A DIACHRONIC ACCOUNT OF EXCEPTIONAL PROGRESSIVE NASALIZATION PATTERNS IN GUARANI CAUSATIVES

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Nasal harmony in Paraguayan Guarani spreads mostly leftward in a morphological word. This regressive nasalization is triggered by a phonologically nasal consonant or stressed nasal vowel and does not affect voiceless stops. A limited process of progressive nasalization affects morpheme-initial voiceless stops across a morpheme boundary. Many forms that include a causative prefix show this kind of progressive nasalization. However, this nasal spread lacks any obvious nasal trigger and does not occur consistently. In this paper, I propose an explanation of these cases as vestiges of earlier phonological rules from pre-Proto-Tupi-Guarani but not active in Paraguayan Guarani, followed by the emergence of a regressive oralization rule and ending in a reanalysis of the basic form of the causative prefix. In so doing, I will provide a revised sequence of changes involving contour allophones in the reconstruction of Proto-Tupi-Guarani (PTG).

[KEYWORDS: nasal harmony, Tupian, prenasalized consonants, aperture theory, sandhi]

1. A puzzle involving nasal harmony in Paraguayan Guarani. Modern Paraguayan Guarani (ISO 639-3: gug; autonyms Avañe’ẽ ‘language of men’, Guaraní; henceforth PyG) is, with around 6 million speakers, the most widely spoken language of the Tupi-Guarani (TG) family. As is common in TG, PyG shows nasal harmony: phonologically nasal segments (the source or trigger) in a root or prefix cause some non-nasal segments in the phonological word (the targets) to become nasal (1).

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2 The Tupi-Guarani (TG) family is composed of approximately 40–50 languages, with a very wide geographical distribution due to extensive migration. Speakers of TG languages are present in Argentina, Bolivia, Brazil, French Guiana, Paraguay, and Peru (Jensen 1998; Mello 2000; Guarani Ñe’ẽ Rerekupavẽ 2018). Despite this geographical spread, the TG family is morphologically remarkably consistent (Jensen 1998).

3 Since morphophonemics are important in this paper, the PyG examples will be presented as follows: the first line gives an established orthography; the second line gives a phonetic representation (separating phonological words); the third line presents a morphemization (using the allomorphs considered the underlying forms); the fourth line presents the analysis of the parsed elements; and the fifth line gives a free translation into English. For other languages, all of this information may

Let’s put your milk in your house.

‘Let’s leave your meat in your room.’

These sentences have parallel morphological structure: their phonetic transcription shows the oral and nasalized segments, while their orthography shows a few of the nasal alternations in prefixes and enclitics that are reflected in the spelling (discussed more fully in 3 below). In (1a) we see that each of the boxed segments triggers nasalization of segments to its left, and occasionally to its right, whereas in (1b), oral versions (note the underlined consonants) of the same morphemes appear, due to the fact that the stressed vowels (see 2 for stress) are oral and do not trigger nasal harmony.

The particular cases that this paper aims to explain concern the behavior of nasalization triggered by causative prefixation. Example (2) shows the oral intransitive root guata ‘(to) walk’, which contains no nasals, prefixed with the transitivizing causative mbo- (henceforth, simply “causative”).

not be available and may not be easy to supplement. In those cases, the first line will show the example as rendered in the cited source—that is, either in orthographic rendering or in phonetic/phonemic transcription. In the running text and tables, graphemes are given between angled brackets (<>). Root compounds are marked in the analysis lines with a plus sign (+). PyG examples without a source have been created by the author (a heritage speaker) for the purposes of exemplification, on the basis of similar examples from published grammars. For audio files that accompany some of the examples, see the online version of this article. Abbreviations used in the glosses are 1,2,3 first, second, third person; 3PL.SUBJ = third person plural post-verbal subject; ACT = active person marking; AGD = agent-demoting voice; CAUS = causative voice for intransitive verbs; COLL = collective plural; EVID = reportative evidential; IMP = imperative; INACT = inactive person marking; INCL = inclusive of the addressee(s); INTR = intransitive; LOC = locative; NMLZ.PASS = passive nominalizer; PFV = perfective; PL = plural; PLEAD = pleading imperative; POSSM = possessed form of relational roots (for non-third-person pronominal possessor); POSSM3 = possessed form of relational roots (for third-person pronominal possessor); PST = verbal past tense; RECP = reciprocal; SG = singular; STAT = stative person marking; SUBJ = subject; THEME = theme vowel.
amboguata kure
[aⁿbɔtʰwᵃ’ta ku’re]
a–mbo–guata kure
1SG.ACT–CAUS–walk pig
‘I make the pig walk’

(Krivoshin de Canese and Acosta Alcaraz 2007:113)

This prefix contains the nasal-oral contour consonant /mb/, which nasalizes the person prefix to its left, but no other nasalization is visible in the root or the causative prefix itself. Contour consonants do not nasalize segments to their right; see 3.2.

Contrast this situation with the one in example (3), showing the oral root ky ‘rain’.

omongy
[õmõ̞ŋi]
o–mbo–ky
3.ACT–CAUS–rain
‘s/he made it rain’

(Dietrich 2018:14)

Even though ky begins with the oral voiceless stop /k/, when prefixed with the causative marker mbo-, the root surfaces with the nasal-oral contour consonant /ⁿɡ/ <ng>, and concomitantly the causative surfaces with its nasal allomorph mo-.

Given current descriptions of nasal harmony in PyG, it is unclear what the trigger for this nasalization is. The root is oral, and the prefix only nasalizes to its left (as shown in (2)). Moreover, not all intransitive roots beginning with an oral voiceless stop show this behavior. In (4) below, the oral intransitive root kapu shows no nasalization (*ngapu), and the causative prefix surfaces as mbo-, in accordance with what is expected for oral roots.

mbokapu
[mᵇoˈka pu]
mbo–kapu
CAUS–explode
‘to shoot’

(Estigarribia 2020:144)

In this paper, I propose that these patterns can be understood by reconstructing an early pre-PTG stage that had a productive rule of **progressive nasalization** and a single, fully nasal allomorph mo- (or, more generally, mV-) for the causative. I will argue that progressive nasalization was lost in the passage from pre-PTG to PTG and that a rule of **regressive oralization** emerged later, in PTG. When this happened, the causative allomorph mbo- became more frequent than
the original mo-, triggering a reanalysis of the former as the basic form and leaving the progressive nasalizations triggered by the causative as exceptional, fixed remnants of the application of a pre-PTG rule. I will begin by laying out the basics of Guarani phonology (2) and nasal harmony (3) and then proceed to the diachronic analysis (4).

2. Basics of Paraguayan Guarani phonology. The following phonological sketch is adapted from Estigarribia (2017, 2020). Table 1 presents the 12 vowel phonemes of PyG—6 oral vowels and their nasal counterparts. Only stressed vowels (usually a root’s last vowel) are specified phonologically for nasality. The oral-nasal contrast is neutralized in unstressed position, where phonetic nasality results from allophonic variation due to nasal harmony (see 3.2). Table 2 shows the consonant phones of PyG, with the corresponding graphemes in the most widely used modern Paraguayan orthography (see Estigarribia 2020).

There is no consensus on the underlying representations of the voiceless stops [p,t,k], the nasals [m,n,ŋ], and the nasal-oral contours [ᵐb,ⁿd,ⁿg] of PyG and TG. Some authors consider /ᵐb,ⁿd,ⁿg/ to be phonemic and [m,n,ŋ] to be allophones (e.g., Lunt 1973); others suggest that both /m,n,ŋ/ and /ᵐb,ⁿd,ⁿg/ are phonemic (e.g., Robboy 1987; Kaiser 2008); and yet others consider /m,n,ŋ/ phonemic, with [ᵐb,ⁿd,ⁿg] allophones (e.g., Gregores and Suárez 1967; Hart 1981; Adelaar 1986). I adopt the third position here.

It is important to note that I assume that voiceless stops have internal structure, composed of a closure followed by a release phase, as proposed in Steriade’s (1993) aperture theory. Both these phases have a raised velum: they are oral. Nasal phones are produced by lowering the velum, thus opening the oro- and nasopharynx to allow pulmonic air to flow out through the nose (Botma 2017). The nasal consonants are articulatorily voiced nasal stops and also have a closure and release phase. Both these phases are nasal—that is, the velum is lowered during both. Contour consonants are also stops, with a nasal closure phase and an oral release phase (see Figure 1; also see Maddieson and Ladefoged 1993). This understanding of the timing of articulators in contour consonants will be crucial for understanding nasalization patterns. In this paper, I represent orality and nasality via a feature VELUM with the discrete values [r] (raised) for

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4 I will transcribe non-syllabic vowels in diphthongs using the IPA non-syllabic diacritic /\.

5 I use the neutral term “nasal-oral contour” instead of “prenasalized” or “postoralized” (both terms found in the literature) whenever I want to remain neutral as to the process that gives rise to these consonants, diachronically or synchronically.

6 Thomas (2014) also avails himself of this segmental representation for Mbyá, as does Singerman (2016) for Tupari (Tuparian). It is important to note that, although useful here, aperture theory can run into problems explaining other patterns of shielding, such as circumoralization in Kaingang and Karitiana, but a discussion of those problems is outside the scope of this paper.
oral segments/morphemes, [l] (low) for nasal segments/morphemes, and [l-r] (low-raised) for nasal-oral contour segments. In PyG, native roots bear oxytone stress, with a few mostly paroxytone exceptions. The addition of unstressed suffixes and enclitics yields non-oxytone morphological words, marked in the standard orthography with an acute stress mark or a nasal tilde. As mentioned above, nasality is only contrastive for stressed vowels (5a–f).

(5a) aka /aka/ [ˈa ˈka] ‘quarrel’ ~ akã /akã/ [ãˈkã] ‘head’
(5b) oke /oke/ [oˈke] ‘he/she sleeps’ ~ okê /lokê/ [oˈkê] ‘door’
(5c) piri /piɾi/ [piɾi] ‘fiber mat’ ~ pirĩ /piɾĩ/ [piɾĩ] ‘chill, shiver’
(5d) kói /koi/ [ˈkoi] ‘farm’ ~ kõi /kõi/ [ˈkõi] ‘pair; twin’
(5e) pytũ /pitũ/ [piɾũ] ‘breath’ ~ pytã /pitã/ [piɾã] ‘dark’
(5f) aky /aki/ [aˈki] ‘green; tender’ ~ akỹ /aki̞/ [ãˈkĩ] ‘wet’

(Estigarribia 2020:28)

However, phonetically nasal vowels occur frequently in unstressed positions as a result of nasal harmony.

3. Nasal harmony in Tupian and Tupi-Guarani languages. Harmony is the “phonological assimilation for harmonic feature(s) that may operate over a string of multiple segments” (Rose and Walker 2011:240). Triggers are the segments that cause harmony, targets are the segments affected by harmony, blockers/opaque segments stop the spread of harmony, and transparent segments are not affected themselves but allow harmonization to proceed past

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7. I am abstracting here over the fact that velum position is continuous, not discrete, and also that the articulation of nasality and the perception thereof are most likely not solely determined by velum position and timing. Also, as a reviewer notes, this contradicts the position of many phonologists for whom [nasal] is a privative feature, but I believe the distributions of nasal and oral segments in many Amazonian languages (TG, broader Tupian, and Jê) and the facts in this paper warrant this treatment.
them (Walker 2011). Nasal harmony is the transfer of the nasality of a vowel or consonant to other vowels or consonants that are not inherently nasal. Languages with opaque segments have segment-to-segment nasal harmony (called type-A), whereas languages with transparent segments have nasal harmony.

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>CONSONANT INVENTORY OF PHONES</th>
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<tbody>
<tr>
<td></td>
<td>Labial</td>
</tr>
<tr>
<td>Voiceless stops</td>
<td>p &lt;p&gt;</td>
</tr>
<tr>
<td>Nasal</td>
<td>m &lt;m&gt;</td>
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<tr>
<td>Nasal-oral contour</td>
<td>mб &lt;mb&gt;</td>
</tr>
<tr>
<td>Fricative</td>
<td>s &lt;s&gt;</td>
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<tr>
<td>Approximant</td>
<td>v &lt;v&gt;</td>
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<tr>
<td>Flap</td>
<td>r &lt;r&gt;</td>
</tr>
<tr>
<td>Lateral</td>
<td>l &lt;l&gt;</td>
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FIG. 1—Relative timing of velum lowering (nasality) and closure (orality) for contour consonants
syllable nucleus to syllable nucleus coupled with tautosyllabic nasalization or nasalization by coarticulation (type-B) (Piggott and van der Hulst 1997). PyG is a language with nasal harmony where voiceless stops are transparent segments, hence it is a type-B language (Walker 2011). Piggott and van der Hulst (1997) analyze nasal harmony in type-B languages such as Barasano (Tucanoan) and Kaingang (Jê) as the result of a process of vowel harmony spreading nasality across syllable nuclei (vowels) and another process that associates nasality to the whole syllable, enforcing a match of nasality between all tautosyllabic sonorant segments. Although it is not clear that PyG reflects type-B nasal harmony exactly, these two processes account for the regressive nasalization we will examine in 3.1. Relevantly, alongside nasal harmony between adjacent syllable nuclei, Thomas (2014) posits for Mbyá nasal coarticulation from a vowel to an adjacent consonant edge and from a consonant onset to the vowel nucleus. The first process is consistent with our understanding of progressive nasalization (see 3.2). The latter is crucial to understand the emergence of oralization in PTG. This leads us to expect nasalization in PyG to depend on syllable structure (Walker 2011).

Phonemic nasality is a basic feature of almost all languages in the Tupian stock. Nasal harmony is present in many of them, with PyG following it most systematically (Dietrich 2018). Regressive nasalization (aka “anticipatory” or “leftward”) triggered by stressed nasal vowels to preceding segments is very frequent in the stock. Additionally, regressive nasalization triggered by nasal consonants is found in PyG, Mbyá, Aché, Kaiowá, Xetá, Avá-Ñandeva, Western Guaraní, and Tapiete (the Branch 1 or Guaranian subgroup of TG), although it is also present in the non-Guaranian languages Guarayu and Siriono (Branch 2), Kamayurá (Branch 7), Kawahib (Branch 6), and some dialects of Wayampi (Branch 8) (Dietrich 2018). Regressive nasalization triggered by nasal consonants is not present in other Tupian languages such as Mundurukú and Kuruaya (Picanço 2010). Both types of nasalization are unbounded/iterative/long-distance, meaning that they spread beyond the first potential target (Thomas 2014; Lapierre and Michael 2018). In addition to regressive nasalization, some languages show limited progressive nasalization that changes an unvoiced stop into its prenasalized counterpart across a morpheme boundary.

3.1. Regressive nasalization in Paraguayan Guarani. Regressive nasalization is unbounded in PyG, since it skips over transparent stops. It is triggered by stressed vowels in roots (6, 7). The (a) examples show the oral allomorphs of prefixes, whereas the (b) examples show the nasalized allomorphs. Triggers are boxed, and the allophones reflected in the orthography are boldfaced for clarity.

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8 Singerman (2016) notes that nasal harmony is widespread in lowland South America in many genetically unrelated language families, thus making it an areal feature.
(6a) ndejagua
[ⁿdeja`u̯w a]
nde–jagua
2SG.INACT–dog
‘your (sg.) dog’

(6b) neakə
[nẽá ká]
nde–aká
2SG.INACT–head
‘your (sg.) head’

(7a) ojehecha
[ojehe`fa]
o–je–h–echa
3.ACT–AGD–POSSM3–see
‘they saw themselves’

(7b) oñenupə
[õñênu̯ pá]
o–je–nupá
3.ACT–AGD–hit
‘they hit themselves’ / ‘they are hit’

Nasal consonants also trigger regressive nasalization (8).

(8a) ojotopa
[ojoto pa]
o–jo–topa
3.ACT–RECP–run.into
‘they run into each other’

(8b) oñopohano
[õñopôhə nô]
o–jo–pohano
3.ACT–RECP–cure
‘they cure each other’

Finally, triggers are also contour consonants in roots (9) and prefixes (10).

(9a) ndetarekaja
[n¹detareka`ja]
nde–tarekaja
2SG.INACT–turtle
‘your (sg.) turtle’
(9b) **nembaraka**
[ne’baru’ka]
nde–mbaraka
2SG.INACT–rattle
‘your (sg.) rattle’

(10a) **nderecha hikuái**
[nder’e fa hi’ka’i]
nde–r–echa hikuái
2SG.INACT–POSSM–see 3PL.SUBJ
‘they saw you (sg.)’

(10b) **nembotavy hikuái**
[nem’bot a’i hi’ka’i]
nde–mbo–tavy hikuái
2SG.INACT–CAUS–stupid 3PL.SUBJ
‘they fooled you (sg.)’

It must be noted that suffixes and enclitics with nasal segments do not spread nasality to the left—that is, in the direction of the root (11).9

(11a) **ahendúma** (not *ahenúma)
[ãhen’umu]
a–h–endu–ma
1SG.ACT–POSSM3–hear–PFV
‘I already heard (it)’

(11b) **ehendumi** (not *ehenumi)
[õhen’um]i
e–h–endu–mi
IMP–POSSM3–hear–PLEAD
‘please, listen a bit’

Furthermore, the final syllables in these examples show that tautosyllabic onset consonants and nucleus vowels agree in nasality, which will become important in 4.2. (see also Gregores and Suárez 1967:42; Piggott and van der Hulst 1997; Thomas 2014).

### 3.2. Progressive nasalization in Paraguayan Guarani and a puzzle involving causatives.

According to Dietrich (2018) and others, PyG also shows

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9 On occasion, a suffix with an inherently nasal segment can trigger nasalization. For example, the nasal suffix -rõ spreads nasality to the left (until blocked by the oral stressed vowel) in *upe + icha + rõ > [u.’pei,ʃa.rõ] > [u.’pei,ʃa,tõ] (Kaiser 2008:295). These cases are exceptional and still poorly understood.
progressive nasalization spreading rightward from stressed nasal vowels and nasal consonants in a morpheme’s last syllable to the following segment across a morpheme boundary. This process is bounded to one syllable and creates voiced contour allophones of morpheme-initial voiceless stops or, exceptionally, fully nasal allophones. These targets are precisely those segments which are otherwise transparent to regressive nasalization (note the differing behavior of the two instances of /t/ in (13) below). These two facts help differentiate progressive from regressive nasalization, in agreement with theoretical proposals that allow obstruents to be either transparent or targets (see Walker 2003).

In PyG, progressive nasalization is visible in compounds (12) and in suffixes (13).10

(12) akāmbuku
    [ãkã̃bu'ku]
    akā+puku
    head+long
    ‘that has a long head, dolicocephalic’
    (Ávalos Ocampos 2017:21)

(13) petỹndy
    [pẽtɨ̃'dɪ]
    petỹ–ty
    tobacco–COLL
    ‘tobacco plantation’
    (Dietrich 2018:14)

Only fully nasal consonants and nasal vowels trigger this kind of progressive nasal spread. Nasal contour consonants do not (14).

(14) kumandaty (not *kumandandy)
    [kũmã̃dɐˈtɬ]
    kumanda–ty
    bean–COLL
    ‘bean plantation’ (also a toponym in Paraguay)

This is to be expected on articulatory grounds, since the later part of contour consonants (the release phase) is oral, therefore there is no nasality to spread forward in the word. Even though nasality “jumps over” voiceless stops in vowel-to-vowel regressive nasalization, the nasality on the closure of the stop cannot “jump over” the oral release phase because progressive nasalization is segment to segment (see 3 above).

10 For a complete list of suffixes subject to progressive nasalization, see Estigarribia (2020).
Of particular interest in this paper, the third trigger identified for progressive nasalization by Dietrich (2018) is the prefix \textit{mbo}-, which applies to intransitive roots (verbal or otherwise) and yields a transitive verb with a causative meaning (15).\footnote{The resultative/instrumental nominalizer prefix \textit{–em(b)i}– also occasionally causes exceptional nasalization. It is seldom discussed in connection with these cases, and I will not do so here for reasons of space.}

(15) Ambojere ŋa'ɛmbɛ.
\[
\begin{array}{ll}
\text{a–mbo–jere} & \text{ŋa'ɛmbɛ} \\
\text{1SG.ACT–CAUS–turn} & \text{dish}
\end{array}
\]

‘I turn the dish around.’

(Krivoshein de Canese and Acosta Alcaraz 2007:113)

Example (16) shows that this prefix surfaces as \textit{mo}- when prefixed to a nasal root.

(16) \textit{mohe}'ɛ
\[
\begin{array}{ll}
\text{mõhe'ʔɛ} & \text{CAUS–sweet/salty} \\
\text{mbo–he’ɛ} & \text{‘to make sweet or salty’}
\end{array}
\]

(Ávalos Ocampos 2017:153)

Crucially, roots that begin in a voiceless stop \textit{/p/, /t/, or /k/} surface with the homorganic contour \textit{\textit{mb}/, \textit{nd}/, or /\textit{ŋ}/} when they are prefixed with causative \textit{mbo}-, Concomitantly, the causative surfaces as nasal \textit{mo}-, as shown in (17).

(See also (17d–f) in the appendix.)

(17a) \textit{mongora}
\[
\begin{array}{ll}
\text{mõŋgo’ra} & \text{CAUS–pen} \\
\text{mbo–kora} & \text{‘to corral’}
\end{array}
\]

(Krivoshein de Canese and Acosta Alcaraz 2007:38)

(17b) \textit{amombáy}
\[
\begin{array}{ll}
\text{ãmõmbāj} & \text{1SG.ACT–CAUS–wake.up\textsubscript{INTR}} \\
\text{a–mbo–pāy} & \text{‘I wake (someone) up’}
\end{array}
\]

(Guasch 1956:27)
Interestingly, not all intransitive roots with an initial voiceless stop show progressive nasalization. First, nasal roots never do (18) (more examples in the appendix).

(18a) amokane’õ (not *amongane'õ)
[ãmõkãnẽˈʔõ]
a–mbo–kane’õ
1SG.ACT–CAUS–tired
‘I make (someone) tired’

(Krivoshein de Canese and Acosta Alcaraz 2018:64)

(18b) amotatatĩ (not *amondatatĩ)
[ãmõtãtãˈtĩ]
a–mbo–tataţi
1SG.ACT–CAUS–smoke
‘I make (something) smoke’

(Kaiser 2008:291)

Second, most oral roots beginning with a voiceless stop take the oral allomorph mbo- and do not nasalize the initial consonant (19) (more examples in the appendix).

(19a) mbokapu (not *mongapu)
[ˈbokaˈpu]
mbo–kapu
CAUS–explode
‘to shoot’

(Ávalos Ocampos 2017:193)

(19b) mbopuka (not *mombuka)
[ˈbopuˈka]
mbo–puka
CAUS–laugh
‘to make laugh’

(Ávalos Ocampos 2017:196)

(19c) mbotarova (not *mondarova)
[ˈbotaroiˈva]
mbo–tarova
CAUS–crazy
‘to make crazy’

(Ávalos Ocambos 2017:199)

These patterns were already remarked upon in the first Jesuit grammars beginning with Ruiz de Montoya ([1639] 1724) and Restivo ([1724] 2010). Later authors also mention this phenomenon, although none of them provides an explanation of why these forms exist or how they fit in the synchronic system of PyG nasal harmony. For Bottignoli (1940), the form mo- appears here for reasons of “nasal euphony” for which it is difficult to provide precise rules. Guasch (1956:29–30) states that root-initial k sometimes nasalizes to ng with the factitive prefix mbo- and that the change p to b (that is, mb) is frequent, whereas t to d (that is, nd) is very rare. Cadogan (1959:51) states that the Mbyá word űembopyta ‘to make it stay, to abandon’ (without progressive nasalization) is equivalent to the Guarani word ŗemombyta ‘to make it stay, to abandon’, noting that in the latter, “without any apparent motive, p has morphed into mb.” Liuzzi (2006) attributes these alternations to a weakening of the nasal harmony rules in colloquial discourse, particularly with roots beginning with /p/ and /k/. Melià, Farré, and Pérez (1995:136) conclude that this causative prefix nasalizes the “letters” p, t, and k and then in turn is nasalized to mo-.

The forms in (17) create a problem for the analysis of nasal harmony in PyG, under the accepted assumptions that (i) the causative prefix mbo- surfaces as mo- when prefixed to a nasal morpheme, as a specific consequence of the general process of regressive nasalization, and (ii) that a voiceless stop becomes a homorganic contour consonant if it is root-initial, in a non-nasal root (equivalently, in a non-nasal syllable), and the root is prefixed by the causative mo-. The problem is identifying how these processes apply. Taking the root ky ‘rain’ as an example, if process (i) applied first, we would obtain *mboky, contrary to fact. Conversely, if process (ii) applied first, the context necessary for process (ii) to apply would not be satisfied, since the underlying causative form is mbo-. We would thus again obtain *mboky. In other words, assuming that mbo- is the trigger, it is hard to see how it could cause progressive nasalization, given that contour consonants only spread nasality to the left. We are forced to assume that the trigger must be mo-, but this allophone should not occur with oral roots.

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12 Restivo’s grammar is a systematization of Jesuitic Guarani, as spoken in the area of the Jesuit missions, comprising today’s southern Paraguay (departments of Itapúa and Misiones), southwestern Brazil (states of Santa Catarina and Rio Grande do Sul), and northeastern Argentina (province of Misiones and the north of the Argentinian province of Corrientes).

13 Lunt (1973:135) also mentions (in passing) this phenomenon and credits Guasch (1956) for discussing it.
4. A diachronic explanation. The solution I propose in this paper hinges on the following key claims:

- As early as PTG, progressive nasalization of the kind exemplified in (12), (13), and (17) was not a productive process. The forms that show it in all the TG languages are fossilized forms (consistent with Schleicher’s (1998) reconstruction).
- Progressive nasalization was a productive rule in the pre-proto language (pre-PTG). One of the regular triggers for this process was the causative prefix, which I am assuming only had a fully nasal allomorph, mo- or mV- (contra Schleicher), therefore automatically triggering progressive nasalization in all cases.
- A series of changes are responsible for the current distribution of forms in PyG. First, progressive nasalization was lost in the passage from pre-PTG to PTG (allowing for the existence of modern-day forms that are not subject to progressive nasalization); later, regressive oralization appeared. This results in the emergence of the allomorph mbo-. This sequence is different from the one posited by Jensen (1989) and accepted by Schleicher (1998).

In the next section, I will reconstruct a sequence of stages and diachronic changes involved in the evolution of PyG and other TG languages. I will make clear that the exceptional progressive nasalization patterns are remnants of a pre-PTG rule and that the current distribution of forms is a combination of both regressive nasalization and regressive oralization processes. I will provide articulatory and perceptual evidence in favor of the proposed reconstruction of the sequence of changes. The diachronic changes and the development of different stages with respect to nasalization are presented in table 3, with examples of synchronic forms for each stage to aid the reader. Shaded cells contain forms that diverge from the previous stage. The relevant diachronic developments depend on the following parameters:

- Monomorphemic words vs. words with causative derivation;
- In cases of causative derivation, whether the root is /p,t,k/-initial or not and whether the words contain an oral stressed syllable or a nasal stressed syllable;
- Whether the nasal consonant is in the onset of the stressed syllable, in the pretonic syllable, or before the pretonic syllable.

Aside from PyG, I will present comparative data from other TG languages given below, grouped according to the (somewhat standard) classification by Rodrigues and Cabral (2012). For completeness, I give in brackets a slightly different classification from Michael et al. (2015), based on computational phylogenetic methods, which will be taken up again in the discussion.

Branch 1 (Guaranian branch): Chiriguano (ISO 639-3: gui; autonym Ava, Guaraní; also Eastern Bolivian Guaraní); Jesuitic Guarani (extinct; also Guaraní
Misionero); Kaiwá (ISO 639-3: kgk; also Kaingwá); Mbyá (ISO 639-3: gun; also Bugre, Mbiá, Mbuá); Paraguayan Guarani (ISO 639-3: gug; autonyms Avañe’ẽ ‘language of men’, Guaraní); Xetá (ISO 639-3: xet; possible autonyms jáñe kanómi, jáñe kõja)

Branch 2 [Southern branch, non-Guaranian]: Guaráyo (ISO 639-3: gur; also Guarayo); Siriono (ISO 639-3: sqr; autonym Mbia, Mbia cheë)

Branch 3 [Diasporic branch, non-Southern]: Tupinamba (extinct; ISO 639-3: tpn; also, Old Tupí)

Branch 4 [Nuclear TG, Central, Tapirapé/Parakanã/Tocantins sub-branch]: Guajajára (ISO 639-3: gub; autonym Ze’egete; also, Eastern Tenetehara); Tapirapé (ISO 639-3: taĩ; autonym Apíaya)

Branch 5 [Nuclear TG, Central, Araweté/Xingú sub-branch]: Araweté (ISO 639-3: awt)

Branch 6 [Nuclear TG, Peripheral, Kayabí/Parintintin sub-branch]: Kayabí (ISO 639-3: kyz; also Maquirí, Parua); Parintintin (ISO 639-3: pah; autonym Kagwahí/Kagwahíva)

Branch 7 [non-Nuclear TG]: Kamayurá (ISO 639-3: kay; autonym Apíap, historical autonym Jamyrá; also Kamaiurá)

Branch 8 [Nuclear TG, either Peripheral (Wayampi) or non-Peripheral/non-Central (Urubú Ka’apor’): Jo’é (ISO 639-3: pto; also Buré, Poturu, Poturujara, Tupí of Cuminapanema, Zo’ê); Urubú Ka’apor (ISO 639-3: urb; autonyms Ka’a-poř, Awa je’êha); Wayampi (ISO 639-3: oym; autonym Wajãpi; also Øyampi)

4.1. The reconstructed system of pre-Proto-Tupí-Guarani. All authors reconstruct the nasal phoneme series /m, n, ŋ/ for PTG (Jensen 1998, 1999; Mello 2000; Meira and Drude 2015; Baraúna and Picanço 2017; Dietrich 2018). Where PyG has nasal-oral contours, other TG languages have cognates with nasals (table 4).14

Since there are languages in this sample with nasal consonants only, but no language has contour consonants exclusively in all contexts, it is logical to reconstruct all of these forms as having had nasal consonants in pre-PTG, with the contour consonants being a later development in some members of the family.15 This phonemic nasal series is conserved in PyG and in the TG languages in general. Regressive nasalization starting from a stressed nasal vowel or nasal

14 Words in languages other than PyG are cited exactly as they appear in the source publications.
15 This is the generally accepted reconstruction today. In his notes on Lingua Geral Amazônica, Hartt (1872:59–60) proposed that the nasal-oral consonants were the original sounds that, through “[speakers’] laziness,” were simplified to nasals. He noted, however, that the nasal forms are more widespread in the modern Tupi languages than the nasal-oral ones and that it is almost always the oral part that “disappears” in diachronic change and almost never the prenasal part. This, of course, is to be expected if the original sounds are nasal.
<table>
<thead>
<tr>
<th align="center">TABLE 3</th>
<th align="center">DIACHRONIC DEVELOPMENT OF HYPOTHESIZED NASAL CONSONANTS</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th align="center">stressed nasal</th>
<th align="center">pretonic nasal</th>
<th align="center">ante-pretonic nasal</th>
<th align="center">monomorphemic</th>
<th align="center">causative</th>
</tr>
</thead>
<tbody>
<tr>
<td align="center">not /p,t,k/-initial</td>
<td align="center">/p,t,k/-initial, oral</td>
<td align="center">/p,t,k/-initial, nasal</td>
<td align="center"></td>
<td align="center"></td>
</tr>
<tr>
<td align="center">pretonic caus.</td>
<td align="center">ante-pretonic caus.</td>
<td align="center">pretonic caus.</td>
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</tr>
<tr>
<td align="center">ante-pretonic caus.</td>
<td align="center">ante-pretonic caus.</td>
<td align="center"></td>
<td align="center"></td>
<td align="center"></td>
</tr>
</tbody>
</table>

- **Pre-PTG**
  - *memy(r)*
  - *ma’e*
  - *maraka*
  - *mo–’i*
  - *mo–jahu*
  - *mo–mbë*
  - *mo–ngy’a*
  - *mo–’ã*
  - *mo–kane’ô*

- **Early PTG**
  - *memy(r)*
  - *ma’e*
  - *maraka*
  - *mo–’i*
  - *mo–jahu*
  - *mo–mbë*
  - *mo–ngy’a*
  - *mo–’ã*
  - *mo–kane’ô*
  - *mo–puka*
  - *mo–kapu*
## Later PTG

<table>
<thead>
<tr>
<th>memy(r) / memby(r)</th>
<th>ma’e</th>
<th>maraka</th>
<th>mo–’i</th>
<th>mo–jahu</th>
<th>mo–mbé</th>
<th>mo–ngy’a</th>
<th>mo–’ã</th>
<th>mo–kane’ô</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>mo–puka</td>
<td>mo–kapu</td>
<td></td>
</tr>
</tbody>
</table>

## Beginning of expansion of oral spans

<table>
<thead>
<tr>
<th>memby</th>
<th>ma’e / mba’e</th>
<th>maraka / mbaraka</th>
<th>mo–’i / mbo–’i</th>
<th>mo–jahu / mbo–jahu</th>
<th>mo–mbé</th>
<th>mo–ngy’a</th>
<th>mo–’ã</th>
<th>mo–kane’ô</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mo–puka</td>
<td>mo–kapu</td>
<td></td>
</tr>
</tbody>
</table>

## PyG

<table>
<thead>
<tr>
<th>memby</th>
<th>mba’e</th>
<th>mbaraka</th>
<th>mbo–’i</th>
<th>mbo–jahu</th>
<th>mo–mbé</th>
<th>mo–ngy’a</th>
<th>mo–’ã</th>
<th>mo–kane’ô</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mbo–puka</td>
<td>mbo–kapu</td>
<td></td>
</tr>
</tbody>
</table>
consonant was present in PTG, as assumed in all reconstructions, and presumably also present in pre-PTG.

I am making two further assumptions about this stage. The first is that progressive nasalization was active: morpheme-final nasal syllables would have productively nasalized the initial voiceless stops of an oral morpheme across a morpheme boundary (with concomitant voicing). This nasalization was often partial, affecting only the closure (i.e., initial) phase of the stop to yield a prenasalized contour consonant, but it was sometimes full, yielding nasal consonants. I agree with Schleicher’s (1998:42–43) claim that nasalization of the initial voiceless stop of a non-nasal morpheme when preceded by a nasal morpheme (e.g., the causative prefix) in the same phonological word was reflective of pre-PTG. Evidence for the general character of this rule in pre-PTG comes from TG languages across all of Rodrigues and Cabral’s (2012) branches (20–30) (further examples in appendix).

<table>
<thead>
<tr>
<th>TG language</th>
<th>TG language word</th>
<th>PyG cognate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tupinambá (Branch 3)</td>
<td>moçapîr ‘three’</td>
<td>mbohapy</td>
</tr>
<tr>
<td></td>
<td>mobîr ‘how many; how many times’</td>
<td>mbovy</td>
</tr>
<tr>
<td>Guajajára (Branch 4)</td>
<td>hemireko ‘wife’</td>
<td>hemireko</td>
</tr>
<tr>
<td></td>
<td>hemo ‘penis’</td>
<td>hembo</td>
</tr>
<tr>
<td></td>
<td>memyr/mymyr ‘son (of woman)’</td>
<td>memby</td>
</tr>
<tr>
<td></td>
<td>wenu ‘s/he hears’</td>
<td>ohendu</td>
</tr>
<tr>
<td>Araweté (Branch 5)</td>
<td>/maj/ [maj] ‘snake’</td>
<td>mbói</td>
</tr>
<tr>
<td></td>
<td>/eno/ [e nu] ‘listen!’</td>
<td>ehendu</td>
</tr>
<tr>
<td></td>
<td>/he ra mị/ [hera mi] ‘my (outer) ear’</td>
<td>chenambi</td>
</tr>
<tr>
<td>Kayabí (Branch 6)</td>
<td>ene ‘you(sg.)’</td>
<td>nde</td>
</tr>
<tr>
<td></td>
<td>eny ‘saliva’</td>
<td>–endy</td>
</tr>
<tr>
<td></td>
<td>kumana ‘bean’</td>
<td>kumanda</td>
</tr>
<tr>
<td></td>
<td>mainnymy ‘hummingbird’</td>
<td>mainnumby</td>
</tr>
<tr>
<td>Kamayurá (Branch 7)</td>
<td>/tsimo/ [tsi’mə] ‘timbo’ (a leguminous plant that is a fish toxin)</td>
<td>timbo</td>
</tr>
<tr>
<td></td>
<td>/oʔanup/ [hɔŋ’nup] ‘he is listening’</td>
<td>ohendu</td>
</tr>
<tr>
<td>Urubú Ka’apór (Branch 8)</td>
<td>ma’e ‘thing’</td>
<td>mba’e</td>
</tr>
<tr>
<td></td>
<td>rymy’y ‘edge (of the water)’</td>
<td>rembe’y</td>
</tr>
</tbody>
</table>
Kaiwá (Branch 1)
(20) oke-mí
    okê-pí
    door–LOC
    ‘in the doorway’

Mbyá (Branch 1)
(21a) inhakŷmba
    inh-akŷ-pa
    3.STAT–wet–completely
    ‘he is completely wet’

     (Dooley 1998:xxi)

     (21b) ijayvu porâmby
    ij–ayvu    porā–py
    3.STAT–speak    good–NMLZ.PASS
    ‘blessed person’

     (Dooley 1998:xcvi)

Guaráyo (Branch 2)
(22a) zêñgatu
    zê+catu
    sweet+more
    ‘sweeter; very sweet’

     (Hoeller 1932:8)

     (22b) omombita
    o–mo–píta
    she–make–stay
    ‘she made them stay’

     (Newton 1978:200)

Tupinamba (Branch 3)\(^16\)
(23a) paranáme
    paranã–pê
    sea–LOC
    ‘in the sea’

(23b) omanombâ
    o–mano–pá

\(^16\) In these examples from Anchieta ([1595] 1874), when no nasality is indicated, stress for monosyllabic words is marked with the grave accent (`), last vowel stress with a circumflex accent (ˆ), and all other words with an acute accent (´) (although this is done somewhat inconsistently by Anchieta).
3.ACT–die–all
‘they all died’

(Anchieta [1595] 1874:4)

Guajajára (Branch 4)\(^\text{17}\)

(24a) **momor**
* mu–por
  CAUS–throw.oneself
‘to throw; to play’

(Harrison and Harrison 2013:121)

(24b) **ipokwagwar**  (NB: \(<\text{g}>=[\text{ŋ}]\))
  i–po–kwa–kwar
  3–hand–finger–hole
‘in between the fingers’

(Harrison and Harrison 2013:70)

Tapirapé (Branch 4)

(25) **konomĩŋãto**
  konomî+kãto
  child+beautiful
‘beautiful child’

(D’Angelis and Costa 2008:233)

Parintintin (Branch 6)

(26) **–apyingwar**
  –apynh+kwar
  nose+hole
‘nostril’

(Betts 1981:35)

Kayabí (Branch 6)

(27a) **–momot**
  mo–pot
  CAUS–jump
‘to make jump; to play’

(27b) **–monorok**
  mo–torok
  CAUS–torn
‘to tear; to rip’

\(^{17}\) A reviewer notes that Guajajára, like closely related Tembé, no longer has nasal vowel phonemes and therefore no nasal harmony, nor is there any contrast between nasal and nasal-oral contour consonants. Guajajára is nevertheless relevant because it has fully nasal consonants where PyG has contour consonants, has the putative earlier from *mo-* for the causative, and shows progressive nasalization with roots like *iru* or *kwa* that are assumed to have had a final nasal vowel that was later lost.
(27c) –magwap
mo–kwap
CAUS–passar
‘to make pass; to sift’

(Dobson 1997:107)

Kamayurá (Branch 7)

(28a) /omoŋje/
o–mo–kije
3–CAUS–be.frightened
‘he frightens him’

(28b) /omomap/
o–mo–pap
3–CAUS–finish
‘he makes it finish’

(Seki 2000:431)

Wayampi (Branch 8)

(29a) akāŋge
akā–ke
head–PST
‘ancient head’ (the name of the Pleiades constellation)

(Grenand 1989:122)

(29b) ŝīŋge
šī–ke
grow–PST
‘heartwood’

(Grenand 1989:325)

Jo’é (Branch 8)

(30a) [kuðambugu]
kuða+puku
woman+tall
‘tall woman’

(30b) [nã“dik¹]
nã+tik
Brazil nut+small
‘small Brazil nut’

(Cabral 1996:42)

Siriono (Branch 2) and Araweté (Branch 5) also show progressive nasalization across morpheme boundaries (31, 32). According to Schleicher (1998), the change /ɾ/ → [“d] exemplified below occurs in relational roots with the classifier τ–.
Siriono (Branch 2)\(^\text{18}\)

(31a) chichimï ñdirï
chichimï rirï
joči son
‘young of a joči (Lowland paca)’

(31b) mä ngiti
mä kiti
what side
‘on what side?’

(Gasparini and Dicarere Mendez 2015:9)

Araweté (Branch 5)

(32) [hedʒaˈɾĩ] /he dʒaˈɾĩ/ 1 grandmother tooth
‘my grandmother’s tooth’

(Alves 2008:74)

Progressive nasalization may have been present in proto-Maweti-Guarani or even in proto-Tupi. Singerman (2016) shows that Tupari (Tupian, Tuparian branch) has progressive nasalization triggered by nasal consonants or vowels, targeting highly sonorant segments in the word as well as voiceless stops (33).

Tupari (Tupian, Tuparian branch)

(33a) ōmāořa [õ.māo.řa]
o–m–aot–a
1SG–CAUS–leave–THEME
‘make me leave’

(33b) māmnān [mām.nān]
mā–pnē–a–t
plant–EVID.SG–THEME–PST
‘planted (non-witnessed)’

Singerman (2016:454–455)

Drude (2008) also shows that both Mawe and Aweti, thought to conform with TG the Maweti-Guarani subfamily of Tupian, have limited progressive nasalization (34).

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\(^\text{18}\) The dieresis (¨) indicates nasality in the Siriono community-adopted alphabet.
Aweti (Maweti-Guarani, Aweti branch)

(34) [ẽntäm]
ɛ̃–tãP
2.SG–village
‘your village’

Drude (2008:243)

My second assumption about the pre-PTG stage is that its causative was \( mV^- \), as reconstructed for PTG by Jensen (1998, 1999) and for Proto-Tupian by Rodrigues and Cabral (2012:530–31), not \( mbV^- \). This somewhat contradicts Schleicher’s (1998) reconstruction (although see 5). This is plausible since causative morphemes in TG and other Tupian languages often display the form \( mV^- \) independently of the roots’ value for VELUM. Table 5 shows this for all of Rodrigues and Cabral’s (2012) branches of TG (with the exception of Branch 2, the Guaráyo branch).

### TABLE 5

| TG Fully Nasal Causatives with Fully Oral Roots (More Examples in Appendix) |
|---|---|
| TG language | TG language causativized word |
| Jesuitic Guarani (Branch 1) | amoguapy ‘I make return’ |
| Tovar (1949:47) | |
| Chiriguano (Branch 1) | pemopua ‘you (pl.) lift’ |
| (Farré 1991:21) | |
| Tupinambá (Branch 3) | amoobb ‘I make rejoice’ |
| (Anchieta [1595] 1874:53, 14) | aimogebr ‘how many; how many times’ |
| Tapirapé (Branch 4) | amapyyro ‘s/he makes (someone) have shoes’ |
| (Neiva Praça 2007:14, 70) | erematarak ‘you (sg.) tear (something)’ |
| Guajajára (Branch 4) | omopok ‘s/he causes (something) to burst’ |
| (Harrison and Harrison 2013:123) | omoxorok ‘s/he cuts (something); s/he carves (something)’ |
| Araweté (Branch 5) | mu–pīpu ‘to cook (something)’ |
| (Solano 2009:148, 196) | mu–pariri ‘to frighten’ |
| Kayabí (Branch 6) | mojoo’ ‘make cry’ |
| (Dobson 1997:106) | mōjepiit ‘make climb’ |
| Kamayurá (Branch 7) | /omotorok/ ‘he tore (it)’ |
| (Seki 2000:431) | /omokuj/ ‘he tore (it) down’ |
| Urubú Ka’apór (Branch 8) | re–m–aku ‘you (sg.) heat’ |
| (Garcia Lopes 2009:92, 93) | –mu–pīʔa ‘to make think’ |
Furthermore, whereas some TG and Tupian languages have \( mV \)- in all contexts, no TG or Tupian language has \( mbV \)- for all contexts. Finally, other Tupian non-TG languages also support this reconstruction. On the basis of the Mundurukú causative \([ma]\)- and the Kuruaya causative \([ma]\)-, Picanço (2010) reconstructs a Proto-Mundurukú causative \([^ma]\)-. Galucio and Nogueira (2011) show that the Tupari branch has fully nasal but not contour causatives.\(^{19}\) Coupled with the above data, this allows us to confidently surmise that the initial contour consonant in PyG causative \( mbo- \) is a later development. This view will receive further support with the discussion of regressive oralization in 4.2.

4.2. Changes from pre-Proto-Tupi-Guarani to Proto-Tupi-Guarani. This first step involves two changes: the loss of progressive nasalization and the emergence of a regressive oralization rule.

4.2.1. Loss of progressive nasalization. Consider PyG \( mbo-kapu \) in (35).

(35) mbokapu (not *mongapu)
[\( \text{mboka'pu} \)]

\( mbo-kapu \)
CAUS–explode
‘to shoot’

(Ávalos Ocampo 2017:193)

The pre-PTG rules predict not this form but rather the ungrammatical \(*mo-ngapu\) with a nasalized stop. Hence, progressive nasalization has to have been lost going from pre-PTG to PTG (or arguably somewhat later, after PTG started to diversify via southern migrations).\(^{20}\) We know that progressive nasalization is not operative in PyG. First, we can exhaustively list the suffixes that undergo it, the root compounds that show it, and the two prefixes that cause it, which are the causative and, much more infrequently, the nominalizer \(-em(b)i\)-. Most root compounds in PyG show an initial voiceless consonant instead (36a). Contour variants are often in free variation (36b).

(36a) \( \text{ñe'êkuua} / \text{*ñe'ênguaa} \)
\( \text{ñe'ê+kuaa} \)
speak + good
‘to be able to speak (a language); philology (neologism)’

(Krivoshein de Canese and Acosta Alcaraz 2018:74)

(36b) akâpe ~ akâmbe
akâ+pe
head + flat
‘flat-headed’

(Ávalos Ocampo 2017:21)

\(^{19}\) I thank an anonymous reviewer for pointing out the data from Tupari.

\(^{20}\) I thank a reviewer for raising the possibility of this alternative timeline.
Furthermore, even though other TG languages have forms with progressive nasalization such as Tupinambá *akámitáŋ* ‘red(dish) head’ (*< akáy* ‘head’ + *pitáy* ‘red’; Rodrigues [1981] 2010:18), PyG often eschews it (*akãpytã* ‘red-head’). Additional evidence is provided by native speakers’ causativization of nonce intransitive roots with initial voiceless stops. Four unrelated Paraguayan speakers were given each of the four nonce forms below, in writing and verbally, with their putative translations and asked to provide translations that encode a causative meaning. Progressive nasalization was never present. Speakers always used the allophone *mbo* and conserved the voiceless stop, as shown in table 6 under “consultant response.”

With progressive nasalization unavailable in PTG, newer causative forms conserve the initial voiceless stops, as shown in table 3 for Early PTG. A variant of this stage may be exemplified by modern-day TG languages such as Tapirapé and Guajajára (Branch 4), Araweté (Branch 5), Kayabí (Branch 6), and Kama-yurá (Branch 7). These languages have nasal consonants but do not have contour consonant phones. As a result, their /p,t,k/-initial roots do not nasalize when causativized (see table 5). These languages may represent the earliest stage of the loss of progressive nasalization, before any forms became fossilized, or conversely an ulterior development where causative forms with contour-initial roots were lost by analogy with the other forms.

### 4.2.2. Emergence of regressive oralization in stressed syllables.

Since the pre-PTG causative is *mV*-, I am taking PyG *mbo-* to be an epiphenomenal result of the emergence of regressive oralization affecting nasal segments followed by a non-nasal context—that is, followed immediately or at some distance by a stressed oral vowel. Regressive oralization is posited by Rodrigues and Cabral (2011:81) at the point of TG diversification. This process (/m, n, η/ → [mb, nd, ng]) would have yielded a second set of nasal-oral contour consonants in PyG as well as in other TG languages. Hence, alongside the prenasalized

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**TABLE 6**

**Nonce Causatives in PyG Do Not Show Progressive Nasalization**

<table>
<thead>
<tr>
<th>Nonce form and meaning given</th>
<th>Translation requested</th>
<th>Consultant response</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>kore</code> ‘to hide (oneself)’</td>
<td>‘to hide something’</td>
<td>ńembokore</td>
</tr>
<tr>
<td><code>kapa</code> ‘lukewarm’</td>
<td>‘to make something lukewarm’</td>
<td>ńembokapa</td>
</tr>
<tr>
<td><code>pevo</code> ‘strong’</td>
<td>‘to make something strong’</td>
<td>ńembopevo</td>
</tr>
<tr>
<td><code>ta’a</code> ‘to jump on one leg’</td>
<td>‘to make someone jump on one leg’</td>
<td>ńembota’a</td>
</tr>
</tbody>
</table>

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21 The data were collected as part of my fieldwork conducted between 2018 and 2020. One consultant was from the Cordillera Department (a department is a governmental unit like a state or province), another from the Itapúa Department, another from the Alto Paraná Department, and the last from San Pedro Department (but living as an adult in the Central Department, close to the capital Asunción).
contour allophones present from relic forms of pre-PTG progressive nasalization, now contour phones would have also surfaced as postoralized allophones of nasals. In fact, postoralization is a rule proposed by Goldsmith (1976:88) to account autosegmentally for the current nasalization patterns of PyG.

In order to provide stronger evidence for the emergence of this rule, we must examine in more detail what the loss of progressive nasalization means from an articulatory perspective. Progressive nasalization is a kind of perseveratory effect (a carryover effect), where a raised velum remains raised sometime after the articulation of a nasal phoneme during the articulation of the next phonologically oral phoneme. Articulatorily, loss of progressive nasalization is the earlier timing of velum raising to coincide with the end of the stressed nasal syllable and to avoid carryover across the morpheme boundary (assuming that tautosyllabic nasal coarticulation is a separate process; see Piggott and van der Hulst 1997; Thomas 2014 for Mbyá; Singerman 2016 for Tupari).

I am hypothesizing that regressive oralization emerged first from a stressed phonologically oral vowel to the immediately preceding nasal consonant, which becomes a postoralized consonant. This is a plausible development for perceptual reasons. With progressive nasalization lost, the right edge of the nasal span now matches the end of the stressed syllable of words and the contrast between stressed oral and stressed nasal vowels is at risk, since both are produced with some degree of nasalization when the syllable onset is nasal (as I mentioned in 3). There is a cross-linguistically documented need for environmental shielding (Stanton 2018), whereby nasal consonants develop a brief oral phase in contact with an oral vowel to preserve the contrast between oral and nasal vowels (see also Wetzels 2008). Lapierre (forthcoming) shows that nasal consonants in Panãra (Jê family, northern branch, Eastern Amazon) are synchronically postoralized (and further devoiced) to enhance perceptually this contrast between the following oral and nasal vowels, thus giving evidence of shielding by postoralization. Lapierre also mentions that this is a widespread phenomenon in the Amazon. Back to articulatory terms, if an oral vowel follows a nasal, the resulting postoralized contour is a consequence of the nasal consonant naturally developing an oral release phase by closing the velum even earlier, anticipating the oral vowel, therefore “shielding” it from nasal coarticulation. Notably, this denasalization happens in composition, in suffixation, and also lexeme internally. Thus, it is phonological, without morphological conditioning.

Similarly, contrast enhancement of oral/nasal differences plays a crucial role in Picanço’s (2010) explanation of nasal harmony and phonotactic restrictions in Mundurukú (Tupian). In Proto-Mundurukú, /b/ > [m] before a nasal vowel due to regressive nasalization; therefore, the contrast /b/ ~ /m/ is at risk in nasal spans, since in that context both /b/ and /m/ map to [m]. In order to enhance and preserve the contrast, regressive nasalization is prevented from affecting
the voiced stop and the segments prior to it, effectively turning /b/ into a blocking segment.

In the TG diachrony, this process of contrast enhancement applies first only optionally to the nasal onsets of stressed syllables. Modern-day Wayampi and Urubú Ka’apór reflect this early stage. Wayampi has mostly nasal allophones and only has postoralized allophones optionally in the onset of stressed syllables (37).

Wayampi (Branch 8)
(37a) [momáʔe] / [mobáʔe]
‘thing’

(37b) [anéʔe] / [angéʔe]
‘now’

(Jensen 1989:52)

Similarly, in Urubú Ka’apór nasal consonants have prenasalized plosive allophones in free variation before oral vowels and non-nasal consonants (38).²²

Urubú Ka’apór (Branch 8)
(38a) /móí/ > [moi] or [mboi]
‘snake’

(38b) /itaŋʷa/ > [itaŋʷa] (more frequent in fast speech)

/itaŋʷa/ > [itaŋgʷa] (more frequent in normal speech)

‘his buttocks’

(Kakumasu 1986:399)

There is also evidence from Tupinamba that nasals in composition followed by stressed oral vowels often become contour consonants (39).

Tupinamba (Branch 3)
(39a) acembê
a–cêm–e
1.SG–go.out–when
‘when I go out’

²² These examples should probably be [mõĩ] or [mboi], [itaŋʷa] or [itaŋgʷa], given that the language has progressive nasalization (or, more accurately, tautosyllabic nasal coarticulation) of vowels immediately after nasals but blocked after prenasalized stops (Kakumasu 1986:401). There is another source of contour consonants in Urubú Ka’apór—namely, the prenasalization of voiceless plosives between two nasal vowels (/hẽtũ/ [hẽtũ] ‘he smells’, Kakumasu 1986:400)—but this fact is not relevant in this discussion, other than to note that there can be many sources for nasal-oral contour consonants. Note that this pattern is essentially the one described for prenasalized voiceless plosives in Aweti (the closest Tupian language to TG) by Drude (2008).
(39b) nhauumbóca
  nhaúma+óca
  mud+house
  ‘mud house’

(Anchieta [1595] 1874:3)

I am taking the emergence of this rule to mark the earliest stages of PTG.

4.3. The reconstructed system of Proto-Tupi-Guarani. I am assuming that this stage has regressive nasalization starting from a stressed nasal vowel or nasal consonant and fixed remnants of progressive nasalization after a nasal phoneme of the initial voiceless stops of an oral morpheme across a morpheme boundary (Schleicher 1998:39–47). Because of the emergence of regressive oralization starting from a stressed oral vowel, the phonemes /m, n, ŋ/ have developed postoralized allophones [mb, nd, ng] that optionally provide the environmental shielding needed for accurate perception of phonologically oral vowels after nasal onsets. With regard to the causative, it still has the single nasal allomorph mo-, contrary to Schleicher (1998). The systems of modern-day Wayampi and Urubu Ka’a pó (Branch 8) are consistent with this stage.

4.4. From Proto-Tupi-Guarani to Paraguayan Guarani: Widening of oral spans. At a later stage, regressive oralization from stressed oral vowels expands leftward, oral spans become wider, and nasal consonants solidify as blockers (with concomitant change to contour). The first step in this development is exemplified by TG languages—for example Tupinambá as described by Anchieta ([1595] 1874) and Xetá (Vasconcelos 2008)—that have obligatory contour consonants in the onsets of stressed oral syllables and optionally in onsets of pretonic syllables.

This optionality later disappears in some languages in favor of oralization as they increase the domains of contrast between nasal and oral spans. Rodrigues and Cabral (2011:73) ground this development by leveraging these languages’ need for “balanced symmetry” between nasal and oral patterns. As a result, in the languages that have widened the oral span, the system is fixed to one where both nasal and oral stressed vowels spread their VELUM values to the left, until they find a blocking segment. The regressive spread of nasalization is subject to the same conditions as in pre-PTG, with stressed nasal vowels and phonological nasal consonants as triggers and voiceless stops as transparent. On the other hand, the regressive spread of oralization is triggered by stressed oral vowels

23 It would perhaps be more proper to represent these allophones at this stage as [mb, nd, ng].
24 Xetá is a critically endangered language of Branch 1 that had only one speaker in 2006, according to Vasconcelos (2008).
25 I am not discussing the role of oral stressed vowels as blockers in cases of root compounds because they are not relevant to the argument here.
and blocked by nasal consonants. These blockers surface as postoralized contours, reliably marking the boundary between nasal spans to the left and oral spans to the right.

4.5. The synchronic system of Paraguayan Guarani. The sequence of changes proposed yields the system of modern-day PyG and of other TG languages such as Kaiwá and Mbyá. It also makes clear why PyG only allows three types of words: oral (I r VELUM) (40a), nasal (I l VELUM) (40b), and disharmonic with a nasal span followed by an oral span ([Ir velum]) (40c) and a contour consonant at the boundary (Barratt 1981:190). (Additional examples of each type can be found in the online appendix.)

(40a) mbarakaja
   [mbaɾakaˈja]  ‘cat’
   (Adelaar and López 1986:20)

(40b) marakanã
   [mãɾãkãˈnã]  ‘macaw’
   (Adelaar and López 1986:20)

(40c) marangatu
   [mãɾãŋgaˈtu]  ‘pious, noble, honest’
   (Adelaar and López 1986:21)

Synchronically, table 3 PyG forms like mo-ˈã and mo-kaneˈõ appear to be governed by a nasal span triggered by the stressed nasal vowel of the roots, whereas historically no nasal span was required for the allomorph mo- to surface. Likewise, for mo-mbe and mo-nyˈa, occurrence of mo- appears to be governed by a nasal span triggered by the initial contour consonant of the roots, whereas, again, no nasal span was historically required to justify the appearance of mo-. Therefore, the distribution of the causative allomorphs can be described as always determined by the VELUM value of the segments to the right: the original nasal allomorph mo- for use in nasal spans and a newly developed oral allomorph mbo- for use in oral spans.

Furthermore, since progressive nasalization has disappeared and regressive oralization has widened its scope of application, occurrences of mo- have become less frequent, because this allomorph is used with fewer roots. This can be seen by comparing the type frequencies of mo- and mbo- for each stage in table 3. This yields a reanalysis of the basic form of the causative as the most frequently encountered, mbo-. In other words, for a native speaker of PyG, the default form the causative takes is oral mbo-, with mo- only used in nasal
contexts. In connection with this claim, it is telling that \textit{mbo-} is the form presented as basic in all modern grammars, with \textit{mo-} as its variant. The form of the causative is predictable for most roots from the regressive nasal harmony rule that is generally operative in PyG: if the root is oral, the nasal-oral form \textit{mbo-} is used; if the root is nasal, the nasal form \textit{mo-} is used. As a result, the appearance of prenasalized initial consonants in causative forms has now become unpredictable and arbitrary.

5. Discussion. I believe the proposed sequence of changes is plausible both articulatorily and perceptually. Since regressive nasalization is anticipatory, in articulatory terms, the velum lowers before this lowering is absolutely necessary to produce the nasal phoneme. On the other hand, progressive nasalization is perseveratory—that is, the velum raises after the end of the nasal phoneme. In a system that has both types, the velum is, to use a crude metaphor, “lenient.” It is slow to open fully for a nasal phoneme (hence the anticipatory lowering to hit the articulatory target, the nasal phoneme in the stressed syllable), and it is slow to close fully after the nasal phoneme (hence the perseveratory lowering).26 This was presumably the case in pre-PTG, according to the evidence surveyed in this paper. Crucially, the twin changes of loss of progressive nasalization and emergence of regressive oralization can be understood as a single articulatory change: the increasing speed with which the velum is raised after the articulation of a nasal phoneme. The fact that articulatory properties play an important role is consistent with observations about differences in nasalization rates in normal versus slow speech, noted by Harrison and Taylor (1971) for Kaiwá and Kaiser (2008) for PyG. This entails that nasalization is not categorical but can be influenced by speech rate and monitoring factors.

To understand the perceptual basis for the changes, one must remember that PTG had no progressive nasalization but still had tautosyllabic coarticulatory nasality. The latter nasalized a phonologically oral vowel nucleus following a phonologically nasal consonant onset. Thus, there would not have been any phonetic [NV] sequences (N=any nasal consonant). The presence of coarticulatory nasality means that a sequence [N\textbar V] can be interpreted as /N\textbar V/ (with a phonemic nasal vowel) or /NV/ (with a phonemic oral vowel that is nasalized due to coarticulation). Preserving the /V/-\textbar / contrast in this environment requires a mechanism to prevent the nasal coarticulation of the vowel and maintain

26 We must note that Walker (1999) presents experimental data suggesting that transparent voiceless stops are produced without any velum lowering in a nasal span. She leaves open the issue of how exactly this interacts with the clear presence of anticipatory nasalization found in PyG, which is not stopped by voiceless stops. I will not address this here either and will simply assume with Walker that anticipatory nasalization can be conceptualized at some level as a single velum gesture.
its oral character (Stanton 2018). This is accomplished in PTG (and other Amazonian non-TG languages) by oralizing the release phase of the consonant (environmental shielding: Stanton 2018; Wetzels and Nevins 2018). This yields postoralized (not “prenasalized”) contour consonants first in the onset of stressed syllables with an oral nucleus where the contrast is phonological. The greater importance in TG languages of the nasal or oral quality of stressed as opposed to unstressed vowels has been substantiated at length by Beckman (1999) and Rodrigues and Cabral (2011).

The timing of velum raising to coincide with the release phase of a nasal consonant, then, becomes a phonetic feature of the pronunciation of nasals in all syllables with a non-nasal vowel, stressed as well as pretonic. The velum raises as soon as possible after articulation of the last phonologically nasal sound in the prefix + root structure. The sequence of changes can thus be uniformly seen as an increase in the accuracy of velum-raising timing with respect to the end of a nasal articulatory span rather than as a set of disparate developments. The stricter timing of velum raising is reinterpreted phonologically as a regressive oralization process that begins at the stressed vowel and is blocked by nasal consonants or stressed nasal vowels. At this point, the system has

- Regressive nasalization triggered by stressed phonologically nasal vowels or phonologically nasal consonants;
- Regressive oralization triggered by stressed phonologically oral vowels.

Taking into account the importance of stressed vowels in TG systems, this situation can be reanalyzed as

- Regressive VELUM harmony (both nasalization and oralization) triggered by the stressed vowels in a root and blocked by consonants and stressed vowels specified phonologically with a different VELUM value to the left;
- Regressive nasalization only, triggered by phonologically nasal consonants and blocked by stressed oral vowels to the left.

The surface contour consonants of this system can be a historical prenasalized consonant or a synchronic postoralized consonant, which are phonetically indistinguishable in PyG. Note that in this view the diachronic change from a unique form *mo*- to a default oral allomorph *mbo*- is an epiphenomenal product of the regressive oralization process.

27 As Stanton (2018) notes, the duration of acoustic nasality is an important cue to the phonological /V/ ~ /Ñ/ contrast.

28 Consistent with footnote 25 above, this may not have been necessarily the case in early PTG, where the prenasalized consonants [mb, nd, ŋg] and the postoralized consonants [m̩, n̩, ŋ̩] may have had different phonetic realizations.
My reconstruction of PTG in this paper differs in two important respects from extant reconstructions: (i) the order of phonological changes involving nasal phonemes and the source of their allophones and (ii) the reconstructed form of the causative prefix. With respect to the sequence of phonological changes in PTG, Jensen (1989) hypothesized that postoralization of nasal consonants in PTG was initially obligatory in both tonic and pretonic syllables as it is in modern-day PyG, modern-day Parintintín, and modern-day Mbyá and that the Wayampi pattern of optionality in pretonic syllables is a further development. Schleicher (1998) also agrees with this hypothesis. However, neither of them provides independent evidence for this claim, other than the fact that Parintintín and Mbyá seem to be more conservative than Wayampi with respect to other phonological changes. I believe this evidence is not strong enough. First, conservatism with respect to some features does not automatically entail conservatism across the board: a language can have both conservative and innovative features. Second, Jensen’s proposed reconstruction presents two problems.

The first problem is that positing that regressive oralization originally targeted pretonic syllables (as in PyG, Parintintín, and Mbyá) but was subsequently restricted to obligatory application in the stressed syllable (to give rise to the patterns in Tupinambá and Wayampi) means that, in articulatory terms, velum raising began to lag after articulation of nasal consonants or, in terms of rules, that progressive nasalization gained some ground in the language. Yet, before that, the progressive nasalization rule had disappeared from the language, presumably because of a better timing of velum raising to the end of the articulation of the nasal consonant (see 4.2). These developments are at odds in articulatory terms, whereas positing first a loss of progressive nasalization, then the emergence of preoralization, and last the widening of oral spans can be uniformly interpreted as a single type of articulatory change (see 4.4).

Perhaps more important, the second problem is that if oralization had been lost in pretonic syllables, that would mean that PyG words like mba’e ‘thing’ actually conserve a putative original form *mba’e and that the initial contour consonant became nasalized in all the other TG languages that have ma’e today (for example, several TG languages without contour consonants). It is difficult to identify a likely source for this nasalization, since there are no other nasal segments in the word. One could still assume that this putative change would simply be the articulation of the faithful allophones of nasal consonants, but in a language like Mbyá or PyG (assuming these are indeed closest to PTG, as Jensen and Schleicher do) there is scant synchronic evidence to unequivocally identify the underlying phonemes as nasal instead of contour. Also, Schleicher himself notes the interesting fact (unexpected in this account) that TG languages that have lost morpheme-level (autosegmental) nasality such as Tapirapé and Guajajára have retained the nasal allophone and lost the contour one. Since according to Jensen originally nasal allophones only occurred in nasal spans to the right
and contour allophones in oral spans to the right, there would have been no reason for the nasal allophones to emerge when nasal spans were lost. Therefore, from articulatory and phonological grounds, it seems more defensible to assume as I do here that the Wayampi pattern is the closest to PTG. In that case, languages in Branches 4 to 7 seem to reflect the earliest stages, with no evidence of regressive oralization. Languages in Branch 8 seem to show the earliest evidence of regressive oralization. Branch 3, then (but also Xetá in Branch 1), shows widening of oral spans. And finally Branches 1 (including PyG) and 2 would be the most innovative ones. Based on the classification in Michael et al. (2015), it seems that full regressive oralization (PyG style) distinguishes mostly the Southern split and wide but variable regressive oralization the Diasporic split. Languages with minimal optional regressive oralization or without it completely are all non-Diasporic.

The second point on which my proposal diverges from previous PTG reconstructions is the claim that the original (transitivizing) causative was mo-, with a fully nasal initial consonant. This contradicts Schleicher’s (1998:55, 43) reconstruction of the PTG causative as mbo- or, perhaps, /mbõ/. (The exact reconstructed form is unclear from the text.) If the reconstructed form is /mbõ/, as is suggested by his examples on page 55, to derive forms like mbo-karu > mongaru or nupã + katu > nupâŋatu, Schleicher is forced to assume that progressive “nasalization of fortes” also works reggressively—that is, that the contour consonant that is the outcome of progressive nasalization in turn nasalizes the causative. This application of progressive nasalization where a nasal-oral contour consonant nasalizes to the right is unexpected on articulatory grounds.

If the reconstructed form is /mbõ/, an immediate problem is that this is a very marked sequence cross-linguistically, given that the oral phase of a contour consonant in general is in contact with an oral segment (Wetzels 2008). It is not completely clear from Schleicher’s discussion whether this should have surfaced as [mõ] or not. In any case, the author suggests that all contours in PTG come from an original voiceless stop. Presumably, then, the original form of the causative would have been /põ/, at which point the question is how these segments came to be produced as nasal-oral contours (instead of the articulatorily more plausible oral-nasal sequence [bm]) and further interpreted as contour phonemes. The problem that afflicts these reconstructions is the lack of attention paid to the fact that contour segments have two well-differentiated phases and that there are articulatory reasons why the phases occur in the order they occur and behave in the way they do. To summarize, Schleicher’s reconstruction is contradicted by the TG and Tupian cross-linguistic evidence I presented in 4.1 that shows the generality of the mV- form for the causative and is also unlikely on a purely phonetic basis.

The only published study that proposes an explanation for nasalization patterns under causative prefixation is Robboy’s (1987) analysis of morpheme-initial
sandhi in PyG. For this reason, it is worth going into in some detail here. The examples of exceptional nasalization help him establish the existence of a nasalization rule that targets segments that are otherwise transparent with respect to the leftward spread of nasal harmony. Robboy notes that not all voiceless stops exhibit this behavior and also that only the causative but no other prefixes (such as negation or nasal person prefixes) cause it. Like Dietrich (2018), he includes as outcomes of this rule the alternations shown by the stressed suffixes -pa/-mba ‘completely’ and -ty/-ndy ‘place where a lot of X grows’, when affixed to a root that contains a nasal trigger. His analysis (restated in the terminology I am using here) assumes that stressed vowels are underlyingly associated with one of the two VELUM values (and are therefore phonemically oral or nasal); voiceless non-continuants are underlyingly not associated with a VELUM value (and cannot be associated by regular leftward nasal harmony, thus explaining their transparency); and voiced non-continuants are underlyingly associated to [lVELUM] (hence surfacing as prenasalized stops or nasal consonants). Moreover, he hypothesizes a rightward nasal spreading rule that nasalizes voiceless non-continuants to the right of a nasal segment immediately across a morpheme boundary (consistent with the general description of progressive nasalization in TG). This rule is taken to be “a minor rule, restricted both lexically and morphologically in its range of application” (Robboy 1987:276). Application of this rule to a voiceless non-continuant segment X triggers concomitant voicing of X, since all nasals must be voiced in PyG, and this in turn triggers leftward nasal harmony beginning at X, necessary to nasalize the causative prefix mbo- to mo-. Deriving the observed forms depends on the correct ordering of these processes, namely, that rightward nasal spreading applies first and feeds the voicing of nasals, which in turn feeds leftward nasal harmony.

I believe this analysis has the same problem that I first identified in 3.2: there is no likely trigger for rightward nasal spreading. If the underlying form of the causative is mbo- then, again, rightward nasalization would be very exceptional, since contour consonants only nasalize to the left. But, although he is not clear on this point, Robboy seems to implicitly assume that the underlying form of the causative is mo- (as suggested by his diagram of the autosegmental rules [1987:276]). This necessary step is consistent with my proposal that mo- is the pre-PTG causative at the stage when progressive nasalization was productive. If this is correct, however, then the whole prefix (including the vowel) would

29 His proposal is couched in the framework of autosegmental phonology, but I will freely gloss over technical details that are not necessary here.

30 Rodrigues and Cabral (2011) explicitly state that the nominalizing prefix t–emi– also triggers nasality in various TG languages. There are a few surviving forms that show this in PyG, but Robboy seems to have been unaware of this.
be a nasal span, and hence the last step of leftward spread from the initial conso-
nant of the root posited by Robboy is unnecessary.

6. Conclusion. In this paper I have tackled a curious aspect of nasaliza-
tion in PyG—namely, the nasalization of the initial segments of some roots 
under causative prefixation. These cases are often mentioned in grammars and 
have been known since the first grammar ever written of a Tupi-Guarani lan-
guage (Anchieta [1595] 1874). The problem posed by progressive nasalization 
under causative prefixation is that no obvious nasal trigger is available from the 
assumed underlying forms of the morphemes involved.

My solution hinges on reconstructing an early pre-PTG stage that satisfies 
these two conditions: (i) progressive nasalization was a productive rule; (ii) the 
causative prefix had the single, fully nasal allomorph mo- (or, more generally, 
mV-). Under these assumptions, progressive nasalization is unexceptional, and 
the trigger for it is indeed the causative prefix. Progressive nasalization was lost 
in the passage from pre-PTG to PTG. I interpreted this loss as the loss of carry-
over nasalization, implemented articulatorily by a faster timing of raising of the 
vllum after a phonologically nasal segment, to anchor it more accurately to the 
end of the stressed nasal syllable. This put the basic PTG contrast between 
stressed nasal vowel phonemes and stressed oral vowel phonemes at risk, be-
cause both types of vowels would have been produced with some amount of na-
salization. A rule of regressive oralization beginning from stressed oral vowels 
emerged, then, in PTG, to enhance this contrast. This rule produced postoralized 
contour allophones of nasal consonant phonemes in the onsets of oral stressed 
syllables, as a kind of environmental shielding. In some TG languages, the sub-
sequent leftward widening of these new oral spans until a nasal blocker is found 
yields the known distribution in PyG of fully nasal, fully oral, and disharmonic 
nasal-oral prefix+root morphological words, with contour consonants at the 
boundary of nasal and oral spans in the latter word type. Specifically concerning 
the causative prefix, at this point the allomorph mbo- became more frequent than 
the historically original allomorph mo-, triggering a reanalysis of the former as the 
basic form and the latter as an alternative allomorph for use in nasal spans. This 
is the current synchronic system of PyG, where the exceptional nasalizations 
with the causative are fixed remnants of the application of a pre-PTG rule.

In addition, this proposal makes a more general contribution to the re-
construction of PTG and the TG family diachrony. Specifically, it argues in 
favor of a different sequence of changes involving oralization processes than 
what has been argued for by Jensen (1989) and Schleicher (1998). An advan-
tage of my proposal over extant ones is that the posited diachronic develop-
ment is justified by well-established cross-linguistic articulatory and percep-
tual phenomena.
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