

Post-aspiration in standard Italian: some first cross-regional acoustic evidence

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Abstract

Voiceless geminate stops in Italian are typically described as unaspirated in all positions (e.g. [1, 2]). However, recent acoustic phonetic analysis of part of a corpus of standard Italian speech data has shown that the geminate voiceless stops /pp tt kk/ are frequently realized with both preaspiration i.e. [h^hp: h^ht: h^hk:] (cf. [3]) and post-aspiration. This paper focuses on the latter phenomenon, presenting acoustic phonetic evidence in the form of VOT duration values for /pp tt kk/ tokens recorded in 15 Italian cities (based on the CLIPS corpus of spoken Italian [4, 5]). The co-occurrence of post-aspiration with preaspiration is considered and results are discussed with a focus on regional patterns.

Index Terms: post-aspiration, Italian, geminate, voiceless stop, preaspiration

1. Introduction & background

Italian is often broadly contrasted with languages such as German and English in which the phonological voicing contrast in stops involves post-aspiration. Voiceless stops /p t k pp tt kk/ are described as phonetically unaspirated in standard Italian, while the voiced series /b d g bb dd gg/ is pre-voiced ([1, 2]). Therefore, in a feature-based account, only [voice] is taken to play a role in the distinction between /bb dd gg b d g/ and /pp tt kk p t k/ (e.g. [1]).

In terms of phonetic evidence, discussion of VOT is generally absent from studies on Italian (cf. e.g. [7, pp. 136] for discussion). For example, some investigations into the singleton-geminate distinction in Italian have focused on voiceless stops (e.g. [6] on Roman standard Italian), but only closure duration is reported to increase with gemination and post-aspiration is not reported to occur. Such results are in line with existing descriptions of voiceless stops as always unaspirated in standard Italian.

One recent investigation into the singleton-geminate contrast based on Pisan standard Italian [8, pp.158] implies the presence of post-aspiration, referring to the inclusion of “voice-delaying aspiration” in labeling /tt/, but does not discuss the presence of post-aspiration or its role in the /C/ v. /CC/ contrast any further.

During an ongoing investigation into preaspiration in Italy (e.g. [3, 9]) post-aspiration was frequently visible on acoustic displays for voiceless geminate /pp tt kk/. For example, both pre- and post-aspiration are visible in Figure 1.

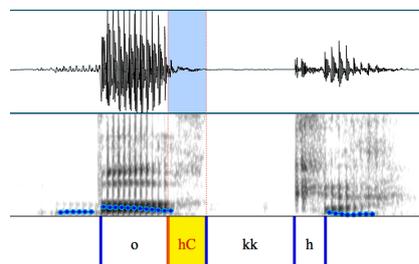


Figure 1. An example of a voiceless geminate stop /kk/ with both pre- and postaspiration in bocca ‘mouth’. Male speaker from Turin (LTp1A04T); nb. preaspiration duration 63ms, post-aspiration 51ms.

When a period of aspiration can both precede and follow consonant closure, as in Figure 1, it suggests something of a mismatch between existing phonological descriptions and the phonetic reality of spoken Italian. With this in mind, this paper investigates post-aspiration in the voiceless geminate series /pp tt kk/ and any regional differences that may exist in terms of their pronunciation. We leave aside comparisons between geminate /pp tt kk/ and other stop categories, primarily because such comparisons are complicated by possible lenition of intervocalic singleton /p t k/ to a range of typically non-occlusive variants - depending on various factors including a speaker’s regional origin.

1.1. Standard Italian and regional varieties

The linguistic situation in Italy is complex and the notion of standard Italian is somewhat problematic (e.g. [5]). Aside from an increasingly small number of professional, trained speakers [2], native listeners can nearly always determine the regional origin of the speaker. This is due to the influence of local dialect on the pronunciation of standard Italian (an example of which is seen in §1.2). Notwithstanding this variability according to a speaker’s regional origin, precise descriptions of standard Italian are important, particularly as it remains the model for L2 learners. The present investigation refers primarily to standard Italian, as it is based on Italian words read in isolation. Nonetheless, keeping in mind the influence of regional origin on pronunciation, and post-aspiration in particular (see §1.2 below), the regional origin of the speakers is considered throughout.

1.2. Postaspirated /pp tt kk/ in Calabria

Exceptionally amongst standard Italian and other regional varieties, post-aspiration is reported to be a feature of voiceless stops in Calabria. Native listeners are aware of the phenomenon, and it has been the subject of a detailed acoustic phonetic investigation, involving speakers from the Calabrian city of Cosenza [7]. Table 1 shows VOT duration values reported in that study for geminate /pp tt kk/ in the local Cosenza dialect (CosD), as well as standard Italian spoken by 3 speakers from Cosenza (CosI), one speaker from Florence (FI) and one speaker from Milan (MI).

	CosD	CosI	FI	MI
/pp/	28	37	11	11
/tt/	74	51	17	22
/kk/	76	67	28	39
Av. /pp tt kk/	59	52	19	24

Table 1. Average VOT duration values for /pp tt kk/ in post-tonic, phrase-final position, reported in [7]).

Comparing across the 4 varieties, we can see that VOT durations are longest in the local Cosenza dialect (CosD), at just under 59ms. for /pp tt kk/ combined. VOT durations are also appreciably longer for Italian as spoken in Cosenza (CosI) than in Florence or Milan. This illustrates the influence of a speaker's local dialect on their pronunciation of Italian (as noted in [7], and in §1.1). These values provide us with a benchmark against which we can usefully compare the present corpus: in the the two left-hand columns /pp tt kk/ are post-aspirated, whereas although /pp tt kk/ in Florence and Milan still showed a VOT lag between 19 and 24ms (in post-tonic phrase-final position), they were not considered post-aspirated in [7]. Supporting their interpretation as post-aspirated in Cosenza, VOT duration values were also consistently longer in post-tonic than in pre-tonic position in Cosenza, but not in Milan or Florence (n.b. only post-tonic position is shown in Table 1). Consistent with cross-linguistic patterns, VOT durations were also consistently longer for velar /kk/ than other places of articulation, except for /tt/ in the local Cosenza dialect, (cf. [7] for detailed discussion, and cf. §4.3 below).

1.3. Preaspiration and post-aspiration

Preaspiration, seen earlier in Figure 1, has been found in the present corpus of data and is described in [3]. Broadly speaking, both preaspiration and post-aspiration involve the same phonetic gesture i.e. voiceless glottal aspiration [ʰ], and as we saw in §1, neither is typically understood to be a feature of voiceless geminate stop production in standard Italian. Preaspiration is remarkably less frequent for speakers from Catanzaro (Calabria) than for all other varieties, occurring in only 3.2% of /pp tt kk/ tokens in comparison with the average of 30% [3]. Recalling from §1.2 that Calabria is the only region in which *post*-aspiration is reported to be perceived by native listeners, these patterns suggest there may be an interaction between the two aspiration phenomena.

2. Aims

This paper aims to provide some preliminary acoustic phonetic evidence of post-aspiration in geminate /pp tt kk/ in standard Italian. We also aim to investigate whether there are any regional patterns in terms of frequency or duration of post-aspiration. In particular we focus on any differences between speakers from Calabria, for whom post-aspiration is known to be a feature, and those native to other regions of Italy. Finally, we aim to document, at least in part, the interaction between pre- and post-aspiration, as part of our ongoing investigation of aspiration phenomena in Italy and sound changes related to them e.g. lenition, that may be taking place.

3. Data and methods

Data for the current study were drawn from part of the CLIPS corpus of spoken Italian [4, 5], involving isolated words read by speakers from 15 Italian cities: Bari, Bergamo, Cagliari, Catanzaro (Calabria), Firenze, Genova, Lecce, Milano, Napoli, Palermo, Parma, Perugia, Roma, Torino and Venezia. The following words from the *Vignetta A* word list, each containing one or more /pp tt kk/ token, were analysed: *bocca*

'mouth', *bottoni* 'buttons', *cappello* 'hat', *macchina* 'car', *occhi* 'eyes', *specchietto* 'little mirror', and *tetto* 'roof'. Each word was read once by eight speakers from each city, giving 8 x 8 x 15 tokens. Some tokens were eliminated due to background noise, leaving 935 tokens. For each token the duration of the preceding vowel, closure and release were measured in Praat, as the labels in Figure 2 illustrate.

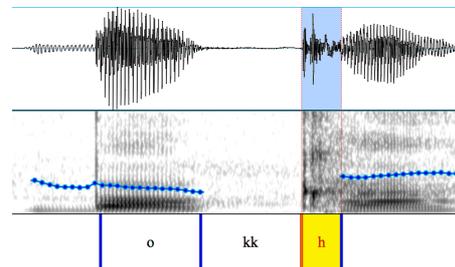


Figure 2. An example of labeled vowel, closure and release (burst + post-aspiration) portions in the word bocca 'mouth'. Female speaker from Catanzaro (L2p1A02H); nb. release duration 53.0ms..

The duration of preaspiration was also separately measured, where present preceding closure, from the offset of modal voice in the vowel to the onset of closure (as shown in Figure 1, earlier; see [3] for detail on segmentation criteria for this portion). The duration of the release portion, the focus of this paper, was measured following criteria described in [7]. That is, referring to both spectrogram and waveform displays, the release (or VOT) was measured from the start of the burst until the onset of voicing for the following vowel, in order to allow for comparison with the Italian data reported in [7].

4. Results & discussion

Results are discussed first in terms of overall duration values. We then concentrate on VOT durations alone according to the city of origin of the speakers (§4.2), and stress and consonant place of articulation in §4.3. Given limited space, after §4.1 only VOT durations are presented, not those of surrounding segments. In this way we concentrate on documenting post-aspiration and leave aside other secondary questions e.g. its impact on closure durations or potential role in the singleton-geminate contrast, for future investigations.

4.1. Overview of /pp tt kk/ duration values

Table 2, below, shows the duration measurements for all 935 tokens, for each of the components of the *vowel + /p t k/* sequence. They are separated according to whether the voiceless stop was realized with ([V^hC^h]) or without ([VC:^h]) a period of preaspiration preceding closure.

	Vowel	Pre.	Clo.	Rel.	n
VC: ^h	101.3 (38)	0.0 (0)	182.9(44)	42.5 (25)	666
V ^h C ^h	98.6 (28)	47.9 (19)	154.2(48)	52.7 (28)	269
All	100.6 (36)	13.8 (24)	174.6 (47)	45.4 (26)	935

Table 2. Duration measurements in ms. (standard deviations in parentheses) for all /pp tt kk/ tokens combined. Number of tokens in final column.

The average duration of the release (burst + post-aspiration) is, at 47.8ms., much longer than would be expected following existing descriptions of voiceless stops geminate stops as unaspirated. It is closer to that reported for voiceless geminate /pp tt kk/ in Italian spoken in Cosenza (52ms.), than in Florence or Milan (cf. Table 1, earlier). Given voiceless stops

are considered post-aspirated in Calabria, this average release value for all 15 cities together, suggests they are frequently post-aspirated in other cities as well. Moreover, the overall average value in Table 2 includes 353 tokens in pre-tonic position, for which VOT durations are predictably shorter (see §4.3).

We can also see that VOT durations are longer for voiceless stops when preaspiration also occurs on the same token, a point which we discuss in §5. Notwithstanding the relatively high average duration value, the standard deviation values of up to 28ms. show there is variability across the corpus. In §4.2 we consider whether this variability may be explained by regional patterns in terms of post-aspiration.

4.2. VOT durations by city

Figure 3, below, shows average VOT durations for /pp tt kk/ across the 15 cities in the present corpus. The sample was balanced across cities inasmuch as it involved the same list of words, but the actual number of tokens varied slightly between cities (between 56 and 64 tokens) where tokens were deleted for background noise.

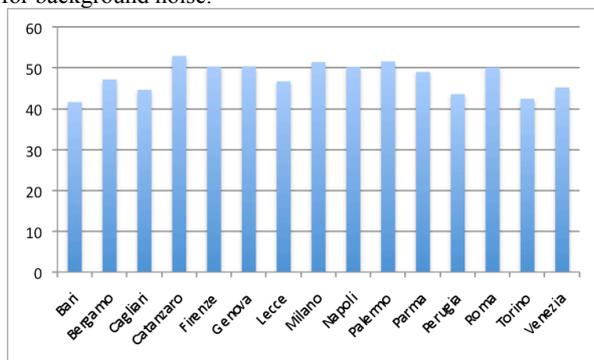


Figure 3. Average VOT durations (in ms.) for /pp tt kk/ tokens across the 15 cities. Values range between 41.6ms in Bari to 52.9ms in Catanzaro.

Average VOT durations are longest in Catanzaro, as expected given post-aspiration is known to occur in Calabria (cf. §1.2). More surprising however is that Catanzaro does not stand out as we may have expected: the average VOT duration is comparably long in other varieties, namely Milan, Palermo and Rome. In terms of the benchmarks established earlier (cf. Table 1), these average VOT durations are consistently closer to those for Italian in Cosenza (52ms), than for Florence (19ms) or Milan (24ms). In other words, if voiceless stops are considered to be post-aspirated in Cosenza, at least based on VOT duration, then they are also post-aspirated in the other 15 cities in this corpus. This pattern raises the question of why Calabria would be the only place in which post-aspiration is reported to be perceived by native listeners.

In terms of what might distinguish voiceless /pp tt kk/ in Calabria, we noted earlier that preaspiration is remarkably less frequent than for speakers native to other Italian cities [3]. In other words, the presence of preaspiration may hinder the perception of post-aspiration. In order to investigate the interaction between pre- and post-aspiration more closely, Figure 4 shows the average VOT duration value for /pp tt kk/ tokens realised with and without preaspiration, for each city in the data set.

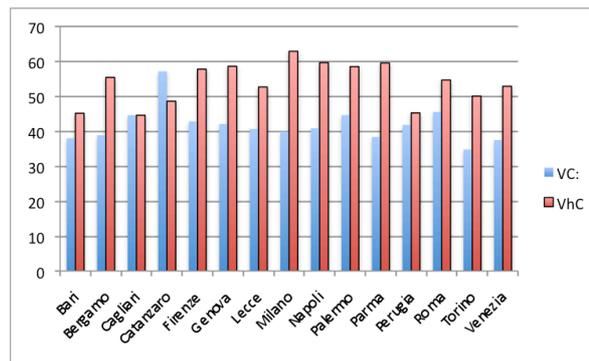


Figure 4. VOT duration values according to whether preaspiration co-occurred on the same voiceless stop token or not (labelled VhC & VC.), for each city in the corpus.

In Figure 4, values on the left are for plain stops, and values on the right (outlined) are for those realised with preaspiration. Only in Catanzaro is VOT duration longer in plain, rather than in preaspirated stops. This, together with the fact that preaspiration is much rarer in Catanzaro, suggests there may be some interaction between preaspiration and native listeners' perception of post-aspiration. However, this can only be usefully investigated with perceptual tests with native listeners. Nonetheless, in terms of regional patterns in these acoustic data, it seems only Catanzaro stands out: here preaspiration is of very low frequency and does not imply an increase in post-aspiration duration.

4.3. By stress and C place

To allow closer comparisons with [7], we consider the impact of consonant place of articulation and lexical stress (pre- or post-tonic, e.g. *bot'toni* and *'bocca*, respectively) on VOT durations. [7] reported that in Cosenza, post-aspiration durations were most perceptually salient and consistently longer in post-tonic phrase-final position. In Florence and Milan, on the other hand, only closure duration increased in phrase-final position. This was interpreted by Soriano as further evidence that post-aspiration is only a phonetic cue to geminate /pp tt kk/ in Cosenza.

Table 3 shows average VOT duration values in pre- and post-tonic positions, for all cities together. We can only compare stress, not phrase-position here as all tokens in the present corpus of data were read in isolation, i.e. in phrase-final position.

	Pre-tonic	Post-tonic	No. tokens
/kk/	59.9 (14)	67.9 (22)	465
/tt/	25.7 (6)	27.9 (7)	356
/pp/	19.2 (5)	n/a	114
Av. /pp tt kk/	35.1 (21)	51.7 (27)	935

Table 3. VOT duration values (standard deviations in parentheses) for voiceless stops in pre-tonic (e.g. *bot'toni*) and post-tonic (e.g. *'bocca*) contexts. N.B. There were no tokens for /pp/ in post-tonic position in the word list.

This table shows that VOT durations are dependent on consonant place of articulation i.e. $kk \gg tt \gg pp$, consistent with established cross-linguistic patterns. The VOT duration for velar /kk/ is longer in post-tonic position, consistent with patterns for Cosenza [7], but /tt/ is not appreciably longer. On this measure therefore, only /kk/ would be considered post-aspirated. Keeping our focus on regional patterns, these VOT duration values were further broken down according to city. Figures 5 and 6, below, show VOT durations for post-tonic and pre-tonic, respectively.

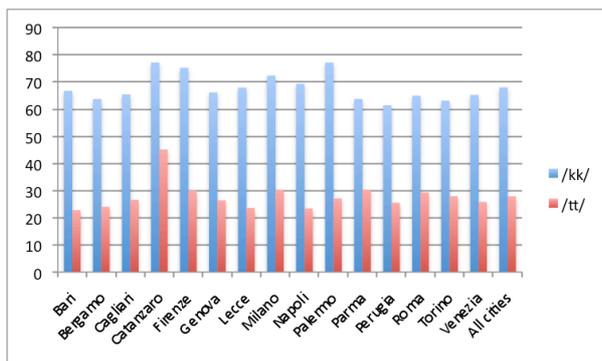


Figure 5. VOT duration values for post-tonic /tt/ /kk/ according to speaker's city of origin. There were no /pp/ tokens in post-tonic position available for analysis.

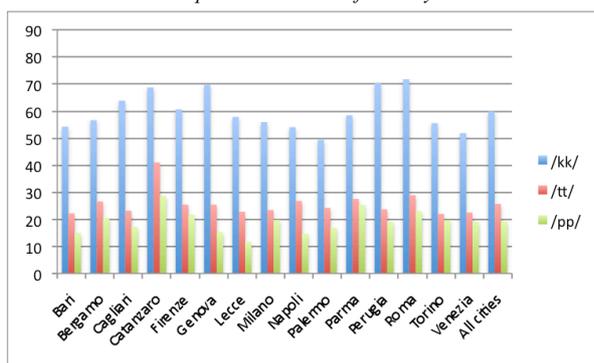


Figure 6. VOT duration values for pre-tonic /tt/ /kk/ according to speaker's city of origin.

Figures 5 and 6 show the pattern for consonant place was upheld in each city, i.e. VOT durations are consistently longer for velar /kk/ than at other places of articulation. Comparing across cities, the VOT duration of /tt/ is relatively longer in Catanzaro than elsewhere, and nearly twice as long as for /tt/ in Bari, Napoli, Lecce and Bergamo, for example. A similar pattern was also found and described in detail in [7] for Cosenza; this result for Catanzaro in these 2 Figures suggests post-aspiration is especially prominent for /tt/ more widely in Calabria. Comparing Figures 5 and 6, we can see that the effect of stress is not always as consistent as that of C-place. While the final columns show overall average VOT durations are slightly longer in post-tonic position for /tt/ and /kk/, this pattern is not upheld within each city. In particular, VOT durations are slightly longer for pre-tonic /kk/ in Rome, Perugia and Genova, and for /tt/ in Naples. We note that these patterns for lexical stress, based on VOT values taken in isolation, must be interpreted with caution: the perception of consonant length and stress in Italian depends on the duration of the consonant relative to that of the preceding vowel (cf. [6] on the C/V ratio). Nonetheless, these preliminary results suggest post-aspiration is not a correlate of lexical stress in these data. Other than the specific pattern for /tt/ in Catanzaro, there appear to be no other regional patterns when the data are broken down according to C-place and stress.

5. Further discussion

In terms of whether voiceless geminate stops should be described as post-aspirated in standard Italian, we refer back to Soriano ([7]) who argues that they are generally post-aspirated in Cosenza, but found that in Florence and Milan VOT values were “in fact decisively lower than those found for Cosenza” (pp. 138, translation ours). Instead, we have seen here that post-aspiration, at least in these data, is a frequent feature of voiceless stop production everywhere. More

specifically, the VOT duration values for all 15 cities better match those for Cosenza in [7] than for Florence or Milan – varieties considered as lacking post-aspiration in that study. Therefore, /pp tt kk/ appear to be more generally post-aspirated, to a greater or lesser extent, more widely in Italy as well as in Calabria. As to whether post-aspiration may be a relatively new development in Italian, [10] argues that in Spanish, post-aspiration is a secondary development following aspiration of coda /s/ in Andalusian e.g. /pasta/ > [pahta] > [pahtʰa]. Following this hypothesis, the presence of preaspiration in Italian, documented in [3], might be a conditioning factor for occurrences of post-aspiration documented here. However, this remains to be tested further for Italian. Moreover, as noted earlier, post-aspiration is not reported to be perceived by native listeners outside of Calabria. Therefore perception tests are much needed to determine the role, if any, of post-aspiration in signalling stop contrasts in Italy, as well as to investigate its interaction with preaspiration, (particularly given the different patterns uncovered for Calabria (cf. §4.2)).

The fact that /pp tt kk/ can be realised with aspiration on either side of the supralaryngeal closure portion does not match existing descriptive sources for standard Italian. [1], for example states “Italian employs the contrastive feature [voice] as opposed to [spread glottis]” (pp. 46). If the presence of aspiration is the phonetic cue to the phonological feature [spread glottis] (e.g. [11]), then it follows that [spread glottis] would play a role in the phonological distinction between voiced and voiceless stops in standard Italian. Acoustic phonetic evidence of the realization of /bb dd gg/ is needed to determine whether they are prevoiced (ie. [voice]) or whether +/-[spread glottis] might be sufficient to account for the voice/voiceless distinction in Italian.

6. Acknowledgements

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7. References

- [1] Kramer, M. “The phonology of Italian”. OUP, 2009.
- [2] Bertinetto, P. M. & Loporcaro, M. “The sound pattern of Standard Italian, as compared with the varieties spoken in Florence, Milan and Rome”. *JIPA* 35 (2): 131-151. 2005.
- [3] Stevens, M. “How widespread is preaspiration in Italy? A preliminary acoustic phonetic overview”. *Proc. FONETIK2010*. Stockholm. 2010.
- [4] CLIPS Corpora e Lessici di Italiano Parlato e Scritto. Online: <http://www.clips.unina.it/it/index.jsp>, accessed on 31 March 2010.
- [5] Savy, R. and F. Cutugno. “CLIPS Diatopic, diamesic and diaphasic variations in spoken Italian”. *Proc. 5th Corpus Linguistics Conference*. 2009. Available at: <http://people.na.infn.it/~cutugno/new/publicazioni.php>
- [6] Pickett E., S. Blumstein & M. Burton. “Effects of speaking rate on the singleton/geminate contrast in Italian”. *Phonetica* 56, 135-157. 1999.
- [7] Soriano, P. “Indici fonetici delle occlusive sorde nel Cosentino”. *Rivista italiana di dialettologia* 20: 123-159. 1996.
- [8] Payne, E. “Phonetic variation in Italian consonant gemination”. *JIPA* 35 (2): 153-181. 2005.
- [9] Stevens M. & J. Hajek. “Towards a phonetic conspectus of preaspiration: acoustic evidence from Sieneese Italian”. *Proc. ICPHS XVI*, 429-432. 2007.
- [10] Torreira, F. “Pre- and postaspirated stops in Andalusian Spanish”. In P. Prieto, J. Mascaró & M-J Solé (eds) *Segmental and prosodic issues in Romance phonology*, 67-82, John Benjamins. 2007.
- [11] Helgason, P. & C. Ringen. “Voicing and aspiration in Swedish stops”. *Journal of Phonetics* 36: 607-628. 2008.