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# “No duration without intonation”.

## The interplay of lexical and post-lexical durational differences

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### Abstract

Current research in typology has shown that durational effects at the phonetic level can have a profound impact on vowel length. Quantity languages, for instance, often display constraints on final lengthening in order to maintain contrasts between short and long vowels. We contribute to this typology by considering two closely related Italo-Romance varieties, Genoese and Ventimigliese, which differ in one crucial feature, namely vowel length. According to the literature, quantity contrasts should be well-attested in Genoese but not in Ventimigliese.

An acoustic analysis based on the duration of stressed syllables suggests that the two varieties may be different not so much in vowel length as in their intonation. Unlike Genoese, Ventimigliese displays longer syllables in the utterance-internal than in the final position. This could be due to the pressure of the Ventimigliese utterance-internal position to adjust to a higher F0. It remains to be seen whether this is due to differences in tone structure. All in all, we claim that only a comprehensive study of prosody and intonation can enlighten durational patterns in language typology.

**Index Terms:** phonological typology, final lengthening, intonation, Northern Italo-Romance.

### 1. Introduction

The duration of syllables (vowels in particular) in natural language plays a key role in prosodic structure, as it is one of the main acoustic cues for signaling the end of prosodic units ([1] for a comprehensive survey on recent literature). This phenomenon is usually known as final, prepausal or pre-boundary lengthening. Recent research has discovered fine-grained phonetic details of final lengthening, such as its gradual and progressive nature, which is sensitive to the type of boundaries within the prosodic hierarchy, as in [2] based on English data, and the relative proximity to the boundary itself, as in [3] based on Hebrew.

The interplay between final lengthening and phonemic duration is also relevant for understanding phonological and perceptual constraints operating in quantity languages, as shown in [4] and [5]. From a typological perspective, [4] discusses three major strategies for coping with final lengthening observed in a variety of quantity languages:

(i) Unconstrained lengthening of both short and long vowels resulting in ‘phonemes of ambiguous durations’ and possible perceptual confusion between phonological short and long vowels (as in several Bantu languages, [6]);

- (ii) unconstrained lengthening tempered by other competing acoustic cues on which listeners can safely rely for distinguishing short and long vowels, such as vowel quality (as in Swedish, [4]);
- (iii) constrained lengthening observed in languages that signal vowel length contrasts mainly through phonetic duration. Short vowels are more likely to display ceiling effects compared to long vowels (as in Estonian and Hungarian, [4]).

In our view, this broad picture can be refined by micro-typological comparisons involving specific linguistic areas and by focusing on other acoustic cues that are well known to interact with prosodic structure, such as F0 ([7] for an overview).

In this paper, we contribute to this aim by conducting an empirical study on two (typologically and genetically) close varieties, which only differ in one crucial phonological feature, namely vowel length. These varieties are Genoese and Ventimigliese, two Italo-Romance dialects belonging to the Ligurian group ([8]). While Genoese displays vowel length contrasts (among others, [8], [9], [10] and [11]), in Ventimigliese vowel length does not seem to have phonemic status ([12], [13]). Instead, some recent studies have shown that utterance-final lengthening is at play in both Genoese and Ventimigliese ([13]). However, their language-specific patterns are not so clear yet. While clarifying this issue, we also aim at offering some preliminary remarks on the relation between utterance-position and F0 in these varieties.

### 2. Research questions and hypotheses

The research questions that we intend to address are:

- Do Genoese and Ventimigliese show different typological patterns in terms of utterance-final lengthening?
- Are there differences in F0 related to the utterance position between the two varieties?

Regarding the first question, we expect that the data confirm the results presented in [13], in which both Genoese and Ventimigliese display utterance-final lengthening effects. In order to answer this question, we compare the utterance-internal with the final position (§3). Lengthening effects are also expected to be ‘moderate’, as our analysis concerns stressed syllables in trochaic words (see Table 1). Since the syllables are not immediately adjacent to the boundary, they should not be subject to substantial lengthening. Moreover, as suggested by the empirical analysis in [13] and the typological considerations in [4], we expect different patterns for the two dialects: more specifically, utterance-final lengthening effects for Genoese should be (somehow) constrained by vowel length (in

particular, by the need to maintain the functional load of vowel length in this position), while unconstrained phonetic durational effects should occur more likely in Ventimigliese.

With respect to the second question, besides the fact that F0 is expected to be lower in the final position in both varieties (our stimuli are declarative sentences), at the moment we are not able to propose any clear predictions concerning possible differences between the dialects. This is mostly because little is known about the intonation of Genoese (see [14] for some remarks) and literally nothing is known about Ventimigliese. Therefore, we offer a first, exploratory study based on the comparison between F0 mean values in the utterance-internal and final position of the two dialects.

### 3. Data and methods

The data were gathered from 10 interviews with native speakers: 5 for Genoese (1 female), 5 for Ventimigliese (1 female). The average age of Genoese informants is 68 ( $\pm 11.02$ ) and of Ventimigliese is 56 ( $\pm 6.32$ ). They were recorded by means of a *Marantz PMD 661* recorder and *Sennheiser MKE 2* microphones in quiet rooms. Each speaker was asked to translate short made-up sentences from Standard Italian into their own dialect, which were read aloud by the experimenter. The sentences were declarative SVX statements uttered without a context and with an intended pragmatically ‘neutral’ meaning (broad focus). The target items (cf. Table 1) occurred in two different sentence positions: utterance-internal and final.

- (1) Il nonno è andato a **Genova** prima di cena (internal)  
‘The grandfather went to Genoa before dinner’
- (2) Il nonno è andato a **Genova** (final)  
‘The grandfather went to Genoa’

The target items are words shared by Genoese and Ventimigliese. In Genoese, however, they are meant to represent (sub)minimal pairs, while in Ventimigliese the stressed vowels of the words belonging to the (sub)minimal pairs are expected to have the same duration.

Table 1: (sub)minimal pairs.

Vowels	Target items
/a:/ ~ /a/	/ˈna:zu/ ~ /ˈmazu/, ‘nose ~ may’
/œ:/ ~ /œ/	/ˈkœ:ʒe/ ~ /ˈkœʃe/, ‘to cook ~ thighs’
/ɔ:/ ~ /ɔ/	/ˈpɔ:ku/ ~ /ˈtɔku/, ‘a bit ~ a slice (of)’ /ˈpɔ:su/ ~ /ˈfɔsu/, ‘I rest ~ moat, trench’
/e:/ ~ /e/	/ˈze:na/ ~ /ˈzene/, ‘Genoa ~ son-in-law’
/i:/ ~ /i/	/ˈri:zu/ ~ /ˈrisu/, ‘rice ~ hedgehog; curl’ /ˈfri:tu/ ~ /ˈsitu/, ‘fried ~ shut up; quiet’
/u:/ ~ /u/	/ˈdu:se/ ~ /ˈduze/, ‘sweet ~ twelve’ /ˈspu:zu/ ~ /ˈpusu/, ‘groom ~ well, pit’
/y:/ ~ /y/	/ˈfry:tu/ ~ /ˈbrytu/, ‘fruit ~ ugly’

The target items were manually segmented into syllables in Praat, [15]. Only 364 of the expected 400 syllables (10 speakers x 20 target items x 2 sentence positions) have been analyzed (191 for Genoese, 173 for Ventimigliese). This is due to a few missing value and, above all, to the target items ‘I rest ~ moat, trench’, which the Ventimigliese speakers have systematically realized by means of different words than the ones presented in

Table 1. Subsequently, syllable durations and mean values of F0 were extracted with Praat scripts. Data analysis was carried out by means of R, [16].

## 4. Results

### 4.1. Data exploration

Syllable duration in ms. in both utterance-internal and final position is displayed in Figure 1.

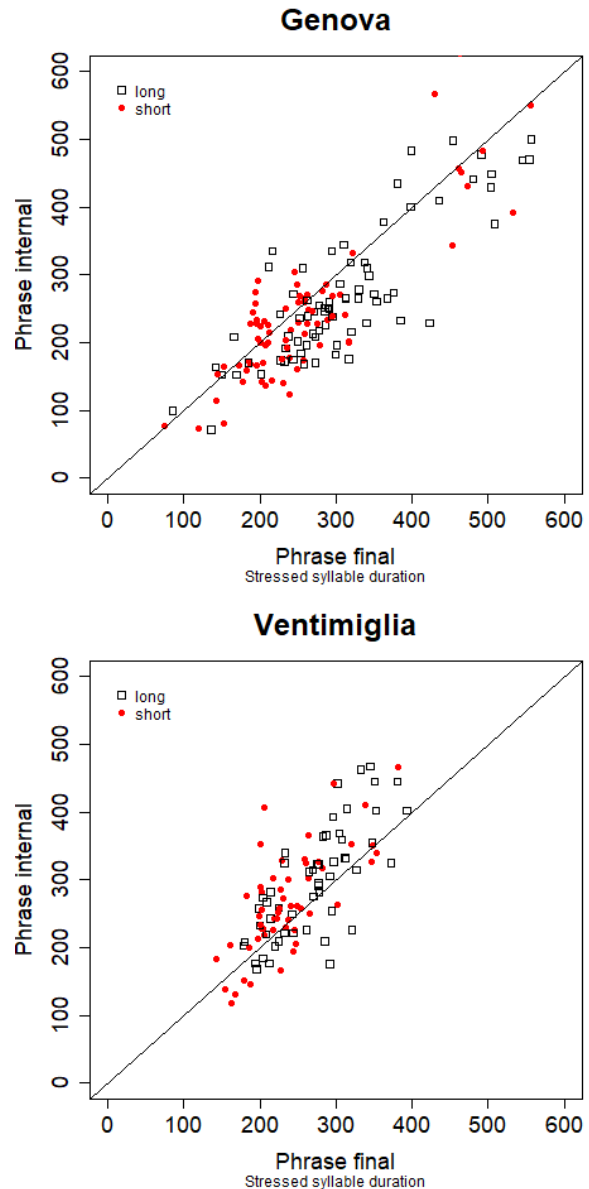


Figure 1: Syllable duration (ms.).

The plots suggest that in both varieties syllables with a long vowel are longer than the ones with a short vowel, although this information seems more clearly conveyed by Genoese data. This visual impression has been confirmed by inferential statistics (two-sample Welch *t*-test: Genoese,  $t = 8$ ;  $p < .0001$ ; Ventimigliese,  $t = 3.76$ ;  $p < 0.001$ ).

In Genoese, in which most of the datapoints are located under the diagonal in the lower half of the quadrant, syllables in the final position are longer than in the internal one ( $t = 2.45$ ;  $p < .05$ ). In Ventimigliese, the opposite is true ( $t = -2.25$ ;  $p < .05$ ). Moreover, in Genoese there is a difference in final lengthening between syllables with long and short vowels: the former show a lengthening effect compared to the internal position ( $t = 2.58$ ;  $p < .05$ ), unlike the latter ( $t = 0.85$ ;  $p = .39$ ).

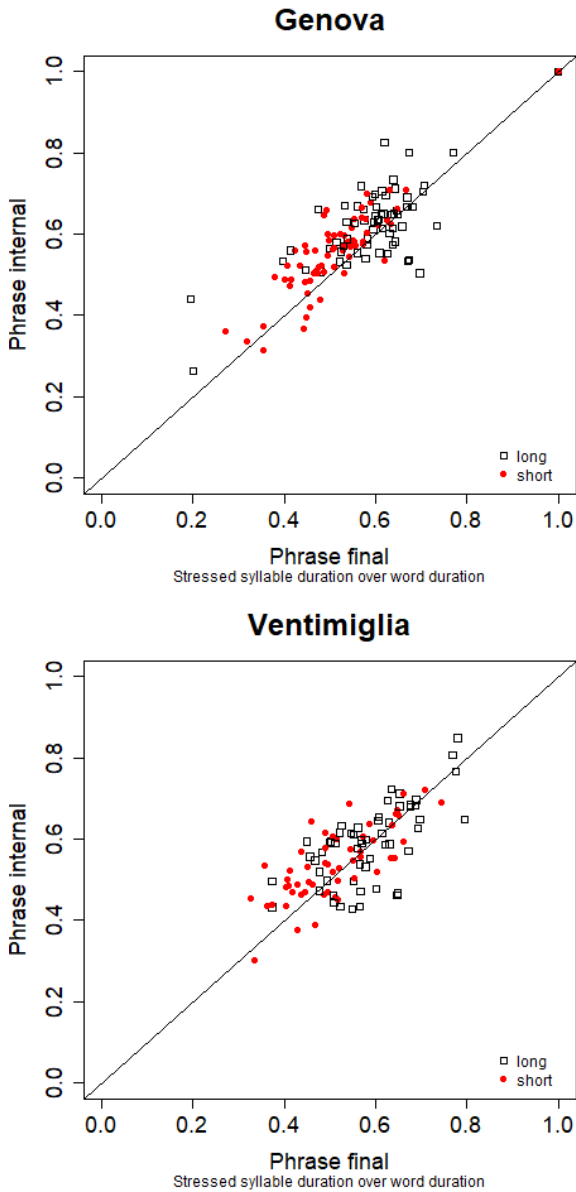


Figure 2: Syllable duration over word duration.

If we also consider normalized values (i.e. syllable duration over word duration), in Figure 2, the information concerning the difference between short and long vowels remains stable, whereas the relationship between the internal and final position is reversed in Genoese. This probably happens because stressed syllables in trochaic words are subject to a lesser lengthening effect compared to the final unstressed syllables. In Ventimigliese, the normalized values confirm the pattern shown by the absolute ones.

These observations hint at two unexpected facts: the possible presence of short vs. long contrasts in Ventimigliese as well as the lack of final lengthening in this variety. A third interesting fact is provided by Figure 3, which displays mean F0 values. Although F0 is lower in the final position in both dialects (Genoese,  $t = -7.94$ ;  $p < .0001$ ; Ventimigliese,  $t = -6.60$ ;  $p < 0.001$ ), Ventimigliese has higher F0 values than Genoese (internal position,  $t = -4.30$ ;  $p < .0001$ ; final position,  $t = -4.34$ ;  $p < .0001$ ).

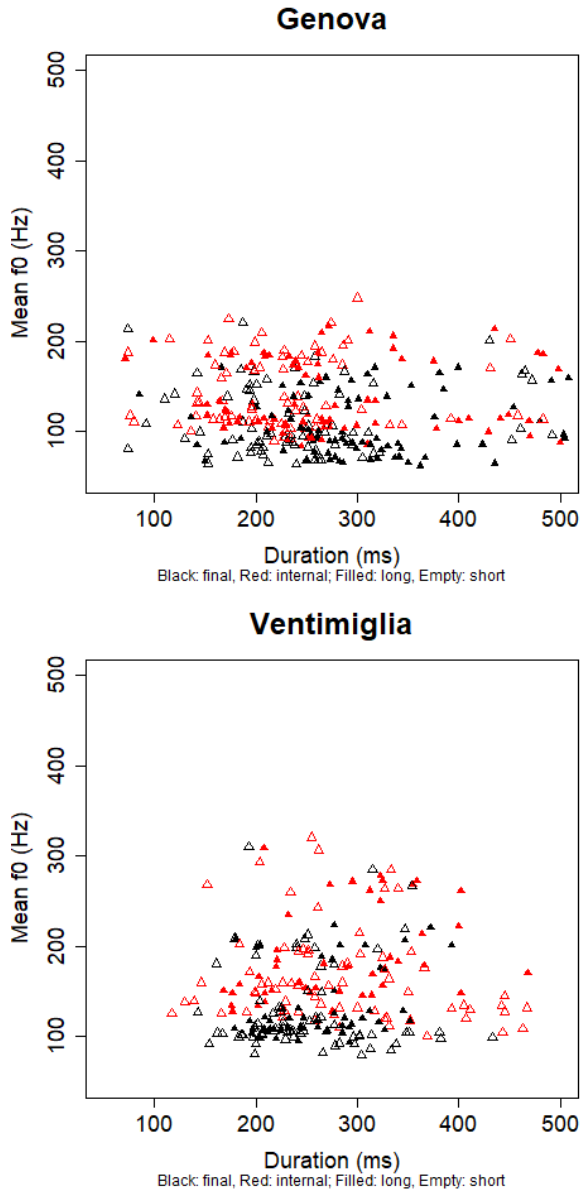


Figure 3: mean F0 values.

#### 4.2. Statistical modelling: Conditional inference trees and Random Forest

In light of the limited number of data and speakers, we refrain from using linear mixed models, which are postponed to a next stage of our research. In this exploratory study, we rely instead on conditional inference trees and random forests [17]. These are non-parametric methods that suit well cases in which not

much data is available and complex interactions between different predictors are expected ([18], [19] for details).

First, we have generated a decision tree which predicts the probabilities for a syllable to be Genoese (GE) or Ventimigliese (VM) based on the factors Vowel Length (LEN; short vs. long), Utterance-Position (POS; internal vs. final), Duration (DUR, ms.), F0 mean values (F0, Hz) and Pairs (PAIR; levels are the (sub)minimal pairs in Table 1). The algorithm splits the dataset starting from the variable which has the strongest association with the response and goes on until there are no more variables associated with the response at the .05 threshold, [19].

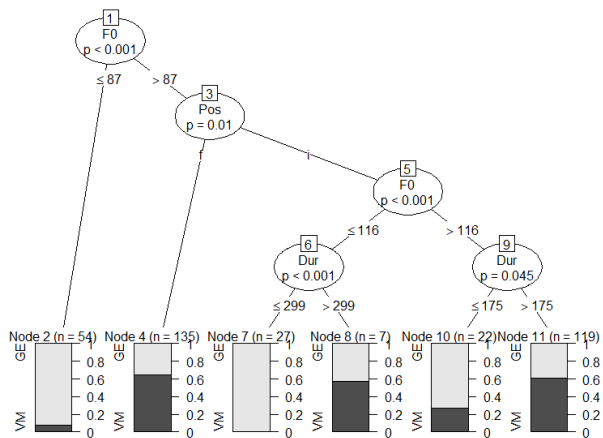


Figure 4: *Conditional Inference Tree (C-index: .73).*

The tree depicts the structure of the data by highlighting the role of three variables (F0, Position and Duration) and their interactions in discriminating between Genoese and Ventimigliese. As pointed out by the three-way interaction between Position, F0 and Duration, the probability that an internal syllable has higher F0 mean and duration (as shown by the rightmost barplot in Figure 4) is greater for Ventimigliese. The likelihood that a syllable in utterance-final position has higher F0 is also greater for Ventimigliese, as shown by the two-way interaction between the predictors F0 and Position in the first branch of the tree. However, Duration is not involved in this case.

Finally, a random forest model, which results from constructing a large number of conditional inference trees, confirms the utmost importance of F0, Position and Duration in the dataset (the values on the  $x$ -axis in Figure 5 only serve to allow comparison between the factors, [19]).

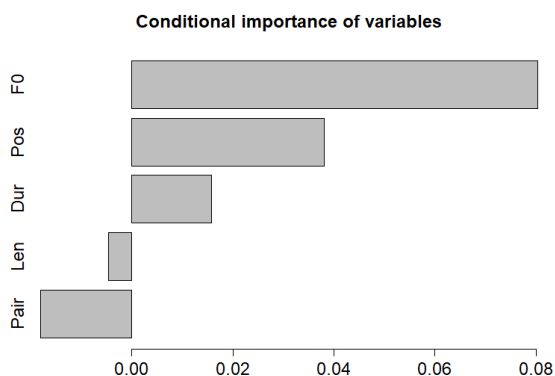


Figure 5: *Random Forest (C-index: .92).*

The factor Vowel Length and Pair do not play any significant role in discriminating between Genoese and Ventimigliese, despite the literature suggesting otherwise.

## 5. Discussion and conclusion

Our analysis has shown that, unexpectedly, (i) vowel length contrasts are perhaps present also in Ventimigliese, (ii) stressed syllables are longer in the final position (compared to the internal one) in Genoese but not in Ventimigliese, and, finally, (iii) syllable duration, F0 and utterance-position significantly interact, resulting in higher F0 values associated with longer stressed syllables in the Ventimigliese internal position. As for (i), we might briefly speculate that the difference with [13], in which vowel length did not play a role, could depend on the metrics used for measuring duration in the two studies (stressed syllables vs. stressed vowels and post-stress consonants). Leaving post-stress consonants may have a dramatic impact on information about vowel length at the segmental level. Moreover, it is also worth mentioning that the speakers in [13] were from different parts of the Intemelian area (i.e. the most Western Ligurian group including Ventimigliese).

Regarding (ii) and (iii), Genoese shows an expected pattern in terms of vowel length and conforms to the third typological scenario sketched in §1, in which syllables with short vowels are subject to ceiling effects in the final position. The lack of final lengthening in Ventimigliese is also surprising if compared with the results in [13], which present a very different situation. Again, this can be due to the differences in the metrics and the speakers mentioned above.

However, the ‘puzzling’ situation of Ventimigliese can be better appreciated if we consider F0 values, given that durational and melodic parameters are known to interact in many languages ([20], [21]). Since longer stressed syllables in the internal position are also accompanied by higher F0 values, we can hypothesize that this durational pattern is linked with intonation. In other words, the increased syllable durations found in Ventimigliese could be due to the pressure faced by the utterance-internal position to adjust to a higher F0. Such higher F0 might be the consequence of intonational differences between the two varieties, for example in the number and type of tonal events that can be expected to take place sentence-internally. This would lend further support to current research on the impact of post-lexical accents on lexical material ([22], [23]). However, given the highly constrained elicitation method employed for this study, it is possible that the reported differences in F0 are instead the consequence of speakers’ reactions to the task. Despite our aiming at pragmatically neutral interpretations, it is possible that speakers inferred (and realized) some form of contrast on the target words, due to their nature as (sub)minimal pairs. In order to dispel this possibility, as a next step we are analyzing data of different nature, such as connected speech gathered from Map Task and spontaneous interactions (see [24] *inter alia*).

In conclusion, our analysis strongly suggests that a comprehensive study of prosody and intonation can substantially contribute to enlighten durational patterns in language typology.

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