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Miran Kim and Lori Repetti

Bitonal pitch accent and phonological alignment in Sardinian

Abstract: This study presents new data on pitch accent alignment in Sardinian, a Romance language spoken in Italy. We propose that what has been described as "stress shift" in encliticization processes is not a change in the word level *stress*, but variation in the association of the *pitch accent*. Our claim is that word level stress remains in situ, and the falling tune which our data exhibit can be interpreted as a bitonal pitch accent (HL*) associated with the entire verb + enclitic unit: the starred tone is associated with the rightmost metrically prominent syllable, and the leading tone is associated with the word-level stressed syllable. The research questions we address are twofold: (i) how are the landing sites of the two tonal targets phonetically identified; (ii) how are the phonetic facts reconciled with prosodic structure.

Keywords: Sardinian, bitonal pitch accent, tonal alignment, stress shift, stress placement

Miran Kim: Department of English Language & Literature, Hanyang University; Research Institute for Language & Information, Korea University, Seoul, Korea.
E-mail: mirany@korea.ac.kr
Lori Repetti: Stony Brook University – Linguistics, Stony Brook, New York, United States.
E-mail: lori.repetti@stonybrook.edu

1 Introduction

This paper is concerned with the role of intonation and pitch accent in the stress patterns involving verb + enclitic phrases in Sardinian, an endangered Romance language spoken on the island of Sardinia, Italy.[1] Many Romance languages, including Sardinian, are described as undergoing "stress shift" when an enclitic pronoun is added to a verb. However, studies on stress patterns of verb + enclitic phrases discussed in the relevant literature are based mostly on impressionistic

1 The Sardinian dialects are classified as "definitely endangered" according to UNESCO's Atlas of the World's Languages in Danger.

transcriptions: these types of studies are insufficient in assessing intonational patterns. Thus, linguistic studies with empirical phonetic data – which we provide – are crucial. Furthermore, given the endangered status of Sardinian, it is particularly important not only to record the spoken characteristics of an individual variety, but also to understand general linguistic phenomena across varieties.

In this paper, we address questions about the identification of the starred tone in a bitonal pitch accent (i.e., the more prominent of the two tones) and its phonological association (Grice 1995; Arvaniti et al. 2000; Grice et al. 2000; Prieto et al. 2005; Sadat-Tehrani 2009). We accomplish this by examining the association of the two tones of a bitonal pitch accent in Sardinian: the high tone (H) and the low tone (L), which we argue constitute an HL* bitonal pitch accent. We focus on how the landing sites of the two tonal targets are phonetically identified and how the phonetic facts are reconciled with prosodic structure. Our findings also contribute to the recent literature on intonation and pitch accent, and in particular the way in which pitch accents are associated with metrical structure, and microvariation in tonal alignment with or without perceptual references (Grice 1995; Grice and Savino 1995; Ladd 1996; Grice et al. 2000; Face 2001; Frota 2002; Prieto et al. 2005; Elordieta and Calleja 2005; Mücke et al. 2009; Petrone and D'Imperio 2011; Frota in press).

The structures investigated in this paper involve verb + enclitic pronouns. Most standard Romance languages do not vary in stress patterns when an enclitic is added to a verb. In other words, when a clitic pronoun is in postverbal position, the stress remains on the verb. Thus, for the example in (1), (1a) is the only acceptable form in Italian, and (1b) and (1c) are ungrammatical. (All imperative verb forms in this article are second person singular informal imperatives, unless otherwise indicated.)

(1)	Italian	/kjáma/	'call'
	(a)	/kjáma mi/	'call me'
	(b)	*/kjamá mi/	
	(c)	*/kjama mí/	

However, a number of Romance languages, such as Sardinian, southern Italian dialects, Corsican, Balearic Catalan, Gascon, and some Ligurian dialects, undergo so-called "stress shift" when clitic pronouns follow the verb (Ordóñez and Repetti 2006). Examples are illustrated in (2) (Blasco-Ferrer 1988: 112).

(2)	Dialects of Sardinian	/nára/	'tell'
	(a) Ogliastra	/narά mi/	'tell me'
	(b) Campidanese	/nara mí/	'tell me'

In this article, we propose that what has been described as "stress shift" is not a change in the word level *stress*, but variation in the association of the *pitch accent*. Our claim is that word level stress remains on the verb, and the bitonal pitch accent (HL*) is associated with the entire verb + enclitic unit: the starred tone is associated with the rightmost metrically prominent syllable, and the leading tone is associated with the word-level stressed syllable, i.e., the stressed syllable of the verb.

This article is organized as follows. In Section 2 we provide a brief overview of prosodic phenomena in Sardinian, including the structure of the stressed syllable, stress with enclitics, and intonation. In Section 3 we describe the data that we use in this article, and in Sections 4 and 5 we provide a phonetic and phonological analysis of the data, respectively. We conclude the article in Section 6.

2 Stress and intonation of verb plus clitic(s) in Sardinian

In this section we review some facts about Sardinian prosody that are relevant for the discussion at hand. We examine the structure of stressed syllables (Section 2.1), cross-dialectal variation involving verb + enclitic structures (Section 2.2), and the literature on intonation in Sardinian varieties (Section 2.3).

2.1 Stressed syllables

Sardinian allows antepenultimate, penultimate and final stress. The vast majority of words have penultimate stress: approximately 85.2% of underived words have penultimate stress, but that percentage is actually higher since monosyllabic words and words with final stress are often realized with penultimate stress through word-final epenthesis of a vowel ("paragogic vowel"), whose quality is usually /i/~/e/ or /u/~/o/: /kissá/ > Campidanese /kissái/ (Bolognesi 1998: 66), Nuorese /kissáe/~/kissái/ (Pittau 1972: 19) 'maybe' (see also Lai 2002, 2004). (Throughout the paper, we use a lower-case italicized "*v*" to represent an epenthetic vowel).

There is a second type of paragogic vowel that interacts with the calculation of stress: a paragogic vowel is inserted in "absolute final position" with consonant final words. For example, stress is penultimate in /andámuz/ 'let's go', and it is antepenultimate when a paragogic vowel is inserted: /andámuz*u*/ 'let's go' (Jones 1997: 376). Termed a "vocale paragogica mobile" ("mobile paragogic vowel") by Pittau (1972: 16–19), its use or avoidance in phrase-internal position

varies greatly from dialect to dialect and in different phonological contexts (Bolognesi 1998: 46; Jones 1997: 376; Pittau 1972). The quality of the "mobile paragogic vowel" is identical to that of the preceding vowel, i.e., it is a copy vowel: for example, /komporamídaz*a*/ 'buy them (fem.) for me' and /komporamíduz*u*/ 'buy them (mas.) for me' (Contini 1987; Bolognesi 1998: 46). Furthermore, it can be realized as a weak, nearly inaudible vowel (Bolognesi [1998: 46] for Campidanese; Mameli [1998: 97–98] for central Logudorese), or as a very pronounced, almost accented vowel (Pittau 1972; Bolognesi 1998).

The structure of stressed syllables in Sardinian has been recently examined by Bolognesi (1998), Lai (2002), and Molinu (2005). For the purposes of this paper, the duration of the stressed syllable is of particular interest. (See also Lai [1999: 143].) First, stressed vowels are longest when they are in open syllables (Bolognesi 1998: 24); however, stressed vowels are also lengthened in closed syllables. In the description of the variety of Italian spoken in Cagliari, Canepari (1980: 84) notes that in a closed syllable the stressed vowel is "semi-lengthened". Second, the duration of the stressed syllable is increased not only through vowel lengthening, but also through consonant lengthening: short intervocalic consonants (except /r/) tend to lengthen when preceded or followed by a stressed vowel (Canepari 1980: 84).[2] Third, a stressed vowel is longest when it is in the penultimate syllable (vs. antepenultimate syllable) (Bolognesi 1998: 24, 71).[3] Finally, vowels are longest when they are stressed and accented (Bolognesi 1998: 24, 71).[4] The accented syllable in Sardinian (i.e., the syllable receiving phrasal stress) corresponds to the stressed syllable of the final word of the phrase (Bolognesi 1998: 71).

2.2 Verb + enclitic pronoun

It is commonly claimed that Sardinian verbs undergo a so-called "stress shift" when an enclitic pronoun is added; however, there is great variation among Sardinian dialects. Stress patterns with verb + one enclitic vary among Sardinian subvarieties. In most Logudorese varieties, in Nuorese, and in "central varieties", stress remains unchanged with one enclitic, as shown in (3) (Pittau 1972: 82–83;

2 Posttonic voiceless consonants lengthen more than pretonic voiceless ones, and pretonic voiced consonants lengthen more than posttonic voiced ones (Canepari 1980).

3 See D'Imperio and Rosenthall (1999) for lengthening of vowels in stressed penults, but not antepenults, in Italian.

4 See Turk and Dimitrova (2007) for a discussion of vowel lengthening in English, comparing accented (i.e., phrasally stressed) vs. unaccented words.

Atzori 1982: 27; Wagner 1984 [1941]: 23; Blasco-Ferrer 1988: 112; Jones 1993: 367, n. 8).

(3) *No stress shift with one enclitic*
Logudorese, Nuorese and "central varieties"
(a) /nára/ 'tell'
(b) /nára mi/ 'tell me'

However, in some Logudorese varieties, in the Barbargia area, and in Campidanese varieties, stress shifts when one enclitic is added to the verb (Atzori 1982: 27; Blasco-Ferrer 1986: 111, 211, n. 47; Blasco-Ferrer 1988: 112). The syllable on which stress is realized depends in part on the subdialect (4a), and in part on the morpho-syntactic structure of the clitic pronoun (4b).[5]

(4) *Stress patterns with one enclitic*
(a) *Penult or final stress depending on dialect variety*
i) Ogliastra, Logudoro, Barbargia:
/narά mi/ 'tell me' (Blasco-Ferrer 1986: 211, n. 47; 1988: 112)
ii) Campidanese:[6]
/nara mí/ 'tell me' (Blasco-Ferrer 1988: 112)
(b) *Penult or final stress depending on nature of clitic pronoun*
i) 3rd person singular dative pronoun (Campidanese):
/narά ḍḍi/ 'tell him' (Atzori 1982: 27)
ii) 2nd person plural reflexive pronoun (Campidanese):
/setsei ozí/[7] 'sit yourself' (Blasco-Ferrer 1986: 211, n. 39)

With two enclitics we generally find a change in stress (e.g., from the verb to the enclitic) in all varieties, as shown in (5): Nuorese (Jones 1993: 28), Logudorese (Blasco-Ferrer 1986: 114), Campidanese (Blasco-Ferrer 1986: 111).[8]

5 We standardize all transcriptions by indicating geminate consonants as "CC" even when the original sources use "C:".
6 Wagner (1984 [1941]: 23) notes two accents: /náramí/ 'tell me'.
7 Blasco-Ferrer (1986: 211, n. 36) reports that the final /i/ of the verb is not pronounced in this form.
8 However, even in this context, some variation is present. Wagner (1984 [1941]: 25) reports no change in stress in these phrases in the dialects of Nuoro and Macomer (/náramilu/) and Désulo (/náramiddu/) 'tell it to me'. For Nuorese, Pittau (1972: 20–21) reports both unchanged and "shifted" stress with proparoxytonic verbs + enclitics: /bókina lu/ = /bokiná lu/ 'call him', /bókina mi lu/ = /bokina mí lu/ 'call him for me'.

(5) *Stress pattern with two enclitics*
   (a) Logudorese and Nuorese: /nara m ílu/ 'tell it to me'
   (b) Campidanese: /nara s íɖɖu/ 'tell it to him'

Before presenting the results of our phonetic investigation of these phases, we will briefly review the literature on Sardinian intonation.

2.3 Intonation

Sardinian intonation has received some attention in the literature: Contini (1992) and Lai and Zucca (2004) examine dialect variation in Sardinian intonation, and Contini (1984) and Lai (2002) provide experimental evidence of the role of F0 in differentiating questions and affirmative statements. Contini (1984) concludes that declarative sentences are characterized by a tonal peak on the initial syllable of the phrase, which he describes as a "level 3 peak" (Contini 1984: 148), followed by a fall on the post-accented syllable, while Lai (2004) notes that the F0 peak is on the pretonic syllable.

Another source is Canepari (1980, 1992) who studies the intonational patterns of regional varieties of Italian. For Cagliari Italian, he describes a slightly falling intonation for the "conclusive tone": a fall from a low mid tone in pretonic position to a low tone in tonic position (Canepari 1992: 202). A similar description is found in Schirru (1981–1982) for the variety of Italian spoken in Cagliari.

The falling intonational pattern associated with declarative sentences is also attested in our data. We will describe this pattern as consisting of a bitonal pitch accent: HL*.[9]

3 Data analyzed

The stress patterns of verb plus enclitic pronouns discussed in the literature are based mostly on impressionistic transcriptions, and there are no detailed phonetic analyses of these structures. In this paper, we provide an in-depth analysis of the intonation and durational characteristics of verb + enclitic phrases in Sardinian.

9 Floricic (2010) reports another intonational pattern (used with vocatives) in which the pitch accent is associated with the pretonic syllable.

Our data come from 4 informants: 3 male speakers (A, B, C) and 1 female speaker (D), who range in age from 29–63.[10] They are all bilingual in Italian and Campidanese, a Sardinian variety spoken in the province of Oristano (near the boundaries of the Logudorese dialects).[11] Each of the informants was born and raised in the town where they were interviewed, namely Seneghe (A), Cabras (B), Oristano (C), and Milis (D). For the purposes of this paper, the four varieties investigated show no main differences, and we analyze them as a single group.

Data were collected during field research conducted in the summer of 2007 by Francisco Ordóñez, as part of a 2006–2011 NSF funded research grant, "Stress Patterns with Clitics and Weak Pronominals in Post-Verbal Position in Romance Languages" (#0617471) awarded to Francisco Ordóñez and Lori Repetti. The data were recorded with a Zoom H4 digital recorder, and the utterances were then transcribed by a phonetician. All data are available in the *Clitics of Romance Languages (CRL)* database (Repetti and Ordóñez 2011).

The data from the four informants were produced in a question and answer format, namely, the Sardinian speaker performed a translation task.

(6) (a) Investigator asks (in Italian):
Come si dice *dammelo*? ('How do you say *give it to me*?')
(b) Informant answers (in Sardinian):
/dzammiḍḍu/ ('give it to me')

Each informant was asked to translate approximately 150 phrases. The questionnaire was designed to investigate the syntax, morphology, and phonological structure of verb + enclitic phrases.[12] Not all the data were included in our phonetic analysis: Of the nearly 600 utterances collected from these speakers, we investigated only phrases with the vowels /i e a/ associated with the tonal peaks.[13] The actual number of phrases that matches our criteria relative to the total number of utterances is as follows: 62/138 (A), 68/155 (B), 52/154 (C), 64/148 (D). In the

10 The speakers (A–D) analyzed in this paper correspond to the informants (Speakers 20, 2, 17, and 15, respectively) of the online database *Clitics of Romance Languages (CRL)* (Repetti and Ordóñez 2011). All data used in this paper from these informants is available there.

11 Italian and the dialect of Oristano are not mutually intelligible.

12 Our data were collected during field research and recorded in the home of the informant or in a public place. The recordings sometimes include background noise or interference of other neighboring conversations, or incomplete target utterances. Due to these kinds of limitations, the utterances that we compare are not perfectly balanced, as we had to exclude some cases. We will pursue our research with more extensive and controlled data in the future.

13 We excluded forms with other vowels such as [ɔ] and [o] because vowel quality was not clear, and the phonetic analysis, for example, of duration, would not have been precise.

next section we provide a phonetic analysis of the vowel duration and tonal characteristics of these 246 utterances, looking at pitch (Section 4.1) and vowel duration (Section 4.2).

The linguistic identification of the discourse context involved in the data collection is significant since sentence level prosody conveys meaning that is intended for the entire phrase or utterance (Ladd 1996). The discourse context in our data was a request for new information.[14] In other words, the prosody of the target phrases in (6b) is best identified as broad focus, even though the verb is in the imperative form.[15]

4 Phonetic description of the data

In this section, we describe the phonetic characteristics of the data collected, in particular, the intonation pattern of the phrases (Section 4.1) and vowel length of the prominent syllables (Section 4.2).

4.1 Pitch: falling tune

We find a consistent intonational contour in the speech data: a single falling tune (high tone followed by low tone: HL) throughout the entire phrase. This characteristic tune is consistent across all informants (A–D). We will use the pitch accent contours of speaker A to illustrate the falling contour, unless comparison among the speakers/dialects is relevant.[16] We will describe four examples in detail; each example presents a different number of syllables in the verb and clitic combina-

14 In some cases, the 'new' information in the answers may convey contrastiveness. For example, a different prosody was found when the informant attempted to correct/emphasize the clitic form of his/her initial answer. In these cases, the informant employed the intonation for narrow (or contrastive) focus, which is known to differ from broad focus prosody cross-linguistically (Ladd 1996). We exclude such cases in our analysis.

15 We believe that the informants were not influenced by the intonational pattern of the researcher because the researcher used different intonational patterns in his prompt: question intonation, imperative intonation, declarative intonation. The informants consistently used the intonational pattern described in this paper.

16 Our focus is on the realization of the pitch accent consistently found in the given data. Boundary tones are beyond the scope of this paper, particularly because the data collection did not control the pragmatic context of each target utterance. For our purpose, the common context of each utterance can best be described as broad focus which is employed in a question and answer pair task.

tion.[17] We will see that the High (H) tone is associated with the lexically stressed syllable of the verb, and the Low (L) tone is associated with either the penultimate or antepenultimate syllable of the phrase which corresponds to either the last syllable of the verb or the (first) clitic.

The first example is provided in Figure 1, and illustrates a verb with initial stress (/dzá(*i*)/) followed by two clitics (m iḍḍu/): [dza(*i*) m(m) iḍḍu] 'give it to me'.[18]

Figure 1a (Speaker A) shows the segmental boundaries and the pitch contour where each tone target is marked with a circle. The H and L tone targets are identified together with the segmental boundaries to illustrate the syllables associated with each tonal target. The H tone target appears in the vowel of the first syllable that coincides with the lexical stress of the verb. It then falls to the L tone target around at the end of the vowel of the penultimate syllable of the enclitic pronoun. The other three subjects B–D (Figures 1b–d, respectively) show similar patterns in the realization of the two pitch targets.

The second example (from Speaker A), shown in Figure 2, also illustrates a similar falling tune. In this example, the lexical stress of the verb is non-initial (/abáðia/), and a monosyllablic enclitic (/mi/) is adjoined to the verb: [abaðia m(m)i] 'look at me'.

The high tone peak in this second example appears in the second syllable (circled), and the low tone in the penultimate syllable of the phrase (circled). If we compare this to the first example, a difference emerges with respect to the location of the H tone target, which was in the initial syllable in the first case and in the second syllable in the second case, but which corresponds in both examples to the lexically stressed syllable of the verb. On the other hand, the L tone target appears in the penultimate syllable of the phrase in both examples. Based on these two examples, we predict that the H tone is associated with the lexically stressed syllable of the verb, and the L tone with the penultimate syllable (either part of the verb or the clitic).

Further examples reveal more locations for the H and L tone targets. We see below that the H tone is associated with either the initial syllable (Figure 3, from Speaker A), or the second syllable (Figure 4, from Speaker D); as we have seen earlier, this is the lexically stressed syllable of the verb. The L tone, on the other

17 The utterances illustrated in the four figures correspond to the following on the online database, *Clitics of Romance Languages* (Repetti and Ordóñez 2011): Figure 1(a) (Speaker 20_3), Figure 2 (Speaker 20_24), Figure 3 (Speaker 20_21), and Figure 4 (Speaker 15_46).

18 See Section 2.1 for the optional paragogic vowel (in parenthesis) after a monosyllabic verb: /dzá(*i*)/. The boundary between the two clitics is represented as /m + íḍḍu/; however, our analysis does not change if we segment the morphemes as /mí + ḍḍu/.

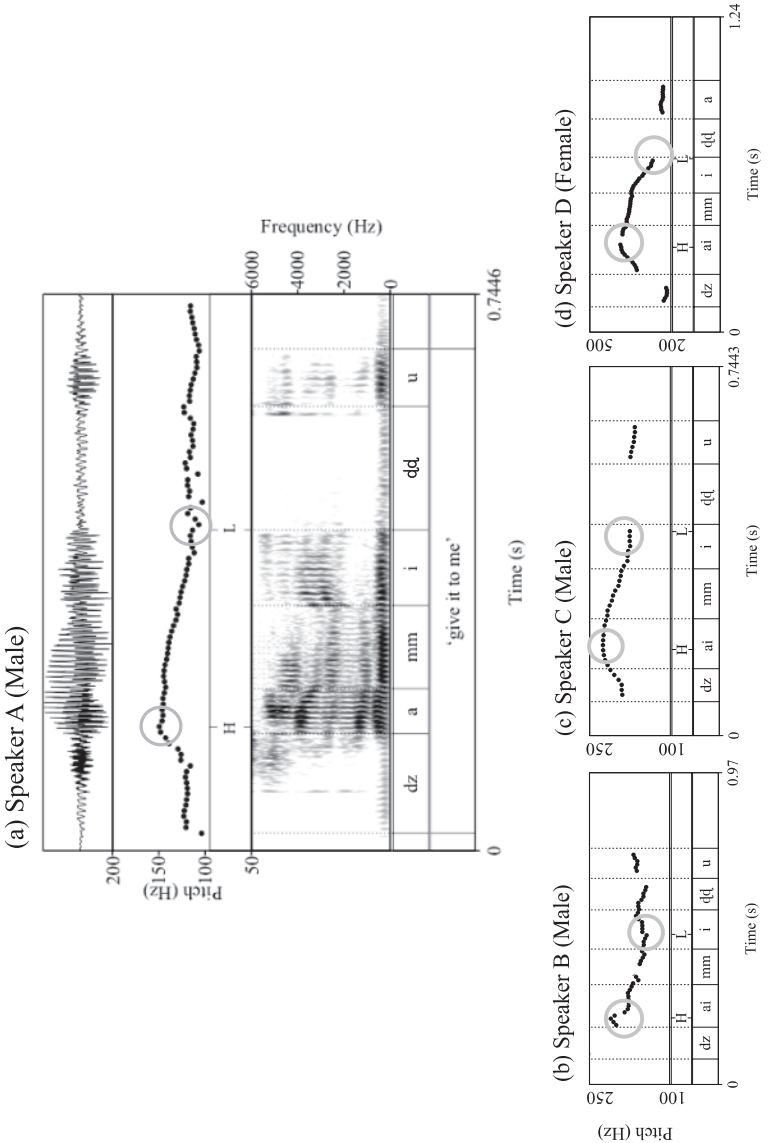


Fig. 1: Falling tune with initial syllable H and penultimate L: the phrase consists of a monosyllabic verb (σ́) and two enclitics (σσ).

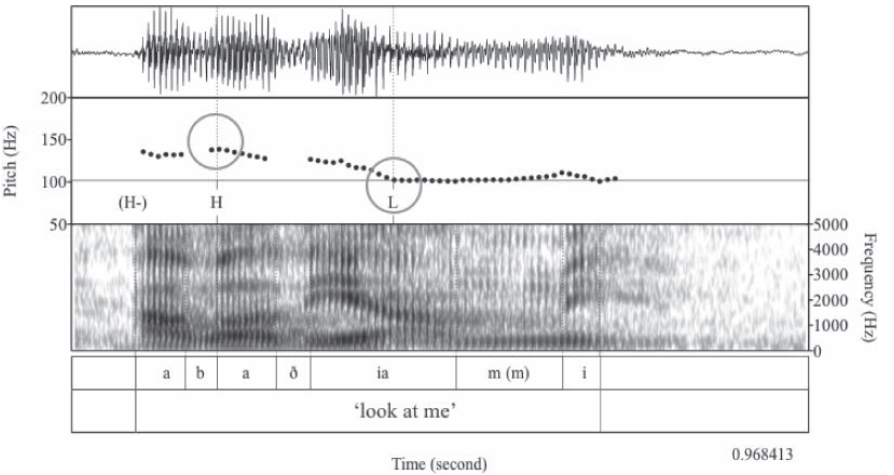


Fig. 2: Falling tune with second syllable H and penultimate L: the phrase consists of a tri-syllabic verb with a stress on the second syllable (σσσ) and one enclitic (σ). The utterance in this figure begins with an apparently high initial pitch, which we observe occasionally and inconsistently throughout the data. This optional initial high pitch is analyzed as an initial H phrasal boundary tone.

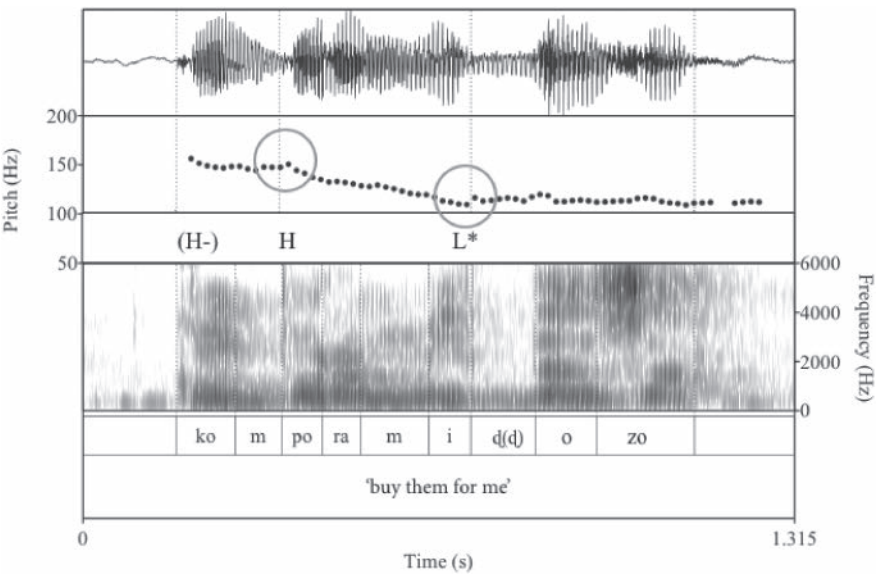


Fig. 3: Falling tune with initial syllable H and antepenultimate L: the phrase consists of a tri-syllablic verb with initial stress (σσσ) and two enclitics (σσν). The final vowel is paragogic.

hand, is associated with the antepenultimate syllable (either part of the verb or the clitic) rather than the penult.

The example in Figure 3, [kompora m iɖ(ɖ)ozo] 'buy them for me', depicts a pattern similar to that illustrated in Figure 1, where the H tone appears in the initial syllable, i.e., the lexically stressed syllable of the verb.[19] However, the L tone now seems to be aligned with the antepenultimate syllable. It is relevant that the final vowel in this example is paragogic. While epenthesis in Sardinian is not the focus of this article, paragogic vowels are relevant to our study since they are involved in the determination of the tonal landing sites, and in particular, the location of the L tone: with verb + enclitic phrases, the L tone is associated with the antepenultimate syllable only when the phrase ends in a paragogic vowel.

This antepenultimate L alignment is also found in Figure 4 below (Speaker D).

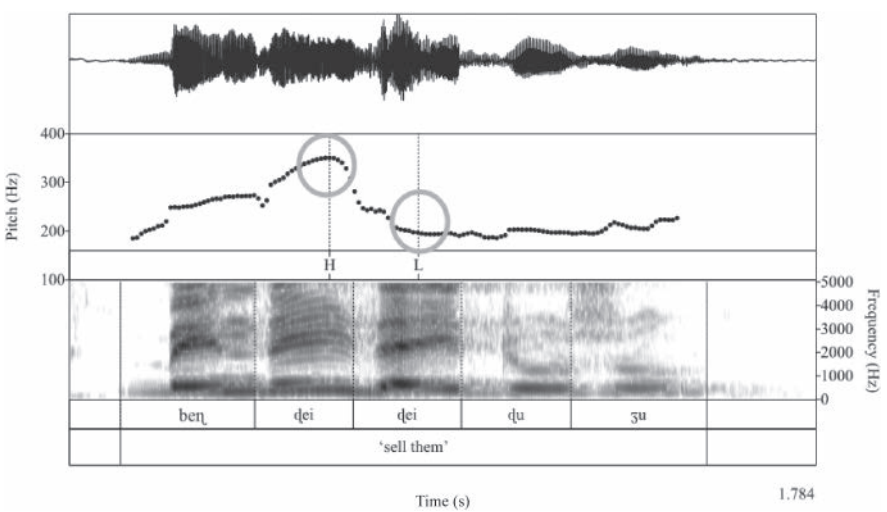


Fig. 4: Falling tune with second syllable H and antepenultimate L: the phrase consists of a verb with stress on the second syllable and one enclitic. The final vowel is paragogic.

19 We put one of the /ɖ/'s in parentheses to note the fact that it is longer than a singleton but not quite as long as a geminate. For example, the mean duration of singleton /ɖ/ is 79.6 ms (stdev. 24.8 ms) while that of geminate /ɖɖ/ is 151.3 ms (stdev. 19.7 ms). When there is a paragogic vowel at the end, the mean duration of /ɖ/ is 102.7 ms (stdev. 17 ms), which is longer than the singleton's but shorter than the geminate's mean duration.

In this example, the H tone appears on the second syllable, which is the syllable with verbal stress, and the L tone target is on the antepenultimate syllable. This is what we expect, given that the final vowel is a paragogic vowel.

One question is why the L tone is associated with the antepenultimate syllable if the final vowel is paragogic. We can account for this in two ways, although we do not take a particular position in this paper: (i) the paragogic vowel is invisible to tonal targets, i.e., if the final copy vowel is ignored, the L tone is associated to the penultimate syllable; (ii) the copy vowel is inserted after the tonal targets are assigned to specific positions.

In each of the four Figures above, the H tone is associated within the verb. In other words, the H tone landing site coincides with the lexical stress of the verb: the initial syllable (Figure 1 and Figure 3) or the second syllable (Figure 2 and Figure 4). The association of the L tone varies: it is either penultimate (Figure 1 and Figure 2) or antepenultimate (Figure 3 and Figure 4) depending on the absence/presence of a final paragogic vowel. Furthermore, in Figures 1, 3, and 4 the L tonal target is associated with the clitic, while Figure 2 shows that the L tone target is aligned within the verb. This comparison tells us that the L tone target does not necessarily designate a morphosyntactic or lexical unit as its landing site (clitic or verb), but that there must be a phonological unit that determines the landing locations within the phrase.

The falling tune is further examined to identify more precisely the locations of the F0 peaks (H) and valleys (L) (vowels are labeled as V_H and V_L). This tonal examination, together with the durational results presented in the next section, will provide evidence that the falling tune can best be described as an HL* pitch accent.

Local F0 values are measured for each syllable where either a H peak or a L valley appears. F0 values are calculated in four places: at the beginning of the designated vowel (a), at the end of the designated vowel (d), as well as at two intermediate points: the middle of the first half of the designated vowel (b), the middle of the second half of the vowel (c). F0 at points b and c are averaged pitch values: b = 1st half and c = 2nd half of the vowel. In addition, phrase-final vowels (V_F) are also included in the F0 analysis to capture the complete falling tune of the entire phrase. This is illustrated in Figure 5 for the utterance in Figure 1(a).

Vowels that carry a tonal target, either H or L, were manually identified and labeled as either V_H, V_L, or V_F. Four F0 values (a~d, a′~d′, a″~d″) from each vowel were then extracted using a Praat script. In Figure 5, for example, four F0 values (a~d) were taken for the vowel /a/ (V_H), four F0 values (a′~d′) for the vowel /i/ (V_L), and another four (a″~d″) for the vowel /u/ (V_F).[20]

20 The acoustic specifications for the pitch analysis in Praat are as follows: 50 ms window length (broadband spectrogram), 10 ms time step. Data were recorded at a sampling rate of 44,000 Hz. Apparent errors, such as pitch doubling/halving, were manually corrected through pitch inspection.

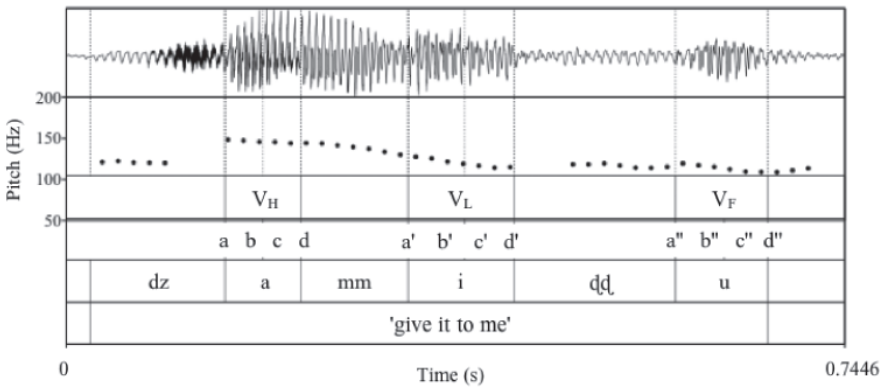


Fig. 5: F0 references within target vowel: V_H (a~d), V_L (a′~d′), and V_F (a″~d″)

The following figure provides a representative F0 contour of the phrases with an initial H and a penultimate L. F0 values at each time reference are averaged respectively for each subject.

Each marker in the following figure represents a tonal target placement for each speaker. For the male speakers (A–C), the H target appears earlier in the initial vowels and retained over the syllable. It starts to fall at the end of the vowel

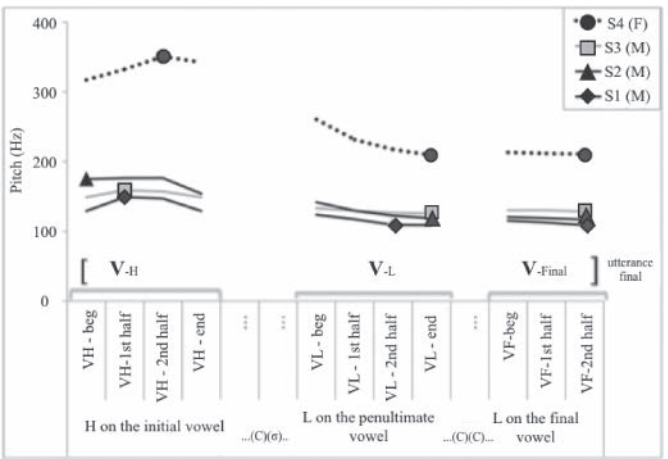


Fig. 6: Averaged F0 contour with penultimate L (within subject representation): F0 at the end point of the final vowel (V_F) is excluded in the figure because utterance final F0 values were not reliable mostly due to the voice quality at utterance final position. Note that one or more syllables (σ) or consonants (C) may intervene between the target syllables (e.g., between the initial and penultimate, or between the penultimate and final syllable).

to the L target, which generally appears close to the end of the penultimate vowel. When there is a sonorant coda, the L tone tends to continue to fall to the end of the coda. This falling continues to the end of the utterance (V_F). One difference between them and the female speaker (D) seems to be the relatively delayed H target, which tends to be formed within the later half of the vowel.

In the case with antepenultimate L, the falling tune is similar to that found with the penultimate L contour except that the L tone target appears on the antepenultimate syllable.

Based on these facts, our first generalization can be stated as follows:

(7) *Falling tune in verb + clitic phrases*: the H tone falls on the lexically stressed syllable of the verb, and the L tone on the penultimate syllable; when a paragogic vowel is present at the end of the utterance, the L tone falls on the antepenultimate syllable.

In the following section, we will examine the durational characteristics of the vowels associated with the H or L tonal target in more detail.

4.2 Vowel length

Another observation connected to the HL tone targets is that the syllable associated with L tone target is much longer than the one associated with H tone target. In other words, the L tone is associated with lengthening, rather than the H tone. In addition, the lengthening is greater when the L tone is associated with the penultimate syllable than when it is associated with the antepenultimate syllable. This is precisely what is described in the literature (see Section 2.1 above). Bolognesi (1998: 71) says that in Campidanese Sardinian "the stressed vowel is considerably lengthened if phrasal stress falls on the penultimate. No lengthening takes place if it falls on the antepenultimate lexical vowel of the phrase." This durational information is included in our generalization regarding tonal targets and their landing sites (8):

(8) A. *Falling tune in verb + clitic phrases*: the H tone falls on the lexically stressed syllable of the verb, and the L tone on the penultimate syllable; when a paragogic vowel is present at the end of the utterance, the L tone falls on the antepenultimate syllable.

B. *Duration*: the syllable associated with the L tone is lengthened. Lengthening is greatest when the L tone is associated with the penultimate syllable.

In the following sections we analyze in more detail the durational characteristics of the syllable associated with the H tone and with the L tone (in penultimate and antepenultimate position).

4.2.1 Duration: length of vowel associated with L and H tones

We now investigate the durational characteristics of the vowels associated with a H tone vs. a L tone, examining L tone vowels in penultimate position only. (Antepenultimate position is reserved for the Section 4.2.2.) We begin with the /a/ group, comparing the /a/'s associated with a H tone and the /a/'s associated with a L tone to see if there are differences in duration. Our comparison is illustrated in (9): data are from Speaker A, and the total duration of each phrase is provided together with the durations of vowel /a/. In (9a) the H tone is associated with the lexically stressed /a/, and in (9b) the L tone is associated with the final unstressed vowel of the verb.

(9) (a) [ab**á**ðia + m(m)i] 'look at me'
| |
H L

Dur. of /a/$_{H}$ = 78.22 ms.
(Dur. of phrase: 682.4 ms.)

(b) [teléfon**a** + m(m)i] 'call me'
| |
H **L**

Dur. of /a/$_{L}$ = 110.7 ms.
(Dur. of phrase: 703.6 ms.)

It is clear that the /a/ associated with the L tone (9b) is longer than the /a/ associated with the H tone (9a). This is surprising for a number of reasons. First, the vowel in (9a) is lexically stressed, so we would expect it to be longer than a lexically unstressed vowel (9b); however, this is not what we find. Second, let us consider the structure of the syllables from which each /a/ is taken: the /a/ in (9a) (H-tone) is in an open syllable, and the /a/ in (9b) (L-tone) is in a closed syllable. We expect that the duration of /a/ would be longer in an open syllable (9a) than in a closed syllable (9b). Surprisingly, we find that the /a/ in the closed syllable (9b) is longer than the /a/ in the open syllable in (9a). Third, we might predict a longer duration of each syllable in the shorter word (9a), and a shorter duration of each syllable in the longer word (9b), given word compression effects (Vayra et al. 1987; D'Imperio and Rosenthall 1999; Vayra et al. 1999; Kim and Cole 2005; Hajek et al. 2007). However, this is not the case in the given example.[21]

21 The total number of syllables in (9b) (five) is greater than or equal to the number of syllables in (9a) (four or five, depending on how we syllabify the sequence /ðia/); therefore, word-

Table 1: Vowel duration associated with H and L tones

	/a/$_H$	/a/$_L$	/e/$_H$	/e/$_L$	/i/$_H$	/i/$_L$
Mean length (in ms)	65.7	134.4	60.7	112	66. 8	109.3
SD	12.5	21.5	16.9	19.7	13.9	24
Number of tokens	15	27	47	19	15	64

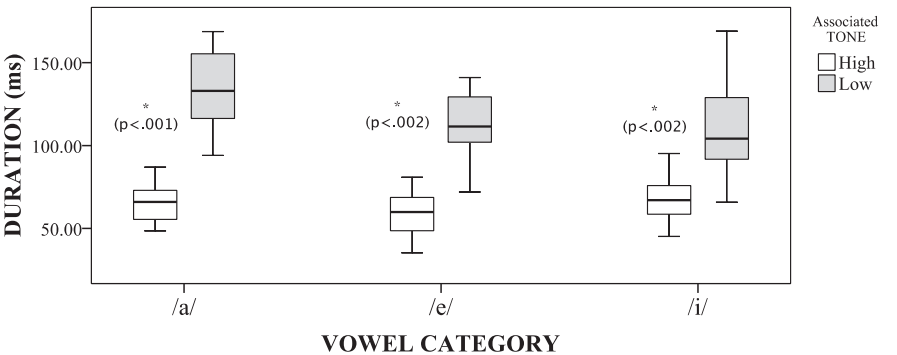


Fig. 7: Vowel durations associated with H and L tones

The measurements in (9) are not limited to the vowel /a/. In Table 1, a durational comparison is made between V_H and V_L for three vowels /a, e, i/, averaged across the four subjects (3M, 1F). We see that the vowel associated with the L tone is consistently longer than the vowel associated with the H tone, as shown in Figure 7.[22]

It is clear that the durational differences among vowels correlate with the tone associated with them: vowels with a L tone are longer than the ones with a H tone. Repeated Measures ANOVAs confirm that the durational difference is

compression effects may or may not be relevant. However, even in cases where the total number of syllables is unquestionably different, the penultimate L-tone vowel is always longer than the lexically stressed H-tone vowel. For example, the /a/ of /dzá$_H$-mm-i$_L$ddu/, which is lexically stressed and associated with the H tone, is 60 ms, as opposed to the penultimate L-tone /a/ in (9b), which is 110.7 ms.

22 It should be noted that the one female informant showed very slow speech compared to the other three male subjects. A separate analysis of the duration by gender confirms that the significant durational difference shown in Figure 7 does not change with or without the female's data.

statistically significant within each vowel category: /a/ [$F(1,5) = 57.396$, $p < .001$*], /e/ [$F(1,5) = 48.245$, $p < .002$*], and /i/ [$F(1,5) = 25.827$, $p < .002$*]. No significant difference is found between vowel categories ($p > 0.7$). We will see in the next section that the durational difference also depends on the position of the vowel in the word.

4.2.2 Duration: length of L tone vowel in penultimate vs. antepenultimate position

The HL falling tune with penultimate L is similar to that found with antepenultimate L, but the duration of the vowel that carries the L tone target is different: the antepenultimate vowel hosting the L tone is shorter than the penultimate vowel hosting the L tone, as shown in Figure 8.

The average length of V_L (averaged across the four speakers) in antepenultimate position is 97.13 ms (SD = 24.3), while in penultimate position it is 120.96 ms (SD = 29.3). The durational difference by position in word is statistically significant, as confirmed by a paired samples t-Test ($p < .015$; 95% level).[23]

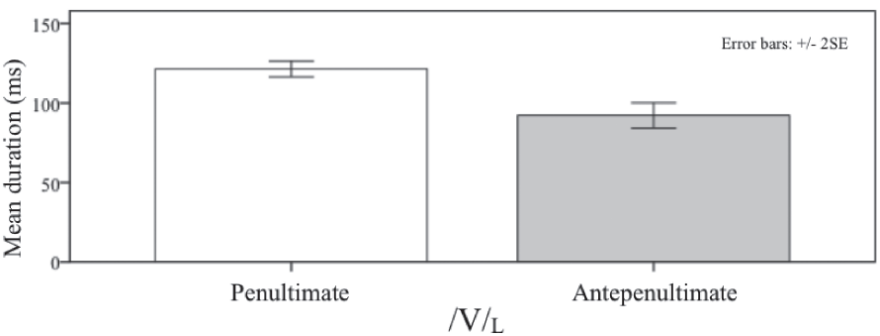


Fig. 8: Vowel duration (/a, e, i/) associated with L tone in penultimate vs. antepenultimate position

23 The onset consonants in the examined target syllables were not controlled. The onset consonants preceding /a/ include /d, g, n/, those preceding /e/ are /b, p, d, t, l/, and those preceding /i/ are /b, p, d, t, z, m/. The most frequent onset consonant before /a/ is /n/ (72%), before /i/ is /m/ (42%), whereas the five onset consonants before /e/ are evenly distributed. The effect of onset type (e.g., voicing) on vowel duration was examined, as suggested by an anonymous reviewer. Among the mid vowel tokens (CV syllables that contain [e], among the four-syllable

These durational findings confirm the description of prominence in (8): vowels associated with the L target undergo lengthening, and vowel lengthening is greater for penultimate vowels than for antepenultimate ones. The durational prominence of penultimate /V/$_{L}$ leads us to the conclusion that there is a metrical source that assigns phonological prominence to the penultimate vowel/syllable, which may or may not be part of a clitic. In the following sections, we provide a phonological analysis of the tonal pattern found in Sardinian, in order to capture the main characteristics of the data as well as to provide a general picture of where the Sardinian data can contribute to current theories of tonal phenomena.

5 Phonological analysis of verb + clitic phrases

Now that we have explored the phonetic characteristics of the falling tune in the data, we consider the details of the phonological description based on the theory of intonation proposed by Pierrehumbert (1980). We describe the falling tune as a bitonal pitch accent (Section 5.1) whose primary and secondary associations are described (Section 5.2). In Section 5.3 we propose a prosodic account of the tonal landing sites.

5.1 HL* bitonal pitch accent

We analyze the falling tune as a bitonal pitch accent, which is connected to broad focus with scope on the entire verb + clitic phrase. We now need to decide whether the falling tune (HL sequence) consists of two independent pitch accents (H* and L*), a bitonal pitch accent with prominence on the L tone (HL*), or with prominence on the H tone (H*L).

We begin by examining the tonal association more closely. Observe the two examples shown in Figure 9 (a–b) (which correspond to Figures 1a and 3), where verb stress is on the initial syllable. The H tone target appears at the initial syllable, whereas the L tone target appears on the penultimate syllable (a) and antepenultimate syllable (b).

phrases in the examined data), the vowel duration was not significantly different depending on the voicing contrast in the onset [Mean-dur([e])/$C_{[+voice]\_}$ = 69.7 ms; Mean-dur([e])/$C_{[-voice]\_}$ = 62.3 ms; ($p < 0.5$)]. The duration of the high vowel tokens with a voiced obstruent onset vs. a sonorant onset is nearly identical [Mean-dur([i])/[d]_ = 109.5 ms; Mean-dur([i])/[m]_ = 108.7 ms; ($p < 0.5$)]. Thus, we assume that the difference in vowel duration depends mainly on the position (e.g., penultimate vs. antepenultimate) of the target syllables within a word rather than on the composition of the onset.

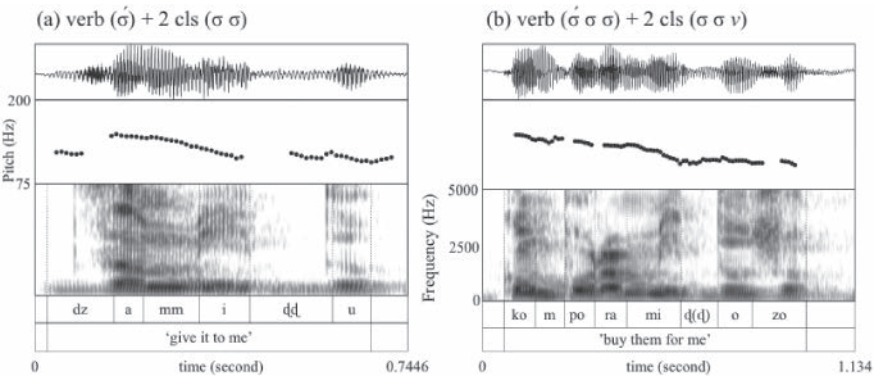


Fig. 9: Tonal description of verb plus two enclitics: (a) monosyllabic verb and (b) trisyllabic verb. We observe an initial high boundary tone in (b), also noted in Figure 2.

In the relatively short phrase (a) /dza$_{H}$-mmi$_{L}$ɖɖu/ 'give it to me', the H target is followed by a fall to the L target in the next syllable. Considering the durational prominence on the L tone, and not on the H, the falling tune in this case can best be described as HL*. In the case of /kom$_{H}$pora-mi$_{L}$ɖ(ɖ)ozo/ 'buy them for me' in (b), H and L are separated by two syllables, which may suggest that the two targets are independent pitch accents (H* and L*).

Neither of the examples in Figure 9 supports the H*L bitonal pitch analysis. In neither of these cases does the H tone (the proposed starred tone) have a greater duration than the L tone (the proposed unstarred syllable).

We are left with two possible descriptions of the pitch accent, either a bitonal pitch accent (HL*) or two pitch accents (H* L*), illustrated in (10).[24]

24 A third possible analysis was pointed out by an anonymous reviewer: H* pitch accent followed by a L boundary tone with pre-boundary lengthening. Although it is also a possibility, we reject this for two reasons: First, the duration of the syllable associated with H is never lengthened in the given data. As described in the literature, durational prominence is one of the clear phonetic manifestations of stressed syllables in Sardinian varieties, and there is no convincing reason to assume that a H* pitch accent is an exception. Second, we believe that the lengthening of the syllable associated with a L tone may not be attributed to a pre-boundary lengthening since it is not predictable with reference to the right-edge boundary (e.g., penultimate or antepenultimate). In addition, variation found in the association of boundary tones is often motivated by tone crowdedness to resolve potential conflicts of tone-to-segment association in timing, but this is not the case in our data. We will continue to work on this issue.

(10)	a. /d z a̲ m m i̲ ɖ ɖ u /		b. /k o̲ m p o r a m i̲ ɖ(ɖ)o z o /	
i. Bitonal PA analysis	H+	L*	H+	L*
ii. Two PA analysis	H*	L*	H*	L*

The two analyses in (10) can properly describe the tune at hand, and each of them has advantages and disadvantages. The *Bitonal pitch accent analysis* in (10i) attributes the falling tune to a HL* bitonal pitch accent. This enables us to express the relative prominence in duration within the domain, and also to capture a transparent mapping relationship between prosody and meaning: a single pitch accent expresses a similar meaning (broad focus) in a consistent way (Ladd 1983; Gussenhoven 1984; Pierrehumbert and Hirschberg 1990; Gussenhoven and Rietveld 1991). It also finds support in the fact that neighboring languages, such as Italian, have been described as expressing broad focus with a single pitch accent HL* (D'Imperio 2002). One disadvantage of the bitonal analysis has to do with locality of the tonal event. How far can the two tonal components of a single pitch accent be separated from each other? For instance, H and L in (10b) are separated by two syllables. This is problematic considering the fact that one of the common criteria in identifying bitonal pitch accents is a "local" drop, meaning that the H and L tones are a single tonal event (Pierrehumbert 1980).

The locality issue does not arise in the two pitch accent analysis described in (10ii), because the two tonal targets are interpreted as two independent pitch accents. However, the coherent mapping relationship between prosody and meaning is lost in this two pitch accent analysis: Is it H* or L* that expresses broad focus? Or is it a combination of both? Furthermore, if we were to analyze (10a) as HL* and (10b) as the combination of H* and L*, assuming that both possibilities can be used to express broad focus, then the choice between the two would depend on how far the lexical stress is located from the penultimate syllable. This implies a disconnect between the phonological description of the tune and its fundamental semantic role.

We have identified the main problem with the bitonal pitch accent analysis as having to do with the great distance between the two tonal components that are part of a single tonal event (a single pitch accent). For the bitonal pitch accent analysis to be adopted, the landing sites for the two tones should be predictable. In the following section, we show how this can be done.

5.2 Tonal alignment: primary and secondary associations

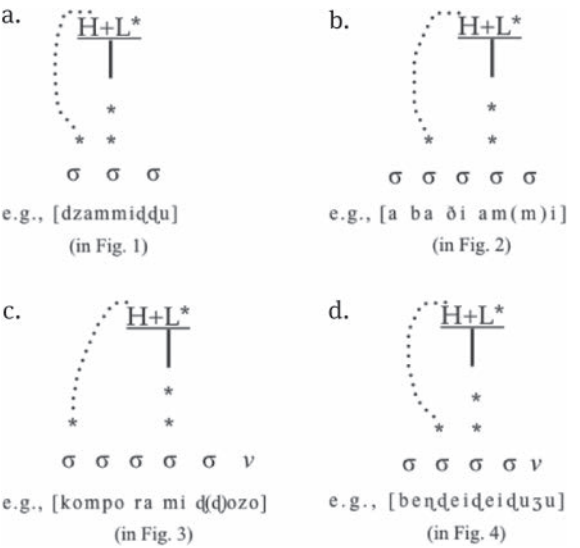
A pitch accent is generally assumed to associate with a metrically prominent position, such as the syllable with primary stress. However, this principle cannot

account for all of the cases described in the literature. For example, many cases of imperfect phonetic alignment between a tone and a segment are documented and discussed (Ladd 1996; Arvaniti et al. 2000). For example, Arvaniti et al. (2000) addresses this issue explicitly with bitonal pitch accents in Greek: no tonal target is exactly associated with the stressed syllable, instead the starred tone appears in the vicinity of the metrically prominent position.

In connection with the problem of imperfect alignment, Prieto et al. (2005) develop the notion of "phonological anchoring", a notion adopted from Pierrehumbert and Beckman (1988)'s proposal of "secondary association". (See also Grice [1995] and Grice et al. [2000].) Prieto et al. (2005) investigate possible contrastive alignment patterns of H* (in a LH* pitch accent) in three Romance varieties (Central Catalan, Neapolitan Italian, and Pisan Italian), where the same pitch accent seems to associate with variable prosodic boundaries such as mora, syllable, or word edge. They account for the alignment variation by attributing it to a secondary association of the H tone to a specific prosodic boundary, which can be language-specifically encoded in the phonological representation of the pitch accent. Thus, the primary association of any pitch accent is determined by a metrically prominent position in the phrase, but the secondary association, if specified in a language, finds edges as anchoring sites for the given tones. In the Romance varieties that they investigate, the secondary association of the H* tone (within the LH* pitch accent) can be with a mora (a rise with an non-delayed peak), a syllable (a rise with a delayed peak), or a word edge (a posttonic rise). The three-way alignment patterns in these three Romance varieties could not otherwise be distinguished based on the LH* primary association alone.

Following this "phonological anchoring" hypothesis, we explore a possible account for the Sardinian HL falling tune as a single tonal event, which we believe to be more advantageous in describing the data consistently. First, the pitch accent is assigned to a metrically prominent prosodic position: in our data, the penultimate or antepenultimate syllable, as illustrated in (11). In the case of a bitonal pitch accent, we assume that the leading tone is specified for its secondary association, namely, it associates to another metrically strong position, if one is available. That is, the landing site of the leading H tone is the next most prominent position in the phrase. (For more on the details, see Section 5.3.)

(11) Tonal association



The various possibilities are illustrated in (11): each example corresponds to Figures 1–4 shown earlier. In (11a) and (11b), the pitch accent is associated with the penultimate syllable, and the leading H tone is associated with the stressed syllable of the verb. In (11c) and (11d), the pitch accent is associated with the antepenultimate syllable and the leading H tone with the lexically stressed syllable. These examples support our earlier generalization in (8): the leading tone H is associated with the syllable which has lexical stress; thus, the variation of the H tone loci is predictable. The starred tone L* is associated with the penultimate syllable, or with the antepenultimate syllable in the presence of a paragogic copy vowel (see Section 4.1 above).

To summarize, the analysis of the falling tune as a bitonal pitch accent (HL*) enables us to capture the connection between the tonal description and its associated meaning, to highlight the similarities between Sardinian and other Romance languages with a similar pitch accent system, and to provide evidence that the two components of a single bitonal pitch accent need not necessarily be adjacent segmentally (e.g., when secondary association involved). We now need to specify in more detail the phonological anchoring sites, which we described above simply as "metrically prominent syllables". In the next section we propose a prosodic account of the association of the HL* bitonal pitch accent to the verb + enclitic pronoun phrases.

5.3 Prosodic structure of verb + enclitic units

In this section we first review the literature on stress assignment in verb + enclitic clusters (Section 5.3.1), and we then explore a prosodic structure that can accommodate our bitonal analysis of the phrases (Section 5.3.2).

5.3.1 Romance stressed enclitics

As summarized in Ordóñez and Repetti (2006), Torres-Tamarit (2010), and others, the phonological literature on stress patterns involving verbs + enclitics in Romance languages is extensive. In this section we briefly describe the prosodic accounts of the patterns attested in our data set, and suggest an analysis of them.

The patterns attested in our Sardinian data include the following (repeated here from (3)–(5) above).

(12) Verb + enclitic pronoun(s)
  a. stress on verb with one enclitic:
     /nára mi/ (Logudorese, Nuorese and "central varieties") = (3b)
  b. prominence on the penultimate syllable with one enclitic:
     /narά mi/ (Ogliastra, Logudoro, Barbargia) = (4ai)
     /naráḍḍi/ 'tell him' (Campidanese) = (4bi)
  c. prominence on the penultimate syllable with an enclitic cluster:
     /nara m ílu/ 'tell it to me' (Logudorese and Nuorese) = (5a)
     /nara s íḍḍu/ (Campidanese) = (5b)
  d. prominence on the final syllable with one enclitic:
     /nara mí/ (Campidanese) = (4aii)
     /setsei ozí/ 'sit yourself' (Campidanese) = (4bii)

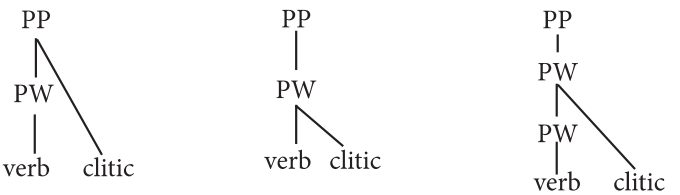
As seen in (12a), prominence may remain on the verb even in the presence of an enclitic pronoun (as in standard Italian), or it can be realized on the penultimate (12b) or final (12d) syllable of the verb + pronoun phrase. With enclitic clusters, prominence is generally on the penultimate syllable (12c) (except in the presence of a paragogic copy vowel, in which case it is realized on the antepenultimate syllable).[25]

25 For discussion of individual patterns in various Romance languages, see Peperkamp (1997), Moyna (1999), Huidobro (2005), Bonet (2009), Colantoni et al. (2010), Torres-Tamarit (2010) and references therein.

Many phonologists have proposed a prosodic account of the variation illustrated above. We will use Peperkamp (1997)'s model as the basis. Peperkamp (1997), following Selkirk (1995), claims that patterns (12a–c) can be accounted for as different ways in which a clitic is incorporated into prosodic structure. (Pattern [12d] is not discussed in Peperkamp [1997] or in any of the relevant literature on the topic.) For example, clitics may be incorporated at the Phonological Phrase (PP) level, and stress remains on the verb (13a), or they may be incorporated at the Prosodic Word (PW) level resulting in penultimate stress (13b). Alternatively, an enclitic cluster may be adjoined recursively to the PW (13c).[26]

(13) Peperkamp (1997)

(a) ***PP-incorporation*** (b) ***PW-incorporation*** (c) ***PW-adjunction***



Variations on the above model are also attested. Loporcaro (2000) suggests that in all Romance varieties clitics adjoin to the Prosodic Word (PW-recursion is allowed), and differences in stress assignment have to do with whether or not stress can be reassigned postlexically. Similarly, Bonet (2009) and Torres-Tamarit (2010) account for the complex stress patterns in Catalan by positing a single PW for verb + enclitic units. Monachesi (1996) posits different prosodic structures for single clitics vs. clitic clusters: one clitic adjoins to the host to form a single PW, while two clitics form a unit (PW) separate from the host resulting in a compound structure. Nespor and Vogel (1986) posit the Clitic Group, refined in Vogel (2009) as the Composite Group, an independent layer in the prosodic hierarchy between the PP and the PW level, where clitics are adjoined; within this domain unique rules and constraints apply.

Although these proposals can account for certain cases, there are a number of problems with the purely phonological approach to enclitics and stress assignment when the full range of data is taken into consideration (Ordóñez and Repetti 2008). For example, in many Romance languages, stress position may be affected by the morphosyntactic structure of the verb, the type of enclitic pronoun, or the

26 See Bafile (1991–1992), Kenstowicz (1996) and Loporcaro (2000) for a derivational approach to these patterns.

order of the clitics in a cluster (dative-accusative vs. accusative-dative). In addition, while variability is attested in the stress patterns with a single enclitic, the same cannot be said for enclitic clusters.

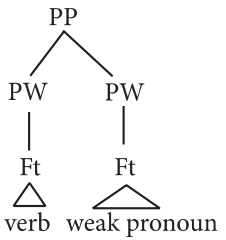
These patterns cannot be handled by the prosodic hierarchy alone. A solution to some of these problems has been suggested by Ordóñez and Repetti (2006, 2008): postverbal pronouns are not all the same. The term "clitic" has been used to refer to two different groups of pronouns that are morphosyntactically distinct: true clitics and weak pronouns (Cardinaletti and Starke 1999). The morphosyntactic problems identified above are solved if we adopt the "weak pronoun" analysis of certain enclitics.

While it is beyond the scope of this paper to provide a detailed analysis of the diagnostics for a clitic vs. weak pronoun, suffice it to say that those diagnostics include tests that are syntactic (*weak pronouns are syntactically lower than clitic pronouns; weak pronouns land in a Spec position, while clitics land in a head position*), morphological (*weak pronouns are morphologically more complex than clitic pronouns*), and phonological (*weak pronouns can be stressed, while clitics cannot*) (Cardinaletti and Starke 1999; Cardinaletti and Repetti 2008; Ordóñez and Repetti 2006, 2008).

As shown elsewhere (Ordóñez and Repetti 2006, 2008), some Sardinian postverbal pronouns meet the criteria of weak pronouns. The crucial characteristic of weak pronouns for our purposes is the phonological one: weak pronouns can be stressed, i.e., they are part of a foot. The foot associated with the weak pronoun is part of the Phonological Phrase; however, there are many possible models describing how the two are connected: the foot can be its own Prosodic Word, it can be part of the Prosodic Word of the verb, it can adjoin recursively to the Prosodic Word of the verb, or it can form part of a Composite Group. The details of the prosodic structure between the Phonological Phrase and the foot are beyond the scope of this paper, and the Sardinian facts are consistent with various analyses. For the purposes of this paper, we adopt the model in (14), although other models are also possible.[27]

27 We have identified one diagnostic that would allow us to identify a PW boundary within verb + enclitic phrases. In some Sardinian dialects, there is a paragogic vowel found after the final stressed vowel of monosyllabic words: /dá/ > /dá*i*/~/dá*e*/ 'give' (see Section 2.1). It may also be found after a monosyllabic verb which is followed by an enclitic pronoun cluster, suggesting that the verb is aligned with the end of a PW: /da/ + /milu/ > /da*i* milu/ 'give it to me' (Repetti and Ordóñez 2011, speaker 16, utterance 4); however, when only one pronoun follows the verb, the paragogic vowel is not present: /da/ + /mi/ > /da mi/, */dá*i* mi/ 'give me' (Repetti and Ordóñez 2011: speaker 16, utterance 1), suggesting that the verb is not right-aligned with a PW boundary. (See also Pittau 1972: 18–19.) We analyze these patterns as follows: some postverbal pronouns are true clitics, others are weak pronouns, and pronoun clusters may consist of a clitic and a weak

(14)



The remaining questions we address in the next section include the following. How is prosodic structure involved in the tonal association of the bitone? And how is each tone aligned with a particular prosodic unit?

5.3.2 Prosodic structure and the HL* bitonal pitch accent

We have seen above that the difference in prosody between a verb vs. a verb + postverbal pronoun, has been described as "stress shift"; however, we have shown that there is really not a "shift" in the word-level stress, since the verb's stressed syllable remains metrically prominent. Instead, we propose that what varies is the association of a bitonal pitch accent HL* to the entire verb + postverbal pronoun phrase. In particular, the starred tone is associated with the rightmost metrically prominent position, which may be the foot that includes the weak pronoun in Sardinian. We will describe how the pitch accent is phonologically associated to the verb + weak pronoun phrase by illustrating the phonological association derivationally.

One of the word-level stresses of a PP must be the most prominent, and in Sardinian it is the final word of the phrase that receives the phrasal stress (Bolognesi 1998: 71). It is this syllable that is associated with the L* tone and lengthening (if in penultimate position). In some cases, the penultimate syllable is part of the postverbal pronoun, and in other cases it is part of the verb.[28]

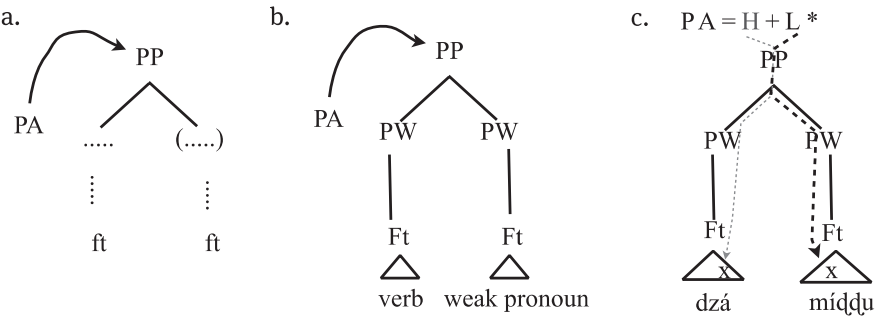
The starred tone of the bitonal pitch accent is associated with the most prominent syllable of the phrase, and we suggested above that the leading tone is associated with the next most prominent syllable. In our data, that is the stressed syllable of the verb. (15a) describes the assignment of a pitch accent (PA) to the

pronoun which form (at least) one foot. Following this reasoning, the pronoun in the verb + pronoun phrase /da mi/ should be analyzed as a clitic, but the cluster /milu/ (in /da*i* milu/) should be analyzed as a clitic plus a weak pronoun that form their own foot.

28 This is because Sardinian, like other Romance languages, undergoes phrasal resyllabification. (See Cardinaletti and Repetti [2009]).

Phonological Phrase (PP), (15b) is a schematic representation of verb + weak pronoun, and (15c) shows an example of /dzá + míḍḍu/ 'give it to me'.

(15)



We assume that broad focus introduces a specific pitch accent that is assigned to the relevant domain, which is PP in (15a). The semantic domain of the broad focus in the given data is the entire phrase, and thus the association of the pitch accent to the PP is transparent. Since the verb + weak pronoun phrase (PP) consists of two prosodic words (15b), both will have a word-level stress (metrical prominence). The starred tone is specified to anchor to the rightmost metrically prominent position: the first syllable of the weak pronoun cluster (15c).[29] The leading tone H is also specified to land at a metrically prominent position. Since the left PW is available for the leading tone, it anchors to the syllable with verb stress (15c).

The proposed association and derivation allow us to make a couple of predictions. First, if there is only one PW available, L* is associated with the only metrically prominent position, and the leading tone H either within the same syllable or in the vicinity of the metrically prominent position. Second, the HL* pitch accent will be associated with two prominent positions even when there are more than two PWs within a PP. We provide evidence for the latter prediction, and leave the former for future study.

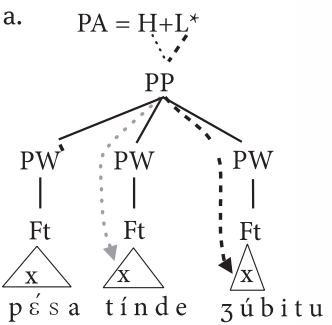
If there are more than two PWs in a phrase, we predict that the L* tone is associated with the rightmost PW, and the leading tone is associated with the stressed syllable of the PW that is the next most prominent one. In our data, the leading tone associates with the stressed syllable of the immediately preceding PW. (For differences in prominence among various words in a phrase, see Lai [2002] and Lai and Zucca [2004].)

29 It is the head syllable of a trochaic foot.

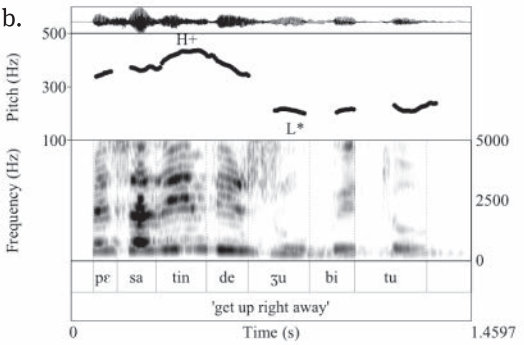
Below is an example of a phrase that consists of three PWs: [pɛsa tinde ʒubitu] 'get up right away' (verb + weak pronoun cluster + adverb) from Speaker D. The metrical structure of the phrase is provided in (16a), and the pitch contour in (16b).

(16)

a.



b.



Since the postverbal pronoun(s) can form an independent PW, in (16a) we have three PWs in the PP: the first PW for the verb, the second for the weak pronoun cluster, and the third for the adverb. Given the metrical structure in (16a), the pitch accent (HL*) that is introduced to the PP finds its primary association with the rightmost metrically prominent position, i.e., the stressed syllable of the adverb. Since the leading tone (H) is also specified to associate with a metrically prominent position, it looks for the closest metrically prominent syllable, which happens to be the stressed syllable of the weak pronoun.[30] Thus, the phonological association predicts the H leading tone to land on the weak pronoun cluster, while the starred tone goes to the stressed syllable of the adverb. This association is confirmed by the pitch contour of the phrase in (16b), where the H and L tones are realized on the syllables predicted in (16a).

6 Conclusion

In this paper we have suggested that what has been described as "stress shift" involved in encliticization is actually the association of the pitch accent to the

30 The association of the H leading tone with the second PW and not with the first PW requires us to assume a constraint (e.g., LOCALITY) that ensures bitonal association is as local as possible. We will further explore this proposal in future studies.

entire verb + pronoun phrase, and is not a shift in word level stress. Using both phonetic measurements of pitch and duration, as well as phonological analyses of the prosody of these phrases, we claim that word-level stress remains in situ, and the falling tune which our data exhibit can be interpreted as a bitonal pitch accent (HL*) associated with the entire verb + pronoun unit. We have argued, within a derivational model, that the starred tone is associated with the rightmost metrically prominent syllable (the penultimate or antepenultimate syllable), and the leading tone with another metrically prominent syllable in the phrase (which happens to be that of the verb in most of the data we considered).

The postverbal pronoun in Sardinian can have a metrically prominent syllable to which a tone can associate if it is a weak pronoun and not a true clitic. For our purposes, the weak pronoun analysis provides a number of positive results; most importantly, the foot of the weak pronoun provides the metrically prominent position for the pitch accent to associate with. Furthermore, the non-local alignment of the two tones provides empirical information that can help us better understand the connection between metrical structure and tonal alignment.

Our bitonal analysis provides crucial evidence of the need to incorporate a mapping relation between tonal description and intonational meaning in a more explanatory way. The non-local bitonality proposal increases the possible associations of tone to metrical structure and awaits further exploration on both empirical and theoretical grounds. Just as important is the documentation of this endangered Romance language whose complex and rich phonology holds many secrets yet to be discovered.

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