An Acoustic Analysis of the Vowels of Mebêngôkre and Panará

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Introduction

About Mebêngôkre and Panará

- Languages of the Jê family
- Number of speakers in 2010 (Povos Indígenas no Brasil, 2014):
  - Mebêngôkre: **10,456**
  - Panará: **437**
- Both spoken in the Brazilian Amazon

Research questions

1. Where are each one of the vowels of Mebêngôkre and Panará situated within the acoustic space?
2. Can a theory of Dispersion account for the organization of the vowels of Mebêngôkre and Panará?

Vowel inventories

Mebêngôkre (17)

Oral (10)			Nasal (7)		
i	ɨ	u	ĩ	ɨ̃	ũ
e	ɘ	o	ẽ		õ
ɛ	ʌ	ɔ		ʌ̃	
	a			ã	

Adapted from Salanova & Reis Silva, 2010; Salanova, 2001; Stout & Thompson, 1974

Panará (15)

Oral (9)			Nasal (6)		
i	ɨ	u	ĩ	ɨ̃	ũ
e	ə	o	ẽ	ã	õ
ɛ	a	ɔ			

Adapted from Dourado, 2001

Data collection

Participants

- 12 male speakers of Mebêngôkre
  - Village of Djudjêkô
  - Aged between 18 and 47 years (mean=29)
- 12 male speakers of Panará
  - Village of Nãsepotiti
  - Aged between 22 and 45 years (mean=31)

Materials

- 5 practice items
- Carrier phrase
  - Mebêngôkre: "Ba [X] bit jarẽ"
  - Panará: "Ĩkjẽ hẽ ka sũ [X]"
  - Translation: "I say the word [X]"
- One target word for each vowel phoneme
  - Monosyllabic
  - CV (C is a bilabial stop)

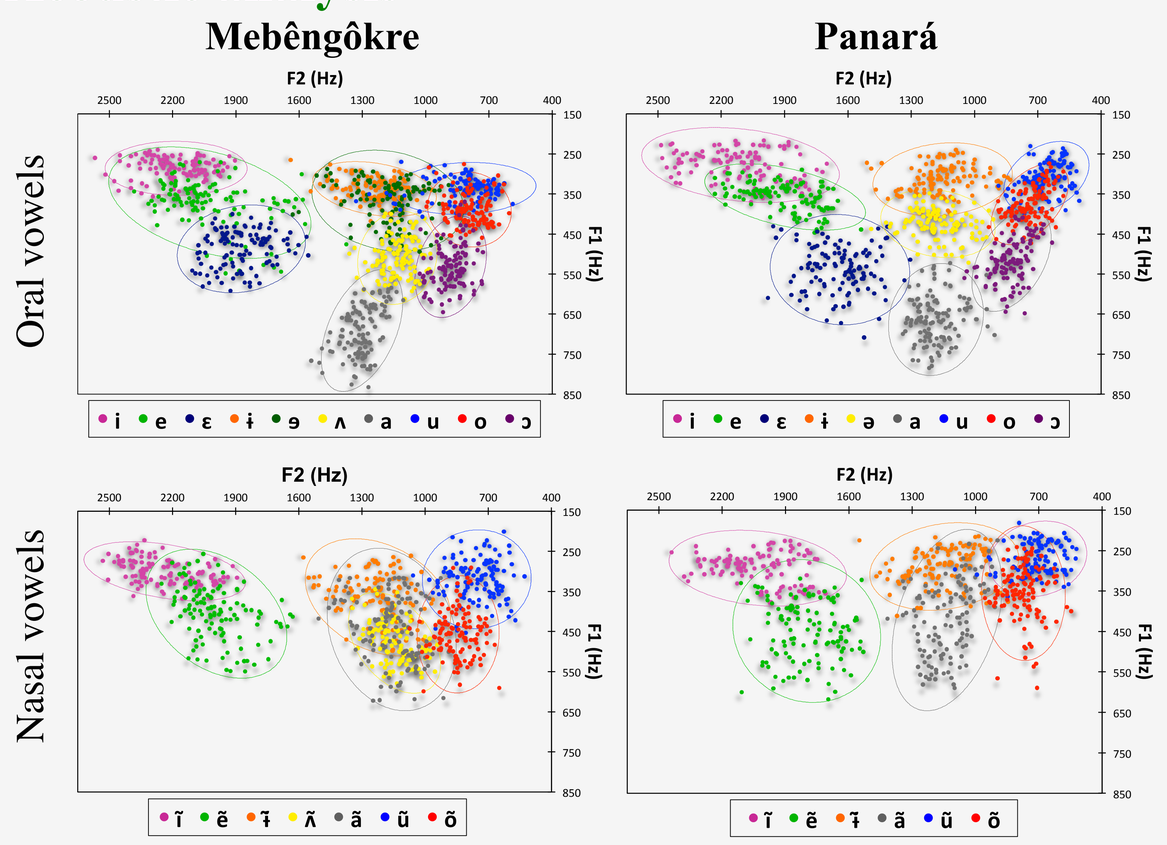
Procedure

- Target word presented with a picture on a computer screen inside a carrier sentence
- Words presented in semi-randomized order
- Each target word repeated 10X

Corpus

- Total of 3826 vowel tokens
  - Mebêngôkre: **2027**
  - Panará: **1799**

Acoustic analysis



Dispersion theories

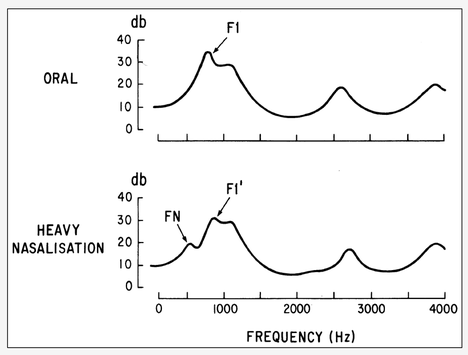
- Predict the dispersion of sounds within the acoustic space, such that contrastive sounds are maximally distinct.
  - **The theory of adaptive dispersion** (Lindblom, 1972, 1990)
  - **The dispersion-focalization theory of vowel systems** (Schwartz et al., 1997a)
  - **The dispersion theory of contrast** (Flemming, 1996, 2004, 2006, among others)

Testing the predictions:

	Mebêngôkre	Panará
Oral vowels	✔	✔
Nasal vowels	✖ Low vowels absent	✖ Low vowels absent

Why does this happen?

- Nasal formants are introduced in the acoustic signal when the oral and nasal cavities are coupled.
  - FN1 is generally found around 400-500 Hz.
- FN1 and F1 are perceptually merged by listeners.
  - The center of gravity is reanalyzed.
  - Low vowels are raised.
  - High vowels are lowered.
  - Overall reduction of the acoustic space in the F1 dimension for nasal vowels.



Spectra for [ɑ] and [ɑ̃], from Beddor et al. 1986

Discussion

- Although Mebêngôkre is said to have an additional nasal vowel ([ã]), this vowel is **merged** with the mid central nasal vowel ([ʌ̃]).
  - Mebêngôkre and Panará show the same organization for nasal vowels.
- Panará has only 3 central oral vowels (as opposed to 4 in Mebêngôkre), suggesting that its mid high ([ɘ]) and mid low ([ʌ]) vowels may have **merged** ([ə]).
  - Panará's mid central vowel ([ə]) is distributed over the same acoustic space as Mebêngôkre's mid high ([ɘ]) and mid low ([ʌ]) central vowels.
- Nasal and oral vowels are analyzed separately.
  - The forces constraining the organization of the two types of systems are different.
  - The separate analysis is generally accepted in the literature (Schwartz et al., 1997b).
- The perceptual process by which the acoustic space of nasal vowels is reduced is **well attested in the literature** (Beddor et al., 1986; Beddor, 1993; Maedda, 1993, among others).
- Our knowledge of the way in which nasal vowel inventories are organized remains **unintegrated into phonological theories of vowel systems** (see Beddor, 1991).

Proposal

- The acoustic space for nasal vowels is inherently smaller along the F1 dimension than for oral vowels.
  - Dispersion applies normally for nasal vowels.
  - The reduced size of nasal vowel inventories (Kingston 2007) is a natural consequence of the contracted acoustic space.

Future directions

- According to recent fieldwork data, all vowel qualities in Panará are contrastive in length.
- A way to predict the direction of the shift in the height of nasal vowels.
- A way to predict the degree to which the acoustic space for nasal vowels is reduced.

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