

# Preaspirated /pp tt kk/ in standard Italian: a sociophonetic v. phonetic analysis

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## Abstract

This paper investigates preaspiration of geminate stops in Standard Italian /pp tt kk/. We first compare voiceless stops produced in isolated words according to speaker sex and then region (Northern, Central and Southern Italy). We find that the frequency and duration of preaspiration remain relatively stable across these sociophonetic categories. Given these patterns we suggest that the appearance of preaspirated stops is conditioned primarily by phonetic (consonant place, vowel type, lexical stress) rather than the sociophonetic factors under consideration.

**Index Terms:** preaspiration, Italian, geminate, duration

## 1. Introduction

In standard Italian the phonological voiced/voiceless contrast in long stops is typically described as involving phonetically fully voiced /bb dd gg/ [bb dd gg] v. voiceless unaspirated /pp tt kk/ [pp tt kk] with full oral occlusion until release [1, 2]. That is, neither post-aspiration nor preaspiration is thought to play a role in the phonological voiced/voiceless contrast. Recently, however, preaspirated voiceless stops, with a portion of voiceless frication before the closure period e.g. [ʰk], has been found alongside full stops, e.g. [kk], for Italian voiceless geminate stops [3, 4]. Such preaspiration has to date been documented for spontaneous Sieneese Italian e.g. [3, 4, 5], and now also in controlled standard Italian speech recorded across spread across Italy [6, 7].

Preaspiration, well known in some Scandinavian languages (eg [8, 9]), is also a recent finding in some British varieties of English (e.g. [10, 11]). Detailed studies (e.g. [10]) have also shown that socially conditioned, i.e. sociophonetic, and more intrinsic phonetic factors influence the inter-gestural timing for voiceless stop production in Newcastle English. Here the frequency of preaspiration is conditioned by phonetic factors such as place of articulation (most frequent for alveolar /t/) and phrase-final position, but it is also sociophonetically conditioned, occurring most frequently in the speech of young females (female speakers of Swedish also show a greater tendency to preaspirate than males [9]).

We are interested in this preliminary study in whether sociophonetic factors could also help to explain the realization of voiceless geminate /pp tt kk/ with preaspiration in Italy. Our initial hypothesis about possible interaction with gender is uncertain (see 2.2) but we would certainly expect regional origin to have an impact on our results, given important differences in voiceless stop production across different parts of Italy.

## 2. Background

### 2.1. Preaspiration in Italian

Preaspiration was first found in a corpus of spontaneous speech recorded in Siena (e.g. [3, 4, 5]). At that time we

suggested that it may be a regional feature associated with Sieneese speakers in particular, given it had not been previously reported for any other variety of Italian (see [8] for cross-linguistic information and phonetic detail on preaspiration). However more recent analyses of standard Italian in [6, 7] have shown that voiceless geminate stops can be produced with preaspiration (and post-aspiration) throughout Italy. [6] focused mainly on frequency counts, and reported that across the sample one-third of the /pp tt kk/ tokens analysed were produced with a portion of preaspiration. In these Italian data, preaspiration was most frequent for velar /kk/, in contrast with varieties of English in which /t/ is most affected (as noted in §1). The frequency of preaspiration in Italian is also influenced by vowel type and stress: it is most frequent after low central /a/; and after stressed vowels. ([3] reported it not to be affected by stress but this was due to destressing in spontaneous speech data; cf. [6]). Position in the phrase has not yet been investigated, although our auditory impression is that it is also most salient phrase-finally, as in Newcastle English [10]. Importantly, it should be noted that in these earlier studies ([6, 7]) no attempt was made at lower level analysis of results, eg influence of speaker sex or regional origin.

### 2.2. Speaker sex and preaspiration

As noted in §1, speaker sex is reported to interact with preaspiration. In language varieties where preaspiration is non-obligatory, such as in Newcastle English [10, 11] and Central Standard Swedish [8, 9], female speakers show a greater tendency to preaspirate, as well as showing longer preaspiration durations.

This tendency was not found to be the case in our earlier investigation of spontaneous Sieneese Italian speech [5], but the very nature of these data did not allow for possible interaction between different factors to be easily controlled for across comparisons. Therefore it remains to be tested – by means of a controlled corpus - whether speaker sex might play a role in the rise of preaspiration in Italian.

### 2.3. Standard Italian and regional effects on pronunciation in Italy

Regional origin is well known to impact on the pronunciation of standard Italian. General regional (north, centre, south), if not much more local, identification of Italian speakers by their accent is normal in Italy. Very different dialect substrata play an important role in this variation – even amongst those who do not speak dialect. In the first instance Northern Italy needs to be distinguished from Central-Southern Italy. In the north, there is at dialect level no distinction between long and short stops – which always appear short. Similar is also reported to be characteristic of northern speakers of Standard Italian: long stops are often short or at least not fully lengthened. In central and southern Italy, long stops are always traditionally reported to be maintained as such – whether in dialect and in regional Italian [2]. There is to date, however, no experimental

confirmation of these cross-regional claims which remain based on impressionistic observation.

With respect to singleton voiceless stops, there is a three-way regional difference. They are fully articulated in the north with no trace of lenition. In central and southern Italy they are frequently lenited: in the former (especially in Tuscany) to voiceless fricatives, e.g. /la kasa/ > [la xasa]/[la hasa] ‘the house’ and elsewhere, especially in the south they may be partly or fully voiced - often with a laxed articulation, e.g. [la gasa].

Our hypothesis is that preaspiration should be much less frequent and/or robust in duration in northern varieties of standard Italian, since partial supralaryngeal gesture reduction or laryngeal modification in stops is normally thought to be characteristic of Central and Southern Italy only. Previously mentioned temporal reduction of long stops in the north involves the loss of all laryngeal and supralaryngeal gestures for that time period. With respect to Central and Southern Italy, our expectation is that preaspiration should be much more frequent and robust in the former. Earlier work in [3, 4, 5] points to preaspiration as frequent in Sienese Italian (spoken in Tuscany). The same authors also hypothesized that preaspiration of stops here can be justified as: (a) a strategy used by speakers to enhance voicelessness at stop onset (even in singletons); and (b) linked to voiceless fricativization of stops – all of which avoids any voicing encroachment into voiceless stops – long or short. On the other hand, we would expect preaspiration to be less frequent and/or robust in southern Italy than in the centre, but possibly more frequent/evident than in the north since long voiceless stops are normally considered to be fully and properly articulated, but short voiceless stops are often voiced and lenited.

### 3. Aims

The primary aim of this paper is to determine whether there is any evidence that preaspiration of voiceless stops in Italy is sociophonetically motivated. Here we investigate whether regional origin of the speaker or speaker sex has an impact on preaspiration, ie. on its frequency of occurrence or on its relative and absolute duration. That is, whether these two sociophonetic factors might help to explain the variability in intergestural timing that we have found for geminate voiceless stop production in Italian. We then examine the impact of phonetic context on the frequency and duration of preaspiration, allowing us to gauge the relative impact of the sociophonetic v. selected phonetic factors on geminate voiceless stop production in our corpus.

## 4. Method

### 4.1. The data

The data are drawn from part of the Clips corpus of spoken Italian [12, 13]. To allow a balanced comparison across regions, we focus on data recorded in nine cities: three in Northern Italy (Venice, Milan, Turin), three in Southern Italy (Bari, Napoli, Palermo) and three Central cities (Perugia, Florence, Rome).

The data involve standard Italian words read in isolation, containing word-medial voiceless geminate stops /pp tt kk/ (specifically *bocca* ‘mouth’, *bottoni* ‘buttons’, *cappello* ‘hat’, *macchina* ‘car’, *occhi* ‘eyes’, *specchietto* ‘little mirror’, and *tetto* ‘roof’, giving eight /C:/ tokens). Each word was read once by eight speakers. Some tokens were eliminated due to background noise, leaving 556 tokens.

### 4.2. Labelling

The 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. In addition the duration of preaspiration, for tokens where it intervened between the vowel and the closure period, was also recorded. Preaspiration was measured from the offset of modal voice in the vowel to the onset of closure, with reference to the spectrogram and waveform. These labels are shown in Figure 1, showing two V+CC sequences in part of the word *specchietto*.

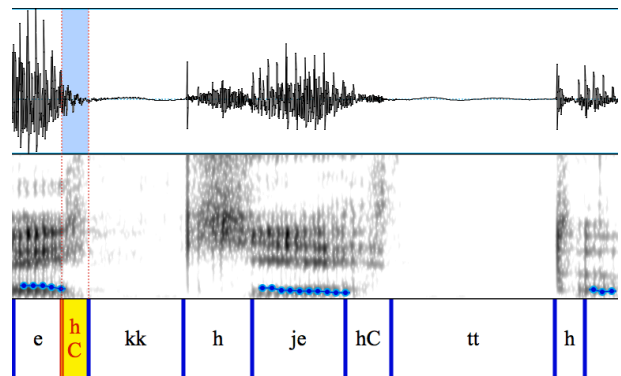


Figure 1. Two preaspirated stops in the word *specchietto* “little mirror”. Preaspiration is labeled ‘hC’ to distinguish it from postaspiration ‘h’. Produced by a male speaker from Perugia (central Italy; LTp1A030).

We compare these duration values across tokens with and without preaspiration, according to sociophonetic and phonetic factors. Preliminary statistical tests (t tests) were done in R.

## 5. Results

### 5.1. Overview of preaspiration

We first broadly compare the /pp tt kk/ tokens realized with and without preaspiration. Table 1 shows that 184 (33%) of the 556 tokens were preaspirated, and that its average duration is 48.5ms.

	V	pre	clo	rel	Number tokens
V <sup>h</sup> C	97.0 (28)	48.5 (21)	159.1 (48)	52.3 (29)	184
VCC	99.5 (37)	n/a	191.5 (46)	41.1 (24)	372
All					556

Table 1. Duration values for the component parts of /VC:/ sequences with (V<sup>h</sup>C) and without (VCC) preaspiration; standard deviations in parentheses.

The occurrence of preaspiration (pre) in /VC:/ sequences has the greatest impact on closure duration (clo), which is 32.4ms shorter compared with tokens realized without preaspiration. In contrast the duration of the preceding vowel (V) remains stable whether preaspiration occurs or not; the release duration (rel) is longer when preaspiration occurs. These overall patterns are consistent with earlier findings and are described in [6, 7].

### 5.2. Speaker sex

In Table 2 the tokens were broken down according to speaker sex. Ninety of the 289 tokens for males were preaspirated

(31%); preaspiration was only slightly more frequent for female speakers, (35.2% of tokens). In this respect the Italian data differ from available data for other languages. Preaspiration is substantially more frequent for female speakers in Newcastle where it occurs in 63% of phrase-final intervocalic /t/ produced by females, but only 13% for males [11].

		V	pre	clo	rel	no tokens
Female	V <sup>h</sup> C	96.2 (28)	51.7 (22)	159.3 (49)	47.5 (26)	94
	VCC	99.7 (39)	n/a	192.4 (45)	39.3 (24)	173
Male	V <sup>h</sup> C	97.8 (28)	45.0 (19)	159.0 (48)	57.3 (31)	90
	VCC	99.3 (35)	n/a	190.8 (47)	42.7 (24)	199
All						556

Table 2. Duration values for /VC:/ sequences with and without preaspiration, for male and female speakers (standard deviations in parentheses).

On the other hand, preaspiration was marginally longer (7ms) in tokens produced by female than male speakers (51.7ms v. 45.0ms). However this difference is below the perceptual threshold and was not statistically significant. [9] report a greater difference for central standard Swedish: 52ms for female and only 35ms for male, i.e. 17ms. The average duration of the release portion in Table 2 shows a greater difference between sexes than does preaspiration, and is 10ms longer for male speakers. All this suggests that there is no clear effect of speaker sex on preaspiration in Italian, at least compared with the frequency data available for Newcastle English and the durations for Central Standard Swedish.

### 5.3. Regional origin of the speaker

Table 3 shows the same data broken down according to regional origin of the speaker as Northern (N), Central (C) or Southern (S). Looking first at the frequencies, we can see that preaspiration is no more frequent for speakers from Central Italy (32%), where preaspiration was first reported, than elsewhere. In fact the frequency of preaspiration is stable across each the three regions at roughly a third of the tokens (albeit, and to our surprise, slightly more frequent for Northern speakers (35.9%) and not less frequent for Southern speakers (31.4%).

		V	pre	clo	rel	no tokens
N	V <sup>h</sup> C	91.3 (28)	48.0 (25)	165.9 (53)	54.7 (27)	66
	VCC	98.0 (40)	n/a	192.5 (47)	37.7 (21)	118
C	V <sup>h</sup> C	100.8 (29)	48.7 (19)	156.8 (48)	52.0 (28)	58
	VCC	101.6 (36)	n/a	182.5 (44)	43.7 (23)	123
S	V <sup>h</sup> C	99.7 (27)	48.7 (18)	153.9 (43)	50.0 (31)	60
	VCC	98.8 (35)	n/a	199.2 (47)	41.8 (27)	131
All						556

Table 3. Duration values for /VC:/ sequences with and without preaspiration, for Northern, Central and Southern regions (see text). Standard deviations in parentheses.

The duration of the preaspiration portion is remarkably stable across the three regions, and here t tests showed no significant differences.

Keeping in mind the effect of regional origin on stop production in standard Italian (described in §2.3), we also look at the duration values for the whole geminate consonant here. Table 4 shows the overall duration for voiceless stops, summed from Table 4 (i.e. “pre” “clo” and “rel” columns).

	Overall /CC/ duration (ms)	No. tokens
	<sup>h</sup> C	
N	268.6	184
C	257.5	181
S	252.6	191
All	259.9	556

Table 4. Overall duration of geminate voiceless stops according to region of origin of the speaker. Overall duration refers to the sum of the “pre” “clo” “rel” columns in Table 3.

We can see two patterns in Table 4. First, overall values are longest for Northern speakers, whether produced with preaspiration or not. Referring back to Table 3, we see that vowel durations were also shorter for Northern speakers. In other words consonants were longer in absolute terms, and relative to the preceding vowel (see [14] on the crucial role of the consonant:vowel ratio for Italian listeners).

What is important here is that Northern speakers appear to reliably produce geminates when speaking standard Italian – at least in isolated speech (in contrast to [2]).

The second pattern seen in Table 4 is that the total durations are longer everywhere for voiceless stops produced with preaspiration. This pattern can perhaps best be explained by phonetic factors, which we consider in the next section.

### 5.4. Phonetic factors: stress, vowel type, consonant place of articulation

Table 5 shows an overview of the impact of three phonetic factors on preaspiration in our corpus of data, namely vowel type, consonant place and stress. It lists the frequency of preaspiration as a percentage and its average duration, according to each factor. Only three vowel types /a e o/ preceded geminate voiceless stop tokens in the word list analysed.

	% pre	ave.du (sd)	total no
<b>Vtype</b>			
/a/	39.9	58.2(21)	138
/e/	30.7	43 (19)	212
/o/	31.1	45.7(20)	206
All			556
<b>Cplace</b>			
/pp/	2.9	50.5 (27)	68
/tt/	33.5	43.8 (22)	212
/kk/	40.2	51.4 (20)	276
All			556
<b>Stress</b>			
/VC:/	40.3	53.1 (19)	345
/*VC:/	21.3	34.2 (19)	211
All			556

Table 5. The frequency of preaspiration (as % of the total number of tokens listed in right-hand column), and its average duration, according to vowel type, consonant place and stress (where /VC:/ is stressed; /\*VC:/ is unstressed).

Looking first at vowel type, we can see that preaspiration occurs after all vowel types but was relatively most frequent for low central /a/. More striking is the effect of consonant

place – only two bilabial /pp/ tokens were preaspirated, whereas preaspiration occurred in a third of the /tt/ tokens and 40.2% of the velar /kk/ tokens. The presence of lexical stress also favoured occurrences of preaspiration in these data, where it was twice as frequent following stressed vowels.

In more general terms, Table 5 suggests a correlation between the frequency and duration of preaspiration: within vowel type, consonant place and stress conditions we can see that where it is most frequent it also shows the longest duration values (after /a/, for velar /kk/, and following stressed vowels).

## 6. Discussion

The results of this preliminary investigation showed there was no significant/clear effect of speaker sex or regional background on whether standard Italian /pp tt kk/ were realized with or without preaspiration.

First in terms of speaker sex, the data did not suggest that preaspiration is a feature particularly associated with female speech, as we may have expected from the literature [8, 9, 10, 11]. Preaspiration was slightly more frequent amongst the tokens produced by female speakers but it nonetheless occurred in around a third of the tokens for both sexes.

As noted in §2.3, regional background is known to influence a native speaker's pronunciation of standard Italian [2] and there is good reason to hypothesize regional differences in preaspiration patterns. Our expectation was that preaspiration would be more frequent and robust in terms of duration in Central Italy than elsewhere. Surprisingly, it was found to occur slightly more frequently for northern speakers, although the difference in frequency between the North on the one hand and Centre and South on the other, was small nevertheless. There was no regional difference in duration of preaspiration at all in /pp tt kk/.

In this sense then, if preaspiration of standard Italian /pp tt kk/ is sociophonetically conditioned, it is not speaker sex or region of origin that play a role, at least in these data.

In §5.3 we did see that geminates are longest for Northern speakers, both relative to the preceding vowel and in absolute terms. This could be attributed to an effect of the controlled speech data i.e. words read in isolation, which can lead to hyperarticulated or more standardized speech. This would perhaps especially be the case for Northern speakers, who would exaggerate geminate consonants - not present in their local variety – in an effort to conform to the standard.

What is perhaps more interesting is that preaspiration, as a non-normative feature of stop production for Italian, would occur in such a setting – at relatively high frequency (33% across the board). This suggests that preaspiration is a low level phonetic phenomenon in Italian inasmuch as native speakers are not aware that they produce it, or at least do not minimize it in controlled settings. We suggest that preaspiration is a strategy for enhancing either the voicelessness or the length of /pp tt kk/ geminates. This interpretation is supported by the fact that Northern speakers, who are reported not to reliably produce geminates as phonetically long, also regularly produce geminates with preaspiration in our controlled sample.

In contrast with the minimal differences according to speaker sex and region, we saw in §5.4 that phonetic context does influence preaspiration, both in terms of frequency and duration. Comparison of these results suggests that preaspiration in Italian voiceless geminates can be better explained by phonetic rather than sociophonetic factors.

There is no evidence to suggest that it is associated with one region of Italy, i.e. that it could be attributed to the

influence of a certain regional variety on standard Italian pronunciation. At least at this point it appears to be a tendency for all speakers when speaking standard Italian. Future work will involve perceptual tests with native listeners to determine the impact of preaspiration on the distinction between phonologically short and long voiceless stops. It is well known that preaspiration is difficult to perceive, even when its presence has important phonological consequences (e.g. [7] for references). Our own view, based on extensive impressionistic evaluation, is that preaspiration is easier to perceive in Central Italian varieties, such as Siennese/Tuscan Italian, than elsewhere in Italy. This may be due to the fact that it appears in central Italy to be a part of a broader and very audible overall phonetic setting of 'breathy' voicelessness which also includes the previously cited voiceless fricativization of short voiceless stops.

## 7. Acknowledgements

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## 8. References

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