

## PHONOLOGICAL LENGTH AND PHONETIC DURATION IN BOLOGNESE: ARE THEY RELATED?

J. Hajek

Department of Linguistics  
University of Melbourne

**ABSTRACT** - The phonetic basis of a reported phonological correlation between stressed vowel and post-tonic consonant length is examined for the first time. Whilst a vowel length distinction is confirmed for all subjects, a correlation between vowel and consonant duration is not universal.

### INTRODUCTION

A phonologically pertinent correlation between vowel and consonant length in tonic VC sequences is reported to be regular in some languages, e.g. Italian (Vincent 1988, Vogel 1982), Swedish, Icelandic and Norwegian (Eliert 1964, Lehiste 1970). In these languages it has been observed that where a stressed vowel is long, the following single consonant in non-cluster position is predictably short. Conversely, where the tonic vowel is short, the following consonant is always long, i.e. [V:C] vs. [VC:]. From a phonological perspective, such an inverse correlation has often been ascribed to considerations of syllable weight: in the languages cited tonic syllables are in most contexts predictably heavy. The results of experimental work confirm that the observed allophonic correlation has a phonetic basis: long consonants after short vowels have a substantially greater duration than short consonants after their long vowel counterparts in these languages (see Vogel 1982 and Eliert 1964 for details).

Whilst an inverse correlation between tonic vowel and consonant length, otherwise known as V/C complementation (Bannert 1973), is normal in Standard Italian and the Romance dialects of Central and Southern Italy, the same phenomenon is not considered to be typical of the Romance dialects spoken in Northern Italy. However, most descriptions of the Northern dialect of Bolognese (e.g. Gaudenzi 1889, Coco 1970) agree that V/C complementation is well-established in this particular dialect, notwithstanding its geographical location. Traditional Bolognese orthography supports such a claim by indicating as doubled all simple consonants after short tonic vowels, e.g. *gréll* [gret:] 'cricket', *sacch* [sak:] 'dry' (m. sg.). In contrast, short consonants after long vowels are never orthographically doubled, e.g. *bél* [be:] 'nice' (m.), *sáčh* [sa:k] 'bag'.

Exceptionally, Rizzi (1984) rejects the claim of any length correlation in Bolognese and suggests that the so-called 'long' consonants after short tonic vowels have been erroneously described. Instead, in her view they represent, at least perceptually, segments produced with a very intense articulation but with no increase in duration. Coco (1970) occupies a position somewhat in the middle between the traditional view and Rizzi's non-lengthening hypothesis: he refers to differences both in duration and intensity affecting post-tonic consonants. Nevertheless, he makes more frequent reference to the former rather than to the latter when discussing the phenomenon.

The purpose of this first experimental study of any kind on Bolognese is to test the more traditional claim of V/C complementation in Bolognese by comparing consonant duration after short and long tonic vowels. The conflict in opinions reported here suggests that the purported length correlation may have no phonetic basis. If Rizzi's hypothesis is correct, post-tonic consonants in Bolognese differ solely in terms of relative intensity, and no differences in duration will be uncovered.

In addition to consonant duration, details of vowel as well as vowel + consonant duration in Bolognese are also provided in this study. Whilst all sources agree that vowel length is phonemically contrastive in Bolognese, e.g. /mo:la/ (= [mo:la]) 'spring' vs. /mola/ (= [mol:a]) 'mule' (f.), vowel duration has not previously been measured. The duration of short and long vowels is established and the relative ratio of the former to the latter is also compared.

### PROCEDURES

To test the disputed hypothesis of V/C complementation in Bolognese, seven minimal or close-to-minimal pairs/sets highlighting differences in vowel and consonant length were established, e.g. [pa:na] 'cream' v. [pan:a] 'feather', and [sa:k] 'bag' v. [sak:] 'dry' (m. sg.). Recordings of these items were then made with three native speakers (A, B, C) of Bolognese (and Italian). A translation technique (Italian to Bolognese) was used to avoid the influence of Bolognese orthography. Speaker

A speaks the urban variety of Bolognese traditionally described in the literature. B and C were born and raised in the village of Monteveglio, approximately fifteen kilometres to the west of Bologna, but still within the confines of the province of Bologna. Their variety of Bolognese is perhaps best classified as rural and conservative.

For technical reasons, slightly different methods of elicitation were used for speaker A and speakers B and C. A was able to read the randomized list in a normal reading manner. It was found easier in the case of speakers B and C to go through the list orally with them once again in a normal reading manner (B and C were also allowed to look at the list at the same time). As a result of the particular elicitation technique adopted, speech rate was found for both speakers to be slightly more rapid than that used by speaker A.

Measurements were taken for all tonic vowels and post-tonic consonants, which were then summed to provide figures for V+C duration. For each category (vowel; consonant; and vowel + consonant) there was a total of 192 measurements - sixty-four per speaker.

## RESULTS

### Vowel Length and Duration

Mean durations and standard deviations of short and long vowels for all speakers and for each speaker are provided in Figure 1. Since the predictable derivation of consonant length in Bolognese is assumed to depend on the existence of contrastive vowel length, statistical evidence for vowel duration is discussed first. Long and short vowel duration were compared by means of the Mann-Whitney U-test. The difference between the two categories was found to be highly significant for all speakers individually and as a group ( $p < .0001$  in all cases). The percentage ratio of short vowel to long vowel was 34.7% for speaker A, 57.2% for speaker B, 56.3% for speaker C, and 45.8% for the group. For both short and long vowels, average duration of A's vowels was greater than that for B and C. Whilst A's short vowels (125 ms) were on average only 22 ms (17.6%) longer than the average for B and C combined (103 ms), the difference between the duration of A's long vowels (360 ms) and the combined average of 181 ms for B and C was a more substantial 179 ms (49.7%).

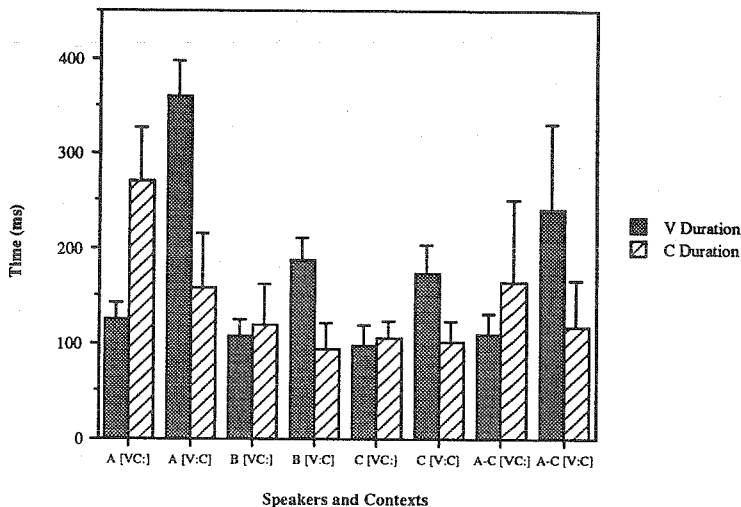


Figure 1: Mean durations and standard deviations of short and long tonic vowels and post-tonic consonants for each speaker and for all speakers

## Consonant Duration

Mean durations and standard deviations for 'long' and 'short' consonants are also shown in Figure 1 for each speaker and averaged across speakers. Whilst long and short vowels were found to be significantly different in all cases, the results of the Mann-Whitney U-test for 'short' and 'long' consonant duration were less consistent. A significant difference ( $p < .0087$ ) was found for the whole group. However, such a result hides substantial inter-speaker variation. Only in the case of speaker A was a (highly) significant result obtained ( $p < .0001$ ). The results for speakers B ( $p = .1239$ ) and C ( $p = .704$ ) were not significant. The percentage ratio of 'short' consonant to 'long' consonant was found to be 58.5% for speaker A, 79% for speaker B and 97% for speaker C. As the percentage ratio suggests, speaker C presented practically no difference in duration between 'short' (102 ms) and 'long' (105 ms) consonants. As with vowel duration, segment duration was substantially greater in the case of A across both consonant types. A's 'short' consonants (158 ms) were 60 ms (38%) longer than the combined average of 98 ms for B and C. The difference were far higher in the case of 'long' consonants: mean duration of A's 'long' consonants (270 ms) was 158 ms (58%) longer than the combined average of 112 ms for B and C.

## The Interrelationship between Vowel and Consonant Duration

The percentage ratios of vowel and consonant duration relative to V+C duration were calculated for each speaker and averaged across speakers on the basis of the results presented in Figure 1. In the case of [V:C], ratios are similar across speakers. Only a relatively small range of variation is reported. The vowel to V+C ratio ranged from 63% (speaker C) to 69.5% (speaker A) with a cross-speaker average of 67%. In the same context therefore, the consonant ratio ranged from 30.5% (A) to 37% (C) with a cross-speaker average of 33%. In the case of [VC:], the ratios for speaker A differed markedly from those of speakers B and C: for the former the vowel ratio was 31.6% compared to 47.3% for B and 48.3% for C. The cross-speaker average was 40%. Such variation between speakers can be accounted for. As only speaker A was found to have significantly longer consonants after short vowels than after long vowels, we would expect in his case more of the average V+C duration to be derived from the consonant rather than vowel.

The results suggest that in the case of [V:C] the vowel occupies for all speakers approximately two thirds of the overall duration of the sequence. This 2 to 1 ratio between vowel and consonant holds notwithstanding differences in dialect variety and speech rate, and is compatible with the phonological representation as long vowel and short consonant. In the case of [VC:], the cross-speaker ratios of 40% and 60% for vowel and consonant length respectively are not far from a 1 to 2 relationship, and might be adequately represented phonologically as short vowel plus long consonant. However, inter-speaker differences show that such a representation is accurate only for speaker A. For speaker A the degree of complementation is better than the cross-speaker average suggests: the vowel occupies slightly less than one third and the consonant slightly more than two thirds of the overall duration of the [VC:] sequence. The same cannot be said for speakers B and C for whom the relative ratios of vowel and consonant duration are approximately one to one. In such circumstances, a more accurate phonological description of durational behaviour in the context of short vowels appears to be [VC] for B and C. The representation of the post-tonic consonant as short reflects also the non-significant differences in consonant duration after long and short tonic vowels for B and C.

To this point the suggested inverse correlation between vowel and consonant duration has been discussed in gross terms, i.e. analysis has focussed on the inverse phonetic correlation between very general, phonologically oriented categories (short vowel + long consonant, long vowel + short consonant). However, it also needs to be asked to what extent changes in consonant duration are sensitive to very small changes in vowel duration. The results for vowel and consonant duration were subjected to a simple linear regression (Pearson's product-moment) test. In Figure 2, values of consonant and vowel duration for all speakers are plotted against each other in scattergram form. No negative correlation was evident at all for the group ( $R = .047, p = .6505$ ). For speakers B ( $R = .056, p = .7606$ ) and C ( $R = .066, p = .7191$ ) the negative correlation was very slight and not significant. Such a result for B and C is, however, not unexpected. Previously, it was seen that for these two speakers vowel length had no significant impact on consonant duration.

Only for speaker A was a negative correlation strongly evident ( $R = .687, p = .0001$ ), as the steep diagonal line in Figure 2 demonstrates. The very clear separation of values for speaker A's short and long consonants in the scattergram is the result of the very large difference in duration between short and long vowels along the X-axis.

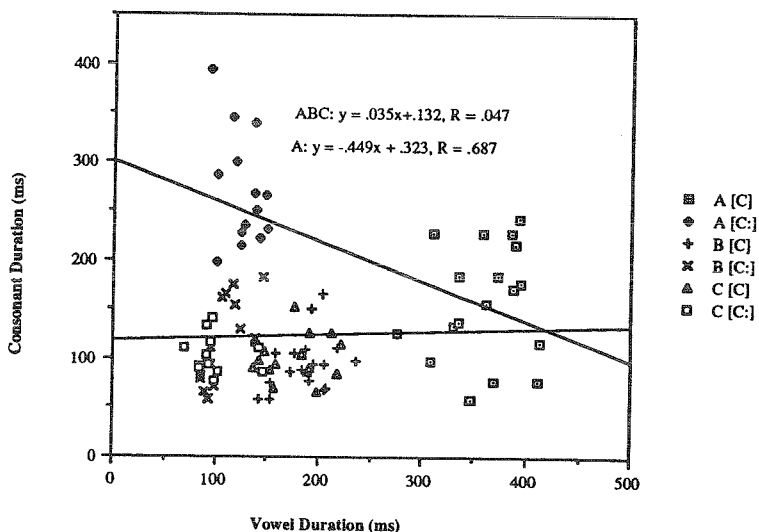


Figure 2. Consonant duration (Y-axis) plotted against vowel duration (X-axis) for all speakers. Pearson's product-moment R-values and regression lines are provided. Horizontal line represents regression for all speakers. Steep diagonal line represents regression for speaker A only. Points represent averaged duration for each word item. See right legend for details of speaker and consonant type.

#### DISCUSSION AND CONCLUSIONS

The existence of contrastive vowel length in Bolognese is accepted by all descriptive sources. The phonetic basis of such a contrast is confirmed by the experimental evidence discussed in this study: all three speakers showed highly significant differences in vowel length ( $p < .0001$ ). The relative short to long vowel ratio (V/V:) was 45.8% across the group. However, the reliability of the cross-speaker figure may be questioned given the high level of inter-speaker variation. The V/V: percentage ratio of 34.7% for speaker A is much lower than the average ratio of 56.9% for speakers B and C. Two factors may account for these substantial inter-speaker differences in relative vowel duration ratios. The difference in dialect variety (urban vs. rural) may be expected to account for some divergence in results. Some support for this may be found in the fact that speakers B and C group together in this context. However, such an explanation may be insufficient to account for the degree of difference separating the results of speaker A from those of speakers B-C. A more likely account could lie in the inter-speaker difference in speech rate mentioned previously. Cross-linguistic evidence cited by Sock (1984) and Cheikh Rouhou *et al.* (1988-1989) shows the duration of long vowels to be particularly sensitive to changes in speech tempo. In slow speech long vowels may in some languages (e.g. Wolof, Franco-Provençal) show a particularly large increase in duration. Conversely, when the speech rate is increased, long vowels appear to be particularly prone to a reduction in duration. By way of comparison, short vowels tend to be relatively stable and in the same languages show very little or no evidence of changed duration when speech tempo is altered. In these circumstances, the particularly high levels of long vowel duration found for speaker A, resulting in a particularly low short vowel to long vowel ratio, may be ascribed to the slow, careful, speech rate and style adopted. The hypothesis of relative short vowel stability across speech rates appears to find some confirmation in this study. Little inter-speaker variation in short vowel duration was uncovered, cf. Figure 1. Speaker A's result of 125 ms. was only 15 ms. longer than group average (110 ms), and 22 ms. greater than the combined

average for B and C (103 ms.). In contrast, differences in long vowel duration were very substantial: the average duration for speaker A of 360 ms. was some 120 ms. longer than the group average of 240 ms. and 179 ms. longer than the combined average of 181 ms. reported for speakers B and C. On the other hand, the influence of inherent cross-speaker differences in speaking rate (and hence duration) cannot be excluded: in a study where 5 speakers were asked to use a normal speaking rate in reading a list, interspeaker differences in rate and vowel duration were comparable to those reported here (Johnson, Ladefoged & Lindau 1993).

With regard to consonant duration, the results of this study provide at least partial confirmation of the V/C complementation hypothesis. Comparison of 'short' and 'long' consonant duration showed differences in duration to be statistically significant for the group. However, it need be pointed out that such a result masked substantial inter-speaker variation. More detailed examination of the results found 'short' and 'long' consonants to be significantly different in duration only in the case of speaker A ( $p < .0001$ ). No such difference was found for speakers B and C. The results of the statistical analysis confirm impressionistic evaluation of the recordings: whilst post-tonic gemination of consonants after short vowels appeared - at least perceptually - to be regular in the case of speaker A, for speakers B and C gemination seemed sporadic and unpredictable. It is unclear to what extent the difference in performance of A on the one hand and B-C on the other should be ascribed to dialectal variation or differences in speech rate. With regard to the former factor, absence of regular consonant gemination in Monteveglio Bolognese may not be unexpected. There is at this point insufficient descriptive data on the varieties of Bolognese spoken to the west of Bologna, which includes Monteveglio, very close to the provincial border with Modena. However, my own fieldwork with Modenese informants suggests post-tonic gemination in this area, even in careful styles, also to be very sporadic and inconsistent.<sup>1</sup> If the rural Bolognese of Monteveglio is more archaic than its urban counterpart, then post-tonic gemination may be an urban innovation yet to spread to rural varieties such as that used by speaker B.<sup>2</sup>

Speech rate variation also provides a plausible basis for the type of inter-speaker variation in consonant duration reported in this study. Both Sock (1984) and Cheikh Rouhou *et al.* (1988-1989) report that as speech tempo is increased or decreased, long consonants after short tonic vowels are particularly prone to compression or expansion respectively. Such an observation is derivable from the previously noted stability of short vowel duration across speech rates which predicts that tempo-induced changes in duration will affect post-vocalic consonant duration primarily. Therefore, the faster speech rate used by B and C, relative to that of A, may have resulted in the substantial compression of 'long' consonants after short vowels, and the absence of regular consonant gemination. Conversely, the careful style and relatively slow speech rate used by speaker A may plausibly have led to an exaggerated expansion of 'long' consonants with little change in short vowel duration, as the duration of the whole word was increased.

The extent to which the absence of regular gemination in the speech of B and C may be ascribed to speech rate and/or of dialectal variation can only be determined by a new study in which the same speakers B and C produce the tokens at different rates of speech (slow, normal and fast). At this point, with the available data we can only conclude that V/C complementation is characteristic of the urban variety of Bolognese - as confirmed by impressionistic assessment. However, the results for the two rural speakers B and C suggest that V/C complementation may not have spread to more archaic varieties of Bolognese, or perhaps is not characteristic of (some varieties of) Bolognese when the speech rate is increased.

With the absence of any [V:C] ~ [VC:] distinction, it is not surprising that an inverse correlation between vowel and consonant duration was not found for speakers B and C. Only in the case of speaker A did consonant duration appear sensitive to small changes in vowel duration and a significant inverse correlation uncovered, cf. Figure 2.

A possible hypothesis that V/C complementation might result in a comparable duration of heavy syllables, [V:C] and [VC:], was not confirmed by this study. [V:C] was significantly longer in duration than [VC:] for each speaker and averaged across speakers, cf. Figure 1. In fact, examination of the relative [VC:] to [V:C] ratios, shows almost no inter-speaker variation. In the case of speakers B and C for whom complementation is not reported, such a result is not unexpected since [V:C] contrasts with what in reality is a sequence of short vowel and short consonant, i.e. [VC]. More surprising, however, was the discovery that even for speaker A for whom V/C complementation was marked, the duration of [V:C] was also significantly greater than that of [VC:]. Such an unexpected finding appears to have its basis in the relatively extended duration of long vowels (380 ms.).

The hypothesis put forward by Rizzi (1984) and Coco (1970) that 'short' and 'long' consonants differ in terms of relative intensity has not been specifically addressed in this study and requires further investigation. Whilst it is clear that durational differences provide the basis for a 'short' vs. 'long' consonant distinction only in the case of speaker A, it may be that speakers B and C operate a non-durational 'lax' and 'tense' consonant distinction. However, impressionistic perceptual evaluation of Bolognese, in particular of the Monteveglio variety, does not provide any initial confirmation of a difference in consonant intensity as has been suggested.

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<sup>1</sup> Similarly inconsistent gemination is reported by Cheikh Rouhou *et al.* (1988-1989) to occur in at least one variety of Franco-Provençal for which V/C complementation is often reported in the descriptive literature.

<sup>2</sup> Bolognese post-tonic gemination is a recent secondary development, the first evidence of which comes from the 19th century. It is not related to post-tonic lengthening in Standard Italian, Tuscan, and other dialects to the south.