

# **Towards an articulatory characterization of European Portuguese /l/**

Catarina Oliveira<sup>1</sup>, António Teixeira<sup>2</sup>, Paula Martins<sup>3</sup>

<sup>1</sup>Health School (ESSUA)/ IEETA, University of Aveiro, Portugal

<sup>2</sup>DETI/ IEETA, University of Aveiro, Portugal

<sup>3</sup>Health School (ESSUA)/ IEETA, University of Aveiro, Portugal

<https://doi.org/10.36505/ExLing-2010/03/0034/000154>

## **Abstract**

Based on EMA data, this study investigates timing and magnitude properties of lingual gestures involved in the production of European Portuguese /l/ in onset and coda positions. Syllable position effects were found: coordination pattern for syllable-initial /l/ is distinct from those observed for syllable-final /l/; the tongue dorsum is more retracted in the syllable-final /l/; /l/s in coda showed, for one of the speakers, a reduction in magnitude of the tongue tip gesture.

Key words: (European) Portuguese /l/, EMA, clear/dark allophony

## **Introduction**

For the last decades, it has been argued that European Portuguese (EP) exhibit allophonic variation in /l/. The “clear” variant occurs syllable-initially and the “dark” variant occurs in coda position (Mateus & d’Andrade 2000). However, this point of view is not completely consensual (Andrade 1999). Unfortunately, the majority of the descriptions are based on impressionistic observations and the only extensive empirical descriptions of Portuguese /l/ come from the acoustic data of Andrade (1999).

For other languages, the most commonly cited articulatory distinction between the two allophones is that there is a greater tongue dorsum retraction in the dark /l/ than in light variety (Giles & Moll 1975; Sproat & Fujimura 1993; Narayanan 1997). Also, the consonantal gesture of alveolar contact is considered to be articulatorily stronger in onset position, and weaker in coda position (Giles & Moll 1975; Browman & Goldstein 1995; Gick 2003). The tongue dorsum gesture does not follow the same pattern and seems to be unaffected by syllable position (Sproat & Fujimura 1993). Studies about the temporal organization of /l/ gestures (Browman & Goldstein 1995, Sproat & Fujimura 1993, Gick 2003) have also revealed different timing patterns that distinguish initial and final allophones. In syllable-final /l/s, tongue dorsum movement precedes tongue tip raising, while in initial allophones, tongue tip constriction tend to occur earlier than, or simultaneous with, tongue dorsum gesture.

1

The purpose of this paper is to improve the knowledge of the articulatory properties of EP /l/ in order to bring some new light into the controversial question whether the Portuguese /l/ is categorically associated with two positional allophones or not. Based in Electromagnetic Articulography (EMA) data, tongue gestures amplitudes and coordination were investigated for onset and coda /l/.

## **Experimental method**

### **Data collection**

Two native speakers of European Portuguese (AT and PM) were recruited for the experiment.

The speech material includes short meaningful expressions (e.g. “laca de cabelo” “hair spray”), where /l/ occupies the word-initial position, intervocalic position and coda position. The lateral was flanked by corner vowels ([a], [i], [u]). Four to six repetitions of each item were collected for each speaker.

Recording sessions for both subjects took place at the Gipsa-lab in Grenoble, using the Carstens AG100 Articulograph. Kinematic data were sampled at 500Hz and acoustic speech signal was sampled at 20 kHz. EMA coils were placed on each subject's tongue (near the tongue tip and at the dorsum), upper lip, lower lip and jaw. In this study we focus on data from the tongue tip (TT) and tongue dorsum (TD) coils. Standard calibration and post-processing procedures were applied.

### **Data analysis**

The EMA data were processed in *Matlab*, using routines written by the second author. Following Nakamura (2009), the time and position for a constriction were defined as the minimum of the tangential velocity of TT and TD. Gestural coordination was quantified as the time between gestural landmarks (*tip delay*), algorithmically derived from local velocity profiles of the relevant receivers in the vocal tract.

## **Results**

A first topic of investigation was the **magnitude** properties of the two gestures (TT and TD) in the production of syllable initial and final /l/.

The analysis of the TT vertical position (TTy) revealed that for AT coda /l/ exhibits a significantly lower position than onset /l/ while for the other speaker (PM) the situation is the opposite (Fig1). The TD horizontal position (TDx) is also affected by syllable position in both speakers: the coda /l/ shows a more posterior position than the onset /l/.

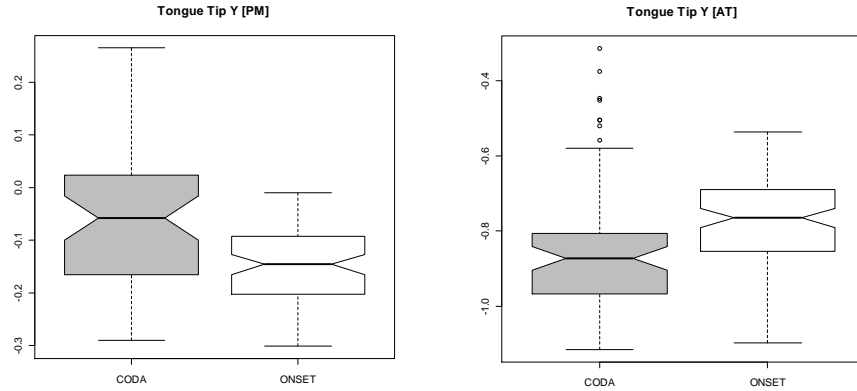


Figure 2 – TTy displacement for /l/ in onset and coda (PM and AT).

A second research goal of this study was to measure the **intergestural timing** between tongue tip and tongue dorsum movements in the two syllable positions. For both speakers (except for one vowel), the results revealed positive values for coda /l/ and negative values for onset /l/. Positive value means that the achievement of the TD gesture occurred earlier than the TT gesture, while a negative value indicates that TT preceded TD (Fig2).

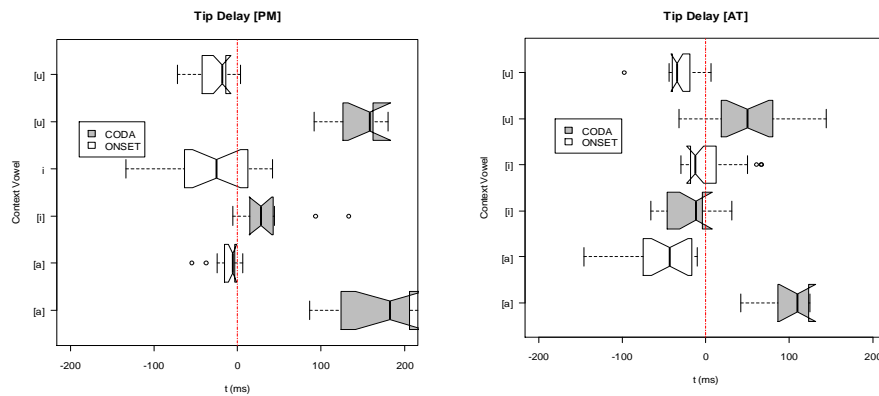


Figure 3 - Tip delay for the onset and coda /l/ (PM and AT).

## Conclusion

Using EMA data, this paper investigated differences in articulatory properties of /l/ as function of syllable position. The preliminary results

reveal some changes in the spatiotemporal parameters of the tongue gestures (TD and TT) for the onset and coda /l/.

Evidence that syllable-final /l/ is associated with lower positions of the tongue tip than syllable-initial /l/ was observed only for one subject. Although little differences in the tongue body magnitude of the two varieties of /l/ were expected, our results showed that the tongue dorsum tended to be further back in the syllable-final than syllable-initial productions. The “tip lag” tendency predicted for /l/ on the basis of Sproat & Fujimura’s (1993) findings is also apparent in the present data.

The temporal findings are in general agreement with those obtained for languages with clear/ dark allophony (e.g. English). However, the reduction in magnitude of the TT gesture was not consistent across subjects. Since our study is limited to two speakers, to fully understand these patterns and to bring some light into the question of allophonic variation in EP /l/, we need more information. A systematic examination of the roles of the different articulators (using MRI) and acoustic consequences is now being carried out.

### Acknowledgements

This work was supported by FCT (grant SFRH/BD/18058/2004 and HERON project). Many thanks are due to Solange Rossato and Christophe Savariaux (GIPSA-Lab), for help with the EMA recordings.

### References

- Andrade, A. 1999. On /l/ velarization in European Portuguese. In Ohala, Y. Hasegawa, M. Ohala, D. Granville, A. Bailey (eds.), 14th International Congress of Phonetic Sciences, 543-546, San Francisco.
- Browman, C., Goldstein, L. 1995. Gestural syllable position effects in American English. In Bell-Berti, F., Raphael, L.J. (eds.) 1995, *Producing Speech: Contemporary Issues: For Katherine Safford Harris*. Woodbury, AIP Press.
- Gick, B. 2003. Articulatory correlates of ambisyllabicity in English glides and liquids. In Local, J., Ogden, R., Temple, R. (eds.), *Papers in Laboratory Phonology VI: Constraints on Phonetic Interpretation*, 222-236. Cambridge University Press.
- Giles, S., Moll, K. 1975. Cinefluorographic study of selected allophones of English /l/. *Phonetica* 31, 206-227.
- Mateus, M.H.M., d’Andrade, E. 2000. *Phonology of Portuguese*. Oxford University Press.
- Nakamura, M. 2009. Exploring Vocalization of /l/ in English: an EPG and EMA study. In *Proceedings of Interspeech 2009*. Brighton, UK.
- Narayanan, S., Alwan, A., Haker, K. 1997. Toward articulatory-acoustic models for liquid approximants based on MRI and EPG data. Part I. The laterals. *Journal of the Acoustical Society of America* 101, 1064-2007
- Sproat, R., Fujimura, O. 1993. Allophonic variation in English /l/ and its implications for phonetic implementation. *Journal of Phonetics* 21, 291-311.