

# How widespread is preaspiration in Italy? A preliminary acoustic phonetic overview

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## **Abstract**

*Preaspiration is a comparatively rare phonetic feature, almost entirely confined to languages spoken in far northwestern Europe (Andersen 2002; Helgason 2002). A recent acoustic phonetic investigation into consonant gemination in Siene Italian (e.g. Stevens & Hajek 2007), however, found that preaspiration occurred in one third of geminate /pp tt kk/ tokens. Up until that point preaspirated stops had not been reported to occur in Siene or any other variety of Italian including the standard language. With this in mind, the present paper presents the results of an acoustic phonetic investigation into voiceless geminate stops /pp tt kk/ in a controlled corpus of words read by speakers from 15 other Italian cities. Results are analysed according to city as well as factors (e.g. speaker sex, vowel type) known to favour occurrences of preaspiration in other better known preaspirating languages. Preliminary duration values are presented and results are discussed in terms of two specific hypotheses regarding the rise of preaspiration in Siene Italian.*

## **Introduction & background**

### **Geminate consonants in Italian**

Consonant length is contrastive in (standard) Italian e.g. *pala* ‘shovel’ v. *palla* ‘ball’. The duration of the consonant, that of the preceding vowel, and the ratio between them (C/V) all play a role in signalling phonological consonant length (e.g. Pickett et al. 1999).

Geminate voiceless stops /pp tt kk/, in particular, are described as unaspirated in all prosodic positions in standard Italian (e.g. Bertinetto & Loporcaro 2005). Manner of articulation has not been a focus of existing experimental phonetic studies on geminates in standard Italian (e.g. Pickett et al. 1999), however post-aspiration of geminate voiceless stops is reported to occur in Calabria (Soriano 1996). Degemination is a feature of northern varieties and the geminates of standard Italian as pronounced by these speakers are often less salient (Bertinetto & Loporcaro 2005).

### **Standard Italian and regional varieties**

The linguistic situation in Italy is complex and the standard language, while historically derived from Florentine Italian, is today perhaps best described as an abstraction only used, and increasingly less so, by trained speakers

(Bertinetto & Loporcaro 2005). The pronunciation of standard Italian is influenced by distinct regional accents, which can be very broadly categorized into those of the north, centre (Tuscany) and south.

The present study involves a list of standard Italian words read by speakers from 15 cities spread over these three regions. The controlled circumstances mean less regional influence on speakers’ pronunciation than would occur in a less formal setting. However, such data allow us to test whether preaspiration is a regional feature of Siene or whether it occurs more widely and in standard Italian, as spoken across Italy.

### **Preaspiration**

Preaspiration involves a breathy h-like sound before the closure period for voiceless stops i.e. [hp ht hk], which results from early glottal abduction relative to the supralaryngeal closure gesture. The term preaspiration is often taken as a cover term for a range of finegrained realisations including ‘archetypal’ [h], breathy voice [ɦ] and preglottalization (e.g. Stevens & Hajek 2007). Preaspiration, like glottal /h/ more generally, is hard for listeners to hear, which may explain why it could go unnoticed or at least unreported, despite occurring relatively frequently in Siene Italian speech.

## Preaspiration in Sienese Italian

An earlier investigation found that third of /pp tt kk/ are realised with preaspiration in spontaneous Sienese speech (e.g. Stevens & Hajek 2004, 2007). While the frequency and distribution of preaspiration are described in detail elsewhere, we note here that preaspirated stops occurred for all 6 speakers in the corpus (albeit more frequently for some than others) and was also found to interact with consonant place (most frequent for velar /k:/) and vowel type (most frequent following low central /a/), but not stress.

In terms of why preaspiration would occur in this variety, here we consider two potential hypotheses. (1) Preaspiration could be related to the *Gorgia toscana* (GT), which weakens intervocalic singleton /p t k/ to voiceless fricatives including glottal [h] in Sienese and some other Tuscan varieties (e.g. Villafaña-Dalcher 2008). With an articulatory similarity to preaspiration (also glottal [h]), GT distinguishes these Tuscan varieties from those spoken elsewhere in Italy, including the standard language. This may explain why preaspiration was found in Siena, but not, to date, elsewhere.

Alternatively, (2): in contrast to other experimental phonetic studies on Italian (e.g. Pickett et al. 1999), the investigation into Sienese was based on spontaneous speech. Keeping in mind the partial debuccalization involved (e.g. [k:] > [hk]), preaspiration may be a kind of weaker, hypoarticulated form of plain unaspirated [pp tt kk] that would typically, and perhaps only, occur in less formal, fast and/or careless speech. However, such an interpretation is not supported cross-linguistically: preaspiration occurs in both controlled and spontaneous Swedish speech (Helgason & Ringen 2008).

Under either hypothesis, recall from above that preaspiration is hard for listeners to hear, even when especially listened for. Therefore it may only have come to light in Sienese Italian because of the detail that more recently developed acoustic phonetic methods allow.

## Aims

This paper aims to investigate why preaspiration would occur relatively frequently in spontaneous Sienese Italian speech, and yet had not previously been reported to occur in this or any other variety of Italian. We aim to test the two specific hypotheses suggested above, i.e.

whether preaspiration in Sienese may be explained by either (1) the presence of GT in that variety, or (2) the use of spontaneous speech data in the earlier investigation into Sienese Italian. This paper tests both hypotheses by investigating the realisation of voiceless geminate /pp tt kk/ in controlled standard Italian - in which GT is not present. On this point, however, recall from that it is difficult to find examples of standard Italian unmarked by regional influences - such as GT weakening of /p t k/ for speakers native to Siena, Florence and some other parts of Tuscany. Therefore, while the data are essentially standard Italian, speakers' regional origin is also taken into account.

## Data & methods

The data were drawn from part of the CLIPS corpus of spoken Italian. Only words read in isolation were analysed - at least for the purposes of this preliminary overview, in order to have a balanced set of data across geographical locations. Sociocultural background and age of the speakers was controlled in the original corpus (see Sobrero 2006 for details). For the present study only word-medial voiceless geminate stops /pp tt kk/ in the *Vignetta A* word list were analysed (the specific words analysed here were *bocca* 'mouth', *bottoni* 'buttons', *cappello* 'hat', *macchina* 'car', *occhi* 'eyes', *specchietto* 'little mirror', and *tetto* 'roof', giving 8 /C:/ tokens). Each word was read once by eight speakers for each variety. Some tokens were eliminated due to background noise, leaving 935 tokens.

These individual words were extracted and for each /VC:/ sequence, the duration of the preceding vowel, the closure period, and the release (comprising the burst and any postaspiration) were manually measured in Praat. These labels are shown in Figure 1.

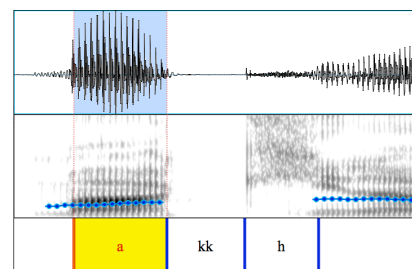


Figure 1. A voiceless velar stop /kk/ in *macchina* 'car' realised without preaspiration by a male speaker from Florence (LTp1A01F).

In addition, preaspiration was also labelled separately as hC when it preceded the closure portion, as shown in Figure 2.

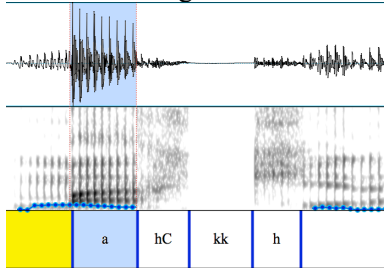


Figure 2. Macchina produced by a male speaker from Turin (LTp1A04T), with preaspiration (hC) in addition to the three labels seen in Figure 1.

Preaspiration was measured from the offset of modal voicing in the vowel (consistent with e.g. Helgason & Ringen 2008). This criterion meant that tokens realised with visible breathy voice in the vowel offset were included as preaspirated tokens. For example the /ak:/ sequence in Figure 3 closely resembles that in Figure 2, above, except that here the pitch trace (i.e. voicing) continues throughout the ‘preaspiration’ portion.

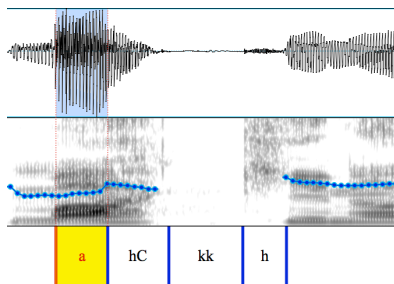


Figure 3. Macchina produced by a female speaker from Rome (LTp1A04R), with breathy voice (labelled as hC) preceding velar closure.

Finally, some /pp tt kk/ tokens were realised with preglottalization, i.e. with adducted rather than abducted vocal folds, as in Figure 3, below. These were counted as preaspirated alongside those of the type seen in Figures 2 and 3, primarily because they both differ from expected plain [p: t: k:].

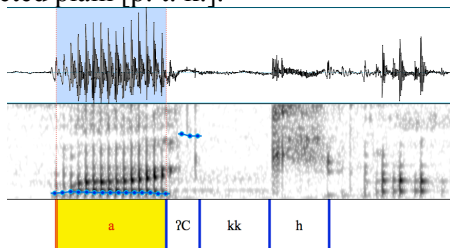


Figure 4. Macchina produced by a male speaker from Lecce (LTp1A04L), with preglottalization. Creak is also clearly visible on the final vowel.

Tokens were classified into two groups according to the presence or absence of preaspiration (including preglottalization and breathy voice), and analysed according to the speakers’ native city, speaker sex, individual speaker; as well as vowel type, consonant place and lexical stress. Preliminary statistical tests were conducted on the duration values within Excel (single factor Anovas).

## Results & discussion

Overall, preaspiration occurred in 269 of the total 935 /pp tt kk/ tokens analysed, i.e. 28.8%. Of these 269 preaspirated tokens, 17 were realised with glottal adduction, further described below. This overall frequency patterns very closely to the Sienese corpus (29.2%; Stevens & Hajek 2007). First, duration values for /VC:/ sequences with and without preaspiration are compared in Figure 5.

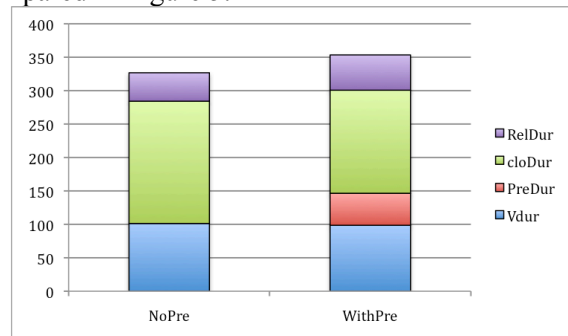


Figure 5. Average duration values (in ms.) for components of /VC:/ sequences with preaspiration (right; 269 tokens) and without (left; 666 tokens).

We can see that the overall duration of /VC:/ sequences is longer when preaspiration intervenes between the vowel and the closure portion. At 26.7ms. this is a statistically significant difference ( $p < 0.005$ ). The duration of the preceding vowel remained relatively stable whether preaspiration occurred or not ( $p = 0.293$ ). The average duration of the preaspiration portion at 47.9ms. is very similar to the value of 44ms. reported by Helgason & Ringen (2008) for preaspiration in isolated words read by Swedish speakers. These authors point to considerable interspeaker variability in terms of preaspiration duration which there is not space to investigate here, although note that preaspiration durations ranged from only 11ms. to 137ms. across the present corpus. The average closure duration was significantly shorter (-28.9ms.;  $p < 0.005$ ) when preaspiration

intervened in the /VC:/ sequence, whereas the release was significantly longer (+11ms;  $p < 0.005$ ). Indeed, while /pp tt kk/ are always described as unaspirated in standard Italian, post-aspiration - discussed below - was frequent across the data set and can be seen in all four tokens in Figures 1-4. In terms of the neighbouring segments therefore, only closure duration and not vowel duration appears to interact with preaspiration. However while the shorter closure duration compensates somewhat for the intervening segment, when preaspiration is included as part of the consonant (i.e. preaspiration + closure + release), the preaspirated tokens are 29.4ms. longer, again a significant difference ( $p < 0.005$ ). Given vowel duration remains stable, the overall /VC:/ sequence duration is also significantly (26.7ms.;  $p < 0.005$ ) longer for the preaspirated stops.

Turning to frequency, Figure 6 shows the frequency of preaspiration according to each of the 15 cities included in the CLIPS corpus.

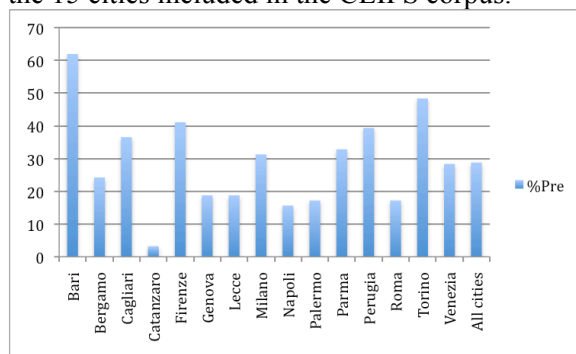


Figure 6. Frequency of preaspiration in the /pp tt kk/ tokens analysed for 15 Italian cities. Actual token numbers ranged between 56 and 64 for each city.

Values are shown as a percentage of the total tokens for each city, which were between 56 and 64 in each case. We can see that in every city in the corpus at least some of the geminate voiceless stops were produced with preaspiration. It is most frequent in Bari, occurring in just over 60% of the tokens analysed, whereas only 2 (3.2%) of the tokens from Catanzaro showed a preaspiration portion. Therefore there is no clear pattern in terms of the geographical distribution of preaspiration e.g. according to northern, central or southern cities: Bari (Puglia) and Catanzaro (Calabria), with the highest and lowest frequencies of preaspiration, respectively, are both in the far south of Italy. Moreover, given preaspiration was first reported in Siena, in central Italy, we might have expected it to be relatively more

frequent for the central Italian cities in the present corpus. However again there is no clear pattern: preaspiration occurs in 40% of the tokens drawn from nearby cities of Florence and Perugia, i.e. well above the average of 28.8%, but only half as frequently for speakers from the other central variety spoken in Rome (17.2%). Figure 6 clearly shows that preaspiration is not confined to speakers from Florence, the only region with GT in the sample, so there appears to be no direct link between GT and the rise of preaspiration. Nonetheless, regional allophonic processes like GT may explain the way preaspiration is more frequent for speakers from some regions than others (most notably Catanzaro) in Figure 6. We return to this point below.

Turning to other potential influences on the frequency of preaspiration, it has been reported to be more frequent for female than male speakers (Helgason & Ringen 2008). However in these data there was little difference in the frequency of preaspiration according to speaker sex: preaspiration occurred in 132 of 440 tokens (30%) for females, and it was only slightly less frequent for male speakers at 27.7% of 495 tokens.

Tokens were then further broken down according to individual speaker. Figure 7 shows the percentage of speakers within each variety with at least one preaspirated /VC:/ token amongst the 8 analysed. Here the preglottalized tokens are shown separately, in order to determine whether individual speakers may prefer one gesture over the other.

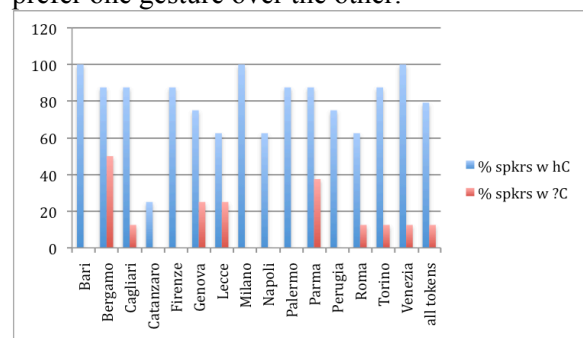


Figure 7. Percentage of speakers (8 for each city) with preaspiration, and preglottalization in /VC:/ sequences. 8 tokens per speaker.

Preaspiration is relatively evenly distributed across speakers in the corpus, inasmuch as for all cities except Catanzaro, half the speakers show at least one preaspirated token. While marginal in comparison to the frequency of preaspiration, it is worth noting the 17

preglottalized tokens were spread across 15 speakers in the corpus, each of whom also realised one or more /pp tt kk/ token with preaspiration. In other words, it does not appear that certain speakers favour either preglottalization or preaspiration.<sup>1</sup> Overall, Figures 6 and 7 show that preaspiration is a relatively widespread feature in Italy, albeit more occurring more frequently for some regions and for some individual speakers than others. In this sense Italian is very similar to Swedish, for which preaspiration is also a non-obligatory but relatively frequent feature (Helgason & Ringen 2008).

The impact of phonemic context on the frequency of preaspiration in the data was then examined, beginning with consonant place of articulation as shown in Figure 8.

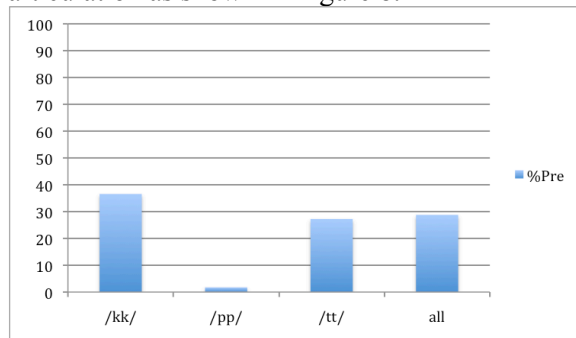


Figure 8. Frequency of preaspiration according to consonant place of articulation (as a percentage of total tokens for each C-place, 465 velar, 114 bilabial and 356 dental).

Preaspiration is most frequent for velar /k:/ (36.6%) and less frequent for dental /t:/ (27.2%), whereas only 1.75% of the /p:/ tokens analysed showed preaspiration. This overall pattern for consonant place (kk >> tt >> pp) is consistent with Sienese Italian spontaneous speech (Stevens & Hajek 2004).

The frequency of preaspiration was then examined according to vowel type in Figure 9 below. The sample is restricted because only three vowels /a e o/ preceded /p: t: k:/ in the data. Nonetheless, preaspiration is most frequent after low central /a/, a pattern that is consistent with the earlier corpus (Stevens & Hajek 2004).

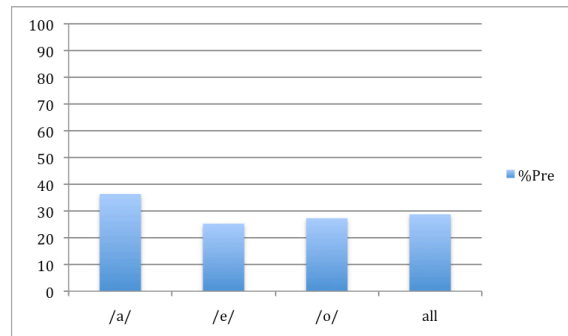


Figure 8. Frequency of preaspiration according to vowel type (values show the percentage of the 231 /a/, 356 /e/ and 348 /o/ tokens that were followed by a preaspiration).

Finally the frequency of preaspiration was examined according to whether the vowel in the /VC:/ sequence was stressed (e.g. *occhi*) or not (e.g. *bottoni*). Here we refer to lexical stress, although phonetic destressing was not an issue as the words were read in isolation, and lexical stress was realised phonetically in every case. Figure 9 shows the frequency of preaspiration in unstressed (\*VCC) and stressed (‘VCC) sequences, as well as for all sequences combined.

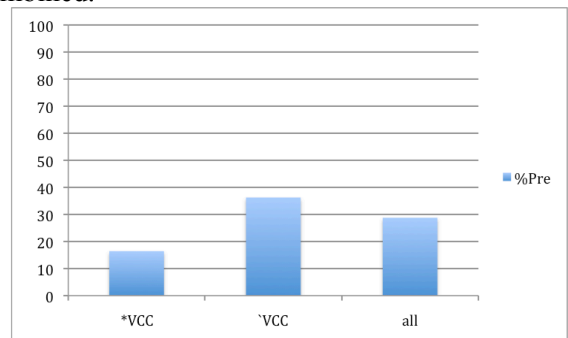


Figure 9. Frequency of preaspiration in pre-tonic (\*VCC) and post-tonic (‘VCC) positions.

We can see that preaspiration was twice as frequent in post-tonic position (36.2%) as following unstressed vowels (16.4%). This is consistent with existing evidence for preaspiration in Swedish (Helgason & Ringen 2008) but not with evidence for Sienese Italian (Stevens & Hajek 2004). However that earlier study did not take phonetic destressing – prevalent in spontaneous speech – into account. The controlled speech data in Figure 9 are therefore more reliable and show a clear interaction with stress: preaspiration is more likely to occur following lexically stressed than unstressed vowels in standard Italian.

<sup>1</sup> Further research is needed into these categories and whether they should in fact be treated as part of the same overall phenomenon as they are here (indeed Andersen (2002) categorises preglottalization as weakening, but preaspiration as strengthening).

## Further discussion

While not previously reported, results just presented show that preaspiration occurs in standard Italian, and with a similar frequency and distribution to patterns already documented for Sienese spontaneous speech (e.g. Stevens & Hajek 2004, 2007). Therefore preaspiration is not a specific regional feature of geminate production in Sienese Italian, but rather a more widespread feature in Italy, occurring as it does in controlled standard Italian in all regions sampled in the CLIPS corpus. Given these results, it is unclear why preaspiration has not been reported elsewhere for Italian.

The issue of more interest, however, is why preaspiration would arise in Italian, and what it may mean for sound patterns in Italy. There is not space here to adequately address these issues. Nonetheless in terms of the 2 specific hypotheses raised earlier, results do not support a direct link with GT. Preaspiration occurred in the standard Italian of all 15 cities, and no more frequently for speakers from Florence, for whom GT is a regional feature, than in places without GT e.g. Bari or Turin. On the other hand while preaspiration appears to be a tendency across Italy, it is clearly more frequent in some regions than others, and perhaps it is regional allophonic processes that can explain these differences. The relative lack of preaspiration for speakers from Catanzaro, for example, is striking as Calabria is the only Italian region for which post-aspiration of /p: t: k:/ is reported (Soriano 1996). At this point the interaction between pre- and post-aspiration remains unsolved, particularly as post-aspiration was in fact widespread in the present corpus of standard Italian.

Hypothesis 2 was also not supported by these results: just under one third of /pp tt kk/ tokens are preaspirated in the isolated words analysed here. Therefore preaspiration cannot be considered a kind of hypoarticulation associated with or even confined to spontaneous speech. On the contrary, duration values were longer for /VC:/ sequences with preaspiration. This could perhaps support its interpretation as a deliberate reinforcement of the geminate, although again, more detailed investigation is needed on this point.

Overall, while voiceless stops are described as unaspirated in standard Italian (Bertinetto & Loporcaro 2005) this study has shown that both pre- and post-aspiration are prevalent. This preliminary result suggests that [spread glottis]

plays a role in phonological stop contrasts in Italian, although phonetic research into voiced /b: d: g:/ is necessary here, as well as perceptual tests with native listeners to determine what impact, if any, preaspiration has on these contrasts (i.e. singleton-geminate & voiced-voiceless). Now that preaspiration has been broadly documented here for standard Italian, further dialect specific research (e.g. involving more natural speech styles) is also clearly necessary in order to shed light on the possible interaction between regional allophonic processes and the rise and distribution of preaspiration in Italy.

## Acknowledgments

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