How pervasive is preaspiration? Investigating sonorant devoicing in Sienese Italian

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Abstract

We have recently found that voiceless geminates in Sienese Italian are frequently preaspirated, eg. /sette/ > [sehte] 'seven'. Within the few (mostly Scandinavian) languages that are reported to have preaspirated voiceless stops, a phonetically similar process of sonorant devoicing before voiceless stops is often reported to occur, eg. Icelandic /vitt/ [viht] 'breadth' and /lampi/ [lam̥pɪ] 'lamp' (Hansson, 2001:157). Given that voiceless geminate stops are also frequently preaspirated in Sienese Italian, in this pilot study we investigate whether devoicing of sonorants might also occur, given the co-occurrence of the two phenomena in other preaspirating languages. Our preliminary investigation of /lt/ sequences in spontaneous speech (6 speakers) shows that sonorant devoicing is very frequent, occurring in 85% of all tokens analysed. We provide specific details of its frequency according to speaker, and context, as well as information about its acoustic characteristics.

1. Introduction

1.1. Preaspiration and sonorant devoicing – are they linked?

Preaspiration is typically associated in the literature with the Scandinavian and Celtic languages of North-western Europe (see e.g. Helgason 2002 for a detailed overview). Whereas in normal voiceless stops the onset of supralaryngeal closure is aligned with the onset of glottal abduction, in preaspirated stops the supralaryngeal closure occurs some time after the glottis is widely abducted. This lack of temporal alignment results in some voiceless glottal frication between the preconsonantal vowel and the following stop closure (eg. Ladefoged & Maddieson 1996:70). The specific acoustic appearance of preaspiration can also be influenced by the preceding vowel as well as the consonantal place of articulation, and by the presence of stress (eg. Helgason 2002 and Silverman 2002 for details).

A phenomenon thought to be related to preaspiration is the devoicing of sonorants preceding voiceless stops eg. *valt* > Icelandic [vaɬt] 'rolled (3sg.)' (Hansson 2001:157). Hansson (2001:162) notes that "[v]irtually all dialects with preaspiration proper also have preaspiration in the form of sonorant devoicing". Although it has attracted far less linguistic attention than the preaspirated voiceless stops, Hansson claims that sonorant devoicing is actually more widespread than preaspiration "proper" in the Scandinavian region. In light of this situation, we seek in this pilot study to determine whether sonorant devoicing occurs alongside the preaspiration of voiceless geminate stops in Sienese Italian. If they are found to co-occur in Sienese Italian, then we have independent support for the position taken by Hansson (2001) and others that sonorant devoicing and preaspirated stops are not isolated, independent phenomena, but rather parts of a unified and more general process of preaspiration. We are also interested in determining the effects of factors (specifically stress and vowel height) known to influence the preaspiration of post-vocalic stops in Sienese & other languages, on sonorant devoicing.

1.2. Preaspiration in Sienese Italian

An important outcome of our ongoing acoustic analysis of spontaneous Sienese Italian speech is the finding that the voiceless geminate stops /pp tt kk/ are frequently preaspirated (eg. Stevens & Hajek 2004b). Not only is

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preaspiration extremely rare cross-linguistically, it is also not reported to occur in other varieties of Romance beyond Central Italy where Sienese Italian is spoken. Nonetheless, the phenomenon is quite pervasive in our Sienese data, occurring in almost half (48%) of our sample of 224 tokens, across all 6 speakers. While preaspiration is an unexpected finding in Sienese Italian, a study of laryngeal coarticulation across 5 languages (Gobl & Ní Chasaide 1999) did report breathy voice and other anticipatory effects (but not apparently preaspiration) in vowels preceding word-medial voiceless stops in Italian, similar to those found in Swedish. This unexpected parallel between the two languages may be important since many varieties of Swedish are known to have preaspiration (eg. Helgason 2002).

Not unexpectedly, the acoustic appearance of preaspiration varies considerably across our Sienese data. It typically involves archetypal voiceless glottal frication [h], but we also find examples of palatal frication [ç] following high vowels, breathy voice, and very occasional creaky voice (see Stevens 2004 for more detail, and also Silverman 2002 for a cross-linguistic overview of phonetic variation). Results presented by Stevens and Hajek (2004b) indicate that preaspiration is typically of segment-like duration (48ms.) and involves an appreciable drop in stop closure duration (93ms. > 61ms.), such that phonetic [hC] alternates with [C:].

1.3. Sonorant + voiceless stop clusters in Italy

Sonorant consonant + voiceless stop clusters in Standard Italian are of three kinds: (1) nasal + stop, eg. /kampo/, /kanto/, (2) rhotic + stop, eg /karta/, /korpo/, and (3) lateral + stop, eg. /alpi/, /balkone/. The lateral /l/ is normally alveolar in Italian, but is dental before dental stops /t d/, eg [a̪l̪̪to], [ka̪l̪̪do]. Although pre-consonantal /l/ has proven itself to be very stable over time in Standard Italian, in many dialects spoken across Italy its modern outcome can vary significantly: it may be rhotacised, nasalized, glided or even deleted, eg Italian /alto/ but dialectal [arto], [antu], [awtu], [ajtu] and [atu] 'high' (Rohlfs 1966). None of these changes have ever been reported to involve any kind of lateral devoicing. Moreover, experimental studies of Italian, eg. Fava & Magno Caldognetto (1976), McCrary (2004), which provide limited acoustic data on sonorant + stop clusters, make no reference to lateral devoicing.

2. Method

2.1. The data set

Our data are taken from a corpus of spontaneous speech recorded for 6 adult speakers (3 male, 3 female) in Siena, Tuscany, in 1997. Speakers were not related to each other, and were middle-class monolinguals who had lived their whole lives in Siena. Sienese Italian is very close to Standard Italian in most respects, with the exception of the presence in the former of the so-called *Gorgia toscana*. This is a pervasive process of spirantization affecting underlying singleton stops, eg. /la patata/ > [la φa'θaθa] 'the potato', especially between vowels though it can also occur also after non-nasal sonorant consonants (Giannelli & Cravens 1997). At this initial stage in our investigation into sonorant devoicing, we limit our analysis to the sequence /lt/ in the data. We identified all occurrences of /lt/ for our six speakers (n = 60), and inspected the acoustics of each token using the Praat program.

2.2. Measurements

Five different duration measurements were recorded for all 60 tokens using the spectrogram, waveform and pitch trace displays in Praat: (1) vowel, (2) voiced lateral portion, (3) voiceless lateral portion, (4) stop closure and (5) release.

A sudden reduction in formant energy indicates the boundary between vocalic and voiced lateral portions, while the voiceless lateral segment was measured with reference to change in the pitch trace as well as the onset of high frequency frication energy which occurred in most sequences. Not all 5 portions occurred in all /Vlt/ sequences. In particular, some tokens had a transition from vowel to voiceless lateral without an intervening voiced lateral portion, and occasionally no stop closure occurred in /t/. In these cases, /t/ was realized phonetically as [θ] due to the aforementioned *Gorgia toscana*. In such cases the /t/ duration was recorded as the consonant release.

Statistical analysis was also conducted (ANOVA) and results are discussed below.

3. Results and Discussion

3.1. Frequency of devoicing in /Vlt/

We first present an overview of the frequency of sonorant devoicing in /Vlt/ sequences. Table 1 shows the total number of /Vlt/ sequences analysed, the number of these sequences for which a voiceless lateral portion was recorded, and the overall percentage of devoicing in /Vlt/ sequences across speakers:

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Table 1*: Frequency of lateral devoicing (and %) in all tokens (n = 60) across speakers.*

Speaker	*No. tokens*	*No. devoiced*	*%*
s1	2	1	50%
s2	10	2	20%
s3	7	7	100%
s4	10	10	100%
s5	10	10	100%
s6	21	21	100%
Ss1-6	60	51	85%

Overall lateral devoicing occurs in 85% of the tokens, and we note that this frequency is much greater than that of voiceless geminate preaspiration (48%) cited above. We can see from Table 1 that for four of the six speakers (speakers 3-6) partial or full devoicing of /l/ was recorded in all cases. Of the other two speakers, one of only two tokens for speaker 1 is not devoiced. In this token /l/ was realised as a fully voiced palatal lateral approximant [ʎ]. Given the paucity of data for speaker 1, we do not attempt to draw conclusions about this subject's speech. Nonetheless we note that the other (partially devoiced) token for this speaker closely resembles the /Vlt/ tokens of the four speakers who always partially or fully devoice pre-stop laterals.

Speaker 2 seems to behave differently from the other 5 subjects: only two of his ten tokens showed any devoicing of the lateral, and the acoustic appearance of the lateral is quite different for this speaker. We return to Speaker 2 below.

3.2. Acoustic appearance of /Vlt/ sequences

Very broadly speaking, the acoustic appearance of devoiced /lt/ sequences is more consistent than that observed for preaspirated voiceless geminates /pp tt kk/ in Sienese (described in more detail in Stevens 2004). Across all speakers the most frequent acoustic appearance for /Vlt/ sequences was that seen in Figure 1, below:

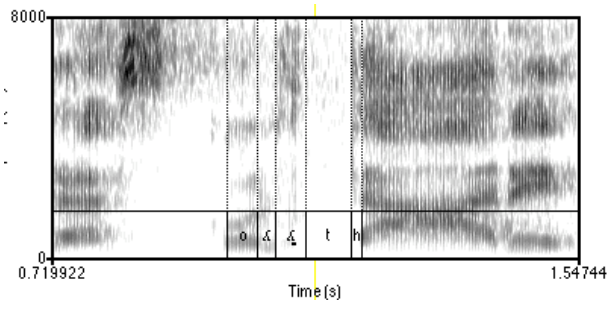

Figure 1. *Spectrographic display of the word* ascoltare *'to listen' (speaker 5: line 95). The vowel, voiced & voiceless palatal lateral portions, closure and release are marked.*

As can be seen in Figure 1, the lateral typically had the appearance of a palatal lateral [ʎ]. The formant pattern in the preceding vowel (rise in F2, drop in F1), coupled with the onset of high frequency frication energy and concomitant cessation of voicing mid-sonorant point to a partly devoiced (and semi-fricated) palatal lateral. Elsewhere we have noted that in preaspirated voiceless stops the preaspiration portion can be realised as a palatal fricative but only when preceded by a high vowel (Stevens & Hajek 2004b). However, in the case of /Vlt/ sequences, palatalization of /l/ often occurs even after back vowels, as in *ascoltare* (Figure 1). In addition, our auditory impression of the expected voiced lateral /l/ was often closer to [j] than to any kind of a lateral. Such an observation is confirmed by the acoustic appearance of the voiced /l/ portion in Figure 2, below:

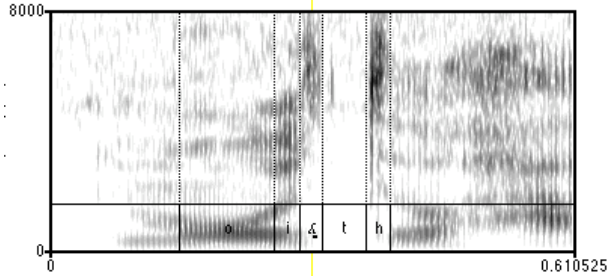

Figure 2. *Spectrogram of the word* molto *'much' in speaker 3's speech (line 71), in which the /l/ is realized as [jʎ̥].*

A palatal lateral was by far the most common realization of /l/ in the data. In fact, of 51 tokens (all tokens showing lateral devoicing), 45 were palatal. Amongst these, a fully devoiced lateral was not uncommon, occurring in 21 of the 45 cases.

Aside from these palatal tokens, 3 of the 5 remaining sequences involved partially devoiced dental laterals, while the other two sequences had a palatal offglide followed by a glottal stop, ie. /molto/ [mojʔtʰo] 'much'. Finally, we note that in one or two of the partially devoiced lateral tokens the voiceless portion showed only glottal frication [h], without any evidence of supralaryngeal constriction. This kind of acoustic variability, while not widespread when compared with preaspirated voiceless stops (Stevens 2004), nonetheless confirms the phonetic similarity between sonorant devoicing and preaspiration.

Referring briefly back to Table 1, we saw that speaker 2 presented eight /Vlt/ sequences without any sonorant devoicing. Instead, these /Vlt/ tokens had a fully voiced dental lateral portion (as expected for Standard Italian). An example appears below:

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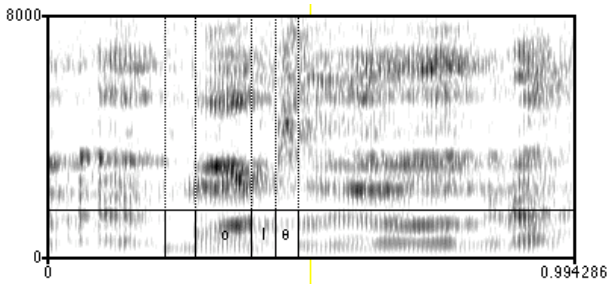

Figure 3. *Spectrogram of a voiced [l], as expected for /Vlt/ sequences, in the word* molto *'much' (speaker 2, line 39).*

The remaining two /lt/ tokens for speaker 2 showed a voiced dental lateral and some voiceless glottal frication preceding consonant closure.

3.3. Duration figures

After our initial acoustic inspection of all tokens, we then calculated average duration values for each of the five categories we measured across speakers:

Table 2. *Average duration measurements (in ms.) for /Vlt/ sequences, and number of tokens, for each speaker. The 2 rows for speakers 1& 2 show separately the partially devoiced tokens (a), and the fully voiced tokens (b).*

Speaker	V	[l]	[l̥]	clo	rel	No.
*s1a	72	41	50	40	22	1
*s1b	95	73	-	-	29	1
*s2a	53	16	70	57	22	2
*s2b	73	59	-	21	30	8
s3	97	23	43	35	27	7
s4	60	18	56	26	27	10
s5	99	19	56	40	29	10
s6	103	25	51	47	26	21
Ss1-6	82	34	54	38	27	60
Ss1a, 2a 3-6	81	24	54	41	26	51

We can see that the duration of the voiceless lateral portion (labelled [l̥] in Table 2) remains similar across all speakers except speaker 2. For speakers 1 and 2 we can see that the duration of the fully voiced lateral portion (Ss1-2b) is much longer than when devoicing is present (Ss1-2a). For all speakers where lateral devoicing is present, the duration of the voiced portion is substantially reduced.

3.4. Lexical stress

Preaspiration of stops is reported to occur preferentially in stressed position across languages (eg. Silverman 2002). The same effect of stress on sonorant devoicing is confirmed by Helgason's (1999) experimental investigation of Gräsö Swedish. He reports that for the function word *inte* in particular, sonorant devoicing occurs only in strong, i.e. stressed position.

We wished to see whether a similar preference was also evident in the case of sonorant devoicing in Sienese Italian. In the first instance, lateral devoicing occur in both stressed and unstressed positions – in contrast to Gräsö Swedish. We can also see from Table 3 that in terms of absolute duration the devoiced portion has similar values in unstressed and stressed positions. Stop closure and release values are also similar. However, the durations of the vowel, voiced lateral portion, and overall rhyme are substantially less in unstressed position. Only differences in vowel duration were statistically significant ($p = 0.038$). While differences are not statistically significant for the other two factors ($p = 0.109$ for both), we suspect this is due to the data set itself: the function words *molto* 'much' and *altro* 'other' were the most frequent. They are often phonetically destressed in spontaneous Italian speech. Nonetheless, sonorant devoicing as a phenomenon does not appear at this stage to interact with stress in Sienese Italian, neither in terms of frequency nor duration.

Table 3. *Average duration measurements in ms. and number of tokens for /Vlt/ across speakers 1, 3-6, according to whether the preceding vowel is stressed /'Vlt/ or unstressed /Vlt/ (n = 51).*

	V	*[l]*	*[l̥]*	*clo*	*rel*	*/Vlt/*	*no*
/Vlt/	65	12	57	44	24	202	10
/'Vlt/	97	25	51	39	27	239	41

3.5. Vowel type

Hajek & Stevens (2004) investigated the possible interaction between preaspiration and vowel height in Sienese Italian. They found that the duration of preaspiration and vowels differed according to vowel height. In order to see whether there were any similar effects in sonorant devoicing, we divided all tokens according to the four pre-sonorant vowel types observed in the data set. Tokens are too few for /u/ and /i/ at this stage for detailed discussion. Other than noting that results for /u/ and /i/ tokens are nevertheless consistent with the overall pattern of results, we focus discussion here on low /a/ and mid /o/.

Table 4. *Average duration measurements (in ms.) and number of tokens, for all tokens (n = 51) according to vowel type.*

	V	*[l]*	*[l̥]*	*clo*	*rel*	*No.*
/a/	106	13	55	30	28	20
/o/	81	27	51	46	26	29
/u/	72	41	50	40	22	1
/i/	56	32	47	55	23	1

As vowel height increases, vowel duration falls, as it typically does across languages (Lehiste 1970). At the same time, the duration of the voiced lateral and of the obstruent rises in an inverse correlation. It may be that we have some kind of temporal compensation (see McCrary 2004 who argues for this in Italian). However, statistical analysis (single factor ANOVAs) of /a/ and /o/ tokens confirmed a significant effect of vowel height on vowel duration ($p = 0.019$), and on voiced lateral duration ($p = 0.022$), but not on stop closure ($p = 0.115$). The difference in effect may reflect the way in which the segments in the sequence are syllabified in Italian: the vowel and lateral form part of the rhyme of the first syllable, while the stop is automatically assigned to the onset of the following syllable. The duration of lateral devoicing is stable across both vowels, just as it appears to be across speakers and stress position. Not surprisingly, there was no statistically significant vowel height effect on the devoiced lateral portion ($p = 0.343$). It is not clear at this stage why this period of lateral devoicing is such a stable target, compared to other parts of the syllable rhyme before the stop.

4. Further discussion and conclusion

The devoicing of sonorants before voiceless stops in Scandinavian languages that also have preaspirated voiceless stops has led scholars to link the two phenomena. While such a link seems intuitively plausible, such a correlation would be strengthened by independent confirmation from another language area. Our investigation of /Vlt/ sequences in Sienese Italian provides such evidence. It is also the first to report the same correlation in the Romance-speaking area.

Our results show that sonorant devoicing, like preaspiration of voiceless long stops, is found in the speech of all subjects and occurs in the same contexts, eg both stressed and unstressed syllables. The acoustic variability associated with devoiced laterals is also consistent with the variable acoustic appearance of preaspiration. On the other hand, while the range of acoustic variation is similar, the acoustic appearance of devoiced laterals is a little more stable overall. We also find that overall sonorant devoicing (85%) occurs much more often than stop preaspiration (48%). However, one speaker (S2) in our sample is relatively conservative: he maintains voiced laterals before voiceless stops at a relatively high rate.

The effect of contextual factors on sonorant devoicing in Sienese Italian is not identical to that reported elsewhere. For instance, stress does not condition the presence or nature of sonorant devoicing. As for possible vowel height interactions, the limited data we have suggest an effect on all parts of the rhyme in /Vlt/ sequences, other than the devoiced portion of the lateral.

Although not a focus of our study, an unexpected outcome was frequent palatalization of the pre-stop lateral. Curiously, a similar phenomenon is also widely reported in preaspirating Scandinavian languages. Hansson (2001:162-163) does not, however, ascribe lateral palatalization to preaspiration, but considers it as "…most probably due to a widespread [allophonic] distinction … between two types of /l/: 'clear' v. 'dark' /l/ …' in the Scandinavian area. Hyperdifferentiation of the two lateral types would presumably favour palatalization of 'clear' [l] alongside the velarization of its 'dark' counterpart. At this stage, we would also wish to view palatalization as an independent effect in Sienese Italian, unrelated to sonorant devoicing. Support for such a position comes from cross-dialectal evidence from elsewhere in Italy which shows that the phenomenon, seen in frequent pre-stop gliding of historical /l/ to palatal [j], is not restricted to pre-voiceless stop position, eg. *albero* > *aiburo* 'tree' in Grosseto Tuscan and *palm* > *paimu* 'palm' in Ligurian (Rolhfs 1966:345).

Finally, we note that results presented here are restricted to a small initial investigation of /lt/ sequences only. We see this pilot study as the first stage of a larger investigation of possible sonorant devoicing in sonorant + voiceless stop clusters in Sienese Italian. Future work will investigate similar effects, if any, on laterals before bilabial and velar stops as well as on rhotics and nasals before voiceless stops at all three places of articulation.

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