

1 Introduction

EP /l/ has been traditionally described as having two contextually determined allophones:

- **non-velarized allophone** ("clear") in syllable onset
- **velarized allophone** ("dark") in coda position.

The production of dark /l/ involves greater **tongue dorsum retraction towards the uvular region or the pharyngeal wall** than clear /l/

Acoustically, these differences yield a relatively **high F2 for clear /l/** and a **lower F2 for dark /l/**

Goal

Investigate whether there are systematic differences in velarization of /l/ as function of syllabic position and dialect

3 Audio Acquisition

Recordings were performed in a **sound-treated room (Aveiro)** and in **quiet spaces (Porto and Bragança)**

Condenser microphone connected to an **external 24-bit sound system**

Sampling rate of **22 kHz**

5 Acoustic Measures

F1 and F2 values were computed at the mid-point of the liquid, using **Burg algorithm** (as implemented in Praat)

Two acoustic measures were taken as indicative of the degree of /l/ velarization:

- (a) F2 frequency
- (b) distance between F2 and F1 (F2-F1)

2 Corpus

30 EP speakers (10 from Porto, 11 from Bragança, 16 from Aveiro) with ages ranging from 18 to 28

Short meaningful expressions (e.g. "laca de cabelo" "hair spray"), where /l/ occupies simple and complex onsets and coda positions

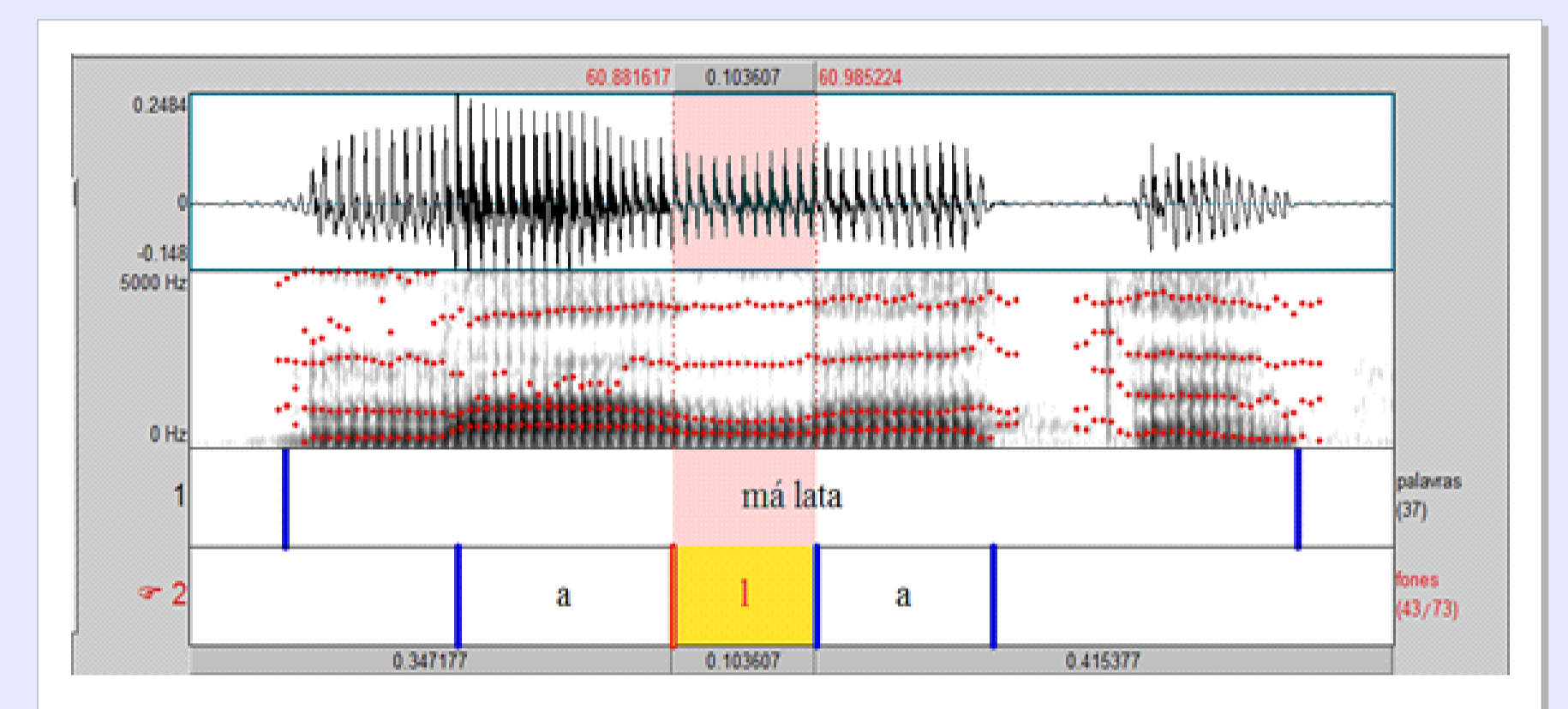
Lateral consonant was flanked by **vowels /a/, /i/, /u/**

	Ataque Simples	Ataque Ramificado	Coda (Final de Palavra)
/a/	laca de cabelo	a placa de madeira	pão com sal
/i/	litro de água	a plica da palavra	palavra com til
/u/	lupa preta	a pluma branca	mar do sul

Each stimulus was repeated **three times**

4 Audio Annotation

Each lateral consonant was **manually segmented and labeled** by using the program Praat



Segmentation of "má lata" (poor can) in Praat

6 Statistical Analysis

A three-way ANOVA was carried out:

- **word position and vowel context** as **within-subject factors**
- **dialect** as a **between-subject factor**

Level of significance was **p<0.05**

7 Results

		F2 (Hz)	F2-F1 (Hz)
Syllable Position	Onset	972,9±117,6	602,3±93,2
	Complex Onset	982,0±99,9	589,5±97,5
	Coda	1006,6±171,5	652,6±187,0
Vowel Context	/a/	987,2±128,6	553,9±110,1
	/i/	1067,5±131,9	702,4±105,1
	/u/	905,2±135,7	588,1±136,1
Dialect	Bragança	1022,8±91,4	641,9±73,2
	Porto	966,8±91,4	590,1±73,2
	Aveiro	970,2±91,4	612,4±73,2

Conclusions

F2 values were always **below the splitting boundary** which separates clear from dark /l/ (1300–1400 Hz in the /i/ context and roughly at 1000 Hz in the /a/ context) → Recasens (2012)

- **Narrowing** of the vocal tract at the **velar and/or pharyngeal** regions
- **Raising and/or retraction of the posterior tongue body** (Oliveira et al. 2011)

Trend to strongly dark realization of /l/ across all country (cf. Andrade 1999)

Differences in F2 and F2-F1 of /l/ due to **vocalic context** (coarticulation)

Further Work

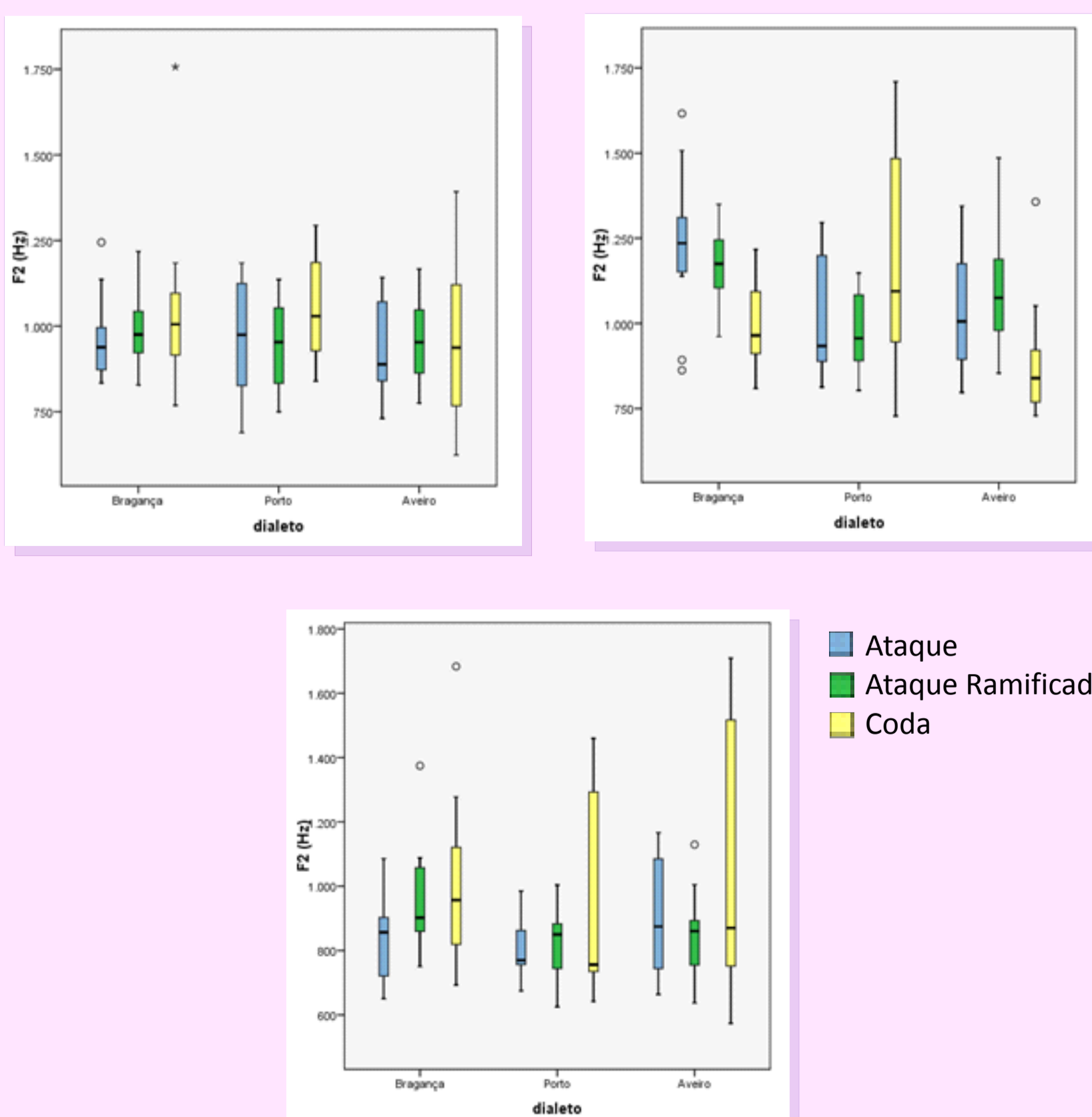
- Acquire data from more regions/dialects
- Increase the number of speakers per dialect

8 F2

Syllable position (F(1,4;44,6)=0,9; p=0,398) and **dialect** (F(2;31)=2,6; p=0,3) were not statistically significant

Vowel context (F(1,6;48,6)=16,9) was statistically significant (p<0.05)

- /i/ (1068 Hz) > /a/ (987 Hz) > /u/ (905 Hz)
- /i/ and /a/ ≠ /u/ (Bonferroni multiple comparisons)

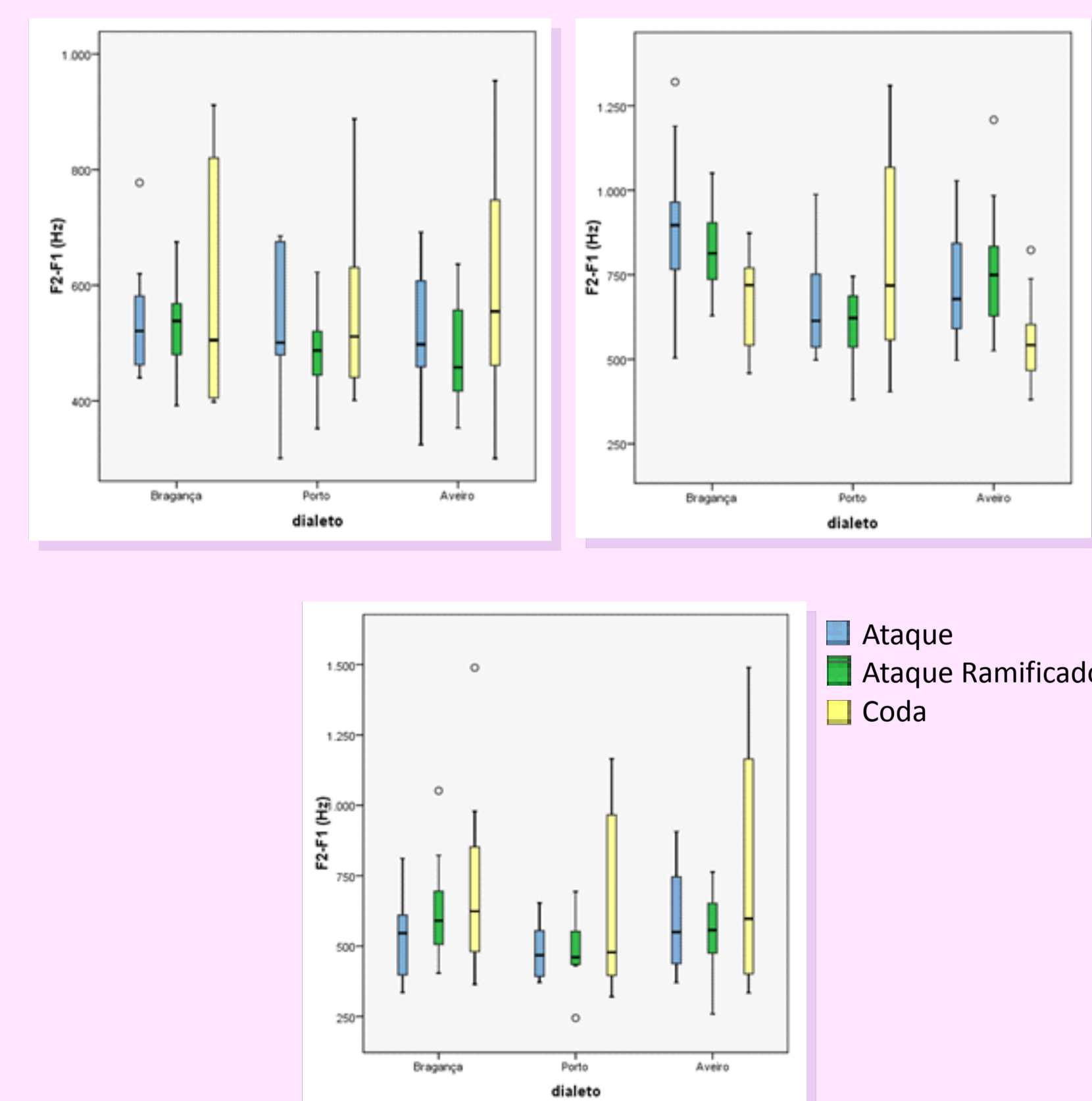


F2 (Hz) for the vowels /a/ (top left), /i/ (top right) and /u/ (down) in different syllabic positions for the different dialects

9 F2 - F1

Only **vowel context** (F(1,7;47,9)=15,0) was statistically significant (p<0.001)

- /i/ (702 Hz) > /u/ (588 Hz) > /a/ (554 Hz)
- /a/ and /u/ ≠ /i/ (Bonferroni multiple comparisons)



F2-F1 (Hz) for the vowels /a/ (top left), /i/ (top right) and /u/ (down) in different syllabic positions for the different dialects

Relevant References

- Andrade, A. 1999. On /l/ velarization in European Portuguese. *International Congress of Phonetic Sciences (ICPhS)*, San Francisco, 543-546.
- Giles, S.B., Moll, K.L. 1975. Cinefluorographic study of selected allophones of English /l/. *Phonetica* 31, 206-227.
- Oliveira, C., P., A., I., P. 2011. *17th International Congress of Phonetic Sciences (ICPhS)*, Hong Kong.
- Recasens, D. 2012. A cross-language acoustic study of initial and final allophones of /l/. *Speech Communication*, 54(3), 368-383.

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