

Nasal harmony in Kamaiurá: Syllabification and spreading*

Stephen Nichols, stephen.nichols@manchester.ac.uk, University of Manchester

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1 Introduction

First, a brief introduction to Kamaiurá:

- Kamaiurá is a Tupi–Guarani language spoken in the Upper Xingu region of Brazil by around 300 people (Seki 2000:31).
- Previous work includes Sälzer (1976), Everett & Seki (1985), Seki (1982, 1983, 1987, 1990, 1997, 2008, 2014), Camargo (2008), Camacho (2010), Kamaiurá (2012), Seki & Nevins (2013).
- Additionally, Seki (2000) is a detailed 500-page grammar of the language.
- Kamaiurá has fourteen consonant phonemes:

	Labial	Dental	Alveolar	Palatal	Velar	Glottal
Nasal	m	ṃ			ŋ	
Stop	p	t̪			k k ^w	ʔ
Affricate			ts			
Fricative						h h ^w
Approx.			r	j	w	

Table 1: Kamaiurá consonant phonemes

- And twelve vowel phonemes, six oral and six nasal:

	Front	Back
High	i ĩ i ĩ	u ũ
Mid	e ẽ	o õ
Low		a ã

Table 2: Kamaiurá vowel phonemes

- However, underlying nasal vowels are restricted in their distribution to root-final syllables (Seki 2000:418).
- The approximants /r w j/ are nasalised in nasal environments and are realised as [r̃ w̃ j̃] respectively (Seki 2000:412f).
- Stress is not contrastive and reliably falls on the final syllable (Seki 2000:419).¹

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¹Additionally, prefixes and proclitics are atonic, certain suffixes are also atonic but others are tonic.

- Syllables may have the shape (C)V(C), with codas only being permitted word-finally, but not /k^w ʔ ts h h^w r/ (Seki 2000:419f).
- Glottal prothesis: following a pause words beginning with a vowel acquire a prothetic glottal consonant. This is most often [h] but may also surface as [ʔ] before /i a/.
- This is incidental² when it comes to nasal spreading (Seki 2000:417f) but I note this as it crops up in the transcribed examples below.
- Seki (2000) describes and provides examples of nasal harmony but does not develop a theoretical analysis.

This presentation:

- Using data taken from Seki (2000), I discuss the variety of nasal harmony encountered in Kamaiurá.
- First I present some data and a description thereof: regressive spreading from a nasal nucleus or coda which propagates throughout the word unless an opaque segment, namely a plosive or affricate, is met; nasal onsets cannot initiate spreading.
- I consider how one might analyse such a pattern in an Optimality-Theoretic framework:
 - Firstly, I consider how work on nasal harmony using alignment and feature co-occurrence constraints might be applied to Kamaiurá.
 - And find this wanting, specifically with regard to the behaviour of onsets.
 - Then consider what licensing constraints might be able bring to this.
 - Find this an improvement but still far from perfect.
 - I will then discuss some of the remaining problems.
- Finally, I present a summary and some conclusions.

Some disclaimers:

- As the data are taken exclusively from Seki's (2000) grammar and not from recordings, no acoustic or articulatory information is available.
- Nasal spreading is most consistently transcribed in the grammar when discussing nasality itself and Seki does provide a consistent description of the behaviour of nasal spreading.
- If it turned out *not* to be true for Kamaiurá, this is still a possible instantiation of nasal harmony which presents analytical challenges that merit attention.

²Despite the potential link between nasality and glottality (see Matisoff 1975 et seq.).

2 The data and the pattern

- (1) Underlying nasal vowels spread nasality:

/me'jũ/	[mẽ'ɲũ]	'beiju'
/ka'wĩ/	[kã'wĩ]	'mingau'
/ku'jã/	[kũ'ɲã]	'mulher'
/ɲĩ'wã/	[ɲĩ'wã]	'sobrinho (voc.)'
/ja'ʔẽ/	[ɲã'ʔẽ]	'panela'
/ha'ʔĩɲ/	[hã'ʔĩɲ]	'semente dele'
/oja'rõ/	[õɲã'rõ]	'está bravo (o animal)'
/jũ/	[ɲũ]	'campo'
/we'ʔĩɲ/	[wẽ'ʔĩɲ]	'ele coça'
/iʔa'rõ/	[hĩ'ʔã'rõ]	'é gostoso'
/iʔi'rũ/	[ĩ'ʔĩ'rũ]	'marido dela'

- (2) Coda nasals spread nasality regressively:

/a'jaɲ/	[ã'ɲãɲ]	'eu corro'
/a'kaɲ/	[a'kãɲ]	'cabeça'
/aje'ʔeɲ/	[hãɲẽ'ʔeɲ]	'eu falo'
/i'peɲ/	[i'pẽɲ]	'sobrinho dele'
/am/	[ãm]	'aqui'
/oje'wuɲ/	[hõɲẽ'wũɲ]	'ele cospe'
/ʔupa'ham/	[ʔupã'hãm]	'corda'
/ai'kaɲ/	[ai'kãɲ]	'peixe-cachorra'

- (3) No progressive spreading from nasal onsets:

/mi/	[mi]	'pé'
/mi'ʔu/	[mi'ʔu]	'pulmão'
/ma'ʔit̩/	[ma'ʔit̩]	'idosa'

- (4) Plosives block spreading:

/iroʔi'tsaɲ/	[iroʔi'tsãɲ]	'está frio'
/i'tsũ/	[i'tsũ]	'nariz dele'
/ipi'ʔuɲ/	[ʔipi'ʔũɲ]	'noite'
/ʔiwa'kuɲ/	[ʔiwa'kũɲ]	'nuvem'
/ʔa'peɲ/	[ʔa'pẽɲ]	'tesoura (pássaro)'
/mi'ʔũ/	[mi'ʔũ]	'mutum'
/pe'ʔim/	[pe'ʔĩm]	'tobaco'

- (5) No regressive spreading from nasal onsets:

/a ^h ma/	[ha ^h ma]	‘mamãe (voc.)’
/a ^h mo/	[ha ^h mo]	‘outro’
/a ^h ni ^h te/	[ha ^h ni ^h te]	‘não’
/e ^h ne/	[he ^h ne]	‘você’
/i ^h ni/	[hi ^h ni]	‘rede’
/ka ^h ni ^h ne/	[ka ^h ni ^h ne]	‘arara’
/mi ^h na ^h ta/	[mi ^h na ^h ta]	‘castanha’
/mi ^h na ^h u/	[mi ^h na ^h u]	‘reclusa’
/para ^h na/	[para ^h na]	‘rio’
/tsi ^h ni ^h at/	[tsi ^h ni ^h at]	‘pesca com timbó’

- It seems likely that, articulatorily at least, the glottals /ʔ h h^w/ are nasalised in nasal environments, especially given that, as onsets, they permit the transmission of nasality; however, Seki does not transcribe them as such and so neither have I.

3 Alignment

- Kamaiurá seems to fit rather nicely into the typological hierarchy of nasal harmony systems (see e.g. Schourup 1972, Pulleyblank 1989, Piggott 1992, Cohn 1993a,b, Walker 1995, 2003).
- Spread of nasality is halted by plosives (including the affricate).
- Sonorants and glottals are transparent to the spread of nasality.
- The attempt at an analysis in this section is in the vein of work such as Walker (1995, 2003).
- The constraints:
 - ALIGN-L([+nasal], PrWd) = SPREAD-L(+nasal): spread instances of [+nasal] leftwards
 - IDENT(nas): don’t make changes to the feature [nasal]
 - IDENT(son): don’t make changes to the feature [sonorant]
 - *NASLIQUID: don’t nasalise liquids
 - *NASOBSTRUENTSTOP = *NASPLOSIVE: don’t nasalise plosives
 - *NASSEMIVOWEL: don’t nasalise semi-vowels
 - *NASVOWEL: don’t nasalise vowels
 - NOGAP: no gapped configurations
- There is no skipping segments so NOGAP is undominated.
- Plosives are blockers so *NASPLOSIVE and is equally high-ranking.
- Changes to [±sonorant] are dispreferred so IDENT(son) is not far behind.
- Nasality likes to spread so SPREAD-L(+nasal) is fairly high up there.
- Changes to [±nasal] are also somewhat dispreferred, so IDENT(nas) comes next.

- Liquids, semi-vowels and vowels are all readily nasalised so *NASLIQUID, *NASSEMI VOWEL and *NASVOWEL come bottom of the pile (following the typical hierarchy).
- This gives the following ranking:
 - NOGAP, *NASP » IDENT(son) » SPR-L(+nas) » IDENT(nas) » *NASL » *NASSV » *NASV
- This correctly generates forms that spread nasality leftwards throughout the word from both nasal nuclei and codas but has the propagation of nasality stopped by plosives:³

(6)

/kujã/	NOGAP	*NASP	IDENT(son)	SPR-L(+nas)	IDENT(nas)	*NASL	*NASSV	*NASV
kujã				**_!*				*
kujã̃				**_!	*			*
☞ kujã̃				*	**			**
kũjã	*_!			**	*			**
kũjã̃		*_!			***			**
ɲũjã̃			*_!		***			**

(7)

/akaŋ/	NOGAP	*NASP	IDENT(son)	SPR-L(+nas)	IDENT(nas)	*NASL	*NASSV	*NASV
akaŋ				**_*_!				
akak			*_!	***	*			
☞ akãŋ				**	*			*
ãkãŋ	*_!			*	**			**
ãkãŋ̃		*_!			***			**
ãŋãŋ̃			*_!		***			**

- But incorrectly predicts that nasal onsets should also spread nasality:

(8)

/eŋe/	NOGAP	*NASP	IDENT(son)	SPR-L(+nas)	IDENT(nas)	*NASL	*NASSV	*NASV
☞ eŋe				*_!				
☺ eŋe					*			*
eŋe			*_!	*	*			

- Which is a problem.

³Positioning IDENT(cont) in between *NASSEMI VOWEL and *NASVOWEL could also explain why /j/ becomes [ɲ] when nasalised rather than [j], though this might then lead one to conclude that /w/ ought to be realised as [m] rather than [w̃] when nasalised, which is not the case (though this might be a somewhat trivial detail in the grand scheme of things).

4 Licensing

- The fact that nasal onsets cannot initiate spreading but do not later impede it once spreading has begun appears to be somewhat of a paradox.
- Time to go back to the drawing board.
- Could this have anything to do with stress? After all, it is seemingly only in stressed syllables that spreading begins.
- Nevertheless, it is still only nuclei and codas, not onsets, that cause spreading.
- Perhaps positional licensing can help (Steriade 1995, Zoll 1998a,b, Piggott 2000, Walker 1998, 2001, 2004, 2005, 2011, Kaplan 2008).
- Positional licensing requires that a given feature be associated with a prominent position.
- Let's first (very briefly) look at Walker's (2005) treatment of height harmony in Vèneto (Romance, Indo-European; Italy).
- In this case, as in other instances of metaphony in Romance, post-tonic high vowels raise stressed mid vowels.
- Walker (2005) employs three constraints relating to height:
 - LICENSE([+high]_{post-tonic}, ó): [+high] in a post-tonic syllable must be associated with a stressed syllable (p.942)
 - IDENT-ó(high): a segment in a stressed syllable in the output and its correspondent in the input must have identical specifications for [±high] (p.944)
 - IDENT(high): do not change feature specifications for [±high] between the input and output
- Ranking such constraints in that order generates the correct pattern:

(9)

	/bev-i/	Lic(+high)	IDENT-ó(high)	IDENT (high)
☞	bívi		*	*
	bévi	*!		

- Licensing constraints such as LICENSE([+high]_{post-tonic}, ó) require that a given feature be associated with a perceptually strong position.
- Usually, this involves spreading a perceptually difficult feature from a weak position.
- But surely, in Kamaiurá, nasality is already in a strong place to begin with, namely a stressed syllable? So why invoke positional licensing?

- I propose that segments bearing [+nasal] in nuclei and codas project this feature to higher levels in the structure, which might also be considered stronger position.
- Having transmitted this feature upwards in the structure, this may then “percolate” down (à la Halle & Vergnaud 1981) a projected tree to affect other segments and thus be propagated throughout the word, but this is still not allowed to bypass opaque segments.
- One further detail of nasal harmony in Kamaiurá is that, upon affixation of a vowel-initial suffix, spreading is not blocked, as if resyllabification occurs after spreading:

(10) /a.'kaŋ.-e.'tɛ/ → a.kãŋ.e.tɛ, *a.ka.ŋe.tɛ → [a.kã.ŋe.'tɛ], *[a.ka.ŋe.'tɛ] ‘cabeçudo’⁴

- For this reason, nasal spreading should be excluded from suffixes and confined to the root or stem.
- This effect is governed by the relative ranking of similar licensing constraints:⁵
 - LICENSE([+nasal]_v, μ): [+nasal] in a nucleus must be associated with a mora
 - LICENSE([+nasal]_κ, μ): [+nasal] in a coda must be associated with a mora
 - LICENSE([+nasal]_μ, σ): [+nasal] in a mora must be associated with a syllable
 - LICENSE([+nasal]_ó, ω): [+nasal] in a stressed syllable must be associated with a root/stem
 - LICENSE([+nasal]_o, μ): [+nasal] in an onset must be associated with a mora
- Of our previous constraints, only SPREAD-L(+nasal) need be jettisoned.
- LICENSE([+nasal]_v, μ) and LICENSE([+nasal]_κ, μ) are equally ranked as codas and nuclei seem to behave alike, coming in between IDENT(son) and IDENT(nas).
- LICENSE([+nasal]_μ, σ) and LICENSE([+nasal]_ó, ω) are also ranked higher than IDENT(nas) but lower than the two constraints directly above, with the former being ranked higher than the latter.
- Thus the new constraint ranking is:
 - NOGAP, *NASP » ID(son) » LIC(v,μ), LIC(κ,μ) » LIC(ó,ω) » ID(nas) » *NASL » *NASSV » *NASV
- This not only maintains our correct predictions for spreading from the rhyme of stressed syllable:

⁴The second vowel in /akaŋ/ can be shown to be underlyingly oral rather than nasal elsewhere in the language by the morphologically-induced deletion of the nasal coda and subsequent lack of nasal vowel (Seki 2000:428).

⁵I have used κ for coda, ν for nucleus, o for onset, μ for mora and ω for root/stem (rather than word, as is usual).

	/kujã/	NOGAP	*NASP	IDENT(son)	LIC(v,μ)	LIC(k,μ)	LIC(μ,σ)	LIC(ó,ω)	IDENT(nas)	*NASL	*NASSV	*NASV
(11)	kujã				*!							*
	kujã̃							*!	*			*
	☞ kujã̃								**			**
	kũjã	*!					*		*			**
	kũjã̃		*!						***			**
	ɲũjã̃			*!					***			**

	/akaŋ/	NOGAP	*NASP	IDENT(son)	LIC(v,μ)	LIC(k,μ)	LIC(μ,σ)	LIC(ó,ω)	IDENT(nas)	*NASL	*NASSV	*NASV
(12)	akaŋ					*!						
	akak			*!					*			
	☞ akãŋ						*		*			*
	ãkãŋ	*!							**			**
	ãkãŋ̃		*!						***			**
	ãŋãŋ̃			*!					***			**

- But also correctly prevents nasal onsets from spreading nasality:

	/eŋe/	NOGAP	*NASP	IDENT(son)	LIC(v,μ)	LIC(k,μ)	LIC(μ,σ)	LIC(ó,ω)	IDENT(nas)	*NASL	*NASSV	*NASV
(13)	☞ eŋe											
	ẽŋe								*!			*
	eŋe			*!					*			

- This must also mean that if LICENSE([+nasal]_o, μ) were to be included in the above ranking, it would be somewhere below IDENT(nas).
- Finally, this also solves another problem with SPREAD-L(+nasal) in the case of Kamaiurá: the nasalisation of codas by nuclei, as in /ha'ʔij/ → [hã'ʔij̃] and /we'ʔij/ → [wẽ'ʔij̃] in (1).
- This approach is not entirely dissimilar to Piggott & Hulst's (1997) analysis of nasal harmony in Barasano (Tucanoan; Colombia), in which spreading appears to target sonorants but skip obstruents.
- Piggott & Hulst (1997) propose that the [+nasal] feature is associated with syllable heads and spread locally from syllable to syllable, with nasality being realised on the syllable head, i.e. the nucleus (with a separate process then spreading nasality from nuclei to appropriate onsets).
- However, applying this directly to Kamaiurá would incorrectly predict that the plosives would not impede spreading.

5 Remaining problems and other thoughts

- In feature spreading processes, eligible segments are usually defined in terms of features rather than syllabic positions; the licensing account proposed above effectively combines the two.
- Is this a valid use of licensing constraints?
- Does this truly capture the pattern in Kamaiurá?
- Directionality: is nasal harmony actually truly regressive than just epiphenomenally regressive? Cf. The two separate processes Piggott & Hulst (1997) propose for Barasano: one spreading from syllable to syllable and another from nucleus to onset.
- How might I refine/deal with the (potential) problem of affixes and the concept of the root/stem being the domain of harmony?
- Why should nuclei and codas be treated equally when onsets and morae are not? Is onset a stronger position than rhyme?
- Additionally, according to Seki's (2000) transcription, /eem/ 'saia!' is realised as [heẽm]. Is this a mistake or can empty onset blocks nasality?

6 Summary and conclusions

- I hope to have convinced you that the data from Kamaiurá are at least interesting.
- I have shown that, in terms of transparency and opacity, Kamaiurá is broadly in accord with the current typology but with an unusual twist, namely the problem of onsets.
- I have demonstrated that the pattern as it appears to be poses analytical problems for certain theories of harmony.
- I also hope to have provided you with the beginnings of a solution to the problem.

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