THE MIGRATORY HABITS OF NASAL CONSONANTS:
A STUDY IN PHONOLOGICAL UNIVERSALS

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0.0 Introduction

The following paper is a study of some universal phonological rules involving changes in the point of articulation of nasal consonants. The study is based on rules observed in approximately one hundred languages, half of which receive specific mention here. The proposed universal rules are based on:

a) the types of rules I encountered in the individual languages.

b) a plausible physiological explanation for the operation of each rule.

In at least one case, economy of rules in the grammar of a particular language was ignored in favor of economy in the universal rules.

The paper is divided into two major sections:

1. Prejunctural Rules (i.e. changes in the point of articulation of nasal consonants before a boundary)

2. Preconsonantal Rules (i.e. changes which occur before some other consonant).
1.0 Prejunctural Rules

Ferguson (55-56) predicts that there will be at least one nasal phoneme in every language and that it will be apical n. If there are two nasal consonant phonemes, m will be the second. The other nasal phonemes will appear if and only if the apical and bilabial nasal phonemes exist in the language. Ferguson predicts that if there is to be neutralization of nasal consonants in a language, it will occur in prejunctural or preconsonantal position. From these facts, it is tempting to predict that in prejunctural neutralization the least expected nasal consonants will become either m, or more likely, n. This prediction is borne out in a few cases.

1.1 Nasal → n Rules

1.1.1 η → n Rules

1.1.1.1 Sweet (520) mentions that there are two lexical items in Welsh which have n and η in free variation in final position. Zwicky (personal communication) has checked this with his informant. Although he has found many words which end in η, he has found no other occurrence of this alternation:

\[
gollwng \quad \text{or} \quad \text{gollwng} \\
gastwng \quad \text{or} \quad \text{gastwng}
\]

\text{\textit{gollwng}} \quad \text{\textit{gastwng}}

The conditioning factors are obscure at this point.

1.1.1.2 In English, the η → n rule appears to operate in unpredictable environments. The occurrences of η

\[
\text{\textit{gollwng} \quad \text{or} \quad \text{gollwng}} \\
\text{\textit{gastwng} \quad \text{or} \quad \text{gastwng}}
\]

The conditioning factors are obscure at this point.
other than before a velar are limited to syllable-final position. It occurs there only as the result of two ordered rules:

1) Nasal $\rightarrow$ $\eta/\_\_\$velar (Chomsky and Halle, 413)

2) $g \rightarrow \emptyset/Nasal__$

The only environment for operation of the rule $\eta \rightarrow n$ is in suffixes -(C)in# and the rule does not always apply there.

There are two suffixes -(C)in# in English. The first, which marks the present participle, is most likely to undergo the change $\eta \rightarrow n$.

A) John is walking home.

walking in many dialects is obligatorily walk[ɪn].

The other suffix -(C)in# forms a noun from a verb. It is less likely to undergo the $\eta \rightarrow n$ change than the present participle, but nonetheless does in a number of English dialects. In:

B) Walking is great exercise.

walking may be phonetic walk[ɪn].

It is interesting to note that historically the present participle and the nominal formative come from two distinct suffixes. The nominal suffix in Middle English was -ynge. The form of the present participle varied with the dialect area, but basically it was -Vnd(e). The change in the present participle began in the Southern dialect area where the suffix was -inde. The reason
behind the change from -inde to -inge is not clear. The most popular theory (presented in Prokosch, 205) is that there was some syntactic confusion between the present participle and the nominal forms, leading to leveling. A number of other phonologists of the period (see Baugh, Moore, Wylde) mention the change, but offer no explanation. I would like to note that the present participle, which is most favorable to the \( \eta \rightarrow n \) change is the form derived historically from original alveolar consonants.

Another highly favored environment for the operation of the \( \eta \rightarrow n \) rule is in \textit{prefix} + \textit{thing} when the prefix is monosyllabic, i.e. \textit{nothing}, \textit{something}. However, the rule does not operate on polysyllabic \textit{prefix} + \textit{thing}, i.e. \textit{anything} and \textit{everything}. In polysyllabic \textit{prefix} + \textit{thing}, \textit{thing} invariably receives some stress. In none of the cases of \( \eta \rightarrow n \) thus far in English has the syllable in question received any stress. Therefore the rule now takes on a form:

\[
3) \quad \eta \rightarrow n/(C) \left[ \overset{-}{\text{Stress}} \right] \quad \#\text{word}
\]

one case, however, of stressed \textit{thing} appearing in a compound, \textit{thing-a-ma-jig}, seems to be subject to the rule in some dialects. This is most probably not an example of \( \eta \rightarrow n \), but a reanalysis of syllable boundaries. If the syllable break occurs before \textit{n}, (CVCV syllables), the second syllable seems to begin with \textit{n}. Since \textit{n} is restricted to post-vocalic position in English, it is replaced by the
nasal n. n is a better choice than m because, combined with a velar, is the source for η in English.

The last possible environment for application of the rule is the diminutive suffix -ling. In most American dialects, there appear to be only a few environments where this suffix actually undergoes Rule 3: chitterling, darling and duckling. The form chitterling can be considered a borrowing from a dialect which has Rule 3 in its broadest form. darling seems to be subject to Rule 3 mostly when it is used as a term of endearment and less often when it is used as an adjective. duckling is subject to Rule 3 when referring to the table food. The use of dar[lin] and duck[lin] then is limited by some semantic property which I will call [affectionate]. There are, of course, some forms in -ling which never undergo Rule 3: hireling, fledgling, underling, starling, princeling, changling. Based on the phonetic similarity of forms such as starling and darling I will say that the rule η → n is not phonologically conditioned for -ling forms.

This seems to be in keeping with the original formulation of Rule 3. The vowel in -ling suffixes receives some stress, although a relatively small amount. The following hierarchy for the favored environment for the rule begins with a) the most favored environment and works down to the least favored environment: 2

a) present participle, nothing, something
b) nominal formative (gerundive)
c) -ling [affectionate]

In English sentences, nouns receive comparatively heavy stress. It then seems that Rule 3 favors the least possible stress (an unstressed suffix on a comparatively lightly stressed stem). The rule, then, is:

3a) \[\eta \rightarrow n/(C) \frac{Vowel}{!-stress} \]

There are still several problems with the analysis of Rule 3. It is possible to question its presence at all in English. A possible alternate solution would be to simply reorder two rules which already exist for independent reasons in the grammar of English.

2) \[g \rightarrow \emptyset/Nasal\]

3) \[n \rightarrow \alpha/pos/\emptyset/pos\] (See Part 2 for assimilation rules)

Very similar to Rule 2 is another rule in English:

4) \[b \rightarrow \emptyset/Nasal\]

Rules 2 and 4 can be combined into one rule:

2a) \[\begin{cases} +\text{voice} \\ \text{peripheral} \end{cases} \rightarrow \emptyset/Nasal\]

If we do that, we must not ignore the fact that there is no rule \[m \rightarrow n/\_\_\] in English. This means one of two things. Either Rules 2a and 1a cannot be ordered 2a, 1a, or that there are really no underlying n's directly preceding b to be assimilated in word-final position.

There doesn't appear to be much evidence for a syn-
chronic rule \( b \rightarrow \emptyset /\text{Nasal} \# \) within morphemes. The exceptions: \textit{iamb} - \textit{iambic}, \textit{bomb} - \textit{bombastic} can be marked for \( \emptyset - b \) alternations in the lexicon. Since \( m \), unlike \( \eta \), exists as a separate phoneme in English, there is no need for a rule to explain its occurrence. This provides some evidence for separating Rule 2a into two separate rules again—Rule 2 and possibly Rule 4. Rule 2 is productive, while Rule 4 is, for the most part, vestigial.

If we consider Rules 2 and 4 as separate rules, we can now postulate a series of rules:

5) \( g \rightarrow \emptyset / \left[ \text{Vowel} \right] \text{-stress} n \# \text{syllable} \)

1a) \( n \rightarrow \text{\&pos/} \left[ \text{C} \right] \text{\&pos} \)

6) \( g \rightarrow \emptyset / \eta \# \text{syllable} \)

Rule 5 drops \( g \) in final position in unstressed syllables (where we want to predict surface \( n \)). Rule 1a, assimilating a nasal to a following stop, is blocked in unstressed syllables where \( g \) has already been lost. Rule 6 drops \( g \)'s which follow \( \eta \)'s (i.e. in syllables with some stress). These rules eliminate the need for Rule 3a in English. Ironically, this set of rules also supports the theory of "\( g \)-dropping", often attributed to a spelling pronunciation fallacy.

There is an alternate solution. If we order the Assimilation Rule (1a) before the \( g \)-loss Rule (5), we have a different sort of a problem. To see it more clearly,
I would like to examine the first line of the refrain in the song *Clementine*:

0, my darling, o my darling, o my darling, Clementine

darlings 1 and 2 have both undergone 3 ordered rules. These are Rules 1a, 2 and 3a. In darling 3, the final nasal can be velar before the velar stop k. Rather than claim that Rule 3a is blocked before a velar stop, I want to say that it applies, followed by an assimilation rule. Rule 1a (the Assimilation Rule) provided the input for Rule 3a and has already applied. It appears that Rule 1a is really two distinct rules, one applying within a syllable boundary and the other applying across syllable boundaries. The ordering would be:

1a) \( n \rightarrow \text{pos}/\ldots[\text{C}] \text{pos} \ldots\text{#syllable} \)

6) \( g \rightarrow \emptyset/\text{J} \ldots\text{#syllable} \)

3a) \( \text{n/(C) [Vowel} \text{!-stress} \ldots\text{#} \)

1b) Nasal \( \rightarrow \text{pos}/\ldots[\text{C}] \text{pos} \)

This solution is not only an explanation for the occurrence of a velar nasal before a velar stop (as in darling 3). It also helps to explain the fact that in words like *congress*, the nasal must be velar, while in *congressional*, the nasal may be velar or apical. This can be attributed to the position of the syllable boundary in each word:

7) cong\#gress
7a) congresional

When the nasal and g fall in the same syllable, Rule 1a applies and is obligatory. When the nasal and g have a syllable boundary between them, Rule 1b is optional.

1.1.2 m→ n Rules

1.1.2.1 In a large number of Indo-European languages, a final m changed diachronically to n. Beeler (30) mentions Venetic, Messapic, Greek, Celtic, Germanic, Slavic and Hittite as languages which manifest this change.

eg. PIE accusative sg. ending

* m→ -n/

1.1.2.2 In Sanskrit (Whitney, 50), a root-final m appears in word-final position as n.

- m+root → -n/

Each of the above shows a tendency to reduce the number of nasal consonant phonemes in a language in prejunctural position in accordance with Ferguson's predictions.

1.2.0 Nasal → [-coronal] Rules

There are a large number of languages which, in a sense, defy Ferguson's predicted universals. In each of these languages there is a boundary sensitive rule which changes the point of articulation of nasal consonants to velar before some type of juncture.
1.2.1 Nasal Consonant → η Rules

1.2.1.1 In several Spanish dialects (Robe, 55) n and η are in free variation in word-final position:

1) el melo[n] or el melo[η]
2) alacra[n] or alacra[η]

In these words in other Spanish dialects, the expected final nasal is n and η occurs only as the result of assimilation to a following velar consonant.

1.2.1.2 In Cora (McMahon, 132), there are several types of syllables. They are classified by whether or not they are laryngeal and by their relative length:

a) (C)V(C)        c) (C)V?(C)
b) CV₁V₁(C)        d) (C)Vh

In type (a) syllables, n → η when it is in syllable final position.

1.2.1.3 In Koya (Tyler, 26), the velar nasal allophone of the apical nasal appears word finally.

1.2.1.4 In Hausa (Hodge, 10-11), there are three possible phonetic realizations of n in free variation in word-final position: Vn or Vη or Vη may appear.


1.2.1.5 In Twi (Christaller, 10-11), there is a rule which creates geminate n and η in final position. A later rule deletes final vowels in certain compounds. When an n is stranded in final position by the vowel dropping rule,
it becomes \( \eta \). \( m \) keeps its bilabial point of articulation.

Rules: a) \[
\text{Nasal} \quad \text{coronal} \quad \text{geminate/} \ 
\]

b) \( V \rightarrow \emptyset \)

c) \( n \rightarrow \eta \)

e.g. abien\( u \rightarrow \text{abien} \rightarrow \text{abien} \)

menya mu\( \rightarrow \text{menyam} \)

1.2.1.6 In \( G \) (Westerman and Ward, 131), there is a rule which deletes \([-vocalic] \) elements in final position. When either \( n \) or \( m \) appears in final position as a result of the deletion rule, it becomes \( n \).

e.g. \( l\_ni \rightarrow l\_n \rightarrow l\_n \quad \text{'it is he'} \)

\( \text{nidi mini} \rightarrow \text{mid\_i min} \rightarrow \text{mid\_im}\_n \quad \text{'it is I'} \)

\( t\_\_mli \rightarrow \text{tsum} \rightarrow \text{tsun} \quad \text{'in the house'} \)

1.2.1.7 In Sinhalese (Coates and DeSilva, 168), all word-final \( m \) and \( n \) become \( n \).

\( \text{lium} \_n \quad \text{'letter'} \quad \text{liu}_\eta \quad \text{'letters'} \)

\( \text{uyan} \_n \quad \text{'garden'} \quad \text{uyan} \_\eta \quad \text{'gardens'} \)

1.2.2 Nature of the Rule Nasal\( \rightarrow \eta \)

From the above data we can see that if the rule Nasal\( \rightarrow \eta \) is going to apply, it will be most apt to apply to the apical nasal in prejunctural position. This is evidenced by the number of languages which apply the rule only to \( n \):
Spanish (nasals: m, n, n)
Cora (nasals: m, n, m^w)
Koya (nasals: m, n)
Hausa (nasals: m, n)
Twi (nasals: m, n, n)

The languages which have an \( m \rightarrow \eta \) rule invariably also have the \( n \rightarrow \eta \) rule. From this there are two possible conclusions. First we can conclude that the \( m \rightarrow \eta \) rule and the \( n \rightarrow \eta \) rule are part of one rule. \( m \) will become velar only if \( n \) too becomes velar. If part of the rule is to be suppressed, it will be the part which specifies that \( m \) becomes velar.

The other possibility is that there are two separate rules operating. \( m \rightarrow n \) (See Section 1.1.2) and then \( n \rightarrow \eta \). I wish to support this latter claim. I will save discussion of this until Section 1.3.2. For the present time, I will still consider the rule to be Nasal \( \rightarrow \eta \).

1.2.3 \( \eta \rightarrow \eta \) Rules
In Sanskrit (Whitney, 50), final palatal nasals become velar, but this is not the result of the nasal \( \rightarrow \eta \) rule. Palatal nasals can only occur as the result of assimilation to an adjacent (either preceding or following) palatal consonant. A palatal nasal can only come to be in final position due to an iterative rule which prevents final consonant clusters by deleting all but the first consonant in a cluster in final position. There is a general rule
which makes all palatals velar in final position. If the rules are ordered:

a) Palatal → velar/__#

b) Cluster Reduction (C₁C₂ → C₁/__#)

c) Nasal Assimilation (Nasal → n/__ Palatal__)

There is no need for adding a rule n → n in Sanskrit.

Sanskrit is the only language I have found which appears to have a n → n rule. I therefore predict that palatals do not provide a proper environment for operation of the Nasal → n rule. The rule is then amended to read:

1) [+anterior] → n/__#

1.3.0 Phonetic Motivation for Prejunctural Change

1.3.1 The question of why nasals become velar in prejunctural position remains to be answered. It is best to consider this problem in conjunction with vowel nasalization. Vowel nasalization, like the Nasal → n rule, is most favored in final position (See Schourup, 3). In many cases of vowel nasalization, the nasal consonant is lost. Schourup (37-41) argues that when nasal consonants are lost, there is a migration of the oral closure, leaving nasality behind (Cf. Drachman, 22, for the complete argument).

This makes good sense in light of the behavior of the mora nasal in Japanese. According to McCawley (84), the mora nasal always assimilates to a following consonant. However, when this segment is heard outside of the environment of a following consonant, it has been heard variously as
a nasalized transition to the following vowel, a nasalized continuation of the preceding vowel, a velar nasal consonant, or a velar nasal consonant with incomplete closure.

Keeping in mind that nasality is the result of lowering the velum to create another resonating chamber, we can see that all of the acoustic outputs which have been described for the unassimilated mora nasal can be the result of a nasal consonant which has lost its oral point of articulation, but maintains its nasality. When qualities of either the preceding or following vowel are heard, the velum has lowered slightly. Which vowel is heard is largely dependent on velic timing, i.e. at what point in the utterance the velum has lowered enough to produce nasalization.

If the velum opens more, it is conceivable that there will be contact between it and the tongue. In that case, a velar consonant (with or without complete closure) will result. The mora nasal can then be described as a nasal segment with no specified point of articulation. Its phonetic manifestation is dependent upon two factors: velic timing and degree of velic stricture. In final position it is heard as \( \eta \). It is easy to understand why \( \eta \) is favored in this position because elsewhere the effort to raise the velum in anticipation of the following non-nasal sound would be too great.
The case of Hausa (Hodge, 10-11) presents evidence for a possible intermediate stage of velic lowering. From the data in 1.2.1.4, it can be seen that speakers of Hausa have the option of applying no rules or considerably lowering the velum for the nasal element or of a more gradual velic lowering. In the last case, the velum lowers enough for nasalization and keeps lowering until it creates a stop on the nasal vowel, i.e. until the velum nearly touches the tongue.

It is not so far-fetched to think of the velum as the articulator for nasal consonants with no point of articulation. There is some reason to believe that back nasal (or nasalized) sounds are sometimes articulated by varying the amount of velic opening. One outstanding example of this is the system of vowel nasalization in Sora (David Stampe, personal communication). After a nasal, back vowels are nasalized. The degree of nasalization is directly proportional to the height of the vowel. For example, u, the highest back vowel, is most heavily nasalized, while a, the lowest back vowel, is least nasalized. It seems that after being lowered for a nasal consonant, the velum becomes the moving articulator and creates a stricture with the tongue equal to the stricture of the back nonnasal vowels. Therefore, the largest velic opening will result from articulating the highest vowel so that this vowel will be most heavily nasalized.
In all the languages that have the Nasal $\rightarrow \eta$ rule, there is complete loss of the point of articulation of a nasal. Velic opening, hence nasality and a potential velar point of articulation, is all that remains.

1.3.2 Several points still remain. In Section 1.2.2 I stated that I believe two rules are operating:

- $m \rightarrow n/\_
$ 
- $n \rightarrow \eta/\_
$

We have already seem the operation of a rule $m \rightarrow n$ in final position. If we consider this rule as a simplification of a phonemic inventory\(^9\), it is easier to see a motivation for a rule $n \rightarrow \eta$. It will be seen that coronal consonants tend to lose their coronality (See Section 2).

The rules, then, are:

1) $\left[ \text{bilabial} \right] \rightarrow \text{apical}/\_
$ 
2) $\left[ \text{apical} \right] \rightarrow [\text{-oral point of art}]/\_
$

In all cases thus far the rules are in feeding order, their most natural order.

1.3.3 Those languages which have a rule $\eta \rightarrow n/\_
$ are those which have restrictions on nasals which are unspecified for point of articulation. David Stampe (personal communication) uttered the sentence "Gaberell was sin on the Oval" to a class. He asked various members of the class to repeat what they had heard. The responses were
varied:

a) Gaberell was **singing** on the Oval.
b) Gaberell was **sitting** on the Oval.
c) Gaberell was **sinning** on the Oval.
d) Gaberell was **seeing** on the Oval.
e) Gaberell was **seen** on the Oval.

Each of the above interpretations may be accounted for by phonological rules present in the grammar of English except for (e). There is no rule \( n \rightarrow \eta/\_\_\_\# \) in English. The fact that **seen** was heard is evidence for two things:

1. \( n \rightarrow \eta/\_\_\_\# \) is a natural rule. It has been suppressed for the most part in English. The segments **\( \eta \)** are what native English and German speakers often substitute for French **\( \tilde{\eta} \)**. (Wolfgang Dressler, personal communication).

There is some reason to suppose that nasality can be reconstructed as **\( \eta \)**. Nasality must have a point of articulation in English. Therefore:

2. **\( \eta \rightarrow n \)**.

1.4 Other Prejunctural Processes

There are two dialects of Twi (Christaller, 10-11) which exhibit rather strange behavior. In Fante, the final coronal nasal does not lose its point of articulation. We have already stated (See Section 1.2.1.5) that the rule that makes apicals [+point of articulation] is part of the grammar of Twi. There are two possible explanations for the lack of such a rule in Fante. Either the rule has never
existed or a new rule, reflecting the intolerance of \( \eta \) in Fante, has been added to the grammar:

1) \( n \rightarrow \eta/\_\_\_\_\# \)

2) \( \eta \rightarrow n/\_\_\_\_\# \)

In Ayem, all final nasal consonants become palatal \( \eta \).

This is the only language in which I have observed this.

Up to this point, I have talked only about innate rules or processes. In each language there exists a set of learned rules\(^{10}\) which need not have a phonetic explanation. For the present, I will consider the prejunctural rule in Ayem to be learned, although it is possible that there is a phonetic explanation for such an alternation.
2.0 Assimilation to a Following Consonant

2.1.0 Phonetic Motivation for Assimilation Rules

The most widespread context-sensitive rules involving nasal consonants are those which impose constraints on clusters of nasal consonant + obstruent. The reasons for limitation of the types of nasal + obstruent clusters which occur in a language are fairly obvious when looked at from the point of view of articulatory factors. A nasal consonant is articulated with some complete oral stop and a lowered velum. A following obstruent demands velic closure and possibly a change in the point and manner of articulation. The velum is a relatively slow moving organ, as is the body of the tongue. Any transition between two consecutive sounds which demands movements of both the tongue and the velum will tend to become simplified in the name of ease of articulation.

There are several ways of simplifying a cluster of nasal consonant + obstruent. Those involving some change in the nature of the obstruent or the insertion of an epenthetic consonant are listed in Footnote 11. Since this paper is concerned with changes in nasal consonants, I will focus only on those processes which affect the point or manner of articulation of the nasal component of a consonant cluster. Several things can happen to nasal consonant before a following obstruent:

A) The nasal can lose its nasality.
B) The nasal can lose its point of articulation (possibly in favor of that of the following sound).

C) The nasal can lose its nasality and its point of articulation.

D) The nasal consonant may be lost entirely. Any of the above will aid in ease of articulation by lessening the number of articulators which must move. If Rule A is part of the grammar of a language, the only process needed in transition from nasal to obstruent is movement of the oral articulators. If Rule B is part of the grammar, the only process needed is velic raising. If Rules C or D apply, there is no longer a transition.

Up to this point, I have discussed only clusters in which the nasal consonant precedes the obstruent. Of course, there are many languages with obstruent followed by a nasal consonant. We would expect that the constraints against these clusters will be as strong as those against nasal + obstruent clusters. This is not the case, however. Again the reason for this can be traced to articulatory factors. The velum can be lowered more quickly than it can be raised (Björk, 21). Since raising the velum requires more effort than lowering it, an obstruent + nasal cluster will be easier to articulate than a nasal + obstruent cluster.

2.2 Nature of the point of articulation

By point of articulation, I mean where there is the greatest constriction in the oral tract; which articulators are
causing that constriction, and how those articulators are shaped. The most basic features are those Chomsky and Halle (303-304) have devised for the notion of primary stricture, \( [ + \text{ coronal} ] \) and \( [ + \text{ anterior} ] \). I will assume three basic points of articulation:

a) \( [ + \text{ anterior} ] \)
\( [ + \text{ coronal} ] \)

b) \( [ + \text{ anterior} ] \)
\( [ - \text{ coronal} ] \)

c) \( [ - \text{ anterior} ] \)
\( [ - \text{ coronal} ] \)

These, of course, do not describe all of the possible variations in the point of articulation of nasal consonants. For clearer definition, in the case of assimilation, I am assuming that if any articulator, other than the velum must move in the transition between nasal and obstruent, then the points of articulation are different. If the nasal becomes identical to a following obstruent except that it is articulated with the velum lowered, the point of articulation of the nasal consonant has changed. Also keeping in mind that nasal consonants are \( [ + \text{ consonantal} ] \)
\( [ - \text{ vocalic} ] \)

we are ready to investigate changes in the point of articulation of nasal consonants preceding an obstruent.

2.3 Problems in Investigation

In the process of researching nasal assimilation, I had a great deal of difficulty. Many of the grammars I consulted entirely avoided the issue of whether or not nasals
assimilate to a following consonant. Those who did suggested that such rules exist in their languages often only referred to morphophonemic alternations and ignored syllable structure or morpheme structure rules. Most languages possess a nasal consonant system of m, n. When n appears before a velar, but n never does, it is assumed that there is a rule $n \rightarrow n/\text{velar}$. However, if m occurs before a bilabial, but n never does, it may go unnoticed. There is some question whether there is a constraint against clusters consisting of some nasal other than m preceding a bilabial or whether there is an accidental gap in the lexicon. Since m already has phonemic status in the language, there is no need to explain its occurrence. Unfortunately, this type of analysis may have prevented as complete an investigation as I would have liked. However, on the basis of the data I did gather, many sound generalizations can be made.

2.4 Changes in the Point of Articulation of the Apical Nasal

2.4.1 In Cypriot Maronite Arabic (Tsiapera, 18), the only nasal phoneme is n. The obstruents in the language include the following points of articulation: bilabial, dental, alveolar, palatal, velar, uvular, pharyngeal and glottal. The only allophonic variant of n is $n$ which occurs before velars:
Rule 1:  a) \( n \rightarrow \eta/\_\_velar \)

b) \( n \rightarrow n/\_\_elsewhere \)

Rule 1a exists in a number of languages. However, for reasons given in Section 2.2, the status of

Rule 2: \( n \rightarrow m/\_\_bilabial \)

is in question. Chitimacha (Swadesh, 314), Aztec (Whorf, 371), Cora (McMahon, 132) and Koya (Tyler, 26) all possess nasal consonants of at least \( n, m \). None of the grammars above deals with the status of \( n \) before a bilabial. None of the above languages has a phoneme \( \eta \). The only occurrence of \( [\eta] \) is before a velar. Therefore, the status of the rule for nasal assimilation in the above languages is in question.

In many languages, the rule for nasal assimilation is that the apical nasal in a cluster nasal + obstruent agrees with all the features of the following segment, but it remains \( [+\text{nasal}] \). The rule in its most complete form is:

Rule 3: \( n \rightarrow [+\text{position}] \_ [+\text{position}_{\text{obstruent}}] \)

This rule occurs in Chiricahua Apache (Hoijer, 59), Delaware (Voegelin, 134-135), Sinhalese (Coates and DeSilva, 169), Southern Paiute (Harms, 228) and Indo-European (Prokosh, 46).

In addition, there are those languages whose clusters are limited to nasal + homorganic (i.e. identical except for nasality) consonant. These include Moëa (Leslau, 8), and Papago (Saxton, 30-32). The nasal consonant system
of Papago consists of m, n, \( \eta \). The language avoids clusters of nasal consonants + velar obstruent except in loan words. When nasal consonant + velar does occur, the nasal is \( \eta \). This treatment of loan clusters supplies evidence for the existence of Rule 3 in the grammar of Papago.

The rules thus far seem to be straightforward. Rules 1, 2 and 3 can be collapsed into one rule which has a strict implicational hierarchy:\textsuperscript{12}

**RULE A:**

\[
\begin{align*}
\text{apical} & \rightarrow \text{position} \rightarrow \text{velar bilabial} \quad \text{(Cypriot Arabic)} \\
\text{+coronal} & \rightarrow \{ \text{+anterior} \} \\
\{ \text{-coronal} \} & \quad \text{+anterior} \\
\{ \text{-coronal} \} & \quad \text{-anterior} \\
\{ \text{-coronal} \} & \quad \text{+anterior} \\
\{ \text{-coronal} \} & \quad \text{-anterior}
\end{align*}
\]

2.4.2 In Chontal (Keller, 47-48), the nasal phonemes are m and n. The rest of the consonant system consists of bilabial, alveolar and velar stops (p, b, t, d, k, g, ?) alveolar, alveo-palatal and glottal spirants (s, ñ, h) and alveolar and alveo-palatal affricates (c and ñ). In slow speech, n changes its point of articulation before any \{ -coronal \} segment. One of two processes may take place:

a) n can nasalize and lengthen the preceding vowel.

b) a velar nasal \{ -coronal \} may be heard in place of n. Before the bilabial and glottal consonants
(p, b, ?, h), (a) and (b) are in free variation. Before
the alveo-palatal spirant, only (a) occurs. Before velars
(k, g), only (b) occurs. The Chontal slow-speech rules
are:

\[
c) n \rightarrow \eta / \_\_ \text{velar} \quad ([-\text{back} \mid \text{coronal}])
\]

\[
d) n \rightarrow \eta \quad \text{or} \quad \ddot{\eta} / \_\_ \text{bilabial} \quad ([-\text{coronal} \mid -\text{back}])
\]

\[
e) n \rightarrow \ddot{\eta} / \_\_ \text{alveo-palatal} \quad ([-\text{coronal}])
\]

This situation looks suspiciously like the prejunc-
tural \(n \rightarrow \eta\) rule (see Section 1.3.1). Except before a
velar, the point of articulation of the nasal will be lost,
leaving behind a lengthened nasalized vowel (See Drachman,
22) or velic lowering will occur.

In fast speech Chontal, m always appears before bi-
labials. The slow speech rules for assimilation to non-
coronal consonants remain otherwise unchanged.

In light of the slow speech rules, it is now neces-
sary to consider the nature of a nasal which has lost its
point of articulation (hereafter \([-\text{position}]\) ). Because
all we expect it velic opening, we have already suggested
that this segment is \([-\text{coronal} \mid -\text{anterior}])\). The lowered velum will
will create some stricture with the back of the tongue,
therefore the articulation is \([+\text{back}]\). Because the
\([-\text{position}]\) nasal can be potentially phonetically consonantal
(as n) or vowel-like\(^{13}\), I believe that the \([-\text{position}]\) nasal
segment is a glide (i.e. nonsyllabic). The composite features of this glide seem to be:

\[
\begin{array}{l}
\quad +\text{nasal} \\
\quad +\text{high} \\
\quad +\text{back} \\
\quad -\text{syllabic} \\
\quad -\text{round}
\end{array}
\]

or phonetic \(\tilde{u}\). If the velum continues lowering (or the tongue backs more, see footnote 7), the perceptual result will be the velar nasal \(\eta\). Velic lowering (or tongue back- ing) creates the stricture necessary to make the sound \(+\text{consonantal}\).

In Chontal (just for example), the slow speech process is:

1. \(Vn \rightarrow V\tilde{u} \rightarrow \tilde{u} \rightarrow \tilde{u}/\_ \{\text{bilabial, glottal}\} \quad (a)\)

2. \(Vn \rightarrow V\tilde{u} \rightarrow V\tilde{u} \rightarrow V\eta /\_ \{\text{bilabial, velar, glottal}\} \quad (b)\)

The fact that only the velar nasal occurs before velars can be explained by a tendency of the nasal to remain consonan- tal if it is potentially homorganic to the following consonant. Elsewhere, either of the processes 1a or 1b may occur.

In fast speech, the process is:

1. \(Vn \rightarrow Vn/\_ \text{bilabial}\)

2. \(Vn \rightarrow V\tilde{u} \rightarrow V\tilde{u} \rightarrow \tilde{u} \rightarrow V\tilde{u} /\_ \text{glottal}\)

\(\rightarrow V\eta /\_ \{\text{velar, glottal}\}\)
The fast speech rule is the result of simultaneous lowering of the velum for the nasal glide and closure of the lips in anticipation of the bilabial consonant immediately following. If the lips create a stop before Rule 1b can apply, a bilabial nasal results.

There is a nearly identical situation in French (Morin, 43-44). I believe that the first stage of every assimilation rule is the loss of position:

3. \[ n \rightarrow \tilde{n}/\_\_ [-\text{coronal}] \]

In Chontal slow speech and French, Rule 1 then applies.

In Chontal fast speech and in all of the other languages I have mentioned so far, simultaneous lowering of the velum for the nasal glide and oral closure in anticipation of the following consonant create the effect of a change of position of the nasal. The assimilation rule is then in two parts:

4a) \[ n \rightarrow \tilde{n}/\_\_ [-\text{coronal}] \]

    b) \( \tilde{n} \rightarrow [-\text{position}]/\_\_ [+\text{position}] \)

Rule 4, in its most limited form, applies before velars only (eg. Cypriot Maronite Arabic, Tsiapera, 18).

The tendency of rules which change the position of nasals seems to be toward greater phonetic similarity to a following segment. Then, it seems reasonable that the loss of position occurs before a velar consonant, articulated much like the nasal glide except for the degree of stricture between the tongue and the velum. The only feature which
must change to make the nasal homorganic to a following consonant is the assignment for consonantalility.

In Teco (Kaufman, 158), there is a rule which makes the coronal nasal velar before a glottal stop. The language has two nasals \( m \) and \( n \) and bilabial, apical, palatal, velar and glottal obstruents. If we consider \( ? \) as a positionless (i.e. without oral closure) stop, it becomes clearer why the rule operates in its most limited form in this environment. Before a positionless stop (?), \( n \) assimilates to nonposition (no oral closure):

5. \( n \rightarrow \tilde{u} \rightarrow \eta/\_\_\_\_\_\_\_\_? \)

In languages where \( ? \) functions as glide, \( ? \) will not be the most favored environment for the operation of the rule.\(^{14}\)

The \( n \rightarrow \tilde{u} \) rule has the following hierarchy of preferred positional environments:

6. \( n \rightarrow \tilde{u}/\_\_\_\_\_\_\_\_\uparrow \left\{ \begin{array}{l} \text{[+consonantal]} \\
\text{[+position]} \\
\text{([+back] \ (velars))} \\
\text{[-coronal]} \\
\text{[+coronal]} \end{array} \right\} \)

2.4.3 I don't want to make the claim that all changes of point of articulation of a nasal involve a loss of position followed by assimilation of the oral closure of the following consonant. In situations where the nasal consonant and the following consonant have the same assignment for primary stricture, the nasal will merely take on the same features (except \([-\text{nasal}]\) ) of the following consonant.
1. \[\text{coronal} \rightarrow \mathcal{F} /\_ [\text{coronal}] \]

I will call these changes Local Changes. Operation of Rule 2.3.4.1 can be seen in Sinhalese (Coates and DeSilva, 168) where alveolar n becomes dental before a dental consonant and retroflexed before a retroflex consonant. Velar n becomes palatal before a palatal:

2. \[
\begin{bmatrix}
+\text{nasal} \\
+\text{coronal} \\
+\text{anterior}
\end{bmatrix} 
\rightarrow
\begin{bmatrix}
-\text{nasal} \\
+\text{coronal} \\
+\text{anterior}
\end{bmatrix}
\]

\[
\begin{bmatrix}
-\text{distributed} \\
+\text{coronal} \\
+\text{anterior}
\end{bmatrix}
\]

\[
\begin{bmatrix}
+\text{nasal} \\
-\text{coronal} \\
-\text{anterior}
\end{bmatrix} 
\rightarrow
\begin{bmatrix}
-\text{nasal} \\
-\text{coronal} \\
-\text{anterior}
\end{bmatrix}
\]

In Egyptian Colloquial Arabic (Khalafallah, 26) and Jewish Spanish of Bucarest (Sala, 173), the bilabial nasal becomes labiodental before a labiodental consonant (f or v):

3. \[
\begin{bmatrix}
+\text{nasal} \\
-\text{coronal} \\
+\text{anterior}
\end{bmatrix} 
\rightarrow
\begin{bmatrix}
-\text{nasal} \\
-\text{coronal} \\
+\text{anterior}
\end{bmatrix}
\]

Both languages also possess long distance assimilation rules, involving the loss of position of the apical nasal and anticipatory closure:

\[
n \rightarrow \tilde{n} /\_ [\text{coronal}]
\]

\[
\tilde{n} \rightarrow [\text{position}] /\_ [\text{position}]
\]
2.5 Changes in the Position of Bilabial Nasals

Thus far we have seen only one rule which affects the position of the bilabial nasal before another consonant—a local change from bilabial to labiodental.

In Atsugewi (Olmstead, 217) and Maidu (Shipley, 235) the nasal systems consist of m and n which contrast everywhere except before velars. In this position, n contrasts with n and m never appears. Olmstead (217) claims that a rule:

1) \[ m \rightarrow \eta / \_\_ \text{velar} \]

operates in this position. We have already seen independent evidence for two rules:

1a) \[ n \rightarrow \tilde{\eta} \rightarrow \eta \] (See Section 1.3)

b) \[ m \rightarrow n \] (See Section 1.1.2)

If we assume that Rule 1b in its broadest form can also apply before consonants, and that the potential hierarchy is the same as that for Rule 2.2.4.6, Rule 1 when ordered \( \tilde{\eta} \) will predict \( n \) and \( \eta \) before velars in Maidu and Atsugewi without adding a new rule for preconsonantal changes in nasals.

With the exception of local changes, I have found no cases of \( m \) (or \( p \) or \( \eta \)) losing its point of articulation and assimilating to a following consonant.¹⁵

There appears, then, to be several rules which may account for assimilation of a nasal to a following obstruent:
2.6 Other Types of Assimilation Involving Change in the Nasal Consonant

2.6.1 Obstruent + Nasal

There are cases where a nasal following an obstruent changes its position to become more like the obstruent. In Sanskrit (Whitney, 50), any nasal adjacent to an obstruent takes on the position of the obstruent. In English, a syllabic nasal will assimilate to a preceding consonant:

\[
\text{bek} \eta \rightarrow \text{bek} \eta
\]

\[
\text{hev} \eta \rightarrow \text{hev} \eta \rightarrow \text{he(v)} \eta \rightarrow \text{he(b)} \eta
\]

A diachronic process in Germanic (Prokosch, 69) assimilated a nasal to a preceding +voice stop and denasalized the nasal:

1. \[
n \rightarrow \text{position}\left\{\begin{array}{c}
\text{+consonantal} \\
\text{-position}
\end{array}\right\}
\]

2. \[
\text{+Consonantal} \rightarrow \text{-Nasal}\left\{\begin{array}{c}
\text{+voice} \\
\text{-continuant}
\end{array}\right\}
\]

For example:
IE lug-no--- ON lokkr 'lock, curl'
IE (s)tud-no--- MHG stutzen 'be startled'

I found only one other case where a nasal following another consonant becomes nonnasal. In Walapai (Redden, 8) the nasal consonant phonemes are m, n, ɲ, ɳ and the stops are p, t, c, k, q. The cluster km can be modified in one of two ways:

\[
k \rightarrow ɬ/\_m \\
m \rightarrow b/k\_ \\
\]

It seems that Consonant + Nasal clusters are considerably rarer than Nasal + Consonant clusters and the rules for changing the nasal consonant are not quite so clear.

2.6.2 Changes in Position and Nasality in Nasal + Obstruent Clusters

2.6.2.1 There are languages where a nasal consonant will lose its position and its nasality before an obstruent. Prokosch (86) lists some diachronic rules in Germanic in which a nasal consonant is lost preceding a spirant.

In Primitive Germanic:

1. ɳ \rightarrow \emptyset/\_x \\

In Norse:

2. n \rightarrow \emptyset/\_\{s\} \\

In Anglo-Frisian:

3. n \rightarrow \emptyset/\_\{s\} \{f\} \\

Of course, Rule 1 also applies to Norse and Anglo-Frisian.
2.6.2.2 Kitsai (Brucca and Lesser, 18) has the following morphophonemic rules:

1. n → ʘ/___w
2. n → ʘ/___n
3. r → ʘ/___n
4. r → ʘ/n___
5. n → /h//___t
6. n → /h//___k
7. n → /h//___?

n is the only nasal. From the above, we can conclude that a nasal is lost before another resonant (except r which is always lost when adjacent to n—See 3 and 4 above). Before a stop (? is analyzed as a stop, not a glide in this language), the nasality and the point of articulation of the nasal are lost, leaving a glottal resonant.

2.7 Incomplete Assimilation for Position in Nasal Consonants

There are two examples of incomplete assimilation for position that I have found. In Koya (Tyler, 26), n becomes ŋ following a velar. In French (Pope, 133), the Latin cluster ŋn (orthographically gn) became palatal ŋ.

In French there was a general tendency to make consonant clusters of velar + dental palatal (Pope, 133). It seems that both nasal segments are influencing each other. The velar segment loses its backness before a [back] segment. The apical nasal then may lose its position:

1. ŋ → [back]_/___ [back]
2. [+coronal] \rightarrow \sim \sim / [-coronal] ___

This argument is rather weak since it supplies the only case of loss of position following another consonant (and a nasal at that).

Instead, I would like to propose a fusion of features between the sounds:

3. \eta \rightarrow \sim \sim / [-back] ___ (n)

4. n \rightarrow / [-coronal] ___ / [-coronal] ___ (n)

5. \eta \rightarrow n

The situation in Koya then presents less of a problem. Rule 4 applies to the cluster gn. Since the apical nasal is specified [-back] and [-high], the resulting nasal is palatal.
3.0 Conclusions

From the preceding chapters, it seems clear that there are two types of rules which account for the changes in point of articulation of nasal consonants in prejunctural and preconsonantal position:

1) \( m \rightarrow n \)

2) \( n \rightarrow \alpha \)

Since \( \alpha \) does not appear on the surface, a number of things can happen to it:

3) \( \alpha \rightarrow \eta \)

4) \( \text{position} \rightarrow \text{position} \) [consonant]

It is tempting to assume that Rule 2 is really a single rule, and that the prejunctural environment is part of the implicational hierarchy. However, my investigation did not go so far as to show conclusive evidence for the assumption.

The rule:

5) \( \eta \rightarrow n/\_
\)

is an attempt to avoid 'positionless' nasals and to recapture the input of a natural rule which is a possible source of \( \eta \) (via Rules 2 and 3).

A widespread use of Rules 1 and 2 is further supported by languages which only have \( \eta \) in syllable and word final position and/or \( m \) in syllable or word final positions.\(^{17}\) This accident in distribution may be attributable to operation of Rule 1 or Rule 2 or both in the grammar. These five rules which have some phonetic motivation, and there-
fore, may be termed 'natural', are capable of predicting and explaining many types of phonological processes and gaps in distribution found in the languages of the world.
4.0 Epilogue

In the course of researching and writing my thesis, it became increasingly apparent that the present convention for writing rules is largely inadequate. This is true for a number of reasons.

First, and probably most easily remedied, is the problem of the scope of binary distinctive features. I found that several processes could not be written in terms of features since there were no features which expressed distinctiveness between two segments. For example, one process I encountered was a local assimilation rule which made the bilabial nasal labiodental before another labiodental segment. Since m and n are not distinctive in any language, there is, apparently, no need for a feature which distinguishes between such sounds. However, if processes are more naturally expressed in terms of feature changes, how can the process \( m \rightarrow n \) express the fact that the input and output have different phonetic realizations? \( m \rightarrow \text{position} \rightarrow \text{position} \) is the only way to write the rule. However, this does not capture the fact that this can only be a local rule. And, further, the feature can’t be broken down any more (and, in fact, is not a binary feature at all), since the distinctive features for m and n are the same. I have a feeling that the m - n distinction is not the only one which can’t be expressed by features. In that case, maybe a total revision of the use
of features, with substitutions for various binary features by absolute features, is in order.

A more fundamental problem is how to represent a process which is unattested in surface form, but is necessary to explain a later process in some natural way. Basically, this problem is that if natural processes are gradual, and I am convinced many of them are, what stages should be represented by rules? I personally answered that question by assuming that there is some initial state in nasal assimilation:

\[
\begin{array}{c}
n \\
\text{[+coronal]} \\
\text{[+anterior]}
\end{array}
\]

Nasal consonants can then become homorganic to a following stop, remain at the apical point of articulation, or become \( \eta \). Since \( \eta \) is a velar nasal (a physiological redundancy of sorts), we can assume that when \( \eta \) occurs for \( n \) before a non-velar consonant, velic lowering is occurring—enough velic lowering to create contact with the tongue. In cases where \( n \) becomes homorganic, there is premature oral closure for a following consonant (i.e., a left-ward migration of closure) coupled with pure velic lowering. Both of these processes have velic lowering as a stage in the larger process. I therefore devised a rule which lost the oral closure of the apical \( n \) and then another rule which predicted the phonetic output of a nasal which has lost its oral closure:
Proposing two rules like the above captures a general-
ity about the change in position of apical nasals and, in
fact, explains some of it quite naturally. The problem
is that the output of Rule (and therefore the input of Rule
2) is totally unattested in the phonetic level of any lan-
guage. How natural can such rules be? Of course, the
fact that "pure" velic lowering is unattested in surface
phonetics may be due to field linguist's having used only
the available symbols to describe the sounds they have
heard. It is also due to a current theoretical bias that
all phonetic outputs must be expressed in terms of all
their distinctive features.

To fix up the above deficiency, I think I made matters
worse by positing a real phonetic output for Rule 1---\( \hat{\alpha} \)
(whose derivation is well-described in my thesis). This
segment never occurs on the phonetic level and there is
little reason to suppose that for velic lowering, the ton-
gue must be in a position for a high back vowel. Further-
more, I think that (i.e. the tongue position) is irrelevant.

The problem is that although naturalness can be better
explained by positing Rule 1 as the input for Rule 2, can
a rule be written which demands a succeeding rule to com-
plete the process it has begun? If so, what does this
type of rule, as the basis of natural phonology, mean? It refers to no real single natural process, but to a stage of many divergent processes. Do these rules adequately express the process to which they refer? I don't believe so. Unfortunately, at this point, I can think of no viable alternative.
Notes

1. There are, in fact, two languages which have unconditioned diachronic rules $\eta \rightarrow n$. Several Tarascan dialects (Friedrich, 174) have this rule (except before velar stops, which indicates a nasal assimilation rule is ordered later in the grammar). Also, Chipaya, in its divergence from Maya-Chipayan (Hamp, 74-76) makes all proto velar nasals apical.

2. This may be considered an example of a phonological rule which is subject to the category hierarchy (see Ross, forthcoming). In this case, verbs are most favored and nouns least favored.

3. See Stampe (forthcoming) for the reason for positing $g$ in both syllables of congress.

4. Yoruba (Ward, 18) shows a contracted form of the future [emi] and the negative [mo] which is phonetically [$\eta$]:

   $\eta$ o l$\ddot{\imath}$ 'I shall go'

   $\eta$ ko l$\ddot{\imath}$ 'I did not go'

   This is the only reference I found to a nasal-$\eta$ rule in the language so it seems not to be phonologically determined.

5. Sanskrit palatals originally came from PIE velars before palatal vowels. This rule is dead, however, so we will assume that there is a rule which makes final palatals velar
rather than assume that the velar to palatal rule does not function in word-final position.

6. Trubetzkoy (233) claims that \( n \) is the most vowel-like consonant. He uses as evidence the neutralization of \( o-u \) and \( ö-ü \) in German before \( \eta \). If \( n \) is so vowel-like, we may be justified in claiming that the first stage of vowel nasalization is really a diphthongization:

\[
\eta \rightarrow v \ddot{y}
\]

\( \eta \) is then a nonsyllabic nasal segment—a nasal glide unspecified for point of articulation.

7. Gaberell Drachman (personal communication) has brought to my attention the fact that nasalized vowels tend to be articulated with a retracted tongue. He further claims that what is heard as \( \eta \) is really not the result of contact between the velum and the tongue. The stricture between the retracted tongue, the lowered velum, and the pharynx result in a perceptual \( \eta \).

8. In fact, \( ĩ \) in Yoruba has been heard a phonetic \( [\eta] \) after \( k \) and \( g \) (Dunstan, 167)

9. Keeping in mind Ferguson's (55) claim that any language with an m phoneme will have an n phoneme, but neither an m or an n phoneme will predict the presence of an \( \eta \) phoneme, \( \eta \) may appear as an allophone of some other nasal consonant (or possibly an oral consonant, eg. \( g \)), but it will not
necessarily have phonemic status of its own.

10. See Stampe (forthcoming) for a discussion of processes as opposed to rules.

11. Exceptions do exist. There are languages which allow any nasal + obstruent clusters such as Southern Sierra Miwok (Broadbent, 16) and the Kuskokwim dialect of Alaskan Eskimo (Mattina, 44-45).

There are also languages which resolve difficult clusters by inserting a consonant between the nasal and the nonhomorganic obstruent. Diegueño (Langdon, 8) has a rule which inserts a [voice] stop homorganic to the nasal between the two segments:

\[ \text{m} \rightarrow \text{m}p/\_\{t\} \]
\[ \text{n} \rightarrow \text{n}t/\_k \]

This seems to be a case of velic timing (see Drachman, b, 201-205 for a discussion of velic timing). The velum raises before the release of the oral closure for the nasal consonant.

12. By a strict implicational hierarchy, I mean a set of environments for operation of the rule which are ordered from the most highly favored to the least highly favored. If the rule applies in some specified environment in a language, it will also apply in all of the more favored environments in that language. The arrow (↑) specifies
the direction of implication:

\[
\uparrow \begin{cases} a \\ b \\ c \end{cases}
\]

Environment c implies environment b implies environment a.

13. For vowel-like quality of [-position] nasal, see Section 1.3.1 (mora nasal in Japanese) and 2.4.2.1 (preconsonantal vowel nasalization in Chontal).

14. There seems to be some sort of implicational hierarchy for manner of articulation functioning in the environment of the nasal assimilation rules. This is only hypothetical since once again the literature is vague on the true nature and domain of assimilation rules. However, I hypothesize that assimilation is most likely to occur before -continuant consonants. For this reason, I have predicted that when ? functions like a glide, it will be less likely to trigger a loss of oral closure of a preceding nasal than when it functions like a stop.

15. It has been pointed out to me (David Stampe, personal communication) that the rule \( m \rightarrow \eta/\_velar \) seems to apply across syllable boundaries in English:

eg. I'm going \( \rightarrow \eta g \)

pumpkin \( \rightarrow \eta k \)

some cat \( \rightarrow \eta k \)

them guys \( \rightarrow \eta g \)

This seems to be a simple case of reordering Rules (2.5) 1a
and (2.5) 1b. If ordered 1b 1a:

1b. \( m \rightarrow n/\_\_\text{velar} \)

1a. \( n \rightarrow \hat{\omega} \rightarrow \eta/\_\_\text{velar} \)

16. In the word *heaven* \([\text{he(b)m}]\) there seems to be a bilabial obstruent before the nasal syllabic. However, as David Stampe (personal communication) has pointed out to me, this may be a velic explosion—the sound of a suddenly and forcefully opened velum, following the nonnasal vowel.

17. In Hupa (Woodward, 200), \( m \) only appears in syllable initial position.

There are many more cases of \( n \) being limited to final position. These include: Southern Sierra Miwok (Broadbent, 16), Sinhalese (Coates and DeSilva, 167), Alaskan Eskimo, Kuskokwim Dialect (Mattina, 44), French (Morin, 44) and Sora (Stampe, 167).
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