

## **Nasal spreading in Paraguayan Guaraní: Introducing long-distance continuous spreading<sup>1</sup>**

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### **1. Introduction**

Languages tend to prefer syllables consisting of one consonant and one vowel, abbreviated as CV. That is to say, the most common syllable structure, cross-linguistically, is one with a simple onset and no coda (MacNeilage *et al.* 2000). It is no surprise, then, that Guaraní (Tupi-Guaraní, Paraguay) displays this tendency toward CV syllable types. While Guaraní does have some vowel-only (V) and closed (CVC) syllables, the vast majority of syllables in the language conform to this unmarked CV template.

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Furthermore, Guaraní is a particularly apt example of a tendency toward CV syllables in regard to the behavior of nasal consonants. Over time, many word-final CVC syllables in Guaraní, specifically ones ending in a nasal consonant (CVN), became CV syllables via deletion of the last segment (Columbus 1974, Lemle 1971). However, the nasal feature did not simply disappear; the vowel preceding the nasal consonant took on the nasal feature and became either a partially or fully nasalized vowel (see section 3 for a full account of this process).

An interesting side effect of vowels becoming partially or fully nasalized in Guaraní due to the processes mentioned above is the spreading of the nasal feature onto certain vowels and consonants of already-ideal CV syllables. Articulatorily, there is little motivation for nasalizing segments that are surrounded by other oral segments. These nasalized syllables, in fact, have become more marked, or less "perfect", by being nasalized in oral contexts. This paper demonstrates the various nasalization patterns in Guaraní, looking at which segments become nasalized, which segments trigger this nasalization, and the variability that depends on the type of nasal spreading and most likely on other factors as well.

Guaraní displays at least three different types of nasal spreading, which I will define later and refer to as (1) "local", (2) "discontinuous", and (3) "long-distance continuous" nasal spreading. In this paper, all three types of spreading will be discussed, concentrating on the third type of spreading, which has not been introduced in previous nasal spreading literature.

In the following section (section 2), I will describe the vowel and consonant inventories for modern Guaraní, then present some reconstructed historical forms from Proto-Tupi-Guaraní. I will also provide some explanation for the evolution of the modern nasal phoneme inventory based on the proto-language, paying particular attention to nasalization of certain vowels and the subsequent deletion of nasal consonants. Section 3 is an account of synchronic processes of vowel nasalization. In sections 4 and 5, I detail the three types of nasal spreading to consonants and vowels in Guaraní; regarding first, consonant phonemes that are affected by nasality (section 4), and second, nasality spreading to vowels from nasal

consonants (5.1) and from nasal vowels (5.2). The majority of the original data and analyses are found in these two sections. Section 6 deals with nasal spreading in fast speech (as opposed to careful speech found in the other sections). Finally, in section 7, I summarize the main points of the paper and offer suggestions for further research.

## 2. Background

### 2.1. Modern Paraguayan Guaraní

Paraguayan Guaraní is a member of the Tupi-Guaraní subfamily of the Tupi family of languages (Gordon 2005). There are twelve vowel phonemes in modern Guaraní: six oral vowels /i, i̇, u, e, o, a/ and six nasalized counterparts of each of those oral vowels. These vowels are shown in Figure 1.

Oral vowels:    i    i̇    u    Nasal vowels:    ï    ï̃    ù̃  
                   e            o                            ě            õ  
                                   a    ã

Figure 1: Guaraní vowel phonemes

Vowel nasalization in Guaraní is phonemic only in stressed syllables (Walker 1999, Barratt 1981). Note that this means nasalization on unstressed syllables is always non-contrastive, and it can often be predicted.<sup>2</sup> The aim of this work is to generalize when and where nasalized segments occur, and which segments trigger this nasalization.

<b>p</b>		<b>t</b>		<b>k</b>	<b>ʔ</b>
<b>mb/m</b>		<b>nd/n</b>	<b>ɕ/ɲ</b>	<b>ŋg/ɲ</b>	
		<b>s</b>	<b>ʃ</b>		<b>x/h</b>
<b>w/ɣ<sup>w</sup></b>	<b>v</b>		<b>ɽ/r</b>		

Figure 2: Guaraní consonant phonemes

<sup>2</sup> Sometimes, however, the degree of nasalization varies depending on the rate of speech of the talker, and thus cannot be predicted with complete accuracy in all cases; this will be dealt with later in the paper.

Figure 2, adapted from Walker (2000), shows the modern consonant inventory for Guaraní. Guaraní has voiceless stop phonemes /p, t, k/ but not voiced stops /b, d, g/. The nasal consonants found in Guaraní are [m, n, ŋ, ɲ] and they vary allophonically with [mb, nd, ɲg, ŋg], respectively, in certain environments which will be elaborated upon in section 4. The plain nasal consonants are also underlying phonemes in their own right. The bilabial and alveolar nasals are found word-initially and word-medially, functioning as homorganic prenasalization of a following voiced stop. The palatal nasal [ɲ] is also found in word-initial and word-medial positions, but does not serve as prenasalization for a voiced stop (as the other nasals do); instead, it is found in allophonic variation with the [ɲg] phone. The velar nasal [ŋ] is found only word-medially, varying allophonically with [ŋg], and is the rarest type of the four nasal consonants. The sonorant phonemes /w, v, r/ undergo nasalization in certain nasal environments to become [w̃, ṽ, r̃]. Figure 2 lists variants [h], [w] and [r] of /x/,<sup>3</sup> /y<sup>w</sup>/, and /r/,<sup>4</sup> respectively, which are not nasal variants as with [mb]/[m], etc., but rather dialectal variants. The fricatives in Guaraní /s, ʃ, x/ are all voiceless and do not undergo nasal alternation (although the dialectal [h] variant of /x/ may do so).

## 2.2. Stress

Stress in Guaraní is not phonemic and is almost always found on the last syllable in a word. If no stress is shown orthographically, it is assumed that the final syllable is stressed. When a non-final syllable is stressed, the vowel in the stressed syllable is marked with an acute accent,<sup>5</sup> as in **óga** 'house'.

Stress and nasality interact in two main ways. First, only vowels in stressed syllables can be phonemically nasal (as noted earlier in 2.1); non-stressed syllables contain either oral or allophonically nasal vowels. Second, according to Trigo (1993), stressed syllables which have phonemically oral vowels are never allophonically nasalized. (However, I

<sup>3</sup> This phoneme will hereafter be written /h/ because the main language consultant usually used this variant.

<sup>4</sup> This phoneme will hereafter be written /r/ for convenience.

<sup>5</sup> One may ask why, then, the final syllable in the word Guaraní is marked with an accent, to which I would reply, "Silly rabbit, it's so Spanish speakers can pronounce the name of the language correctly."

have recorded data that counter Trigo (1993)'s generalization, as seen in example (19) in section 4.)

### 2.3. Distinctive Nasalization

At some point in the history of Proto-Tupi-Guaraní, the consonant phonemes were also found word-finally (Lemle 1971, Columbus 1974); but now the word-final position can only be filled by vowels, either nasal or oral.

The following is slightly modified from Columbus (1974) and is taken originally from Lemle (1971)'s historical reconstruction of Proto-Tupi-Guaraní:

- (1) Proto-Tupi-Guaraní > Modern Paraguayan Guaraní
- |                        |   |                 |         |
|------------------------|---|-----------------|---------|
| a. */ <b>ɕukɨr</b> /   | > | <b>juky</b>     | salt    |
| b. */ <b>kɨb</b> /     | > | <b>ky</b>       | louse   |
| c. */ <b>petɨm</b> /   | > | <b>petỹ</b>     | tobacco |
| d. */ <b>meʔeŋ</b> /   | > | <b>me'ẽ</b>     | give    |
| e. */ <b>tɨŋ</b> /     | > | <b>(moro)tĩ</b> | white   |
| f. */ <b>tatatiŋ</b> / | > | <b>tatatĩ</b>   | smoke   |
| g. */ <b>akaŋ</b> /    | > | <b>akã</b>      | head    |

Based on the reconstructed data above, it is clear that as modern Guaraní evolved from Proto-Tupi-Guaraní, all word-final consonants were lost. Furthermore, directly preceding the place where Proto-Tupi-Guaraní had final nasal consonants, modern Guaraní has nasal vowels. Because of this loss of final consonants, final oral vowels are now in contrastive distribution with final nasal vowels.

Below are some minimal pairs from modern Guaraní that demonstrate the phonemic status of final nasal vowels (see Beckman 1998: 158 and Walker 1999: 93, for more minimal pairs):

- (2) a. **pytã** red  
 b. **pyta** heel
- (3) a. **tupã** God  
 b. **tupa** bed

- (4) a. **kuã** finger  
 b. **kua** hole
- (5) a. **hu'ũ** soft, flexible  
 b. **hu'u** to cough

This change most likely occurred due to a common diachronic vowel nasalization process, which is often called "distinctive nasalization", (as documented in, inter alios, Hindi, French, Polish, Portuguese, Romanian, Ojibwe, and some Bantu and Chinese languages (Hajek 1997, Tronnier 1998)). Distinctive nasalization is represented in rule format in (6) below.<sup>6</sup>

- (6)  $V > \tilde{V} / \_N$   
 $N > \emptyset / \tilde{V}\_\#$

The rules above state that when an oral vowel (V) is found before a nasal consonant (N) it will become nasalized ( $\tilde{V}$ ), and that when a nasal consonant is found at the end of a word it will be deleted. It is also possible to remove the word-final symbol (#), and instead appeal to the stressed position triggering the distinctive nasalization change, as seen in many other languages (Schourup 1973, as cited in Hajek 1997: 95). The rules above are illustrated in the following diachronic change, seen in (7), from Latin to French:

- (7) Latin: [bonu] > [bon] > [bõn] > French: [bõ] 'good'

The change in (7) illustrates that after the final vowel was deleted, an oral vowel preceding a nasal consonant became (partially) nasalized in anticipatory co-articulation. Then the nasal consonant at the end of the word (a rather tenuous position for a voiced consonant in the first place, historically speaking) became somewhat redundant and underwent deletion, leaving an open syllable with a partially-nasalized vowel. Technically, there was one more step to arrive at the final pronunciation (which we cannot clearly represent by rule notation): the final vowel at the end of the word went from partially to fully nasalized; thus nasal vowels

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<sup>6</sup> Although these rules adequately account for how the modern forms result from historical forms, they do not illustrate the graduality and patterns of lexical diffusion of nasalization and N-deletion that underlies most of these diachronic changes (Hajek 1997:83).

came to contrast with preexisting oral vowel phonemes because they could both be found in the same position and signal a difference in meaning.

The pairs of related modern Guaraní words below support the claim that nasal vowels in the language were once followed by nasal consonants which later underwent deletion.

- (8) a. **pohano** to medicate  
 b. **pohã** medicine
- (9) a. **ha'ánga** to almost succeed, to imitate  
 b. **ha'ã** I try  
 c.f. **ha'a** I fall

Given these pairs of words in (8) and (9), it is evident that the noun 'medicine' and the verb 'to try' are derived from the verb 'to medicate' and the verb 'to almost succeed', respectively. The (a) forms of each example above do not have a nasalized vowel where the (b) forms do, but the (a) forms both have a nasal consonant after that vowel instead. Assuming the older form of 'medicine' was **pohan** and that of 'to try' was **ha'ang**, we can conclude that the nasal vowels in **pohã** and **ha'ã** were originally oral vowels that became nasalized in anticipation of the following nasal consonant. This nasal consonant survives in the longer (a) forms, but when the nasal consonant is word-final, as in the (b) forms, the final nasal consonant has been deleted, leaving a nasal vowel in its wake.

### 3. Synchronic nasalization processes

There are a number of synchronic phenomena in Guaraní that serve to create simpler syllables. One of these processes, an almost inevitable cross-linguistic phonological phenomenon, is the resyllabification of onset clusters where the first consonant is more sonorous than the second consonant. This phenomenon falls under the Sonority Sequencing Principle (SSP) (Sievers 1876) and is illustrated by the following rule:

- (10) CV.NCV → CVN.CV

Whereas the NCV syllable above is a very marked syllable type according to the SSP, the CVN is less so; thus the syllable structure is becoming simpler in (10).

In Guaraní, there are three consonants that can be posited as underlyingly prenasalized voiced stop phonemes: /**mb**, **nd**, **ŋg**/. These phonemes usually become resyllabified according to the rule in (10); when prenasalized stops are found word-medially, the nasal consonant changes from tautosyllabic to heterosyllabic with the voiced stop. Here are some examples of that resyllabification in action:

- (11) **tembi'u** /te<sup>m</sup>biu/ > [tem.bi.ʔu] food  
 (12) **ñande** /ɲa<sup>n</sup>de/ > [ɲan.de] we (inclusive)

We know that the underlying forms of these nasal consonant-voiced stop pairs are part of the same phoneme because when they are word-initial they always appear together.<sup>7</sup> In other words, there are no word-initial [**b**, **d**, **g**] on their own, as in:

- (13) **mboi** [mboi] snake  
 c.f. \***boi**  
 (14) **nde** [nde] you  
 c.f. \***de**

#### 4. Consonant alternations due to the [+nasal] feature

It is helpful to assume that a Guaraní word has the feature [+nasal] if a nasal consonant or vowel is present in the word. Similarly, a word has a [-nasal] feature if no nasal consonant or phonemic nasal vowel appears. The [nasal] categorization then applies to the whole word, and most of the other segments in that word. Nasal consonant allophones [**m**, **n**, **ɲ**, **ŋ**] replace [**mb**, **nd**, **ɟ**, **ŋg**], respectively, when a word has a [+nasal] feature.

The [nasal] categorization predicts which forms of allomorphic affixes will be used, as seen in (15), (16), and (17). The first allomorph, in (a) of each pair below, is used when there is no nasal vowel or consonant in the word ([-nasal]), while the second allomorph, in (b), is used in the [+nasal] context.

Remember, however, that these nasal alternations are used not only in the allomorphs listed in (15), (16), and (17), but whenever the

<sup>7</sup> Unless another nasal phoneme appears in the word, causing predictable phonological alternations in the nasal consonants (see section 4).



underlying phonemes are among the following: /**mb**, **nd**, **ɟ**, **ŋg**/, which are represented orthographically as **mb**, **nd**, **j**, **ng**. For clarity and brevity, the only alternations shown below are ones that happen to involve affix shape.

(15) CAUSATIVE **mbo** / **mo**

- a. /**ro**        **mbo**        **ɣwata**    **nde**    **ve**/  
 (1p. sg.) + (causative) + to walk + you + (obj.)  
 [rōm.bo.wa.tān.'de.ve]  
**romboguata ndeve**  
 I make you walk.
- b. /**a**        **mbo**        **tataŋi**        **kosina**    **pe**/  
 (1p. sg.) + (causative) + to smoke (intr.) + kitchen + (obj.)  
 [ã.mō.tā.tā.'tī.ko.si.'na.pe]  
**amotataŋi kosinápe**  
 I make the kitchen smoke.

(16) REFLEXIVE **je** / **ñe**

- a. /**o**        **ɟe**        **prepara**/  
 (3p.) + (reflexive) + to prepare  
 [o.ɟe.pre.pa.'ra]  
**ojeppara**  
 He prepares himself.
- b. /**o**        **ɟe**        **pirũ**/  
 (3p.) + (reflexive) + to step  
 [õ.ŋ ē.pĩ.'rũ]  
**oñepyrũ**  
 He takes himself.

(17) NEGATIVE **ndo-** **-i** / **no-** **-i**

- a. /**ndo**    **ro**        **haihu**    **i**/  
 (neg.) + I-you + to love + (neg.)  
 [ndo.ro.hái.'huí]  
**ndorohaihui**  
 I don't love you.
- b. /**ndo**    **ro**        **he<sup>n</sup>du**    **i**/  
 (neg.) + I-you + to hear + (neg.)  
 [no.ro.hēn.'duí]  
**norohendui**  
 I don't hear you.

The continuant consonants /**h**, **w**, **v**, **r**/ also undergo some amount of nasalization when they are in the same word as a nasal vowel, as in (16b). I will refer to this phenomenon as *long-distance continuous* nasal spreading, which is triggered only by phonemically nasal vowels (see figure 3 below). But when the [+nasal] feature is due to the presence of a nasal consonant, as in (17b), only /**mb**, **nd**, **ɟ**, **ŋg**/ and vowels are affected. I will call this *discontinuous* nasal spreading, which is triggered only by nasal consonants, not nasal vowels. As shown in example (17b), the rightmost nasal consonant is underlyingly /**nd**/, which triggers discontinuous nasal spreading. The discontinuous spreading in this example targets the only other nasal consonant in the word, also /**nd**/, which becomes [n] on the surface. The only seemingly transparent (to nasal spreading) segments are [p, t, k, s, ʃ, ʔ] (Trigo, 1993).<sup>8</sup> See (18) and (19) for examples.

- |      |                       |                   |                   |
|------|-----------------------|-------------------|-------------------|
| (18) | a. <b>hague/rague</b> | [ha.'we]/[ra.'we] | hair              |
|      | b. <b>akã.rague</b>   | [ã.kã.řã.'wẽ]     | hair of the head  |
| (19) | a. <b>ñotýhára</b>    | [ɲõ.tĩ.'hã.řã]    | person who plants |
|      | b. <b>pohanohára</b>  | [po.hã.no.'ha.ra] | doctor            |

In (18), the nasal vowel at the end of the word **akã** causes nasality to spread leftward and rightward throughout most of the word **akãrague**, including the continuants [r] and [w]. From (19) above, we see that Guaraní nasal vowels trigger long-distance spreading whereas nasal consonants do not. Compare the two forms in (19): (a) displays long-distance continuous nasal spreading to all segments (including even the stressed vowel) in the word, save the [t], due to the presence of **ý**, a nasal vowel. In (b), on the other hand, the nasal consonant in **pohanohára** only causes the preceding vowel to gain nasality; none of the other segments in the word are affected. This phenomenon has also been observed in many other languages with phonemically nasal vowels: "Long distance spreading is triggered more commonly by nasalized vowels than nasal consonants, but both cases occur" (Cohn 1993: 335). We will see more of this tendency in the following section, where we will compare nasality spreading onto vowels from nasal consonants and from nasal vowels.

<sup>8</sup> However, Walker (1999) provides some evidence to suggest that even the voiceless stop consonants /p, t, k/ are somewhat phonetically affected by nasal vowels, usually measured by a slightly longer VOT on the following vowel.




	Nasal spreading type	Trigger
Local	XXXVN 	/č/ , [č]
Discontinuous	CXCXN 	/č/
Long-distance continuous	XXXXN 	/ŋ/

Figure 3: Types and triggers of nasal spreading

## 5. Vowel alternations: Scope of nasal spreading onto vowels

In section 4 we saw how consonants can be affected by the [+nasal] feature. Vowels are affected by nasal spreading differently than consonants. Specifically, while placement relative to the nasal phoneme can be important, the particular type of vowel does not matter. In other words, all vowels can be nasalized, while not all consonants can.

### 5.1. Spreading due to nasal consonant triggers

As shown in figure 3 above, nasal consonants are responsible for the local spreading of the [+nasal] feature to adjacent vowels via nasal assimilation, as seen in the historical process noted above in section (2.4) which produced contrastive (phonemic) nasalization on vowels in word-final stressed syllables. As noted previously, contrastive nasalization on vowels usually evolves from partial assimilation with an adjacent nasal consonant and subsequent deletion of the nasal consonant. The most likely place in the word for a consonant to delete is at the end of the word; thus we tend to find most phonemically nasal vowels at the ends of words in most languages, and this is usually the case in Guaraní. One exception to this is when a word contains a non-final free morpheme with a contrastively nasalized vowel; in this case the nasal vowel phoneme will appear in the middle of a multi-morphemic word. See below for examples:

- (20) **akā** 'head' + **rasy** 'pain' > **akārasy** headache  
 (21) **tī** 'nose' + **gua** 'from' (postposition) > **tīgua** nasal

Another apparent exception to final vowel nasalization is when the word ends in a diphthong, in which case only the first vowel in the diphthong is orthographically marked with nasalization, as shown below. However, this is not really an exception to the claim that only final stressed vowels are contrastively nasalized because the whole diphthong is actually stressed, and thus contrastively nasalized.<sup>9</sup> The words shown below in (22), (23), and (24) are fully nasalized on the last syllable –which includes both vowels of the diphthong.

- |      |              |           |        |
|------|--------------|-----------|--------|
| (22) | <b>mokōi</b> | [mõ.'kõĩ] | two    |
| (23) | <b>tāi</b>   | [tãĩ]     | tooth  |
| (24) | <b>sỹi</b>   | [sĩĩ]     | smooth |

The local nasal assimilation process seen historically is also active synchronically; currently, vowels that occur before nasal consonants very often undergo anticipatory nasal assimilation. This process has been extensively researched for a wide variety of languages, and Guaraní also shows this common tendency, as shown in (25) and (26). Unlike contrastive nasalization described above, this process affects vowels in unstressed positions. Note that vowel nasalization here is localized: only the vowel directly preceding a nasal consonant undergoes nasalization; we will see more extensive nasal spreading in the next section.

- |      |                 |               |      |
|------|-----------------|---------------|------|
| (25) | <b>kangue</b>   | [kãŋ.'we]     | bone |
| (26) | <b>kuimba'e</b> | [kwĩm.ba.'ʔe] | man  |

## 5.2. Spreading due to nasal vowel triggers

The examples in (25) and (26) above demonstrate a common cross-linguistic phenomenon of nasal spreading to a vowel caused by an adjacent nasal consonant. An exciting and relatively uncommon phenomenon is found in Guaraní, which involves nasal spreading beyond just the adjacent phonemes. In fact, nasalization is able to spread leftward over multiple syllables to nonadjacent vowels throughout the word. Rightward spreading is also found in Guaraní, but is often limited to the adjacent syllable.

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<sup>9</sup> There is evidence in Lemle (1971) that diphthongs existed in Proto-Tupi-Guaraní.

### 5.2.1. Leftward nasal spreading

When a nasal vowel phoneme appears in its normal position at the right edge of a word, nasality is observed to spread leftward to all the vowels of the word, as seen here in (27) (taken from section 4, example (15b)):

- (27) **amotatafĩ kosinápe** [ã.mõ.tã.tã.'tĩ.ko.si.'na.pe]  
I make the kitchen smoke.

Because the last syllable in the first word **amotatafĩ** contains a phonemically nasal vowel, the entire word gains the [+nasal] feature; thus that word undergoes long-distance nasal spreading, causing all vowels to nasalize, and the **mb** consonant undergoes the regular nasal alternation to **m**.

However, when a word begins with a vowel, that vowel is often not nasalized.<sup>10</sup>

- (28) **opyryryĩ** [o.-pĩ.rĩ.'rĩ] jump, shake (3p)

An exception to initial vowels being opaque to spreading is when a word with a nasal vowel is only two syllables long. In this case, both syllables are usually nasalized, as in:

- (29) **akã** [ã.'kã] head  
(30) **okẽ** [õ.'kẽ] door

It is also possible that the morpheme boundary in (28) is blocking nasal spreading to its left, but because there is no morpheme boundaries in (29) or (30), nasalization is allowed to spread to the initial vowel. More data is needed to evaluate whether it is the morpheme boundary or the first vowel in a three or more syllable word that blocks spreading.

Another segment that is usually opaque to spreading is a stressed syllable with an oral vowel. (31) is an example of leftward spreading blocked by an oral stressed syllable:

- (31) **upéicharõ** [u.'pei.ʃã.rõ]  
then, because of that

<sup>10</sup> Example (27) is an apparent exception to this generalization, but the reason the initial vowel is nasalized in (27) is more likely due to the influence of the preceding nasal consonant.

### 5.2.2. Rightward nasal spreading

Just as with leftward spreading, nasality can spread rightward from phonemically nasal vowels to an adjacent unstressed oral vowel in the same word. It is unknown if spreading is blocked by a stressed oral vowel or if spreading can only proceed rightward by one syllable. Again, more data is needed to determine which is the case. The first two examples (32) and (33) are reproduced from (20) and (21) found in subsection 5.1:

- (32) **akã** 'head' + **rasy** 'pain' > **akãrasy** [ã.kã.-rã.'si] headache  
 (33) **tĩ** 'nose' + **gua** 'from' (postposition) > **tĩgua** [tĩ.'wa] nasal  
 (34) **tĩruguy** [tĩ.rũ.'wi] nosebleed

Walker (2000) claims that nasality spreads equally leftward and rightward, but I haven't seen enough data to conclude that nasality can spread more than one syllable rightward.

## 6. Spreading in fast speech

Most of the above examples were taken from very controlled elicitation techniques, where sentences, phrases, or even single words were spoken in isolation, after a prompt was given. Although the use of careful speech is important in determining a speaker's underlying phonological judgments, it is often not reflective of real-time spoken dialogue. It is another common universal phenomenon that careful speech can vary greatly from fast speech in terms of phonetic output. In order to get an idea of the true extent of nasal spreading in Guaraní, we must also investigate fast speech, as challenging as it is. The data in this section were taken from naturalistic conversations between two native speakers of Guaraní.

First of all, nasality can spread across word boundaries, both leftward (as in (35)) and rightward (as in (36)).

- (35) **ajogua haguã** [a.ɔgo.wã.-hã.'wã] in order (for me) to buy  
 (36) **hi'ã cheve** [hĩ.ʔã.-'ʃẽ.ve] it seems to me

Secondly, sometimes the "transparent" segments may not actually be so transparent in fast speech. We see nasality spreading across a word boundary in (a) of example (37), as we might expect in fast speech. But (b)

does not conform to the same pattern. Perhaps the explanation lies in the supposedly "transparent" voiceless velar stop [k].

- (37) a. **che ao-rã** [ʃẽ.ã.õ.-'rã] my future clothes  
 b. **che kirirĩ** [ʃe.kĩ.rĩ.'rĩ] I (am) quiet.

To complicate matters more, on the **che** in (a) of example (37) nasalization was observed as variable. Sometimes **che** appeared with nasalization, and other times without. Spreading in fast speech is an area that requires substantial further investigation. Tronnier (1998: 21) cites Ladefoged and Maddieson (1996) on the subtleties of nasality, which holds especially true for fast speech in Guaraní:

"Ladefoged and Maddieson (1996) point out that vowel nasalization is not simply a binary characteristic. In some languages, oral, lightly nasalized and heavily nasalized vowels may occur. This is usually the case, if a language has phonemic oral/nasal vowel contrast and phonologically oral vowels, which become contextually nasalized."

In the above quote, Tronnier (1998) reminds us about the difficulties of drawing categorical conclusions about nasal spreading. Perhaps the solution lies in a more gradient evaluation of nasality and nasal spreading, but the technology needed to measure enough gradient details is expensive and hard to come by, and the time required to make such measurements are considerable.

## 7. Summary and further research

As difficult as it is to pin down exactly how far and from whence nasality can spread in a given utterance, especially in more natural speech, we can still come away with a general picture of nasal spreading in Guaraní.

Figure 3 from section 4 illustrates the following summary. We have seen that any kind of nasal consonant triggers preceding vowels to become allophonically nasalized in what is called local nasal spreading. Historically, nasal consonants even caused preceding vowels to become phonemically nasalized. We also observed that both nasal consonants and nasal vowels trigger discontinuous nasal spreading, that is [+nasal]/[-nasal] consonant alternations within the same word. Finally, we examined long-

distance continuous spreading, a type of nasal spreading in which nasal vowels (only ones that are phonemically nasal) trigger spreading to most consonants and vowels in the same word.

The next step along this line of research is to investigate the interaction of morpheme boundaries, word boundaries, stress, and nasality to a greater extent. This will involve an in-depth analysis of Guaraní syntax in order to determine which morphemes are really part of the "word," and which morphemes are really separate words.

Furthermore, there is a distinct possibility that there are non-phonological, non-syntactic factors affecting Guaraní nasal spreading. Lexical frequency may prove significant (as in Hay & Bresnan 2006), as well as social factors such as age, gender, educational background and/or socioeconomic status (as in Pluymaekers *et al.* 2005). There is still a great deal of research that must be done in order to determine to what extent, if any, these other factors influence variation and gradience in Guaraní nasal spreading.



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