

The Diachronic Coronal-Velar Nasal Relationship

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ABSTRACT

This paper investigates the phonetic factors of diachronic nasal place change from the alveolar to the velar place of articulation. Evidence is given from Cuban Spanish, Hausa, Brazilian Portuguese, and Chinese. There appear to be two distinct pathways leading to change. The first is a pathway in which the word-final alveolar nasal becomes velar with no independent stage of phonemic word-final nasalized vowels (Cuban Spanish, Hausa, and certain dialectal groups of Chinese). In the second pathway (Brazilian Portuguese), there is a documented stage of phonemically nasalized vowels. It is concluded that the change from alveolar-to-velar nasal is one of phonetic changes, in no way explained by an abstract notion of markedness.

1. INTRODUCTION

In many languages, velar consonants have undergone place of articulation shift to the alveolar region. Some of this diachronic place change and synchronic alternation has been collected and summarized in favor of a phonological argument that coronals and velars are the two unmarked places of articulation, and further that coronals and velars result from a single representation, a Place node with no dependent (Rice, 1996).

The goal of the current analysis is to investigate and explain this special diachronic relationship, relying more upon acoustic and articulatory factors, while shying away from any phonological explanation of markedness and unmarkedness. The focus on nasal place shift and the reasons for this shift will exemplify the complexity of these specific phonetic/phonemic changes. Nasals are susceptible to place change simply because of their nasality.

This paper is organized as follows. In Section 2, several unrelated languages will be examined in detail as evidence for the diachronic change from [n] to [ŋ]. Shared phonetic characteristics of the sample languages will be summarized. Section 3 will consist of experimental acoustic and articulatory studies, which will serve as more evidence toward the specific acoustic and articulatory reasons that these changes occur diachronically. And, finally, Section 4 will be a list of necessary phonetic factors that serve as a roadmap for this specific diachronic process.

2. DIACHRONIC EXAMPLES

(2.1) Cuban Spanish

A prototypical case of the alveolar nasal sifting to the velar nasal is that of Cuban Spanish (Hammond 1976, Lederer 2000). In Cuban Spanish, all word-final instances of a nasal consonant appear as the velar nasal [ŋ]. By contrast, in Peninsular Spanish, word-final nasals appear as the alveolar [n] (with the exception of dialects such as Andalusian, which also exhibits the word-final velar nasal).

Spain

pā[n]
esta[n]
kamjo[n]
perutʃi[n]
segu[n]

Cuba

pā[ŋ] ‘bread’
etā[ŋ] ‘they are’
kamjō[ŋ] ‘truck’
perutʃi[ŋ] ‘Peruchin’
segū[ŋ] ‘following’

Table 1: Spanish examples of the [n] → [ŋ] change

One can hypothesize that the word-final [n] of pre-colonial Spanish evolved into the word-final [ŋ] spoken in Cuba, since the alveolar nasal is found in most parts of the Iberian Peninsula, and the velar nasal is realized word-finally only in Southern Spain, Cuba, and other former Spanish colonial countries in the Caribbean (e.g. Puerto Rico, dialects of Caribbean Mexico).

In order to begin the process of reconstructing how a change like this might take place it is crucial to note several factors about the phonetic differences between the two dialects, differences that perhaps served as catalysts for the resulting change in articulatory position. The first point to be noticed is that the Cuban velar nasal is pronounced in a word-final environment. In Cuban Spanish pre-consonantal nasals assimilate to the place of articulation of the following consonant: [ẽmfasi] ‘emphasis’, [ẽntʃufar] ‘to plug in’, [mãŋgo] ‘mango’, but in the word-final environment, the velar nasal serves as the ‘default’ nasal. In continental Spanish, the system of phonemic nasals consists of [m], [n], [ɲ]. The velar [ŋ] is simply an allophonic variant of the alveolar nasal. In Cuban Spanish, however, a phonetic neutralization seems to have occurred. Because the velar-nasal is pronounced word-finally, and in the unconditioned coda position sporadically (Hammond 1976), the [ŋ] has now taken over many of the positions of [n].

Another crucial difference between the two dialects, a key factor to the alveolar-velar sound change, rests on the quality of the vowel which precedes the word-final nasal. The vowels preceding nasals in continental Spanish are not phonologically nasalized, but the vowels preceding nasals in Cuban Spanish are (Lederer 2000). Maria-Josep

Solé (1995) experimentally demonstrates the difference between a phonologized pattern of pre-nasal vowel nasalization in American English and phonetic co-articulatory pattern of pre-nasal vowel nasalization in Continental Spanish:

In (Continental) Spanish, vowels are oral for most of their duration; onset of VP (velopharyngeal port) opening is timed relative to the following nasal consonant and peak VP size occurs at nasal consonant onset across (speech) rates, which suggests that the motor commands for opening the velar port are part of the instructions for the nasal consonant. In American English, on the other hand, VP opening onset coincides with vowel onset and peak VP size occurs in the middle of the vowel across rates, which indicates that opening movements are part of the programming instructions for the vowel. It is argued that, in (Continental) Spanish, vowels followed by a nasal consonant are targeted as oral and are nasalized as a result of a co-articulatory effect, whereas in American English, vowels are targeted as nasalized as a result of a phonological rule (p. 1).

The phonetically nasalized vowels in pre-nasal position in Continental Spanish can be compared the phonologically nasalized vowels in pre-nasal position in Cuban Spanish. Cuban Spanish pre-nasal vowels pattern with the pre-nasal vowels of American English (Lederer 2000). In Cuban Spanish nasal airflow begins at the release of the onset and increases during the duration of the vowel until it peaks at the closure of the nasal. This nasal airflow indicates that the entire pre-nasal vowel is nasalized, due to the *early* opening of the velopharyngeal port, and is thus not simply a result of phonetic co-articulation. Cuban Spanish differs crucially from Continental Spanish in this aspect of vowel nasalization. This distinction will be shown later to be one of the most important predictive factors in the change from alveolar to velar nasal.

(2.2) Modern Hausa

Like Cuban Spanish, Hausa has undergone the same nasal place change. Though not as universal as the word-final velar constraint in Cuban Spanish, modern Hausa demonstrates the allophonic variation in word-final position. In most dialects, both final /m/ and final /n/ may be realized as the velar [ŋ] (Bello 1992). A couple of examples demonstrate the sound change:

	Historical Form	Modern Pronunciation	
(Bello 1992)	mùtum	mùtuŋ	‘man’
(Bello 1992)	cân	câŋ	‘there’

Table 2: Hausa examples of the [n] → [ŋ] change

The orthography of the language as well as the synchronic alternation between different dialects point to the directional change from two different word-final nasals: [m] and [n] to the merged word-final velar nasal, [ŋ]. This view is consistent with the analysis given by Newman (2000). Newman explains that the nasal

phoneme /n/ commonly occurs in syllable final-position, and that, when it does, it is always homorganic with the following consonant. This nasal-coda situation in Hausa seems at first very similar to the Cuban homorganic nasal coda phenomenon. However, Newman (p. 405) goes so far as to say that the nasal in this position should not be linked to the coda, but is in fact part of a “nasal diphthong”, which behaves comparably to an oral diphthong. This type of description raises the possibility that Hausa vowels in pre-nasal position are phonemically nasalized as is the case in Cuba.

(2.3) Chinese

In several areas of the Min dialects of Chinese, the historical contrast of word-final [m], [n], and [ŋ] in Middle Chinese (MC) have merged to be pronounced as the velar nasal (Chen, 1973). Chen exemplifies this ‘unidirectional merging’ by observing that in dialects that merged to only two-way contrasts, either /m/ merged with /n/ or /n/ merged with /ŋ/. The merges never resulted in just word-final [m] and never resulted in just word-final [n]. Often the two-way distinction then neutralized to only one word-final nasal, the velar [ŋ]:

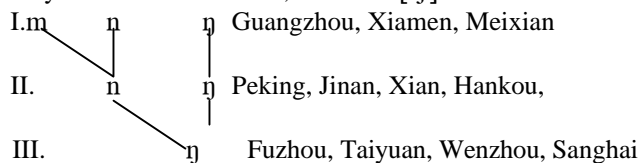


Table 3: The unidirectional pattern (Chen, p.102)

Chen notes too, that /m/ and /n/ historically tend to drop after nasalizing the preceding vowel more readily than /ŋ/. A special relationship formed from the appearance of the velar nasal on nasalized vowels. A potential articulatory/acoustic explanation for this occurrence will be outlined in Section 3.

(2.4) Brazilian Portuguese

Brazilian Portuguese represents the second pathway to change, in which a stage of word-final velar nasals has been preceded by a long stage of word-final phonemically nasalized vowels. Ryan Shosted (2003 (in this volume)) shows how Brazilian Portuguese fits into a similar diachronic nasal place change as the other languages. Shosted has demonstrated, through the study of nasal airflow, that what once were simply word-final nasalized high vowels in Brazilian Portuguese can now be documented as ending in the articulation of the velar nasal. The change from bilabial and alveolar word-final nasals (from the evidence of Latin) has come about through a very long diachronic time span, but the result of the change is nonetheless the same as the previous languages.

The following examples demonstrate the historical form and the current pronunciation in the Minas Gerais dialect of Brazilian Portuguese:

	Historical	Brazilian Alternative	
(Shosted 2003)	sĩ	sĩŋ	‘yes’
(Shosted 2003)	nũ	nũŋ	‘in a, in one’
(Shosted 2003)	bě	běŋ	‘well’

Table 4: Brazilian [ṽ] → [ṽŋ]

As the Portuguese examples demonstrate, it looks as though the word-final nasalized vowel is being re-interpreted as a word-final nasalized vowel with a velic closure, a nasalized vowel with the velar nasal attached.

(2.5) Summary

Based on the four languages detailed above and the countless others that exist, the alveolar-velar nasal shift is a noteworthy cross-linguistic sound change, for which a phonetic explanation is due. Evidence points to commonalities among the specific sound changes:

- the sound change happens in the *word-finally*
- a current stage of phonological nasalization on the pre-nasal vowel of the language is hypothesized with descriptive support (Hausa, Chinese), or experimentally demonstrated to exist (Cuban Spanish, Brazilian Portuguese)

• the language exhibits nasal assimilation to the following consonant within the word.

3. EXPERIMENTAL INSIGHT

(3.1) The Word-Final Environment

The word-final environment itself plays a crucial part in allowing the alveolar-velar nasal sound change to occur. At the end of a word, before a pause, the consonantal release of a word-final consonant is not heard and often not pronounced because quite obviously there is no following segment to carry the acoustic quality of the release. In his collection of acoustical studies of speech transmission, Harvey Fletcher (1929) indirectly comments on the word-final environment, when describing the results of one of his word-perception experiments, in which the intensity of the speech signal is correlated with phoneme recognition:

A consonant sound may sometimes be identified by the modification produced on the following or preceding vowel even though it is below the threshold as determined by an isolated sound. It might seem logical to consider this modification of the vowel as part of the consonant. If it is so considered, then it is evident that as long as the vowel is heard there is always a chance of identifying the consonant preceding or succeeding it . . . (p.277)

What Fletcher describes as the consonant's modification of the vowel can be technically clarified as the lowering or raising of the vowel's formants in the transition from vowel to consonant and from consonant to vowel in the acoustic signal. When one factors in pre-pausal consonant positioning, a crucial acoustic cue is lost from the speech signal. In pre-pausal position, no vowel follows the word-final consonant, thus one acoustic cue is stolen from the speech signal, and the probability of correct consonant recognition is lowered. Likewise, in word-final position, the probability of realizing the consonantal formant transition onto a vowel is very low since cross-linguistically words overwhelmingly begin with consonant onsets not vowels.

In another experiment of speech recognition over a telephone system, Fletcher verifies the claim that the word-final position is crucial to perpetuating misinterpretation of segments. When two callers pronounced 174 English word lists of 50 words each to eight listeners over a telephone system transmitting only frequencies as high as 1250 cycles per second, an analysis of the results obtained with the standardized lists showed that 42 % of the errors were initial consonants and 58 % of the errors were final consonants. The word-final environment has to be a factor considered to contribute to the re-interpretation and shift from the alveolar-to-velar word-final nasal.

(3.2) The Velar Nasal Itself

As demonstrated in Section 2, the velar nasal of the daughter dialects, which have undergone the alveolar-to-velar shift, almost always co-occurs with a preceding phonologically nasalized vowel, [ṽŋ]. Articulatorily, the only difference between a nasalized vowel, and the velar nasal is a full dorsal tongue closure at the velum. During the articulation of a nasalized vowel, the lowered velum creates a small obstruction in oral airflow, thus, to produce the velar nasal consonant, the only articulatory step necessary is to slightly raise the tongue dorsum, creating a full closure with the lowered velum.

The small articulatory difference between a nasalized vowel and a word-final velar nasal can be realized as acoustic confusion in the speech signal. Ohala & Ohala (1993) argue, based on phonetic universals derived from acoustic primitives, that back nasals are less consonantal than front nasals:

The further back a nasal consonant is articulated, the less "consonantal" it is. . . The further back the oral constriction is, the higher will be the antiresonances contributed by the oral cul-de-sac branching off the pharyngeal-nasal airway. Given this and the fact that in the spectrum of a nasal, as in all voiced sounds, energy decreases with increasing frequency (Fant, 1960), the antiresonances will fall in the high end of the spectrum, which has very little salient acoustic energy or spectral peaks. The listener is therefore more likely to overlook it. In so far as the auditory effects of the antiresonance may be weakened, the spectrum that remains will be dominated by the resonances of the pharyngeal-nasal airway and will resemble a nasalized vowel. (p. 234)

(3.3) Unpacking: Acoustic Compensation Effects

The term *unpacking*, coined by Paradis & Prunet (2000), refers to the phenomenon in which loan words from a language which has phonemic nasalized vowels, [ṽ], such as French, are borrowed into a language which has only vowel nasal sequences, [VN], such as English, and these words are pronounced not with the nasalized vowel, but rather with the customary, native /VN/ sequence: French *chiffon* [ʃif̃ɔ̃] is pronounced [ʃifən] in English. The basic idea of unpacking that Paradis & Prunet describe between two languages, the donor language and the receiver

language, should not be thought of as a specifically inter-language phenomenon. Unpacking can be a language internal phenomenon as well.

In an experiment of the perception of coarticulatory nasalization, Beddor & Krakow (1999) demonstrate the phenomenon of *unpacking* within speakers of one language. They rightly predict the ‘coarticulatory compensation hypothesis’, that a speaker/listener of English will attribute vowel nasalization to its context (before a nasal consonant), and thus, perform poorly when judging nasal vowels in a nasal consonant context. The experimenters demonstrate that listeners are more likely to judge a nasalized vowel in an oral context, C̃VC, as nasal, attributing the acoustic effects of nasalization to the vowel, and less likely to judge a nasalized vowel in a nasal context, ÑVN, as nasal, attributing the acoustic effects of nasalization to the nasal consonants.

The fundamental idea that nasalized vowels can be re-interpreted as /VN/ sequences is a crucial factor in the spread of the re-interpretation of word-final nasalized vowels as word-final velar nasals. This process is hypothesized to account, in part, for the current situation of the word-final velar nasal in Brazilian Portuguese. The unpacking process is most likely part of a two-step sequence resulting in re-interpretation. As mention in Section (3.2), during the articulation of the nasalized vowel, a small but significant obstruction is created by the lowered velum, and at the height of nasalization, towards the end of the vowel, the velum is in its lowest position (Belli-Berti & Krakow, 1991). The acoustic quality of the fully lowered velum and resulting partial obstruction presents the listener with the option of mistakenly interpreting the partial closure for a full consonantal closure. The strategic (young) listener may even make the full closure to emphasize nasality. Once this process begins within the speech community, the second step of *unpacking* can take over. The phonetic word-final nasalized-vowel—velar-nasal sequence is unpacked to the phonemic word-final vowel—velar-nasal sequence, and the vowel nasalization is, thus attributed to the word-final velar nasal, not the nasalized vowel. The two-step process finishes, and a re-introduction of the word-final nasal segment has occurred.

4. CONCLUSION -ROADMAP FOR CHANGES *Stage 1 -Phonological Nasalization of Pre-nasal Vowels Via Hypercorrection*

The pre-nasal vowels, which have only slight co-articulatory nasalization, become fully nasalized, phonologically nasalized, before a following nasal. The co-articulatory nasalization on the vowel is mistaken for full phonological nasalization.

Stage 2 –Highly Nasalized, Word-Final Environment Allows for Place Error

Misinterpretation happens during rapid speech. The highly nasalized word-final environment masks the intended speech signal and the nasalized-vowel—alveolar-

nasal sequence, [ṽn], is re-interpreted, via hypocorrection, as the nasalized-vowel—velar-nasal sequence, [ṽŋ].

OR Stage 2 –Word-Final Nasalized Vowel is ‘Unpacked’

The word-final nasalized vowel is misinterpreted in the speech signal. Via the process of *unpacking*, a type of hypercorrection, the word-final nasalized vowel is re-interpreted as a word-final nasalized vowel with a full velic closure.

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