A phonetic 'conspiracy'. Low vowels and velarized lateral in Leghorn Italian

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ABSTRACT

The Italian spoken in Leghorn shows two peculiar features: a pair of low vowels and a velarized lateral in the context of gemination. These segments share an articulatory gesture, that is the lowering of the tongue dorsum. A phonetic conspiracy, i.e., an articulatory correlation between the degree of lowering in vowels and the velarization degree in the lateral is hypothesized. A set of target-words including the velarized lateral consonant in intervocalic position after stressed vowels with a different degree of height was analysed as produced by three speakers from Leghorn. The data collected confirm the hypothesis for the context relative to the front vowels only: in the velarized lateral segment, F2 values, as well as the difference between F2 and F1, decrease progressively in reference to the degree of lowering of the preceding vocalic segment.

1. INTRODUCTION

This paper focuses on some phonetic peculiarities of Italian as it is spoken in Leghorn. Leghorn is a Tuscan town located on the Tyrrenian coast, at almost one hundred kilometers away from Florence. It was officially founded in 1577, when the so-called *leggi Livornine* ('Leghorn laws') were issued by the government of the Medici family. As a rather young city, Leghorn cannot easily be identified as a typical Tuscan town. Therefore, in the place where a small village of fishermen already existed, after the middle of the XVIth century a multitude of random people, particularly traders and merchants, came to Leghorn from all over Europe (especially from Spain, Portugal and Holland). This mixture of people coming from different nations and speaking different languages might also have contributed in giving a special status to the language spoken in Leghorn. Compared to other Tuscan varieties, Leghorn Italian shows two peculiar phonetic features: first, a pair of low vowels, both at the front and the back side, instead of the standard central low segment; second, a velarized lateral consonant in the context of gemination. As far as the former feature is concerned, i.e. the lowering of /ɛ/ into [æ] together with a shifting of /a/ into [ɑ], it has been traditionally acknowledged by the literature, although only recently has it been esperimentally documented ([1]). In particular, the lowering of the mid-open front vowel can be very easily perceived, so that it becomes a sort of *shibbolleth* for Leghorn people. S. Calamai [1] presented the values of F1, F2 and their difference for all the vowels of Leghorn Italian in a stressed syllable, showing that they are different from those relative to other varieties of Italian, even Tuscan. Thus, in Leghornese the classic triangle-shaped vocalic system of Italian moves into a trapezoid shape, becoming more similar to the English vowel system. As far as the second peculiar feature of Leghorn Italian is concerned, i.e. the velarization of the lateral consonant, in a recent acoustic analysis we demonstrated that /l/ is consistently produced as [ɬ] in the context of gemination (see [2]). Indeed, F2 values for /l:/ produced by four Leghornese speakers were consistently lower than those relative to speakers of other varieties of Italian. In that work, the threshold for F2 as an index of velarization was fixed on about 1200 Hz. The difference between F2 and F1 was also found lower than in the /l/ produced by other Tuscan speakers. Finally, we would recall that in Leghorn Italian, as well as in Standard Italian, the lateral can either be short or long. It is important to point out that a long lateral is a single, long and uniform sound; therefore, it is not produced as two different segments, with some kind of visible boundary between them ([2], [3]).

1.2 VELARIZATION OF LATERALS

From the acoustic point of view, lateral segments present a vowel-like structure, since they show formants, although their frequencies and amplitude tipically differ from those of vowels ([3]). They are strongly prone to coarticulation, both anticipatory and carry-over. The great variability they show is due to a number of factors, such as segmental context, prosody and characteristics of the speaker. In some languages, the lateral phoneme shows two allophones, a *clear l* ([l]) and a *dark l* ([ɬ]) depending on the syllabic structure. For instance, in English as well as in Catalan and Portuguese, *dark l* occurs in coda position. A similar picture can be found in Leghorn Italian, where a velarized segment is produced when the lateral is geminated. We know from literature that velarization is an articulation which involves raising the back of the tongue ([4]). Previous studies indicate a greater retraction of the anterior section of the tongue body in the production of *dark l* ([5]). Velarization implies two articulatory gestures: first, the movement of the tongue apex towards the teeth followed by a lowering of the dorsum and a subsequent raising of the post-dorsum towards the soft palate ([6]; [7]; [8]). An increase in velarization is correlated to a lesser dorso-palatal contact; acoustically, *dark l* is characterized by a relatively lower F2 and higher F1 when compared to the values for *clear l.*

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1.3. THE HYPOTHESIS

If we consider the articulation of both low vowels and velarized lateral consonant, we see that these segments share an articulatory gesture, that is the lowering of the tongue dorsum. In fact, during the production of a low vowel, the dorsum of the tongue is lowered and the tongue root moves further back. As we have already underlined, velarization involves two lingual gestures: a primary apico-alveolar closure followed by a dorso-velar and dorso-pharyngeal constriction (cf. [6], [7]). In producing low vowels, the lowering of the tongue dorsum may play a role in the velarized pronunciation of the lateral consonant, for the whole body of the tongue is still lowered and the post-dorsum bowing take places after the raising of the apex towards the alveolar ridge. If such an articulatory correlation between low vowels and velarized lateral consonant could be therefore hypothesized, it would be possible to identify a phonetic 'conspirancy'.

As is well known, 'conspiracy' is a notion proposed in the dawn of generative phonology to refer to the co-occurrence of different processes moving towards a same direction ([9]). In this case, the conspiracy would be between the lowering degree of the vowel preceding the lateral segment and the velarization degree of the same consonant. Considering the coarticulatory effects undergone by the lateral segment, if such a conspiracy is at work, the *dark l* should show a lower F2 when preceded by a low vowel. In other terms, in Leghornese [ɬ:] a progressive lowering of F2 as well of F2-F1 should be positively correlated to the vowel height. At the same time, a higher F1 value could be expected in the case of a low vowel preceding the long velarized lateral in respect to non-low vowels. Taking the front vowels as a reference, [ɬ] should therefore be more velarized when preceded by [æ] than by [e] and [i].

2. THE ANALYSIS

2.1 METHOD

Four male speakers participated in the study. Three come from Leghorn and are all native speakers. The fourth, native of Lucca, was included in the test in order to compare the data from Leghorn with other data from another variety of Tuscan Italian which does not show a *dark l.* Speakers are all homogeneous in terms of age (25-28 years) and cultural background. They were recorded in a sound-proof booth with a SONY DAT recorder. Speech material consisted of 21 disyllabic and trisyllabic words including the long lateral consonant in intervocalic position after a stressed vowel (/ˈVl:V/). The ˈV slot in the sequences was filled with [æ], [e], [i], [ɑ], [ɔ], [o]; the last unstressed vowel was always [o]. We had therefore real Italian words contaning the sequences [-ˈæɬ:o], [-ˈeɬ:o], [-ˈiɬ:o], [-ˈɑɬ:o], [-ˈɔɬ:o], [-ˈoɬ:o]. Target-words were put into a carrier sentence (*Dico X tre volte* "I say X three times") and randomized for the speakers from Leghorn and Lucca. Each subject uttered the items selected in the carrier phrase three times. All the repetitions were uttered as a single intonational phrase. Speech material has been sampled to a 22050 Hz sampling rate at 16 bits using *Multi-Speech* software (Model 3700, Version 2.4, *Kay Elemetrics*). Measurements of F1 and F2 were taken for the whole duration of the lateral segment using the Long Term Average (LTA) procedure.

Analysis of F2 was motivated by the positive correlation existing between the retraction and lowering of the tongue body. Moreover, F1 is known to be inversely correlated to dorso-palatal contact size ([3]; [7]). Therefore, an increase in degree of velarization causes an F1 rising together with an F2 decrease. LTA power spectrum is the average of a number of power spectra that are computed from adjacent frames in the specified range. Each power spectrum is computed by using the FFT algorhythm of the same frame length until the end of the selected range. Then, the resulting power spectra are averaged together to produce the long term average power spectrum. We decided to use this technique because it allows us to obtain the mean frequency values for the entire lateral segment, taking into account the coarticolatory effects of both the preceding and the following vowel.

2.2. DATA

As we have already stated, we measured F1, F2 and their difference for the long lateral segment included in the target-words produced in the carrier sentence. Tables I-IV present the results obtained from three repetitions of the target-words for each speaker, with the indication of the average value and its standard deviation. The acoustic parameters quoted are taken as indexes for the degree of velarization. We expect that an increase in velarization triggers the lowering of F2 and F2-F1 as well as a small rising of F1.

Let us first consider F1. In Table I we present the results relative to the subjects from Leghorn. F1 values range between 300 and 430 Hz, whereas those of the speaker from Lucca are between 370 and 470 Hz. This wide variability in F1 values is directly connected to the features of the vowel preceding the lateral segment. F1 seems to decrease according to the vowel height: vowels marked [+high] show lower F1 values in the following lateral segment, whereas vowels marked [-high] have greater values. In articulatory terms, the three front vowels differ in the degree of contact along two dimensions, anterior *vs.* posterior and peripheral *vs.* central: the sides of the tongue touch the palate in the alveolar area for [i] and [e], but not for [æ], according to the progressive hierarchy [i] > [e] > [æ].

As far as the speaker from Lucca is concerned, F1 values pattern in a different way (see Table II), since the percentages relative to the sequences [ˈel:o] and [ˈɛl:o] are quite similar, while in [ˈil:o] the value drops sharply. This result is not surprising, given the substancial difference between the two vocalic systems: in the Italian spoken in Lucca, where there is no [æ], but rather [ɛ], the

phonetic distance between this mid-open front vowel and the mid-closed front vowel [e] is small, while in Leghornese Italian, [æ] has a wider distance from [e], as it shifts towards a low vowel (see [1]).

speaker	GB-LI		DG-LI		EG-LI	
	F1	σ	F1	σ	F1	σ
[ˈæɬːo]	367	70	428	64	367	38
[ˈeɬːo]	306	93	393	38	361	1
[ˈiɬːo]	332	18	340	65	357	36
[ˈɑɬːo]	350	53	405	76	352	14
[ˈɔɬːo]	398	52	370	58	352	26
[ˈoɬːo]	355	48	334	53	367	30

Table I: F1 mean values and standard deviation σ for the three male Leghorn subjects.

	F1	σ	F2	σ	F2-F1
[ˈɛlːo]	391	65	1633	149	1242
[ˈelːo]	404	31	1627	77	1222
[ˈilːo]	371	80	2486	247	2115
[ˈalːo]	400	65	1333	164	932
[ˈɔlːo]	471	104	1267	81	797
[ˈolːo]	373	34	1291	71	917

Table II: Mean values of F1, F2 and F2-F1 for the Lucca subject.

In the sequences with preceding back vowels produced by the Leghornese subjects, F1 of the long lateral segment does not show a higher value in [ˈɑɬːo] compared to those for [ˈɔɬːo] and [ˈoɬːo] (cf. Table I). As far as the speaker from Lucca, who does not show any *dark l*, F1 values for [lː] rise according to the following order: [ˈɔɬːo] > [ˈalːo] > [ˈolːo] (cf. Table II). In this case too, the vocalic system is different: in the Italian spoken in Lucca, the /a/ phoneme is produced as a central vowel. From an articulatory point of view, this means that the tongue dorsum is flat and more fronted than in the back rounded vowels, while in Leghornese Italian, the production of a back low vowel [ɑ] implies a different position of the tongue body, which has an acoustic correlation to the lowering of F1.

Our hypothesis regarding a possible 'conspiracy' between the degree of the vowel height and velarization would predict a higher F1 value for [ɬː] when preceded by a low vowel rather than when preceded by a non-low vowel The hypothesis seems to be proved only for the front vowels, since for all the speakers from Leghorn the average F1 values of the long lateral segment are higher in [ˈæɬːo] than in [ˈeɬːo] and [ˈiɬːo].

The F2 values obtained for the long lateral consonant produced by the speakers from Leghorn in the different vocalic contexts of our corpus confirm the occurrence of a velarized segment [ɬː]. Tables III and IV show the average values relative to F2 and the difference between F2 and F1 for the long lateral segment. As in our previous study (cf. [2]), F2 values allow us to outline a clear boundary between Leghorn and Lucca: in all the sequences belonging to our corpus, the mean F2 values for the lateral range from 900 to 1300 Hz in Leghornese speakers, while they rise to about 2500 in the speaker from Lucca (see Table II) , with a minimum value of 1267 Hz in the case of [ˈɔlːo].The minimum threshold for the speaker from Lucca (= 1267 Hz) is close to the maximum value reached by the Leghornese subjects in the context of a preceding front vowel.

speaker	GB-LI		DG-LI		EG-LI	
	F1	σ	F1	σ	F1	σ
[ˈæɬːo]	1124	115	978	75	1144	58
[ˈeɬːo]	1295	37	1112	100	1228	89
[ˈiɬːo]	1267	146	1126	83	1264	67
[ˈɑɬːo]	1069	85	907	69	1091	60
[ˈɔɬːo]	891	113	929	197	983	71
[ˈoɬːo]	947	76	944	117	1045	63

Table III: F2 mean values and standard deviation σ for the three Leghorn subjects.

speaker	GB-LI	DG-LI	EG-LI
	F2-F1	F2-F1	F2-F1
[ˈæɬːo]	757	550	777
[ˈeɬːo]	988	719	867
[ˈiɬːo]	936	786	907
[ˈɑɬːo]	718	502	739
[ˈɔɬːo]	492	559	631
[ˈoɬːo]	592	610	678

Table IV: F2-F1 mean values for the three Leghorn subjects.

This specular picture found in the two Tuscan varieties under consideration allows us to demonstrate that the production of the velarized lateral in Leghorn Italian is dependent on the syllabic context (i.e. gemination) more than on coarticulation. Although we know that the velarized lateral consonant is strongly resistant to coarticulation (see [7]), clear coarticulatory effects are still present in our data, since F2 values of the lateral segment are higher in [ˈiɬːo] than in [ˈæɬːo] or [ˈeɬːo]. However, for all the speakers from Leghorn they are much lower than for the speaker from Lucca.

We go on now to to consider the F2 values of the long velarized lateral consonant in relation to the degree of lowering of the preceding vowel. With respect to the

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conspiracy hypothesis, we expect a progressive decrease of the value of F2 according to the scale: [ˈiɬːo] > [ˈeɬːo] > [ˈæɬːo] for the front axis, and [ˈoɬːo] > [ˈɔɬːo] > [ˈɑɬːo] for the back axis.

If we look at the data shown in Tables III and IV, we see that our hypothesis is confirmed for the first set of vowels only. In fact, for all the speakers from Leghorn, the lateral consonant reaches its lowest mean value of F2 in the [ˈæɬːo] sequence. For two speakers (DG and EG), in [ˈeɬːo] F2 values are higher than in [ˈæɬːo], but lower than in [ˈiɬːo], while in the third speaker (GB), the value in [ˈeɬːo] is higher than that in [ˈiɬːo]. Furthermore, the computation of the average value of F2 in the [ɬː] of the three speakers gives a promising result, since we obtain 1104 Hz for [ˈæɬːo], 1212 Hz for [ˈeɬːo] and 1242 Hz for [ˈiɬːo]. The scale we expected is found: we have decreasing values of F2 in the lateral consonant and more lowering in the preceding vowel. The same pattern is found for the difference between F2 and F1, since this acoustic parameter shows a progressive reduction going from [ˈiɬːo] to [ˈeɬːo] and then to [ˈæɬːo] (see Table IV).

Unfortunately, a different picture has to be aknowledged for the back vowels. In this case, the variability among speakers is wider. However, in one Leghornese speaker (DG), the velarized lateral segment does show its lowest value of F2 in [ˈɑɬːo], which is what we expected according to our hypothesis, whereas in the other two speakers the lowest value concerns [ˈɔɬːo] (see Table III). The average values of F2 of the three speakers reflect the lack of a consistent trend: we have indeed 1022 Hz for [ˈɑɬːo], 1045 Hz for [ˈɔɬːo] and 983 Hz for [ˈoɬːo]. As far as the difference between F2 and F1 is concerned (see Table IV), the pattern does not change: one Leghornese speaker (the same DG as before) shows a lesser value in the case of the sequence [ˈɑɬːo], whereas for the other two speakers the lowest value is reached in the case of [ˈɔɬːo] (see Table IV). These data can be explained by taking into account the articulatory gestures employed in the production of middle back vowels ([o] and [ɔ]): the post dorsum of the tongue is lowered, whereas the tongue body is in a mid position and the lips are rounded. If we consider velarization as the addition of a [u]-like position without any lip rounding, it is clear how the sharing of the tongue dorsum is crucial in the articulation of [ɬː]: the tongue dorsum is still lowered and the tip of the tongue is high in the middle of the mouth, ready to produce the alveolar contact which allows air to escape from the lateral sides of the mouth.

3. CONCLUDING REMARKS

We hypothesized a phonetic conspirancy between the lowering degree of the vowel preceding the lateral segment and the velarization degree of the same lateral consonant. The results collected proved a positive correlation between the two parameters in the context of the front vowels only. In fact, in the sequences [ˈiɬːo], [ˈeɬːo] and [ˈæɬːo] a progressive lowering of F2, as well of F2-F1 difference, in the lateral segment was found, together with an increase of F1. In the context of the back vowels however, no such a conspiracy was proved, probably because of the specific articulatory features of the back vowels. We hope that following studies will offer new data and new suggestions in order to understand the factors playing a role in the velarization degree of the lateral consonant.

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