

ON /l/ VELARIZATION IN EUROPEAN PORTUGUESE

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ABSTRACT

F2 and duration characteristics associated with onset and coda /l/ and its immediate phonetic environment, of speech material produced in the laboratory by European Portuguese (EP) speakers have been examined to bring some light into the empirical question whether lateral velarization has a categorical manifestation or not, in this language (Lisbon variety). The results are interpreted in terms of production, in accordance with a co-production model. The present findings have some implications with respect to the historical phonology of EP.

1. INTRODUCTION

There are conflicting positions in the literature with respect to the phonetic manifestation of the apical lateral in EP. The dominant position for the last two decades has been that /l/ is categorically associated with a non-velarized ('clear') allophone in syllable onset and a velarized ('dark') one in coda position [1, 2]. According to earlier phonetic descriptions, however, lateral velarization may also occur in syllable onset, depending on the preceding vowel for some speakers [3], or it is a gradient phenomenon which attains its highest degree in syllable final position [4]. In a recent study based on three Lisbon speakers, we have found some evidence of lateral velarization in syllable onset [5].

The following structural facts have to be considered in the interpretation of our phonetic observations for EP: (i) /l/, together with /r, s, j, w/, pertains to the relatively small subset of "entities" which can unquestionably be associated with syllable coda in Portuguese; (ii) from a phonological point of view, EP may be said to have a seven vowel system, /i, e, ε, a, u, o, ɔ/; the non-high vowels typically undergo stress dependent phonological reduction, that is /ε, e/ and /ɔ, o/ rise to [i]² and [u], respectively, and /a/ to [ɐ], in unstressed position; (iii) this phonological process does not take place, however, if the vowel is followed by a tautosyllabic lateral or glide, or is nasalized. It is generally accepted that the blocking of stress-dependent vowel reduction resulted, historically from the profound prosodic changes that occurred in the evolution from Latin to Portuguese and which incurred in the loss of consonants in the coda.

Measurements of F2 as well of segmental durations associated with the lateral and its adjacent environment were carried out. Analysis of F2 was motivated by the well known fact that it is positively correlated with the tongue body retraction and lowering which characterizes lateral velarization.³

2. METHOD

2.1. Speech material.

The material utilized includes laterals occurring in complex and simple onsets as well as in coda position and consists of the following sets: (a) the sequences /'pli/ and /pe'li/ in the word 'explicas' preceded by the pronoun 'a' ([ɐ ʃ'plikɐʃ] - 'you explain it') and the word 'pelicas' preceded by the article 'as' ([ɐʃ pi'likɐʃ] - 'the pieces of fine leather') produced at the end of short declarative sentences; (b) LV sequences, in which V corresponds to ([i, ε, ɐ]); (c) and the words 'cela', 'celta', 'seta', ([ʃɛlə], [ʃɛltɐ], [ʃɛtɐ] - 'cell', 'celt' and 'arrow', respectively) and the nonsense words 'séli' and 'seli' ([ʃɛli], [sɛ'li]) produced in isolation.

With respect to (a), the choice of a labial for the initial element of the complex onset had the purpose of minimizing gestural interaction in the production of the two onset elements (C and L). Although acoustically, C labiality might have some effect on the F2 of L, the tongue body gesture for the latter would not be constrained by articulatory requirements of C. As for the sequence /pe'li/ (cf. note 2), a strong carryover effect of the lateral was expected, if the vowel were to be realized. The vowel contexts are dominantly front ones. This was motivated by the existence of empirical evidence that, generally, the tongue body gesture in the production of a clear /l/ is significantly less resistant to coarticulatory effects than in the production of a dark /l/ [6, 7, 8]: it was thought that if indeed, we were to find clear onset laterals the front vowel environment would enhance their "clear" nature and raise F2. A secondary criterium in the choice of vowel environments was the preference for words existing in the language (only two nonsense words were used).

The material was read at the rate individual speakers felt to be their normal one. Naturalness and clarity were further requirements of the reading task. All of the speech items in question were elements of larger lists which were read four times in different random orders: (a) pertains to a list of 120 sentences, (b) to a list of 52 of sequences and (c) to a 39 word list.

2.2. Vowel and lateral segmentation criteria.

As is well known, the acoustic manifestation of laterals is characterized by considerable variability, depending on a number of factors, namely the adjacent context, prosodic factors (stress and syllable position, in the present study) and speaker characteristics. From the acoustical point of view, in optimal conditions in syllable initial position, laterals are typically characterized by a vowel-like region with a clear formant

structure and a consonant-like dynamic region. Depending on the circumstances, one or the other may not be visible. In the present paper we identify the former as *L* (cf. 3.3.) and the latter as *Lc* (cf. 3.3.); *L'* stands for the interval between the stop burst and final transient associated with the lateral coronal release, in the C(V)L sequences (cf. 3.1.1.).

Segmentation marks were made in the following “points” of the signal: onset of the stop burst and onset of voicing in the C(V)L sequences, onset and end of the lateral vowel-like region (*Lo* and *Le*, respectively), end of the consonant-like region (*Lr*), midpoints of the lateral (*Lm*) and the preceding vowel or the following one (*Vm*), and some fixed “points” in the lateral and vowels, namely *Vo+15* ms, *Lr-20* ms and *Lo+25* ms.

Establishment of the beginning and end “points” of the lateral was, in a number of cases, problematic.

2.3. Subjects.

The subjects are Lisbon EP native speakers and are relatively homogeneous in terms of age (30-24 yrs), and cultural background (they have all got a university degree).

The number of subjects used in the present study was not the same for all sets of material.⁴ The data from seven subjects were analysed in the case of the /pli/~pe'li/ set: four women (S2, S3, S4 and S6) and three men (S1, S5 and S7). With respect to the other sets, the analysis was based on two men and three women, in the case of the LV sequences, and one man and two women (namely S1, S2 and S3) in the case of the remaining material.

3. RESULTS

3.1 Onset laterals.

3.1.1. The lateral in a complex onset.

Five of the seven subjects present significantly low F2 values for the lateral in /pli/ which are typical of a velarized variant (cf. table 1). The highest F2 values, correspond to two of the female subjects (S2 and S4). The F2 values obtained for the lateral and the following /i/ realizations of subjects S1, S2 and S3 are represented in figure 1.

L	S1	S2	S3	S4	S5	S6	S7
F2m	883	1377	950	1537	970	1024	829
sd	56,2	-	73,6	127,8	76,2	130,3	22,6

Table 1. Average F2 values obtained at *Lm* in /pli/ realizations and the corresponding standard deviations, for 7 subjects. S2 is represented by a single token.

Upon examination of the F2 data for /l/s produced by male speakers of languages that distinguish velarized and non-velarized laterals (e.g. Russian, Bulgarian and Albanian [9, 10]) and languages that have either clear /l/ (e.g. Castilian Spanish, French, Italian, and German [7, 11]) or dark /l/s (e.g. Catalan and some varieties of English [7, 8, 12]), there is reason to think that S4, too, falls within the range of values associated with velarized laterals; however, while the F2 values of subjects S1,S3, S5, S6, S7 indicate their laterals are strongly velarized (or pharyngalized), those of S4 reflect weak velarization.

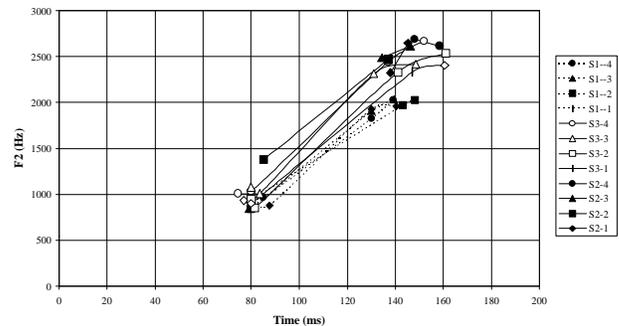


Figure 1. F2 values corresponding to *Lm*, *Lr-20*, *Vo+25* and *Vm* of the individual realizations of /pli/ of S1, S2 & S3.

S4 is also the subject who displays the highest degree of dispersion with respect to the F2 values at *Lm*; for S1, S3, S5, S6 and S7 we find very little variation. This observation suggests that the articulatory constraints on the tongue body gesture for the lateral are weaker for S4 than for the other subjects and that, therefore, the lateral articulation is more resistant to the coarticulatory effect⁵ of the following /i/ in the case of S1, S3, S5, S6 and S7 than in the case of S4.

/l/	S1	S2	S3	S4	S5	S6	S7
Dur	56,3	38,6	57,5	61	74	77	55
VOT	17	30,4	18,5	31,6	18,7	26,2	10

Table 2. Average *p-VOT* and *L'* durations in /pli/ realizations for 7 subjects.

Table 2 includes the average durations of the interval between the labial and the apical transient onsets (*L'*), and *VOT* for the seven subjects. S2 diverges from the rest of the subjects for the extreme closeness between her *L'* and *VOT* values (cf. table 2). In fact, it is to be noted that longer *VOTs*⁵ had been previously observed for S2 relative to other subjects in an independent study where this parameter was examined for /l/ before /i/ [13].

The F2 values measured at *Vo* of /i/ for S2 are, on average, lower than those of S4 (1795 Hz and 1920 Hz, respectively; the corresponding standard deviations are 160,9 and 183,7); however, the difference is not statistically significant (according to the Mann-Whitney test).

Considering what has been said above, we are led to think, at this stage, that the 7 subjects constitute two groups with respect to degree of velarization and degree of coarticulatory resistance of the lateral tongue body articulation: S2 and S4 with the weaker velarization and less coarticulatory resistance, and the other 5 subjects exhibiting strong velarization and coarticulatory resistance.

The most striking aspect that emerges from the comparison of the F2 values and durations associated with the /i/ in the /pli/ and /pe'li/ sequences is the fact that the underlying vowel segment preceding the lateral in /pe'li/ behaves like a “targetless schwa” and the VL sequence is basically manifested as a

lengthened lateral, for all speakers. This may be observed even for S2, as shown in figure 2. As for S4, her “lengthened laterals” in /peˈli/ are clearly velarized, unlike her short laterals in /pli/.

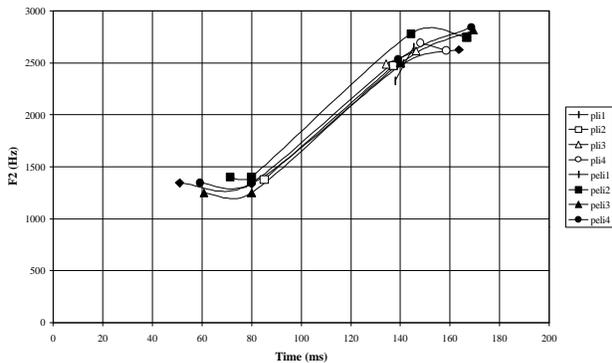


Figure 2. F2 values corresponding to *Lm*, *Lo-20*, *Vo+25* and *Vm* of /*(V)l*/ and /*i*/ individual realizations of /peˈli/ and /pli/, produced by S2.

3.1.2. The lateral in LV sequences. Influence of following vowel. The LV material analysed corresponds to subjects S1, S2, S4, S5 and S6.

Table 4 contains the average F2 values obtained at *Lm* for LV sequences in which /l/ is followed by [i], [ɛ], [a] or [ɐ]. The results in question require a revision of our interpretation of the /pli/ data, to some extent. In fact, while S2 reveals a remarkable constancy with respect to the F2 (average) values associated with the /pli/ and /li/ sequences (cf. table 1), S4 velarizes her /l/s quite markedly, in the “optimal” LV conditions. One possible, interpretation of the difference in behaviour of S4 relative to S2 is that she is more prone to reduction in connected speech than the latter.

F2	S1	S2	S4	S5	S6
[li]	906,2	1374,9	1074,7	941	1019,5
[lɛ]	874,9	1296,8	1052	915,7	1027
[la]	871,1	1161,4	982,4	845	937,5
[lɐ]	835,9	1249,9	1101,6	914,7	767,1

Table 4. Average F2 values obtained for at *Lm* in LV sequences (V= [i, ɛ, a, ɐ]) produced by 5 subjects (S1, S2, S4, S5 & S6).

The five subjects under analysis converge with respect to one further aspect: they all evidence an effect of the following vowel characteristics in the front-back dimension; moreover, all but S6 have their highest and lowest F2 values in the context of /i/ and /a/, respectively, as expected [4].

3.1.3. Intervocalic /l/: influence of the following vowel and stress. The results presented in this section and in 3.3 correspond to subjects S1, S2 and S3.

The F2 values sampled at *Lo*, *Lo+25* and *Lm* in ‘sela’- [ˈsɛla] and ‘séli’ - [ˈsɛli] realizations of the three subjects in question

reflect the occurrence of an effect of the following vowel on the lateral at *Lm* (cf. figure 3): F2 is higher in the context of /i/ than in the context of /ɐ/. In accordance with what was observed previously, it’s S2 who presents the largest effect.

Analysis of the F2 values associated with the preceding vowel (/ɛ/) shows that the influence of the following vowel extends beyond the lateral region, though in differing degrees from speaker to speaker.

As may be seen in figure 3, shifting stress from the initial syllable to the final syllable, in [sɛˈli], results in a further rise of /l/ F2 relative to the corresponding F2 value in [ˈsɛli]. Again, the degree of this effect is speaker dependent: it is more marked for S3 and S2 (though not as much) than for S1. It is notable that the lateral is shorter when it pertains to the stressed syllable than when it fills the onset of the post-stress syllable.

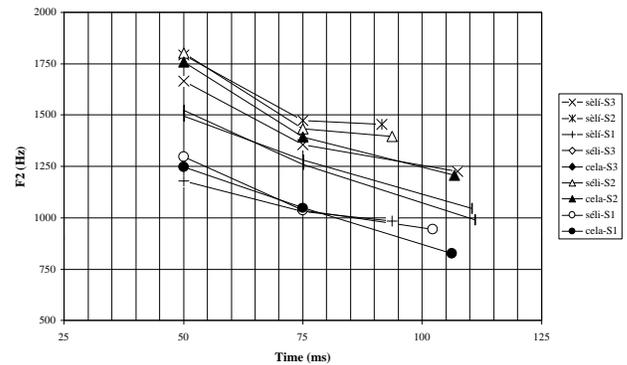


Figure 3. Average F2 values for /l/ taken at *Lo*, *Lo+25* and *Lm* for [ˈsɛla] and [ˈsɛli] produced by S1, S2 and S3.

3.2 Coda vs onset position.

Analysis of the segmental durations associated with the [ɛl] realizations F2 of ‘sela’ - [ˈsɛlɐ] and ‘celta’ - [ˈsɛltɐ] of S1, S2 and S3 shows there is a marked, systematic vowel shortening as well as a strong tendency for shortening the lateral sonorant region (*L*) in [ˈsɛltɐ] relative to [ˈsɛlɐ]. The VL sequence is shorter in the coda case than in the onset one even when the consonant-like region of the lateral (*Lc*) is taken into consideration, as well. These observations are illustrated with figure 4, which contains the segmental duration results for S1. Comparison of the F2 average values for the front vowel in ‘sela’ - [ˈsɛlɐ], ‘celta’ - [ˈsɛltɐ] and ‘seta’ - [ˈsɛtɐ] indicates, in turn, that F2 lowering towards the velarized lateral values takes place earlier in the coda context than in the onset one. This may be observed for S1 and S2 in figure 5.

It may be inferred from figure 5 that the exact timing of F2 lowering relative to vowel onset varies across speakers: of the three subjects, it is S1 who exhibits lowering of F2 earliest. With respect to the lateral itself, S1 produces a clearly lower F2 for [ˈsɛltɐ] than for [ˈsɛlɐ], which is in accordance with what has just been observed for this subject’s [ɛ] and S3 produces the opposite pattern; as for S2, the F2 difference found is not

significant. Such observations lead us to hypothesize that S1's tongue body lateral gesture is more resistant to the influence of the preceding vowel than that of S2 and particularly S3.

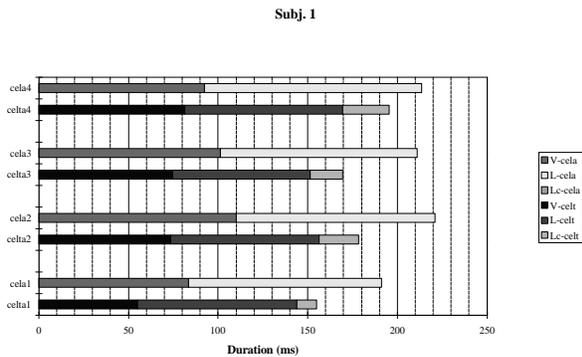


Figure 4. Durations of V, L and Lc corresponding to the individual repetitions of [ˈsɛlɐ] and [ˈsɛltɐ] of S1.

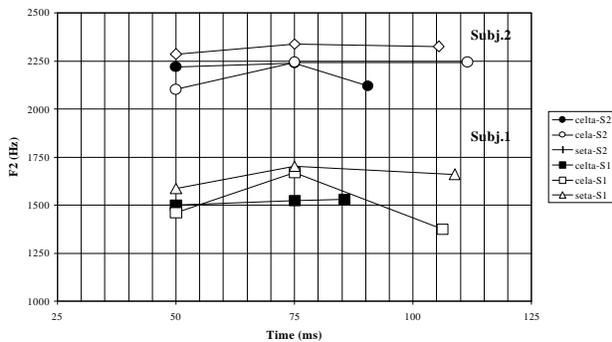


Figure 5. Average F2 values obtained at Vo, Vo+25 and Vm in the realizations of [ˈsɛlɐ], [ˈsɛltɐ] and [ˈsetɐ] of S1 and S2.

4. CONCLUSION

The results based on the onset data show that /l/ velarization does take place in this syllable position, for speakers of the Lisbon variety of EP. The degree in which it is manifested varies across individual subjects, strong velarization dominating in the present subject sampling. Evidence of anticipatory effects of the post-lateral vowel on the lateral and the vowel preceding it point to the occurrence of interaction between tongue body gestures for the three segments (3.1.2 and 3.1.3). The combination of shorter duration and higher F2 in stressed syllable onset than in post-stress onset, are compatible with the view that greater co-production takes place between the lateral and the following vowel gestures in stressed syllable. On the other hand, the coda position entails an increased co-production of the lateral and the preceding vowel.

The present findings indicate that the tongue body retraction and lowering gesture associated with the lateral together with the strong co-production between this consonant and the preceding vowel gestures when it occurs in the syllable coda converge towards the blocking of stress-dependent vowel rising. Phonological facts indicate this process is stronger with the

lateral than with other consonants, namely /r/ and /ʃ/. We may therefore, hypothesize that the two factors in question were active historically, when unstressed vowel reduction got structured in EP.

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NOTES

1. In order to account for vowel nasality, the set also includes an underlying /n/ or an underspecified N, for some authors; we prefer to postulate a nasal autosegment which anchors on the preceding vowel when followed by a C or at word boundary.
2. The vowels /ɛ, e/ can be said to alternate with a high schwa: a high vowel that is highly context dependent which may be produced in a very reduced manner, devoiced or even have no phonetic manifestation [3].
3. Analysis of other parameters, namely F1 and F2-F1, is under way.
4. Analysis of further data is being carried out.
5. Portuguese does not have aspirated stops.

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