

Domain Initial Strengthening in Sentences and Paragraphs: Preliminary Findings on the Production of Voiced Bilabial Plosives in Two Varieties of Italian

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Abstract

This work focuses on acoustic and kinematic data relating to the voiced bilabial plosive /b/, produced at the beginning of domains of various levels by speakers of different varieties of Italian.

The productions by two speakers, from the north and the south of Italy, are analysed for investigating the voiced bilabial plosive in sentences, either in utterance initial position or in internal position. In the latter case, the consonant was initial in various prosodic domains, ranging from prosodic word to phonological and intonational phrase. Moreover, the consonant was also investigated in utterances that were inserted in various positions (initial, medial, and final) in three paragraphs of a short discourse.

Preliminary findings reported here support the existence of initial articulatory strengthening, as found in the literature, for the utterance and lower domains; on the contrary, the findings do not appear to support it for higher level prosodic units such as those related to discourse structure.

1 Introduction

Italian shows a length contrast in the consonantal system although many studies have been pointing out peculiarities in the way different varieties of the language exploit the length opposition. In standard Italian, and in many varieties, singleton vs geminate consonants contrast within the phonological system [7], and show different acoustic and articulatory characteristics. Geminate consonants in word internal position show an acoustic duration which is about twice the singleton duration [1], and their opening gesture has longer duration and greater amplitude than singleton opening gesture [5,10]. However, some varieties, mainly spoken in the northern part of the peninsula, are reported not to show the length contrast for consonants [3,8]. Apart from the fact that speakers of these areas may actually show the length contrast while speaking (regional) Italian rather than the dialect [10], other peculiarities are observed in the singleton vs geminate contrast. In some varieties,

mainly in central and southern regions, singletons are lengthened in comparison to singletons produced by northern speakers. For instance, in southern regions, the extensive use of long consonants in word initial position is often observed for specific segments, such as the voiced bilabial plosive /b/ [9].

Thus, in Italian consonant duration appears to play both a phonological and a sociolinguistic role. In this paper, these characteristics concerning consonants will be considered in their interaction with acoustic lengthening and articulatory strengthening that may be expected in initial position in prosodic domains, as reported by some works in the literature [2,4]. For instance, in [4] the authors found that the linguo-palatal contact increases for consonants initial in prosodic word, phonological phrase, intonational phrase, and utterance domain. Similar results are reported for acoustic duration, although the correlation is weaker. Moreover, the degree of "effort" in speech production varies depending on the position in the speaker's production [6], and this is expected to have an impact on acoustic properties and articulatory gestures. Thus a question arises as to what happens in terms of strengthening of domain initial consonants for speakers of varieties that differently exploit the consonantal length feature.

This work is part of a bigger project and aims at exploring such issues by focussing on acoustic and kinematic data relating to the production of the voiced bilabial plosive /b/, produced at the beginning of domains of various levels by speakers of different varieties of Italian.

2 Corpus and methods

Four speakers of northern (Turin, north-west) and southern (Lecce, south-east) varieties of Italian (age 25-45) were recorded when reading aloud two corpora: in the first corpus the voiced bilabial plosive /b/ was inserted in sentences, either in initial position (initial in the utterance domain) or in internal position. In the latter case, the consonant was placed at the beginning of various expected prosodic domains, ranging from the prosodic word (e.g., *battere* "to beat") to phonological phrase (e.g.,

at short subject noun phrase and verb phrase boundary) and to intonational phrase (e.g., at parenthetical or subordinate clause boundary). Indeed, target sentences were created whose syntactic and prosodic structure (number of syllables) was expected to induce the presence of higher level prosodic boundaries apart from the prosodic word boundary. Six control conditions were also included, in which the voiced bilabial plosive was included in target words (e.g., *la biglia* vs *l'abbiglia* "marble (of glass)" vs "s/he dresses her") and pseudo-words (e.g., *abi*, *abbi*), where it appeared as either singleton or geminate. In these cases, the consonant was never in absolute initial position, but rather in sentence initial (first syllable) or sentence medial position.

Moreover, as works in the literature argued that a gradual decrease in the articulatory "effort" may be expected during speech production, a second corpus was created for investigating the consonant's characteristics depending on the position in the paragraph and the position of the paragraph in the discourse. Thus, in the second corpus, the target consonant was always sentence/utterance initial, and was inserted in various positions (initial, medial, and final position) in three paragraphs (first, second, and third paragraph) composing a short discourse. Only the position of paragraph in discourse will be considered in this paper. As for the segmental context, in both corpora the target consonant was inserted in a (V₁)-to-V₂ context, such as /iba/, /abi/, /(a)ba/.

Speakers were asked to read the corpora at a comfortable rate for at least 10 times: the reading of the paragraphs was alternated with the reading of the sentences (that were randomized). Acoustic and kinematic data were collected at the CRIL Research Centre. Kinematic data include synchronized EMA (AG500) and ultrasound images (Toshiba Aplio). Only EMA data will be considered here: EMA coils were placed on the tongue midsagittal plane (4 coils), on upper and lower lips (2 coils), upper and lower incisors (2 coils), and behind ears for reference (2 coils).

Contexts where prosodic boundaries were expected on the basis of the syntactic and prosodic structure were first independently checked by three transcribers (the first three authors), who performed an auditory analysis in order to label the actual prosodic boundary on the basis of auditory analysis of tonal and/or durational cues (plus pauses).

All the materials were then segmented and labelled as for the main acoustic (segments boundaries) and articulatory events (gesture onset and offset, and velocity peaks for target consonant and adjacent vowels).

Data from two speakers ("North-3" from Turin; "South-4" from Lecce) are reported here, regarding the following measures on acoustic and EMA data: acoustic duration of target consonant, closing/opening consonantal gesture duration and amplitude, as measured for the lower lip. Statistics consists of one- and two-ways ANOVAs.

3 Results on domain initial strengthening

3.1 Acoustics

The control conditions were considered in order to check whether speakers similarly exploit the length contrast. For North-3, the word position in the sentence (initial vs mid) did not affect the target consonant duration [$F(1,30)=.711$; $p>0.05$], while a significant difference was found in relation to the singleton vs geminate contrast [$F(1,30)=30.664$; $p<0.0001$] (with no interaction between the two [$F(1,30)=.3786$; $p>0.05$]). On the contrary, consonant duration in South-4's productions were affected both by the position of the word in the sentence [$F(1,29)=13.537$; $p<0.05$] and by the presence of a singleton or a geminate consonant [$F(1,29)=4.743$; $p<0.05$] (with no interaction between the two [$F(1,29)=.042$; $p>0.05$]). Notice, indeed, that in South-4's production the singleton consonant in initial position has longer duration than the geminate in sentence mid position - Figure 1, panel on the right, third vs second bar from the left - and show a duration that is alike the geminate duration in North-3's productions - Figure 1, panel on the left, first two bars on the left.

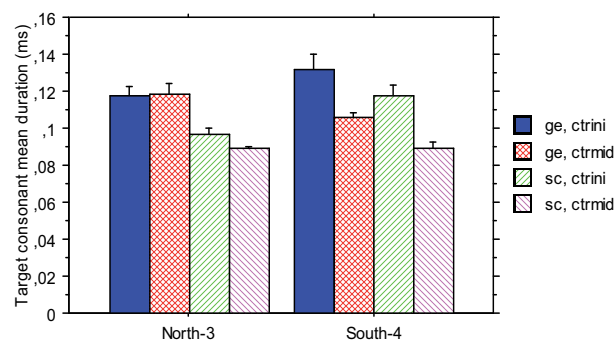


Figure 1: Target consonant mean duration for the two speakers across geminate/singleton (ge, sc) and initial/mid conditions (ctrini, ctrmid)

Thus, speakers produce geminate consonants that show longer duration than singletons, but while the difference appears to be more stable for North-3, e.g. independent from target position in the sentence (no significant difference is found for singleton or geminates in initial and mid position [$F(3,30)=10.379$; $p<0.0001$]), South-4 produces longer singleton consonants in sentence initial position and shorter geminates in sentence mid

position (the two geminates and singletons are significantly different [$F(3,29)=5.555$; $p<0.05$]).

As for the presence of prosodic boundaries in test conditions, for both speakers the target consonant duration is affected by target position, both in terms of sentence initial vs mid position and in terms of position in the prosodic hierarchy of the constituent the target belongs to (for North-3 [$F(7,58)=5.518$; $p<0.0001$]; for South-4 [$F(7,50)=2.223$; $p<0.05$]). However, the Fisher post-hoc revealed that South-4 shows longer duration in mid ("frmid") rather than in initial position ("frini", "frini2"), and, in fact, only significant difference due to the longer duration of subordinate clause condition ("sub" and "sub2", where an intonational phrase boundary was realized) in comparison to the initial position (utterance boundary). North-3 shows equal acoustic duration in initial and mid position, and significant differences due to the longer duration in the other conditions involving internal prosodic boundaries (parenthetical ("par"), subordinate, and long noun phrases ("npl") conditions; the difference is also found between short noun phrases ("nps") and parenthetical, as well as between parenthetical and subordinate).

For both North-3 and South-4, the position of the paragraph in the discourse has no significant effect on the target consonant duration ([$F(2,26)=0.478$; $p>0.05$] for North-3, and [$F(2,27)=2.224$; $p>0.05$] for South-4), although an increase in the first consonant duration is observed from first to third paragraph – see Figure 2.

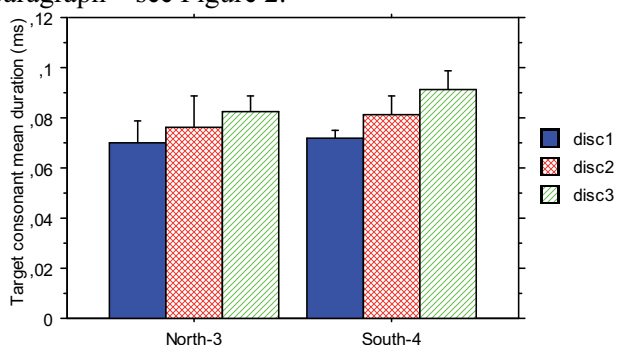


Figure 2 Target consonant mean duration for the two speakers across positions of the paragraph in the discourse (disc1, disc2, disc3)

3.2 Kinematics

Measurements on lower lip's kinematics production of control conditions give similar results across speaker, apart from the amplitude of the closing and the opening gesture: while the former is affected by the target position only for North-3 ([$F(1,30)=9.806$; $p<0.05$]; for South-4: [$F(1,29)=0.050$; $p>0.5$]), the latter is affected by target position only for South-4 ([$F(1,29)=54.733$; $p<0.0001$]; for North-3: [$F(1,30)=$

0.0665 ; $p>0.05$]) – see Figure 3. According to previous works in the literature, the opening gesture represents an important correlate in the kinematic differentiation between singleton and geminate consonants: in fact South-4 appears to change more drastically this correlate depending on target position in utterance.

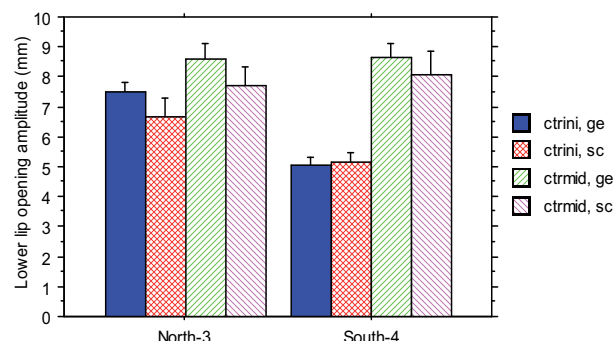


Figure 3: Lower lip opening gesture amplitude for the two speakers across geminate/singleton (ge, sc) and initial/mid conditions (ctrini, ctrmid)

As for the presence of prosodic boundaries in test conditions, the lower lip closure rather than the opening gesture was found to be more clearly affected by the various conditions. In fact, both duration and amplitude of the opening gesture are affected by the condition considered, but no clear correspondence is found between kinematic correlates and strength of prosodic boundary. However, the closing gesture duration is significantly different in relation to target position for North-3 [$F(7,61)=8.8081$; $p<0.0001$]. Moreover, the Fisher's post-hoc shows that it is significantly different in initial position as compared to all other positions, and in conditions relating to the presence of lower vs higher prosodic boundaries – see Figure 4 where duration in middle position ("frmid"), short and long noun phrase ("nps" and "npl") is shorter than in subordinate and paragraph conditions ("sub", "par") and absolute initial conditions ("frini", "frini2"). As for amplitude, results are significant [$F(7,61)=8.106$; $p<0.0001$] with higher initial values in comparison to other conditions, apart from few exceptions relating to one subordinate condition. Significant results are also found for speaker South-4 [$F(7,50)=6.239$; $p<0.0001$], and the Fisher post-hoc shows that the closing gesture is significantly longer in utterance initial position than in other conditions, apart from "par" and "sub" (other results go in the direction of shorter duration for lower prosodic boundaries, with shorter duration in "frmid", "nps", and "npl" than in "par", and "sub") – see Figure 4. As for amplitude, significant differences are found [$F(7,50)=3.836$; $p<0.05$], and the post-hoc shows that the initial condition is different from others, apart from few exceptions relating to subordinate condition.

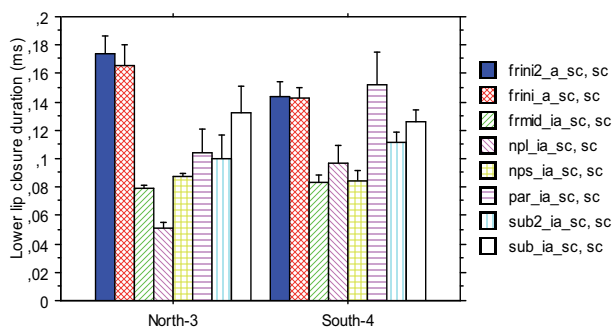


Figure 4: Lower lip closing gesture duration for the two speakers, across prosodic position conditions in the sentence

Only for South-4 the duration of the lower lip gesture is significantly affected by the position of the paragraph in discourse [$F(2,27)=5.319$; $p<0.05$] and the Fisher's post-hoc shows that the consonant in the final paragraph is significantly longer than in other positions – see Figure 5. For South-4, a significant effect was also found for the lower lip amplitude [$F(2,27)=5.305$; $p<0.05$] and the Fisher's post-hoc showed that the consonant in first position is characterized by smaller amplitude. No significance was found for North-3 for either lower lip gesture duration [$F(2,26)=1.202$; $p>0.05$] - see Figure 5 - or lower lip gesture amplitude [$F(2,26)=1.665$; $p>0.05$].

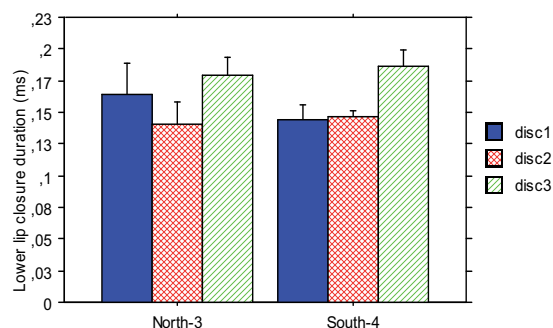


Figure 5: Lower lip closing gesture duration for the two speakers, across prosodic position conditions in the discourse

4 Discussion

Both acoustic and kinematic data were collected in order to investigate phenomena of strengthening of domain initial consonants by speakers of varieties that differently exploit the consonantal length feature in Italian.

The two speakers whose productions have been analysed so far exploit the geminate vs singleton distinction, although depending on sentence position one speaker produces singleton consonants that may be longer than geminates. However, both speakers also differentiate consonants at the beginning of the prosodic domain considered, e.g., the utterance, the

intonational phrase, and lower domains: in this respect kinematic correlates of the closing gesture appear to offer data quite consistent with previous results in the literature.

For strengthening phenomena related to discourse structure, the expectations were not confirmed by our preliminary findings: only one speaker shows significant differences in consonant production, and these differences do not support the existence of (discourse) initial strengthening phenomena.

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