

Preaspiration in Sienese Italian & Its Interaction with Stress in /VC:/ Sequences

Mary Stevens & John Hajek

School of Languages
University of Melbourne, Australia
{mes; j.hajek}@unimelb.edu.au

Abstract

This paper reports some initial results from our investigation into effects of stress in /VC:/ sequences in Sienese Italian. Our spontaneous speech data show preaspiration in /VC:/ sequences, not previously reported for any variety of Italian. We investigate preaspiration in /VC:/ sequences, and more specifically whether it should be considered a correlate of stress in Sienese Italian, as has been suggested for other languages. In addition we investigate how preaspiration interacts with vowel type, and vowel and consonant duration. We then seek to explain the patterns uncovered.

1. Introduction

1.1. Overview

1.1.1. Preaspiration & other glottal effects in Italian

Preaspiration is an extremely rare phenomenon cross-linguistically, and is often associated only with Nordic languages (eg [4], [12]; [5], [6] for Swedish but see also [7] for English).

For preaspirated stops “the oral closure occurs when the glottal aperture is near its maximum, about halfway through the voiceless period, whereas in the unaspirated voiceless geminate the oral closure occurs as the glottal opening starts” [9; pp.72]. This results in a period of glottal friction and voicelessness at the end of the vowel before consonant closure.

The acoustic appearance of preaspiration can be influenced by the place of articulation of the consonant, or by the vowel preceding it.

Preaspiration has not previously been reported for any variety of Italian. This may in part be due to the data used in previous experimental studies which typically consists of elicited phrases or word-lists recorded in controlled circumstances (eg [2], [3], [4], [5], [10], [11]), rather than natural spontaneous speech.

Aside from preaspiration, breathy voice has been occasionally reported to occur, in word-final stressed vowels in Tuscan Italian [13], but also preconsonantly [4].

1.1.2. Geminates in Italian

Consonant duration is lexically contrastive in word-medial (WM) position in Italian eg 'sete' 'thirst' vs 'sette' 'seven'. WM geminates occur following both stressed and unstressed vowels, eg *parrucchiere* /par:uk:'jere/ 'hairstylist' where /kk/ follows a phonologically unstressed vowel.

Standard Italian has an inverse phonological correlation between the duration of tonic vowels and that of the following consonant. That is, stressed vowels are predictably long preceding singleton consonants and short preceding geminates and clusters, ie /V:C/ vs /VC:/. Unstressed vowels are always short regardless of syllable structure.

Existing experimental studies confirm closed syllable vowel shortening for Italian, eg [2], [3] and [11].

1.1.3. Stress & VC: sequences in Italian

Theoretically, both stressed and unstressed vowels preceding geminates should be phonetically short in Italian, eg [14]. However, previous acoustic studies of Tuscan & Roman Italian in [10], [11] have shown that before geminate consonants, stressed vowels are consistently longer than unstressed vowels. These results are not accounted for in traditional phonological descriptions of Italian.

Here we consider whether in the Sienese variety of Italian preaspiration and other glottal effects are a particular feature of stressed /VC:/ sequences, as suggested in [5], [12] for other languages, by comparing stressed and unstressed /VC:/ sequences in our Sienese data.

1.2. Aims

Firstly we examine the frequency of preaspiration and related effects in the data according to consonant place of articulation. We then consider the incidence and duration of preaspiration according to the different vowel types in the data.

In §3.3 we investigate the potential prosodic role of preaspiration in Sienese Italian by comparing the duration of /VC:/ and /VC:/, according to the frequency and duration of preaspiration. We also investigate the

interaction between preaspiration and vowel & consonant duration in Siense Italian.

2. The experiment

2.1. The data

The data are taken from a corpus of spontaneous Siense speech, recorded in Siena (Tuscany) in 1997. Siense Italian closely resembles the Standard variety of Italian apart from the phenomenon known as *Gorgia Toscana* (GT) under which intervocalic singleton consonants are optionally spirantized eg /la kasa/ > [la hasa] ‘the house’. Results for this paper are taken from 4 speakers, two male and two female, who all live and work in Siena. All speakers spoke spontaneously on a subject of their choice for 5-10 minutes.

2.2. Methods

In this small-scale study we consider only WM /pp/ /tt/ and /kk/ geminates that occurred in the spontaneous speech data. All occurrences were listed for the four speakers, and then examined acoustically with spectrographic and waveform displays using the Praat program.

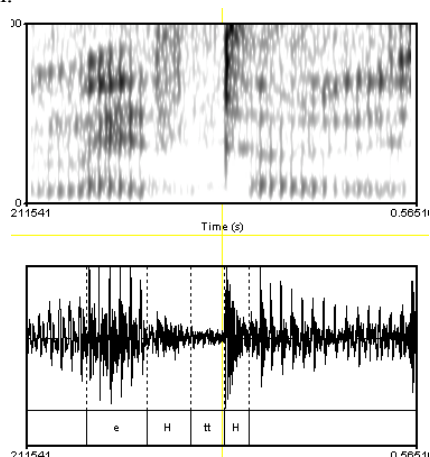


Figure 1 Preaspiration preceding the post-tonic WM geminate in *permetto* ‘I allow’ in s4’s speech (male) in the phrase ‘non mi permetto di studiare più di tanto’. The vowel, preaspiration segment, closure and release are marked.

The duration of the vowel, the closure period and release of the consonant were measured. In addition, for /VC:/ tokens that showed pre-aspiration or other glottal effects, the duration of this portion was recorded separately. Figure 1 shows an example of preaspiration in the word-medial sequence /et:/. In the data examined, other related but less frequent effects also occurred, including breathy voice, friction and preglottalization (see [12] for an overview of the different manifestations of preaspiration). For the purposes of this initial study it was decided to separate the tokens into 2 groups: (1) ‘normal’ voiceless unaspirated stops and (2)

‘preaspirated’ voiceless stops, which includes all tokens with preaspiration but also examples of much less common but related glottal phenomena, such as breathy voice, present in the /VC:/ sequence.

A primary motivation for separating the data into only 2 groups at this preliminary stage is that there is considerable overlap between glottal processes, that is, preaspiration is often preceded by a period of breathy voice, while for other tokens the voicing continues right through the high-frequency aspiration noise, making consistent categorization difficult. We acknowledge the continuing importance of research into this finegrained variation, since we already know that this can account for different distributions of preaspiration and preglottalization in English [7]. In a separate study currently under way we focus more closely on such variation in our data and investigate whether different elements in fact have specific linguistic functions in Siense Italian.

3. Results

3.1. Frequency of preaspiration in the data by C-type and by speaker

Table 1 shows the frequency of the preaspiration phase in the data for each speaker and geminate type. Both /VC:/ and /VC:/ are included together at this stage.

Table 1. Frequency (and %) of the incidence of preaspiration in the data for each geminate type (/pp/ /tt/ /kk/) and each speaker (s1-s4).

	s1	s2	s3	s4	Overall
pp	-	2/2	0/5	0/3	2/10 (20%)
tt	17/35	5/9	12/28	14/16	48/88 (55%)
kk	1/2	1/1	7/10	4/4	13/17 (76%)
Overall	18/37 (49%)	8/12 (67%)	19/43 (44%)	18/23 (78%)	

From the final column we can see that preaspiration is most common for /kk/. We also observe considerable variation in the rate of occurrence between speakers. However, preaspiration occurs for all speakers and at all places of articulation examined. Interestingly, it is more common for the 2 male speakers (s2 & s4) than for the female speakers (s1 & s3), a result that contrasts with findings for preaspiration in Swedish [5] and in English [7]. However, we suspect our result merely reflects the different frequencies of specific place of articulation /pp/ /tt/ of /kk/ across speakers in the spontaneous data set.

3.2. Influence of vowel type on preaspiration in the data

We have seen that preaspiration and glottalization effects are more common before /kk/ than before /tt/ or /pp/ in the data. Similarly, preaspiration can also be

influenced by the quality of the vowel preceding it [12]. Therefore we now examine the incidence and duration of preaspiration according to vowel type in the data.

Table 2 shows the number of vowels in stressed and unstressed position preceding /t/ tokens, for all speakers combined.

Table 2. Actual number of occurrences of preaspiration according to vowel type (a, e, i, o, u) and +/- stress, for /Vt:/ sequences only, data for all 4 speakers combined.

	a	a	e	e	i	i	o	o	u	u
	+pre	-pre	+pre	-pre	+pre	-pre	+pre	-pre	+pre	-pre
/VC:/	17	1	6	7	1	1	2	4	5	17
/VC:/	12	2	0	7	5	1	0	0	0	0
total	29	3	6	14	6	2	2	4	5	17

The spontaneous data make for an irregular distribution across vowel types. However, preaspiration and related effects occur for all vowel types in stressed position. For stressed and unstressed vowels taken together, we can see that preaspiration is much more common preceding /a/ (91%) than /u/, where it only occurs in 23% of cases. These effects might be attributable to the inherent length of different vowel types, where regardless of stress and position in the syllable, the duration of (close) /i/ is shorter than that of (open) /a/ (see [1] and references therein). With these effects in mind, in Table 3 we now examine duration measurements for all preaspirated stressed /Vt:/ according to vowel type:

Table 3. Duration measurements for all stressed Vt: sequences, according to vowel type (a, e, i, o, u) and where preaspiration was found in the Vt: sequence.

	A	B	C	D	E	F	G
	vowel	pre	clos.&rel.	B+C	A+B+C	C/VC:	no. tokens
'a +pre	92	76	84	160	252	0.63	17
'e +pre	129	75	73	148	277	0.54	6
'i +pre	70	41	75	116	186	0.62	1
'o +pre	91	30	90	120	211	0.57	2
'u +pre	72	45	71	116	188	0.61	5

We see that as well as being more common, preaspiration also has a much longer duration for /a/ and /e/ (column B). Therefore, preaspiration might be longer for open vowels than for closed vowels as a compensatory measure to keep the overall V/VC: ratio intact. We note that although the overall consonant duration (including preaspiration) varies significantly (44ms) (Column D) between /a/ and /u/ & /i/, the overall C/VC: ratio (Column F) remains very similar.

3.3. Preaspiration and primary stress

Here we investigate the potential prosodic role of preaspiration in the data by comparing the duration of /VC:/ and /VC:/ sequences, according to the frequency and duration of preaspiration. It has been suggested that preaspiration could be associated with relative prominence or stress for some Swedish dialects [5], [6] and a survey of the phenomenon [12] concludes that preaspiration is often limited to stressed domains.

In Table 4 all 115 tokens (/pp/, /tt/ & /kk/ for all speakers) are divided into /VC:/ vs /VC:/ sequences. The criterion was lexical stress, so that the tokens were divided up according to whether the vowel had lexical (primary) stress or was unstressed. Results in Column B show that in fact preaspiration occurs in both stressed and unstressed /VC:/ sequences:

Table 4. Overall results for stressed vs unstressed /VC:/ sequences, where C in /VC:/ is the average of /pp/ /tt/ & /kk/ for all speakers together.

	A	B	C	D	E	G
	vowel	pre	clos.&rel.	B+C	A+B+C	no. tokens
'VC: +pre	87	52	83	135	222	40
-pre	115	-	107	107	222	35
VC: +pre	51	49	86	135	186	22
-pre	60	-	122	122	182	18

We see in Column A that the average duration of the vowel is shorter when preaspiration occurs, for both /VC:/ and /VC:/, although the effect is greater for stressed vowels. The average duration of preaspiration hardly changes between /VC:/ and /VC:/ (Column B). These findings suggest that the duration of preaspiration is not influenced by stress in Sieneese Italian.

Instead, stress is signalled by increased vowel duration in the data. Referring to Table 4, we can see that stressed vowels are on average 36ms longer than unstressed vowels (Column A), a perceptually salient difference that is in line with acoustic evidence for other varieties of Italian [10], [11]. Although these results do not support traditional phonological accounts (eg [14]) of Italian, it is not surprising from a phonetic perspective that stressed vowels show increased duration.

3.4. Preaspiration, V, C & overall duration

Having found that preaspiration should not be considered a property of stress, based on the initial data examined, we now examine more closely the interaction between preaspiration and vowel & consonant duration. Column E of Table 4 shows that the average total duration of /VC:/ sequences is around 40ms longer than

unstressed sequences. In Column C however, the average duration of the consonant closure period does not vary between /VC:/ and /VC:/. Therefore it is the vowel duration that increases with stress, rather than the period of preaspiration or the consonant closure period. While the duration of the closure period is not significantly affected by stress in these data, it does vary dramatically depending on whether preaspiration occurs or not in the /VC:/ sequence. This suggests that the preaspiration is most closely associated with the timing and articulation of the closure gesture for voiceless geminates overall.

4. Discussion

Some possible factors that might account for preaspiration in Siense Italian, including primary stress, vowel type, and consonant place of articulation do not appear to specifically condition the incidence of preaspiration. Although preaspiration is more common for /kk/ than /pp/ or /tt/, it cannot be associated exclusively with one particular place of articulation in the data. Similarly, preaspiration is more common and has a longer duration following (open) /a/ and /e/ than other vowels, but it occurs for all vowel types, and for all speakers. As preaspiration occurs in both stressed and unstressed /VC:/ sequences, its incidence should not be attributed to stress, as has been suggested for other languages.

In §3.4 however we saw a marked difference in the duration of the consonant closure period depending upon the presence or absence of preaspiration. According to these preliminary duration measurements, where [hC] alternates with [C:], preaspiration should be considered to be part of the overall consonant duration within the /VC:/ sequences in Siense Italian.

In light of these results, we believe that preaspiration (and other related glottal effects) are the result of an articulatory gesture intended to maximise the perception of geminate consonants in natural speech, with minimal supralaryngeal articulatory effort. In this way, the perceptual effect of consonant duration within the /VC:/ sequence is preserved.

It is also likely, but as a secondary effect, that preaspiration serves to enhance the voicelessness of /pp tt kk/, by blocking voicing in and around the closure (see [8]). Support for this effect is found in [4], where breathy voice is found preceding /pp/ but not /bb/ in Swedish. The authors note a similar distributional tendency towards breathy vowels in the same contexts for Italian, although to a lesser extent. As Swedish is now well-known to have preaspiration, it is not unlikely that Siense Italian, with a similar tendency towards breathy vowels in this context, could also show preaspiration and other glottal effects across natural speech as a result of the articulatory timing of vowel-voiceless stop transitions.

5. Future directions

As this is the first study to report preaspiration in any variety of Italian, we must acknowledge the importance of continuing research into the phenomenon. In particular, the issue of phonetic gradience in the data must be further explored, for at this stage we have used preaspiration (the most common segment in /VC:/ sequences in the data) to refer to a whole range of glottal phenomena. Additionally, further research is needed to investigate whether the *Gorgia toscana*, which optionally weakens intervocalic singletons to fricatives in varieties of Tuscan Italian, is in some way a motivating factor in the preaspiration of geminates in Siense Italian.

6. References

- [1] Esposito, A., 2002. On vowel height and consonantal voicing effects: data from Italian. *Phonetica* 59, 197-231.
- [2] Esposito, A.; Di Benedetto, M., 1999. Acoustical and perceptual study of gemination in Italian stops. *Journal of the Acoustical Society of America* 106 (4) Oct, 2051-2062.
- [3] Farnetani, E.; Kori, S., 1986. Effect of syllable structure and word structure on segment durations in spoken Italian. *Speech Communication* 2, 17-34.
- [4] Gobl, C.; Ni Chasaide, A., 1999. Voice source variation in the vowel as a function of consonantal context. In *Coarticulation* W.J. Hardcastle & N. Hewlett (eds.) Cambridge: CUP, 122-143.
- [5] Helgason, P., 1999. Phonetic preconditions for the development of preaspiration. In *Proc. 14th ICPHS*. San Francisco, 1851-1854.
- [6] Helgason, P., 1999. Preaspiration and sonorant devoicing in the Gräsö dialect: preliminary findings. In *Proc. XIIIth Swedish Phonetics Conference (FONETIK 99)*, Göteborg, Sweden, 77-80.
- [7] Jones, M.; Llamas, C., 2003. Fricated preaspirated /t/ in Middlesbrough English: an acoustic study. In *Proc. 15th ICPHS* Barcelona, 655-658.
- [8] Keating, P., 2003. Phonetic and other influences on voicing contrasts. In *Proc. 15th ICPHS* Barcelona, 375-378.
- [9] Ladefoged, P.; Maddieson, I., 1996. *Sounds of the World's Languages*. Oxford: Blackwell.
- [10] McCrary, K., 2002. Syllable structure vs. segmental phonotactics: geminates and clusters in Italian revisited. In *Proc. of the Texas Linguistics Society*. University of Texas, Austin.
- [11] Pickett, E.; Blumstein, S.; Burton, M., 1999. Effects of speaking rate on the singleton/geminate consonant contrast in Italian. *Phonetica* 56, 135-157.
- [12] Silverman, D., 2003. On the rarity of preaspirated stops. *Journal of Linguistics* (to appear).
- [13] van Santen, J.; D'Imperio, M. 1999. Positional effects of stressed vowel duration in Standard Italian. In *Proc. 14th ICPHS*. San Francisco, 241-244.
- [14] Vogel, I., 1982. *La sillaba come unità fonologica*. Bologna: Zanichelli.