Blocking of word-boundary consonant lengthening in Sienese Italian: some auditory and acoustic evidence

Mary Stevens & John Hajek
School of Languages and Linguistics
University of Melbourne,
Australia
mes@unimelb.edu.au; j.hajek@unimelb.edu.au

Abstract

This paper examines an aspect of *Raddoppiamento sintattico* (RS), the lengthening of word-initial consonants following certain words e.g. *tre* [mm]*ele* 'three apples' in Italian. Most phonological accounts claim the phenomenon is predictable and obligatory (e.g. Nespor & Vogel 1986). However, descriptive sources on Italian (e.g. Camilli 1941) have long claimed that RS interacts with and can be blocked by other phenomena operative in natural speech e.g. pausing. In this paper we outline the phonetic details of the RS blocking phenomena and present the results of an auditory and preliminary acoustic analysis of the interaction between RS and these other phenomena based on a corpus of spontaneous speech data.

1. Introduction & overview

Raddoppiamento sintattico (RS) has long been a major focus of phonological research on Italian. Although many phonological accounts of RS present it as predictable and straightforward in occurrence and appearance, closer inspection of the literature reveals ongoing disagreement about both aspects of RS (see Absalom, Stevens & Hajek 2002 for details). Results presented here are part of a larger ongoing acoustico-perceptual study of RS in Italian designed specifically to address these and other issues. In an earlier study (Stevens, Hajek & Absalom 2002), we presented some first results of an acoustic experimental study of RS in spontaneous Italian, focusing upon glottalization phenomena in RS contexts and elsewhere. In this new study, based on a larger data corpus, we extend the previous research to look at the issue of the blocking of RS more widely. We consider the impact of so-called blocking processes, such as glottalization, upon the otherwise predicted occurrence of RS in natural speech. Our results show that RS blocking is not infrequent and involves a series of different phonetic processes, as previously identified by Camilli (1941) and others, and discussed in some detail here.

2. Background

2.1. RS and blocking phenomena

Raddoppiamento sintattico (RS) refers to the lengthening of word-initial consonants following certain words in e.g. *tre* [mm]*ele* 'three apples'. The process happens, with differing distributions, in Standard Italian and most non-Northern varieties. There are essentially two kinds of word that can trigger RS: (1) all words with final stress, e.g. <u>*caffé*</u> [kk]*aldo* 'hot coffee'; and (2) a small number of words with penultimate stress, e.g. <u>*come*</u> [mm]*ai* 'how come', and unstressed monosyllables, e.g. <u>*da*</u> [mm]*ilano* 'from Milan' (e.g. Loporcaro 1997; Absalom et al. 2002). The first kind, stress-conditioned RS, has attracted most attention in the literature, although in practice both types should be considered part of the same, more general phenomenon. Here we analyze both kinds of RS sequences together.

In theoretically oriented accounts of RS the issue of blocking phenomena has been either ignored (e.g. Borrelli 2002), or it has been claimed that RS is blocked by structurally derived, rather than phonetic, boundaries (e.g. Nespor & Vogel 1986 and others on RS in prosodic phonology).

However, other sources have rejected such accounts (see e.g. Loporcaro 1997; Absalom & Hajek 2006 on the empirical failure of prosodic phonological accounts of RS). Instead, they report that the occurrence of RS can be blocked by certain phonetic phenomena where they occur in RS word$_1$-word$_2$ sequences (e.g. Camilli 1941, Loporcaro 1997, Absalom et al. 2002). These phenomena, most typically referred to as a pause (e.g. Loporcaro 1997), comprise silent gaps, unexpected pitch breaks, glottal stops or vowel lengthening (cf. §2.3).

At present phonetic evidence of the interaction between these phenomena and RS is scant. We note that the impact of pausing upon predicted RS sequences was investigated in two existing studies (Campos-Astorkiza 2004; D'Imperio & Gili Fivela 1997). However, both studies were based upon highly controlled speech data, and defined pauses in structural terms (e.g. at phonological phrase boundaries) rather than in phonetic terms (see §2.2 below). This limited the usefulness of the findings to our understanding of the interaction between RS and other phenomena, particularly those operative in real, naturally occurring speech. More importantly however, these studies showed that structurally derived phrase boundaries, did not reliably block RS, even in controlled speech. For example, in

Proceedings of the 11th Australian International Conference on Speech Science & Technology, ed. Paul Warren & Catherine I. Watson. ISBN 0 9581946 2 9
University of Auckland, New Zealand. December 6-8, 2006.

Accepted after full paper review

one constructed phrase doubling was perceived to happen across a phonological phrase boundary in 33% of cases (D'Imperio & Gili Fivela 1997:92). We suggest that in order to better understand how and when RS is blocked, and by which phenomena, we need to start at the phonetic (not a structural) level, as described below.

2.2. The domain of RS

In this study the principal domain of RS application was taken to be the phonetic phrase (Camilli 1941). In other words RS can apply within, but not across phonetic phrase boundaries.

While in line with traditional descriptive accounts of RS in Standard Italian (e.g. Norman 1937, Camilli 1941) this approach contrasts with other analyses of RS, noted above, that have taken the syntactically derived phonological phrase (following e.g. Nespor & Vogel 1986) as the domain of RS.

The phonetic phrase differs from the phonological phrase in that it is defined phonetically, not structurally, and refers to a stretch of speech uninterrupted by an audible phonetic pause or break.

A phonetic phrase break, in turn, refers to an audible disruption to the continuity of speech (cf. §2.3 below). Very importantly, such a phonetic break may or may not correspond to a syntactically or structurally derived phrase boundary (see also Hurch 1986:107-108).

2.3. RS blocking phenomena

As Figure 1 shows, there are four specific blocking phenomena, all of which may signal a break in the phonetic phrase: silent pause, vowel lengthening, glottal stop and a sudden pitch break (e.g. Absalom et al. 2002).

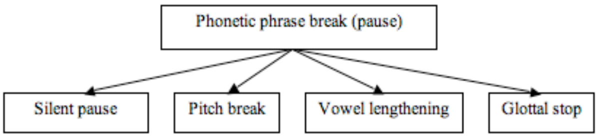

Figure 1. The phonetic correlates of phonetic phrase breaks.

As noted earlier, these phenomena are all reported to be able to block RS consonant doubling across the word boundary, by introducing a phonetic break between $word_1$ and $word_2$ (Camilli 1941; Absalom et al. 2002), as shown in Table 1.

Blocking factor		*sarà difficile*
'pause'	phonetic pause	[saˈɾa	difˈfiːtʃile]
	vowel lengthening	[saˈɾaː difˈfiːtʃile]
	pitch break	[saˈɾa ↑difˈfiːtʃile]
	glottal stop	[saˈɾaʔ difˈfiːtʃile]
speech error		[saˈɾa % difˈfiːtʃile]
none		[saˈɾa ddifˈfiːtʃile] [saˈɾa difˈfiːtʃile]

Table 1. The phonetic realization of *sarà difficile* 'it'll be difficult' in contexts with a blocking phenomenon, and without, where RS doubling may optionally occur (Absalom et al. 2002).

All four phonetic blocking phenomena were taken into account in this phonetic investigation into RS, *contra* existing acoustic phonetic sources that have only considered a period of phonetic silence to be indicative of a pause e.g. Campos-Astorkiza (2004).

This point is especially important given our corpus involved spontaneous speech: an acoustic phonetic comparison between spontaneous and read Italian speech (Magno-Caldognetto et al. 1997) reported that complex pauses (i.e. those signalled by more than one acoustic correlate) were particularly frequent in the spontaneous speech data, comprising 95.6% of all pauses analysed.

3. Aims

We aim to determine the impact of the four blocking phenomena identified in §2.3 upon the frequency of RS in natural speech. We also aim to provide some initial acoustic phonetic evidence to confirm their presence in, and impact upon, predicted RS sequences.

4. Methods

4.1. The data

The data were drawn from a corpus of spontaneous Sienese speech (6ss, 3mm, 3ff) recorded in Siena (Tuscany). All speakers were born and raised in Siena. Specifically, the initial data set comprised 762 $word_1$-$word_2$ sequences where $word_1$ was an RS trigger and $word_2$ began with an initial consonant that could be lengthened. These sequences were subsequently subjected to repeated auditory analysis (§§4.2, 4.3). Acoustic analysis was then carried out on a subset of tokens involving voiceless stops /p t k/ only (§4.4).

4.2. Auditory analysis of all sequences

Initial auditory perceptual analysis enabled the separation of all potential RS sequences into two groups: *RS not possible* (RSNP) and *RS possible* (RSP), according to whether a break of any sort occurred, or not, at the word boundary (cf. §2.2). This enabled us to determine the frequency at which RS was blocked by pausing and other phonetic phenomena operative

Proceedings of the 11th Australian International Conference on Speech Science & Technology, ed. Paul Warren & Catherine I. Watson. ISBN 0 9581946 2 9
University of Auckland, New Zealand. December 6-8, 2006.

Accepted after full paper review

in natural speech. Fifteen RSNP sequences with intervening speech errors and excessive background noise were left aside, leaving 175 RSNP sequences in total.

4.3 Close auditory analysis of RS-blocked sequences

Subsequent repeated listening of these RSNP sequences allowed the auditory correlates of the perceived phrase phonetic break to be specifically identified (cf. §4.3).
Specifically, tokens were listed according to which of the following phenomena was most perceptually prominent at the $word_1$-$word_2$ juncture:

- Phonetic pause (primarily a silent gap, but including filled pauses e.g. 'mmm')
- Vowel lengthening (where the final vowel of $word_1$ was abnormally long in relation to the duration of surrounding segments, following e.g. Duez 1982:14)
- Pitch break (where there was an unexpected discontinuity between the pitch of $word_1$ and $word_2$)
- Glottal stop

Where more than one correlate was perceived to have occurred at a particular word boundary, sequences were labeled according to the most perceptually salient blocking phenomenon. This ensured each token was only counted once.

4.4 Acoustic analysis of RS-blocked sequences

The acoustic analysis of RSNP sequences focused on those with voiceless stops, to avoid any possible confounding effects of different segment and manner types. A visual inspection was conducted, using spectrogram and waveform displays, in order to confirm the existence of blocking phenomena where they were perceived to have happened during the auditory analysis. We made some acoustic measurements, specific to the blocking phenomena that occurred. We measured the duration of silent pauses and lengthened vowels, and measured the magnitude of the pitch break with reference to the pitch trace (fundamental frequency) function within Praat. Only initial brief observations about these measurements are given here.

5. Results

5.1. Frequency of RS-blocked sequences in the data

We first examined the overall frequency at which phonetic phrase breaks were perceived to have occurred at predicted RS word boundaries in the spontaneous speech data. Table 2 shows the number of sequences in which a break was perceived (RSNP), and not perceived (RSP) to have occurred, as well as the total number of sequences. The data were divided according to whether $word_1$ was an unstressed, or stress-conditioned RS trigger.

	no. RSNP	% total	no. RSP	total
unst. RS	69	16.8	341	410
stress. RS	106	31.5	231	337
total	175	19.2	572	747

Table 2. Number of tokens in which a break was perceived (RSNP) and those where RS was instead possible, according to RS type.

Overall, we can see from Table 2 that RS was blocked following nearly 20% of the RS triggers that occurred in the spontaneous speech corpus. Blocking phenomena were twice as frequent following stress-conditioned RS triggers. This difference between unstressed and stress-conditioned RS has not been previously reported, and appears to conflict with Payne's (2000:90) claim that "differences between the behaviour of the two types of RS [...] were not statistically significant". This pattern, which was also upheld across individual speakers, may reflect the fact that stress-conditioned RS triggers can occur phrase- and utterance-finally, whereas most unstressed RS triggers cannot.

We note that the absence of a phonetic phrase break does not guarantee that RS consonant lengthening will happen: it is an optional phenomenon in RSP sequences (e.g. Absalom et al. 2002). The frequency of actual consonant lengthening in RSP sequences is beyond the scope of this paper.

5.2. Auditory correlates of RS blocked

In order to better understand and accurately describe the RS blocking phenomena, the precise auditory phonetic correlates of the phonetic phrase breaks were identified for each of the 175 RSNP sequences.

perceived phenomenon	total no. tokens	% total
phonetic pause	82	46.8
vowel lengthening (VL)	67	38.3
pitch break	19	10.9
glottal stop	7	4.0
total	175	100

Table 3. Specific auditory correlates of the pauses that occurred in predicted RS $word_1$-$word_2$ sequences, in order of descending frequency.

We can see from Table 3 that phonetic pauses were the most frequent RS-blocker, comprising almost half (46.8%) the tokens. Amongst these sequences, concomitant phenomena were perceived to have happened in some cases (see §5.3), although the auditory impression was most clearly that of a silent pause. Vowel lengthening was also relatively frequent, involving 38.3% of the tokens, whereas pitch breaks and glottal stop, comprising 10.9% and 4.0% of the tokens respectively, were instead perceived relatively infrequently.
In terms of the relative frequency of blocking phenomena shown in Table 4, these patterns were upheld across

Proceedings of the 11th Australian International Conference on Speech Science & Technology, ed. Paul Warren & Catherine I. Watson. ISBN 0 9581946 2 9
University of Auckland, New Zealand. December 6-8, 2006.

Accepted after full paper review

speakers, although some more fine-grained differences were found.

	s1	s2	s3	s4	s5	s6	s1-s6
pause	17	9	17	6	12	21	82
VL	13	6	13	9	18	8	67
pitch	1	2	8	2	2	4	19
glottal	4	0	1	0	1	1	7
all	35	17	39	17	33	34	175

Table 4. Number of tokens divided according to perceived blocking phenomenon across speakers.

Specifically, all speakers made use of at least three blocking types: only speakers 2 and 4 showed no evidence of primary glottaling. Notably, four of the seven cases in which glottal stop was listed as the most salient auditory correlate were in the data drawn from speaker 1. These results are in line with existing reports that speakers can vary according to the way in which pauses are realized phonetically, but with the same perceptual effect (see e.g. Collier et al. 1993 for Dutch).

5.3. Acoustic correlates of RS blocked

We focused on sequences involving voiceless stops, which numbered 60. Seven sequences were discarded because of speech errors or background noise, leaving 53 tokens. The distribution of tokens according to the primary auditory correlate is shown in Table 5.

1^0 perceptual correlate	no. tokens
phonetic pause	27
vowel lengthening	20
pitch break	5
glottal stop	1
total	53

Table 5. Number of RS word$_1$-word$_2$ sequences with intervening pauses examined acoustically, listed according to the primary auditory cue to the pause for all 6 speakers.

The acoustic appearance of each sequence was examined in order to confirm the presence of the blocking phenomenon that was perceived to have occurred during the auditory analysis. The presence of additional phenomena, where visible, was also noted. Table 6 lists the 53 tokens analyzed according to the primary auditory correlate, and the acoustic cues that were seen upon visual inspection.

1^0 perceptual correlate	visible correlate/s	no. tokens
phonetic pause	pause, pitch, glottal	10
	pause, pitch	4
	VL	3
	VL, pitch	3
	pause, glottal	3
	pause, VL, pitch	2
	glottal	1
	pause, VL, glottal	1
	total	27
vowel lengthening (VL)	VL	10
	VL, pitch	3
	VL, pitch, glottal, pause	2
	VL, pitch, pause	2
	VL, glottal, pause,	1
	VL, glottal	1
	pitch	1
	total	20
pitch break	pitch	2
	pitch, glottal	1
	pitch, VL	1
	pitch, pause	1
	total	5
glottal stop	glottal, pause	1
Total		**53**

Table 6. Auditorily primary blocking types divided according to visible acoustic cues for all 6 speakers.

Turning first to the tokens for which the primary auditory correlate was a silent pause, its presence was confirmed upon acoustic inspection in all but 7 cases (74.1%). Notably, phonetic (silent) pauses never occurred in isolation: all of the sequences in which the presence of a phonetic pause was confirmed showed at least one other concomitant blocking phenomenon, most typically a glottal stop.

Regarding the sequences in which vowel lengthening was perceived to have been the primary auditory cue, its presence was confirmed in 19 of the 20 sequences examined (95%). As such, these preliminary results suggest that vowel lengthening alone can block RS, whereas concomitant blocking phenomena were more frequent in perceived silent pauses.

The presence of a pitch break was confirmed for all five sequences in which it was perceived to have been the most salient auditory cue. Concomitant phenomena occurred in three sequences, while the remaining two showed only pitch breaks at the word boundary. Although comprising only a small number of sequences, this preliminary evidence confirms the role of pitch breaks as an RS blocker in naturally occurring speech. Moreover, it also suggests that a pitch break alone, like vowel lengthening, can signal the presence of a pause in RS sequences.

Proceedings of the 11th Australian International Conference on Speech Science & Technology, ed. Paul Warren & Catherine I. Watson. ISBN 0 9581946 2 9
University of Auckland, New Zealand. December 6-8, 2006. Copyright, Australian Speech Science & Technology Association Inc.

Accepted after full paper review

A glottal stop was perceived to have blocked RS in only one sequence amongst those where word$_2$ began with a voiceless stop. As shown in Figure 2, the presence of this particular glottal stop was clearly visible during the acoustic inspection.

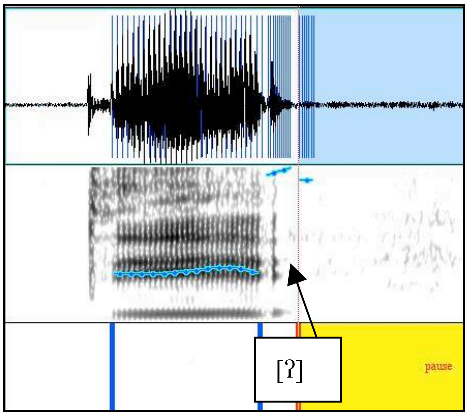

Figure 2. An example of a glottal stop that occurred following the RS trigger te in the sequence te prendi un filo di capelli 'you take a bit of hair' (s3:211).

6. Discussion

Our results confirm previous reports (e.g. Absalom & Hajek 1997; Absalom et al. 2002) that RS does not occur as frequently as many phonological accounts suggest. The important claim that RS can in fact be blocked by phonetic phrase breaks is confirmed by auditory and acoustic analysis of spontaneous speech. Our study also supports the description of RS blockers as silent pauses, vowel lengthening, pitch breaks and insertion of glottal stops, each of which can cue a break in the phonetic phrase. However, while breaks in the phonetic phrase are easy to detect auditorily, the subsequent identification of the individual blocking phenomena themselves is sometimes difficult. This appears to be due to the fact that more than one blocking phenomenon is often present – as confirmed by acoustic inspection (see Table 6). In this respect, our results are fully in line with those presented by Magno Caldognetto et al. (1997) who found that complex pauses (i.e. involving more than one phonetic element) are very frequent in spontaneous Italian speech.

In terms of auditory evaluation of the entire RSNP corpus of 175 items, there appears to be a clear scale of frequency as to the primary auditorily salient blocking process: so-called silent pauses (46.8%) >> vowel lengthening (38.3%) >> pitch break (10%) >> glottal stop (4%). While pausing and vowel lengthening are easily perceptible blocking processes, pitch breaks and especially glottaling are much less commonly perceived.

With respect to duration and other acoustic characteristics of blocking processes, we note that the average duration of the acoustic silent pauses was 988ms. However, it varied considerably across the 20 sequences for which the auditory presence of a pause was also confirmed acoustically. Whilst the longest pause was 8490 ms., the shortest pause was only 100 ms. (see also Campione & Véronis 2002). In particular, the finding that some of the perceived RS-blocking pauses in the present corpus were extremely short also confirms reports that no matter how slight, a phonetic pause can block RS (e.g. Absalom et al. 2002:6). We note also the seven sequences in which the auditory impression of a phonetic pause was not confirmed by the acoustic evidence (cf. Table 6). Of these, vowel lengthening was found to be visible in six sequences, while a glottal stop was the only visible phenomenon in the remaining sequence. These show that a pause does not necessarily have to be realised as phonetic silence to be perceived as such, and to block RS.

Turning to vowel lengthening, the average duration for the 19 audibly and visibly lengthened vowels was 487ms. However, like that of phonetic pauses, the duration of lengthened vowels was found to vary considerably across tokens, from 157ms to 958ms. While the former value does not appear to be particularly long, the fact that it was perceived as lengthened in relation to the surrounding segments demonstrates that it was still sufficient to signal a break in the phonetic phrase, thereby blocking RS.

With respect to pitch breaks, at this stage there appears to be no specific restriction on magnitude nor direction of F0 movement. The difference between F0 end and start points across word$_1$-word$_2$ junctures varied from 97Hz (s3:193 *no perché* 'no because') to only 16Hz (s3:194 *no praticamente* 'no practically'). In addition, the break involved a sudden decrease in pitch for some sequences but a sudden increase across the word boundary in others (e.g. *no↓perché* v. *no↑praticamente* in the sequences above).

Glottal stop was relatively less frequent than the other pausal phenomena in the present corpus of spontaneous speech data. Nonetheless, we were able to confirm the description of glottal stop as a fourth RS blocking phenomenon in Italian. Indeed, glottal stops were visible on acoustic displays more frequently than they were perceived: 19 of the 53 sequences involving other pausal phenomena i.e. vowel lengthening, pitch breaks, and true phonetic pauses showed concomitant glottal stop (cf. Table 6). The relative lack of perceptual salience (compared with the frequency at which they were visible) and co occurrence with other phenomena in RSNP sequences may help to explain why glottal stop has only recently been reported as an RS blocker (Absalom et al. 2002).

7. Conclusions

Overall, our results fully confirm earlier claims (Absalom et al. 1997, 2002 and others) that *Raddoppiamento sintattico* is not an obligatory categorical phenomenon: it can be blocked by a number of blocking processes. We have identified these processes as silent pauses, vowel lengthening, pitch breaks and glottal insertion, and have shown that they all function as perceptual cues to a break in the phonetic phrase. Such breaks categorically block RS: the issue of the length or duration of word-initial consonants is irrelevant, because RS can only apply where no break is perceived between word$_1$ and word$_2$.

Phonological analyses of RS that present the phenomenon without referring to these processes appear to be describing a highly idealized phenomenon that has little bearing with RS as it really occurs. As such these accounts need to be modified so that they better reflect the facts of RS.

Proceedings of the 11th Australian International Conference on Speech Science & Technology, ed. Paul Warren & Catherine I. Watson. ISBN 0 9581946 2 9
University of Auckland, New Zealand. December 6-8, 2006. Copyright, Australian Speech Science & Technology Association Inc.

Accepted after full paper review

At this stage our work on RS-blocking phenomena remains preliminary. While it confirms the existence of RS blockers as both perceptual and acoustic phenomena, the issue of why they occur where they do needs to be addressed. In addition, the observed mismatches between auditory and acoustic results (e.g. the auditory identification of one primary cue without its acoustic presence, cf. Table 6) are most intriguing and also merit further investigation.

8. References

Absalom. M. & J. Hajek (1997). Raddoppiamento sintattico: What happens when the theory is on too tight? In Bertinetto, P.M. (Ed.), *Certamen Phonologicum III*, pp. 159-179. Turin: Rosenberg & Sellier.

Absalom, M. & J. Hajek (2006). Prosodic phonology and *raddoppiamento sintattico*: a re-evaluation. In K. Allan (ed.) *Selected Papers from the 2005 Conference of the Australian Linguistic Society*, Melbourne: Monash University. http://www.arts.monash.edu.au/ling/als/.

Absalom, M. Stevens, M. & J. 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 Linguistics Society.* http://www.arts.unsw.edu.au/als2002.

Borrelli, D. (2002). *Raddoppiamento sintattico in Italian: a synchronic and diachronic cross-dialectal study.* Routledge: New York.

Camilli, A. (1941). I rafforzamenti iniziali. *Lingua Nostra* 3: 44-45.

Campione, E. & J. Véronis. (2002). A large-scale multilingual study of silent pause duration. In B. Bel & I. Marlien (Eds.) *Proceedings of Speech Prosody 2002,* Aix-en-Provence: 199-202.

Campos-Astorkiza, R. (2004). What is raddoppiamento? Lengthening and prosody in Italian. Unpublished manuscript. University of Southern California.

Collier, R., Roelof de Pijper, J. & A. Sanderman (1993). Perceived prosodic boundaries and their phonetic correlates. In *Human Language Technology*: *Proceedings of a workshop held at Plainsboro, New Jersey, March 21-24, 1993*. San Francisco: Morgan Kaufmann Publishers, 341-346.

D'Imperio, M. & Gili Fivela, B. (1997). Focus, phrasing and boundary phenomena in Italian read speech. In A. Botinis (Ed.) *Intonation: Theory, Models, and Applications*. Athens: pp. 91-94. http://www.isca-speech.org/archive/int_97.

Duez, D. (1982) Silent and non-silent pauses in three speech styles. *Language and Speech*, 25, 1: 11-28.

Hurch, B. (1986). Some considerations on the phonological nature of rafforzamento sintattico. *Quaderni dell'Istituto di linguistica dell'Università di Urbino* 4: 93-113.

Ladefoged, P. & I. Maddieson (1996). *The sounds of the world's languages.* Oxford: Blackwell.

Loporcaro, M. (1997). *L'origine del raddoppiamento fonosintattico*. Basel and Tübingen: Francke Verlag.

Magno Caldognetto, E., Zmarich, C. & F. Ferrero (1997). A comparative acoustic study of spontaneous and read Italian speech. *Proceedings of EUROSPEECH-1997*: 779-782.

Nespor, M. & I. Vogel (1986). *Prosodic phonology*. Dordrecht: Foris.

Norman, H. (1937) Reduplication of consonants in Italian pronunciation. *Italica* 14: 57-63.

Payne, E. (2000). *Consonant gemination in Italian: phonetic evidence for a fortition continuum*. PhD, Cambridge University.

Stevens, M., J. Hajek & M. Absalom (2002). Raddoppiamento sintattico and glottalization phenomena in Italian: a first phonetic excursus. *Proceedings of the 9th Australian International conference on Speech Science and Technology*. Melbourne.

Stevens, M. & J. Hajek (2005). Raddoppiamento sintattico and word-medial gemination in Italian: are they the same or are they different? The evidence from spontaneous speech. In R. S. Gess & E. J. Rubin (Eds.) *Theoretical and experimental approaches to Romance linguistics*, pp. 257-272. Amsterdam and Philadelphia: John Benjamins.

Proceedings of the 11th Australian International Conference on Speech Science & Technology, ed. Paul Warren & Catherine I. Watson. ISBN 0 9581946 2 9
University of Auckland, New Zealand. December 6-8, 2006.

Accepted after full paper review