronals [**n t**] in the final position of the rightmost copy of the root; example (e) shows that the glottal stop [?] fails to coronalize:[12]

41)

a. **t'iam t'iam** -->(coronalization) **t'iam t'ian** -->(other rules)[**liam t'in**] 'tired'
b. **t͡sap t͡sap** -->(coronalization) **t͡sap t͡sat** -->(other rules)[**lap t͡sit**] 'ten'
c. **hɔŋ hɔŋ** --> (coronalization) **hɔŋ hɔn** -->(other rules)[**lɔŋ hin**] 'wind'
d. **pak pak** --> (coronalization)**pak pat** -->(other rules) [**lak pit**] 'north'
e. **pia? pia?** -->(coronalization)**pia? pia?**(other rules) [**lia pi?**] 'wall'

It is possible that the exceptional behavior of the glottal stop in this language is not accidental. Since I know of no example where coronalization applies to laryngeal glides, I will assume that coronalization is restricted to [+consonantal] segments, whereas velar insertion is free to target [-consonantal] segments. Such a view harmonizes with the idea that vowels, being [-consonantal], are predictably dorsal, not coronal. I leave this issue open.

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[12]I note that in the related Cantonese secret language only labials coronalize, while velars remain velar. Thus in Cantonese fuŋ fuŋ --> luŋ fiŋ 'wind'; pak pak --> lak pik 'north'. Chen's(1973) investigation of syllable attrition in Chinese dialects indicates that in the vast majority of cases, velars do not coronalize in final position.

3.3.2 Murut

Another instance of velarization of a place-less segment (an empty timing slot or perhaps an [h]) occurs in Murut(Prentice 1971). The velarized X-slot can be in inter-vocalic, initial or pre-consonantal position, indicating that velarization in Murut is context free. This language has the following phonemic inventory: labials /p b m w/, coronals /t d n s d͡z l y/, dorsals /k g ŋ /, vowels / i u o a/ , and laryngeal /ʔ/. Voiced stops [b d g] are continuant [β ř ɣ] after vowels, glides, heterorganic voiced stops and [ʔ]. After homorganic voiced stops, they vary between stop and fricative; after other consonants and initially, they are stops. The manifestation of [g] varies from dialect to dialect, ranging through [ɣ] and [x] to [h]. [d͡z and ʔ] have limited distribution: [d͡z] cannot occur finally in morphemes and words; [ʔ] can only occur finally in morphemes and words.[13]

A morphological operation requiring the velarization of an empty timing slot in Murut is reduplication. There are various reduplication operations in Murut. I will not discuss exactly how reduplication takes place since this is not the issue here. Instead I simply note that the most common type of reduplication appears to copy the first CV sequence of the

[13]The irregular distribution of [ʔ] may be significant. The analysis of velarization proposed in the text allows one to derive the distribution of [ʔ] as follows: [ʔ] velarizes whenever it is not in final position. This derivation is made plausible by the fact that the manifestation of [g] varies from dialect to dialect, ranging through [ɣ] and [x] to [h].

root. If the root begins in a vowel, a "prothetic" voiced velar consonant is inserted and reduplicated:

42)

bulud --> **bu-βulud** 'ridges in which tuberous crops are planted'
insilot --> **gi-γinsilot** 'toothpick'

The "prothetic" velar consonant shows up in other types of reduplication as well. There is a type of reduplication in Murut which appears to copy the first CV sequence that follows the first syllable of the word. If what follows the first syllable of the word is a vowel, a "prothetic" velar consonant is inserted and reduplicated:

43)

/**ulampoy**/ --> (**u**)**lampoy** --> (**u**)-**la-lampoy**	(no gloss provided)
/**i-ŋ-dimo**/ --> (**in**)**dimo** --> (**in**)-**di-řimo**	'about five times'
/**i-baŋkay**/ --> (**i**)**βaŋkay** --> (**i**)-**βa-βaŋkay**	'plays dead'
/**i-abas**/ --> (**i**)aβas --> (**i**)-**γa-γaβas**	'(swimmer) floats'

This "prothetic" consonant can be analyzed as an empty timing slot which undergoes a velar insertion rule, as often happens to such objects:

44)

Velar insertion: ø --> place
                         |
                      dorsal
                         |
                     [+back]

The empty timing slot is added to satisfy some condition requiring the original and the copy of a reduplicated morpheme to begin with an onset.[14]

Empty timing slots are inserted in a variety of other morphological contexts in Murut. Like the "prothetic" consonant of reduplication, these empty timing slots are pronounced as velar consonants [g] or [ŋ] whenever they do not assimilate the place features of a neighboring consonant. In the verbal and nominal morphology an empty timing slot (X) is affixed between prefix and root:

45) prefix - X - root

The addition of the empty timing slot is conditioned at least in part by the roots. For example, the timing slot is not usually added before borrowed roots. The presence vs. absence of the timing slot changes the meaning of the expression in subtle ways; differences in meaning are also achieved by specifying the timing slot [+nasal] or [-nasal]. This is most evident in the verbal morphology, where the timing slot may be oral or nasal after the prefix /**ma**-/ 'FT aspect' or after the prefix /**pa**-/ 'caus. mode'. The empty timing slot surfaces as velar unless it assimilates the point of articulation from a neighboring consonant.

46)

pa-ɣ-andu-a-n	'caus.mode-trans.stat.mode-marry-A.focus-FT.asp'
pa-ŋ-iŋ-iřu?	'caus.mode-trans.dyn.mode-I.focus-remove'
pa-ɣ-ally-i-n	'caus.mode-trans.instr.mode-exchange-R.focus-FT.asp'
pa-ŋ-inuy-i-n	'caus.mode-trans.stat.mode-allude-R.focus-FT.asp'

[14]If the CV sequence to be reduplicated follows the morpheme /ta-/ the "prothetic" consonant is always [l]. "Prothetic" [g] ~ [ɣ] appears if the preceding string of morphemes contains no consonant.

ma-ɣ-asa?	'FT asp-trans.stat.mode-sharpen'
ma-ŋ-andu	'FT asp-trans.dyn.mode-marry'

Before consonant initial roots, the empty timing slot surfaces as a homorganic nasal (see examples (47)(j-k); Prentice(1971) provides no examples with root initial glides). The timing slot deletes if the root initial consonant is nasal (example (47)(h)):[15], [16]

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[15]The timing slot also deletes if the root already contains a nasalized geminate cluster: me-ø-tumbuk 'FT asp-reflexive-thump' so-ø-yongom 'one fistful' ta-ø-pumpu 'S comes into bud'. Murut has a structure constraint that prohibits the creation of more than one prenasalized geminate cluster per word (any two consonants may occur adjacently if separated by a word boundary). Morphemes and words in Murut cannot have heterorganic consonant clusters but homorganic consonant clusters are permitted. These are of two types: oral geminate clusters and prenasalized geminate clusters. Oral geminate clusters [pp bb tt dd kk gg] are optionally produced by word concatenation: [maŋúřař řasúliɣ] or [maŋúřad dasúliɣ] 'will scrub the floor'. They are also produced by an optional process of vowel syncope applying in sequences such as $C_1V_2C_1V_2$ --> $C_1C_1V_2$ and occasionally in sequences such as $C_1V_2C_1V_3$ --> $C_1C_1V_3$: [ǵitio řiřun] or [ǵitio ddún] 'this is yours'. Prentice does not mention how many oral geminate clusters are allowed per word. Prenasalized geminate clusters [mp mb nt nd ns ŋk ŋg] occur morpheme internally in intervocalic position; never initially or finally: ampu 'leopard-cat' ambay 'mistress' onto 'smell of burnt rice' punsu 'anthill' baŋkay 'corpse'.

[16]The following are some facts which remain to be explained. In some verb paradigms, if a verb root begins in a consonant it cannot prefix an empty timing slot directly but interposes the syllable /-pa-/: prefix - X - pa - C-initial.root

a. ma-ɣ-asa?		'FT asp-trans.stat.mode-sharpen'
b. ma-p-pa-latok	--> ma-m-pa-latok	'FT asp-trans.stat.mode-mix'
c. ma-ŋ-andu?		'FT asp-trans.dyn.mode-marry'
d. ma-m-pa-lopot	--> mo-ma-lopot	'FT asp-trans.dyn.mode-wrap'

Note that the empty timing slot velarizes in example (a). In example (b) it assimilates the place features of the intermediary /-pa-/ syllable and prenasalizes to [m]. Examples (c) and (d) show analogous examples with a nasalized timing slot. Example (c) shows velarization of a place-less segment just like example (a). Example (d) is more complex: the place-less nasal seems to "merge" with [p] and derives a single nasal with the place of articulation of [p]. I have no explanation for this fact. If the root begins in a voiceless consonant or in a labial consonant "syncope" applies to the vowel of the intermediary /-pa-/ syllable. The resulting cluster surfaces as pre-nasalized and homorganic to the rightmost consonant. The following are two examples with an oral and a nasal timing slot: ma-p-pa-tutu --> ma-n-tutu 'FT asp-trans.stat.mode-pound'; ma-m-pa-baya? --> ma-m-baya? 'FT asp-trans.dyn.mode-follow'.

47)

a. **so-ŋ-oɣow** 'one day'
b. **sa-n-taun** 'one long cylindrical thing'

c. **ta-ŋ-ama?** 'S treats O like a father'
d. **ta-n-sapul** 'S carries a blowpipe'
e. **ta-m-puta?** 'S foams at the mouth'
f. **ta-m-basikol** 'S rides a bicycle'

g. **i-ŋ-gomon** 'six times'[17]
h. **i-ø-malayu** 'S speaks Malay'

i. **ma-ɣ-andu** 'FT asp-reflexive-marry'
j. **ma-d-dulug --> ma-n-dulug** 'FT asp-reflexive-sleep'
k. **ma-g-gayo --> ma-ŋ-gayo** 'FT asp-reflexive-rises'

If consonant insertion in Murut were directly inserting a supraglotally articulated consonant we must explain why a velar consonant is inserted rather than the universally unmarked coronal consonant. The question is especially urgent in the case of the insertion of [ŋ] since the velar nasal is cross-linguistically more marked than the labial or coronal nasals (§ 5.2). The Murut data suggests that [ŋ] is created by the velarization of a placeless segment rather than by a rule inserting this marked segment.

[17] The root is underlyingly /onom/ but acquires a "prothetic" empty consonant which also velarizes.

3.3.3 Chukchi

A language where velarization might be effected in two steps (debuccalization and velar-insertion) is Chukchi (Odden1988)[18]. The surface consonant inventory of Chukchi is that given in (48):

48)

p	t	k	q	?	voiceless stop
	č				voiceless affricate
	ɬ				voiceless fricative
m	n	ŋ			nasal
	r				voiced sonorant stop
(w)	y	ɣ(w)			voiced continuant

The glide [w] acts both like a labial and a velar and the glide [y] acts as a member of the class of coronal consonants. The velarization applying in Chukchi is the following: the coronal glide [y], surfaces as [ɣ] in position before a coronal consonant as the following examples show:

49)

w?ey-ək	'grass'	**w?eɣ-tɬ**	'grasses'
ŋin-qey	'boy'	**ŋen-qaɣ-čəŋ-ən**	'big boy'

[18]**The analysis of Chukchi consonants to be presented here owes a great deal to Odden. Any divergences between Odden's analysis and mine are mentioned explicitly. Primary data on Chukchi are available from Skorik(1961) and Bogoras(1922); generative analyses of Chukchi phonology are available in Krause(1980) and Kenstowicz(1986).**

čay	'tea'	**čay-nalk-ək**	'to make tea'
qey-we	'correct'	**qey-lənanyet**	'truth'
qwyəqey	'nestling'	**qay-ya?yaq**	'young seagull'

Following Odden, I analyze this process of coronal dissimilation as a two step process involving (a) debuccalization and (b) velar insertion:

50) (a)

```
                              [-cons]
                                 :
Coronal debuccalization:  place ---> ø / ___  place
                                 |              |
                              coronal        coronal
```

51) (b)

```
Velar insertion: ø --> place
                         |
                       dorsal
                         |
                       [+back]
```

where velar insertion is a context-free process usually undergone by placeless segments (e.g. laryngeal glides, empty X-slots) independently of their position in the syllable. This analysis predicts that, cross-linguistically, coronal dissimilation (via debuccalization) should yield laryngeals or (if velar insertion applies) velars and should rarely, if ever, yield labials or palatals. For example, the historical evolution of Romance languages has led to the formation of intrusive stops in position between certain consonants and liquids as shown in table (5) (facts from Clements 1987):

52)

C2	=		**r**	**l**
C1	=	**s**	**str**	**skl**
		z	**zdr**	-

m	**mbr**	**mbl**
n	**ndr**	**ngl**
l	**ndr**	-

I will not discuss how intrusive stops are formed since this is not the issue here. Rather, I will limit my observations to the fact that the point of articulation of the intrusive stop is predictable: it is the same as the point of articulation of the preceding consonant except in the case of intrusive stops arising between coronals and laterals which are always velar [**k**] or [**g**]. I will follow Clements' hypothesis that the velarization of intrusive stops is due to a phonotactic constraint disallowing laterals after coronals (***tl** ***dl** ***nl**). The phonotactic contraint can be viewed as a filter that blocks the derivation of the starred sequences; alternatively, it can be viewed as resulting from a special debuccalization rule which delinks the place features of a coronal consonant in place before [**l**] (the process may be understood as a dissimilation on the assumption that [**l**] is coronal cf. Levin (1988)):

53) Romance debuccalization:

```
place --> ø /    σ[__ [+lateral]
  |
coronal
```

The intrusive coronal stops which loose their place features undergo velarization much in the same way that dissimilated (i.e. debuccalized) coronals undergo velarization in Chukchi. The fact that coronal dissimilation leads to the creation of velar segments is not a coincidence if coronal dissimilation involves debuccalization and if velar insertion is a process that place-less segments tend to undergo.

3.3.4 Spanish

We saw from the behavior of [m n] in Japanese that [n] is prone to debuccalization whereas [m] resists it. If velarization involves debuccalization+velar insertion, then [n] should velarize more promptly than [m]. Chen(1973)'s scheme of syllable final attrition in Chinese (§ 2.0), shows that labial stops (oral or nasal) do not velarize unless they coronalize first. This hierarchy can be seen in Spanish:

Two facts of the "velarizing" Spanish dialects indicate that coronals velarize more promptly than labials: (1) All word-final [n]'s velarize, whereas word-final [m]'s do not (at least they do so only in fast speech and in the speech of some individuals only); (2) Coronalization precedes word-level affixation and re-syllabification, whereas velarization follows these processes. This means that in the synchronic derivation coronalization precedes velarization; so, [m] cannot velarize directly: Latin [adam] becomes "velarizing" Spanish [adaŋ] through an intermediate stage [adan]. "Velarizing" Spanish dialects are spoken in and around the Caribbean basin. I follow Harris(1984)'s account of standard Spanish dialects but will include data from my own "velarizing" dialect (Puerto Rican Spanish) which differs minimally from Cuban Spanish(Guitart 1981).

Standard dialects neutralize nasals in final position to coronal. With a few exceptions such as **[album]** 'album' and **[cataplum]** 'crash', a word-final nasal is predictably **[n]**. The phonemic inventory of these dialects (e.g. Castilian) is labial /**p f β**[19] **m**/, coronal /**t s θ δ n l** t͡ʃ **ɲ λ**[20] **r ʀ(trilled)** /, and velar /k χ γ/. The following examples show an instance of the coronalization process:

54)

[desden] 'disdain' **/desdeɲ/** (cf: **[desdeɲ-ar]** 'disdain-verbalizer')
[čampan] 'champaigne' **/čampaɲ/** (cf: **[čampaɲa]** variant of **[čampan]**)

Coronalization affects not only nasals but laterals as well. Final palatal **[λ]** becomes **[l]**: **[e λ a]** 'she' **vs [el]** 'he'; **[donse λ a]** 'lass' **vs [donsel]** 'lad' ; **[deta λ ista]** 'retailer' **vs [detal]** 'retail' (new lexical item).

Nasals and laterals neutralize in place before consonants. Laterals coronalize before another consonant: **[be λ o]** 'beautiful' **vs. [beldad]** 'beauty'. If an obstruent follows a nasal in standard dialects, the nasal acquires the place features (but not the continuancy) of the following obstruent (data from Harris(1984)):

---

[19] **I assume /β δ γ/ are unspecified for continuacy following Lozano(1979).**

[20] **The realization of the palatal sonorant stops in Spanish varies from dialect to dialect. In a number of dialects palatal nasals and laterals are doubly articulated both coronal and dorsal(high)-- palatal nasals and laterals are pronounced with the tip of the tongue touching the hard palate. In other dialects /λ/ and /ɲ/ are exclusively dorsal(high)-- are pronounced with the tip of the tongue touching the root of the lower front teeth. The cross dialectal developement of the palatal lateral /λ/ suggests that /λ/ was doubly articulated coronal-dorsal at least in some standard dialects where /λ/ has developed into coronal [ʒ] or [ʃ].**

55)

/n/	/m/	/ɲ/	
in-util	**presum-o**	**tiɲ-e**	'useless' 'I presume' 'he dyes'
im-pio			'impious'
iɱ-finito			'infinite'
in̪-digno	**presun̪-to**	**tin̪-te**	'undignified' 'presumed' 'dye'
in-seguro	**presun-sion**		'insecure' 'presumption'
iŋ-kapaθ			'incapable'

Unlike nasals, laterals do not acquire the place of articulation of a following obstruent: **[alkalino]** 'alkaline' **[alpes]** 'Alps'. I conclude that laterals neutralize to coronal in coda position and that nasals do the same unless they assimilate the point of articulation of a following segment.

Velarizing dialects neutralize final nasals to **[ŋ]**: **[desdeŋ]** 'disdain' **/desdeɲ --> desden --> desdeŋ/**. Labial nasals that failed to coronalize in standard Spanish do not velarize regularly in the "velarizing" dialects. Thus words like **[album]** **'album'** which fail to coronalize undergo velarization in fast speech only, in the speech of some individuals: **[albuŋ]**. The phonemic inventory of these dialects (e.g. Cuban) is labial **/p f β m/**, coronal **/t s ð n l t͡ʃ ɲ ʎ**[21] **r ʀ(trilled)** /, and velar /k **χ** ([h]) ɣ /. As in standard dialects nasals in "velarizing" dialects acquire the point of articulation of the following stop (the strong coronal vibrant **[ʀ]** and the liquid **[l]** also spread their point of articulation, but they do so optionally). Continuants do not trigger place

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[21]**See footnote (20).**

assimilation, nor does the laryngeal glide [h] (underlying [χ] or [h] ?); before these we get [ŋ]:

56)

/n]	/m/	/ɲ/	
in-util	**presum-o**	**tiɲ-e**	'useless' 'I presume' 'he dyes'
im-pio			'impious'
iŋ-finito			'infinite'
in̪-digno	**presun̪-to**	**tin̪-te**	'undignified' 'presumed' 'dye'
iŋ-seguro	**presuŋ-sion**		'insecure' 'presumption'
iŋ-kapaθ			'incapable'
before strong /r̄/: onr̄a			'honor'
before /l/: enlasar			'to link'
before [h]: aŋhel			'angel'

As in the standard dialects, there is a coronalization rule acting in the "velarizing" dialects: the behavior of palatal liquids is the same as that exhibited in standard dialects; nasal consonants neutralize to [n] before word-level suffixes (e.g. /**-es**/ 'plural'):

57) /**desdeɲ**/ -->(resyllabification) **des.de.n-es** 'disdain-plural'

Note that the [ɲ] does not become [ŋ]. This has to do with the fact that the plural affix begins in a vowel. Some constructions are optionally analyzed as involving word-level affixation. The prefix /**san**-/ 'saint' is a clitic-like element which is optionally analyzed as a word-level affix. When this happens, the [n] of /**san**-/ does not become [ŋ] either:

58) /**san-antonio**/ -->(resyllabification) **sa.nan.to.nio** 'St. Anthony'

These facts suggest the following account: In "velarizing" Spanish dialects, velarization and coronalization target coda nasals, but they do so at different stages in the derivation. Velarization does not apply to the nasals in [**desdenes**] or [**san antonio**] because they are in onset position at the relevant stage in the derivation. In the case of [**desdenes**] the nasal undergoes coronalization and changes from [**ɲ**] to [**n**] because coronalization is ordered before word-level affixation and syllabification as shown below:

59) /**desdeɲ**/ --> (coronalization) **desden** --> (word-level affixation; re-syllabification)**des.de.n-es** --> (velarization does not apply) [**des.de.n-es**] 'disdain-plural'

The ordering coronalization --> velarization is the one predicted by Chen(1973)'s scheme of syllable final attrition in Chinese (§2.0). The ordering basically derives the fact that [**m**] resists direct velarization and velarizes by becoming coronal first. I noted above that one way of accounting for the behavior of [**m**] and [**n**] in Japanese is by assuming that [n] is prone to debuccalization whereas [**m**] resists it. This hierarchy also derives the fact that [**n**] velarizes more promptly than [**m**] (assuming that velarization is debuccalization+velar insertion).

An interesting question regarding the analysis of velarization as involving debuccalization+velar insertion is the relation between the velarization of nasals and the debuccalization of [**s**] in the "velarizing" Spanish dialects. "Velarizing" dialects are also "aspirating" dialects: they debuccalize coda [**s**] to [**h**]. Like nasal velarization, this rule is ordered after word-level morphology and re-syllabification:

60)

tos -->(debuccalization)[**toh**] 'cough'
desdeɲ --> (velarization) [**desdeŋ**] 'disdains'

tosko --> (debuccalization)[**tohko**] 'not delicate'
anhel --> (velarization) [**aŋhel**] 'angel'

tos-->(word-level affixation, re-syllabification) **to.s-es** -->
(debuccalization n/a morpheme-final [**s**])[**toseh**] 'cough-plural' not
*[**toheh**]
tren --> (word-level affixation, re-syllabification) **tre.n-es** -->
(velarization n/a to morpheme-final [**n**]) [**treneh**] 'train-plural' not
*[**treŋeh**]

If velarization involves debuccalization, it is not clear how to collapse the debuccalization of [**n**] and the debuccalization of [**s**] without including other coronals segments which do not debuccalize (i.e. [**r l δ**] which are the other segments occurring in coda position). Clements(1988) has proposed that nasals and obstruents can form a natural class in contraposition to liquids and glides and classifies the former as [-approximant] and the latter as [+approximant]. On this view the two debuccalization rules can be unified to:

61)

Debuccalization: place --> ø / [___]coda
:
[-approximant]

I should note here that there are some "velarizing-aspirating" Spanish dialects (e.g. Maracaibo dialect of Venezuelan Spanish: Guitart 1981) that velarize [**h**] (including [**h**] < /**s**/) to [**x**]: [**ehte**] ~ [**exte**] /**este**/. In fact all coda consonants velarize in this dialect. The consonants which are velarized in words like [**oksekio**] /**obsekio**/ and [**exte**] /**este**/ always alternate with the place-less segments [? **h**]: **[o?sekio]** ~ **[oksekio]** **/obsekio/**. One possible interpretation of this fact is that coda consonants velarize first and debuccalize second. But most "velarizing-aspirating" dialects do not velarize coda obstruents and there is no record that [**s**] ever velarized to [**x**] before becoming [**h**] in these dialects. This suggests that in Maracaibo Spanish [**s**] becomes [**h**] (as in the other "velarizing-aspirating" dialects) and in addition, [**p t k**] become [?]. Then [**h** ?] optionally become [**x k**]. This argument is due to Guitart(1981).

3.3.5 Polish

There are three processes of labio-velarization in Polish(Czaykowska-Higgins(1988)). Two affect a nasal in position before certain continuant consonants; another affects the [+back] (dark) lateral [**ɫ**]. Let us study these in order. Nasal stops become [**w̃**] as follows:

62) [**m**] becomes [**w̃**] before labial continuant obstruents [**f**] and [**v**].

Examples:

[**m**] --> [**w̃**] in:

tryuw̃f	'triumph'
taw̃ valow̃	'they are banging there'

compare with: **zvartym šereg'em** 'in close order'

63) [**n**] becomes [**w̃**] before all continuant obstruents [**f v s z x š ž**][22]

[**n**] --> [**w̃**] in:

kow̃flikt 'conflict'
sew̃se 'sense, loc.sg'

Two labio-velarization rules seem to be active above: one applies to [**m**] in position before a homorganic continuant obstruent; the other applies to [**n**] before a continuant obstruent of any point of articulation. It is unlikely that the two labio-velarization processes can be collapsed to one since their environments are different.

A third rule of labio-velarization involves the [+back] lateral [**ɫ**](which contrasts with the [-back] lateral [**l**] (see Czaykowska-Higgins(1988)). In position following or preceding front segments dark [**ɫ**] is pronounced as a [-back] [**l**] or [**l'**]; in all other environments, i.e. in position before or after back or low segments dark [**ɫ**] surfaces as the labio-velar glide [**w**]:

64)

/**ɫ ap-a**/ --> [**wapa**] 'paw'
/**kʃtaɫt**/ --> [**kʃtawt**] 'shape', [**kʃrawćić**] 'to form'
[**škole**] 'dat-loc.sg.' vs. [**škowa**] 'shool n.sg.' [**škuw**] 'g.pl'
[**b'jal'i**] 'm.n.pl' vs. [**b'jawy**] 'white, n.sg'

---

[22]**The behavior of the pre-palatal nasal parallels that of the coronal nasal but the picture is complicated by a process whereby the pre-palatal nasal splits into a palatal part and a coronal part. For a detailed account of splitting see Czaykowska-Higgins(1988). It must be mentioned that a nasal glide derived from [m] or [ñ] may become [-back] [ỹ] depending on the palatal quality of the preceding consonant(s) and vowel. For examples see Czaykowska-Higgins(1988).**

Following Czaykowska-Higgins(1988) I will assume that [ɫ] in underlying representations is not a labiovelar glide which is later specified as a lateral since, in Polish, underlying [**w**] surfaces as a labial fricative, [ƒ] or [**v**], whereas [ɫ] never does. I conclude, then that [ɫ] labio-velarizes to [**w**] in all positions unless it has previously fronted to [**l**] or [**l'**] in the context of a front segment.

It is possible to derive these nasal and oral [**w**]'s mechanically by three special rules that glide, back and round sonorants in various positions. However this approach misses the generalization that the three rules yield labio-velars, and that the labio-velarization process is context-free (dark [ɫ] labio-velarizes in onset as well as in coda position). Following the assumption that universally predictable and context free processes are redundant, I will extract the common denominator of the three processes, i.e. the velar insertion, and set it up as a separate process. Following Czaykowska-Higgins(1988) and references cited there, I will assume that the feature [round] is redundant for [+back -low -consonantal] segments in Polish. The common denominator of the above said processes can be expressed as two rules:

65) Velar insertion:

```
ø --> place
        |
      [+back]
```

66) Rounding: [+back, -low, -consonantal] --> [+round]

Since place-less [-consonantal] segments are the usual targets of velar insertion as shown in preceding sections, I shall assume that at the point in the derivation when velar insertion applies [m n] and dark [ɫ] are place-less glides. In other words these segments debuccalize as follows:

67) Lateral debuccalization:

```
 [+lateral]
    :
place --> ø
 /  \
COR DORSAL
      |
    [+back]
```

68) Coronal nasal debuccalization:

```
 [+nasal]
    :
place --> ø / ___ [+continuant -sonorant]
   |
CORONAL
```

69) Labial nasal debuccalization:

```
 [+nasal]             [+continuant -sonorant]
    :                     :
place --> ø / ___ place
   |                      |
LABIAL                LABIAL
```

There are two points of interest regarding these rules. The first concerns the debuccalization of the lateral. Debuccalizing [l] leads to the loss of laterality because debuccalization causes the loss of stricture distinctions and I assume [lateral] is a stricture feature (see § 1.1). Note also that the rule of lateral debuccalization requires its target to be [+back] and does not apply to laterals that have been fronted next to a front segment. The second point of interest is that the three debuccalization rules trigger a change in stricture from stop: [ɫ **m n**] to glide [**w̃**]. This is reminiscent of debuccalization in Japanese, which also produces [-consonantal] segments and supports the hypothesis that debuccalization leads to the loss of stricture distinctions as proposed in (§ 1.1) (I have assumed to this point processes velarizing [**N ? h**] result in a stop or fricative only if the appropriate stricture features are inserted: see § 3.3.1).

For the sake of completeness I note that Polish distinguishes four types of nasal segments: a coronal nasal stop; a pre-palatal nasal stop; a labial nasal stop, and a labio-velar nasal glide (which must follow a mid vowel).[23] The existence of the labio-velar nasal glide is evident in word-final position, where nasal glides contrast with nasal stops:

70)

ton	'tone'	**sen**	'dream'
toń	'depth'	**śeń**	'vestibule'
tom	'volume'	**ps+em**	'dog, instr.sg'
tow̃	'this, instr.sg.'	**śew̃**	'reflexive'

[**m n w̃**] exhibit distinct behaviors before another consonant. Word-internal [**n**] obligatorily assimilates the point of articulation of a following labial stop; optionally, [**n**] assimilates to a following stop, irrespective of place of

[23] The orthography of Polish distinguishes two nasal vowels ę =[ę] and ą =[ǫ] in addition to six oral vowels 'i ~ y , u, o, e, a '. Phonetic studies have shown, however, that the orthographic nasal vowels are actually sequences of an oral vowel, which is optionally slightly nasalized, plus a nasal stop or a nasal glide [w̃] (which may be fronted to [ỹ] depending on context). Wordfinally the nasal glide need not be pronounced.

articulation, within words and across word boundaries. Word-internal [w̃] assimilates to a following stop irrespective of place of articulation and does not assimilate across word boundaries (see Czaykowska-Higgins 1988).

3.4 Conclusion

The velarization data given above suggests that velar insertion is a context-free rule which targets place-less segments. Since, as shown in (§ 5.1) debuccalization is a process which coda consonants typically undergo, it seems plausible to analyze the velarization of consonants in coda position as resulting from debuccalization followed by velar insertion. This analysis contrasts sharply with Chen(1983)'s account of the cross-dialectal facts schematized in (§ 2.0). Chen suggests that velarization is merely a stage in a process tending towards deletion. He provides evidence based on chronological surveys from MC down to Pekinese records to establish the sound change from MC */k/ to /ʔ/. He also cites recent surveys of Taiwanese spaced over several decades, attesting to the gradual disappearance of the glottal stop. However, the data given above suggests that laryngeal glides are capable of velarizing. This means that velarization need not be a stage in the process towards deletion: the step from [k ŋ] to [ʔ N] can be reversed.

In (§ 3.1) I concluded that there is a hierarchy of nasal debuccalization corresponding to a hierarchy of nasal "absorption"; namely:

71)

(i) [n] [ŋ] debuccalize more promptly than [m]; they also undergo "absorption" more promptly than [m].
(ii) [ŋ] debuccalizes more promptly than [n]; it also undergoes "absorption" more promptly than [n].

I then pointed out that the "absorption" and debuccalization hierarchy [ŋ] > [n] may only hold for intervocalic or pre-vocalic [ŋ] because Chen's(1985) study of nasal "absorption" in Chinese indicates that the hierarchy is [n] > [ŋ] for nasals in word final position. To answer the question of why intervocalic [ŋ] is prone to debuccalization I presented some evidence to the effect that [ŋ] patterns like other velars in that it too is susceptible to weakening in intervocalic or pre-vocalic position. The answer to the question of why intervocalic [ŋ] is prone to "absorption" is that the debuccalization of nasals feeds nasal "absorption" but I have yet provided no arguments to this effect. In this chapter I have only presented evidence that debuccalization and "absorption" tend to occur in the same environments and to affect the same segments: (a) nasal consonants are not all equally susceptible to debuccalization nor are they all equally susceptible to "aborption" ; (b) labial nasals resist both debuccalization and "absorption" and (c) both debuccalization and nasal "absorption" typically target nasals in coda position. From (a) (b) and (c) we can conclude that nasal debuccalization and nasal "absorption" share a set of necessary or sufficient conditions.

Chapter 4

ON THE ORDERING DEBUCCALIZATION --> NASAL "ABSORPTION"

In the previous chapter I argued that nasal "absorption" and debuccalization have quite similar if not identical distributions cross-linguistically. In this chapter I will argue for the ordering:

Debuccalization --> Nasal "Absorption"

Three kinds of argument are given:

(i) Nasal consonants in Oriya (§ 4.1.1) and Aguaruna (§ 4.1.2) spread their nasality onto neighboring vowels only when they debuccalize (i.e. loose their point of articulation) and become place-less nasal glides: [h̃] in Aguaruna, [N] in Oriya. In Oriya, the weakening of the nasal consonant's occlusion is not itself caused by the fact that the neighboring vowel(s) have become nasalized; rather, nasals debuccalize by a rule which targets all intervocalic stops, nasal and oral. Similarly, in Aguaruna a nasal may be surrounded by nasal vowels and remain [+consonantal]. This means that debuccalization is a necessary condition for vowel nasalization in these languages. Since vowel nasalization is part of the nasal "absorption" process, the data suggest that debuccalization is a necessary condition for nasal "absorption" at least in some languages.

(ii) The assimilation of a nasal to a following consonant prevents the nasal from undergoing "absorption" in a number of languages including Aguaruna (§ 4.2.1) , Capanahua (§ 4.2.2) and Western Muskogean (§ 4.2.3). That this bleeding relation holds cross-linguistically can be deduced from the typology of the segments which follow "absorbed" nasals which are those that are less likely to spread their point of articulation and stricture onto the preceding nasal (§ 4.2.0). Such data can be explained on the assumption that only debuccalized nasals undergo "absorption" (this statement may need modification as discussed in § 7.2).

(iii) Assuming that nasal debuccalization occurs before (not after) nasal "absorption" is formally advantageous in languages where nasal "absorption" does not cause vowels to assimilate the place features of nasal consonants. We need not stipulate that the vowels do not assimilate the place features of the "absorbed" nasal along with the nasality because we can assume that the place features of the nasal are no longer present when "absorption" takes place.

4.1 [N] and the spreading of nasality

In this section I will establish that in some languages nasal consonants do not nasalize neighboring vowels unless they lose their point of articulation. I take this as evidence that debuccalization feeds nasal "absorption" at least in some languages.

4.1.1 [N] and nasalization in Oriya

Oriya(Piggott 1987) offers a clear example of the role of the placeless nasal [N] in vowel nasalization. In Oriya colloquial style, intervocalic consonants debuccalize (they do not delete since their timing slot remains in situ to receive the features of a neighboring high vowel by glide formation). Nasal consonants also debuccalize and become [N]; that is, their nasality is preserved. This nasality is subsequently "absorbed" by neighboring vowels and spread bi-directionally (obstruents block):

1)

formal	colloquial	
nabɔ	naa	'boat'
mata	maa	'mother'
nodi	noyi	'river'
kupɔ	kuwɔ	'well'
ɟɔtu	ɟɔwu	'wax'
sɔbɔrɔ	sɔɔrɔ	'tribesman'
bamɔ	bãã	'left'
namɔ	nãã	'name'
samɔntɔ	sããtɔ	'master'
b^humi	b^hũỹĩ	'ground'
d^humɔ	d^hũw̃ɔ̃	'smoke'
swami	sãỹĩ	'lord'

Rather than assume that in the colloquial style nasal stops happen to spread nasality (by some fortunate co-incidence) in the very context in which they lose place features, I think we should relate the two processes by making one feed the other. Since both oral and nasal consonants debuccalize, it seems best to assume that the spreading of nasality is fed by the debuccalization of nasals. The assumption that it is the spreading of nasality that causes nasals to debuccalize would complicate the debuccalization rule and would not account for the debuccalization of oral consonants. Consequently, the first step in the derivation from Oriya /...vnv.../ to [...ṽṽ...] is the creation of a place-less nasal glide /vnv/ --> /vNv/ by a rule deleting the place features of intervocalic stops. I will assume that debuccalization in this case is the limit of a weakening process affecting inter-vocalic stops.

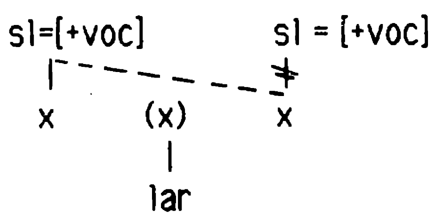
2) Debuccalization: place --> ø / v ___ v

3)

bamɔ --> **baNɔ** 'mother'
nabɔ --> **naLɔ** 'left' L = laryngeal glide

Debucalization feeds a rule of supralaryngeal harmony. Supralaryngeal harmony creates sequences of like vowels. Steriade(1987b) has demonstrated that laryngeal glides are transparent to this kind of harmony--in contrast to all other consonants-- by virtue of the fact that they lack a place component. As expected, the place-less glides [L N] created by debuccalization do not block supralaryngeal harmony:[1]

4) Supralaryngeal harmony



5)

baNɔ --> **baNa** 'left'
naLɔ --> **naLa** 'mother'

Debuccalization also feeds a rule of glide formation. From [N L] we get glides if the vowel following or preceding [N L] is high. The glide agrees in backness and roundness with a tautosyllabic high vowel if there is one, otherwise it agrees with an adjacent high vowel. Since voiceless glides are very marked segments, all glides surface as voiced, even if the original

[1]The fact that [N] fails to block laryngeal harmony gives rise to a number of questions. If the supralaryngeal node contains nasality, then by assumption [N] has a supralaryngeal node; as such it would be expected to block supralaryngeal harmony. Since it does not block, then one of the following must be true (1) what I have called supralaryngeal harmony is in reality place harmony; (2) [N] does not have a supralaryngeal node or (3) [N] deletes <u>before</u> supralaryngeal harmony.

consonant was voiceless. The simplest way to derive this fact is by assuming that only voiced obstruents are underlyingly specified for vocal cord positioning, whereas voiceless obstruents are underlyingly unspecified. Thus when voiceless obstruents debuccalize, they do not leave behind a trace of their voicelessness, but a naked timing slot. The **[y ỹ w w̃]** derived from [L N] do block supralaryngeal harmony. We can derive this if glide formation involves the spreading of [back] and/or [round] and the interpolation of a supralaryngeal node <u>before</u> supralaryngeal harmony has a chance to apply:

6)

```
                                                     [+back]           [+back]
                                                        :                 :
                                                       / \               / \
 sl sl sl            sl  sl                           sl sl  sl        sl  sl  sl
 |  |  |             |   |                            |  |   |         |   |   |
 k  u  p  ɔ -->(sl. del) k u L ɔ -->(glide form) k u w   ɔ -->(sl har.) k u   w   ɔ
```

The next step in the derivation is the "absorption" of [N] as nasalization by neighboring vowel(s). It is not clear what this process consists in. One possibility is that the gesture that opens the velum in [N] "slides" back into the vowel producing a nasal vowel (for a discussion of Browman&Goldstein's(1987) theory of gestural overlap see § 5.2):

7) Gestural timing relations between the gestures performed by the velum and by the tongue dorsum:

```
               no overlap            -->       total overlap
                  [vN]                              [ṽ]
dorsum     [----------]                        [-----------]
velum                 [----------]             [-----------]
```

To derive the bi-directional nasalization facts we must assume that the vowel which "absorbs" nasality subsequently spreads it to other vowels and glides.

The overlap approach to nasal "absorption" is not explanatory unless one can answer the following two questions: The first is, how come total overlap in (7) does not take place when the nasal in question has place features : **vm** --> * **ṽp**. One possible answer is that total overlap in the case of fully specified nasals might be marked because they violate the segmental unity of the nasal, **m** --> ~ **p**. Undermining this argument is the fact that Icelandic pre-aspiration consists in exactly such a violation of segmental unity: $\mathbf{t^h}$ --> **h t**. The second question the overlap approach must answer has to do with the fact that partial overlap in nasalization is usually present phonetically,

8)

```
                no overlap              -->      partial overlap
                   [vm]                                  [ṽm]
dorsum    [----------]                      [-----------]
velum                 [----------]                 [----------------]
```

the task is to explain why such partial overlaps do not lead to bi-directional nasalization in Oriya: **vm** --> **ṽm** --> **ṽmṽ**. It may be that partial overlaps in nasalization are usually ordered very late in the derivation, whereas bi-directional nasalization (8) is ordered early. However, this would only substitute one mystery for another.

The approach which I will take to nasal "absorption" is that it is a two step process. First, the place-less nasal glide [N] triggers nasalization in both directions onto other [-consonantal] segments:

9)

Nasalization (bi-directional)

```
[ +N ]
  ┌ ‐ ‐ ‐ ‐ ‐ ‐ ‐ ‐ ‐ ‐ ‐
  sl=[-cons]          sl=[-cons]
  |
  ø place
```

10) **baNa** -->(nas.) **bãÑã**

The second step in the derivation is the deletion of [N]. This deletion targets place-less glides only:

11) **bãÑã** --> (deletion) **bãã** 'left'

I will call this model of nasal "absorption" the nasalization-deletion model (ND). This model is based on the assumption that the transfer of nasality takes place if the "disappearing" nasal is a place-less glide (the place-less ness my not be as crucial as the glide status see § 7.2).

<u>4.1.2 [ã] and nasalization in Aguaruna</u>

Vowel nasalization in Aguaruna is caused by two place-less nasal glides: [ɦ̃] and [N]. In this section I will discuss the nasalization caused by [ɦ̃]. We have seen in (§ 3.1) that Aguaruna **[ŋ]** surfaces as nasalized breath **[ɦ̃]** pre-vocalically before tense high vowels **[i]** and **[u]** and as **[ŋ]** elsewhere. **[ɦ̃] spreads** nasality in both directions; nasalization is blocked by [+consonantal] segments (including nasals):

12)

ãɦ̃ũm	'later'
t͡sũɦ̃ĩ	'fish'
sũɦ̃ĩk	'beads'
ɨsãɦ̃ĩ	'ridge of roof'
sakãɦ̃ũ	'skeleton'

Nasal consonants which do not debuccalize and become glides, do not spread nasality at all in Aguaruna. Recall that the phonemic inventory of Aguaruna is labials: /**p w m**/, coronals: /**t t͡s s n**/, palatals: /**t͡ʃ ʃ y**/, velars: /**k ɣ ŋ**/, laryngeals: /**h** ʔ/ and vowels:/**i ɨ a u**/:

13)

nimaata	'hang'
amaina	'later'
hapanat͡s	'maybe to the deer'

It is clear that the spreading of nasality is connected to the change from **[ŋ]** to **[ɦ̃]**. This change can be viewed as a debuccalization of the velar nasal from stop [ŋ] to glide [N] while the aspiration of [N] to [ɦ̃] is introduced by a separate rule or is an underlying feature of nasals[2,3]:

---

[2]Possibly, the aspiration is redundant upon the voicing of the nasal. In the Sizhou secret language described by Chao(1931), voiced consonants leave behind voiced breath

```
                  [+N]
                    :
14) Debuccalization:  place --> ø / __ [+high +tense]
                    |
                 [+back]
```

I propose that nasalization in Aguaruna is triggered by a change in the status of the velar nasal from stop to glide. This notion is made explicit in the nasalization rule in (15). The rule requires that the trigger of nasal spreading be [N] (for a modification of this position see § 7.2):

15) Nasalization(bi-directional)

```
[ +N ]
  ┌- - - - - - - -
  sl=[-cons]        sl=[-cons]
  |
  ø place
```

16) Derivation:

[ɦ] upon losing place and stricture: dʰɨ --> dʰɨ dʰɨn --> ɦɨ dʰɨn; d͡zʰɨɨ --> d͡zʰɨɨ d͡zʰɨɨn --> ɦɨɨ d͡zʰɨɨn ; lən --> lən lən --> ɦən lən ; nən --> nən nən --> ɦən nən vs tə --> tə tən --> ə tən ; ɾu --> ɾu ɾən --> u ɾən ; tçɨɨ --> tçɨɨ tçɨɨn --> ɨɨ tçɨɨn . Jim Harris has suggested to me that what is transcribed as [ɦ] in Aguaruna might be a voiceless velar nasal, which is quite plausible. Ohala(1975) argues that it is quite hard to distinguish the point of articulation of completely voiceless nasals. If Harris is right about Aguaruna [ɦ], it is tempting to speculate that the phonetic nasalization of vowels in the neighborhood of nasal consonants becomes more prominent when the point of articulation and stricture of the nasal consonant are hard to perceive either because the point of articulation has been lost or because of voicelessness. Ohala(1976) also suggests that breathiness might give the impression of nasalization.

[3]Turner(1961:1) cited by Payne(1974:48) notes that Aguaruna [ɦ] often affects the timbre of the following vowel to where [ɦa] in the related language Huambisa corresponds in many, though not all, cases to Aguaruna [ɦɨ]. This suggests that, historically perhaps, /N/'s [+high] [+back] features have shifted the following vowel. But there are too many exceptions to consider this to be the actual synchronic derivation.

aŋum --> (debuccalization) **aNum** --> (aspiration) **añum** --> (nasalization) **ãñũm** 'later'

4.2. Place assimilation and nasal "absorption"

In the next section we shall see cases where place assimilation bleeds nasal "absorption" and the explanation will be a straightforward one: place assimilation will bleed nasal "absorption" because the undergoer of "absorption" must be a place-less glide (see § 7.2 for a modification of this position). To begin with let me establish that the bleeding relation is quite general as can be deduced from the typology of segments which tend to follow "absorbed" nasals. These are segments which tend not to spread their point of articulation and stricture onto preceding nasals.[4] This suggests that place assimilation bleeds nasal "absorption" quite frequently across languages.[5] According to Ruhlen(1978) the nature of the segments

[4]I owe this observation to Donca Steriade.

[5]This observation rules out a theory whereby [v+ŋ] becomes [ṽ] directly because it sounds like it. One might be tempted to propose this because the inherent phonetic length of nasal vowels is longer than that of oral vowels DeChene&Anderson(1979:516) and because linguistically naive listeners frequently transcribe nasalized vowels as [v+ŋ] (Morris Halle and Jim Harris p.c.). However, the hypothesis that [v+ŋ] sequences become [ṽ] directly predicts that [v+ŋ] should be interpreted as [ṽ] irrespective of what

following the nasal consonants subject to "absorption" are (in order of preference):

17) Segments following "absorbed" nasals:

i)fricatives
ii)voiceless stops and affricates
iii)voiced stops and affricates

The hierarchy in (17) reflects the fact that the segments in (i)-(iii) tend increasingly to spread their place features onto preceding nasals. Hence fricatives tend to spread their place and stricture features onto preceding nasals less promptly than voiceless stops and affricates, which do so less promptly than voiced stops and affricates. Thus in Basari(§ 7.1) and "velarizing" Spanish dialects (§ 3.3.4) nasals assimilate to obstruents but not to fricatives. In Swahili(Halle&Clements 1983) and in Kolami(Emeneau 1955; Kenstowicz&Pyle 1973) nasals assimilate to voiced obstruents but not to voiceless ones. The hierarchy may be acoustically motivated. Ohala(1976) notes that "the noise spectra of voiceless nasals will be alike and perceptually undifferentiable." If nasals become voiceless before voiceless stops and affricates, their point of articulation will be that much harder to distinguish acoustically and will tend to be deleted.

---

follows; in particular, that it should be interpreted as [Ṽ] when [ŋ] is part of a homorganic [ŋk] stop cluster, contrary to fact.

4.2.1 Aguaruna

Other instances of vowel nasalization in Aguaruna involve disappearing nasals in coda position. I transcribe these disappearing coda nasals as [N] for reasons that will be immediately clear. Disappearing coda nasals trigger a long-distance bi-directional nasal spreading blocked by [+consonantal] segments (including nasal stops):[6]

18)

kaNʃap --> kãʃap	'sting ray'
yaNya --> ỹãỹã	'rat'
bikuaN --> bikũã	'little animal'
yawayaN --> ỹãw̃ãỹã	'dog'
bikuaN-i --> bikũã-ĩ	'little animal-by means'
dasiN-a-ki --> dasĩ-ã- ki	'wind-object in sight-only'
inai-iN --> inãĩ-ĩ	'tongue-his'

Certain forms which on the surface end in a nasal consonant have undergone a rule of vowel deletion, and are not subject to nasal deletion or vowel nasalization:[7]

---

[6] **Aguaruna does not delete all codas, only certain nasal codas: [diismi] 'let's see' [baʧĩŋ] 'monkey' but see footnote (7).**

[7] **Payne does not say whether words ending in a velar nasal e.g. [wiaŋ] 'father in law' end in a vowel in underlying representation.**

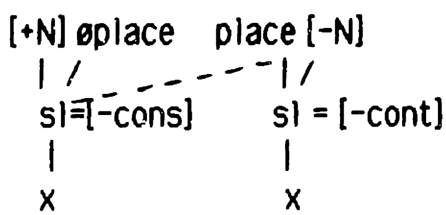
19)

amaina --> **amain** 'other side of the river'
v.del

The form in (19) freely alternates with a form ending in a (voiceless) vowel: **[amainḁ]**. Thus deletion of a final voiceless vowel is optional. The conditioning environment of vowel deletion is not well understood (apparently stress placement is relevant).

What is interesting about the nasal "absorption" process in (18) is that it is bled by a rule which spreads the place features of an (oral) stop onto a preceding nasal segment:

20) Place assimilation (P.A.)



21)

maNt͡ʃi --> **mant͡ʃi** 'grasshopper'
miNkiyat --> **miŋkiyat** 'to lose'
naNpa --> **nampa** 'hoe'
naiNti --> **nainti** 'up'

22)

compare: **bikuaN** --> **bikũã** 'little animal'
bikuaN-na --> **bikũã- na** --> **bikũãn** 'little animal-obj'
piyuN --> **pĩỹũ** 'insect'

piyuN-t͡ʃu-i --> piyunt͡ʃui		'it isn't an insect'
nuNwa --> nũw̃ã		'woman'
nuNwa-t͡ʃu-i --> nũw̃ãt͡ʃui		'it isn't a woman'

Nasal consonants in homorganic clusters such as [**nt͡ʃ**] in [**piyunt͡ʃui**] 'it isn't an insect' remain in coda position and do not trigger the long-distance bi-directional nasalization left behind by disappearing coda nasals. These nasal stops remain in coda position because they undergo a late rule which spreads the nasality of a coda nasal onto the immediately preceding vowel. The rule follows vowel deletion and re-syllabification:

23)

/nuŋi - ŋu/ --> ... --> duhi-ŋ --> duhĩŋ 'nose-possessive'
other rules[8] **local nasalization**
vowel deletion

Now, all nasals in homorganic clusters trigger local nasalization. For example the actual surface form of **/piyuN-t͡ʃu-i /** is not [**piyunt͡ʃui**] but [**piyũnt͡ʃui**]. This suggests that the nasal in the homorganic [**nt͡ʃ**] cluster is not a prenasalization of the following consonant; rather the nasal is a regular segment in coda position because it triggers local nasalization like any nasal in coda position. We can conclude that place assimilation bleeds both the process that causes coda nasals to disappear and bi-directional nasalization. Let us call the former process coda deletion.

Aguaruna does not allow syllables to end in glides. It is tempting to analyze the deletion of coda nasals as prompted by this constraint. I will

---

[8]**The suffix /-ŋu/ [-ñũ] ~ [-ŋ] 'possessive, aspectual, 1goal, 2pl.subj' oralizes the preceding stem up to the first oral obstruent. This rule as well as the [ŋ] ~ [h] alternation is discussed in (§3.1).**

assume that coda [N] triggers nasalization by the rule in (15) and deletes by the rule in (24):

24) Coda Deletion:

```
[-consonantal ]
          :
          X --> ø / [___]coda
          :
          ø place
```

If the derivation given in the preceding paragraph is correct, then we can explain why place assimilation bleeds both nasalization and coda deletion. Nasalization and coda deletion affect only [N]. But a nasal that has assimilated the point of articulation of a following stop becomes a regular nasal stop, fully specified for place (and perhaps also for stricture, as disussed in footnote [9]); therefore, it cannot trigger nasalization, nor can it delete. The derivation envisioned here is as follows:

---

[9]**What I have denominated place assimilation may involve stricture features and the feature [-nasal]: /mp, nt, ŋk, nt͡s, nt͡ʃ/ become intermediate /^{m}bp, ^{n}dt, ^{ŋ}gk, ^{n}d͡zd͡z, ^{n}d͡ʒt͡ʃ/ by P.A. and assimilation of [-nasal]. This can be seen in wordfinal position: After vowel deletion, homorganic NC clusters become word-final: /mpv/, /ntv/ and /ŋkv/ -->(v.del) /mp#/, /nt#/ and /ŋk#/, which simplify to [m#], [n#] and [ŋ#] but /nt͡s#/ and /nt͡ʃ#/ surface as prenasalized stops: /aiNt͡su/ [ai^{n}t͡s] 'people' vs /takuNpe/ [takum] 'parrot'. These forms can be derived on the assumption that /mp, nt, ŋk, nt͡s, nt͡ʃ/ become intermediate /^{m}bp, ^{n}dt, ^{ŋ}gk, ^{n}d͡zd͡z, ^{n}d͡ʒt͡ʃ/. Word internally, prenasalized stops in coda position simplify to plain nasals; word finally, the last C of a CC cluster drops out (Aguaruna does not permit word-final clusters) leaving behind the prenasalized stops. All of these prenasalized stops simplify to nasals, except /^{n}d͡z, ^{n}d͡ʒ/ which simply devoice to [^{n}t͡s, ^{n}t͡ʃ]. Word internally Aguaruna does not allow prenasalized stops in coda position, only in onset position: According to Payne, <u>onset</u> [m] and [n] vary freely with [^{m}b] and [^{n}d] (with any degree of prenasalization) when the next onset begins in an oral consonant or if the imm ediately following rhyme contains a tense high vowel ([i] or [u]): [^{n}d~napi] 'snake', [^{n}d~nasi] 'wind', [^{m}b~mat͡ʃin] 'monkey', [^{m}b~mikiu] 'small animal' but [mama] 'manioc' , [mant͡ʃi] 'grasshopper', [maya] 'ant'; [u^{n}d~nu] 'unripe', [ayuha^{m}b~mahai] 'caused to eat'.**

25)

piyuN	**piyuN-t͡ʃu-i**	U.R.
piyuN	**piyun-t͡ʃu-i**	place assimilation
pĩỹũN	**piyun-t͡ʃu-i**	nasalization
pĩỹũ		coda deletion

Perhaps the most interesting evidence in favor of the existence of [N] in Aguaruna is the behavior of place assimilation. Only [N] undergoes place assimilation (PA); whereas [**m**] [**n**] and [**ŋ**] do not do so:

26) **nuN-a-t** --> **nuN-t** --> **nunt** --> **[nũnt]** 'to hide something'
v. del P.A. local nasalization

27) **t͡sanu-ma-ka-u** --> **t͡sanu-m-ka-u** --> **[t͡sanũmkau]** 'to deceive'
v. del. P.A. & local nasalization

28) **it͡ʃinak-na** --> **it͡ʃinkan** --> **[it͡ʃĩnkan]** 'to the clay pot'
v.del. P.A. & local nasalization

29) **duha-ŋu-tinu** --> **duha-ŋ-tin** --> **[duhãŋtin]** 'rise-asp-fut'
v.del. P.A. & local nasalization

Example (26) shows that vowel deletion feeds PA. Examples (26-29) show that only [N] undergoes PA; a fully specified nasal consonant such as [**m**], [**n**] or [**ŋ**] will not assimilate to the following stop.

Below I present other data that distinguishes [**ŋ**] from [N]. Both [N] and [**ŋ**] can appear in word-final position:

30)

wiaŋ 'father in law'

bikuaN --> **bikũã** 'little animal'

Payne does not mention if [**wiaŋ**] ends in a vowel in underlying representation; comparison with a cognate in the closely related language Huambisa [**wiaɣ̃**] suggests the nasal is word-final (recall A.[ŋ] corresponds to H.[ɣ̃]). A second fact differentiating [N] and [ŋ] is that the latter is a [+consonantal] segment capable of blocking vowel nasalization. Recall that before tense high vowels [i] and [u], [ŋ] becomes [h̃] via debuccalization. Before the other vowels, [ŋ] becomes oral [h]. This [ŋ] to [h] process follows nasalization, so we can see how [ŋ] blocks nasalization like any other nasal stop:

31)

/niŋai-iN/ -->**(nasalization/deletion**--[ŋ] **blocks) /niŋãĩ-ĩ/** --> ([ŋ] to [**h**])
[**nihãỹĩ**] not *[**nĩh̃ãỹĩ**] 'forehead-poss'.[10]

Final rule ordering for Aguaruna:

32)

Place assimilation
Nasalization(bi-directional)
Coda deletion

I have argued that bi-directional nasalization in Aguaruna is triggered by a place-less nasal glide [N]. This analysis allows us to derive bi-directional nasalization from [h̃](< onset [ŋ]) and bi-directional nasalization

---

[10]**The [ŋ]'s which surface as [h] correspond usually to Huambisa [h̃], and in a few instances to Huambisa [ɣ̃]. Forms such as [mĩh̃ĩt͡ʃ] 'banana', [mĩh̃ãn] 'fish, year' etc. have underlying forms with coda [N]: /miNŋit͡ʃ/ or /miNhit͡ʃ/ -> [mĩh̃ĩt͡ʃ]. Payne describes the [h] in [nihãỹĩ] and like forms as being only slightly nasalized as compared with the [h̃] that triggers bi-directional nasalization as in [ũh̃ũk] 'beads' but his measurement was crude enough: he simply put a mirror under the nose of his speakers.**

from [N] with a single rule of bi-directional nasalization. It explains how [N] causes bi-directional nasalization and deletes in word-final position and in position before continuants and nasal stops, whereas nasals in homorganic clusters do not do either.

4.2.2 Capanahua

I will argue in this section that vowel nasalization in Capanahua (Loos 1969) is caused by a place-less nasal glide [N]. I will show that vowel nasalization does not occur if a nasal is incorporated into a homorganic NC cluster.

Capanahua has a rule which spreads the nasality of nasal consonants regressively onto vowels and glides and is blocked by [+consonantal] segments, including **[r]**. The segment inventory of Capanahua is labi[illegible] **w β m**/, coronals: /**t t͡s s r n**/, palatals: /**t͡ʃ ʃ ʂ y**/, velars: /**k ɣ**/, lary[illegible]: /**h** ?/ and vowels:/**i ɨ a o**/:

33) Regressive nasalization

```
        [+nasal]
        - - -‾|
   sĩ          si
```

34)

bĩmi 'fruit'
tʃipõŋki 'downriver'

In position before certain consonants, nasal consonants delete. This deletion appears to trigger bi-directional nasalization:

35) **wiran-wi** --> **wirãw̃ĩ** 'push it over'

Since **[n]** and **[m]** do not spread nasality progressively, a bi-directional nasalization rule triggered by disappearing nasals might seem ad hoc. In fact bi-directional nasalization in Capanahua falls right into line with bi-directional nasalization in Aguaruna and Oriya.

It is my contention here that a place-less nasal glide [N] causes bi-directional nasalization in Capanahua; that is, that the root final nasal in (35) debuccalizes at some point in the derivation. The following debuccalization rule constitutes the first step in the derivation of this form:

36) Debuccalization: place --> ø / ___]σ
:
[+nasal]

37) **wiran-wi** --> **(debucc.) wiraN-wi** 'push it over'

Debuccalization applies after vowel initial suffixes have been added and re-syllabified. Root final nasals do not delete before vowel initial suffixes because they are in onset position at the relevant stage in the derivation:[11]

38)

wiraN-ai? -->	**wirãn-ai?**	'I pushed it'
kayataN-ai? -->	**kayatãn-ai?**	'I went and jumped'
siniN-ai? -->	**sĩnĩn-ai?**	'I reach it'

The above examples also show that nasals which fail to debuccalize do not trigger bi-directional nasalization or delete. These two processes affect only [N]:

39) Nasalization (bi-directional):

```
[ +N ]
  ┌- - - - - - - - -
  sl=[-cons]         sl=[-cons]
  |
  ø place
```

40) **wiraN-wi** --> **w̃ĩr̃ãN-w̃ĩ** 'push it over'

Finally, after nasalization, the place-less nasal glide deletes (Capanahua does not allow [N] [y] or [w] in the coda but it does allow [?] (</t/ see S 5.1):

41) Coda deletion:

[11] Root final consonants are predictably coronal in position before a vowel initial suffix. This generalization can be deduced from Loos morpheme-structure and morpho-phonological rules (Loos:1969:127&144). In some morphological environments, root final nasals are predictably labial(Loos:1969:144). The fact that nasals neutralize in terms of point of articulation in root final position suggests that this is a position in which the point of articulation of nasals is harder to identify, which provides further support for a rule debuccalizing nasals in this position.

41) Coda deletion:

```
[-consonantal,+nasal]
         :
         x --> ø / ___]σ
         :
         ø place
```

42) **w̃ĩr̃ãN-w̃ĩ** --> **w̃ĩr̃ã-w̃ĩ** 'push it over'

This derivation is exactly like the one I have proposed for Aguaruna nasal vowels. As in Aguaruna, [N] deletes in coda position (leaving bi-directional nasalization behind); but [N] is preserved (and does not cause bi-directional nasalization) if it has already assimilated the point of articulation of a following consonant. Nasals in homorganic clusters surface as stop consonants. Homorganic nasal clusters arise by the place assimilation rule in (43). The rule states that [-continuant] consonants (including nasals) spread their place (and perhaps also their stricture) features regressively onto a preceding nasal segment. Examples are given in (44):

43) Place assimilation (P.A.)

```
[+N] ø place       place
  | /  _ _ _ _ _ _ _ |
  sl=[-cons]       sl = [-cont]
  |                  |
  x                  x
```

44)

?onaN-?o-?-kɨ --> **?̃õnã-?̃õ-?̃-kɨ** 'I knew it (last month)'
?onaN-na-wɨ --> **?̃õnãn-na-wɨ** 'learn (pl)'
?onaN-paN --> **?̃õnãm-pã** 'I will learn'
?onaN-kɨN --> **?̃õnãŋ-kɨ̃** 'learned'

That P.A. bleeds nasal "absorption" in (44) can be gathered from the behavior of the glottal stop: **/ʔonaN-ʔo-ʔ-kɨ/** --> **ʔ̃õnã-ʔ̃õ-ʔ̃-kɨ̃** 'I knew it (last month)'. The glottal stop /ʔ/ does not pattern with the other stops; unlike stop-initial suffixes, /ʔ/-initial suffixes cannot protect [N] from undergoing "absorption" because the glottal stop lacks place features and cannot trigger P.A. Since nasalization and coda deletion affect only [N], P.A. will bleed either process by transforming [N] into a regular nasal stop. The derivation of nasal vowels envisioned here is as follows:

45) Final rule ordering:

Debuccalization (D)
Place assimilation (P.A.)
Nasalization (bi-directional)
Coda deletion

46) Derivation:

ʔonan-kɨn	UR	'learned'
ʔonaN-kɨN	Debuccalization	
ʔonaŋ-kɨN	Place assimilation	
ʔonaŋ-kɨ̃N	Bi-directional nasalization	
ʔonaŋ-kɨ̃ø	coda deletion	
ʔ̃õnãŋ-kɨ̃	Regressive nasalization	

For the sake of completeness, I note that the NC clusters in (44) are true clusters (vs. prenasalized stops). The opposite assumption makes it impossible to derive froms like [**ʔ̃õnãnnawɨ**] 'learn (pl)'. To see this let us assume that the homorganic clusters in (44) are prenasalized consonants. Consider the following derivation:

47)

```
 [+N][+N]           [+N][+N]            [+N][+N]
   |  |                |\|                  \/
   :  :                : :                  :
   x x                 x x                 ø x
ʔonaN-na-wɨ --> ʔonaN-n͡nawɨ -->  ʔona  -n͡nawɨ --> *[ ʔõnãnawɨ ]
                prenasalization  coda deletion      not  [ ʔõnãnnawɨ ]
```

In the above derivation I follow Sagey(1986) in assuming that the prenasalization of a nasal cannot create a geminate cluster. Sagey's arguments are based on facts from Kinyarwanda, where there is a process transforming underlying sequences of nasal plus consonant into prenasalized segments. Sagey presents evidence from compensatory lengthening and syllable structure showing that this process must result in single segments, i.e. segments represented on one x-slot. Additional evidence that this process results in single segments can be found in cases of prenasalized nasals. Consider the prenasalization data in (48) from Sagey(1986:88):

48)

a. **/si-n-dod-a/**	**[siindoda]**	'I don't sew'
/si-n-mes-a/	**[siimesa]**	'I don't wash'
b. **/si-n-a-dod-aga/**	[sinadodaga]	'I didn't sew'
/si-n-a-mes-aga/	**[sinamesaga]**	'I didn't wash'

The forms in (48)(b) show that the vowel in /**si**-/ is underlyingly short, and thus that the length of [**ii**] in (48)(a) must be due to compensatory lengthening accompanying the prenasalization. Thus [**siimesa**] in (a) contains prenasalized /**m**/ which is realized simply as [**m**], and not as geminate [**mm**].

This provides evidence that the [**nd**] in [**siindoda**] is also a single segment, for if prenasalization created two-segment sequences of homorganic nasal followed by a consonant, then we would expect a prenasalized /**m**/ to result in [**mm**], not [**m**]. Since x-slots, and not features, represent the timing of the word, a prenasalized nasal such as the one shown in (49) can be interpreted only as a segment of unitary length which happens to be specified twice for certain features. It cannot be interpreted as a geminate:

49)

```
[+N]  [+N]
   \  /
    :
    x
```

I mention these facts because they rule out an analysis of the NC clusters in (44) in terms of a pre-nasalization rule that spreads the nasality of a vowel onto the following oral or nasal stop: **ṽp** --> (pre-nasalization) **ṽ^{m}p**. This analysis will not derive the geminate nasals in (44): **ṽn** -->(pre-nasalization) **ṽ^{n}n** -->(interpreted as single stop) ***ṽn**. Thus, to derive the facts in (44) we must assume that it is the spreading of place features which keeps the nasal consonant in NC clusters from being "absorbed". A similar observation can be made about the effect of gemination rules on nasal "absorption" in Western Muskogean (see § 4.2.3).[12]

---

[12]An analysis which I have not considered in the text, but which is nevertheless a possible one, is one involving epenthesis <u>before a stop</u>: ṽp --> (epenthesis)ṽXp --> (nasalization)ṽNp --> (place assimilation) ṽmp. On this view, place assimilation is merely a consequence of the insertion of an X-slot. I have not assumed this analysis for Capanahua because we have evidence that the nasal stop is there to begin with: instead of ṽ + v we get ṽ + n + v. An analysis in terms of epenthesis cannot possibly derive the facts of Choctaw § 4.2.3, where nasals are not "absorbed" before nasals created by /-li/ gemination: vn-li --> (gemination) vn-ni --> ("absorption" n/a) vn-ni. There is no way to state the epenthesis rule so as to derive the lack of "absorption" before /-li/ and the application of "absorption" before hetero-morphemic nasals and liquids (which may or

I have argued in this section that nasalization in Capanahua can be analyzed in terms of a place-less nasal glide [N] that results from the debuccalization of nasal consonants in the coda. Nasal consonants are not "absorbed" if they are immediately followed by stops because place assimilation creates fully specified nasal stops and nasal "absorption" affects place-less nasal glides.

4.2.3 Western Muskogean

Vowel nasalization in Western Muskogean (Munro&Ulrich1985 Ulrich 1987 Nicklas 1975 Pulte 1975) is also caused by a place-less nasal glide

---

may not be homorganic to the nasal undergoing "absorption") vn-n --> (absorption) ṽ-n or vn-l -->(absorption) ṽ-l. As in Capanahua, there is evidence in Choctaw that the nasal is there to begin with: instead of ṽ+v we get v+n/m+v. Such evidence is lacking in Aguaruna, which could be analyzed as involving epenthesis before an obstruent stop, but only if we made sure to de-nasalize the vowel so as to prevent the emergence of long-distance nasalization in examples (22): ṽp --> (epenthesis) ṽXp --> (nasalization) ṽNp -->(place assimilation) ṽmp -->(denasalization) vmp --> (long distance nasalization n/a) v...vmp (not * ṽ...ṽmp). The denasalization rule might be acoustically motivated if nasal vowels are perceived as less nasalized in the context of nasal stops. The epenthesis rule is harder to motivate, but may be formulated as a tendency to lengthen the syllable rhyme immediately before a stop and especially before a voiced stop (recall that P.A. triggered by voiced stops bleeds nasal "absorption" most frequently; vowels before word-final voiced stops are longer than those before word-final voiceless stops in English).

[N]. We have seen in (§ 2.0) that [Ñ] actually surfaces before certain voiced consonants in Choctaw, one of the W.M. languages. Vowel nasalization does not occur in W.M. if some process transforms the place-less nasal glides into fully specified nasal stops. Also, vowel nasalization does not occur if some process (i.e. place assimilation or gemination) or underlying structure (non derived geminates) prevents the creation of [N] or turns [N] into a fully specified nasal stop.

The Western Muskogean languages Choctaw and Chickosaw debuccalize nasal consonants before another consonant. The rule creates a nasal glide [N] which nasalizes the preceding vowel. The [N] then either deletes by the rule in (52) or else undergoes the rule of vowel spread in (53). Examples are provided in (54):

50) Pre-consonantal Debuccalization (PD)[13]

place --> ø /____ [+cons]
  :
[+N]

---

[13] Apparently PD does not apply to word final nasals in W.M.: some nouns may end in [n]: Ct [niškin] Cs [iškin] 'eye'. The situation is unclear because of the existence of forms such as Ct, Cs [fammikã] from /fammi-ka-N/ where [-N] surfaces as [-n] in other Muskogean languages. This suggests that final nasals are "absorbed" but only in derived environments. The process applying to final [-n], which I will designate R does not apply to final [-m] (Cs. apa-ta-m 'did he eat it?') so it must be restricted to coronals. R could be collapsed with <u>a cyclic application of PD if PD is restricted to [n]</u> and [m] --> [n] before a consonant across the board. On the other hand the rule sequence PD-nasalization-deletion etc. must also have a post-cyclic application targeting only pre-consonantal nasals: it has no morpheme-internal exceptions in either language Cs, Ct: [ipã:ši] 'hair' Cs [konta] Ct [kõ:ta] 'whistle'. <u>If P.A. is feature filling</u> in W.M., P.D. must have a cyclic application. P.A. in Cs applies before Li-Deletion, which is restricted to derived environments. Li-Deletion deletes <u>li</u> between a heavy syllable and a following coronal-initial suffix.: anompohonli-ta --> anompohõ-ta not * anompohonta. Thus P.A. has a cyclic application. If (cyclic) P.A. is feature filling it must be preceded by (cyclic) PD. For arguments that gemination and Li-Deletion are restricted to derived environments see Munro&Ulrich(1985) and references cited there.

51) Nasalization:

```
             [+N]
        - - - - - -┐
sl=[-cons]     sl=[-cons]
                 |
                 ø place
```

52) Coda deletion:[14]

```
[-consonantal +nasal]
             :
             X --> ø / ___ C]σ
             :
      place  ø
```

53) Vowel Spread:[15]

$\tilde{V}_1 N \rightarrow \tilde{V}_1 \tilde{V}_1$

54)

Choctaw	Chickasaw	
im-oka	**im-oka**	'his water'
ĩ:-nita	**ĩ:-nita**	'his bear'
ĩ:-ṣoloṣ	**ĩ:-ṣoloṣ**	'his shoe'
on-apa	**on-apa**	'eat on'
õ:-baṣli	**õ:-baṣli**	'cut on'[16]
õ:-naɬɬi	**õ:-naɬɬi**	'shoot on'
on-ɬitabli	**õ:-ɬitabli**	'spill on'

o-n-na [õ:na]	'to arrive n-grade'
ta-n-kči [tãkči]	'to tie n-grade'
ši:-n-pli [šĩ :bli]	'to stretch n-grade'
nokšo:-n-pli [nokšõ:bli]	'to scare n-grade'

---

[14]This rule applies to nasals also before [b+l] clusters which are not onset clusters. Arguments that [b+l] clusters are heterosyllabicity can be found in Ulrich(1987).

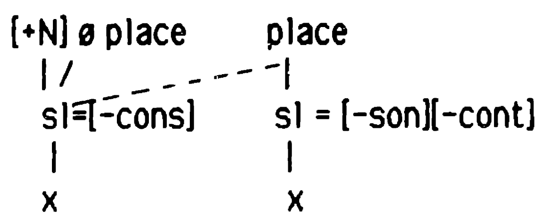
[15]Munro&Ulrich(1985) do not include this rule in their analysis of W.M. nasalization. The rule is given by Pulte(1975) and Nicklas(1975).

[16]I am ignoring the phonetic emergence of [N] before [b l] discussed in (§ 2.0).

In both Choctaw and Chickasaw, the rule sequence PD-nasalization-coda deletion-vowel spread has no surface exceptions and hence appears to apply across the board. Choctaw and Chickosaw have two nasal consonants **[m] and [n]** and three nasal vowels [ĩ ã õ] produced by nasalization of the languages' three oral vowels.

As in Aguaruna and Capanahua, whenever a process turns [N] into a fully specified nasal stop, nasalization, coda deletion and vowel spread do not apply because they affect only [N]. An example of such a process is place assimilation. Place assimilation applies in Chickasaw only (it does not apply in Choctaw). Place assimilation is triggered by obstruent stops:

55) Place assimilation (P.A.)



56)

Choctaw | Chickasaw
ĩ-tali no place assimilation **in-tali** 'his rock' place assimilation

Although there is no evidence that P.A. is feature filling, I will assume that it is for purposes of exposition:

57)

Pre-consonantal Debuccalization
Place assimilation
Nasalization
Coda deletion

Since P.D. creates the [N] that can be "absorbed", if P.D. cannot apply, "absorption" cannot occur either. P.D. is bled by a number of morphologically governed gemination rules in both Choctaw and Chickasaw. One gemination rule is triggered by the morpheme /-li/ shown in (58) below. (58)(a) shows the underlying form of the suffix /-li/. (58)(b) shows gemination of the root-final nasal consonant. Note that the root-final nasal is not "absorbed" even though it is in pre-consonantal position. (58)(c) shows the "absorption" of a nasal before a lateral in a non-geminating environment:

58) /-li/ Gemination:

a) Ct, Cs: **okča-li --> okča-li** 'awaken'
b) Ct, Cs: **fam-li --> fammi** 'whip' not * **fãli**
c) Ct, Cs **anompo-hon-li --> anompohõ:li**[17] 'Does he keep on talking?'

Moreover, morpheme-internal geminates[18] do not undergo PD either; that is, the nasals fail to be "absorbed" even though they are in pre-consonantal position:

59) Morpheme-internal geminates:

Ct, Cs: **homma** 'be red'
Ct, Cs: **banna** 'want'

---

[17]**The sequence <u>hon</u> is an infix associated to the Chickasaw HN grade. Compare [poota] 'to borrow' [pohonta] 'she keeps on borrowing it'; [anompoli] 'talk' [anompohõli] 'does he keep talking?'. I am ignoring the phonetic emergence of [N] before [b l] discused in (§ 2.0).**

[18]**There are no [nm] or [mn] sequences morpheme-internally in Ct, Cs; instead we find only [nn] or [mm]. This suggests an across the board gemination rule for adjacent nasals or a morpheme structure constraint. The former option implies that PD has an across the board application.**

P.D. is blocked from applying to the geminates in (58) and (59) by the Uniform Applicability Principle(§ 1.2); hence, the pre-consonantal nasals in (58) and (59) do not become [N], and do not cause nasalization or delete. We can conclude that nasal "absorption" in Western Muskogean is undergone by the place-less nasal glide [N].

Note that if P.D. is stated as a delinking rule, the Uniform Applicability Principle will not prevent the debuccalization and eventual "absorption" of nasals in homorganic clusters. The reason is that the delinking operation affects the nasal only and leaves the following consonant intact:

60)

```
 place    place
  /\        |
m  p --> N p --> ∅p
```

An example of a language where the debuccalization rule must be stated in terms of delinking is Panamanian Spanish. In Standard Spanish, nasals assimilate to a following obstruent in point of articulation across morpheme boundaries and word-internally (data from Harris(1984)):

61)

/n/	/m/	/ɲ/	
in-util	**presum-o**	**tiɲ-e**	'useless' 'I presume' 'he dyes'
im-pio			'impious'
iɱ-finito			'infinite'
in̪-digno	**presun̪-to**	**tin̪-te**	'undignified' 'presumed' 'dye'
in-seguro	**presun-sion**		'insecure' 'presumption'
iŋ-kapaθ			'incapable'

In Panamanian Spanish, which presumably developed from standard Spanish, nasals are "absorbed" before all consonants (Cedergren&Sankoff 1975). The rule of place assimilation is still active in the language as shown by the alternations:

62)

ca[m]po ~ c[ã]po	'field'
ca[n̪]to ~ c[ã]to	'I sing'
ci[ŋ]co ~ c[ĩ]co	'five'
ca[m]bio ~ c[ã]bio	'I change'
cua[n̪]do ~ cu[ã]do	'when'
co[ŋ]ga ~ c[õ]ga	'the conga'
ni[ɱ]fa ~ ni[ŋ]fa ~ n[ĩ]fa	'nymph'
ca[n]so ~ ca[ŋ]so ~ c[ã]so	'to tire'
ra[n]čo ~ ra[ŋ]čo ~ r[ã]čo	'ranch'
co[n]yuge ~ co[ŋ]yuge ~ c[õ]yuge	'spouse'
hi[m]no ~ hi[ŋ]no ~ h[ĩ]no	'hymn'
calu[m]nia ~ calu[ŋ]nia ~ cal[ũ]nia	'slander'
ho[n]rado ~ ho[ŋ]rado ~ h[õ]rado	'honest'
e[n]lace ~ e[ŋ]lace ~ [ẽ]lace	'bond'

The data is the same for word-final nasals. Before pause word-final nasals alternate between [n]~[ŋ]~[Ṽ]. Before another consonant, word-final nasals exhibit the same behavior as those in (62) except that they optionally velarize before all consonants (including obstruent stops). The data in (62) can be explained on the assumption that Panamanian Spanish has acquired three new rules: an optional debuccalization rule which feeds either "absorption" (obligatory before obstruent stops and optional otherwise) or velarization (obligatory: recall velarization targets [N] (§ 3.0)). But if place assimilation is obligatory, debuccalization must follow it and must be stated as a delinking rule; otherwise, debuccalization would never be able to apply by the Uniform Applicability Principle:

63)

```
  pl                                  pl
  /\                                  |
v m p  --> (debuccalization) v N p  --> ṽp
```

It is important to note that in the case of nasals that precede other nasals (e.g. calu[**mn**]ia 'slander' and hi[**mn**]o 'hymn') debuccalization feeds "absorption" (cal[ũ]nia, h[ĩ]no) or velarization (calu[ŋ]nia, hi[ŋ]no) but not place assimilation. This fact suggests (a) that the lack of place features in a target does not trigger place assimilation and (b) that standard Spanish dialects that do not exhibit nasal "absorption" or velarization because they do not debuccalize their nasals at any point in the derivation, not even before the application of place assimilation. This hypothesis will be explored further in chapter 5.

4.3 Conclusion

In this chapter I have argue for the ordering: Debuccalization --> Nasal "Absorption" by showing that the nasals which spread and delete are place-less nasals. In some languages nasals spread their nasality onto neighboring vowels only when they debuccalize. In many languages the assimilation of a nasal to the point of articulation of a following consonant changes [N] to a regular nasal stop and hence prevents the nasal from undergoing "absorption". These phenomena can be explained on the assumption that [N] undergoes "absorption" but not [**m n ŋ**]. One other argument may be given for this position. If nasal must debuccalize before being "absorbed" we need not <u>stipulate</u> that the vowels do not assimilate the place features of the "absorbed" nasal along with the nasality because we can assume that the place features of the nasal are no longer present when "absorption" takes place as shown in (64):

64)

```
   labial
    |
    pl [+N]          [+N]        [+N]
    | /               |           /\
  sl sl       -->   sl sl  -->   sl sl
   v m               v N          v  N
```

Although I derive nasal vowels from [v+N] sequences, this should not be taken to disprove the existence of underlying nasal vowels. In fact, we have a criterium for deciding when vowels are underlyingly nasal and when they are not, at least in some cases. We know that if vowel nasalization is bled by place assimilation rules, the place-less nasal glide [N] is involved. If there is contrast between nasal and oral vowels in position before NC clusters, [N] is not involved and the nasal vs. oral contrast is in the vowels.

Chapter 5

ON PLACE ASSIMILATION

In this chapter I will argue that place assimilation is not necessarily a feature filling operation. It is my contention that the derivation:

1) vn --> vN --> ṽ

is a natural one in the sense that each step is (acoustically or articulatorily) motivated and cross-linguistically attested. The derivation could not be a natural one in this sense if it could be shown that a great many languages compute derivationally intermediate [N]'s that do not undergo the absorption process in (1) but that behave in such a way that there is no way of predicting what will happen to [N] in a particular context. Mascaro's(1987) theory of place assimilation is a challenge to our theory because Mascaro would derive all NC clusters by debuccalizing nasals first despite the lack of (articulatory or acoustic) motivation for this derivation. I agree with Mascaro that feature filling place assimilations exist; however, I dispute the validity of generalizing feature filling place assimilation to all cases. Three arguments are given:

(i) If place-less segments are preferred targets of place assimilation then the fact that continuant obstruents debuccalize (e.i. [s] --> [h]) much more frequently than they assimilate in place to a following consonant is left without explanation unless one assumes that the [h]'s which derive from continuant obstruents (by debuccalization) resist place assimilation (for whatever reasons). But this assumption is difficult to maintain. Since underlying [h] assimilates place features with relative ease, Mascaro must distinguish [+consonantal] [h] (derived from /f s x/) which resists place assimilation from underlying [-consonantal] [h] which does not resist it. But there is no independent evidence to distinguish two types of [h] (see § 1.1), it seems best to attribute the peculiar behavior of fricatives to their intrinsic articulatory or acoustic properties.

(ii) The feature filling approach to place assimilation cannot explain the markedness facts determining the asymmetrical behavior of the triggers of place assimilation. Labials tend to spread their place features onto a preceding nasal more often than velars (English and Polish place assimilation § 5.2). A possible explanation of this fact is that the assimilation by a nasal to a following velar is discouraged because it gives rise to angma, a linguistically marked segment. This explanation cannot be translated in terms of a strictly feature filling approach to place assimilation because it predicts that nasals which fail to assimilate to velars will surface as place-less [N] contrary to fact.

(iii) Coronal nasals in English and Polish undergo optional place assimilation processes. Since these nasals surface as [n] (not as place-less [N]) whenever they happen not to assimilate, the feature filling theory of place assimilation must assume that the surfacing [n]'s acquire their point of articulation by default after place assimilation has applied: [mp] -->(debuccalization) [Np] -->(place assimilation did not apply) [Np] -->(coronalization) [np]. However, a default rule introducing the coronal point of articulation is not supported by independent evidence. If place assimilation is feature filling and coronals are underlyingly unspecified for point of articulation, one cannot derive the cross-linguistic distribution and typology of segments undergoing and triggering place assimilation. Moreover, there is no evidence that place-less segments [ʔ h N] ever become coronal; if anything, they tend to become velar as argued in (§3.3).

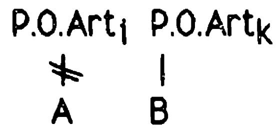
I will begin by presenting Mascaro's analysis of place assimilation and the motivations behind it.

5.1 Mascaro's analysis of place assimilation

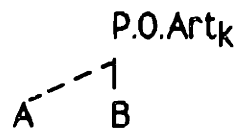
According to Mascaro(1987) place assimilation is a feature filling process defined as in (1):

2) Debuccalize-spread (DS): Place assimilation is an operation consisting of two ordered steps (a) and (b):

(a) Debuccalization:



(b) Spreading:



The intuition behind this approach (henceforth DS) is that the loss of place features (in our terms, debuccalization) of A encourages the spreading of the point of articulation of B onto A. The debuccalization of A is a phenomenon which is not motivated in any sense by the spreading onto A, and hence is ordered prior to the spreading in the derivation.

The DS approach to place assimilation is based on the observation that the typology and distribution of segments that undergo place assimilation and that of segments which undergo debuccalization surfacing as [h or ?] is very similar:

Consonants which assimilate to another consonant are usually in pre-consonantal position: in a cluster AB, A will assimilate to B rather than the other way around because A is in pre-consonantal position whereas B is not. Similarly, consonants tend to debuccalize before other consonants and before pause. In Capanahua(Loos 1969), [t] becomes [?] before a consonant or glide or before pause:

3)

bit͡ʃ-	'to take'
bi?makin	'caused to take'
bi?wi	'take it'
bi?nawi	'take it (pl)'
bi?ba?inkin	'took it away'
bi?tanwi	'go take it'
bi? * ta * haiki	'he is taking it'

Onset stops rarely become homorganic with the following liquid, glide or vowel (Browman&Goldstein1987). Similarly, onset stops rarely debuccalize to [h or ?] in position before liquids, glides or vowels. Place assimilation usually affects stops; fricatives rarely undergo place assimilation. For example in Japanese all consonants assimilate the point of articulation of a following consonant with the exception of obstruent fricatives, which trigger epenthesis instead:[1],[2]

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[1]I follow Ito(1986) in assuming that palatalization is distinctive in Japanese consonants (except before [i] where consonants are always palatalized). The epenthetic vowel is front [i] before palatalized consonants and back [u] before plain consonants. This is true of the Sino-Japanese vocabulary. In the verbal conjugation system, the epenthetic vowel is always [i] (see Poser 1983).

[2]Of course, such data can also be analyzed as involving a rule deleting high vowels (e.g. [i]) after all consonants except obstruent fricatives (assuming place assimilation is a process fed by vowel deletion). Support for this approach can be gathered from the Kagoshima dialect of Japanese (§ 2.0). In this dialect final high vowels delete after consonants triggering a rule of debuccalization: oku --> ok --> [o?] 'to put'. After fricative obstruents, there is no vowel deletion and no debuccalization: osu --> (no vowel deletion, no debuccalization) [osu] 'to push'. To derive [osu], we cannot assume that the [u] is epenthetic (i.e. that epenthesis applies obligatorily after fricative obstruents), because the epenthesis analysis works only if the epenthetic vowel in the verbal paradigm is always [i] and [osu] is a verb (see previous footnote this section). This means that the [u] in [osu] has failed to delete. The same might be occurring in the standard Japanese data in text example (4): the reason why fricative obstruents do not undergo place assimilation is that high vowels do not delete after fricative obstruents (assuming that a rule deleting high vowels after consonants feeds place assimilation).

4)

yom-ta --> yonda	'read-past'
kap-ta --> katta	'buy-past'
kar-ta -> tatta	'shear-past'
kas-ta --> kaʃita	'lend-past'

Similarly, debuccalization usually affects stops. That fricatives tend to preserve their point of articulation can be seen in Capanahua(Loos 1969). In Capanahua the stops [p t k] delete while the affricate [t͡ʃ] becomes [ʔ] before consonants, glides and before pause; in the same context [s] [ʃ] and retroflex [ʂ] remain unchanged:

5)

nanitbaʔini --> nanibaʔini	'get right aboard'
nanitmawi --> nanimawi	'make him get aboard'
hamakwi --> hamawi	'step on it'
hamakʔona --> hamaʔona	'comming stepping'
ʔawapʔon --> ʔawaʔon	'about a tapir'
hamakhakin --> hamahakin	'to step down on it'
ʔiʔsap --> ʔiʔsa	'bird'

but:

hamakʔoʂki --> hamaʔoʂki	'he stepped on it'
nanitʔoʂki --> naniʔoʂki	'he got aboard'
hisis --> hisis	'ant'

Debuccalization/place-assimilation target segments in coda position. One might speculate that debuccalization applies typically to coda segments in obedience to a universal tendency to maximize the sonority of syllable codas (Clements 1987) (assuming that the sonority of a segment increases by debuccalization). However, I do not rule out the possibility that acoustic factors independent of syllable structure are relevant to the above said processes. These additional acoustic factors predict the existence of regular asymmetries that are independent of syllable structure. However, the task of establishing the existence of such asymmetries lies beyond the scope of this thesis, so I must leave the question open. I will only note here that it appears that the positions in which a segment will tend to undergo place assimilation/debuccalization are those in which the <u>release</u> of the segment's occlusion is acoustically disturbed (in contrast to a position where the <u>onset</u> of a segment's occlusion is acoustically disturbed).[3] In pre-consonantal position, the release of a segment can be disturbed by the onset of a following consonant. In pre-pausal position the release of a segment can be disturbed because it can be omitted. It also appears that the types of segments which tend to undergo place assimilation/debuccalization

[3] **We cannot assume that regressive place assimilation is preferred over progressive place assimilation because regressive (anticipatory) spreading is favoured over progressive (conservative) spreading. Though many spreading processes not involving place are regressive (e.g. voicing assimilation in Russian), many are progressive (e.g. round harmony in Turkish) An alternative account for prevalence of regressive place assimilation is proposed by Hankamer and Aissen(1974). Cross linguistically, languages apply syllabification algorithms such as to maximize the sonority of their syllable codas and to minimize the sonority of their syllable onsets. This means that <u>A</u> will tend to be more sonorous than <u>B</u> whenever <u>A</u> and <u>B</u> form a hetero-syllabic consonant cluster <u>A.B</u> . Now, according to H&A(1974) there is a general principle by which more sonorous consonants tend to assimilate the point of articulation of less sonorous ones; consequently, in cluters <u>A.B</u>, where <u>A</u> is more sonorous than <u>B</u>, <u>A</u> will tend to assimilate the place features of <u>B</u> ; consequently, place assimilation will tend to be regressive. H&A's proposal makes some undersirable predictions and some desirable ones. H&A claim that in Pali assimilations such as r+y --> yy, s+y --> ss, r+s --> ss, s+t --> tt^h, l+m --> mm, l+b --> bb, entail that the sonority hierarchy for Pali is r --> y --> l --> N --> s --> t in diminishing order of sonority. But cross linguistically, glides are more sonorous, not less sonorous, than liquids, so this cannot be correct. On the other hand, if coronals are more sonorous than labials and velars at least in some languages (see. e.g. Steriade(1982)); then coronals should assimilate more frequently than labials and velars, as seems to be the case generally. But H&A predict that clusters ending in a coronal should assimilate progressively e.g. [pt]--> [pp] as frequently as clusters begining in a coronal assimilate regressively e.g. [tp] --> [pp]. This does not seem to be true. H&A also predict there should be no preferred direction of assimilation between segments of equal sonority e.g. [p] and [k].**

are those whose point of articulation is best distinguished in the release; hence, stops undergo place assimilation/debuccalization more often than fricatives. The fact that nasal stops assimilate more readily than oral stops may be attributed to the former's weaker perceptual distinctness of the point of articulation.[4]

The above observations indicate that place assimilation and debuccalization share a set of necessary or sufficient conditions. Given this sharing, one might be tempted to hypothesize that the necessary conditions for consonant debuccalization are a subset of the ones needed for place assimilation. The next step is to assume that debuccalization is a necessary condition for place assimilation, as in the DS approach. However, if place-less segments are preferred targets of place assimilation then the fact that continuant obstruents debuccalize much more frequently than they assimilate in place to a following consonant is left without explanation. That is, syllable final continuant obstruents debuccalize in many languages: e.g. [x] --> [h] in Caribbean Spanish(Harris 1969), English(SPE), Yucatec Mayan(Straight 1976), Choktaw (Nicklas 1975), Desano (Kaye 1965); [s] --> [h] in Caribbean Spanish(Harris 1969), Sanskrit (Schein&Steriade 1986), Desano (Kaye 1965) etc. By contrast rules of the type [s] --> [ɸ s x] (or [p t k]) /___[p t k] seem to be very rare. I only know of one example: [s] --> [ɸ s ś ṣ] / __ [p s ś ṣ] **in Sanskrit** (Schein&Steriade 1986).[5] To derive this gap the

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[4]**However, Chen(1973) argues from cross-dialectal comparisons in Chinese that <u>unreleased</u> oral consonants debuccalize more readily than nasal consonants in wordfinal position.**

[5]**Another example may occur in Desano (Kaye 1965), where it appears that a fricative obstruent of some sort becomes [ɸ h x h h] before [p t k s x]. However, this case can be derived as a development from geminate consonants similar to the case occurring in Icelandic: /pp tt kk ss hh/ --> ɸp θt xk ss hh --> [ɸp ht xk hs hh]. With respect to the Sanskrit and Desano cases, it appears that a continuant cannot remain be strident when**

DS analysis must assume that [h] (< [f s x]) does not readily undergo place assimilation. Since underlying [h] undergoes place assimilation with relative ease (e.g. Maliseet § 5.2, Choctaw(Nicklas 1975), [h] in Toba Batak (Hayes 1976a)) the DS analysis must assume the existence of two types of [h]: [-consonantal] [h] which undergoes place assimilation and [+consonantal] [h](< [f s x]) which resists it. However, there is no independent evidence that confirms this distinction between two types of [h]. A simpler account of why [f s x] resist place assimilation would attribute this behavior to the surface acoustic or articulatory properties of [f s x] rather than to the properties of an abstract laryngeal segment associated with these segments.[6]

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it assimilates the place features of a bi-labial stop: e.g. we get [ɸ] and not [f] before [p]. This suggests that the feature [+strident] should be substituted by [+labio-dental] for LABIAL and [-dental] for CORONAL (there appears to be no comparable instruction for the DORSAL articulator). If this is true, [f] and [s] should never spread place without spreading labio-dentality and alveolarity respectively (as in Catalan (§ 7.2) and Spanish (§ 3.3.4)). Labio-dentality and alveolarity should only spread from labial to labial and from coronal to coronal respectively (as in Spanish [m#f] --> [ɱ#f] but [m#s] --> [m#s] Harris 1984).

[6]Moreover, stops debuccalize to [h] if aspirated and to [ʔ] if glottalized (Yucatec Maya Straight 1976) so the DS analysis predicts that [+consonantal] [h] (<[ph th kh]) will resist place assimilation (i.e. that aspirated stops should resist assimilation). I do not know if this prediction is confirmed by the data. Yucatec Maya data: : a) leʔ iŋ w ot t͡ʃoʔ --> leʔ iŋ w oh t͡ʃoʔ 'that house is mine' b) tuŋ kolik kaaʃ --> tuŋ kolih kaaʃ 'he's clearing bush' c) tan a lik'sik --> tan a liʔsik 'you're raising it'. The debuccalization of (a) and (b) applies to the first member of a cluster of homorganic stops or affricates separated by a word boundary. The debuccalization of (c) applies to the first member of a sequence of ejective plosive plus plosive. [p t k] are described as slightly aspirated in coda position and strongly aspirated in onset position.

5.2. Optional place assimilation and the role of markedness

Crucial to the argument against Mascaro's theory of feature filling place assimilation is an understanding of the markedness of [ŋ] and what it implies. The difficulty in articulating dorsal nasal stops is reflected cross-linguistically in the fact that the number of languages which have [ŋ] is approximately half the number of languages which have [m] or [n] ("the presence of either [ɲ] or [ŋ] in a language implies the presence of both [m] and [n]"(Maddieson1984:69)). Languages that contrast nasal and oral stops at the labial and coronal points of articulation often fail to extend this contrast to the velar point of articulation. For example, Russian has the following series of stops in its surface inventory:

6)

p	p͡y	t	t͡y	k	k͡y
b	b͡y	d	d͡y	g	g͡y
m	m͡y	n	n͡y		

where complex C͡y and plain C differ in that the former have a secondary dorsal articulation. Note that oral stops at the labial and dental points of articulation contrast with nasal stops, whereas stops at the velar point of articulation are always oral. We may explain this asymmetry if we assume that velar nasal stops are more difficult to produce than coronal or labial ones.

A similar explanation may be given for languages such as Winnibago (**White Eagle 1988 in progress**) where labial and coronal stops undergo alternations in nasality to the exclusion of the velars. The segment inventory of Winnibago is: labials /**p, p', b, w** /, coronals /**t, t', d̥~ř , t͡ʃ, d͡ʒ, s, s', z, ʃ, ʃ', ʒ, y** /, velars /**k, k', g, x, x', ɣ** /, vowels / **i, ĩ, u, ũ, a, ã, e, o**/ and laryngeals /**h**/. The distribution of nasal consonants in Winnebago is predictable from the distribution of nasal vowels. The consonants under the first column in (7) below cannot precede nasal vowels, those under the second column cannot precede oral vowels:

7) <u>Before Oral vowel   Nasal vowel</u>

b	**m**
d̥~ř	**n**
d͡ʒ	
g	
w	**w̃**
y	**ỹ**
ɣ	

As shown above the Winnebago system is skewed: Winnebago has no [**ŋ**] corresponding to [**g**] or [**ɣ**] and no [**ɲ**] corresponding to [**d͡ʒ**]. Now, there are two ways of deriving these facts, and to date I have no way of choosing between them. One way is to assume that nasal consonants [**m n w̃ ỹ**] are underlyingly unspecified for nasality and become nasal by assimilation to a following nasal vowel. This would imply that there are no underlying nasal consonants in Winnebago; only vowels have an underlying nasal vs oral contrast:

8)
bãã --> **mãã**   'earth'

dĩĩ --> nĩĩ 'water'
wããk --> w̃ããk 'man'

9) but:

gũũs --> gũũs 'teach'
wayĩ yĩ -->wayĩ yĩ 'ball'
howeyũ --> howeyũ 'blow into something'

If we look at the facts in this way, it would appear that the rules of a language avoid creating [ŋ] for reasons of markedness (a similar argument may be given for the avoidance of [ɲ]). --Here I follow Calabrese's(1988) theory of markedness hierarchy and its influence on phonological processes. The fact that certain phonological processes avoid creating certain segments is traditionally attributed to structure preservation: the tendency not to create segments which do not exist in the phonemic inventory. Calabrese(1988) criticizes this approach on the basis that there are too many counter-examples to structure preservation for the principle to have any explanatory power. He reformulates the arguments for structure preservation as arguments for a markedness hierarchy. -- Alternatively the data in (8) may be derived on the assumption that the alternating segments in Winnebago are underlyingly [**m n w y**]: [**m n**] become oral before oral vowels and [**w y**] become nasal before nasal vowels. This second derivation would not require us to say that a rule refrains from applying so as not to create a marked segment.[7]

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[7]**There are two words in Winnebago which have a nasal consonant before an oral vowel: [nee] 'Emphatic pronoun 1&2 person' not used in sentences and [mee] 'interjection'. Since these two words are so special it is arguable that they do not tell us much about the underlying inventory of Winnebago.**

Place assimilation processes in some languages refrain from creating [ŋ]. For example, in Polish (Higgins 1988) word-internal [**n**] obligatorily assimilates the point of articulation of a following labial stop. In fast speech, [**n**] assimilates to a following stop irrespective of place of articulation. The fast speech assimilation applies within words and across word boundaries.[8] This means that word-internal [**n**]+labial sequences always become homorganic [**m**]+labial; but word-internal [**n**]+velar sequences only become homorganic [ŋ]+velar in fast speech. A similar behavior can be observed for the prefixes /**in**-/ 'not' and /**con**-/ 'with' in English(Webster Dictionary 1971):

10) Polish

bomb	'bomb'
bank --> [**bank**] ~ (faster speech) [**baŋk**]	'bank'
pan bug --> [**pan bug**] ~ (faster speech) [**pam bug**]	'Lord God'

11) English:

i[**n**]admissible
i[mp]artial
i[nd]iscreet
i[ng]lorious ~ (faster speech) i[**ŋg**]lorious

co[**mp**]assion
co[**nt**]emporary
co[**nk**]urrent ~ (faster speech) co[**ŋk**]urrent
co[**nk**]ourse ~ (faster speech) co[**ŋk**]ourse

---

[8]A third rule has not always been recognized as distinct from the other two rules in Polish. This third rule makes [w̃] assimilate to a following stop irrespective of place of articulation; it is obligatory and applies within words only: see Higgins (1988). We shall not be concerned with this third rule here.

How do we explain such data? Consider the optional place assimilation rule in Polish and English. The DS analysis predicts that at some stage in the derivation before spreading, debuccalization has applied to the nasals in (10-11), giving [paN bug] and [baNk] etc. If what is optional in the optional place assimilation processes in (10-11) is the spreading, then we should have found [paN bug], [baNk] etc. in free variation with the assimilated forms. But the forms [paN bug], [baNk] etc. never surface. Instead, nasals surface with their original point of articulation whenever they fail to assimilate in both languages. Consequently, the DS theory must assume that what is optional in the place assimilation process of Polish and English is the debuccalization. This assumption is objectionable on two counts:

(i) The analogy between optional place assimilation in Polish and English and optional debuccalization of consonants to [h ʔ] in other languages cannot be easily maintained. Let us assume that what is optional in the optional place assimilation processes of Polish and English is the debuccalization. Since word-internal [n] assimilates obligatorily to a labial in both languages, we must assume that word-internal [n] debuccalizes obligatorily before labials and optionally before velars in both languages. But there is no independent evidence for this hypothesis. In particular, we have no cross-linguistic evidence that [n] or coronal consonants in general debuccalize and become [N h or ʔ] more readily if the following consonant is labial than if it is velar. Rather, the reason why [n] assimilates more promptly to labials than to velars might be that [m] is cross-linguistically less marked than [ŋ].[9] In other words, whatever process spreads the point of

[9]**Alternatively the 'hiding' effect of labials is stronger than the "hiding" effect of velars because an occlusion interrupts the acoustic signal of any occlusion behind it**

articulation of consonants onto preceding nasals is subject to a filter which discourages the creation of cross-linguistically marked segments such as [ŋ]. I conclude that the DS approach cannot explain the markedness facts determining the asymmetrical behavior of the triggers of place assimilation.

(ii) A second drawback of the DS approach is that it does not explain how in Polish and English [**n**] remains [**n**] whenever it fails to assimilate. The only way to solve this second problem and yet preserve the spirit to the DS approach is to assume that, first, [**n**] looses its point of articulation and becomes [N], then, spreading applies, and finally, any [N]'s that have failed to undergo spreading become [**n**] through the application of a context free redundancy rule specifying all [N]'s as coronal. The idea is summarized in the following derivations of word-internal clusters in Polish:

12)

nm -->(debucc.) **N m** -->(obligatory spreading) **mm** --> (coronalization) **mm**
nk -->(debucc) **N k** -->(optional spreading) **ŋk** --> (coronalization) **ŋk**
n k -->(debucc.) **N k** --> (optional spreading n/a) **Nk** --> (coronalization) **nk**

These derivations ensure that [**n**] remains [**n**] whenever it fails to assimilate and at the same time obey the principle that spreading is motivated by the target's loss of point of articulation.

(see further in the text for a discusion of "hiding"). But the "hiding" effect cannot be reduced to the simple principle that a less anterior consonant assimilates to a more anterior one. In Catalan, English, and Ponapean, coronals assimilate to a less anterior velar consonant, while velars do not assimilate to a more anterior coronal consonant. Clearly, other factors are involved.

The weakpoint of the solution given in the preceding paragraph is that it is repetitive: [n] loses its coronal point of articulation and receives that same point of articulation by a special rule. To avoid this redundancy, we can assume that [n] is underlyingly place-less everywhere in Polish; that is, its point of articulation is predictably coronal because coronal consonants are the least marked kind of consonant cross-linguistically. This approach saves us from positing a debuccalization rule eliminating the point of articulation of [n].

The hypothesis that coronal consonants are underlyingly placeless predicts that coronals will assimilate the place features of another consonant more readily than labials or velars (cf. Mascaro(1987)). This hypothesis is confirmed in a number of languages and has been pointed out in the literature (cf. Browman&Goldstein(1987) and others cited therein).[10] In Polish, English, Yakut and Ponapean, coronals undergo place assimilation to the exclusion of labials and velars:

13) English coronal assimilation (morpheme-internal):

n --> m / __ p b m
ŋ k,g

The rule in (13) disallows heterorganic stop clusters beginning in [n] but allows those beginning in [m] and [ŋ]: lu[mp] a[mt]rak to[mk]ins colu[mn]ar la[ŋd]on a[ŋm]a.

[10]Velar nasals can undergo place assimilation to the exclusion of other nasals (inluding [n]): Chukchi [ŋ] (Odden 1988) and Polish [w̃] (§ 3.3.5).

14) Yakut coronal assimilation:

n,t --> m, p / __ - m, p
ŋ, k ŋ, k

sot-	'wipe'	**sop-pot**	'3 p.s. neg'
suun-	'wash'	**suum-mat**	'3 p.s. neg'

but:

tik-	'sew'	**tik-pet**	'3 p.s. neg'

The rule in (14) affects root final nasals. Yakut(Dobrovolsky1983) has three oral and nasal stops that contrast with [**n**] and [**t**]: [**m ń ŋ**], and [**p č k**]. My source does not mention whether or not all these consonants can occur in root final position, but the statement of the rule assumes that this is the case.

15) Ponapean coronal assimilation (within words and across word boundaries):

n --> m/ __p m
mŵ pŵ mŵ
ŋ k ŋ

with prefix [**nan-**] 'in':

nam-par	'trade wind season'
namŵ-pŵuŋara	'between them'
nam-madaw	'ocean'
namŵ-mŵoalchdi	'to rest'
naŋ-kɛp	'inlet'

with words ending in [**n**]:

kisim pakas	'small species of fish'
kilimŵ pŵihk	'skin of a pig'
kilim malek	'skin of a chicken'
tihŋ kidi	'bone of a dog'

pahŋ ɲeteɲete 'roof of the mouth'

The phoneme inventory of Ponapean(Rehg1981) contains the nasals [**m** **m̂w** **n** and **ŋ**]. My source does not give any examples that show that [**m** **mw** and **ŋ**] do not assimilate to a following stop but the rule given by Rehg presupposes this.

16) Catalan coronal assimilation (Mascaro (1978) [**p̧**] [**ɱ**] are [-distributed] labials (see (§ 7.2) for examples of this process):

n, t --> m p / __ p b
ɱ p̧ f
ŋ k k g

This rule affects coronal consonants [**t**] and [**n**] to the exclusion of all other consonants (including [**m ɲ p č k b d ǰ g**]):

The fact that coronals assimilate more readily than other consonants does not have a simple explanation in terms of minimal articulatory distance. Suppose that (alveolar) coronals assimilate to labials more readily than velars because the distance between the (alveolar) coronal point of articulation and the labial point of articulation is smaller than the distance between the velar point of articulation and the labial point of articulation. Then, we should expect palatals to assimilate more readily to velars than coronals since the palatal point of articulation is closer to the velar point of articulation than the (alveolar) coronal point of articulation is. But we can deduce from Mascaro's(1978) description of Catalan that only [**n**] [**t**] assimilate in place to a following consonant (be it velar or otherwise) whereas [**ɲ**] and [**č**] do not do so. The assumption that coronal consonants are underlyingly place-less is an attractive explanation for an otherwise mysterious fact.

Despite its attractiveness, the hypothesis that coronals are underlyingly place-less poses more problems than it solves. If [**n**] is underlyingly place-less in Polish for reasons of markedness holding of all languages, then, it should be underlyingly place-less in other languages. Moreover, it should be place-less in all positions independently of context. This predicts that coronals (e.g. [**n**] [**l**] [**s**]) should fail in their role as spreader of place features whenever spreading precedes coronalization (as it does in Polish). This does not seem to occur in any of the relevant examples known to me.

Consider the case of Maliseet (Woodstock Newbrunswick). In Maliseet (Le Sourd 1988) [**h**] assimilates the point of articulation and nasality of a following nasal or lateral stop giving rise to a geminate. The examples in (17) involve [**h**] since there is no [?] in the language; the sequences preceded by an asterisk (*) can be reconstructed by comparison with Passamaquoddy forms:

17)

həm --> **hm** --> **mm** compare: **í kətóhəm** 'he yawns'
íkətèmmok 'they-dual yawn'

***hn** --> **nn** compare: **náhnákən** 'it is light in weight' (Passamaquoddy)
nánnákən " " " " " (Maliseet)

***hl** --> **ll** compare: **nótéhlal** 'he lets him out' (Passamaquoddy)
nótéllal " " " " (Maliseet)

A similar rule of gemination applies to [h] in the context [l - _s] deriving [ə- ss] (Maliseet&Passamaquoddy):

18)

-hsin	'lie'
ali-hpo	'he/she eats around'
kwsəká-hsin	'he/she lies across'
áli-hsin --> alə́-ssin	'he/she lies around'

This rule applies in all contexts (there are not morpheme or word internal sequences of l+h+s).

If in Maliseet (as in Polish) coronals are underlyingly place-less and coronalization is ordered after the spreading of place features, then we should expect [hn], [hl] and [hs] to give rise to * [hn] *[hl] *[hs] respectively, contrary to fact:

19)

hN -->(spreading)**hN** --> (coronalization) * **hn**
hL -->(spreading)**hL** --> (coronalization) * **hl**
hS -->(spreading)**hS** --> (coronalization) ***hs**

To derive the correct representation, we must assume that coronalization applies before spreading in this language. The problem is that an oposite ordering has not been found in languages exhibiting similar phenomena.

A more serious problem for the theory of place-less coronals is that if coronals are underlyingly place-less, they should readily assimilate the point of articulation of an immediately following consonant independently of their position in the word. For example, onset [t] is predicted to readily assimilate the point of articulation of a following glide ([t w] --> [p w]) (assuming, of course that what motivates the spreading of point of articulation is the fact that the target consonant lacks its own point of articulation). By analogy, if continuant coronals such as [s] are underlyingly place-less, they should readily assimilate to a following consonant ([s p] --> [f p]). But these asimilations do not occur with any degree of frequency in any language. Thus it appears that the DS analysis with coronals underspecified for place features fails to give a satisfactory derivation of those consonant clusters which resist the process of place assimilation.

On the basis of the above discussion, I conclude that the optional place assimilation rules in Polish and English are not preceded by debuccalization. It is interesting that the X-ray data on place assimilation does not disconfirm this conclusion. Browman and Goldstein(1987) propose that the fast rate of speech used in casual speech may have one or both of the effects in (20)(i-ii):

20)

(i) Gestural overlap: Occlusion gestures may partially or totally overlap one another (occlusion gestures on different tiers may overlap in time and yet proceed relatively independently of one another, without perturbing each other's trajectories[11].)

---

[11]The model is over-simplified. B&G treat occlusion gestures as atomic elements which may or may not overlap. But occlusion gestures are composed of a point of articulation plus a stricture component. The points of articulation of two consonants may overlap while the stricture features do not.

(ii) Gestural reduction: The magnitude of some of the occlusion gestures may become reduced.

According to B&G casual speech processes can only produce (i) and (ii). Casual speech processes cannot introduce units (gestures) or alter the units except by reducing their magnitude --phonological rules introducing segments or changing segments are not part of casual speech processes.-- Since optional place assimilation is a casual speech process, we must be able to explain it in terms of (i) and (ii) alone. This means that the removal of the point of articulation of a segment required in the DS model of place assimilation is ruled out, at least for casual speech.

X-ray data taken from English speakers demonstrate that in optional place assimilation processes where AB --> BB a dampened form of A's occlusion gesture is usually present articulatorily, even though acoustically, only the point of articulation of B is heard and recorded. This means that the occlusion gesture of B acoustically "hides" (but does not articulatorily replace) the occlusion gesture of A. For example, X-rays show that the coronal occlusion of the word final nasal in seven is articulatorily present in the phrase seve[m] plus even though the casual speech pronunciation of this word is recorded as ending in [m].

B&G note that the hiding effect takes place in two ways (a) when the occlusion gesture of B slides back into the gesture of A so that there is a total overlap in the two occlusion gestures, the sequence AB may be heard simply as B:

(21) Gestural timing relations between occlusion gestures A and B:

```
             no overlap                 -->       total overlap
              [AB]                                    [B]
A     [----------]                                [-----------]
B                    [----------]                 [-----------]
```

(b) When there is a partial overlap in the occlusion gestures of A and B accompanied by a reduction in the magnitude of A's occlusion gesture, the sequence AB is heard as BB. B&G hypothesize that the acoustic "hiding" of A's occlusion in such cases (which are those that are heard as involving place assimilation) is due to the combined effect of the gestural reduction and the partial gestural overlap. The partial gestural overlap is not enough to cause acoustic "hiding" because partially overlapped clusters AB do not sound homorganic if the magnitude of A's occlusion gesture is not reduced as well:

22) Gestural timing relations between two occlusion gestures A and B:

```
             no overlap                 -->       partial overlap
              [AB]                                     [BB]
A     [----------]                                     [-----------]
B                    [----------]                 [-----------]
```

I conclude that the overlap-reduction model of place assimilation (henceforth OR) sketched above predicts that two articulatory processes in casual speech may cause the acoustic effacement of an occlusion gesture: gestural reduction (affecting magnitude) and gestural overlap (affecting timing relations). B&G do not provide a complete list of the type and distribution of segments that can undergo either process. At the begining of this chapter I have made a proposal identifying the type and distribution of segments undergoing debucalization, which might be conceived as the limit of gestural reduction. I do not know if there are any restrictions on the type and distribution of segments undergoing gestural overlap. Nothing in the OR model prevents spreading (occlusion overlap) from applying in clusters of type AB when the target A is a fricative or when B is a liquid:

23)

sp	-->	s͡ɸ p	or	s͡p p
pr	-->	p͡ɽ r	or	p͡r r

These overlaps are predicted to exist in casual speech, but I have so far seen no instances of them described in the literature. It is nonetheless possible that the overlaps exist at the articulatory level, but are not easily perceived as such.

The OR model of place assimilation is useful as a model of the acoustic effects of co-articulation and as a model of why certain clusters tend to be perceived as homorganic when they are not. If we assume that speakers tend to imitate what they hear, it is a useful model of why languages acquire place assimilation rules, and of why those rules are formulated to affect certain clusters and not others. What the OR model does not do is tell us exactly how place assimilation rules are formulated at the phonological level. The phonological notation is meant to construct the "intended" utterance which is an abstract object whose elements are of a discrete, categorical nature.[12] The notation was developed on the basis of possible phonemic inventories and processes (including non-local and non-

[12] **The term "intended" utterance should not be understood to stand for whatever is actually intended in full awareness of what one is doing, nor is it whatever is obligatory excluding what is optional.**

assimilatory processes which cannot be attributed to co-articulation or subsumed under the OR model). By contrast the OR model is a model of what is actually heard vs. what is actually articulated, and does not explain how an acoustic "hiding" effect is interpreted phonologically by the person trying to imitate that "hiding" effect. In other words it is not clear that the OR model is relevant to a phonological theory of place assimilation. It is nevertheless interesting that the OR model supports the conclusion that place assimilation is not necessarily preceded by debuccalization.

For the sake of completeness I note that the OR models has not yet developed an explanation of why coronal stops are preferred targets of place assimilation. I rejected the hypothesis that coronal stops tend to undergo place assimilation because they are place-less in underlying representation. A possible explanation of the exceptional behavior of coronal stops in place assimilation processes is that they are prone to gestural overlap and hence, are easily 'hidden' (undergo place assimilation) in environments of gestural reduction (i.e. before obstruents etc.). Browman&Goldstein(1987) mention that tongue tip movements show higher velocities than do either tongue dorsum or lip movements (which are about equivalent to each other) suggesting it might be easiest to hide a [**t**] or [**n**] under a slower, longer lip or tongue dorsum movement. This proposal is controversial because the experimental data do not completely support it. Hardcastle&Roach(1979) cited in B&G measured the time from the onset of the first closure to the onset of the second closure in stop consonant sequences using electropalatography. They found that on the average, this interval was shorter for /**tk**/ sequences than for /**kt**/ sequences. Thus, the [**t**] in /**tk**/ sequences show a greater tendency toward a complete overlap than the [**k**] in

/**kt**/ sequences, as predicted by B&G. The problem is that H&R found no difference between /**tp**/ and /**pt**/ sequences: the durations of pre-consonantal [t] and [p] are comparable; hence, the [**t**] in /**tp**/ sequences shows no greater tendency toward a complete overlap than the [**p**] in /**pt**/ sequences.

5.3 Some possible instances of feature filling place assimilation

One possible instance of feature filling place assimilation occurs in Aguaruna. Recall that in this language [N] undergoes place assimilation while [**m, n, ŋ**] do not do so:

24) **nuN-a-t** --> **nuN-t** --> **nunt** --> [**nũnt**] 'to hide something'
v. del P.A. local nasalization

25) **t͡sanu-ma-ka-u** --> **t͡sanu-m-ka-u** --> [**t͡sanũmkau**] 'to deceive'
v. del. P.A. & local nasalization

26) **it͡ʃinak-na** --> **it͡ʃinkan** --> [**it͡ʃĩnkan**] 'to the clay pot'
v.del. P.A. & local nasalization

27) **duha-ŋu-tinu** --> **duha-ŋ-tin** --> [**duhãŋtin**] 'rise-asp-fut'
v.del. P.A. & local nasalization

Example (24) shows that vowel deletion feeds PA. Examples (25-27) show that only [N] undergoes PA in contrast to [**m**] or [**n**] or [**ŋ**]. One way of restricting this process to [N] is by requiring the target to have no place features. But of course, there is another way of restricting this process to

[N], e.g. by requiring the target to be [-consonantal] (there is no need to specify the target as [+nasal] since [**y w** h] never occur in position before consonants anyway). Note that, even if Aguaruna represents a case of feature filling place assimilation, the behavior of [**n**] is not as would be expected if coronals were underlyingly unspecified for place. If [**n**] had been unspecified for place, it would have assimilated contrary to fact. I take this as additional evidence against the underlying underspecification of the coronal point of articulation.

Another possible case of feature filling place assimilation occurs in Japanese. In Japanese [N] readily assimilates in place to a following consonant. It is reasonable to attribute this to the fact that [N] is place-less. Consider the following data:

28) Sino-Japanese compounds:

taN-i	'unit-SJ'
dai-gaku	'university-SJ'
gaku-iN	'school-SJ'
gaku-batsu	'academic clique-SJ'
gaku-čoo	'school president-SJ'

Sino-Japanese morphemes must conform to a monosyllabic CV$_i$(X) template, where X = [**t k N y** V_i]. For purposes of exposition, I will only discuss what happens to the first member of compounds and I will ignore what happens to the second member. If the first member ends in a [+consonantal] segment, an epenthetic vowel (shown in bold letters in (28)) is inserted after that segment. The epenthesis rule explains the contrast between [**dai-gaku**] 'university-SJ' or [**taN-i**] 'unit-SJ' with no epenthesis after [-consonantal] [**i**] or [**N**] and [**gaku-iN**] 'school' with epenthesis after

[+consonantal] [k]. The following data show that no epenthesis occurs if the first element of a Sino-Japanese compound ends in [t] and a voiceless consonant follows or if the first element ends in [N]:

29)

bet-kaku --> **bek-kaku**	'different style-SJ'	(cf: ***betu-kaku**)
bet-puu --> **bep-puu**	'separate cover-SJ'	
bet-situ --> **bes-situ**	'separate room-SJ'	
bet-taku --> **bet-taku**	'detached villa-SJ'	
saN-po --> **sam-po**	'stroll-SJ'	
saN-kai --> **saŋ-kai**	'three floors-SJ'	
saN-teN --> **san-teN**	'three points-SJ'	
saN-sai --> **san-sai**	'three years old-SJ'	

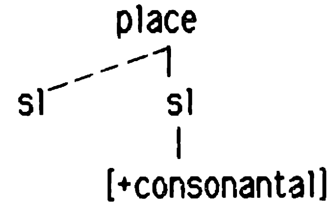
If the first element of a Sino-Japanese compound ends in [t] and a voiced consonant follows, epenthesis applies and [t] does not assimilate; by contrast, epenthesis never applies after [N] and [N] assimilates in all cases:

30)

butu-ryoo	'power of wealth-SJ'	**saN-boN** --> **sam-boN**	'three long pieces'
butu-noo	'payment in kind-SJ'	**saN-geN** --> **saŋ-geN**	'three houses-SJ'
butu-zyoo	'state of affairs-SJ'	**saN-daN** --> **san-daN**	'three steps-SJ'
butu-gi	'public discussion-SJ'	**saN-zeN** --> **san-zeN**	'three coursesSJ'
butu-zei	'tax on possessions-SJ'		

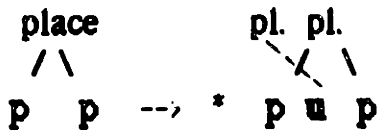
Let us assume that the assimilations of [t] and [N] result from the application of a single rule of place spreading, and that the rule acts quite generally in the Sino-Japanese and Yamato vocabularies:

31) Place spreading:



Let us also assume, following Ito(1986) that spreading bleeds epenthesis because once a homorganic or geminate cluster is created, the insertion of a vowel violates the prohibition against crossing association lines:[13]

32) Epenthesis: ø --> v / [+consonantal] __ #[14]



Finally, if (31) is a feature filling process, we must assume that a prior debuccalization rule targets [t] in the context of a voiceless consonant:

---

[13]But the data in footnote (2) suggests that vowel syncope feeds place deletion, contrary to this assumption. A rule which place asimilation does bleed is the rule changing onset /p/ to [ɸ]. Place assimilation applies in the innermost layer of compounding. Consider the following examples:
a. [[sya = zitɯ] pa] 'realist movement' [betɯ [pai = tatu]] 'special delivery'
b. [bek = kaku] not *[betɯ = kaku] 'different style'
According to McCawley, the innermost morpheme boundary marked (=) joins two morphemes into a self standing word. A comparison between the cases in a and the case in b indicates that the epenthetic vowel is not inserted when place assimilation applies across the innermost morpheme boundary marked (=) creating geminate [kk]. Similarly onset /p/ does not become [ɸ] if it spreads its place features to /N/ or /t/ across the innermost boundary marked (=). Compare: [sam = po] 'stroll'; [[dem = puN] situ] 'starchy matter' ; with: [?ei = zeN] ɸi] 'cost of building and repairing' ; [siN [ɸatu = mei]] 'new invention'. Compare: ?it = piki --> ?ippiki 'one(animal)' go = piki --> goɸiki 'five(animals)' with poo=ritu --> ɸooritu 'law'. It is apparent that the [mp] and [pp] clusters created by place assimilation fail to undergo the onset-/p/ to [ɸ] rule by virtue of inalterability (Schein& Steriade(1986)).

[14]I follow Ito(1986) in assuming that palatalization is distinctive in Japanese consonants (except before [i] where consonants are always palatalized). The epenthetic vowel is front [i] before palatalized consonants and back [u] before plain consonants. This is true of the Sino-Japanese vocabulary. In the verbal conjugation system, the epenthetic vowel is always [i] (see Poser(1983)).

33) Coronal debuccalization (S-J compounds):

```
      coronal
         |
      place --> ø /   __ * x
         :                |
   [+consonantal]  [+stiff glottis]
```

I mention this rule because if [t] were underlyingly place-less like [N], [t] would assimilate to voiced and voiceless consonants, contrary to fact. Thus fully specified [t] assimilates only in the contexts of debuccalization, whereas place-less [N] assimilates everywhere.

In the Sino-Japanese vocabulary, only [t] and [N] undergo rule (31). But in the Yamato vocabulary, all pre-consonantal consonants and glides undergo rule (31) as shown in by the examples in (34-36). If rule (31) is feature filling, then all pre-consonantal consonants and glides should have debuccalized before the application of (31) in the Yamato vocabulary.

A piece of evidence in favor of this hypothesis is the behavior of NC clusters. In position before another consonant [**m n**] assimilate to a following consonant in point of articulation. Both oral and nasal consonants undergo this process:

34)

fum-tuke-ru --> **fun-duke-ru**	'take on-Y'
yob-ta --> **yon-da**	'called-past-Y'
tuk-das-ru --> **tun-das-u**	'put out-Y'

If **[m n]** undergo debuccalization <u>before</u> (31), then, wherever rule (31) fails to apply, these nasals should surface as place-less [N]. This seems to be the case. Before continuants nasal consonants exhibit one of two possible pronunciations depending on the dialect or perhaps idiolect. Some dialects assimilate **[m n]** to the place features of a following fricative. Others have [N] before fricatives (see Martin 1954:25 cited in chapter 2). It is plausible to assume that those dialects that have [N] before fricatives have debuccalized pre-consonantal nasals but have failed to assimilate them:

35) /**m** or **n** + **s**/ -->(debuccalization)**N** + **s** -->(spreading does not apply) [**Ns**]

For the sake of completeness I note that the assimilation of point of articulation in (34) is accompanied by a merger rule. Merger turns homorganic clusters into geminates e.g. homorganic CN clusters become NN clusters. The effect of merger is best seen in the Yamato or native vocabulary of Japanese. The examples in (36) show that homorganic CC and CN clusters assimilate all features:

36)

but-kom-ru -->	**(place assim.**	**-merger)**	**buk-kom-u**	'be full-Y'
hik-sage-ru -->	"	"	**his-sage-ru**	'carry-Y'
nor-kir-ru -->	"	"	**nok-kir-u**	'ride across-Y'
hik-meku-ru -->	"	"	**him-meku-ru**	'strip off-Y'

Homorganic NC clusters are special. Nasal consonants do not acquire the voicelessness, orality or continuacy of a following homorganic consonant: we never get ***[san̥-sai]**; ***[sad-sai]** ; ***[saz̃-sai]** 'three years old-SJ'--in some dialects a nasal consonant becomes oral before an oral consonant: /**sin-ta**/ -

-> **[sid-da]** 'to die-past-Y' (Hachijoojima dialect) but this is not the normal form which is **[sin-da]**. We may assume merger does not produce [ŋ̊] or [z̃] because these are marked; nasals are voiced and stopped by default.

There is also a rule of pre-nasalization active in the examples in (34). Pre-nasalization nasalizes the first member of a voiced geminate cluster. If the first member of a cluster is a voiced obstruent or nasal consonant, or if the second member is a voiced obstruent or nasal the resulting cluster becomes a voiced homorganic NC cluster (this holds of the Yamato vocabulary only). Two rules interact with place assim.-merger to produce the forms in (34): voicing assimilation and pre-nasalization. The first two forms in (34) show that if the first member of a cluster is nasal or voiced (=historically prenasalized) the second member becomes voiced. The third form shows the effect of a rule which nasalizes the first half of voiced obstruent clusters: **/tuk-das-/** -->(place assim.-merger) **/tud-das-/** --> (pre-nasalization)**[tun-das-]** 'put-out-Y'. The second form shows the interaction of the three rules: **/yob-ta/** --> (voicing)**/yob-da/**--> (place assim.-merger)**/yod-da/** --> (pre-nasalization)**[yon-da]** 'called-past-Y'. Most dialects of Japanese do not allow voiced obstruent clusters to surface. The Hachijoojima dialect is exceptional in that e.g. **/ʃin-ta/** 'to die-past-Y' and **/asob-ta/** 'to play-past-Y' are pronounced **[ʃidda]** and **[asdda]**; most dialects nasalize the first half of voiced obstruent clusters and pronounce these words as **[ʃinda]** and **[asonda]**. The most obvious application of the pre-nasalization rule can be seen in the intensive infixation paradigm: **/boyari/--> (infix)/boXyari/ -->(spreading)/boyyari/ -->(nas)[bonyari]; /togaru/ -->(infix) /toXgaru/ -->(spreading)/toggaru/ -->(nas)[toŋgaru].**

Chapter 6

AGAINST ALTERNATIVE ANALYSES OF NASAL "ABSORPTION"

In this chapter I argue against a popular model of nasal "absorption" proposed by Halle&Vergnaud(1981), Safir(1984), and lately by Piggot(1987) which does not require the creation of a place-less nasal glide [N]. According to these authors, nasal "absorption" occurs when some process sets the [+nasal] feature of the nasal consonant "afloat". The "floating" [+nasal] feature then links to neighboring segments as shown in (1). Let us call this the "floating" nasal analysis:

1)

```
 [+N]              [+N]              [+N]
  |                                   |
v ŋ  -->(deletion) v ø C --> (relinking) ṽ C
```

This derivation is stipulative, does not account for the nasalization facts of two languages, cannot explain why place assimilation bleeds nasal "absorption" and predicts the existence of patterns of nasalization that have not been found to date. Moreover, as I shall demonstrate in (§ 6.2) we have little evidence that the feature [nasal] can float at all, since it is possible to analyze cases of nasal "prosody" as involving nasal glides.

6.1 Arguments against the "floating" nasal analysis

Four arguments can be given against the "floating" nasal analysis schematized in (1):

(i) The derivation in (1) assumes that the deletion of the timing slot of the nasal consonant somehow sets the [+nasal] feature "afloat" but does not explain why only this feature and not some other feature is set "afloat". Dorsal features can float (cf. Ito 1984). Why is it that the dorsal features of an "absorbed" [ŋ] do not "float" and re-link along with the nasality?

(ii) The derivation in (1) does not account for the nasalization facts in Mandarin Chinese (§3.1) or Choctaw(§ 4.2.2). The derivation in (1) assumes that the nasality of deleted (=disappearing) nasal segment spreads onto a preceding vowel. Mandarin Chinese is a problem for this analysis because both [n] and [ŋ] are deleted (=disappear) before the diminutive suffix but only [ŋ] leaves behind the trace of nasality:

2)

ian-ɤr --> ian-r --> iar 'seal'
kuɤn-ɤr --> kuɤn-r --> kuɤr --> kuər 'roll'
iaŋ-ɤr --> iaŋ-r --> iãr 'sheep'
k'uɤŋ-ɤr --> k'uɤŋ-r --> k'uɤ̃r --> kuə̃r 'free time'

The "floating" nasal analysis predicts that both [n] and [ŋ] should nasalize the previous vowel, as in (3):

3)

```
 [+N]            [+N]            [+N]
  |                               |
v n  -->(deletion) v ø C --> (relinking) ṽ C
```

One could assume that prior to coda deletion a rule sets the [+nasal] feature of [ŋ] (but not that of [n]) "afloat" as in (4):

4)

```
 [+N]            [+N]            [+N]
  |                               |
v ŋ  -->(delinking) v g C --> (deletion) ṽ ø C
```

But this analysis has two flaws. First, it cannot be generalized to cover the nasal "absorption" of other languages, as we shall see momentarily. Second, it does not really explain the difference between [n] and [ŋ] since we must assume that the point of articulation of a nasal influences the delinking of nasality for no obvious reason.

The derivation in (1) assumes that a vowel is nasalized only if the following nasal consonant deletes. But in Choctaw, a [**v+n**] sequence surfaces as a long nasalized vowel [**ṽ:**], which means that the nasal consonant has not undergone deletion. We cannot derive the Choctaw data on the assumption that the [+nasal] feature of the nasal consonant delinks leaving its segmental content behind, as this produces incorrect results:

5)

```
 [+N]            [+N]          [+N]
  |                             |
am-lowak --> ab-lowak --> ã́b-lowak  'my fire'   cf: [ã́:-lowak]
```

We cannot derive the correct form by lengthening the nasal vowel over the [**b**] as in [**ã́b-lowak**] --> [**ã́:-lowak**], since such a derivation would mess up other forms : [**sihĩ́b-li**] --> *[**sihĩ́:-li**] 'to stretch-hn grade'. The facts of Choctaw cannot be derived on the assumption that the [nasal] feature "floats" at all. Rather, we must assume that the whole nasal segment is set "afloat":

6)

```
                                                              [+N]
                                                               /|
v ŋ  C-->(delink segment) v ŋ C --> (spread and nasalize vowel)  ṽ ŋ C
| |  |                    |   |                                |\  |
x x  x                    x x x                                x x x
```

But like other derivations which "float" nasality, this derivation is counter-intuitive. Recall that not all nasal consonants are equally susceptible to "absorption" (labial nasals resist absorption as compared to coronal nasals etc.) The model in (6) must assume that the point of articulation of a nasal influences the delinking of the root node of the nasal. Since the root node contains both place and nasality, this means that the point of articulation of a nasal influences not only the delinking of the place node (which is to be expected) but also influences the delinking of nasality for no obvious reason.

(iii) Another weakpoint of the "floating" nasal analysis concerns the correct statement of inalterability. Let us assume, for the sake of the argument, that coda deletion deletes the timing slot of a nasal while somehow "floating" the nasal feature which eventually nasalizes the previous vowel:

7)

Coda deletion:

```
 [+N]    [+N]
  |
 sl
  |
  x --> ø   / ___
              coda
```

Coda deletion must be prevented from applying to nasals in homorganic clusters which are not "absorbed" in Aguaruna, Capanahua and Western Muskogean. This means that the coda deletion rule must not apply to the geminate structure in (8):

8)

```
[+N] place
  \/  \
  sl  sl
  |   |
  x   x
```

To derive this fact we must assume that the deletion of the timing slot is sensitive to whether or not the segmental material of the nasal is linked exclusively to the nasal or to the nasal and the following consonant. In other words, we must assume that coda deletion obeys Hayes(1986b) Linking constraint:[1]

Association lines in a structural description are interpreted as exhaustive

However, this solution is unsatisfactory because Schein&Steriade(1986) have shown that Hayes' Linking Constraint cannot be correct as stated. Structure-dependent rules may apply to a geminate cluster as long as its segmental content remains intact. Moreover, the restriction against deleting the timing slot of a nasal if it shares the place features with anything else is not motivated. Long vowels and geminate consonants can shorten even though they share place features (e.g. v_iv_i --> $\o v_i$; c_ic_i --> $\o c_i$) so it cannot be the case that the sharing of place features in principle prevents the deletion of half of a geminate. Rather if the deletion rule is restricted to apply to a place-less glide, then place-assimilation will bleed it.

The derivation of nasal "absorption" endorsed in preceding chapters can derive the bleeding effect of place assimilation without the aid of of Haye's Linking Constraint. Nasal absorption targets [N] and [N] is created by debuccalization or place-node deletion. If place assimilation occurs before debuccalization, it will bleed it because debuccalization is subject to

[1]**This solution was proposed by Gui-Sun Moon(1986).**

geminate blockage as defined in Schein&Steriade(1986) (§ 1.2). By this principle, a rule that deletes the place node of nasals in coda position will not be able to apply to a nasal that shares the place node with the following onset consonant as shown in:

```
     [+N]
       :
9) place --> ø   / ___ ]σ

            place
            / \
           m] [p    rule (9) does not apply to [m].
        coda  onset
```

Alternatively, if place assimilation is ordered after debuccalization, it simply destroys the target of absorption because [N] becomes a fully specified nasal stop.

(iv) The "floating" nasal analysis makes a prediction which is not documented in the nasal "absorption" data; namely, that the [+nasal] feature of the deleted nasal can in principle link up arbitrarily far away from the site of the deleted nasal. Let us see why:

"Floating" features (tones) do not attach to the timing skeleton automatically. For example, "floating" tones may remain unlinked causing downstep and if they link to the skeleton at all, they must do so by rule. Pulleyblank(1983) has demonstrated that the rules which link "floating" tones to the skeleton have a non arbitrary format. Rules of tonal association link each "floating" tone to each tone-bearing-unit in a continuous and directional fashion: tones and tone-bearing-units link-up one to one, starting from the leftmost tone and leftmost tone-bearing unit, or from the rightmost tone and tone-bearing-unit.

The "floating" nasal analysis creates a "floating" [nasal] feature. The behavior of this "floating" [nasal] feature should resemble the behavior of other "floating" features. In particular, the "floating" [nasal] feature should obey the rules of feature association: it should link-up to nasality-bearing-units in a continuous and directional fashion. Consequently I assumed in (10) that the [nasal] feature links one to one and right to left. The derivation shows how a "floating" [nasal] feature created by coda deletion relinks to the rightmost available nasality-bearing-unit, skipping a number of c's and v's:

10)

```
  [+N]                 [+N]                          [+N]
   |                                                   |
cv cvn cv cv -->(deletion) cv cvø cv cv -->(re-linking) cv cvø cv cṽ
```

The problem with this derivation is that all the cases of nasal "absorption" that I am aware of result in the nasalization of a vowel that is next to the site of nasal deletion. To rule out this derivation we must assume that the intervening segments are always already specified as [-nasal] before the nasal feature is set "afloat" (even if these intervening segments are redundantly [-nasal] as e.g. fricatives or vowels in a language without nasal fricatives or vowels). But there is no independent evidence in support of such a move.

The "floating" nasal analysis was first proposed by Safir(1974) and Halle&Vergnaud(1981) to deal with the nasalization facts of Capanahua. Recall that in this language nasal consonants spread nasality regresively. The floating nasal analysis treated the bi-directional nasalization associated with nasal "absorption" as an instance of regressive nasalization:

11)

```
 [+nasal]      [+nasal]       [+nasal]    [+nasal]
    |                            |          ////|
wiran-wi --> wira-wi --> wira-wĩ --> w̃ĩr̃ã-w̃ĩ
      coda deletion   link        nasalization
```

Guy-Sun Moon(1986) proposes a slightly different version of this analysis for Aguaruna; Piggot(1987) has generalized this approach to other languages. However, the analysis in (11) predicts the possibility of a language where the "floating" [nasal] feature "floats" over a future blocker of nasalization. In (12) we see a derivation where the "floating" [nasal] feature skips over a number of segments, including a [**t**]. Then, regressive nasalization applies, and is blocked by [**t**] because [**t**] is [+consonantal]:

12)

```
[+nasal]        [+nasal]                    [+nasal]          [+nasal]
   |                                           |                 /|
wiran-wi-tawa --> wira-wi-tawa --> wira-wi-tawã --> wira-wi-t̃ãw̃ã
             delink            link         regressive nas.
```

What is unnatural about the derivation in (12) is that nasalization fails to reach the position to which the "floating" [nasal] feature was originally attached, and this makes explicit that the location of the trigger of nasalization and the original location of the nasal consonant which disappeared are not one and the same. This sort of situation never arises in natural language and should be ruled out. To do this, we must prevent the [+nasal] feature from "floating" over future blockers of nasalization. One could stipulate that no blockers can be created in the interim between the de-linking and the spreading of the [+nasal] feature. But such a stipulation would be tantamount to making simultanous the de-linking and the spreading of nasality: the need for "floating" the nasal feature would disappear.

Of course the derivations in (10) and (12) are possible phonological derivations in the sense that they are allowed by the notation. However the fact that we have found no instances of them suggests that they do not reflect the natural chain of events that underlies the process of nasal "absorption". If we do not rule out the derivations in (10) and (12) as a matter of principle at least we should reserve them for the realm of the idiosyncratic rather than for a familiar process such as nasal "absorption".

6.1 "Floating" [+nasal] features and the domain of nasalization

The nasal prosodies of Coatzospan Mixtec discussed in this section have been analyzed as involving "floating" [+nasal] features. I will show how they can be re-analyzed as involving nasal glides. I will also argue, based on data from Aguaruna, that we should not set up "floating" [+nasal] autosegments simply because we do not know the exact underlying ordering of a nasal segment with respect to the other segments of the word. Thus we have no convincing evidence that the feature [nasal] can "float" at all. Ruling out "floating" [nasal] features explains why we never encounter the derivation in (10).

6.2.1 Coatzospan Mixtec

Poser(1980) argues that a "floating" nasal feature is needed to account for the nasalization facts of Coatzospan Mixtec(Pike and Small 1974 and Small (p.c.))[2]. However, I will present an alternative account that

[2]The article contains typographical errors which I have corrected in the text after consulting P.Small. The Mixtec data has also been analyzed by Cole(1987), whose discussion is limited to the blocking and transparency effects.

does not make use of "floating" features. In C. Mixtec the second person singular familiar of the verb (2sf) is marked by a nasalization "prosody". The word-final vowel is nasalized, as are the preceding vowels if no voiceless obstruent intervenes. The 2sf marker may thus be described as a nasalization "prosody" that proceeds from right to left, crossing sonorants and voiced obstruents, and halting at voiceless obstruents. Where does this "prosody" come from? The 2fs marker is a <u>suffix</u> corresponding to /-un/ in other Mixtec dialects. Consequently, I will assume in Coatzospan Mixtec the suffix is a place-less [N] which undergoes "absorption" in the regular way. That is, I predict that because the 2sf is a <u>suffix</u>, nasalization must proceed from the locus of the suffix leftwards into the stem (it could never have proceeded rightwards from the left edge of the word, which a "floating" nasal analysis would permit since linking can be to the leftmost or rightmost nasality-bearing-unit). The phoneme inventory of C.Mixtec is labials /p, m͡b[3], m, β~m[4] /, alveolars /t, n͡d, t͡s, n͡dz, s, ð, ð͡y, n, l, r /, palatals /t͡ʃ, n͡dʒ, ʃ, ɲ, y~ɲ[5] /, velars /k n͡g k͡w n͡gw/ and vowels /i ɨ u e o

---

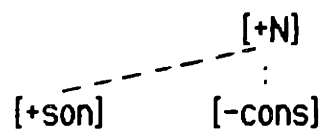
[3]**Prenasalized consonants do not seem to co-occur in the same root with [m n ɲ] or with the place-less [N] unless an obstruent intervenes e.g. [n͡dãũ] (</n͡daauN/) 'brittle' [n͡dĩĩ] (</n͡diiN/) 'handle' [n͡dyũũ] (</n͡dyuuN/) 'honey'; there are two counter-examples [n͡dʒũʔũ] 'doctrine' [n͡dĩʔĩ] 'leg'. There are more voiced stops than nasal consonants in C.Mixtec, so one cannot derive the prenaslized stops as oralized versions of nasal stops. The choice between [t͡s ~ t͡ʃ] [n͡dz ~ n͡dʒ] [s ~ ʃ] does not depend exclusively on the frontness of the following vowel, so [n͡dz] and [n͡dʒ] could not both be derived from /ɲ/; similarly, there are no /ŋ/, /ŋ^{w}/ to derive [n͡g], [n͡gw].**

[4]**Marlett(1988) notes that in Pan-Mixtec (and in C.Mixtec) [β y] cannot co-occur in the same root with [m n ɲ] or with the place-less nasal [N] unless an obstruent intervenes e.g. [βĩĩ] (</βiiN/) 'cold'; [βiʔʃi] (</βiʃiN/) 'sweet, warm'. Marlett also claims that all [m ɲ] are derived from [β y] via root-internal nasalization and states that [m n ɲ] cannot be followed by an obstruent in the same root. This generalization does not hold of C.Mixtec, where we find: [ɲũʔtɨ] 'sand', [nẽʔẽ] 'to comb' [nĩʔt͡sĩ] 'fan' [nĩʔʃĩ] 'sweep'. [ɲũʔtɨ] must derive from /ɲutɨ/ not from /yutɨN/ or /yuNtɨ/. The latter forms would surface respectively as [yutɨ] and [yundɨ].**

[5]**[y] surfaces phonetically as [ʃ]. See footnote (4).**

a/. The so called "prenasalized stops" could be analyzed as clusters because there are other NC clusters in the language: [nɗiʔu] 'goat' (but see footnote (6)):

13) Nasal "prosody":



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[6] Mixtec roots are subject to a series of constraints which determine a template. The assumption that NC clusters in roots are pre-nasalized stops simplifies the formulation of these constraints. Unstressed roots must consist in a foot; that is, they must be bi-syllabic. Stressed roots always bear stress on the first syllable, which must be either CV: or CV? (assuming NC clusters are pre-nasalized stops). The possible forms of stressed and unstressed roots are given below. Syllables are marked with a comma, parenthesized segments are optional:

Unstressed:	Stressed
(C)CV.V*	(C)CV:,V*
(C)CV.CV	(C)CV: , CV
(C)CV.V*	(C)CV?,V
(C)CV.CV	(C)CV?,CV

Vowels which are contiguous or separated by a glottal stop are frequently but not always identical. The first consonant of a root initial cluster must be coronal (native roots only). In stressed roots, if the onset of the second syllable is voiceless, the previous syllable must end in a glottal stop; if the onset of the second syllable is voiced, the presence of a glottal stop in the previous syllable cannot be predicted. Roots which I have marked with an asterisk undergo further changes: unstressed CV_iV_i shortens to CV_i; stressed $CV{:}_iV_i$ shortens to CV_iV_i. Note that stressed CV:CV and CV?CV become CVCV when unstressed; and stressed CV:V and CV?V become CVV when unstressed. The following examples should illustrate the phenomena described in this paragraph:

ða:βi	'rain'	ðaβi-ʃuu	'hail' noun+noun
t͡si:nd͡i	'earrings'	t͡sind͡i-nãnĩ	'long earrings' noun+adj
ʃɨʔʃɨ	'mushroom'	ʃiʃi-kwiʔʃi	'white mushroom' noun+adj
ʃɨʃɨ	'badger'	ʃiʃi-kwiʔʃi	'white badger' noun+adj
duʔnu	'shirt'	dunu-kwiʔʃi	'white shirt' noun+adj
βiʔi	'house'	βi-ʃuu	'stone house' noun+noun

koo 'snake' ɲuʔu 'earth' teʔu 'rotten' ko-ɲu-teʔu 'fer-de-lance'

14)

a) ku2u-N —> kũ2ũ —> kũʃũ 7 'you are dilligent'
b) ki?βi- N —> kĩ?βĩ 'you will be drunk'
c) ku-δii-N —> kũδĩĩ 'you will become angry'
d) t͡sa?m͡ba-N —> t͡sã?m͡bã 'you are fat'
e) koto-n͡dee- N —> kotõn͡dẽẽ 'you will examine'
f) kama-N ---> kãmã 'you will hurry'
g) kunu-N ---> kũnũ 'you will run'
h) ka?ni-N ---> kã?nĩ 'you are working'
i) ka-δaʃi-N --> ka-δaʃĩ 'you will diet'
j) iʃa-βa?a-N --> iʃã-m͡bã?ã[8] 'you are good'
k) kata- N ---> ka?tã 'you will sing'
l) t͡ʃi-kʷet͡ʃi-N --> t͡ʃi-kʷe?t͡ʃĩ 'you will complain'

The examples (14)(a-h) illustrate the transparency of [+slack v.c.] [? 2 β δ m͡b n͡d m n] and the examples (14)(i-l) illustrate the blocking effect of [+stiff v.c.] [ʃ t t͡ʃ]. P.Small reports that whenever nasalization goes through a pre-nasalized stop or through the fricative [δ], the pre-nasalized stop does not become a nasal stop, nor does the fricative lose its friction. This follows if the voiced consonants are transparent to but do not undergo nasalization (See Ohala(1976) and Poser(1981) for arguments that nasalized fricatives are quite difficult, if not impossible, to produce). I note that the

7The spirant in this form is underlyingly [2] because voiceless consonants are always preceded by a glottal stop when they follow a stressed vowel (cf. [ko?ʃõ]' you will fail', and examples (14)(k) and (l)), but the [ʃ] in [kuʃũ] is not preceded by a glottal stop as would have been the case if it had been voiceless underlyingly . The the [ʃ] in ex (14)(j)[iʃã-m͡bã?ã] is not preceded by a glottal stop because of a regular process explained in footnote (6). P. Small reports (pc.) that the underlying voiced palatal fricative [2] in medial position of unstressed roots varies freely between [2] and [ʃ] and moreover occurs in cognate words in other Mixtec dialects (e.g. San Miguel el Grande). Coatzospan Mixtec [ʃ] corresponds to a voiceless velar fricative [x] in other dialects of Mixtec (e.g. San Miguel el Grande).
8See footnote (6).

nasal "prosody" is exceptional in that it is not "blocked" by [+nasal] [**m n ɲ**][9]. If the nasal "prosody" rule targets [+sonorant] segments as in (13), then [**m n ɲ**] will undergo the rule and will not "block" assuming, of course, that the rule is feature changing (see § 1.2).

Although nasalization is characteristic of the 2sf suffix, that is not the source of all nasal vowels. Nasal vowels arise in two other ways:

First, vowels up to the first obstruent are always nasalized following a nasal consonant [**m n ɲ**]. This accounts for the nasal vowels in (16):

15) Progressive nasalization:

```
              [+N]
              :  - - -
[+sonorant]   [+sonorant]
```

16)

a) **du?mã́** 'shirt'
b) **mĩn͡de** 'prickly pear'
c) **ɲũ?tɨ** 'sand'
d) **mã́?mã́** 'sleep'
e) **mãũ** 'aide'
f) **ɲũ?ũ** 'fire'
g) **ɲã́?ã́-nĩsa** 'emphatic-negative'

Second, some morphemes appear to have underlying nasal vowels, that is to say, nasal vowels that result from neither of the two processes presented above. The following are some C.Mixtec roots that appear to have these vowels:

---

[9] **See footnote (4).**

17)

a) **t͡sĩĩ**	'fingernail'
b) **t͡sũũ**	'turkey ben'
c) **n͡dẽʔẽ**	'grease'
d) **tãʔã**	'cousin'
e) **tũʔũ**	'word'
f) **mĩʔĩ**	'where'
g) **βĩðĩ**	'sweet'
h) **ðĩʔt͡sĩ**	'nose'
i) **ðĩʔʃẽ**	'sandal'

C. Mixtec is not the only Mixtec dialect with nasal vowels in roots. In the related Acatlan Mixtec dialect roots ending in nasal vowels end optionally in a nasal vowel+lenis velar nasal (Pike&Wistrand 1974) [**ʔĩĩ**] ~ [**ʔĩĩŋ**] 'nine'; so I will assume that they end in [N] in C.Mixtec. Root-final [N] undergoes "absorption" in the regular way as shown in (18). This assumption is costless given that we need a way of accounting for nasal "absorption" in the loanword vocabulary of C.Mixtec anyway, e.g. Spanish [**xwan**] --> [**xwaaN**] --> C.Mixtec [**xwãã**] 'Juan' (there are no root-final or morpheme-final nasals in C.Mixtec). Again, I predict that since [N] is at the end of the root, nasalization must proceed from the end of the root inwards (it could never have proceeded from the left edge of the root rightwards, as a "floating" nasal analysis would permit). Note that [N] is like any other nasal in that it does not block nasalization from the 2sf suffix as the examples in (19) show:

18)

ku-δiiN	---> **ku-δĩĩ**	'get angry'
ku-βiδiN	---> **ku-βĩδĩ**	'get warm'

19)

ka-ku-βiδiN-tuN	---> **ka-kũ-βĩδĩ-tũ**	'she is getting warm'
ku-δiiN-N	---> **kũ-δĩĩ**	'you will get angry'
ku-βiδiN-N	---> **kũ-βĩδĩ**	'you will get warm'
ka^{n}de-t͡siɲuN-N	---> **ka^{n}de-t͡sĩɲũ**	'you are working'

Before discussing Poser's "floating" nasal analysis, let me establish that the blocking effect of voiceless consonants in the nasalization prosody is a true instance of blocking. The alternative analysis would require a rule denasalizing vowels that precede voiceless consonants. That this analysis cannot work is shown by the following form:

20) **ku-δu?kuN-N**---> **ku-δu?kũ** 'you will get tall'

A rule denasalizing vowels before voiceless consonants would incorrectly predict *[**kũδu?kũ**]. Moreover, there are instances of nasal vowels before voiceless consonants across morpheme-boundaries: [**t͡sũ -ku?tu**] « /**t͡su?uN**/ 'put in' + /**ku?tu**/ 'tight'. The existence of such forms argues against an across the board de-nasalization before voiceless consonants.

Poser's argument that a "floating" [nasal] feature is needed in C.Mixtec is that the distribution of [N] in roots is not random. A careful inspection of the data in (17) leads him to conclude that a vowel may be nasal only if the vowel to its right is nasal (unless it is the word-final nasal), and then only if the intervening consonant is not a voiceless obstruent. Thus there are many roots containing only oral vowels and many roots with the last vowel nasal. There are also words in which nasality extends to vowels preceding the last vowel and these are all words in which the intervening consonant, if there is one, is a sonorant, as in (17)(a-f) or a voiced obstruent, as in (17)(g). When a voiceless obstruent intervenes, as in (17)(h-i), the non-final vowels must be oral. In other words, the possible nasalization patterns for roots are as follows:

21)

cvcv
cvcṽ
cṽcṽ (intervocalic c is voiced)
* **cṽcv**

Of course, exceptions to this pattern may be created whenever a nasal consonant nasalizes the following vowels, as in (17)(b-c & g). Poser argues that the nasalization pattern for roots is readily derivable on the assumption that roots in C.Mixtec are associated with a "floating" nasal feature that associates to the rightmost nasality-bearing-unit, and then spreads regressively until blocked by a voiceless segment:

22)

```
[+N]                [+N]                 [+N]
                     |                   /|
cvδv --> (link)cvδṽ --> (spread) cṽδṽ

[+N]                [+N]                 [+N]
                     |                    |
cvtv --> (link)cvtṽ --> (spread) cvtṽ
```

However, it is quite possible to account for the root nasalization pattern without recourse to a "floating" [nasal] feature. [**cṽcv**] patterns do not exist because whenever [N] precedes a homomorphemic obstruent stop, it undergoes place assimilation and cannot be "absorbed" (Spanish [**syento**] --> C.Mixtec [**syendu**] 'hundred'; Spanish [**sakramento**] --> C.Mixtec [**stramendu**] 'sacrament'); if it precedes a homomorphemic nasal or fricative, it deletes before "absorption" has a chance to apply. As a result only root final [N]'s trigger root-internal nasalization.

Finally, I note that the nasal "prosody" associated with the 2sf in C. Mixtec is bi-directional:

23) **ku - βiðiN - N - n͡du** --> **kũ-βĩðĩ- n͡dũ** 'are you getting warm?'

and voiceless stops block bi-directionally also:

24)

ku-tiβi-N-ko --> ku-tĩβĩ-ko 'you will push us'
neʃiN-N-ko--> nẽʔʃĩ-ko 'you will sweep us'

If, as Poser suggests, the 2sf suffix consists of a "floating" [nasal] feature that links to the rightmost nasality-bearing-unit, then we should expect the "floating" [nasal] feature to "skip" over voiceless consonants, contrary to fact:

25)

```
     [+N]                        [+N]                      [+N]
                                  |                          |
ku-tiβi- ø -ko --> (link) ku-tiβi- ø -kõ --> (spread) ku-tiβi- ø -kõ
                                                     *[kutiβikõ]
```

Of course, mechanically, there are ways of preventing this "skipping" , e.g. by requiring that the linking of the "floating" [nasal] feature take place before further suffixes are added (that is, cyclically), or by stipulating that voiceless consonants are underlyingly [-nasal]. However, these constraints are unnecessary if the nasal feature is linked to the skeleton throughout the derivation.

For the sake of completeness I note that there is an unsolved aspect of C.Mixtec nasalization which is independent of whether the [nasal] feature "floats" or not, but which has to do with the domain of nasalization. Recall that root internal nasal harmony and the nasal harmony triggered by the 2sf suffix are both blocked by voiceless consonants. This suggests that they are one and the same rule. But if this is the case, determining the domain of nasal harmony becomes a problem.

Polymorphemic forms with [N] that do <u>not</u> involve the 2sf suffix fail to spread nasality from one morpheme to another:

26)

a) **ku-βiðiN-u** --> **ku-β̃ĩð̃ĩ - u** 'I got warm'
b) **ta?aN-ika-o** --> **tã-ĩ?ka-o**[10] 'your distant cousin'

In (26)(a) the root boundaries appear to block the spread of nasal harmony. Similarly nasal harmony in (26)(b) fails to spread from the root /**ta?aN**/ 'cousin' to the root /**ika**/ 'distant'. By contrast, the nasality of the 2sf

[10]**For an explanation of what the glottal stops are doing see footnotes** (6,7).

spreads bi-directionally across morpheme boundaries (compare the form in (27) with the form in (26)(a) which has the same root **/βìðN/** 'warm'):

27) **ka-ku-βìðN-N-n̂du** ---> **ka-kũ-β̃ĩð̃ĩ-n̂dũ** 'are you going to get warm?'

It appears that nasalization is defined on two separate domains: the word, as in the form in (27) and the morpheme, as in the forms in (26). The progressive nasalization triggered by nasal consonants **[m n ɲ]** seems to be restricted to the morpheme too: **[ka?mĩ-o]** **'kill-we'**, **[ka?mĩ-u]** **'kill-I'**. I leave this issue open, but note that an analysis where phonogical (e.g. stress) rules are bounded by the morpheme has been proposed for Diyari by Poser(1986). I should mention that root-internal nasalization is not peculiar to C. Mixtec, but is shared by the majority of Mixtec dialects (see Marlett(1988)). Since only C. Mixtec has a nasal "prosody" related to the 2sf marker, this means that the "absorption" process which root-final nasals undergo is probably distinct from that associated with the 2sf marker, though I do not have enough information about C. Mixtec to determine this for sure.

6.2.2 Terena

Terena(Bendor-Samuel 1960, 1966 and p.c.[11]) is another language which has been claimed to have a "floating" nasal (Poser 1980, Piggott 1987). The phonemic inventory of this language is labial /p m w/, coronal /t s ʃ r n y/, velar /k x[12] [h] x͡y [h͡y]/, laryngeal /ʔ h / and vowels /i e a o u/. I will give an alternative analysis. The first person singular subject of a verb or first person singular possessor of a noun is marked by a nasalization "prosody" applied to the unmarked (third person) form of the verb or noun. This prosody is described by Bendor Samuel(1960) as follows:

28)

(a) the nasalization of all vowels and semi-vowels in the word up to the first stop or fricative. In words without stops or fricatives all vowels and semi-vowels are nasalized, together with (b) a nasalized consonantal sequence replacing the first stop or fricative in the word as follows: m͡b replaces p, n͡d replaces t, ŋ͡g replaces k, n͡z replaces both s and h, and nʒ replaces both ʃ and h͡y.

The operation of this process is illustrated in (29). In each case, the first form given is the unmarked third person, and the second form given is the first person singular. In the first person singular forms every sonorant is nasalized until the leftmost obstruent is reached and this is voiced and prenasalized:

---

[11]**Terena is also described by Baldus (1937), Eastlack (1968), Ekdahl et. al (1964 1979), Harden (1946) Eastlack (1968).**

[12]**The descriptions of [x] and [x͡y] are problematic. Bendor-Samuel (1960) and Harden(1946) give [h] and [h͡y]. Ekdahl&Butler(1979) report they sound like plain and palatalized versions of Brazilian Portuguese. When prenasalized these sounds are voiced and fronted to [n͡z] [nz͡y].**

29)

a) **piko**	'he feared'	**m͡biho**	'I feared'
b) **otopiko**	'he chopped'	**õn͡dopiko**	'I chopped'
c) **ikoku**	'well'	**ĩŋ͡goku**	'my well'
d) **simoa**	'he came'	**n͡zimoa**	'I came'
e) **isuko**	'he hit'	**ĩn͡zuko**	'I hit'
f) **ʃupu**	'his mandioca'	**n͡župu**	'my mandioca'
g) **eʃa**	'he knew'	**ẽn͡ža**	'I knew'
h) **haʔa**	'father'	**n͡zaʔa**	'my father'
i) **ahikowo**	'he bathed'	**ãn͡zikowo**	'I bathed'
j) **ahyaʔaʃo**	'he desired'	**ãn͡žaʔaʃo**	'I desired'
k) **iwatako**	'he sat'	**ĩw̃ãn͡dako**	'I sat'
l) **owoku**	'house'	**õw̃õŋ͡gu**	'my house'
m) **yono**	'he walked'	**ỹõnõ**	'I walked'
n) **oyeʔeko**	'he cooked'	**õỹẽʔẽŋ͡go**	'I cooked'
o) **omo**	'he carried'	**õmõ**	'I carried'
p) **eno**	'mother'	**ẽnõ**	'my mother'
q) **niko**	'he ate'	**nĩŋ͡go**	'I ate'
r) **aukopowo**	'he returned'	**ãũŋkopowo**	'I returned'
s) **arunoe**	'girl'	**ãr̃ũnõẽ**	'my girl'

If we assume that the data in (29) involves a "floating" [nasal] feature, then the rules which effect the first linking of this "floating" [nasal] feature can be quite complicated. The simplest alternative apprears to be that the "floating" [nasal] feature links to the leftmost timing slot of the word and spreads rightwards onto sonorants until the spreading is blocked by an association line (assuming that the "blockers" of nasalization are already specified [-nasal] when nasalization takes place):

30)

```
[+N]              [+N]                                                   [+N]  [-N]
                   |                                                       |     |
a r a s a  --> (link) ã r a s a --> (specify "blockers" as [-nasal]) ã r a s a -->

               [+N]   [-N]                      [+N]    [-N]
                 ↖ \   |                          ↖ \ \  |
(spread nasality) ã r̃ ã  s a --> (prenasalization) ã r̃ ã n͡s a
```

31)

```
[+N]               [+N]                                                  [+N][-N]  [-N]
                     |                                                      \ /      |
s a r a s a  -->(link) z̃ a r a s a -->(specify "blockers" as [-nasal]) n͡z a r a s a

                 [+N][-N]   [-N]
                   \/         |
--> (spread nasality) n͡z a r a s a
```

The delicate part of this analysis is the treatment of word-initial nasals. Word-internal nasals are transparent to the spreading process (e.g. (29) (m,o,p,s)) and do not themselves spread nasality (e.g. (29)(d)). The fact that when the "floating" [nasal] feature links to a word-initial nasal, the nasal spreads nasality (e.g. (29)(q)) suggests that nasals are not specified for nasality when spreading takes place:[13]

---

[13]**Crucially, the derivation in (32) assumes that it is possible to specify the [-nasal] feature of [s] before the [+nasal] feature of [n]. This assumption does not follow from the underlying phonemic contrasts in Terena. None of the fricatives contrasts distinctively with a nasal fricative; hence, the [-nasal] value of fricatives is redundant in the sense defined by Steriade(1987a) (see § 1.2). On the other hand oral stops contrast distinctively with nasal stops; hence, the [+nasal] value of [n] is distinctive in the sense defined by Steriade(1987a). Steriade(1987a) argues that universally, segments acquire distinctive values before they acquire redundant values. This**

32)

```
[+N]                    [+N]
                         |
dadasada -->(link) nadasada -->(specify blockers as [-nasal])

 [+N]  [-N]                          [+N]   [-N]
  |     |                             |\      |
--> nadasada --> (spread nasality) nãnã sada -->(specify nasals

                                  [+N]      [-N] [+N]
                                   |\        |    |
as [+nasal], prenasalization) nãnã n͡sana
```

The derivations in (30) (31) and (32) asume that the fact that in Terena nasality spreads <u>from the begining of the word into the word</u> has nothing to do with the fact that the "floating" [+nasal] affix is after all a <u>prefix</u> (the other pronoun affixes in Terena are prefixes and are (at least some of them) glides: [**w-utanna**] 'our plate' [**y-ayo**] 'your brother'). Rather, the pattern of nasalization results from an idiosyncratically defined linking rule which happens to link the "floating" [+nasal] to the leftmost available timing slot. Theoretically, the linking rule could have been quite different: it could have linked the [+nasal] feature to the rightmost available timing slot "skipping" over any unspecified "blockers" (e.g. fricatives are redundantly [-nasal] because there are no [+nasal] fricatives in Terena). I would challenge this assumption. Instead, I would give the derivation in (33) where [N] spreads nasality while [m n] do not because [N] is a placeless glide:

---

ordering is obeyed in (33) and disobeyed in (32). However, as there are many ways of dealing with "blocking" I have not addressed this issue in the text.

33)

```
[+N][+N][+N]  [+N]                              [+N][+N][+N][-N][+N]
  | |  |       |                                  |  |  |  |  |
  N n a n a s a n a --> (specify blockers as [-N]) N n a n a s a n a -->

                                                       [+N]    [-N] [+N]
                                                        |        |   |
([N] nasalizes sonorants in feature changing fashion) N n ã n ã s a n a

                                  [+N]    [-N] [+N]
                                   |        |   |
--> (prenasalization, N deletes) n ã n ã n͡s a n a
```

Thus it is quite possible to give an alternative derivation of the Terena facts that does not assume the existence of a "floating" [+nasal] feature.

6.3 "Floating" [+nasal] features and derivational ambiguity

One of the current arguments which is cited to set up "floating" [nasal] features is the fact that there are cases in which one cannot know exactly where [N] was positioned with respect to the other segments before nasalization took place and [N] was deleted. Such cases can be dealt with by allowing derivationally ambiguous surface forms to have more than one underlying representation: one for each possible placement of [N] in the timing tier. A representation with a "floating" [nasal] feature is considered more economical in that it is unique and yet non-committal as to the uncertain ordering of the [nasal] feature in relation with the other segments of the word. I show below that despite the attractiveness of the "floating" nasal hypothesis, we must allow derivationally ambiguous forms to possess more than one underlying representation.

According to the phonological rules of Aguaruna, a root such as **[ỹãỹã]** 'rat' could be **/yaNya/** or **/yayaN/** underlyingly (for a discussion of Aguaruna nasalization see §§ 4.1.2, 4.2.1)). Similarly the root **[pĩỹũ]** 'insect' could be **/piNyu/** or **/piyuN/**. Old speakers of this language dis-ambiguate their underlying forms when a stop initial suffix is attached to the root: **/vaNya/ becomes [ỹãỹã-kĩ]**(via bi-directional nasalization); **/piyuN/** becomes **[piyũn-tʃu-i]** (via assimilation to the stop and local nasalization). By contrast young speakers of Aguaruna treat **[ỹãỹã]** **[pĩỹũ]** and similar potentially ambiguous forms as though they had two acceptable underlying representations: e.g. **/yaNya/** or **/yayaN/**. Consequently, in the speech of these youngsters **[ỹãỹã-kĩ]** (<**/yaNya/** via bi-directional nasalization) varies freely with **[yayãŋ-ki]** (<**/yayaN-ki/** via assimilation to the stop and local nasalization). Crucially, young speakers do not provide alternative analyses to forms whose derivation is not ambiguous: **[bikũã]** 'small animal' is always **/bikuaN/** ; **[nũŋka]** is always **/nuNka/** 'earth' and **[N]** assimilates to a following stop in all cases. So, clearly, the property of having two underlying forms is not an idiosyncracy of the lexical items **[ỹãỹã]** **[pĩỹũ]** etc., but should be attributed to the fact that these items can be derived in more than one way.

Derivational ambiguity has not led young Aguaruna speakers to posit a "floating" [nasal] feature. Let us assume, for the sake of the argument, that a "floating" nasal feature has been posited. The only way to derive the two freely alternating surface forms, **[ỹãỹã-kɨ]** and **[yayãŋ-kɨ]** is by relativizing the rule linking the "floating" [nasal] feature to the timing tier. Let us say that the "floating" [nasal] feature has a choice of linking to the leftmost or to the rightmost nasality-bearing-unit in the word:

34)

```
[+N]          [+N]                                   [+N]
                |                                     |\\\
yaya --> (link) ỹaya --> (bi-directional nasalization) ỹãỹã
```

35)

```
[+N]                [+N]                                [+N]
                      |                                 ///|
yaya --> (link) yayã --> (bi-directional nasalization) ỹãỹã
```

If the suffix **[-kɨ]** is added to the intermediate form **[ỹaya]**, we get bidirectional nasalization **[ỹãỹã-kɨ]**; if it is added to **[yayã]** a local prenasalization rule spreads nasality from the root vowel onto the following consonant, creating a pre-nasalized stop:

36)

```
[+N]              [+N]                     [+N]                  [+N]
                    |                        |                    |\
yaya --> (link) yayã --> (affixation) yayã-kɨ --> (loc. prenas.) yayã-ŋ͡kɨ
```

To derive the final form **[yayãŋ-kɨ]** where bi-directional nasalization has <u>not</u> applied, we must assume that the application of the local prenasalization rule has created a geminate structure which bleeds any subsequent application of bi-directional nasalization. In other words, we must assume that bi-directional nasalization is a structure dependent spreading rule and that geminates cannot participate as triggers of structure dependent rules:

37)

```
  [+N]
   /\
yayã-ŋ͡kɨ --> (bi-directional nasalization cannot apply) [ yayã-ŋ͡kɨ].
```

But the derivation of the preceding paragraph cannot be correct because Schein&Steriade(1986) have shown that geminates are never restricted from participating in rules that do not affect their segmental make-up. In particular, geminates participate as triggers of structure dependent spreading rules in Tigrinya and Turkish. Thus it is clear that the only possible explanation of the speech of young Aguaruna speakers is that they posit multiple underlying representations for each derivationally ambiguous surface form. I conclude that representational economy does not justify the postulation of "floating" [nasal] features.

6.4 Conclusion

I have argued in this chapter that the "floating" nasal analysis cannot explain the emergence of nasal vowels in nasal "absorption" processes. I have also shown that there is little evidence that the feature [+nasal] can float, since it is possible to re-formulate "nasal prosodies" in terms of a disappearing [N]. If the feature [nasal] cannot "float" at all, we may derive the fact that a derivation such as the one in (10) is not found anywhere.

Chapter 7

ARE ALL NASAL GLIDES PLACE-LESS?

The arguments in this chapter concern the possibility that the nasals undergoing absorption may not necessarily be place-less nasal glides, but may be nasal glides with place features in the same group with the oral glides [**w y**].

(i) Nasal glides exist and can be derived from nasal stops. Based on facts from Basari (§ 7.1) I show that nasals in coda position are not only subject to processes of debuccalization, but may undergo various other "weakening" processes such as spirantization and gliding. On the basis of such evidence I conclude that nasals exhibit the whole spectrum of stricture possibilities e.g. from stop [**ŋ**] to continuant consonant [**ɣ̃**] to glide [**ɯ̃**] ([-round]) or [**w̃**] ([+round]) to place-less glide [**N**]. Chen(1975) and DeChene&Anderson(1979) have reconstructed similar developments in Chinese, Greek and Polish, but their reconstructions are historical or distributional and do not involve alternations.

(ii) Certain facts in Coatzospan Mixtec can be viewed as indicating that when a palatal nasal becomes [ỹ] it spreads its nasality onto surrounding vowels. If this is true then it is not the place-less condition of [ỹ] which prompts the spreading of nasality (since [ỹ] has place features) but the fact that it is a glide. This suggests that nasal "absorption" may be fed by nasal gliding: **vn** --> **vỹ** --> **ṽ**.

7.1 Nasal glides and spirants in Basari

The first step in the argument that nasal absorption may be able to target vocalic nasal glides in the same group with [**y w**] is to demonstrate that such nasal glides exist. In fact I will show that nasals exhibit the whole spectrum of stricture possibilities e.g. from stop [**ŋ**] to continuant consonant [**ỹ**] to glide [**ɰ̃**] ([-round]) or [**w̃**] ([+round]) to place-less glide [N]. A language where nasal stops undergo spirantization is Basari(Abbot&Cox 1966). The phonemic inventory of Basari is labials /**p b m f w**/, coronals /**t d n s l tʃ dʒ ɲ y**/, velar /**k g ŋ h** [**x**]/, labio-velars (pronounced with ingressive lung air) /**k͡p g͡b ŋ͡m** /and vowels /[+hi] **I iː, U uː** ; [**-hi -low**] **eː, oː** ;

[+low] ʌ aː, ɒ ɔː/. In this language, a nasal in coda position becomes [+continuant] unless it is followed by a homorganic stop consonant, in which case the nasal surfaces as a fully occluded stop. This latter restriction suggests that homorganic stops spread their [-continuant] feature onto the preceding nasal in such a way that Basari spirantization cannot apply or is simply undone. The rule is given below on the assumption that the feature involved here is [continuant] (but see footnote ([1]) for discussion):

1) Basari spirantization: [+nasal] --> [+continuant] / ___ C

This rule targets post-vocalic nasal stops in position before a consonant and syllabic nasals in postion after word boundary and before a consonant. Syllabic nasals in isolation (that is, not followed by a consonant) do not undergo the rule. Examples in (2):

[1]The rule in (1) is related to two other rules of "spirantization" (1) [+nasal] --> [γ̃, ð̃ʸ] / vː ___-[u, i]. The nasals in this context pattern like [w, y] in causing the following high vowel to become close. (2)[m n ɲ ŋ b l] --> [β̃ ð̃ d̃ʸ β ʎ] / vː ___ // (end of utterance). According to Abbot&Cox these two rules of "spirantization" would be rules of __lenition__, but Abbot&Cox do not define what they mean by "fortis" vs. "lenis". One possibility is that "lenis" means "continuant", as hypothesized in the text. However, it may also mean "lax": "fortis" [m n ɲ ŋ b l] follow what appear to be short [-ATR] tense vowels (Stewart(1967) describes [-ATR] vowels as "strangled", which suggests that the articulation of these vowels is tense, not lax as usually assumed). "Fortis" [m l] are transcribed as velarized (=[-ATR]?): [m ɫ] "fortis" [b] is unreleased. Whether the feature in question is [continuant] or [tense] it is clear that the process is one of weakening.

2)

before obstruent stops	before other consonants	elsewhere
mbwo:		m
animpu:		me:
iso:m*bI		
ɲtʃʰa:λ	ɣ̃yUntʰI	ɲʷo:
tʰInæɲdʒI	mæɣ̃yindI	
ɳda:β	ɣ̃sIλ	nʷu:
dIdʒindI		
sun*tʰikpiλ	ɣ̃fe:ɣ̃	
ŋkʰætʰIβ̃	ɣ̃wiʃ	ŋʷɒ
wɒŋkʰi	usæpwhɔ:ɣ̃ * fuλ	
	ife:ɣ̃*wi:x	

Similar cases of spirantization have been noted elsewhere by Chen(1975:116) Guanzhong(NW Mandarin) *[aŋ] --> [aɣ̃] and by DeChene&Anderson(1979:530) Icelandic [n] --> [z̃] before fricatives.

In addition to being able to undergo spirantization, coda nasals in Basari can undergo gliding. The rule is given below:

3) Basari gliding: [+nasal CORONAL or DORSAL] --> [-consonantal] /__ //

The rule in (3) targets primarily utterance final [n], (it targets utterance final [ŋ] in a restricted set of cases which is not well defined):

4)

sæn --> sæỹ	'to pound'
ife:n --> ife:ỹ	'wings'
man ɳdi-ŋ --> man ndiw̃	'my guinea corn'
maŋ ŋmi: --> maŋ ŋmi:w̃	'my rope'

The nasal glides in (4) can be seen to alternate with nasal stops before a vowel-initial word:

5)

isɔːỹ	'language'
isɔːn ili	'two languages'

Moreover, there are no utterance final [n]'s in Basari, a gap which is explained by the gliding rule.

The gliding rule really outputs nasal glides because [ỹ w̃] pattern with oral [y w] in at least two phonological processes. Post-vocalic glides in Basari undergo two rules to which nasalized [ỹ w̃] are also subject. The first is given in (6):

6) Nucleus insertion: v(ː) + {**w,w̃, y, ỹ**} --> v(ː) {**ɨ,ɨ̃, u, ũ**}

Nucleus insertion provides an independent syllabic nucleus for oral or nasal glides in Basari as shown below:

7)

sæỹ --> **sæɨ̃**	'to pound'
ifeːỹ --> **ofeɨ̃**	'wings'
man ndiw̃ --> **man ndiũ**	'my guinea corn'
maŋ ŋm̂iːw̃ --> **maŋ ŋm̂iːũ**	'my rope'
kʰɨwaːy --> **kʰɨwaːɨ**	'small one'
kʰɨɲeːw --> **kʰɨɲeːu**	'night'[2]

---

[2]**Abbot&Cox do not mention whether there exist any oral glides after short vowels.**

The second rule is given in (8). Examples in (9):

8) Vowel Spread: v:₁ (ɪ, ɪ̃) --> v:₁ (v₁, ṽ₁)
                    |
                 [-low]

9)

ɪfeɪ̃ --> ofe:ẽ	'wings'
soɪ̃ --> so:õ	'to speak'

*e: ɪ, *o: ɪ, *u: ɪ[3]

cf:	k^{wh}ubʷɒtʰɪ:u	'friendship'
	maŋ ŋmɪ:ɪ̃	'my rope'

Now, clearly, it must be the case that [n] is becoming a glide since, otherwise, it would not undergo nucleus insertion and vowel spread. Note that the [ỹ] (<[n]) must be assumed to be coronal, as e.g. [y] in Chukchi (§ 3.3.3) which velarizes before another coronal (including itself). Similar stages of nasal gliding have been reconstructed by Chen(1975:115-6) for a number of Chinese dialects, though in none of these do the nasal glides alternate with nasal stops as in Basari: Hebei(N Mandarin) *[en, in, uen, yn] --> [eɪ, ieɪ, ueɪ, yeɪ]; Amoy (S Min) *[iaŋ] --> [iŋ] --> [iɪ̃]; Xiang (Chenxi) *[vn] --> [vɪ̃]; [vŋ] --> [vɯ̃]. DeChene&Anderson(1979:515) Lesbian greek [-ns-] --> [is]. On the basis of such evidence I conclude that nasals exhibit the whole spectrum of stricture possibilities, e.g. from stop [ŋ] to continuant consonant [ỹ] to glide [ɯ̃] ([-round]) or [w̃] ([+round]) to place-less glide [N].

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[3]There are apparently no sequences of *[+low]vɪ̃, though there are sequences of [+low]vɪ : [t͡ʃa:ɪ̃] 'to bring' vs. [kʰwa:ɪ] 'small one'.

7.2 Vocalic nasal glides and nasal "absorption"

Since place-less nasal glides are the usual targets of nasal "absorption" one might wonder whether vocalic nasal glides can also undergo the process. The only case I know of where nasalization might be analyzed as triggered by a nasal which becomes a glide while preserving its place features occurs in Coatzospan Mixtec. In Coatzospan Mixtec(Pike&Small 1974), the palatal nasal [ɲ] varies freely with [ỹ]. When [ɲ] becomes [ỹ], the nasal feature spreads out in both directions and is blocked by voiceless consonants (P.Small p.c.): **/kuɲu/** --> **[kũỹũ]** 'meat'. Bi-directional nasalization is not triggered by the loss of place features since the place features of [ɲ] are preserved. Rather, bi-directional nasalization is apparently caused by the change from nasal stop to glide. Unfortunately, the C.Mixtec argument is based on a single form which can be re-analyzed. The [ỹ] in **[kũỹũ]** might be an underlying [**y**] since [**β**] and [**y**] become respectively [**m**] and [ɲ] whenever they co-occur with nasal consonants or vowels in the same root (Mariett 1988). Thus the derivation of **[kũỹũ]** might simply be **/kuyu**N/ --> **[kũỹũ]** -->(optionally)**[kũɲũ]**. For further discussion see footnote (4) Chapter 6.

Nonetheless, according to Chen(1975) vocalic nasal glides underwent "absorption" causing the preceding low vowel to raise in some Chinese dialects: Dengchuan(SW Mandarin) *[an ian] --> [aeɛ̃, iɛ̃] --> [aeɛ, iɛ]. If Chen is right, what role does place assimilation play in bleeding nasal "absorption"? One possibility is that place assimilation bleeds nasal "absorption" because it always involves the assimilation of stricture, including the feature [-consonantal]. However, it is not the case that place assimilation spreads stricture in all cases. Mascaro(1978) formalizes a place assimilation rule in Catalan which involves point of articulation only, and not stricture:

10) Catalan coronal assimilation ([p,] [ɱ] are [-distributed] labials):[4]

n, t	-->	**m p**	/ ___	**p b**
		ɱ p,		**f**
		ŋ k		**k g**

11)

	'they are...		'we are...		
so[**n**]amics	'...friends'	so[**m**]amics	'...friends'	ti[**ɲ**]pa	'I have bread'
so[**m**]pocs	'...few'	so[**m**]pocs	'...few'	a[**ɲ**]feliz	'happy year'
*so[**ɱ**]felicos	'...happy'	so[**ɱ**]felicos	'...happy'		
so[**ŋ**]grans	'...big'	so[**ŋ**]grans	'...big'		

---

[4]Mascaro asserts this rule targets [t] optionally; it is not clear whether it targets [n] obligatorily. [t] and [n] do not assimilate to palatal [ɲ ʎ] or lamino-palatal consonants [š ž č ǰ], which do not spread their palatal articulation: so[n,][ʎ]iures 'they are free', so[n,][ž]ermans 'they are brothers'. The fact that the palatality of these segments fails to spread must be stipulated. [t] and [n] would be expected to become [č] and [ɲ] before a palatal or lamino-palatal ([č] and [ɲ] are underlying segments in Catalan, so structure preservation is irrelevant). In the text I have ignored the effect of place assimilation among coronals: [nd] --> [n̪d][ld] -->[l̪d] [nr] --> [n̪r] [lr] --> [l̪r] [sr] --> [ʀr] ([r] is a trilled [r] and [ʀ] is a fricative, untrilled [r]). Palatals and lamino-palatals behave as though they have a [-anterior] coronal articulation: [n ʎ] --> [n, ʎ] [l ʎ] --> [l, ʎ] [t ʎ] --> [t, ʎ] [n ž] --> [n, ž] [lž] --> [l, ž] [t š] --> [t, ž] ([n,] [l,] [t,] are [-anterior] coronal). Other processes ignored in the text are: nasalization, (e.g. ca[p] **mans** --> ca[m] **mans** 'no hands') voicing assimilation (e.g. se[t] **mans** --> se[d] **mans** '7 hands'), lateral gemination ([t ʎ] --> [ʎ ʎ] [t l] --> [l l]: se[l]linies 'seven lines' se[ʎ][ʎ]ibres seven books') and lateral backing (e.g. e[l]gos --> e[ɫ]gos 'the dog' where [ɫ] is coronal [-back][-high](Mascaro(1978:46)).

se[**t**]	'seven'	ca[**p**]	'no'	po[**k**]	'few'
se[**m**]mans	's. hands'	ca[**p**]ma	'n. hand'	po[**k**]pa	'f. bread'
se[**p,**]focs	's fires'	ca[**p,**]foc	'n. fire'		
se[**k**][**k**]ases	's houses'	ca[**p**][**k**]ases			

Given that we cannot rule out place assimilation rules involving only point of articulation we must assume place assimilation bleeds nasal "absorption" only when point of articulation and stricture are spread together. Nasals in NC clusters that share point of articulation only should be able to undergo "absorption" by gliding as in (12):

12)

```
         pl              pl
         /\              /\
        vm  p  -->     vw̃  p --> ṽp      (gliding)
        |   |           |   |
    [+cons][+cons] [-cons][+cons]
```

I am not aware of any examples of (12). Hence I must leave this issue open to further investigation.

References

Abbot M. and M.Cox (1966) Collected field reports on the phonology of Basari. Collected language notes no.5, Institute of African Studies, University of Ghana.

Bao, Z.(1988) "Fangle languages and reduplication", ms. M.I.T.

Balduw, H. (1960) "Tereno-texte", Anthropos ,32. pp. 528-44.

Bendor-Samuel, J.T. (1960) "Some problems of segmentation in the phonological analysis of Terena", Word ,16. pp. 348-55.

Bendor-Samuel, J.T. (1966) "Some prosodic features in Terena", in C.E. Bazell et.al. (eds.), In Memory of J.F. Firth. London, Longman's, pp. 30-39.

Bethin, C.Y.(1984) "A syllabic analysis of nasal vowels in Polish", Studies in Language ,8.2. pp.163-180.

Bogoras, W. (1923) "Chukchee", Handbook of American Indian Languages, part 2, pp. 631-903, Washington, Bureau of American Ethnology.

Brend, Ruth M. (ed.) (1974) Advances in Tagmemics, Amsterdam, North Holland.

Brosnahan I.f. (1964) "Outlines of the phonology of the Gokana dialect of Ogoni", Journal of West African Languages ,1.1. pp 43-8.

Browman C. and L. Goldstein (1987) "Tiers in articulatory phonology, with some implications for casual speech", paper presented at the first OSU Conference on Laboratory Phonology.

Calabrese, A. (1988) Ph.D. dissertation, M.I.T.

Capo, H. (1981), "Nasality in Gbe", Studies in African Linguistics ,12.1. pp. 1-43.

Cedergren H.& D. Sankoff (1975) "Nasals: a socio-linguistic change in progress", in C.A.Ferguson et. al (ed.), Nasalfest, special publication, language universals project Dept. of Linguistics Stanford University, pp. 27-49.

Chen, M. (1973) "Cross-dialectal comparison: a case study and some theoretical considerations", Journal of Chinese Linguistics ,1.1.pp. 39-63.

Chen M. "An aereal study of nasalization in Chinese", in C.A.Ferguson et. al (ed.), Nasalfest, special publication, language universals project Dept. of Linguistics Stanford University, pp. 81-125.

Cheng, C.(1973) A synchronic phonology of Mandarin Chinese, Mouton.

Chomsky, N. & M. Halle (1968) The sound pattern of English, New York, Harper and Row.

Clements, G.N. (1985) "The geometry of features", Phonology, 2 pp. 225-252.

Clements, G.N.(1987) "The role of the sonority cycle in core syllabification", ms. Cornell University.

Clements, G.N. (1987) "Phonological feature representation and the description of intrusive stops", in a. Bosch et al. (eds.), Parasession in Autosegmental and Metrical Phonology, Chicago Linguistic Society.

Cohn A. (1987) "A survey of the phonology of the feature [+-nasal]", ms. UCLA.

Cole, J. (1987), Planar phonology and morphology, Ph.D. dissertation, M.I.T.

Czaykowska-Higgins, E. (1988) The interaction of phonology and morphology in Polish ,Ph.D. dissertation, M.I.T.

DeChene, B.& S.Anderson (1979) "Compensatory Lengthening", Language, 55.3. pp. 505-535.

D'Introno&Sosa(1984) "Elisio de nasal o nasalizacio de vocal en caraqueño", ms. U.of Massachusetts.

D'Introno&Ortiz&Sosa(19??)"On resyllabification in Spanish", ms. U.of Massachusetts.

D'Introno, F.& Guitart (1985) "On Post-nuclear consonants in Caribbean Spanish", ms. UMass.Amherst and SUNY Buffalo.

Dobrovolsky, M.(1983) "Yakut assimilation and the strength/sonority hierarchy", Berkeley Linguistic Society, Feb 12-13 pp. 74-83.

Eastlack, C. L. (1968) "Terena (Arawakan) Pronouns", IJAL, 34. pp.1-8.

Ekdahl, E. & N. E. Butler (1979) Aprenda Terena, Brasilia, SIL.

Ekdahl, M&J.E.Grimes (1964) "Terena verb inflection", IJAL ,30. pp. 261-8.

Emeneau, M. (1955) A grammar of Kolami, University of California publications in linguistics, University of California Press, Berkeley and Los Angeles, CA.

Farkas, D. and P.Beddor (1987) "Privative and equipollent backness in Hungarian", CLS 23.

Goldsmith, J. (1976) Autosegmental phonology, Ph.D. dissertation, M.I.T., distributed by IULC.

Gudschinski, S.C. & H & F. Popovich "Native reaction and phonetic similarity in Maxakali phonology", Language, 46.1.77-89.

Guitart, J.M.(1981) "Sobre la posteriorización de las consonantes posnucleares en el Español antillano: reexamen teorico-descriptivo", Sexto Simposio de Dialectología del Caribe Hispánico, Universidad Católica Madre y Maestra, Santiago de los Caballeros, República Dominicana.

Hale K. (1976) "Phonological developments in a northern Paman language:Uradhi" in P.Sutton Canberra (ed), Languages of Cape York , Australian Institute of Aboriginal Studies, pp. 41-49.

Halle M. (1981) "Harmony Processes", in Crossing the boundaries in linguistics studies presented to Manfred Bierwisch, Synthese language library, D. Reidel Publishing Company, Boston pp. 1-22.

Halle M. (1988) "Features", ms. M.I.T.

Halle M. & G.N.Clements (1983) Problem book in phonology, M.I.T. press, Cambridge.

Hankamer, J. & Judith Aissen (1974) "The sonority hierarchy. Papers from the parasession on natural phonology", Chicago: CLS, pp.131-145.

Haraguchi, S.(1984) "Some tonal and segmental effects of vowel height in Japanese", in M.Aronoff (ed.), Language sound structure. M.I.T. press Cambridge.

Harden M. (1946) "Syllable structure of Terena", IJAL, 12. pp. 60-63.

Harris, J.(1969) Spanish Phonology, M.I.T. Press.

Harris, J.(1983) "Syllable structure and stress in Spanish: a non-linear analysis", Linguistic Inquiry Monograph 8, Cambridge, MA: M.I.T. Press.

Harris, J.,(1984) "Autosegmental phonology, lexical phonology and Spanish nasals", in M.Aronoff and R.Oehrle (eds.), Language Sound Structure pp. 67-82.

Harris, J.,(1984), "Theories of phonological representation and nasal consonants in Spanish", Papers on the XIIth linguistic symposium on Romance languages,(vol 26 of the Current issues in linguistic theory series) pp153-169.

Harris, J.(1985) "Spanish word markers" ms. M.I.T.

Harris, J.(1988) "The geometry of phonological segments; evidence from Spanish" ms. M.I.T.

Hayes, B. (1986a) "Assimilation as spreading in Toba Batak" LI 17.3 pp. 467-501

Hayes, B. (1986b) "Inalterability in CV phonology" Language 62.2.

Hyman L. (1982) "The representation of nasality in Gokana", in Van der Hulst&Smith (eds.), The structure of phonological representation, part 1. pp. 111-130.

Ingria, B. (1980) "Compensatory lengthening as a metrical phenomenon", LI 11.3 pp. 465-496.

Ito J. (1984) "Melodic dissimilation in Ainu" LI 15.3. pp.505-513.

Ito J.(1986) Syllable structure theory in prosodic phonology, Ph.D.Dissertation, U.of Massachusetts.

Kawasaki, H. (1981) "Voicing in Japanese", ms., M.I.T. speech laboratory.

Kaye J. (1965) Two conceptions of Desano phonology, Masters thesis, Columbia University.

Kaye J (1971) The Desano verb: problems in semantics, syntax and phonology ,Ph.D. dissertation, Columbia University.

Kaye J. (1971) "Nasal harmony in Desano", LI ,2. pp. 37-56.

Kenstowicz, M. and C. Pyle (1973) "On the phonological integrity of geminate clusters", in M.Kenstowicz and C.Kisseberth, Issues in Phonological Theory, Mouton, The Hague.

Kenstowicz, M. (1986) "The phonology of Chukchee consonants", Studies in the Linguistic Sciences, 16.1 pp. 79-86.

Krause, S. (1980) Topics in Chukchee phonology and morphology, Ph.D. dissertation, U. of Illinois.

Levin J. (1988) "A place for lateral in the feature geometry", ms. U. of Texas.

Le Sourd, P. (1988) Accent and syllable structure in Passamaquoddy, Ph.D. dissertation, M.I.T.

Li, P. (1985) "A secret language in Taiwanese", Journal of Chinese Linguistics ,13.1. pp. 91-120.

Lin, Y. (1988) "Nasal segments in Taiwanese secret languages", The Arizona phonology conference at the U. of Arizona.

Lozano, M.C. (1979) Stop and spirant alternations: fortition and spirantization processes in Spanish Phonology, M.A.thesis, Ohio State University, reproduced by Indiana University Linguistics Club.

McCarthy J. (1986) "OCP Effects: Gemination and antigemination", LI ,17 pp. 207-263.

McCarthy (1988) "Feature geometry and dependency", in O.Fujimura (ed.), Articulatory Organization--from phonology to speech signals, S.Sarger, Basel.

McCawley, J.D.(1968) The phonological component of a grammar of Japanese, , Mouton.

Maddieson I. (1984) Patterns of Sounds, Cambridge University Press, N.Y.

Mascaro, J.(1978) Catalan phonology and the phonological cycle, Indiana Linguistics Club.

Mascaro, J.(1987), "Reduction and spreading theory of voicing and other sound effects", ms. Universitat Autonoma de Barcelona .

Marlett S.A.(1988) SSILA/AAA November meeting presentation.

Martin, S. E. (1954) Essential Japanese, Charles E. Tuttle Co. Rutland, Vermont.

Moon, G.S. (1986) "Nasal harmony in Aguaruna", LSA, New York.

Munro, P. and C. Ulrich(1985) "Nasals and nasalization in Western Muskogean", ms. U. of New Mexico and U.C.L.A.

Nicklas T. D. (1975) "Choctaw Morphophonemics", in J.M. Crawford (ed.), Studies in south eastern Indian languages , University of Georgia Press pp . 237-249.

Odden D. (1988) "Dissimilation as deletion in Chukchi", ms. Ohio State University.

Ohala J. (1975) "Phonetic explanations for nasal sound patterns", in C.A.Ferguson et. al (ed.), Nasalfest, special publication, language universals project Dept. of Linguistics Stanford University, pp. 317-333.

Payne D.L. (1974) Nasality in Aguaruna , Masters Thesis, U. of Texas at Arlington.

Piggot G.L. (1987) "On the autonomy of the feature Nasal", CLS, 23 part 2 pp. 223-239.

Pike, E.V., and P.Small(1974) "Downstepping terrace tone in Coatzospan Mixtec", in R.Brend(ed.), Advances in Tagmemics, North Holland Linguistic Series, pp.104-134.

Pike, E.V., and K.Wistrand(1974), "Step-up terrace tone in Acatlan Mixtec", in R.Brend(ed.), Advances in Tagmemics, North Holland Linguistic Series, pp. 81-105.

Poser W. (1976) "Diyari Stress, Metrical Structure Assignment, and the Nature of Metrical Representation", ms. Stanford University.

Poser W. (1979) Nasal contour consonants and the concept of segment in phonological theory, B.A. thesis, Harvard University.

Poser W.(1981) "Nasal stops and nasal fricatives", unpublished ms.

Poser, W. (1980) "Two cases of morphologically induced nasal harmony", unpublished ms. MIT.

Poser, W. (1982) "Phonological representations and action-at-a-distance", in H. van der Hulst & N. Smith (eds.), The structure of phonological representations, Part 2, Foris.

Poser, W.(1983) "The role of the syllable in Japanese phonology", Stanford University ms.

Poser W. (1988) "Glide formation and compensatory lengthening in Japanese", LI, 19.3. pp. 494-503.

Prentice, D.J.(1971) The Murut Languages of Sabah, Pacific Linguistics, Camberra National University.

Pulleyblank D.G. (1977) Tone in lexical phonology, Ph.D. dissertation, M.I.T.

Pulte W. (1975) "The position of Chickasaw in Western Muskogean", in J.M. Crawford (ed.), Studies in south eastern Indian languages, University of Georgia Press, pp. 251-253.

Regh K.L. (1985) A Ponapean reference grammar, The University Press of Hawaii, Honolulu.

Ruhlen M. (1978) "Nasal Vowels", in J.H.Greenberg (ed.), Universals of Human Language , Stanford university press., vol 2 pp. 203-241.

Safir, K. (1979, pb. 1984) "Hierarchical structures in Capanahua: A case study in local harmony", LI, squib.

Sagey E.C. (1982) The representation of features and relations in non-linear phonology, Ph.D. thesis, M.I.T.

Schein B. & D. Steriade (1986) "On Geminates", LI, 17.4. pp. 691-744.

Schourup L. (1973) "A cross-language study of vowel nasalization", Working Papers in Linguistics, Columbus, Ohio, 15. pp. 190-220.

Skorik, P. (1961) Grammatika Chukotskogo Jazyka, Part I, Moskow, Akademia Nauk.

Steriade D.(1982) Greek prosodies and the nature of syllabification, Ph.D. dissertation, M.I.T.

Steriade D. (1986) "A note on coronal", ms. M.I.T.

Steriade D (1987a) "Redundant Values", CLS, 23 part 2 pp. 339-363.

Steriade D. (1987b) "Locality conditions and feature geometry", NELS 17.

Stewart J.M.(1967) "Tongue root position in Akan vowel harmony", Phonetica, 16, pp. 185-204.

Stolte J.(1980) "Nasalización en las lenguas tucanas orientales", Artículos in linguistica y lenguas afines, 7, Enero, pp 1-27.

Straight H.S. (1976) The acquisition of Maya phonology, Garland Publishing Inc., New York.

Ternes E. (1973) The phonemic analysis of Scottish Gaelic, Forum Phoneticum, Hamburg.

Ulrich C.H. "Choctaw verb grades and the nature of syllabification", CLS, 23, part 2, pp. 374-387.

Wanner D.&C.Cravens (1979) "Early intervocalic voicing in Tuscan", in E.C. Traugott et.al. (ed.) Amsterdam studies in the theory and history of linguistic science IV, Current issues in linguistic theory vol. 14, Papers from the 4th International conference on historical linguistics, pp.339-347.

Welch Betty & Birdie Welch (1967) "The Phonemic system of Tucano", in V. Waterhouse (ed.), Phonemic Systems of Colombian Languages, SIL.

Westermann, D. (1907) Grammatik der Ewe-Sprache, Dietrich Reimer, Berlin.

White Eagle, J. (1988) Winnibago Dictionary, Lexicon Project, Center for Cognitive Science, M.I.T.