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Between phonology and typology. Consonant duration in two Gallo-Italian dialects[1]

Segmental correspondences are sometimes due to completely different factors. We exemplify this claim by considering the allophonic gemination of post-stress consonants in Bologna and Porto Maurizio dialects, two varieties which display contrastive vowel length. After the experimental confirmation of vowel length contrasts and the existence of differences in the duration of the post-stress consonants, we qualitatively analyze intensity contours. Despite similar duration values, in light of different intensity patterns and rhythm accounts, we hypothesize that post-stress gemination derives from close contact in Bolognese, due to a stronger compensative pattern, while it is residual or due to the pressure of standard Italian in Portorino.

Key words: Consonant duration, Northern Italo-Romance, Dialectology, Phonology, Typology.

Introduction

The aim of this paper is to propose a first experiment dealing with the coexistence of vowel length oppositions and a longer duration of post-stress consonants after short stressed vowels in two Northern Italo-Romance dialects. We will do this in § 4 by measuring the quantity of stressed vowels and post-stress consonants (the methods are explained in § 3). A further, particularly relevant aim is trying to find out whether the correspondence of these features must be ascribed to a similar rhythm pattern or not, which will lead us to some typological considerations about rhythm. In order to do that, we will provide a short introduction to intensity contours (§ 5) before concluding with a brief discussion (§ 6). Before starting our analysis, we will explain what is meant here by *rhythm* (§ 1), since we will consider single (phonological) words and not longer speech chains, and we will give a brief description of length patterns in Gallo-Italian Dialects (§ 2).

1. *Some preliminary remarks on rhythm*

We call *rhythm* the distribution of features like stress, quantity and tone (the *suprasegmentals* analyzed by Lehiste, 1970) among the segments inside a given unit.

[1] The paper has been jointly written by the three authors. For academic purposes, LF bears responsibility for §§ 1, 2, 6.2; DG for §§ 5, 6.1; DD for §§ 3, 4. While being solely responsible for any weaknesses or inaccuracies that may be found here, the authors would like to thank Chiara Celata, Franco Cutugno, Christine Mooshammer and an anonymous reviewer for their helpful comments.

Since tone does not play a relevant role in the varieties we are going to deal with, we will refer here only to stress and quantity as rhythm-sensitive features. To classify the different typologies of rhythm, we do not adopt the classical categories of *stress isochrony* and *syllable isochrony* (Abercrombie, 1967 after Pike, 1945, and thereafter a large amount of studies). We prefer instead those of *control* and *compensation* (first in Vékás, Bertinetto, 1991, then in Bertinetto, Bertini, 2008; see Filipponio, 2012a), which are explainable as the tendencies either to keep the distribution of quantity stable or to unbalance it, normally in favour of the prominent elements (viz. the stressed syllables). In this way, segmental changes leading to a bigger imbalance between more and less prominent elements can be ascribed to a compensating pattern, while changes balancing them (or at least no changes) may be due to a controlling pattern. Diachronically, these patterns are cyclical (Filipponio, 2012a), so that a controlling pattern can involve a rhythm structure previously modified by a compensating one; at the end, a total compensation should produce an alignment of prominences building a new control phase pattern.

The question is whether it is possible to deal with rhythm by describing processes involving a single (phonological) word – which, in other words, means asking whether a phonological word can be considered as a rhythm unit. Since phonological words are normally realized inside the speech chain, viz. an environment dominated by inter- and intra-speaker (context-sensitive) variation as well as a huge amount of coarticulation (assimilation, elision and so forth), the attempt to obtain a rhythm picture of a language starting from this situation should be immediately abandoned. In more general terms, every attempt to extract rhythmic properties from the speech chain seems to be doomed to failure: one can surely agree on this with Arvaniti (2012), who claims that rhythm classifications based on metrics such as %V, ΔV, ΔC (Ramus, Nespor & Mehler, 1999), PVI (Grabe, Low, 2002) and Varco (Dellwo, Wagner, 2003) are unsafe: their unsafety depends exactly on the fact that they try to find out regularities by measuring speech chains (phonetic utterances), without regard to prominences (stress, length) and contrasts (stressed/unstressed, long/short) – what speakers/hearers contrarily do.

For all these reasons, the definition of rhythm that we have provided above must be understood as phonological. Therefore, the search for rhythmic features should be exclusively phonology-driven (cf. Dauer, 1983; Bertinetto, 1989; Filipponio, 2012a). In that respect, the phonological word considered as a rhythm unit comes back into play, and the diachrony with it: in the sense that, if some rhythm-driven changes such as lengthening, shortening or loss of segments and/or syllables have been lexicalized, we should be allowed to consider the story of a word structure as a clue to reconstruct the rhythm history of a language. Moreover, allophonic phonological rules, as part of the synchronic phonological derivation (Loporcaro, 2015: 234), must be taken into consideration. In sum, we (try to) consider the co-occurrence of segmental phenomena as epiphenomena related to a superordinate rhythm pattern (see the discussion in § 6).

To provide an example of what we mean, consider for instance the Latin proparoxyton PĔRTĬCĂ 'pole'; doing something 'with a pole' (instrumental) would have been expressed through the ablative PĔRTĬCĀ, with a ˈCVC-CV-CV: structure requiring a stable control rhythm pattern in order to preserve vowel length contrasts in unstressed syllables (to save the contrast ablative ~ nominative). This pattern was no longer available in the late stages of Latin (cf. Loporcaro, 2015: 10-11; 59) and in early Italo-Romance, as long vowels in unstressed syllables were banned and afterwards open syllable lengthening came into force as an allophonic phonological rule: all stressed syllables became bimoraic (heavy), so that the Latin variation ˈCV (light), ˈCV: (heavy, open), ˈCVC (heavy, closed), ˈCV:C (superheavy), was reduced to ˈCV: (open), ˈCVC (closed) via ˈCV > ˈCV: and ˈCV:C > ˈCVC. In fact, having only bimoraic stressed syllables and no long vowels in unstressed syllables is already a compensation-oriented pattern, because the moraic weight will always be higher (or at least the same) in stressed syllables than in unstressed ones.

Consider now some Italo-Romance outcomes like /ˈpɛrtika/ (Tuscan), /ˈpɛːrdga/ (Eastern Apennine Emilian), and /ˈpɛrtɛgɛ/ (in the Western Lombard tiny village of Monteviasco, see Delucchi, 2016: 170): all in all, they can be interpreted as a result of the influence of different rhythmic patterns. Tuscan has kept (controlled) the late Latin/early Romance pattern (/ˈpɛrtika/ = ˈCVC-CV-CV);[2] Emilian has heavily unbalanced the word structure by syncope of the post-stress syllable and the secondary lengthening of stressed vowels (which is regular in the case of a following liquid+plosive cluster: /ˈpɛːrdga/ = ˈCV:CC-CV). In Monteviasco's dialect, on the contrary, stressed vowel lengthening is absent and unstressed vowels are fixed by full vowel harmony: this weight balance between stressed and unstressed syllable indicates a controlling rhythm pattern (Delucchi, 2016: 310) probably arisen after a compensative phase (Delucchi, Filipponio, 2013)[3].

Thus, the observation of three different outcomes of the same Latin word brings us to identify three different rhythm patterns. Obviously, all these phonological forms are prone to every kind of phenomenon as soon as they are put in the speech chain. Nevertheless, they do exist in speakers' knowledge (*langue*): as said, since rhythm should be understood as a phonological feature, a phonetic analysis dealing

[2] With some early compensative oscillation which have left a trace in syncopated proparoxytones (PERSĬCA > *pesca* 'peach', PŌSĬTU(M) > *posto* 'posed.PART.M.SG, place' etc., see Rohlfs, 1966: § 138 for further examples), sometimes restored (a control-driven balancing?) with a non-etymological /a/ (JŬVĔNE(M) > *giovane* 'young.SG', CHRŎNĬCA > *cronaca* 'chronicle' etc., see Rohlfs, 1966: § 139 for further examples).

[3] The Western Lombard onset-epenthesis pattern /ˈforna/ < **forn* < FŪRNU(M), which builds a full disyllabic word, can be considered another evidence of a compensation-to-control path (first apocope, then rebuilding of the unstressed syllable), while the Eastern Emilian rhyme-epenthesis pattern /ˈfawren/ is compatible with the persistent compensation pattern mentioned above – notice also the secondary lengthening of the stressed vowel before liquid+plosive (like in /ˈpɛːrdga/, here /o/ > /aw/), which took place before the apocope (see Repetti, 1995, following Broselow, 1992, for the definition of rhyme-dialects and onset-dialects and the discussion in Filipponio, 2012a: 77).

with rhythm must be, in a certain sense, a kind of bottom-up process, seeking for stable features, contrasts and prominences instead of neutralizing them.

2. *On length in Gallo-Italian*

In Gallo-Italian dialects, the vowel length due to the late Latin/early Romance allophonic phonological rule of syllable isochrony (see above) became contrastive (see for example Loporcaro, 2015, and the references reported).

The consonantal degemination, which is a typical feature of Northern Italian dialects (Rohlfs, 1966: § 229), can be considered the trigger of this process: ˈCV:C(V) ~ ˈCVC(V) (< ˈCVC:V) = Western Lombard (Milan) /ˈpa:s/ 'peace' (< PA$CE(M)) ~ /ˈpas/ 'step' (< PAS$SU(M)), but the explanation needs some further elements.

2.1 Contrastive length from consonants to vowels

There was a position in which consonantal length was independent from stressed syllable isochrony, viz. the pretonic one. Pretonic degemination, which is attested in the whole Northern Italo-Romance area, eliminated this option (Table 1):

Table 1 - *Effects of pretonic degemination in Western Lombard (Milan)*[4]

Latin	Word structure before degemination	Word structure after degemination	Western Lombard
*CAM$MĪ$NU(M)	…VCˈCV:CV	…VˈCV:CV	/kaˈmĩ:/ 'march'
*CA$MĪ$NU(M)	…VˈCV:CV	…VˈCV:CV	/kaˈmĩ:/'fireplace, chimney'
*CAP$PĔL$LU(M)	…VCˈCVC:V	…VˈCVC:V	/kaˈpɛl/ 'hat'
*CA$SA+**ello*	…VˈCVC:V	…VˈCVC:V	/kaˈzɛl/ 'butcher's slaughter room'

Given this situation, it would be possible to reanalyze the quantity of stressed vowels as phonological and let post-stress consonantal degemination take place without any further consequence. This could be the stage of a very conservative Gallo-Italian dialect, like that of Soglio (Alpine Lombard spoken in Canton Grisons), which still has pretonic degemination but has kept post-stress geminates. Yet, in this case we are quite sure (following Loporcaro, Paciaroni & Schmid, 2005) that consonantal length is still phonological, because this variety lacks long stressed vowels in final position, viz. in an(other) position which is independent from stressed syllable isochrony (cf. Martinet, [1975: 205]). In a case like this, lacking any further evidence, we do not have any conclusive proof to declare that vowel length has become phonological.

[4] All Western Lombard examples are taken from Arrighi (1896). The phonological transcription is adapted according to Salvioni (1884).

The next stage is shown by the dialect of Castello di Sambuca (a conservative Apennine Emilian variety spoken in Tuscany on the Adriatic watershed), where next to pretonic degemination and persistent post-stress geminates (like in the dialect of Soglio) some final long stressed vowels arose due to secondary phenomena such as the loss of final *-i* in primary or secondary hiatus (**stivali* > **stivai* > /ʃtiˈvaː/ 'boots'). Although receding in internal position, vowel length is constantly realized in the prepausal one (Filipponio, Nocchi 2010), which is enough to consider it phonological (Loporcaro 2015), but peripheral in the system (Filipponio, Garassino 2019).

A further stage is displayed by the dialect of Lizzano (Eastern Apennine Emilian, about 15km north-east from Castello di Sambuca): the set of words with a long stressed final vowel is bigger, and the phonetic realization of this feature is constant (Loporcaro, Delucchi, Nocchi, Paciaroni & Schmid, 2006), while post-stress degemination takes place more easily in non-prepausal position and in *Allegroform* than for instance in an isolated realization (see the data in Filipponio, 2012b and the comparison between two Ligurian dialects in Garassino, Filipponio, forthcoming).

This picture shows that the co-occurrence of pretonic degemination and long stressed final vowels is a sufficient diagnostic tool to confirm the presence of contrastive vowel length, regardless of the behavior of post-stress consonants. However, it may be unnecessary to consider stressed final vowels, if post-stress degemination occurs anyway, like in the dialect of Monte di Badi (close to Castello di Sambuca, but in Emilian territory): in this case, one could ask whether the systematic shortness of stressed final vowels is either a conservative feature or should be ascribed to a secondary contact effect with the neighboring Tuscan dialects; but the whole absence of long consonants is obviously enough to claim the phonological value of vowel length (Filipponio, 2012b: 244-246).

Finally, a canonical Gallo-Italian dialect will display both complete degemination and long final stressed vowels. The combinations discussed here are summarized in the table below.

Table 2 - *At the origins of Gallo-Italian contrastive vowel length (henceforth: CVL)*

Dialect	Pretonic degemination	Final long stressed vowels	Post-stress degemination	CVL-Check
⌜Tuscan⌝	-	-	-	No
Soglio	+	-	-	No
Castello	+	only prepausal	-	yes (periph.)
Lizzano	+	+	residual gemination	yes
Monte di Badi	+	-	+	yes
⌜Gallo-Italian⌝	+	+	+	yes

2.2 Post-stress consonants in Bolognese and Portorino

According to previous studies, the Eastern Emilian dialect of Bologna (henceforth: Bolognese or BO) and the Western Ligurian one of Porto Maurizio (henceforth: Portorino or PM), which have stable CVL, show an incomplete post-stress degemination.

For example, since Coco (1971) up to the more recent Avesani, Vayra & Longo (2016), Bolognese has been pointed out to have long consonants following a short stressed vowel. Similarly, Filipponio, Garassino (2019) found that Portorino shows post-stress long consonants when the stressed vowel is short, at least when the target words occur in internal and non-focalized position. In other words, these two Gallo-Italian varieties are not completely "typical" and are worthy of further investigation.

3. *Materials and Method*

3.1 Stimuli, participants and procedure

The data set of the current study comes from different recording sessions, conducted by the authors at two different times. The former was carried out by the first author in 2006 across the so-called Valle del Reno for his doctoral dissertation (issued in 2007, then expanded in Filipponio, 2012b). The latter is part of an inquiry conducted by the first and the second author during the summer of 2017 in Genoa and Porto Maurizio (IM) (for further details see Filipponio, Garassino, 2019 and Garassino, Filipponio, forthcoming). These data were originally collected for other purposes. For the sake of homogeneity, in this contribution only real words in utterance-internal position will be analyzed.

As reported in Table 3, the first sub-corpus contains data from Bologna and the close dialects of Bazzano, Castello di Serravalle, Marzabotto and Pian di Venola, which can be assimilated to the Bolognese variety for their dialect characteristics (Filipponio, 2012b). All the other recordings come from the Ligurian coastal city of Porto Maurizio, belonging to the dialectal group of Western Ligurian (cf. Forner, 1988).

The Bolognese data were recorded by means of a Sony TCD-D100 DAT recorder and a Sony ECM-717 tie-clip microphone on Sony TDK DAT tapes, while the Portorino ones by means of a Zoom H2n handy recorder.

In both cases the interviews were directly conducted by the authors in the informants' houses or in relatively silent public places. Each informant was recorded alone in a single session.

Table 3 - *Speakers*

Dialect	Abbreviation	Place	Gender	Age
BO	Baz	Bazzano	M	80
	Bol	Bologna	M	68
	Cds1	Castello di Serravalle	M	78
	Cds2	Castello di Serravalle	F	84
	Mar	Marzabotto	M	69
	Pdv	Pian di Venola	M	67
PM	AcTo	Porto Maurizio	M	66
	BoLu		F	77
	LaMa		F	68
	LuTo		M	70
	TeAn		M	38

On the whole, 11 speakers were analyzed; i.e., 6 speakers (1 female and 5 males) for the Bolognese area and 5 (2 females and 3 males) for Porto Maurizio. All speakers were elderly (aged 66-84), except one from Porto Maurizio, aged 38. None of them reported current or past speech or hearing disorders. All the speakers were born and lived in Porto Maurizio or Bologna and surrounding areas and fluently used the local dialect in everyday conversations.

The stimuli, 14 minimal or sub-minimal pairs, are reported in Table 4. The word pairs (8 for BO and 6 for PM) are paroxytones or oxytones which differ in the length of the stressed vowel (long or short). The speakers were asked to orally translate in their native dialect the sentences (each different) that one of the authors read in Italian.

The whole vowel inventory is covered for BO, while it lacks a minimal pair representative of the high anterior vowel /i/ in PM. Although the target items are not the same in the two dialects, they appear in comparable phonetic contexts. The post-tonic consonant is a fricative, a plosive or a sonorant in both dialects.

The experimental corpus thus includes a total of 137 tokens (80 tokens for BO and 57 for PM)[5].

[5] For various reasons (different internal developments, recording problems, etc.) some of the stimuli are missing: /ˈtaːk/~/ˈtak/ for Cds2, Pdv and Mar; /ˈfaːt/~/ˈfata/for Cds1 and Cds2; /ˈbaːla/~/ˈbala/ for Pdv and Mar; /ˈmeːl/~/ˈmel/for Pdv and Cds2; /ˈtroːpa/ for Mar.

Table 4 - *The list of the stimuli*

Vowels	BO	PM
/a:/ ~ /a/	/ˈsa:k/ 'sack' ~ /ˈsak/ 'dry' /ˈta:k/ 'heel' ~ /ˈtak/ 'toll' /ˈfa:t/ 'done' ~ /ˈfata/ 'slice' /ˈpa:s/ 'pass' ~ /ˈpas/ 'fish' /ˈba:la/ 'ball' ~ /ˈbala/ 'bubble'	/ˈna:zu/ 'nose'~ /ˈmazu/ 'May'
/e:/ ~ /e/	/ˈme:l/ 'honey' ~ /ˈmel/ 'thousand'	/ˈse:ne/ 'meals' ~ /ˈsene/ 'ash' /ˈpe:zu/ 'weight' ~ /ˈpezu/ 'worse'
/o:/ ~ /o/	/ˈtro:pa/ 'too much.F.SG' ~ /ˈtropa/ 'troop' /ˈko:r/ 'heart' ~ /ˈkor/ '(he/she/it) runs'	-
/ɔ:/ ~ /ɔ/	-	/reˈpɔ:su/ '(I) rest' ~ /ˈpɔʃu/ '(I) can'
/u:/ ~ /u/	-	/ˈdu:se/ 'cake, sweet.SG'~ /ˈduze/ 'twelve'
/y:/ ~ /y/	-	/ˈfry:tu/ 'fruit' ~ /ˈbrytu/ 'ugly.M.SG, dirty.M.SG'

3.2 Data processing and statistical analysis

The recordings were imported into Praat (Boersma, Weenink, 2016), where the stressed vowel and the post-tonic consonant were manually segmented and annotated. Phoneme boundaries were located at the nearest zero crossing according to the full formant structure criterion (Machač, Skarnitzl, 2009), after a visual inspection of the broadband spectrogram and the waveform. In difficult cases, we relied on repeated listening.

The duration of each annotated segment was automatically measured by using a Praat script. For analyzing the intensity, another Praat script extracted the following values: mean intensity of the stressed vowel, the intensity value and the corresponding time at the maximum peak and at the right end of the stressed vowel.

The statistical analysis was carried out by means of the software R (R Development Team, 2018) and the *lme4* package (Bates, Mächler, Bolker & Walker, 2014). Plots were realized with the help of the package *ggplot2* (Wickham, 2016).

In order to take into account the multiple factors involved, including the random variation, linear mixed models (cf. Baayen, 2008; Winter, 2013; Levshina, 2015) were used. The dependent variable was absolute Vowel Duration in ms for the vowel duration analysis and Post-stress Consonant Duration in ms for the consonant duration analysis. The fixed effects were: (a) Dialect (with two levels: BO / PM); (b) Vowel Length (phonologically short/long vowels); (c) Vowel Type or Consonant Type. In each model, Speakers and Target Items were considered ran-

dom factors. Different models with random intercepts including a two-way interaction term (Dialect * Vowel Length) were incrementally built and tested for significance by comparison with ANOVA based on the Likelihood ratio test. The best model was selected in each case based on the AIC (Akaike Information Criterion) and the BIC (Bayesian Information Criterion) goodness-of-fit values (i.e., the best model being the one with the smallest AIC and BIC values; for a more detailed discussion, cf. Levshina 2015: 194).

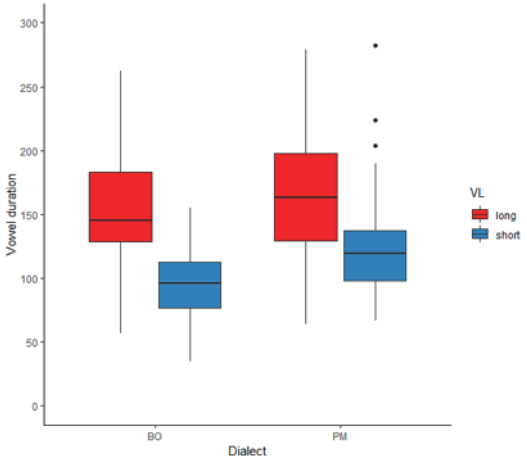
4. *Duration*

4.1. Stressed vowels

In order to describe consonant length and evaluate the nature and the extent of the post-tonic consonant gemination in the varieties at issue, we will consider the whole picture of duration. Firstly, the length distribution of vowels and consonants will be compared between BO and PM. Moreover, being aware of the perceptual salience of the durational ratios to the neighboring sounds in the speech signal, the relationships between vowels and consonants, on the one hand, and long and short segments, on the other hand, will be presented.

The boxplots in Figure 1 show the distribution of vowel duration in BO and PM as a function of phonological length. Long vowels are in red, short vowels in blue.

Figure 1 - *Distribution of vowel duration in the Bolognese area (BO) on the left and Portorino (PM) on the right as a function of the phonological length of the vowel (short vowels in blue and long vowels in red)*



As expected on the basis of the previous literature (cf. for example Uguzzoni, Busà, 1995; Filipponio, 2012b; Loporcaro, 2015; Garassino, Loporcaro & Schmid, 2017; Filipponio, Garassino, 2019), vowel length differences in stressed syllables are clear-

ly realized in both dialects, the median being 96 ms for V vs 145 ms for V: in BO and 119 ms for V vs 163 ms for V: in PM.

Despite the limited and not fully representative composition of the corpus, a series of linear mixed models was performed in order to determine the statistical significance of the results. The best model selected from the analysis (the results of which are shown in Table 5) is as follows: Vowel Duration ~ Vowel Length + Dialect + Vowel Type + Speaker + Target Item.

Table 5 - *Results of the analysis with linear mixed models for stressed vowel duration as the dependent variable*

	β	**Std. Error (SE)**	**Df**	**t value**	**Pr(>|t|)**	
(Intercept)	161.723	12.740	16.665	12.694	5.45e-10	***
VL short	-47.396	7.124	29.144	-6.653	2.63e-07	***
Dialect PM	39.902	19.403	18.207	2.056	0.05436	.
V_type /e/	-24.041	11.114	31.852	-2.163	0.03814	*
V_type /o/	-34.666	10.730	26.275	-3.231	0.00331	**
V_type /ɔ/	-54.043	17.681	33.441	-3.057	0.00438	**
V_type /u/	-39.927	16.929	29.008	-2.358	0.02530	*
V_type /y/	-61.516	17.243	31.017	-3.568	0.00119	**

The effect of Vowel Length on the dependent variable (i.e., Vowel Duration) proved highly significant in both BO and PM ($\beta = -47.40$; SE = 7.12; $p < 0.001$). This systematic difference between long and short vowels is consistent with the traditional claim of a phonological opposition of vowel length in these varieties.

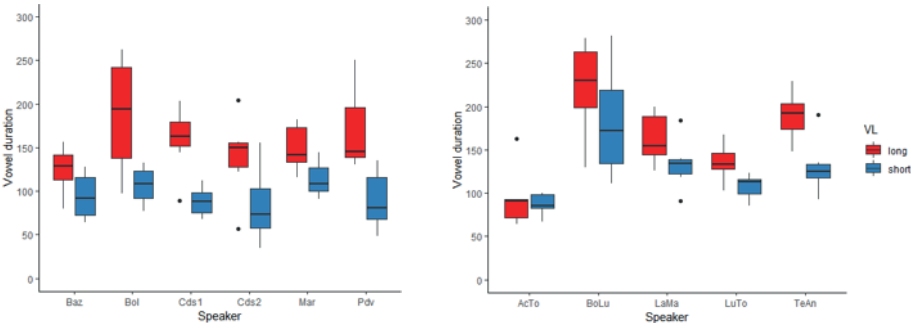
Moreover, the factor Dialect might have an effect on Vowel Duration ($\beta = 39.90$; SE = 19.40; $p = 0.05$), according to which BO vowels are generally shorter than PM ones, thus suggesting a tendency for a higher average speech rate in BO. However, this tendency is yet to be verified on the basis of a larger corpus.

Finally, as expected (cf. Lehiste, 1970: 18; Marotta, 1985), the effect of the Vowel Type on duration was confirmed to be significant, each vowel having its own intrinsic duration (compared to the reference value /a/).

If we consider the distribution of durational values separately for each speaker, the picture outlined so far changes slightly.

The graphs in Figure 2 plot the duration measures of the stressed vowel for each BO and PM speaker, respectively. Comparing the phonetic realization of vowel length across speakers, in BO all the speakers clearly realize vowel length oppositions. On the other hand, PM speakers show a higher inter-individual variability, ranging from AcTo, who essentially does not distinguish long and short vowels, to the outstanding contrasts of TeAn, the youngest speaker in the PM group.

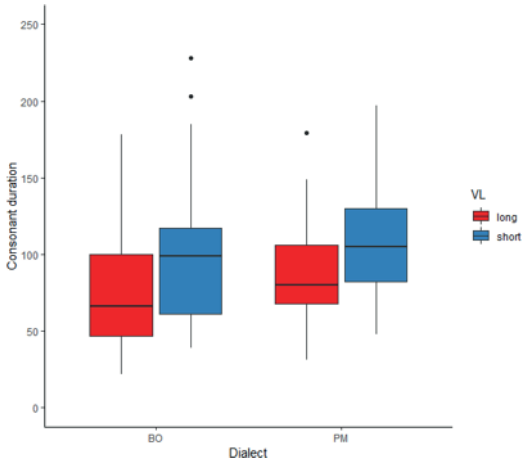
Figure 2 - *Distribution of vowel duration per speaker in BO (on the left) and PM (on the right) as a function of the phonological length of the vowel (short vowels are in blue and long vowels in red)*



4.2 Post-stress consonants

Figure 3 shows the durational values of BO and PM consonants following a long (in red) and a short vowel (in blue).

Figure 3 - *Distribution of consonant duration in BO (on the left) and PM (on the right). Consonants preceded by short stressed vowels are in blue and the ones preceded by long vowels in red*



The medians reveal a temporal difference between the post-stress consonants in both dialects (66 ms for (V:)C vs 99 ms for (V)C in BO and 80 ms for (V:)C vs 105 ms for (V)C in PM), although the boxes are more overlapping than in Figure 1. Even in this case, the results in Table 6 from the best statistical model (Post-tonic Consonant Duration ~ Vowel Length + Dialect + Consonant Type + Speaker + Target Item) show that the duration of the segment is significantly affected by Vowel Length (β = -22.57, SE = 7.62, $p < 0.01$). This finding supports the hypothesis that in these varieties gemination of the post-tonic consonant following a short vowel is a constant feature. In addition, the Type of the consonant proved to have a significant effect

just for the liquids (β = -30.57, SE = 13.56, $p < 0.05$, compared to fricatives chosen as reference value), which were the shortest ones.

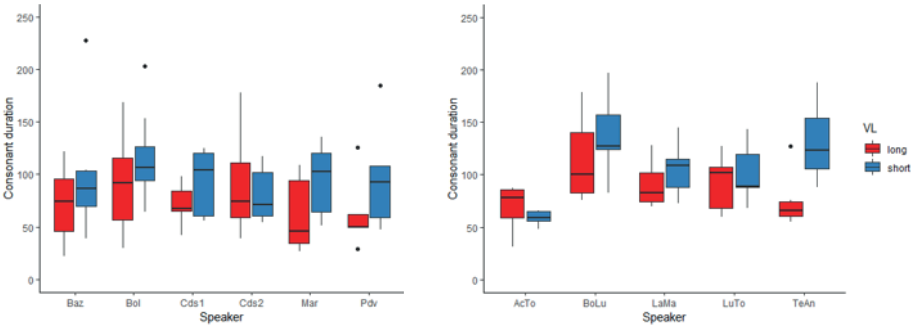
Table 6 - *Results of the analysis with linear mixed models for post-stress consonant duration as the dependent variable*

	β	Std. Error (SE)	Df	t value	Pr(>|t|)	
(Intercept)	77.348	12.422	32.225	6.227	5.48e-07	***
VL short	22.566	7.624	25.689	2.960	0.00654	**
Dialect PM	9.161	13.553	26.627	0.676	0.50488	
C_type lqd	-30.570	13.560	27.595	-2.254	0.03230	*
C_type nsl	-15.992	15.648	25.384	-1.022	0.31644	
C_type stp	18.561	10.948	31.941	1.695	0.09973	.

Turning to by-speaker distribution, consonant length appears more variable than the vowel one, as pointed out in Figure 4. All BO speakers realize length differences, except Cds2. In PM, the same speaker who did not discriminate vowels on the basis of length, i.e., AcTo, does not follow the general trend either. A similar distribution concerns also LuTo. Once again, the strongest opposition is realized by TeAn, who is the only young speaker in the PM group.

All in all, the greater variability in consonant length, combined with less clear contrasts, is not surprising in varieties where vowel length is expected to be phonological (cf. Filipponio, 2012b, Loporcaro, 2015; Forner, 1988, Filipponio, Garassino, 2019). It could be considered as a further evidence of the fact that vowel length is still the only relevant feature for distinguishing minimal pairs in these dialects and gemination is just an allophonic, accessory feature.

Figure 4 - *Distribution of post-stress consonant duration per speaker in BO (left) and PM (right) (consonants after short vowels are in blue and consonants after long vowels in red)*



4.3 Paradigmatic and Syntagmatic Ratios

We now consider the paradigmatic relationship between long and short stressed vowels, on the one hand, and post-tonic consonants following short and long vow-

els, on the other. As shown in Table 7, short vowels correspond to 62% of long vowels in BO or, inversely, the long vowel is 38% longer than the short one. This difference is less marked in PM, where the ratio between the two segments is 0.79, i.e., long vowels are just 21% longer than the short ones.

On the contrary, the ratio between the consonants is similar in the two varieties, thus confirming once again the auditory impression and the preliminary results in Filipponio, Garassino (2019) of a durational difference in post-tonic position for PM.

Table 7 - *Ratio between long and short vowels and between consonants following short and long vowels*

	V/V:	(V:)C/(V)C
BO	0.62	0.78
PM	0.79	0.82

By observing the almost parallel paradigmatic relationships of long/short vowels and the corresponding post-stress consonants in PM (0.79 and 0.82, respectively), we could obtain a further hint about the precarious condition of contrastive vowel length in Western Ligurian, along with the increasingly small number of minimal pairs (cf. Garassino et al., 2017; despite the experimental results in Filipponio, Garassino, 2019).

As far as the syntagmatic relationships are concerned, Table 8 provides the ratio between the stressed vowel and the post-tonic consonant. It summarizes the duration relationships in both dialects and, at the same time, tries to reduce the distortions related to potentially different speech rates.

Table 8 - *Ratio of stressed vowel to post-tonic consonant*

	V:/C	V/C
BO	2.5	1.2
PM	2	1.3

Long stressed vowels are longer than the following consonants, from 2 (for PM) to 2.5 (for BO) times. On the contrary, short vowels tend to be as long as the following consonant. The value of the ratio in favor of the vowel is due to the fact that the absolute duration of the vowels is generally greater than that of the consonants. In other words, there is an initial durational disparity between vowels and consonants, as emerged in the descriptive analysis: on average, consonants are always shorter than vowels and, even when longer, they have the same or a smaller duration than short vowels.

In light of this observation, despite the limited differences between long and short vowels on the paradigmatic level for PM, from a syntagmatic perspective in both varieties vowel quantity contrasts appear still stable and compatible with their interpretation as phonological features.

5. *Intensity*

From the results provided in § 4, one can assume that both varieties are quite similar in terms of allophonic consonant duration, at least in a non-prepausal and prosodic unmarked context. This similarity, however, may appear 'suspicious', especially with regard to allophonic gemination. Bolognese and Portorino have, in fact, quite different features from a prosodic-rhythmic point of view. Bolognese is fully a compensation language (see above § 1), while in Portorino, on the other hand, like in the other Ligurian dialects, compensation phenomena have manifested themselves less dramatically than in Emilian dialects, as is proven by the treatment of unstressed vowels. On the one hand, they have almost completely disappeared in Bolognese, while, on the other hand, they have generally been maintained in Portorino. It is sufficient to consider the developments of Latin PŎRTĬCU(M) 'arcade', a word with a similar structure to PĔRTĬCA (whose developments have been discussed in § 1), to observe the difference between Bolognese /poːrdg/ (with syncope, apocope, lengthening of stressed vowel) and Portorino /ˈpɔrtegu/ (without any of these phenomena).

For this reason, we have decided to include a tentative analysis of the intensity contours of the stressed vowels. In general, absolute data gathered with different instruments in different situations are not fit for this purpose: therefore, the stable difference that was found between the median intensity values of stressed vowels uttered by Bolognese (74.7 (±5) dB) and Portorino speakers (63.8 (±5) dB) needs further investigation and cannot be included in the discussion[6]. In relation to the statements about contrasts and prominences made in § 1, our data offer nonetheless the possibility of verifying if there are any stable intensity patterns whose identification hinges on relative rather than on absolute values.

In light of the already mentioned difficulty of treating intensity, aggravated here by the scarcity of the corpus (n = 137), we have chosen to refrain for now from a statistical analysis, opting instead for some qualitative remarks based on data visualization[7]. Thus, we carried out a preliminary analysis concerning three intensity measures (inspired by previous phonetic research, such as Fischer-Jørgensen, Jørgensen, 1965; Spiekermann, 2000 and 2002 and Mády, Tronka & Reichel, 2005). In what follows, we will then visually inspect and discuss the following parameters:

a. The absolute distance (in ms) from the peak of intensity to the vowel offset, i.e., *Vowel Offset time – Maximum intensity time*;

[6] He, Dellwo (2016: 247) observe, for instance, that "only a turn of the head can lead to a drastic drop of the overall intensity at the receiver's ear (or a microphone)". Such problems are solved by a careful gathering of data and may perhaps become less relevant as the analysis deals with stable and/or contrastive features of intensity contour patterns (viz. with the phonological interpretation of phonetic data, see above § 1).

[7] In fact, more ingredients are needed in order to attempt a careful quantitative study of intensity, such as: truly comparable data for both varieties; normalized measure of intensity (relying, for instance, on z-scores); more fine-grained measures of the intensity curve (i.e., instantaneous velocity of certain specific points vs. average velocity, etc.).

b. The relative distance from the peak of intensity to the vowel offset in relation to the vowel duration, i.e., (*Vowel Offset time – Maximum intensity time*)/*Vowel duration*;
c. The average velocity[8] calculated in relation to the intensity peak and the vowel offset, i.e., (*Vowel Offset intensity – Maximum intensity*)/(*Vowel Offset Time – Maximum Intensity Time*).

Based on the a. and b. measures, we are able to infer the position of the peak of intensity, while c. informs us about the steepness of the curve. As we will see in § 6.1, this information is useful for assessing the relation between the stressed vowel and the following consonant in a phonological perspective.

Figures 5 and 6 show the absolute (ms) and the relative distance from the intensity peak to the vowel offset in both dialects.

Figure 5 - *Absolute distance from intensity peak to vowel offset*

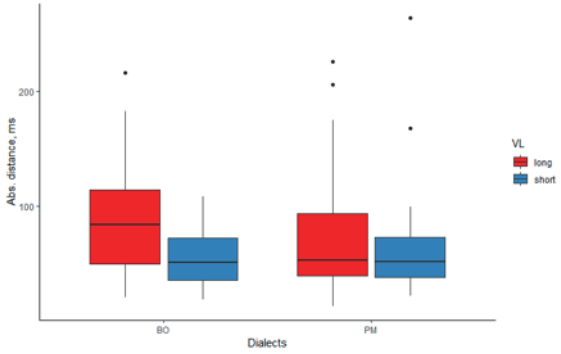
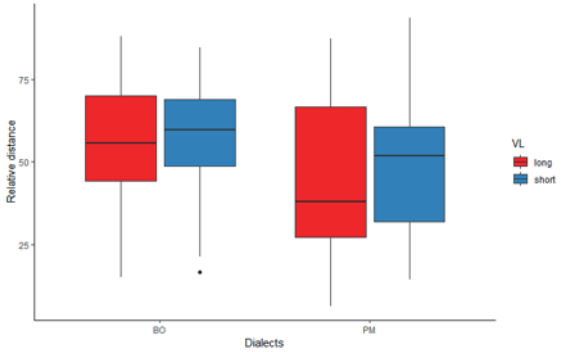


Figure 6 - *Relative distance from intensity peak to vowel offset*



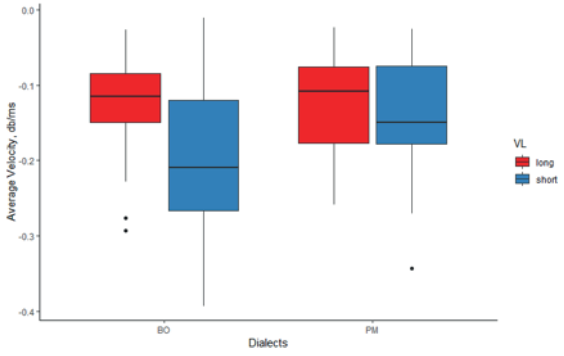
First, it is worth noting that the median values (in particular those of relative distance) hide a high degree of variability. Nevertheless, by crossing the results of ab-

[8] In physics, the average velocity is the distance traveled by an object divided by the time elapsed. In our case, this measure refers to the distance in the intensity curve between the peak of intensity and the vowel offset (divided by the time elapsed between the two).

solute and relative distance, one finds that short stressed vowels behave in the same way, while long vowels show two different patterns: Bolognese speakers place the intensity peak earlier than Portorino speakers, as displayed by the higher absolute and relative distance of the former compared to the latter[9]. In other words, they reach the intensity peak more quickly[10].

Moreover, Figure 7 tells us that Bolognese speakers have bigger fluctuations between peak and offset, which is relevant, because their higher peak values do not correspond in our data to higher offset values, the latter being similar to those of Portorino. For this reason, the difference between the long vowels of the two dialects is 'smoothed' (i.e., the higher distance between peak and offset in Bolognese is balanced by a higher steepness), while Bolognese short vowels fall to the offset more quickly than Portorino ones.

Figure 7 - *Average velocity*

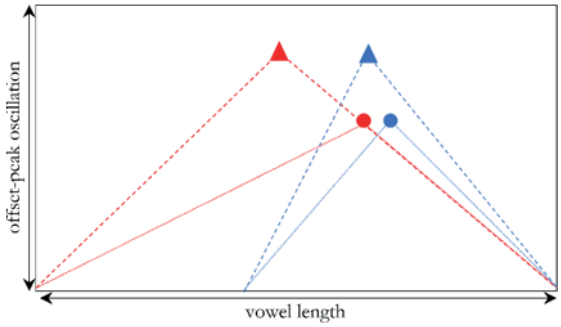


This data, although scarce and extremely variable, suggests that the intensity contour patterns of Bolognese and Portorino are different. In Figure 8 we try to informally visualize this difference. Red and blue lines respectively show long and short vowels; Bolognese is represented by dashed lines and triangle peaks, Portorino by dotted lines and circle peaks.

[9] Following the suggestion of a reviewer, we could also interpret the intensity contours in light of the data on vowel duration (cf. § 4). The absolute intensity-related measure in Figure 5 seems to confirm that vowel length contrasts are more salient in Bolognese than in Portorino: the difference between short and long stressed vowels is, in fact, more striking from an intensity perspective in the former than in the latter. Interestingly, in Figure 6, in which vowel duration is, so to speak, 'neutralized', the relative distance from the peak of intensity to the vowel offset is different between long and short vowels only in Portorino: this suggests that the Ligurian variety, unlike Bolognese, signals vowel length contrasts by means of the intensity contour. Although this data hints at very interesting aspects of the relationship between duration and intensity in the two varieties, due to the absence of a quantitative analysis we prefer to abstain from further speculation.

[10] The mean values of average velocity refer to the difference between vowel offset and the peak of intensity, which accounts for bigger or smaller fluctuations throughout the contour – viz. a relativized value, different than the bare peak of intensity value briefly reported above.

Figure 8 - *Intensity patterns of Bolognese and Portorino*



In the following paragraph, we will explain the meaning of these patterns.

6. *Discussion*

6.1 Eastern Emilian as a syllable-cut language?

In § 4 we have seen that Bolognese and Portorino, viz. both varieties with contrastive vowel length, show a partial post-stress gemination, at least in the elicited contexts. In § 5 we have seen that these dialects seem to have different intensity patterns (although we were not able to conduct a thorough analysis of that). By observing their word structure, we also know that they underwent two different rhythm patterns: today's Bolognese is the result of a strong compensation pattern, while Portorino stabilized its structure after the first (late Latin and early Gallo-Italian) compensative drift. In light of these typological differences, it is plausible to consider the (superficially) similar allophonic gemination as the result of different underlying phenomena.

If we now consider the Bolognese intensity pattern, we observe that the early peak in long vowels as well as the high steepness in the short vowels can be correlates of loose and close contact respectively (as defined by Martinet, 1966) between the stressed vowel and the following consonant. This picture is compatible with the well-known syllable-cut hypothesis, which has been first put forth in the literature concerning Germanic languages (in particular, Standard High German and Dutch): in these varieties, one observes an interaction between stressed vowels and post-stress consonants, in such a way that open syllables can only host long vowels, whereas closed syllable only present short vowels (cf. Fischer-Jørgensen, Jørgensen, 1965; Vennemann, 2000; Spiekermann, 2002; Uguzzoni, Azzaro & Schmid, 2003). Stressed vowels in closed syllables as in the German word *Mitte*, 'middle', cannot fulfil their course since they are 'cut' by the following consonant. As a result, these vowels are short, in terms of vowel quantity, and lax (in this case, [ɪ]), in terms of vowel quality. On the other hands, stressed vowels in open syllables, such as in the German word *Miete*, 'rent', cannot be cut from the following consonant, which belongs to a different syllable, and are long and tense ([i]).

It is worth noticing that Uguzzoni et al. (2003) have suggested on the basis of several in-depth empirical analyses (in particular, see Uguzzoni, Busà, 1995) that

some Emilian dialects can be considered syllable-cut varieties. The emergence of this pattern may be explained by "the need to safeguard the short/long distinction in vowels under dynamic stress" (2003: 2718; according to this perspective, syllable-cut serves as a structural 'crutch' for the survival of vowel length contrasts)[11]. Filipponio (2012b: 250-251) has partially revised this view, because a relevant parameter of syllable-cut languages, viz. the absence of a short stressed vowel at the end of the phonological word, is not satisfied by Emilian dialects (cf. Bolognese /prɛː/ 'meadow' but /ba/ 'oxen', /bvo/ 'drunk'), so that we can at least say that Emilian dialects are still quantity languages which are about to become syllable-cut.

However, in spite of its theoretical attractiveness, syllable-cut has proven difficult to study empirically because its phonetic features have not been properly defined yet. One of the main reasons for this probably lies in the complex interaction between syllable-cut, word stress, vowel quantity and quality. In other words, it is very difficult to disentangle its phonetic correlates from the ones of quantity and quality (as is shown very clearly in Mády et al. 2005)[12]. Moreover, the main phonetic correlate of syllable-cut distinctions has been suggested to be intensity, which is a notoriously elusive prosodic feature.

6.2 Between phonology and typology

We can now put together the pieces of the puzzle: If 1. Bolognese shows loose contact with long stressed vowels and close contact with short stressed vowels, and 2. this alternation is compatible with a (at least partially) syllable-cut pattern, whose most important correlate is intensity, then we can suppose that the allophonic post-stress gemination is another correlate of close contact. Let us consider again the different phonological word structures of Gallo-Italian dialects by taking as an example the outcomes of RŪGĬDU(M) 'rough.M.SG'

Table 9 - *Gallo-Italian outcomes of Latin RŪGĬDU(M) 'rough'*

Dialect	RŪGĬDU(M)	Syncope	Apocope	Compensative force
Ligurian	/ˈrydegu/	-	-	↓
West Lombard	/ˈruvid/	-	+	
Lizzano	/ˈruvdo/	+	-	
Bolognese	/rovd/	+	+	

[11] These Emilian dialects also show spectral differences accompanying vowel length contrasts (cf. Uguzzoni, Busà, 1995).

[12] By means of a fine-grained comparison between Hungarian (a quantity language in which no syllable-cut effects are present) and German, Mády et al. show that the phonetic parameters singled out by Spiekermann (2000 and 2002: number of intensity peaks (*E-Zahl*), their positions (*E-Pos*) and the shape of the intensity contour (*E-Halt*)) do not seem to be specific of syllable-cut languages, since they play some role in Hungarian as well. Ultimately, vowel length may be responsible for all these observed effects.

By observing Table 9, we can hypothesize that the intensity pattern which triggers the close contact is the 'dynamic' implementation of the Bolognese strong compensative pattern.

On the other hand, given the control pattern which nowadays characterizes Portorino, one can argue that the allophonic post-stress gemination is due to other factors: maybe an incomplete degemination (as a conservative feature and not as an epiphenomen of close contact like in Bolognese), or the pressure of standard Italian (which has contrastive consonantal length); this is something we are currently not able to decide.

More generally, in proparoxytones we consider syncope as a stronger correlate of compensation than apocope because the unstressed syllable involved is closer to the stressed one. Indeed, among the consequences of the unbalancing between stressed and unstressed syllables one counts not only the lengthening of the former and the shortening or loss of the latter, but also some attraction effects revealing that the phonological word is treated like a sort of 'macrosyllable'. In this respect, the Apennine Eastern Emilian dialect of Lizzano (see above § 2) behaves exactly like Bolognese, with the only difference of the apocope, and its allophonic post-stress gemination (see above Table 2) can thus be ascribed to the same factors operating in that variety[13].

As a proof, one can observe the exceptions to the reduction of stressed vowel length in proparoxytones in Eastern Emilian and in Ligurian. Eastern Emilian proparoxytones which escape the reduction are characterized by a long tense stressed vowel followed by a sequence of consonantal segments which cannot become a syllable coda, according to Vennemann (1988) (decreasing consonantal strength, unless the first element is a plosive, which systematically undergoes close contact). On the contrary, the presence in Ligurian of proparoxytones with long stressed vowels is not related to these structural constraints, as shown in the following Table 10:

Table 10 - *Vowel length in Eastern Emilian and Ligurian proparoxytones*[14]

Latin	Lizzanese	Ligurian	Consonantal sequence
*JŬVĔNE(M)	/ˈdʒoːvne/	/ˈzuvenu/ (cf. Ghini, 2001: 171)	/v/.../n/
PĔCŎRA	/ˈpegora/	/ˈpeːguɹa/ > /ˈpɛːgwa/ (Genoese, cf. Parodi 1902-5: 157)	/g/.../r/

[13] The interpretation of Lizzanese allophonic gemination as an epiphenomenon of compensation revises the view of Filipponio (2012b: 251).

[14] Further Emilian examples in Filipponio, 2010; Filipponio, 2012a: 78-79; Filipponio, 2012b: 298-301 (LĔPŎRE(M) > Lizzanese /ˈlevora/ 'hare' undergoes shortening in spite of the consonantal sequence /v/.../r/ because the outcome of stressed ĕ was a diphthong *[eə] – according to Filipponio, 2012b: 273 – or *[je] (see Filipponio, 2017: 274-275) and not a tense vowel). For Genoese, Toso (1997: 16) provides examples of postlexical proparoxytones with a long stressed vowel arising in verb + clitic strings (cf. Loporcaro 2015: 206).

Moreover, Eastern Emilian paroxytones which undergo the reduction display a non-etymological allophonic post-stress length explainable as close contact (Lizzano /ˈruvdo/ (Table 9) > [ˈruv·do]; /ˈpegora/ (Table 10) > [ˈpeg·ora]; cf. Malagoli, 1930), while the Ligurian ones do not (according to Ghini 2001).

Thus, the shortening of stressed vowels in proparoxytones, which is normally explained (for example by Filipponio 2012a) as a general reduction process affecting all Gallo-Italian dialects (except the cases mentioned above), could be ascribed, like post-stress gemination, to phenomena due to different factors, despite their superficial similarity. In Emilian, the shortening would be due to the attractiveness of the stressed syllables in proparoxytones, which draw to themselves the unstressed ones, causing the shortening and hence the close contact. In Ligurian, it would simply be the first step of the loss of contrastive vowel length which in other varieties affects also paroxytones (Western Lombard) and even oxytones (Intemelian Ligurian)[15].

Obviously, our hypotheses need further experimental research to be proved, but what we want to emphasize here is that segmental correspondences are sometimes due to completely different factors and that only the analysis of the rhythm patterns, considered as a phonological feature traceable in the diachrony, can provide solid explanations.

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[15] For a detailed discussion, see Loporcaro (2015) and Filipponio (2012b).

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