Some facts about Brazilian Portuguese nasal vowels

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In the last 40 years, different phonological interpretations agreed that in Brazilian Portuguese (henceforth BP) **contrastive** nasal vowels [iːĩ, eːẽ, aːɜ̃, oːõ, uːũ] should be considered as a tautosyllabic VN sequence, e.g. in *lá* [la] 'there' versus *lã* [lɜ̃] 'wool' or *mudo* ['mudʊ] 'dumb' versus *mundo* ['mũdʊ] 'world'. Nasality would spread leftwards from an underlying N, as it does in **allophonic** vowel nasalization due to a subsequent heterosyllabic nasal consonant, which is mandatory in stressed position or derived words (e.g. *cama* [kɜ̃'mɐ] 'bed', *cama+inha* [kɜ̃'mĩɲɐ] 'little bed') and optional otherwise (*caminha* [kɜ̃'mĩɲɐ~ka'mĩɲɐ] 's/he walks'). Underlying N is deleted after [+nasal] spreading except when followed by a plosive, when it sometimes inserts an audible homorganic nasal consonant. Wetzels (1997) has also specifically proposed that N deletion triggers the association of its free mora to the vowel, thus originating compensatory lengthening.

We present two studies dedicated to further investigate those facts at the Laboratório de Fonética (FALE-UFMG). First, acoustic data from a study designed to tap vowel duration investigated the hypothesis of vowel lengthening (Valentim 2009). The moraic interpretation implies that distinctive nasal vowels would be not only longer than oral but also longer than allophonic nasal vowels, since these last underwent no subjacent lengthening. Otherwise, if the cause to increasing vowel duration could be phonetically attributed to velum opening, then no big difference should be found between distinctive and allophonic nasal vowels. Subjects (n=15) repeated a series of words in carrier phrases, where nasality, vowel height and following C was manipulated. A linear model showed that the resulting picture is far more interesting. All three factors are independently important, and oral, distinctive and allophonic nasal vowels have a separate profile.

Second, an aerodynamic study (Medeiros 2009) was dedicated to investigate further the proposition that BP distinctive nasal vowels are completely nasal, since [+nasal] spreads underlyingly *before* phonetic implementation – and no nasal would be heard whatsoever. But facts are quite different. Sousa (1994) has shown that in contrastive nasal vowels three different parts can be clearly distinguished through acoustic analyses: an oral, an intermediate and a nasal portion.

Albano (1999) proposes an explanation to the phenomenon based on Gestural Phonology (GP) – at that time known as Articulatory Phonology – according to which in BP nasal vowels a velum opening gesture in coda position is not aligned to the vocalic gesture. It explains both the acoustic facts and the nasal murmur: If there is a following oral closure, the superposition of velar and consonantal gestures may be heard as an homorganic murmur. Speech samples (N=5) were then recorded by means of the pneumotachograph EVA (*Evaluation Vocale Assisté,* SQLab, France). No statistical analyses were pursued due to sample size. We replicated previous observations that (1) high vowels tend to be more intensely nasalized; (2) nasal vowels are longer than their corresponding oral counterparts; and (3) there are three clearly observable stages in nasal vowel production: a completely oral phase with no nasal air flow, a transient phase where nasal air flow begins to increase and a final phase after the peak of maximum air flow which tend to occur after oral closure. By plotting the duration of velum opening movement as a proportion of vowel length – a strategy for comparing two articulatory gestures in five vowels by different speakers – we see that in high vowels the oral portion is very short (~20%) while in [ɜ̃] it takes twice as long (Fig.1). In allophonic [ɜ̃] velum opening occurs earlier, while the oral portion is longer in the tautosyllabic sequence [ɜ̃s] (Fig.2). The results should be taken carefully, but they clearly suggest that there is the unentrained coordination between the oral articulator and the velum.

References:

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Fig.1

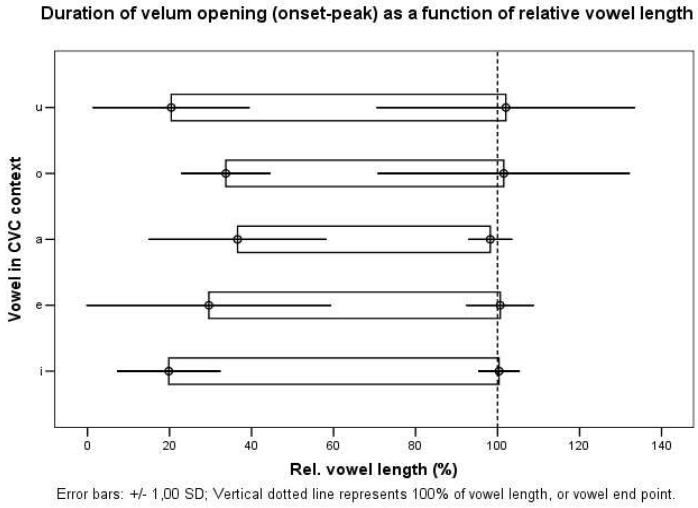
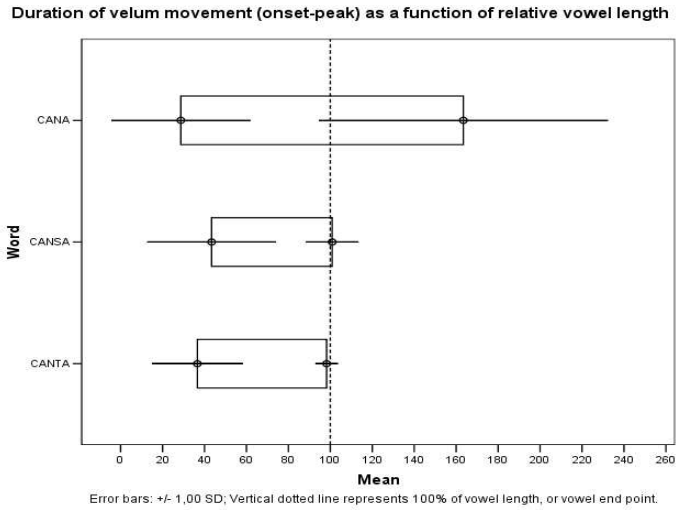

Duration of velum opening (onset-peak) as a function of relative vowel length
Vowel in CVC context
u
o
a
e
i
0
20
40
60
80
100
120
140
Rel. vowel length (%)
Error bars: +/- 1,00 SD; Vertical dotted line represents 100% of vowel length, or vowel end point.

Fig.2


Duration of velum movement (onset-peak) as a function of relative vowel length
Word
CANA
CANSA
CANTA
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Mean
Error bars: +/- 1,00 SD; Vertical dotted line represents 100% of vowel length, or vowel end point.