GRADIENT VERSIONS OF PRE-, POST-, AND CIRCUM-ORALIZED CONSONANTS IN KAINGANG (BRASIL)

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ABSTRACT

Nasal consonants that display voiced stop 'phases' or 'contours' while forming syllables with oral vowels do not constitute a surprising fact for phoneticians and phonologists. The Kaingang language, however, adds complexity to that pattern in that it produces, with equal ease, voiced stop contours at both 'edges' of nasal consonants, when these are preceded and followed by oral vowels, as in the following example:

ti moŋ = [tiˈ b͡mbo͡jɟɲˤ] (*his ox*)

We have interpreted the process that creates such 'contours' as partial 'oralizations' of nasal consonants, through spreading of features present in the oral vowels. Instrumental analyses of those phonetic realizations reveal, however, a characteristic that poses difficulties for current models in phonology: the gradient character of the oralized 'phase' in syllable boundaries. We suggest that a gestural representation can provide a better interpretation of the facts, but we also point out the limitations of current gestural models.

1. INTRODUCTION

Kaingang is a Brazilian indigenous language of the Jê linguistic family, spoken by about 20,000 people that inhabit several discontiguous areas scattered throughout Southern Brazil (São Paulo, Paraná, Santa Catarina and Rio Grande do Sul). The main studies published about this language are those of Floriana [1,2], Guérios [3] and Wiesemann [4].[1]

The phonological inventory of the language, according to our analysis, consists of the following:

Obstruents:	p t k ʔ f ʃ h
Sonorants:	m n ɲ ŋ w ɾ j
Oral vowels:	i e ɛ ɨ ɐ a u o ɔ
Nasal vowels:	ĩ ɛ̃ ɐ̃ ũ ɔ̃

Conducting research on a Kaingang dialect of Paraná, Wiesemann [5] was the first to point out the occurrence of circum-oralized 'allophones' such as [bmb] for the series of "nasal phonemes" (nasal sonorants, in the table above), whenever occurring between two oral vowels. In a later work, Wiesemann [4] restated the context for the occurrence of the circum-oralized 'allophones' of those consonants (which she now called "lenis stops") as one where the consonant was preceded by an oral vowel belonging to the previous syllable, and followed by an oral vowel or by [ɾ] plus an oral vowel. An example taken from Wiesemann (p. 58):

[ŋgři.gŋgře] = 'tanzen' (*to dance*)

Her analysis treated these facts, consistently present in the dialect she studied, as categorical allophonic alternations.

2. PHONETIC FACTS

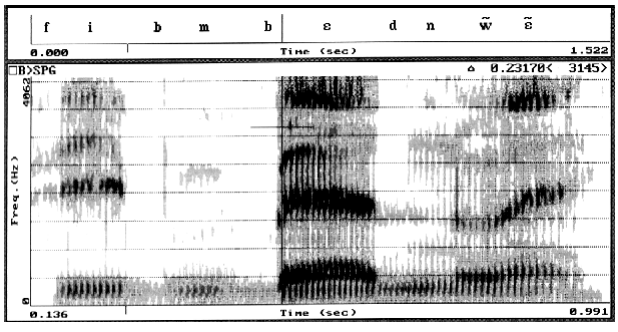
Our initial ear-phonetic studies of the Kaingang dialect spoken in the Xapecó indigenous area (Santa Catarina) showed that, in that dialect, the occurrence of circum-oralized stops was very infrequent, since oralized 'contours' seldom occurred in syllable boundaries, to the left of the nasal sonorant. Thus, in examples such as the one given in the abstract above, the most common audible realization in the Xapecó dialect is:

ti moŋ = [tiˈ m͡bo͡jɟɲˤ] ,

in which the realization of the oral 'contour' internal to the syllable appeared otherwise obligatory and consistent. In the framework of current phonological models, oralization in syllable boundaries needed to receive an optionality mark.

When however instrumental acoustic research of the speech of two native speakers was conducted at LAFAPE-Unicamp the data revealed a complex gradience in the phonetic realization of circum-oralized stops. We have confirmed, in many pieces of data, the non-existence of traces of an oralized 'contour' to the left of the nasal sonorant in syllable boundaries. We confirmed, as well, in several pieces of data, the possibility of occurrence of fully realized and audible circum-oralized stops. We have discovered, however, that in most of the utterances, an oralized 'phase' did appear in syllable boundaries, though with a very short duration, visible on the spectrogram, yet inaudible. These data, despite confirming the auditive perception of a dialectal pattern without circum-oralized stops (since audible occurrences were infrequent), revealed a picture that is much more complex than that suggested by the ear-based transcription.

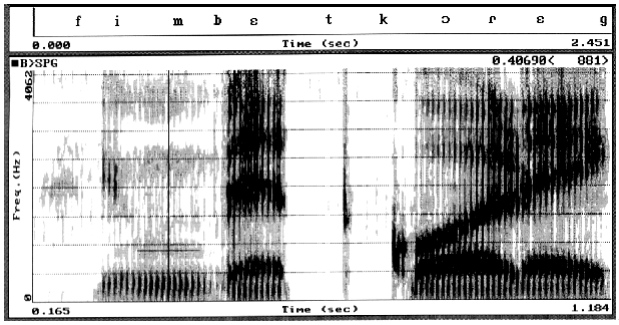
Ten different utterances that include the phrase "her husband" = / fi + mɛn / constitute a case in point. Here is one of the occurrences with a fully realized circum-oralized stop was, [fiˈb͡mbɛd͡nw̃ɛ̃] (speaker FLJ, tape 01-B/246) [Spectrogram 1]:



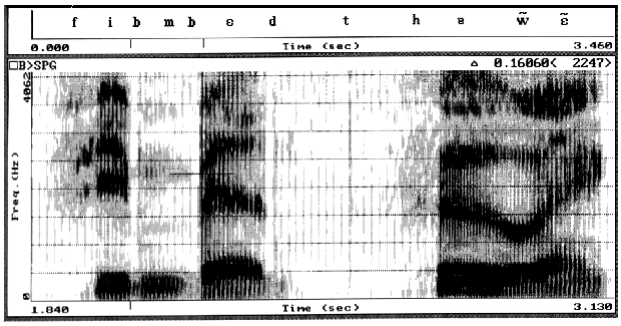
Spectrogram 1: / fi + mɛn + wɛ̃ / = *her husband* [2]

A sample utterance with the same noun phrase, in which one does not find any traces of denasalization on the left margin of the nasal consonant (even while, on the consonant's right side, the process is very clear), can be found in [fim͡bɛtkɔˈɾɛgˤ] = "her ugly

husband" (speaker JMPF, tape 02-A/392-3) [Spectrogram 2].[3] In the utterances that displayed denasalization also on the left margin of the consonant, the duration of the denasalized phase [b] varied between 20 and 61 ms. An example lies in [fib͡mb͡ɛdtʰhə̃ɛ̃] = "her good husband" (speaker FLJ, tape 02-B/78-9) [Spectrogram 3], in which the [b] phase on the left side lasts 23 ms.



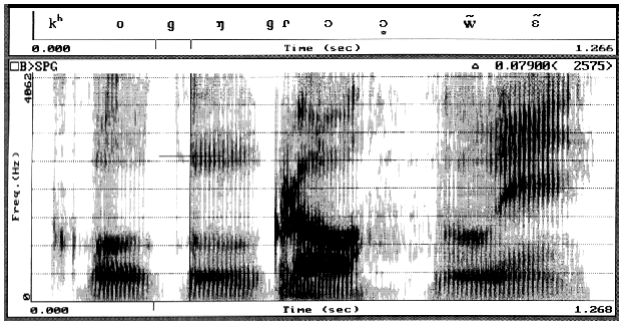
Spectrogram 2: / fi + mɛn + kɔɾɛg / = *her ugly husband*



Spectrogram 3: / fi + mɛn + hɐ + wɛ̃ / = *her good husband*

Circum-oralized realizations can be observed for all places of articulation of the series of nasal sonorants (for instance, for the velar nasal, see Spectrogram 4 - speaker JMPF, tape 02-A/51). For all such places, realizations with oralized contours on the left of the nasal sonorant alternate with realizations of the same words without the implementation of the oralized 'phase'.

Note as well that, in identical contexts, realizations of the same nasal sonorant occur with equal frequency either with a denasalized 'phase' on the left, or with a 'phase' of 'silence' in the same position, as in [ŋ͡gad͡ndoɾ] = "hole in the ground" x [ka∅͡ndoɾ] = "hole in the wood" (speaker JMPF, tape 03-A/307).



Spectrogram 4: / koŋɾɔ + wɛ̃ / = *Brazilian pine forest*

3. POSSIBLE VIEWS IN CURRENT PHONOLOGICAL THEORY

In a recent doctoral dissertation [6], we have discussed the great difficulties of current phonological models in dealing with these facts, which are common to a great number of languages of the Jê family and are present in other related languages. In the specific case of the Kaingang language, we have shown that *ad hoc* treatments could not be avoided adopting the current feature geometry configurations (from Clements 1985 to Clements & Hume 1995), simply because, in such geometries, there is no direct relationship among the features [nasal], [voice] and [sonorant]. We have, at the same time, pointed out the extremely powerful (uncontrolled and arbitrary) character of redundancy rules with which 'phonological' solutions are adjusted to whichever difficulties arise from the empirical data.[4]

We have noted, however, the possibility of a more adequate interpretation of the Kaingang facts in Autosegmental Phonology, once one adopts Piggott's proposal [8] - or, at least, its basic intuition - that Nasal can be located, depending on the particular grammar of each language, under different class nodes or features. According to the author, the feature [nasal] can be located either under a *Soft Palate* (SP) node, or under a *Spontaneous Voicing* (SV) node.[5] These two possibilities allow us to interpret more adequately the different forms of nasal harmony in different languages. In the first case, we have languages that 'select' the **oral x nasal** opposition as phonologically relevant. In the case of languages in which the feature [nasal] is under a *Spontaneous Voicing* node, the phonologically relevant opposition is **sonorant x obstruent**. We point, nevertheless, to persisting difficulties, and we hold that, under *Spontaneous Voicing*, nasality is a resource for phonetic implementation, rather than a phonological feature.

Adopting a 'geometrical' feature configuration that incorporates Piggott's basic intuition, with the necessary adaptations, we represent Kaingang as a language that underlyingly distinguishes [6]:

Obstruents:	specified for SP and not specified for SV
Sonorants:	specified for SV and not specified for SP
Oral vowels:	specified for SV and for SP
Nasal vowels:	specified for SV, for SP and for Nasal

The gain afforded by such an analysis is to identify elements, in the representation of the segment's own internal structure, which guarantee the prevalence of the opposition **sonorant x obstruent**, and confirm the implementation of nasality as a phonetic resource.

Summing up: nasality is a feature central to the opposition among vowels in Kaingang, but, in the consonants, it is merely a phonetic resource for the implementation of spontaneous voicing in segments with an oral obstruction.

The above description of the underlying representation of the components of the phonological system allows us to interpret in a unified manner two apparently distinct processes: the process that creates oral contours in nasal sonorants when contiguous with oral vowels, and the process of partial or total de-sonorantization of nasal sonorants followed by voiceless obstruents (examples of the latter process can be seen in Spectrograms 2 and 3). In both cases, what happens, according this unified interpretation, is the spreading of the node SP to those adjacent elements which are not specified for it. In practice, this implies the spreading of the node SP from vowels to contiguous consonants which are not specified for that node. The vowels' contrastive nasality (as a privative feature) is placed under SP in such away that, when we are dealing with nasal vowels, the spreading of SP with a [nasal] specification

to a nasal sonorant does not make any alterations, since the sonorant is already nasalized. When one deals with oral vowels, however, the spreading of the SP node without nasality specification, leads to the implementation of the default value [-nas]: a Kaingang consonant with an oral tract obstruction, once the nasal tract is blocked, has no means of being voiced, and so becomes voiceless.

4. A GESTURAL APPROACH?

We have suggested the position that partial denasalization at the 'edges' of the nasal sonorant constitutes a resource of the language to preserve the phonological difference between oral and nasal vowels. See, for example, the existence of pairs such as:

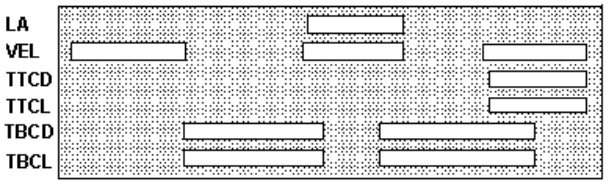
/ mɐ̃ŋ/ = 'honey' x / mɐŋ/ = 'great'

[ˈmɐ̃ŋ] x [ˈm͡bɐg͡ŋ̊]

What the data show, however, is that this important mechanism cannot be taken as categorical.

Despite the fact that the proposed autosegmental analysis describes and, to a certain extent, explains the occurrences of circum-oralized stops in Jê languages, it seems to have no means of explaining the non occurrence of circum-oralized stops in many utterances. That is, the model based on segments whose features and class nodes are hierarchically organized, despite being much less rigid than previous linear phonology models, preserves a fundamental linearity under the guise of a nonlinear theory. This rigidity prevents these models from analysing situations, such as those described here, in which gradience is observed.

The possibility of analysing such facts in the light of a model based on *gestures*, such as that of Articulatory Phonology [10,11], was also explored [6]. We showed, thus, that, if contiguous to oral vowels, the nasal sonorant creates denasalized 'contours', but that, while being obligatory on the margin contiguous to the tautosyllabic vowel (that is, the syllable internal margin), this process appears as optional and gradient at the external edge of the syllable. In fact, we could summarize what occurs at the external edge of the syllable as a gradience, which has in one of its endpoints the zero realization (∅). A gestural score corresponding to [fiˈb͡mb͡ɛd͡n] would be [6]:



We conclude, then: *"if it is easy for Articulatory Phonology to justify that gradience - and, even, the extreme case of non-occurrence of the pre-oralized phase - this is due to alterations in the gesture overlap pattern (...) caused by differences in speech rate or by idiosyncratic differences among speakers, it does not seem as easy to explain the difference between the situations leading to optionality or obligatoriness"* (p. 334). We advance, then, that a solution could be sought for in the cases where *"the model constructs an adequate representation of the relations among syllables and other suprasegmental constituents"* (idem). Articulatory Phonology is not, however, exempt from criticism: the interpretation of pre-, post- and circum-oralized stops in languages such as Kaingang as a matter of "choice" of individual grammars as to the way to phase two or three different *gestures* gives the model a great descriptive power, but undermines its explanatory capacity. In addition, we point out that such power obscures the differentiation of *"processes conditioned exclusively by limitations of a purely mechanical nature (such as persistent nasalization) from those that are actually selected by the phonological system (that is, linguistically motivated), such as the process that, in Kaingang, preserves (and strengthens) the oral/nasal distinction in vowels by altering contiguous consonants"* (p. 335).

5.TOWARDS A REVISION OF THE MODELS

It cannot be said that the processes attested in Kaingang are the crucial facts to determine the adequacy or success of a phonological theory or model. The Kaingang facts are nevertheless part of an important array of empirical data that still await a better treatment in the domain of a phonological theory that may articulate more explicitly its relationship to phonetics. What data discussed here allow us to say is that the two most probable explanations of the facts, eventually not mutually exclusive, are:

(a) Kaingang endeavours to guarantee the phonological distinction between oral and nasal vowels, denasalizing the boundary of nasal sonorants and oral vowels. In the domain of the syllable, something happens that makes this process obligatory. In syllable boundaries, something seems to make the same process occur optionally (in fact, as we have seen, in a gradient that goes from zero to a fully audible realization, passing through several inaudible realizations). It has to be noted, however, that in syllable or morpheme boundaries, even when the speaker utters a syllable final oral vowel contiguous to a nasal sonorant without partial denasalization of the sonorant, some mechanism intervenes so that nasality does not reach the oral vowel even partially. In the same way, in certain utterances, a silence takes the place of the denasalized phase, creating a 'barrier' between the oral vowel and the nasal sonorant of the following syllable.

(b) Kaingang implements spontaneous voicing in consonants with oral obstruction through the phonetic resource of lowering the soft palate, producing a series of nasal sonorants. The different forms of interaction and overlap among the *gestures* of oral obstruction and raising and lowering of the velum create oralized contours at both edges of the sonorant (and, in certain contexts, desonorantization to the right).

6. CONCLUSION

An interpretation such as that given in 5-a, which focuses the phonological relevance of the process of creation of oralized contours in nasal sonorants may suggest that, instead of feature spreading (optional in one type of boundary, obligatory in the other), or of merely gestural targets, the speaker would aim at auditive/articulatory targets. Once the goal of the anticipated partial denasalization of the nasal sonorant, which is the preservation of the oral quality of non-nasal vowels (and, with this, of the phonological contrast they convey), is attained, Kaingang can have a brief closure, or can substitute previous denasalization of the nasal sonorant by a pause. Or it can, in the

limit, even begin the emission of the nasal sonorant immediately contiguous to the vowel.

The great challenge to approach 5-a is to explain how the Kaingang speaker judges to have reached his/her (acoustic? articulatory?) target so that it allows him/her to drastically reduce the denasalized contour of sonorants followed by oral vowels or even to omit it (that is, how he/she can produce the observed gradience). By the same tokens what leads the speaker to always preserve partial denasalization inside the domain of the syllable will have to be explained.[7]

On the other hand, as we outlined in 5-b, an analysis that adopts Piggott's intuition that the feature [nasal] can be allocated in alternative positions in the feature geometry, remits the observed facts to a phonetic interpretation that needs a dynamic model to account for the gradience that we underscore here. Nevertheless, given the apparently categorical nature of the realization of oralized contours in the inner edge of the syllable, such a model will necessarily have to be able to formally express the observed greater 'affinity' or 'cohesion' between the consonant and the homosyllabic vowel.

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NOTES

1 Works by Henry (1935, 1948) that use the expressions *"Kaingang language"* and *"Kaingang text"* refer, in fact, to a indigenous people (and language) related to Kaingang, which has received, in Brazilian anthropological (and linguistic) literature, the name Xokleng.

2 The particle / wɛ̃ / is a demonstrative in Kaingang, so that the expression / fi mɛn wɛ̃ / can be translated as "this is her husband". In the Spectrogram 4, / koŋɾɔ wɛ̃ /, we should translate as "that is a Brazilian pine forest" .

3 In this utterance, [t] corresponds to the denasalized phase that, because of its contiguity with the voiceless stop [k], also devoices.

4 We have also evaluated Steriade 1993's [7] suggestion, according to which the possibility of intra-segmental contours is controlled by the number of aperture positions in a segment, such that stops, including pre-nasalized ones, would consist of a double root node. Among the many difficulties with this suggestion, it is crucial that it makes it impossible to represent post-nasalized and circum-oralized segments.

5 The existence of a *Spontaneous Voicing* feature is also defended by Rice 1993 [9].

6 The *gestures* represented by capital letters are (according Browman & Goldstein 1992:157 [11]):

LA = lip aperture
VEL = velic aperture
TTCD = tongue tip constrict degree
TTCL = tongue tip constrict location
TBCD = tongue body constrict degree
TBCL = tongue body constrict location

7 To account for the internal "solidarity" of syllables in Autosegmental Phonology, we have postulated that, in that domain, vowels and sonorant consonants share a single SV node (by the effect of the OCP). If we adopt or come to construct a phonological theory different from current versions, it should be able to justify, for any language, this 'solidary' cohesion that makes the syllable a notion easily apprehended by any illiterate speaker in his/her own linguistic variety.

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