

## RADDOPPIAMENTO SINTATTICO AND GLOTTALIZATION PHENOMENA IN ITALIAN: A FIRST PHONETIC EXCURSUS

Mary Stevens<sup>1</sup>, John Hajek<sup>2</sup>, & Matthew Absalom<sup>3</sup>

<sup>1&2</sup>School of Languages, The University of Melbourne

<sup>3</sup>Research Centre for Languages & Cultures Education,  
University of South Australia

**ABSTRACT:** This paper is a preliminary phonetic exploration of aspects of the well-known Italian sandhi phenomenon of *Raddoppiamento sintattico* (henceforth RS), which involves the gemination of word-initial consonants under certain conditions, eg *dei* [k]ani 'some dogs' but *tre* [kk]ani 'three dogs'. It is often assumed that RS C-gemination is regular, but there is increasing evidence that it competes with other phenomena such as vowel lengthening. This paper first discusses results of our auditory study of RS contexts, which show that RS is far less frequent in spontaneous speech than is theoretically predicted. This paper then looks specifically at glottal stop insertion and creak in RS contexts, based on the results of an initial small-scale acoustic investigation. The first has controversially been reported as occurring in RS environments where it serves to block RS (Absalom & Hajek, 1997). In addition, glottal stops have also been claimed to provide a coda to short word-final stressed vowels outside of RS environments (Vayra, 1994). We discuss our unexpected finding that glottalization characterizes phrase boundaries in our spontaneous speech data, and the implications that this evidence may have for the phonetic and phonological description of Italian and for our understanding of RS.

### INTRODUCTION

This paper forms part of a larger ongoing acoustic phonetic study of RS in Tuscan Italian. RS is typically described as the "lengthening of the initial consonant of word<sub>2</sub> in a sequence word<sub>1</sub> word<sub>2</sub> under certain phonological conditions" (Nespor & Vogel 1982: 227). Although there are different types of RS triggers, the most productive and open set incorporates all words ending in a final stressed vowel, eg *parlò* [bb]ene 'he spoke well', *finì* [mm]ale 'it ended badly'. In existing phonological descriptions of RS, the phenomenon of word-initial consonant gemination is considered to be fully regular, ie it always occurs when certain syntactic and phonological criteria are satisfied at word boundary. However, there is growing evidence that potential RS is not always triggered, even when expected, due to interaction with other phonetic and phonological processes operative in Italian: left to right vowel spreading, pausing and pitch breaks all block potential RS doubling (see eg. Absalom, Stevens & Hajek, 2002; Camilli 1941, 1965; Chappallaz, 1979). These blocking processes have always been ignored in theoretical treatments of RS. As a consequence, trying to reconcile the phonetic facts with the existing theoretical descriptions of the phenomenon is difficult (see Absalom, Stevens & Hajek, 2002 for a detailed account). To these three phenomena we should add glottal stop insertion, which has been only recently discovered at RS word junctures where it is also claimed to block RS doubling (see Absalom & Hajek, 1997; Stevens, 2001). Glottal insertion and related glottalization phenomena in RS contexts are the focus of this paper.

Vayra (1994) hypothesized that all word-final stressed vowels may be followed by a so-called empty consonant slot which can be filled by right to left gemination of the initial consonant of the following word or by glottal insertion in other contexts eg when the following word begins with a vowel. Using a very small recorded sample of read words in isolation, he claimed to find evidence of glottalization manifested as creak in vowels before the word boundary. Unfortunately he did not seek evidence of potential glottalization before consonants at word boundary. However, van Santen and D'Imperio (1999) found glottalization (glottal stop, creak or breathy voice) to occur in a surprisingly high 366 of 606 (60.4%) final stressed vowels before the word-initial consonant of the following carrier phrase by 1 speaker of Tuscan Italian. They provide no information on the impact of glottalization on consonant duration in these same RS contexts.

It is clear that knowledge of the role of glottalization in Italian and in RS contexts is almost completely lacking at present. The only existing studies (Vayra 1994 and van Santen and D'Imperio 1999) are extremely restricted in scope and focus on limited read data. In our study, we consider in greater detail what happens in RS environments, and examine for the first time the phonetics of RS and potential blockers of RS in spontaneous speech.

## GLOTTALIZATION

Italian, like English, does not use phonation type contrastively. However, there is growing cross-linguistic interest in glottalization, as it has been shown to serve a communicative function turn-taking and boundary-marking (Ogden, 2001 for Finnish, Redi & Shattuck-Hufnagel, 2001 for American English).

By glottalization we mean “a region in the speech signal characterized by irregularly spaced pitch periods and often accompanied by other characteristics, such as full damping, low  $f_0$ , breathiness, or low amplitude...leading to a perceptual impression of a glottal gesture or disturbance in modal voice quality” (Redi & Shattuck-Hufnagel 2001:408). The nature of our results meant that it was important to distinguish between breathy voice, creaky voice and glottal stops, which together we refer to as glottalization. Glottal stops involve complete closure at the glottis, and are often signalled only by creak on surrounding segments (Gordon & Ladefoged, 1996: 392). By creaky voice we mean the phonation type where vocal folds are “tightly adducted but open enough along a portion of their length to allow for voicing” (Ladefoged & Gordon, 1996: 386) which is shown by very irregularly spaced pitch periods (also referred to as jitter) and decreased acoustic intensity. By breathy voice we mean some turbulent airflow through the glottis and the auditory impression of “voice mixed in with breath” Catford, in Ladefoged & Gordon (1996: 386). Individual pitch pulses are difficult to distinguish on the spectrogram for breathy voice, whereas they appear mostly as clear vertical striations for creaky voice. Breathiness was also found in van Santen & D'Imperio's (1999) study of final stressed vowels in Italian, and forms part of our larger study but is not discussed further in this paper.

## THE CURRENT STUDY

Our study is based on the first partial analysis of a corpus of spontaneous Italian speech from 10 participants that was recorded in Siena, Tuscany. Siennese Italian is a Tuscan variety that closely resembles the Standard language, apart from the presence of the famous *Gorgia toscana* in which singleton stops are fricated between vowels in non-RS environments eg. /la kasa/ → [la hasa] ‘the house’.

### Corpus of analysed speech data

Speakers 1 & 3 are female and Speaker 2 is male. All speakers spoke about their daily life in Siena for around 10 minutes, and all three speakers spoke, as is typical for Tuscan Italian, at a very fast rate. The speech data was digitised at 22.05 kHz using ESPS/Waves+ on a Sun Ultra 1-140 workstation, from audiocassettes copied from the original DAT recordings. At this stage we have transcribed three of the 10 speakers using perceptual auditory techniques, which were crosschecked with two authors. We support our auditory analysis with acoustic evidence of Speaker 3 using the Praat program.

### Frequency of phonological RS in the data: predicted vs. actual doubling

This paper focuses on stress-conditioned RS, which is found in Roman and Tuscan varieties of Italian (including the Standard language) and has also been the subject of most studies in the past. In the first phase of our study, we conducted a statistical analysis of what happens in RS contexts based on our auditory perceptual transcriptions of three speakers. This allowed us to determine the relative significance of the blockers to RS in spontaneous speech, something never previously reported. Table 1 presents a summary of our results, where we found RS to be far less frequent than existing theoretical descriptions would have us believe:

Table 1. Results from the auditory perceptual study of the number of occurrences of Stress-conditioned RS in the spontaneous speech data for three speakers of Tuscan Italian.

Actual RS (no.)	RS words (no.)	RS-Possible (no.)
Speaker 1	136	50
Speaker 2	93	42
Speaker 3	101	47

The first column in Table 31 corresponds to the number of words that end in a stressed vowel in the data for each speaker, eg. *così* 'so'. Doubling is theoretically predicted to occur in each and every case, but we found that RS was often blocked by other phenomena present at the word boundary like vowel lengthening and others that were mentioned previously. For more detail of the blockers to potential RS that are included in our calculations of RS in Tuscan Italian, see Stevens (2001). The second column in Table 1 shows the number of stress-final words for each speaker where a blocking factor is not present at the word juncture, that is, where RS should occur in the absence of any possible blocking phenomenon. We see that RS is in fact only possible in 50 out of the 136 (37%) RS words for Speaker 1. RS is possible in 42 out of 93 cases for Speaker 2 (45%) and 47 out of the 101 total predicted cases for Speaker 3 (46%). The ability of blocking phenomena to prevent RS in this sample of spontaneous speech clearly is clearly significant: RS is only *possible* in less than half of the cases where it is predicted to occur for these 3 speakers. Turning now to the final column in Table 1, we found that the initial consonant of word<sub>2</sub> in the RS sequence was not always long. These figures indicate that RS does not always occur even when it is not blocked by some other phenomenon. Significantly, RS doubling appears in only 17 out of the 136 words (12.5%) where it is predicted to occur for Speaker 1. The results for the other two speakers were slightly higher, with RS appearing in 23.7% of predicted cases for Speaker 2 and 16.8% of cases for Speaker 3. RS is therefore not a categorical phenomenon that always applies in the manner presented in the theoretical literature. Where it is not specifically blocked, it is in fact an optional connected speech phenomenon that occurs relatively infrequently.

We now turn to our acoustic examination and focus on the most controversial blocker to RS: glottalization.

#### GLOTTALIZATION IN THE RS ENVIRONMENT: GLOTTAL STOPS AS RS BLOCKERS

Recent perceptual studies (Absalom & Hajek, 1997; Stevens, 2001) have claimed that glottal stops block RS consonant gemination when they occur at RS word junctures, for example *sarà?* [m]eglio and not \**sarà?* [mm]eglio nor always expected *sarà* [mm]eglio 'it would be better'. In order to test the validity of this claim, we have begun acoustic analysis of glottalization and its impact on RS, and report first results here. To this point we have only been able to undertake detailed acoustic analysis for one speaker.

In our initial transcription of data for Speaker 3 there are only 10 examples of glottal stops following the 101 word-final stressed vowels. Of these 10, two were subsequently excluded because on acoustic inspection they did not show clear signals. Of the remaining 8 glottal stops, 7 occurred at phrase boundaries, which is significant and will be discussed in later sections. The only example of a non-phrase-final glottal stop occurred as follows: *per qu'è?*[k]omplicatissimo 'for that (reason) it's very complicated'.<sup>1</sup> In the spectrogram and waveform display in Figure 1, a glottal release is seen following the stressed vowel [e], on both the waveform and in the spike on the spectrogram:

<sup>1</sup> *Qu'è* is the reduced form of *quell'è*.

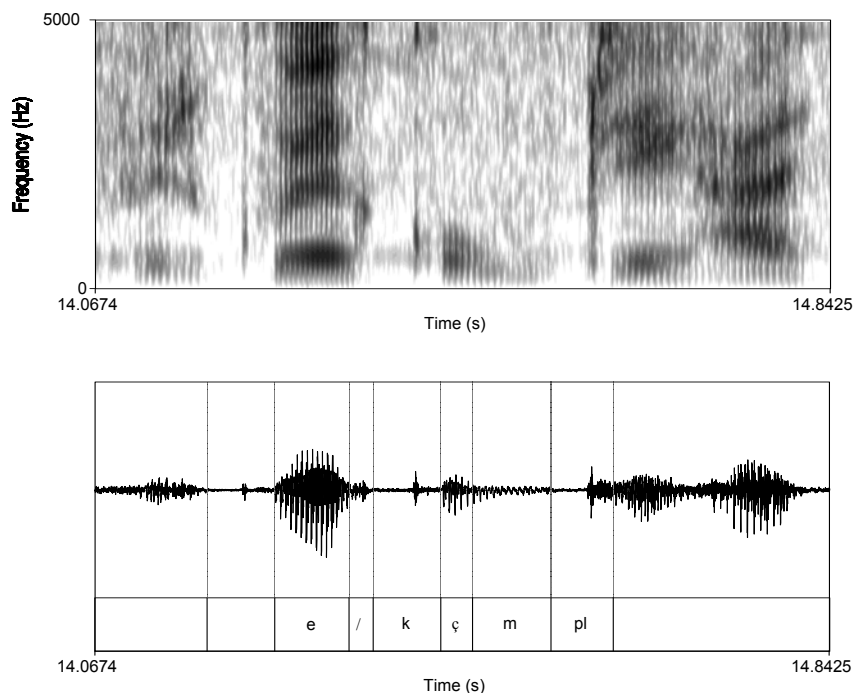


Figure 1. Glottal stop insertion in the RS environment *è complicatissimo*.

Acoustic measurements indicate that RS has not occurred here: the duration of [k] is 73ms, which is significantly shorter than the duration of true word-internal geminates for this speaker (av. 103ms)<sup>2</sup>.

#### GLOTTAL INSERTION BETWEEN VOWELS

We also found glottal insertion after final stressed vowels in other contexts. In examples such as *martedì invece* 'Tuesday instead' word<sub>2</sub> is vowel-initial so RS consonant doubling cannot occur. But according to Vayra's (1994) hypothesis, the word-final stressed vowel could be checked by a glottal stop *martedì[ʔ] invece*. This would, in his words, "provide a *phonetic* reason for maintenance of 'empty' consonants in phonological representations" (1994:279). However, our own data indicate that in this particular context, ie prevocalic position, glottal stops are not particularly attributable to the final stressed vowel, because they also occur in our data between unstressed vowels as well. In Figure 2 we see creak (indicative of a glottal stop) on the final unstressed vowel of *comunque* 'anyhow', which has lexical stress on the penultimate syllable:

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<sup>2</sup> Italian contrasts /k/ and /kk/ phonemically. There are 13 word-internal geminate /kk/ that appear in the spontaneous speech for Speaker 3, eg. *paru/kk/jere* 'hairdresser', and this figure is the average duration of the 13 tokens.

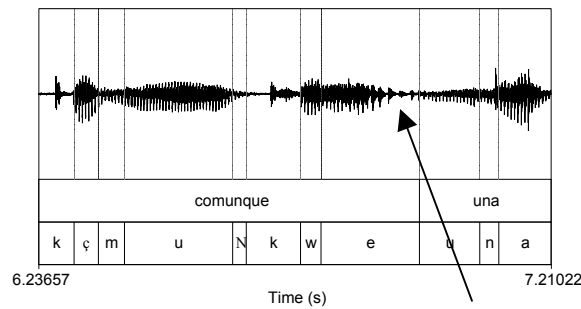


Figure 2. Creak as a hiatus marker between vowels. The word final vowel of *comunque* 'anyhow' is unstressed, yet has a clear final creaky portion, indicated by the arrow.

Given the evidence in Figure 2 and elsewhere, glottal insertion cannot as a result be attributed exclusively to word-final stressed vowels. Furthermore, glottal stops or creak occur only infrequently following prevocalic RS triggers, eg. *può* [e]*sistere* is normal and not \**può* [ʔ]*esistere*. In light of these results, it seems that glottalization in these examples has more to do with hiatus marking following stressed or unstressed vowels than RS does, at least for this speaker.

#### PHRASE-FINAL GLOTTALIZATION IN THE DATA

As already mentioned, Vayra (1994) relied on creak as an acoustic cue for the presence of a glottal stop following word-final stressed vowels in phrase-final position. We mentioned previously that 7 out of the 8 glottal stops that were analysed acoustically for Speaker 3 occurred in phrase-final position. However, creak (which sometimes culminates in a glottal stop) often appears at both stressed and unstressed phrase boundaries for Speaker 3. In fact, creak characterizes 81 out of 213 intonation phrase boundaries for this speaker, and is also typically associated with low pitch. Consequently we suspect that glottalization is used more prototypically as a phrase boundary marker in Italian, rather than as a marker of final stressed vowels in phrase-final position. Our observation of creak as boundary marking in Italian is in line with findings already mentioned for Finnish (Ogden, 2001) and American English (Pierrehumbert & Talkin, 1992; Redi & Shattuck-Hufnagel, 2001; Dilley *et al.*, 1996) though it has not previously been reported for Italian.

Phrase-final glottalization in Italian would also help to explain D'Imperio & van Santen's (1999) unexpected finding that glottalization characterized roughly 60% of word-final stressed vowels in their data, as the nature of their elicited speech data meant that there was a phrase-boundary following every final-stressed word. Turning to our data, in Figure 3 we see an example of phrase-final glottalization that happens on an unstressed vowel:

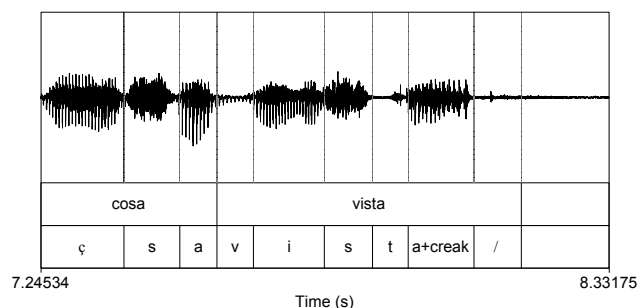


Figure 3. Phrase-final glottalization. The word-final vowel in *vista* 'seen' is unstressed, but exhibits creak on the vowel, which is followed by a clear glottal stop.

In Figure 3 the word-final vowel on *vista* 'seen' is not stressed yet it exhibits creak, which is followed by a glottal stop. In addition, glottalization occurs relatively rarely on stressed word-final vowels when they appear in phrase-final position, eg *praticamente è, da...* and not *\*praticamente è?, da...* 'practically is, from...'. In light of these findings it would seem that glottalization appears phrase-finally regardless of lexical stress, at least in the data we examined.

Although we clearly need to expand our study to include more speakers, our initial findings do not support Vayra's (1994) claim that stressed word-final vowels have a glottal coda when not in RS environments, or that a glottal coda is somehow exclusively associated with final stress.

Overall this paper has shown that other phonological processes operative in Italian have a significant blocking effect upon the frequency of actual RS doubling in spontaneous speech, where RS was only possible in less than 50% of predicted cases for the three speakers. Our acoustic examination of glottalization has shown that glottalization does occur, but it does not seem to be particularly associated with word-final stressed vowels - in either RS or non-RS environments. The discovery of glottalization as a frequently used boundary marker in phrase-final position is particularly problematic for the theoretical claim that word-final stressed vowels are checked by a glottal stop outside of RS locations.

## REFERENCES

- Absalom, Stevens & Hajek (2002) A typology of spreading, insertion and deletion or what you weren't told about Raddoppiamento sintattico in Italian. *Proceedings of the 2002 Conference of the Australian Linguistic Society*. in press.
- Absalom, M. & Hajek, J. (1997) *Raddoppiamento sintattico* What happens when the theory is on too tight? P.M. Bertinetto, L. Gaeta, G. Jetchev, D. Michaels (eds.) *Certamen Phonologicum III. Papers from the Third Cortona Phonology Meeting, April 1996*. Turin: Rosenberg & Sellier, pp. 159-179
- Camilli, A. (1941) I rafforzamenti iniziali, *Lingua nostra* 3, 44-45
- Camilli, A. (1965) *Pronuncia e grafia dell'italiano*, Florence: Sansoni Editore
- Chappallaz, M. (1979) *The Pronunciation of Italian: A Practical Introduction*. London: Bell & Hyman
- Dilley, L., Shattuck-Hufnagel, S. & Ostendorf, M. (1996) Glottalization of word-initial vowels as a function of prosodic structure. *Journal of Phonetics* 24, 423-444
- Nespor, M. & Vogel, I. (1982) Prosodic domains of external sandhi rules. van der Hulst & Smith (eds.) *The Structure of Phonological Representations*. Vol 1. Foris. Dordrecht
- Ogden, R. (2001) Turn transition, creak and glottal stop in Finnish talk-in-interaction. *Journal of the International Phonetic Association* 31. 139-152.
- Pierrehumbert, J. & Talkin, D. (1992) Lenition of /h/ and glottal stop. G. Docherty & D. R. Ladd (eds.) *Papers in laboratory phonology II*. Cambridge: CUP pp. 90-117.
- Redi, L. & Shattuck-Hufnagel, S. (2001) Variation in the realization of glottalization in normal speakers. *Journal of Phonetics* 29, 116-125.
- Stevens, M. (2001) A First Quantitative Perceptual Study of Raddoppiamento sintattico in Sieneese Italian. Honours thesis: University of Melbourne
- van Santen, J. & D'Imperio, M. (1999) Positional effects on stressed vowel duration in Standard Italian. *International Congress of the Phonetic Sciences 1999*, 241-244
- Vayra, M. (1994) Phonetic explanations in phonology: laryngealization as the case for glottal stops in Italian word-final stressed syllables. W. U. Dressler, M. Prinzhorn & J. R. Rennison (eds.) *Phonologica 1992*. Turin: Rosenberg & Sellier pp. 275-294