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Original Citation:

Harmonic processes and metaphony in some Italian varieties / Savoia, Leonardo Maria. - STAMPA. - (2016), pp. 9-53.

Availability:

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(Article begins on next page)

Leonardo M. Savoia

Harmonic processes and metaphony in some Italian varietiesⁱ

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Abstract: This article examines restrictions on the distribution of the phonological content of nuclei within the prosodic domain of the stressed nucleus. Besides metaphony, two types of harmonizing mechanisms are considered which govern the distribution of vocalic quality, specifically **aperture properties**, in the string: restrictions on the mid post-tonic vowels in Central Sardinian varieties and the distribution of [-ATR] vowels in Central Sicilian dialects. Metaphony and harmonic phenomena offer an interesting test for notions like contrastivity and markedness, supporting the hypothesis that the spreading of phonological **cues** in the string is connected to an improved ‘perceptibility’ of specifications relevant for the interpretation (Kaun 1995). The comparison with a treatment in terms of elements **allows the clarification** of the intuitive link that connects metaphony to other harmonic phenomena.

1 Introduction

The classical generative framework assigns phonology a special status, inherently different from that of syntax. Chomsky (2000: 118) restates this difference in terms of *Inclusiveness Condition*. Whereas syntax obeys *Inclusiveness* in the sense that ‘No new features are introduced by C_{HL} (Computational procedure for Human Language)’ in lexical items, phonology escapes this condition, given that ‘there are true phonological features that are visible only to the phonological component and form a separate subsystem of FL (Faculty of Language), with its own special properties’. In particular, ‘the [phonological] subsystem reflects special properties of the sensory-motor systems, which are in a certain sense «extraneous» to language...’. In this perspective, Berwick & Chomsky (2011: 37) argue that

ⁱ I wish to thank my informants, who collaborated with intelligence and generosity, and in particular Musu (Allai), Sabina Lorusso (Andria), Benedetta Mazzei (Iacurso), Paola Melosu (Làconi), Giuseppina De Tommaso (Mascioni), Emanuela Serrao (Milena), Antonietta Sanna (Paulilätino), Marziale Mascia (Settimo S. Pietro), Serafina Landro (Sutera), Maria Fiandaca (Villapriolo), and Raimondo Usai (Sèneghe).

phonology, together with morphology, is an interpretive component working in the externalization procedure of internal mental objects made up of the faculty of language. This characterization of phonology confirms the original distinction between phonology and syntax repeated in Bromberger & Halle (1989).

Actually, this disparity seems to be too drastic. Naturally, we can expect that (morpho-) phonology interacts with the sensory-motor system, at least in the sense that phonology incorporates phonetic information and phonetic changes or imperfections. However, when phonetic data are included in the grammar, they cannot have a cognitive status substantially different from syntax objects. Traditional approaches are based on the separation between underlying and surface representations, in the sense that the former register distinctive properties which phonological rules can make opaque at the level of the latter. In this view, phonology would have the function of manipulating and possibly obscuring the phonetic content specified at the level of lexical representations.

Recent phonological models imply a revision of this pattern. In particular autosegmental requirements reduce the possible types of rules; analogously, fully specified underlying representations (Halle et al. 2000; Calabrese 1998; Nevins 2010) bring about a more adequate phonological analysis. Along this line, Government Phonology (Kaye 1986/87, 1990; Kaye, Lowenstamm & Vergnaud 1990; Charette 1990, 1991; Harris 1994a) has a crucial role in constraining the format of phonological representations and the nature of possible processes in terms of phonetic interpretability. In particular, if according to Harris and Lindsey (1995), phonology operates on mental objects, both lexical underlying phonological representations and surface representations must be equally phonetically interpretable. As a consequence, there is no abstract phonetically uninterpretable level, as assumed in models of underspecification. Processes admitted include mechanisms of linking/spreading of properties which are included in the representations or delinking of features, thus satisfying the *Projection Principle* (Kaye 1986/87, 1990), which prevents arbitrary changes in prosodic relations at all levels of representation. As for the nature of phonological content, the recourse to privative monovalent elements (Kaye, Lowenstamm & Vergnaud 1985; Harris & Lindsey 1990, 1995; Backley 2011) concurs to answer many descriptive problems.

In what follows we will apply autosegmental representation, syllabic and prosodic structure, government relations between syllabic positions, and licensing by prominent segments in the prosodic organization of the string. Metaphony and other phenomena will be analyzed in terms of features; section 4.1 will be devoted to an approach based on elements. Phonological specifications and processes depend on well-formedness constraints which fix the distribution of vocalic/consonantal properties on the basis of prosodic requirements and licensing relations in the relevant domain. Strict phonological mechanisms of

metaphony and other harmonic phenomena associate with their ability to ‘externalize’ morpho-syntactic information, in the sense of Berwick and Chomsky (2011: 37) which identify phonology and morphology with ‘the linguistic processes that convert internal syntactic objects to the entities accessible to the sensory-motor system’. In this perspective, the traditional view which connects metaphony with morphological categories like number/gender/verbal person¹, may imply a valid intuition. The fact that the association with the stressed nucleus can enhance the perceptibility of phonological features fits in with other aspects of the process. In this sense, the stressed nucleus is in many cases the place for phonological contrasts externalizing distinct inflectional categories.

2 Some remarks on metaphony

In Italo-Romance metaphony the stressed nucleus partially or completely agrees with the following high vowel, [i u] the aperture degree (cf. Rohlfs 1966 [1949]). Two fundamental types of Italo-Romance metaphony are recognized, i.e. metaphony of high-mid stressed vowels /e o/ and metaphony of low-mid stressed vowels /ɛ ɔ/. The first process causes the raising of high-mid vowels of lexical bases to [i u], whereas metaphony of low-mid vowels brings about different results, in particular raising to [e o], diphthongs [iə/iɐ uə/uɐ], raising to [i u], according to different varieties. In any case, a system of alternations between lexical level stressed nuclei and metaphonized ones normally shows up. Metaphonic realizations normally preserve cavity properties [+/-back, +/-round] of the underlying stressed vowel, possibly in the former element of the diphthong. Finally, in many varieties post-tonic vowels, including the final ones externalizing nominal inflections, have been affected by different types of neutralization. Thus, in many Southern dialects we find a schwa, [ə]; raising of original *-e*-o to [i u] occurs in Calabrian, Sicilian, and Southern Sardinian dialects.

¹ Here I adopt the model proposed in Manzini & Savoia 2005, 2007, where the nominal inflection includes nominal class/gender and number; verbal inflection refers to verbal (person, tense) categories. This model depends on the analysis generally applied in generative grammar (cf. Chomsky & Halle 1968; Harris 1991), where inflectional morphemes are sub-word units endowed with a specialized semantic content. Traditionally all of these specifications are associated with terminal nodes in syntactic derivation and externalized by morphological exponents (as for instance assumed in a Distribute Morphology framework, cf. Halle & Marantz 1994). Different approaches assume that words are the true units, and morphological segmentation is a secondary abstraction (cf. Blevins 2006). This conclusion is based on the alleged unpredictable character of the relation between inflection and lexical base.

Metaphony of high-mid and low-mid vowels have a common root insofar as they can be conceived as assimilatory mechanisms affecting the distribution of height vocalic properties in the word domain. Nevertheless, the two types are neither entirely unifiable from a phonetic point of view nor in terms of theoretical treatment. Empirical data seem to confirm this conclusion. In fact, their chronology and areal distribution do not coincide (Rohlf's 1966 [1949]; Maiden 1985, 1987, 1991; Savoia & Maiden 1997). In particular, metaphony of high-mid vowels has a wider areal distribution; this possibly supports the hypothesis that it is older than metaphony of low-mid vowels (Maiden 1985, 1987). The two metaphonic processes correspond to different harmonizing properties, which work with independent modalities according to the original vocalic system and, what is more, to the morphological procedures of externalization. Moreover, metaphony cannot be isolated from the set of the other harmonic processes that coexist and interact with it.

Some authors have attempted a reconstruction of a historical and phonetic link between the two types of metaphony of low-mid vowels. A traditional idea supported for example by Castellani (1973) is that high-mid outcomes [e o] could derive from the monophthongization of original metaphonic diphthongs [je uo]. However, other hypotheses are discussed in the literature. A proposal, discussed in Barbato (2008) and Loporcaro (this volume), assumes that metaphonic diphthongs would be a secondary outcome from older high-mid [e o] outcomes deriving from original low-mid vowels. In this perspective, a crucial role is assigned to a conjectured/reconstructed intermediate level whereby simple raising would precede the current diphthongizing metaphony in Center-Southern varieties. Indeed, the evidence appears to be uncertain, if we consider that the observable situation shows a strong areal overlapping of the two types of metaphony. What is more, if diphthongization was a secondary process affecting /e o/ deriving from metaphony, we would expect that it could affect all /e o/ nuclei, including the etymological ones as well. Barbato (2008) notes this problem suggesting that diphthongization could be determined by an impulse towards the morphologization of metaphony. As regards the typology and distribution of metaphonic outputs of low-mid vowels, we see that a large variability between diphthongized outcomes, typically [iə uə] (not [je wo]), and monophthongs [i u] shows up. The outcomes [i u] from low-mid vowels seem to have a clear relation with original diphthongs [iə uə], while there is no evidence for a link between [e o] and [iə uə]. If we take existing phonetics as a serious clue for interpreting the history of sounds, these outcomes suggest different lines of evolution. Anyway, metaphony goes back to a distant past and another solution could be plausible, as, for example, the hypothesis that the outcomes [e o] are due to a process of monophthongization.

As for the relation between diphthongization and metaphony, we know that in many Central and Southern Italian dialects (Abruzzi, Apulia, Lucania)

diphthongization has affected tonic nuclei according to the metric-syllabic contexts, possibly also including metaphonic outputs. However, metaphony of low-mid vowels has normally different outcomes from ‘spontaneous’ diphthongization/aperture processes, which on the contrary systematically include the outcomes of metaphony of high-mid vowels, but only partially those of low-mid vowels. An interesting suggestion can come from the Sardinian, Calabrian, and Sicilian varieties characterized by a three height degree vocalic system lacking high-mid vowels. In Calabrian varieties, raising and diphthongizing metaphony of low-mid vowels coexist, whereas other types of diphthongization are absent and sensitivity to syllabic structure does not emerge. Similarly, in Sicilian dialects metaphonic diphthongization of low-mid vowels is present while other types of diphthongization are absent. This distribution weakens both the hypothesis that metaphony of high-mid vowels precedes the metaphony of low-mid vowels, and the assumption that metaphonic diphthongization is secondary on the raising of low-mid vowels to [e o]. In other words, there is no evidence to argue for the older character of simple raising to [e o]². In fact, reconstruction is an interesting exercise, but on the basis of the available data the most reasonable conclusion we can arrive at is that the two types of metaphony of low-mid vowels – raising vs. diphthongization – correspond to two different harmonizing processes applying to the etymological low-mid vowels in tonic position (Rohlf 1966 [1949]: 128, 154). For that matter, no phonetic or cognitive constraint would seem to exclude this possibility.

It is of note that there are authors who reject the assimilatory nature of metaphony. So, Sánchez Miret (1998) and Russo (2007) propose that metaphonic outcomes are nothing but spontaneous evolutions in contexts where the final vowel is different from /a/. In particular, Russo (2007) holds that raising and diphthongization correspond to the introduction of ‘default’ specifications in the stressed vowels of the system; analogously, the preservation of stressed nuclei would implement a requirement of vocalic aperture triggered by the morphological context *-a*. This entails an overturning of the traditional perspective, requiring explanation of why *-a* would block the default diphthongization or raising of high-mid vowels. The most evident inadequacy is recourse to an unjustified set of default rules to account for not only ‘metaphonic’ outcomes but also the basic vocalic system.

² More in general, in dealing with history of metaphony we must allow for the fact that diphthongization and other vocalic processes have affected tonic nuclei in Northern varieties as well, with separate results from metaphony. For example, metaphony of low-mid vowels emerges in Romansh varieties, at least in a subset of adjectives. In these varieties, however the non-metaphonic outputs also remain distinct from the metaphonic ones: *ɔ* / *ɪə*, etc.

The idea I start out from is that metaphony is not intrinsically different from other types of harmonies. All these phonological mechanisms enhance perceptibility of certain phonological properties within a prosodic domain by increasing their durational extension (Kaun 2004). In the recent phonological debate, harmonic processes and metaphony have been connected with the need for making certain vowel properties recognizable. As for harmonies, according to Kaun, they increase the exposition of the listener to (morpho-)phonological elements characterized by vulnerable phonological properties (Kaun 1995; Zoll 1998; Walker 2005). Distinctiveness can play a crucial role: ‘harmony serves to extend the duration of phonetic information which is phonologically important (i.e. distinctive), but which is transmitted by means of relatively subtle acoustic cues.’ (Kaun 1995: vii). In particular, Kaun (1995) applies these ideas to [round] harmony, noticing that rounding contrasts are ‘perceptually subtle’ in front and non-high vowels. Walker (2005), according to Kaun (1995), characterizes harmonies and metaphonies as processes in which the ‘perceptual weakness’ of some features is circumvented by associating it with the prominent vowel in the string: ‘trigger conditions on spreading constraints may single out perceptually marked properties...’ (cf. Zoll 1998; Walker 2001). This picture provides harmonies and metaphonies with the same interpretive basis, in the sense that harmonies satisfy the durational extension of a phonological structure, whereas metaphony satisfies both durational extension and phonological strengthening of a feature by associating it with a strong position. In particular, associating a feature with the stressed position concurs to preserving its contrastive force (Kaun 2004; Nevins 2010).

Returning to metaphony, the crucial question concerns the relation between raising metaphony of high-mid vowels and that of low-mid ones. Although traditionally unified, they do imply two different types of assimilation, given that in the first case the metaphonizing feature is [+high] ([high] metaphony), while in metaphony of low-mid vowels [+ATR] is involved ([ATR] metaphony). In the literature both descriptive and theoretical approaches provide for the action of the same feature [+high]. Naturally, in the classic feature system worked out by Chomsky & Halle (1968), the problem arises that [e o], or [i u], cannot be treated as the result of a rule changing [–high] to [+high] starting from [–high, +low] /ε ɔ/ underlying vowels. Some readjustments are required which manipulate the combination of the two features, yielding [–high, –low], i.e. [e o], or [+high, –low], i.e. [i u], because of the impossibility of [+high, +low] (cf. Kaze 1991). Anyway, metaphony of low-mid vowels requires a treatment distinct from that of high-mid nuclei.

In frameworks which have recourse to the feature [ATR] for dealing with vocalic tenseness/laxness phenomena (Vaux 1995), metaphony of the high-mid vowels combines [+high] with [+ATR], yielding the basic high vowels [+high, +ATR], [i u]. In the contexts where the underlying vowel affected by metaphony is low-mid, [–high,

–ATR], spreading of [+high], as maintained in Calabrese (1998, 2009), creates an outcome [+high, –ATR], [i u] that corresponds to a possible articulation. However, the usual outcome is [–high, +ATR], i.e. [e o], or [+high, +ATR], i.e. [i u]. Calabrese (1998, 2009) explains this by resorting to repair mechanisms which modify a marked vocalic specification. In particular, the combination [+high, –ATR], derived from spreading [+high] to low-mid underlying vowels, is normally reinterpreted as [–high, +ATR], i.e. [e o] by the operation of ‘negation’, [+high, +ATR], [i u] by ‘delinking’, or, finally, as a diphthong, [ie uo], by ‘fission’. Frigeni (2003, 2004) deals with metaphony in Sardinian varieties as spreading of the feature [ATR]. Optimalist approaches (Walker 2011; Mascarò 2010) relate metaphony of low-mid vowels [–high, –ATR] to the prohibition of *[+high, –ATR] as a marked specification. In particular they assume specialized constraints which block the assimilation to [+high] and admit only the assimilation to [+ATR], bringing about the outcomes [e o].

In most systems, stressed [a] does not metaphonize, except for some Central Italian and Lombard Alpine varieties. The simplest explanation of the behavior of [a] is that there are no possible phonological configurations [+low] able to license the combination [+high]/[+ATR] in post-tonic/final position. This seems to be the case, although actually many varieties have central vowels, so that nothing would prevent an outcome [ə i] from occurring in raising contexts. However, metaphony of [a] generally shows the outcome [ɛ]. This suggests that metaphony is connected with the distribution of mid vowels in stressed position, thus recalling many of the harmonies studied in the literature (Archangeli & Pulleyblank 1989, 1994). More precisely, [i a u] in stressed positions occur without restrictions, whereas mid vowels depend on the height of the following vowel. We can express this point by concluding that [+high]/[+ATR] on the post-tonic vowel has to be licensed by the same specification in the stressed vowel. If the metaphony corresponds to such a mechanism, /a/ is excluded.

The fact that in the majority of varieties stressed [a] is not subject to metaphony, can be related to its isolated position in the vocalic system. In other words, the application of metaphony seems to involve the contrastive capability of the relevant properties. In the terms of Calabrese (1995, 1998) and Nevins (2005, 2010), contrastivity is defined with respect to the existence of two segments differentiated by opposite values for a feature, whereby a segment is *contrastive* for a feature [α F] in a given position if and only if a segment [–α F] may occur in this position. Contrastivity has a role in determining the processes working on phonological properties of segments. Along this line, we can think that metaphonies generally exclude the only vowel, i.e. [a], which lacks a corresponding segment contrasting with it in the feature [high] and [ATR]. In other words, metaphonies apply to [high]/[ATR] contrastive properties.

In brief, harmonies and metaphony can be interpreted as phonological devices which associate some properties with a strong position which licenses

(authorizes) them. As discussed in Harris (1994a,b, 1997), Harris & Lindsey (1995, 2000), Zoll (1996, 1998), Walker (2001, 2011), metaphony and harmony correspond to the requirement whereby some properties in a domain are authorized if they appear in the prosodic head of the domain. As a consequence licensing can manifest itself in the form of the phonological **accord** between the strong position, the licenser, and the licensed position, as in (1) (Harris 1990b).

- (1) A property x in a governed position in the prosodic domain is licensed if it is associated with the head of the domain.

As we will see, this model can be generally applied to the harmonic phenomena we will examine.

2.1 Metaphonies

Let us now take a look at the basic properties of metaphony examined in some concrete cases beginning with metaphony of the dialect of *Mascioni* (Abruzzo). This grammar includes the set of vocalic contrasts in (2a) distinguishing high-mid vowels from low-mid ones. Metaphony implies the raising of lexical /e o/ to [i u], in (2b), and the raising of lexical /ε ɔ/ to [e o], in (2c).

- (2) *Mascioni*

a.	i	u	[+high]	[+ATR]
	e	o	[-high, -low]	

	ε	ɔ	[-high, -low]	[-ATR]
	a		[+low]	

- b. *Metaphony of high-mid vowels*

[ˈveta]	‘fingers’	[ˈvitu]	‘finger’
[ˈroʃʃa]	‘red.fsg’	[ˈruʃʃu]	‘red.msg’
[ˈroʃʃe]	‘red.fsg’	[ˈruʃʃi]	‘red.mpl’

- c. *Metaphony of low-mid vowels*

[ˈpɛrdo]/[ˈpɛrde]	‘I lose/he loses’	[ˈpɛrdi]/[ˈpɛrdu]	‘you/they lose’
[ˈnɔa]	‘new.fsg’	[ˈnou]	‘new.msg’
[ˈnɔe]	‘new.fpl’	[ˈnoi]	‘new.mpl’

Unlike the system of *Mascioni*, Sardinian systems, like that of *Paulilâtino* (Central Sardinia) in (3a), have three height degrees, excluding stressed high-mid vowels, except for metaphonic contexts. In the system of *Paulilâtino* stressed high-mid [e o] occur only when followed by vowels [+high], in (3b); in the other contexts stressed low-mid [ε ɔ] occur, in (3c).

(3) *Paulilätino*

a.	i	u	[+high, +ATR]		
	e/ε	o/ɔ	[-high, -low, +/-ATR]		
		a	[+low, -ATR]		
b.	['bɛttsa]/['bɛttsɔɔ]	'old.fs/mp'	['bɛttsu]	'old.ms'	
	['bɛssɔ]	'I go out'	['bɛssizi]	'you go out'	
	['ɔʎɔɔ]	'eyes'	['oʎu]	'eye'	
	['drɔmmɔ]	'I sleep'	['drommiði]	'he sleeps'	
c.	['tɛndzɔ]/['tɛnɛzɛ]	'I keep/you keep'			
	['kɔttsɔ]/['kɔʎɛzɛ]	'I cook/you cook'			

Let us consider first metaphony in the *Mascioni* dialect in (2b, c) and test the possibility that it is sensitive to the contrastive nature of features [high] and [ATR]. We see that in systems like that of *Mascioni* all the different vowels can co-occur occupying identical vocalic contexts, as illustrated in (4), except for sequences including mid vowels, just like (2b, c), where a low-mid stressed nucleus occurs only when followed by a [-high] vowel. [+high] post-tonic vowels require a stressed [+ATR] nucleus in compliance with metaphony. [high] and [ATR] values associated with [i a u] can freely combine in the domain, admitting sequences like *i...a*, *a...i*, *i...i*, etc. Thus, [high] is contrastive in [+ATR] nuclei, and [ATR] is contrastive in [-high] vowels. Metaphonic contexts select the values [+high]/[+ATR].

(4) *Mascioni*

['sete]	'thirst'	['itʃe]	'he says'	['kalle]	'hot.f.pl'
['bejo]	'I drink'	['iko]	'I say'	['sallo]	'I jump'
['veta]	'fingers'	[or'tika]	'nettle'	['kalla]	'hot.f.sg'
['koʃe]/['koʃo]	'he sews/I sew'			['krue]/['krua]	'raw.fpl/fsg'
['mele]	'honey'			['kɔre]	'heart'
['leɔ]/['leɑ]	'I take/he takes away'			['jɔko]/['jɔka]	'I play/he plays'

In the grammar of *Paulilätino*, [i u] [+high] and [ɛ a ɔ] [-high] can occur in the same vocalic contexts, where they precede [a] or low-mid vowels, as in (5). The contrast between low-mid and high-mid vowels is limited to the stressed position, where it is governed by metaphony, as in (3b).

(5) *Paulilätino*

['limba]	'tongue'	['uŋgra]	'nail'	['krikkɔ]	'I look for'	[is'kurtɔ]	'I listen'
['bɛttsa]	'old.fsg'	['bɛttsɔɔ]	'old.mpl'	['tɛndzɔ] / ['tɛnɛzɛ]	'I/ you keep'		
['nɔɑ]	'new.fsg'	['sɔlle]	'sun'	['kɔttsɔ] / ['kɔʎɛzɛ]	'I / you cook'		
['sana]	'sound'	['frakkɛ]	'scythe'				

We can account for metaphonic processes in (2b, c) and (3b) by assuming that metaphony reflects contrastive specifications, as expressed in the constraint in (6a) for high-mid vowels and in (6b) for low-mid ones. The non-contrasting value [ATR] of [i a u] in stressed position is not involved. In the *Paulilâtino* system in (3b) high-mid and low-mid vowels are in complementary distribution according to the value of [ATR] in the following vowel; we conclude that only (6b) is at work. In this variety [-high, +ATR] vowels interpret metaphonic contexts, where they anticipate and license [+ATR] in the following vowel. Naturally, raising metaphony of low-mid vowels in the dialect of *Paulilâtino* and that one in the dialect of *Mascioni* are not different.

(6) a. *Raising metaphony (of high-mid vowels)*

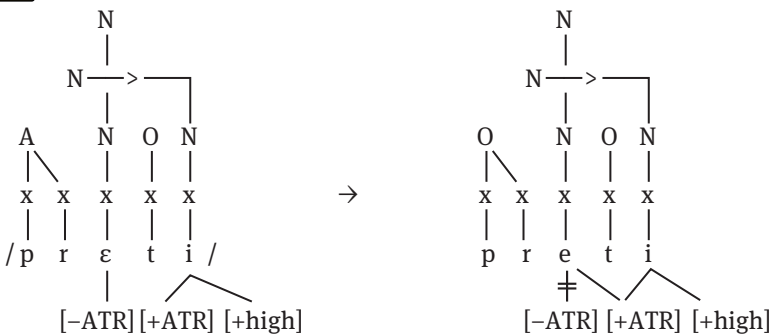
Contrastive [+high] ([i u] vs. [e o]) in the stressed nucleus licenses [+high] in the following vowel.

b. *ATR metaphony of low-mid vowels*

Contrastive [+ATR] ([e o] vs. [ɛ ɔ]) in the stressed nucleus licenses [+ATR] in the following vowel.

In the systems preserving non neutralized weak vowels, as in (2) and (3), (6) is satisfied when the stressed nucleus realizes relevant phonological properties thus licensing their occurrence in governed positions. Licensing implies delinking of incompatible phonological features, as in (7). The mechanism in (7) subsumes metaphony of **medial low** vowels in *Paulilâtino* variety as well.

(7)  *Mascioni*



A crucial dimension of variation concerns the metaphonic status of intermediate weak vowels in trisyllables. In many systems the intermediate nucleus is opaque and triggers metaphony on the stressed nucleus, as in the *Paulilâtino* variety in (8a) and in general in Sardinian dialects. In other varieties, the in-between vowel is transparent and only the final nucleus is involved, as in the *Mascioni* variety in (8b).

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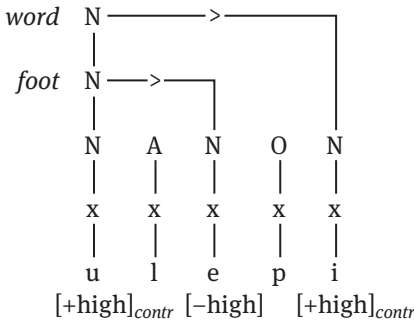
(8) a. *Paulilätino*

[ˈfemmina]	‘woman’	[ˈpessiɣe]	‘peach’
[ˈommine]	‘man’	[ˈpoɖɖiɣe]	‘finger’

 b. *Mascioni*

[ˈolepe]	‘fox’	[ˈulepi]	‘foxes’
[ˈpetteno]	‘I comb’	[ˈpetteni]	‘you comb’
[ˈɔme]	‘man’	[ˈommeni]	‘men’

Varieties like that of *Paulilätino* in (8a) show the result we expect according to the phonological context; we can simply think that (6b) applies to sequences in (8a) as well. In the dialect of *Mascioni* the intermediate vowel of proparoxytones is in any case a high-mid vowel; in other words, in this position only high-mid vowels or [a] are admitted. So, the intermediate vowel is devoid of contrastive height properties. We can conclude that in these positions the intermediate vowel is not seen by metaphony in that its [–high] value is not contrastive, as suggested in (9).

 (9) *Mascioni*


Let us consider finally the variety of Iacurso (Calabria) where metaphony of low-mid vowels shows up as a diphthong. Its vowel pattern coincides with that of Sardinian varieties in (3) insofar as it includes only three aperture degrees, high, low-mid and low vowels. A post-tonic [+high,+ATR] vowel rejects a [–high,–ATR] stressed nucleus. In this context, the stressed nucleus must anticipate these specifications and the diphthong [ie]/[ue] is realized in alternation with the lexical **medial low** vowel, as in (10a). Again, the intermediate post-tonic high vowel of proparoxytones regularly triggers metaphony as in (10b).

 (10) *Iacurso*

a. [ˈpeðe]	‘foot’	[ˈpieði]	‘feet’
[ˈvecca]	‘old.fsg.’	[ˈvieccu]/[ˈviecci]	‘old.msg./pl.’
[ˈperde]	‘s/he loses’	[ˈpierdu]/[ˈpierdi]	‘I lose/ you lose’
[ˈnɔva]	‘new.fsg.’	[ˈnuevu]/[ˈnuevi]	‘new.m.sg/pl.’

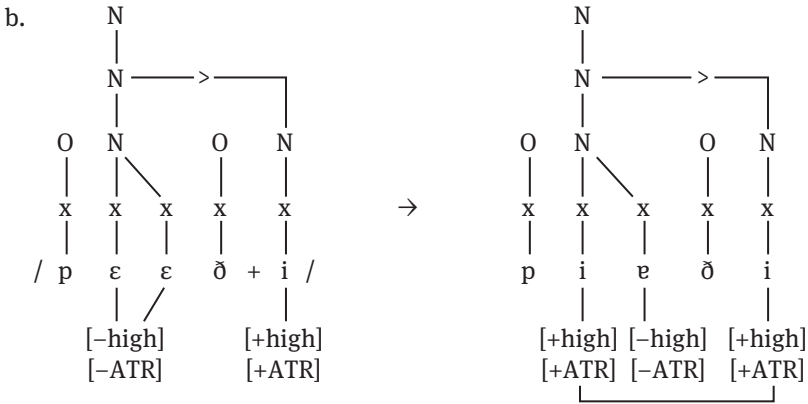
- ['kɔrɛ] 'heart' ['kuəri] 'hearts'
 ['dɔrmɛ] 's/he sleeps' ['duərmu]/ ['duərmi] 'I sleep/ you sleep'
 b. ['priɛvite]/ ['priɛviti] 'priest/ priests'
 ['piekura] 'sheep'

(11a) expresses the requirement whereby the formation of a diphthong in stressed position licenses both [+ATR], as in Sardinian dialects, and [+high], as in the variety of *Mascioni* in (2). The first position in the diphthong, i.e. its head, introduces the phonological content which needs to be licensed, i.e. [+high, +ATR].

(11) *Iacurso*

a. *ATR metaphony*

[+high] and [+ATR] in the stressed nucleus license [+high, +ATR] in the following vowel.



Phonological information of the lexical level, namely [-high, -ATR], is preserved in the weak segment of the diphthong, in (11b), where the lexical base combines with the *-i* formative of m.pl.

2.2 Morphologized metaphonies

Let us now pass on to the relation between morphological properties and metaphony. In the South Sardinian variety, original mid vowels in post-tonic position neutralize in [i u]; the result is that, except [a], only [+high] post-tonic vowels occur, as in (12) for *Settimo S. Pietro*. So, metaphonic contexts are opaque given that only a sub-set of post-tonic [i u], in (12b), deriving from etymological [i u], trigger metaphony (Contini 1987; Frigeni 2003, 2004). (12a) exemplifies contexts in which high vowels deriving from original mid vowels are inactive.

(12) *Settimo S. Pietro*

- | | |
|---|--|
| a. [a'βɛrru] 'I open'

['ferruzu] 'irons'
['brɛmmi]/['brɛmmizi] 'worm/s'
['ɔʝuzu] 'eyes'
['drɔmmu] 'I sleep' | b. [a'βerrizi]/ [a'βerriði] 'you open/
(s)he opens'

[a'βerrinti] 'they open'
['ferru] 'iron'
['oʝu] 'eye'
['drommizi]/['drommiði] 'you sleep/
(s)he sleeps'

['dromminti] 'they sleep' |
|---|--|

The comparison between the data of *Paulilâtino* in (5) and those in (12) points out two different distributions in the post-tonic position. In Northern Sardinian varieties the post-tonic position admits low-mid [ɛ ɔ], high [i u] and low [a] vowels, as provided for by the constraint in (13a). In this position, *Settimo S. Pietro* variety licenses only [i a u]. The exclusion of mid vowels from the post-tonic position can be expressed by a constraint like (13b), which authorizes only [+high] or [+low].

(13) a. *Post-tonic vowels (Paulilâtino)*

Post-tonic position in the word domain licenses [+ATR] only if it combines with [+high].

b. *Post-tonic vowels (Settimo S. Pietro)*

Post-tonic position in the word domain licenses [+high] or [+low].

The distribution of metaphonic outcomes in (12) recalls the one expressed in (6b), with the complication that only a sub-set of [i u] is allowed for by the stressed nucleus, as in (12b). Other [i u], in (12a), do not trigger metaphony. We can single out the metaphonic sub-set of [i u] in terms of the morphological information (gender, number, person) they externalize. To be more precise, we must say that metaphony is selected by the masculine singular inflection and by the 2nd sg and 3rd person of the III verbal class present. We can discover no phonological property that separates metaphonizing [i u] from inert [i u], unless different abstract underlying qualities are involved. Morphologized metaphonies like that of *Settimo S. Pietro* in (12) demand a partial revision in formalizing metaphony. The non-arbitrary link between high-mid nuclei and spreading of [+ATR] is still valid; however we must be able to link metaphony to the morphological context.

We conclude that the phonological content of a sub-set of inflectional exponents *-u/ -i* is not working, although it is phonetically interpreted. If the phonological content of [i u] was involved, we would expect all [+high] vowels to trigger metaphony. In other words, in these varieties metaphony does not depend on phonetic properties of post-tonic vowels anymore; it is now a morphologized process triggered by morphological information (cf. Calabrese 1998).

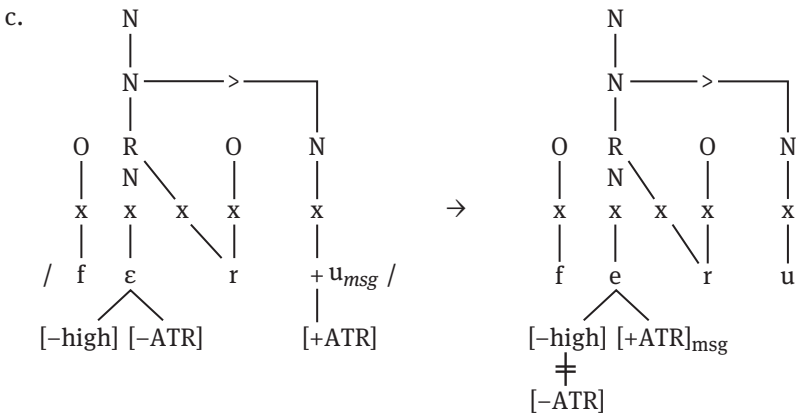
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In the case here examined, the nominal inflectional property of II class masculine (msg.) and verbal inflectional features of 2nd sg./ 3rd person of III class, are externalized by metaphonic properties realized on the stressed nucleus, as in (14b). In this sense, the metaphonic outcome of the stressed nucleus is the true exponent of these morpho-syntactic categories. On the other hand, contrastive values of [ATR] are licensed by the stressed nucleus, as in (14a). Finally, (14c) schematizes the process, where [+ATR] is introduced in correspondence to the specification msg as a floating property subsumed by the stressed head, that licenses it.

(14) a. *Morphologized [+ATR] metaphony (Settimo S. Pietro)*

[ATR] contrastive is authorized on the stressed nucleus.

- b. Inflections msg., 2nd sg./ 3rd person of III class verbs require [+ATR] in the stressed nucleus [-high, -low].



The classical type of morphologized metaphony in Southern Italian varieties is due to the neutralization to [ə] of post-tonic vowels, as in (15) for *Andria* (Apulia). Metaphony of low-mid vowels is illustrated in (15a) and that of high-mid vowels in (15b). The outcomes of metaphony of original high-mid vowels follows the phonological development of the original high vowels /i u/, which diphthongize in open syllables and centralize in closed syllables. Thus [oi eu] in open syllables and [ɪ ə] in closed ones correspond to the metaphonic outcomes. However, for the sake of simplicity, in the discussion we concentrate on low-mid metaphony in (15a).

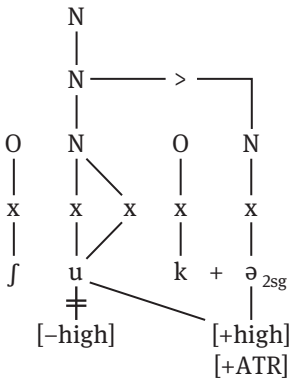
(15) *Andria*

- | | |
|--------------------------------|---------------------|
| a. ['dɛndə] ‘tooth’ | ['dɪndə] ‘teeth’ |
| ['pɛrdə]/ ['pɛrdə]/ ['pɛrdənə] | |
| ‘I lose/ he loses/ they lose’ | ['pɪrdə] ‘you lose’ |
| ['ɔccərə] ‘eyes’ | ['uccə] ‘eye’ |

[ˈʃukə]/ [ˈʃukə]/ [ˈʃukənə]	
‘I play/ he plays/ they play’	[ˈʃu:kə] ‘you play’
b. [ˈmaisə] ‘month’	[ˈmoisə] ‘months’
[ˈkrɛdənə] ‘they believe’	[ˈkrɪdə-mə] ‘believe me!’
[ˈnautʃə] ‘walnut’	[ˈneutʃə] ‘walnuts’
[ˈkɔrtə] ‘short.f’	[ˈkərtə] ‘short.m(pl)’

In (15) metaphonic contexts are opaque given that only a sub-set of post-tonic [ə], deriving from etymological [i u], trigger metaphony. Nevertheless, metaphony appears to be a regular phonological mechanism that realizes the specification [+high, +ATR] in alternation with low-mid vowels. According to the preceding discussion, we relate metaphony to inflectional categories, as in (16a, b).

- (16) a. [+high, +ATR] are licensed in the stressed nucleus.
 b. Inflectional categories msg., mpl., III noun class pl., 2nd sg./3rd pl. of the present associate [+high, +ATR] with the stressed nucleus.
 c. *Andria*



Interestingly, the result of metaphony of low-mid lexical nuclei in this variety is a [+high] outcome, i.e. [i u]. This implies that lexical low-mid content is replaced by the metaphonic specification that needs to be licensed by the stressed nucleus, as in (16c).

3 Harmony and metaphony in Central Sardinian varieties

Metaphony combines with restrictions on the distribution of unstressed vowels in Central Sardinian varieties. The domain of this arrangement is the same as for metaphony, i.e. the strong foot or the sequence including the stressed nucleus

and weak nuclei, both the following and preceding ones. A harmonic distribution of aperture properties in the stressed nucleus and the weak following nucleus characterizes some Central Sardinian varieties, like those of *Àllai*, *Làconi* (cf. Wagner 1941; Contini 1987; Loporcaro 2002, 2002–03, 2005³; Savoia 2005). In particular the constraints on the vocalic sequences include metaphony as well, that, as we saw in (6b), affects the [ATR] content of stressed mid vowels followed by post-tonic [i]/ [u]. (11a) is in turn operating in limiting the occurrence of [+ATR] in final position. Moreover, in the contexts including an intermediate onset, the occurrence of a low-mid vowel [ɛ]/ [ɔ] in post-tonic position implies a low-mid vowel in stressed position, as illustrated in (17), but the contrary is not true. Stressed [ɛ]/ [ɔ] can co-occur with [a] in post-tonic position, whereas post-tonic [ɛ]/ [ɔ] are excluded from the contexts in which the stressed vowel is [a], as in (18).

(17) *Àllai*

[ˈkɛrdzɔ]/[ˈkɛrɛzɛ] ‘I want/ you want’
 [ˈbɛttʃa]/ [ˈbɛttʃɔzɔ] ‘old.fsg/old.mpl’
 [ˈmɔvvɔ]/[ˈmɔvvɛzɛ] ‘I move/ you move’
 [nɛˈβɔðɛ]/[nɛˈβɔðɛzɛ] ‘nephew/ nephews’

Làconi

[ˈbɔʒɔ]/ [ˈbɔllɛzɛ] ‘I want/ you want’
 [ˈɔʒɔzɔ] ‘eyes’
 [ˈpɛrdɔ]/ [ˈpɛrdɛzɛ] ‘I lose/ you lose’
 [ˈbɛttʃa]/ [ˈbɛttʃɔzɔ] / [ˈbɛttʃaza] ‘old.fsg/ old.mpl/ old.fpl’

Vowels [i a u] freely co-occur in the positions here considered, as in (18). So, stressed [a] co-occurs with post-tonic [i a u], and correspondingly stressed [i]/ [u] co-occur with post-tonic [i a u].

(18) *Àllai*

[ˈsannu]/ [ˈsanna]/ [ˈsannuzu]/ [ˈsannaza] ‘healthy.m.sg/ fsg/ mpl/ fpl’
 [ˈpatti] ‘part, portion’

³ The correlation between final vowels and stressed vowels is noticed for the dialects of *Làconi* and *Baunei* in Wagner (1941: 39): “In *Làconi* hab ich beobachtet, dass –e in Ausgang nach vorhergehenden –e oder –o bevorzugt wird, sonst meistens –i; ebenso im Pl. –os mit Vorliebe nach e und o, sonst –us ...”. The harmony of *Àllai* and *Sènéghe* was first highlighted in Loporcaro (2002–03, 2003). In Contini (1987: 443–444) the presence of both mid and high final vowels in the dialects of Central Sardinia is observed; however, Contini does not consider the relation between the mid and high final vowels and the quality of stressed vowels. He notes that the infinitival inflection –re generally resists raising.

[ˈliddʒu]/ [ˈliddʒizi] ‘I read/ you read’
 [ˈkrikku]/ [ˈkrikkaza] ‘I look for/ you look for’
 [ˈsuðru]/ [ˈsuðra]/ [ˈsuðruzu]/ [ˈsuðraza] ‘deaf.msg/ fsg/ mpl/ fpl’
Làconi
 [ˈfraði] ‘brother’
 [ˈsannu]/ [ˈsanna]/ [ˈsannuzu] / [ˈsannaza] ‘healthy.msg/ fsg/ mpl/ fpl’
 [ˈliddʒu]/ [ˈliddʒizi] ‘I read/ you read’
 [ˈitta] ‘what’
 [ˈsurdu]/ [ˈsurda]/ [ˈsurduzu]/ [ˈsurdaza] ‘deaf.msg/ fsg/ mpl/ fpl’

High-mid vowels [e]/ [o] occur only **in+** stressed position when followed by post-tonic [i u], as in (19), agreeing with the requirements of metaphony analyzed in (6b).

- | | |
|-------------------------|-------------------------|
| (19) <i>Allai</i> | <i>Làconi</i> |
| [apˈperizi] ‘you open’, | [aˈberrizi] ‘you open’, |
| [ˈbettʃu] ‘old.msg’ | [ˈbettʃu] ‘old.msg’ |
| [ˈmorizi] ‘you die’ | [ˈdrommizi] ‘you sleep, |
| | [ˈoɣu] ‘eye’ |

A different distribution appears in the contexts in which the stressed nucleus and the following unstressed nucleus are adjacent, i.e. in strings where the intermediate onset is absent. In the dialect of *Allai*, in these contexts, exemplified in (20a)–(20b), stressed [e]/[ɔ] co-occur with post-tonic [ɔ]/[e] and post-tonic [i]/[u] trigger metaphony combining with stressed high-mid vowels, as in [ˈmeu] ‘my’. When the stressed nucleus is [+high], parametric variation shows up. In particular, high stressed nuclei can co-occur with low-mid vowels, in (20a), conflicting with (17).

- | | |
|------------------------------------|---------------------------------------|
| (20) <i>Allai</i> | |
| a. [ˈniɛ] ‘snow’ | [ˈtʰui] ‘thou’ |
| [ˈbiu]/ [ˈbiɛzɛ] ‘I see/ you see’ | [ˈtua]/ [ˈtuaza] ‘your.fsg/ your.fpl’ |
| [ˈmia]/ [ˈmiaza] ‘my.fsg/ my.f+pl’ | [ˈtuɔ]/ [ˈtuɔzɔ] ‘your.msg/ your.mpl’ |
| b. [ˈdʒɛɔ] ‘I’ | [ˈɔɛ]/ [ˈɔɛzɛ] ‘ox/ oxen’ |
| [ˈpɛi]/ [ˈpɛzi] ‘foot/ feet’ | |
| [ˈkrɛi] ‘to believe’ | |
| [ˈmeu]/ [ˈmɛɔzɔ] ‘my.msg/mpl’ | [ˈnou] ‘new.msg’ |

In the *Làconi* system the only low vowel that can follow a high stressed nucleus is [a], as in (21a); thus, a form like [ˈkrua] ‘raw’, encompasses both masculine and feminine reference. Data concerning mid stressed vowels are presented in (21b).

(21) *Làconi*

a. ['nia] 'snow'	['tua]/ ['tuaza] 'your.sg/ your.pl'
['mia]/ ['miaza] 'my.fs/ my.fp'	['krua]/ ['kruaza] 'raw.sg/ raw.pl'
['biu]/ ['biaza] 'I see/ you see+'	
b. ['meu]/ ['meɔzɔ] 'my.ms/ my.mp'	['nou]/ ['nɔa] 'new.ms/ new.fs'
	['nɔzɔ]/ ['nɔza] 'new.mp/ new.fp'
['peɪ]/ ['peizi] 'foot/ feet'	['prɔɛðɛ] 'it rains'
['ðɛɔ] 'I'	

As we saw in (3), in Sardinian varieties the distribution of mid stressed vowels takes into account the height of the post-tonic vowel. In the vocalic systems of *Àllai* and *Làconi* in (22) distributional constraints that relate the height degree of post-tonic vowels to the height degree of stressed ones let [-high, -ATR] combine both with final low-mid vowels and [a], preserving its contrastive status. In parallel, metaphonic outcome [-high, +ATR] is contrastive with respect to stressed [i u], since the latter require in turn final vowels [+high, +ATR]. As to mid vowels, [-low, -ATR] contrasts with [-low, +ATR].

(22) *Àllai, Làconi*

i	u	[+high, -low, +ATR]
ɛ	ɔ	[-high, -low, -ATR]
e	o	[-high, -low, +ATR]
a		[-high, +low, -ATR]

The distribution in (17)–(21) suggests that height properties of post-tonic vowels are licensed by stressed vowel, i.e. the head of the prosodic domain. In this perspective, metaphony represents only one among the different harmonic devices which govern the possible combinations of vowels in the domain of the stressed nucleus, i.e. the foot or the phonological word. A problem stands out for the classical generative framework, i.e. the fact that [a] and the high vowels [i u] form the class of the vowels that exclude post-tonic mid vowels. On the contrary, the traditional feature composition proposed in Chomsky & Halle (1968) gathers [a] together with low-mid by means of the specification [-high, +low], whereas it cannot capture a natural class including [a] and [+high] vowels, [i u]. This difficulty remains in a model **u**[ATR], as (22), where [a] [+low, -ATR] cannot be put together with [+high, +ATR] vowels [i u].

As noted by Loporcaro (2002–03, 2005) and Savoia (2005) the distribution in (17)–(18) recalls conditions discussed in the literature as regards height harmony in Chicheŵa (Harris 1990a, 1994b), and in other Bantu languages (Kula & Marten 2000), where the nucleus of the verbal stem fixes the height degree of the vowel in the suffix. In Chicheŵa, *a* on a par with *i u* selects [+high] vowels in suffixes; Archangeli & Pulleyblank (1989, 1994) and Scullen (1992) connect the harmonic

process with spreading of [-high] only from mid vowels. In these analyses [+high] outcomes are derived from the application of default rules which assign [+high] to the underspecified vowel in the suffix. In other words, the coincidence of the phonological outcomes in the context of [a]/ [i u] is nothing but the surface product of the non-application of harmony. Harris (1990a, 1994b) has recourse to an ‘element’ approach in which it is the element [A] which spreads, whereas the high outcomes [i u] simply realize the lexical content specified by the elements [I]/ [U].

We can suppose that also in the harmonies in Sardinian dialects the relation between [i u] and [a] is only a surface effect of different conspiring processes. Actually, according to Contini (1987), these harmonizing systems represent the passage between the dialects of Logudoro, preserving low-mid final vowels and Campidanian ones that neutralize final mid vowels in high vowels. Loporcaro (2002–03, 2003) provides an explanation involving mechanisms internal to the system. In particular, according to Loporcaro (2003: 41) the existence of Central Sardinia dialects with the harmonic distribution of mid and high final vowels would confirm that Campidanian raising of final mid vowels worked through intermediate stages partially reflected by areal distribution. The change of mid final vowels to high vowels would have been driven by lexical, morphological and phonological factors, in particular the quality of the stressed vowels. The insight is that harmony corresponds to an incomplete expansion of the neutralization in [+high] vowels expressed in (13b). In other words, the distribution attested by the dialects of *Àllai* and *Làconi* depends on a more limited application of neutralization. In particular neutralization in (13b) interacts with metaphony, since in harmonizing dialects metaphonic contexts with [+high] post-tonic vowels are kept separated from post-tonic mid vowels which are preserved in the context of mid stressed vowels. Neutralization applies to the contexts where stressed nuclei occur which are not involved in metaphony, i.e. [i a u].

We will assume that the distribution of unstressed vowels is governed by a constraint which connects the properties of the post-tonic mid vowel with the ones of the stressed vowel, while metaphony obeys the constraint proposed in (6b) for the variety of *Paulilätino*. The distribution of mid post-tonic vowels depends on a requirement that relates stressed low-mid vowels to post-tonic low-mid ones, as in (17), and stressed [i a u] to following [i a u], as in (18). Post-tonic [ɛ ɔ] are legitimated by the presence of the same specification [-low, -ATR] in the stressed vowel, as in (23). As matters stand, all other combinations include high vowels in post-tonic position, and in the case of a stressed mid vowel, the application of (6b) generates the metaphonic outcome [e o].

(23) *Harmony of low-mid vowels*

The contrastive specification [-low, -ATR] in the stressed nucleus licenses [-low, -ATR] in a following vowel.

Morpho-lexical contexts can influence the distribution of the process (Loporcaro 2005). Consider in this connection the data of the variety spoken in *Sèneghe* (also examined by Loporcaro 2005). In this system harmony applies to the same phonological contexts as in *Àllai* and *Làconi*, i.e. in the position following stressed [i a u]. (26a) exemplifies the co-occurrence of low-mid vowels $\varepsilon/\text{ɔ} - \varepsilon/\text{ɔ}$ and $\varepsilon/\text{ɔ}-a$. (26b) illustrates harmony in the sequences *verbal stem-inflection* combining *i/u-a*. (26c) illustrates metaphony, which provides for the distribution observed in Sardinian dialects like those of *Paulilâtino*, *Làconi* and *Àllai*.

(26) *Sèneghe*

- a. ['kerdzɔ]/['kɛrɛzɛ] 'I want/ you want'
 ['bɛttsa]/ ['bɛttsɔzɔ] / ['bɛttsaza] 'old.fsg/ mpl/fpl'
 ['mɔvvɔ]/['mɔvvezɛ] 'I move/ you move'
- a'. ['pɛa] ['pɛaza] 'foot/ feet'
 ['kɔa]/ ['kɔaza] 'tail/ tails'
- b. ['samunu]/ ['samunaza] 'I wash/ you wash'
 ['liu] / ['liaza] 'I take off/ you take off'
 ['buffu]/ ['buffaza] 'I blow/ you blow'
 ['tua]/ ['tui]/ ['tuaza] 'your.msg/fsg/ mpl/ fpl'
- c. [ap'pɛrdzɔ]/ [ap'pɛrizi] 'I open/ you open'
 ['lɛttu]/ ['lɛttɔzɔ] 'bed/ beds'
 ['oɣu] / ['ɔɣɔzɔ] 'eye/ eyes'
 ['drɔmmɔ]/ ['drɔmmizi] 'I sleep/ you sleep'

However, in *Sèneghe* some morphological limitations are in force. The harmony does not apply to the masculine plural inflection $-\text{ɔs}$, as in (27a); moreover, it excludes other lexical sub-sets, like the form ['battɔzɔ] 'four'. Furthermore, [ɛ] is allowed to follow stressed [a], as in (27b), while it is banned in the contexts following stressed [i u], where harmonic outcome [i] occurs, as in (27b'). In the contexts of hiatus in (27c), the sequences *a-ɛ* and *i-ɛ* are allowed.

(27) *Sèneghe*

- a. ['sãũ]/ ['sana]/ ['sãɔzɔ] / ['sanaza] 'healty.ms/fs/mp/ fp'
 ['fra'ittsu]/ ['fra'ittsɔzɔ] 'fox/ foxes'
 ['kru]/ ['krua]/ ['kruɔzɔ]/ ['kruaza] 'raw.ms/ fs/mp/fp'
- b. ['fardɛ] 'brother', ['faɛðɛ] 'to make'
- b'. ['nuɣi] 'walnut', ['piski] 'fish'
- c. ['nia] 'snow'
- c'. ['biu] / ['biɛzɛ] / ['biɛðɛ] 'I see/ you see/ he sees'

As we saw in the case of metaphony, we can expect that morpho-phonological procedures make syntactic information show up. In this case *Sèneghe*'s speakers

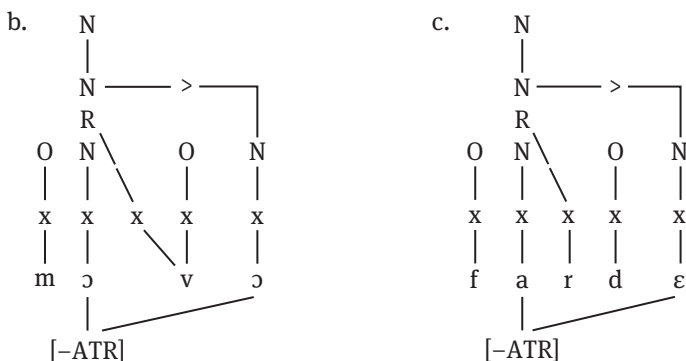
apply the constraint (23) only to the verbs, i.e. syntactic objects of the form [_v X], as in (28).

- (28) In a phonological string associated with a terminal node *v*, the contrastive specification [-low, -ATR] in the stressed nucleus licenses [-low, -ATR] in a following vowel.

Differently from the noun, in the variety of *Sènèghe* verb inflections *-a/-i/-u* are subject to harmonic distribution. As for other combinations, the only context which is left out by (23) is the sequence *a ... ε*. This suggests that (23) must be formulated in a more adequate way, as in (29a). In (29a) the relevant requirement is that [-ATR] in post-tonic position is authorized by [-ATR] in stressed position. The restriction on the contrastivity of [ATR] singling out only mid vowels is no longer working, as shown in (29b), where sharing of the feature [-ATR] is independent of [+/-low] nature of the stressed vowel. Naturally, (29a) operates over the vowel inventory of this variety.

- (29) a. *Harmony of low-mid vowels in Sènèghe*

[-ATR] in the stressed nucleus licenses [-ATR] in post-tonic position.



Loporcaro (2003) aims at explaining the current harmonic distribution of the vocalic properties in *Làconi*, *Àllai*, and *Sènèghe* varieties, connecting it with the generalized raising of Southern Sardinian (Campidanian) varieties, like that of *Settimo S. Pietro* in (12). His idea is that the harmonic constraints which govern the distribution of the height degree of final vowels in the dialects here examined preserve the original conditions which would have initially triggered the raising of final vowels in Campidanian varieties. More precisely, according to Loporcaro (2003), raising of final vowels in Campidanian dialects would derive from an initial mechanism of coarticulation whereby stressed vowels have influenced the raising of post-tonic final vowels. These conditions would be preserved just by the harmonic distribution in dialects like *Làconi* and *Àllai*. In other words, the intermediate area including these dialects would show that the original phonetic cause for raising of final vowels would be a

type of assimilation at a distance rather than a simple process of optimization of the vowel space. Thus, perceptive and articulatory mechanisms like maximization of the articulatory space, co-articulation, inertia, economy would be at work, possibly driven by morphological and lexical constraints.

In particular, we saw that in the variety of *Sèneghe* the plural inflection $-os$ escapes raising in harmonic contexts. In accordance with Loporcaro (2002–03, 2003) we can think that external functional factors are involved which prevent neutralization. A reasonable hypothesis is that the plural morpheme $-os$ has preserved its low-mid vowel in virtue of the fact that it contrasts with other $-us$ inflections occurring in nouns or verbs. Indeed, the inflection $-us$ characterizes the singular of nouns like [ˈtempuzu] ‘time’, [ˈkorpuzu] ‘body’, alternating with plural forms [ˈtempɔzɔ] ‘times’, [ˈkɔrpɔzɔ] ‘bodies’, and generally contrasting with the occurrence of plural $-os$. Moreover, $-us$ occurs as 1st plural inflection in verbs, cf. [buf ˈfauzu] ‘we.drink’. The need for preserving the morphological difference between $-os$ and $-us$ can explain why harmonic raising did not extend to $-os$ inflection. In the case of $-ɔɔ$ in [ˈbattɔɔ] ‘four’ of *Sèneghe*, Loporcaro (2002–03) assumes that it is preserved on the analogy of $-os$, given that in many Sardinian dialects in sandhi final $-r$ has the same phonetic outcomes as the final $-s$. This is possible; nevertheless I note that the phonetic identity in the realization of $-r$ and $-s$ is not systematically attested in the Sardinian varieties. In particular, speakers of *Sèneghe* realize the form [ˈbattɔɔ] with final vowel in sandhi too; moreover in this dialect pre-consonant $-r$ is maintained.

An evolutionary perspective adds interesting elements to the comprehension of this process, specifying the relation between external and internal factors. Indeed, we can think that the external factors that Loporcaro indicates were involved in causing and driving the harmonic distribution in the varieties here studied. More precisely, factors like coarticulation, maximization of phonetic space and generalization, etc. can be conceived as cognitive or perceptive mechanisms working along the boundary between sensory-motor and thinking systems. They would concur to fix the morpho-phonological units which externalize the computational system, in the sense discussed by Berwick & Chomsky (2011)⁴. When the phonetic processes

⁴ Berwick & Chomsky (2011: 37) note that “Externalization ... has to relate two quite distinct systems: one is a sensorimotor system that appears to have been basically intact for hundreds of thousands of years; the second is a newly emerged computational system for thought, which is perfect, insofar as the strong minimalist thesis is correct. We would expect, then, that morphology and phonology – the linguistic processes that convert internal syntactic objects to the entities accessible to the sensorimotor system – might turn out to be quite intricate, varied, and subject to accidental historical events. Parameterization and diversity, then, would be mostly – possibly entirely – restricted to externalization”

or morphological/ lexical constraints driving harmony have been acquired by children, they become a part of their internal language system.

4 Harmony in Sicilian varieties

Some varieties of Central Southern Sicily are characterized by a harmony process involving the distribution of [+ATR]/ [-ATR] in the vowels inside the domain of word⁵. This phenomenon has been described in Rohlfs (1966 [1949]) and Piccitto (1959) and analyzed in detail in Mocciaro (1980) and Cruschina (2007). By virtue of this process [(+high), -low] vowels in the word domain assimilate on the value [-ATR] except in metaphonic outcomes [iə uə]/ [i u] of mid vowels; crucially, the post-tonic/ final vowel [+low] blocks the assimilation. Consider the data of varieties spoken in some villages in the province of Caltanissetta, precisely *Milena*, *Sutera*, *Villapriolo*. Given that the data are very similar in all the varieties, we will use in particular the data of *Milena* for simplicity's sake (a complete presentation is in Savoia 2015). Realizations [+high, +ATR] occur in stressed position in contexts where the following vowel is [a], as in (30a) (30'a, b), in the post-tonic span of a stressed head [+ATR], as in (30'c), and, possibly in the pretonic domain of stressed [a], as in (30'b). Non-final post-tonic [a] is able to select [+ATR] in the stressed [+high], as in [pɪr'divatʊ] 'you lost' in (30'c). In oxytones in (30'd) the stressed nucleus is [-ATR] exactly as in the strings with post-tonic [+high] vowels in (30b) and with post-tonic [+high] vowels in (30'a, b, c). Stressed [a] in (30b) and metaphonic diphthongs [iə uə] in (30d) combine with final [ɪ ʊ], [-ATR].

(30) *Milena*

Paroxytone strings V-v

a. i-a	u-a	e-a	o-a
'fiʌʌa <i>daughter</i>	'kruda <i>raw.fs</i>	'bedɖa <i>nice.fs</i>	'rota <i>wheel</i>
'tira <i>pull.3ps</i>	'fuma <i>smoke.3ps</i>	'leva <i>take off.3ps</i>	'koffja <i>thigh</i>
			'grossa <i>big.fs</i>
a-a			
'amma <i>leg</i>			

⁵ Really, the pronunciation of high vowels of the type we characterize as [-ATR] is attested in many Sicilian varieties, as in (i) for *S. Marco d'Alunzio*, though it is variable and it does not show clear distributional constraints (cf. the discussion in Cruschina 2006).

(i) ['pjɛrɪ] 'foot/feet', ['kwɔrɪ] 'heart/ hearts', ['jɪrɪtʊ] 'finger', [ka'nʊʃʃʊ] 'I know', ['frɪʃʊ] 'I fry'

b. I-I	I-U	U-I	U-U
'fɪλλɪ <i>sons</i>	'fɪλλʊ <i>son</i>	'krʊdɪ <i>raw.p</i>	'krʊdʊ <i>raw.ms</i>
'tɪrɪ <i>pull.2ps</i>	'tɪrʊ <i>pull.1ps</i>	'fʊmɪ <i>smoke.2ps</i>	'fʊmʊ <i>smoke.1ps</i>
a-I	a-U		
'ammɪ <i>legs</i>	'vrattʂʊ <i>arm</i>		
c. E-I	ɔ-I	ɔ-U	
'pɛðɪ <i>foot</i>	'rɔtɪ <i>wheels</i>	'ɔttʊ <i>eight</i>	
'nɛʃʃɪ <i>go out.3ps</i>	'kɔʃʃɪ <i>thighs</i>	'ɔmʊ <i>man</i>	
	'dɔrmɪ <i>sleep.3ps</i>		
d. iə-I	iə-U	uə-I	uə-U
'piəðɪ <i>feet</i>	'viəccʊ <i>old.ms</i>	'uəccɪ <i>eyes</i>	'uəccʊ <i>eye</i>
'biəddɪ <i>nice.p</i>	'niəʃʃʊ <i>go out.1ps</i>	'gruəssɪ <i>big.p</i>	'gruəssʊ <i>big.ms</i>
'niəʃʃɪ <i>go out.2ps</i>		'duərmɪ <i>sleep.2ps</i>	'duərmʊ <i>sleep.1ps</i>

(30') *Milena**Paroxytone strings v-V-v*

a. a-i/u-a	a-e/o-a	a-a-I/U	a-V-I/U
kat'tiva <i>widow</i>	as'petta <i>wait.3ps</i>	ca'marɪ <i>to call</i>	kat'tivɪ <i>widows</i>
ka'rusa <i>girl</i>			af'tʊtʊ <i>put out.1ps</i>
			as'piəttʊ <i>wait.1ps</i>
b. [+high]-[+ATR]	[+high]-[-high]	[+high]-a	
mɪ/i'luna <i>melons</i>	kʊ/u'tedɖa <i>knives</i>	li/i'vatɪ <i>take off.2pp</i>	
krɪ/i'ðiva <i>believe.3ps</i>		pu/ʊr'tammʊ <i>bring.1pp</i>	
[+high]-[-ATR]	[+high]-iə-/uə-		
nɪʃ'ʃɪvʊ <i>went out.1ps</i>	kʊ'tiəddʊ <i>knife</i>		
vɪ'vitɪ <i>drink.2pp</i>	nɪ'ʃiəmmʊ <i>go out.1pp</i>		
mɪ'lʊnɪ <i>melon</i>	dʊr'miəmmʊ <i>sleep.1pp</i>		
c. Proparoxytones			
V-[+high]-a	V-[+high]-[-ATR]	V-a-[+high]	
fʊr'mikula <i>ant</i>	fʊr'mikulɪ <i>ants</i>	'jennarʊ <i>son-in-low</i>	
'nivika <i>snow.3ps</i>	'fimmɪnɪ <i>women</i>	fʊ'mavamʊ <i>smoked.1pp</i>	
'fimmɪna <i>woman</i>	'ruppɪrʊ <i>broke.3pp</i>	'lɔmmarʊ <i>ball</i>	
'niura <i>black.fs</i>	'nɪʊrʊ <i>black.ms</i>	pɪr'divatʊ <i>lost.2ps</i>	
ɛ/ɔ-v-v			
'krɛðʊvʊ <i>believe.3pp</i>			
iə-/uə-V-V			
'piəkura <i>sheep</i>			
'piərdɪvʊ <i>lose.3pp</i>			
'duərmɪvʊ <i>sleep.3pp</i>			
'uəmmɪ <i>men</i>			

d. *Oxytones*

[−ATR]	[−high]	a
nɪf'ɪ <i>went out.3ps</i>	je <i>be.3ps</i>	kka <i>here</i>
fɪ'nɪ <i>finished.3ps</i>	sɛ <i>be.2ps</i>	sa <i>know.2ps</i>
tʊ <i>thou</i>	pɔ <i>can.3ps</i>	

Mid vowels do not occur in unstressed positions; in these contexts [a] and [+high] vowels are admitted in correspondence to [−low] underlying vowels, as illustrated in (31).

(31) *Milena*

[ˈlava]/ [laˈvamʊ] ‘he washes/ we wash’
[arˈrɪdʊ]/ [arrɪˈdiəmmʊ] ‘I laugh/ we laugh’
[ˈpɛrdɪ]/ [pɪrˈdiəmmʊ] ‘he loses/ we lose’
[ˈportɑ]/ [pʊrˈtammʊ] ‘he bring / we bring’
<i>Villapriolo</i>
[ˈvɛnɪ]/ [vɪˈnɪmʊ] ‘he comes/ we come’
[ˈjɔka]/ [jʊˈkamʊ] ‘he pays/ we play’

The vocalic system of these varieties can be characterized as in (32).

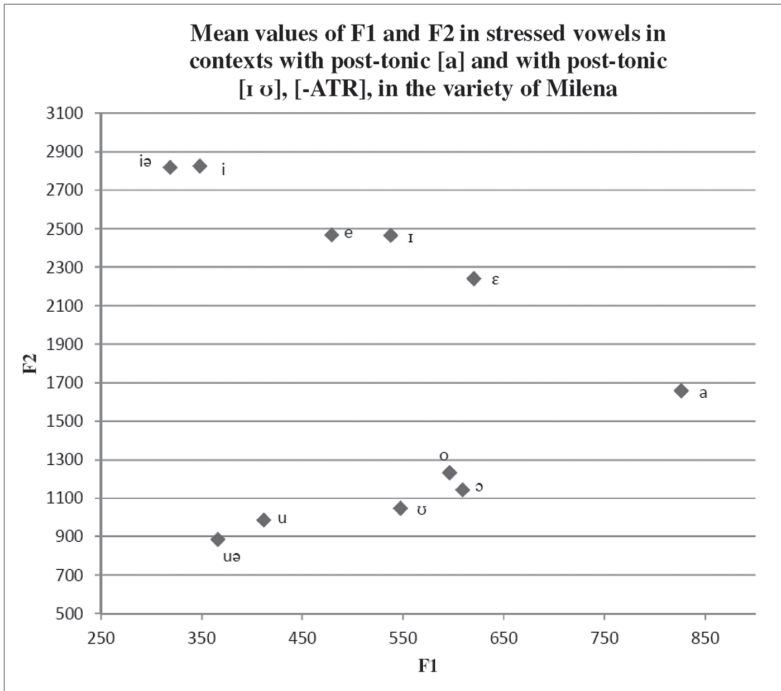
(32) *Milena*

i	u	[+high, −low, +ATR]
ɪ	ʊ	[+high, −low, −ATR]
ɛ	ɔ	[−high, −low, −ATR]
e	o	[−high, −low, +ATR]
a		[−high, +low, −ATR]

The scatterplots in (33)–(34) show the distribution of the vocalic types [+high], i.e. [i u] [+ATR] and [ɪ ʊ] [−ATR], [−high], i.e. [e o] vs. [ɛ ɔ], and of [a] in the acoustic space. Average values are calculated on the basis of a corpus including 250 realizations obtained by means of field research with native informants. In particular, the values represented in graphs in (33)–(34) concern productions of a female native speaker of the dialect. The realizations recorded have been subjected to a spectrographic analysis using the current software Praat. As we can see, average differences in frequency between F1 and F2 in particular in [+high] vowels, distinguish two different vocalic types, sensitive to the context. The F1/ F2 values can be related respectively to [i u] and to lax [ɪ ʊ] on the basis of the vowel prototypes of the corpus *UPSID* (*UCLA Phonological Segment Inventory Database*). In the context ___ *Xa*, we find average frequencies of 348 Hz and 2818 Hz for F1 and F2 respectively in [i], and average F1 of 366 Hz and F2 of 885 Hz for [u]; in the harmonizing context, we find [ɪ] with an average F1 of 537 Hz

and an average F2 of 2464 Hz, [ʊ] with average values of 547 Hz for F1 and of 1046 Hz for F2⁶.

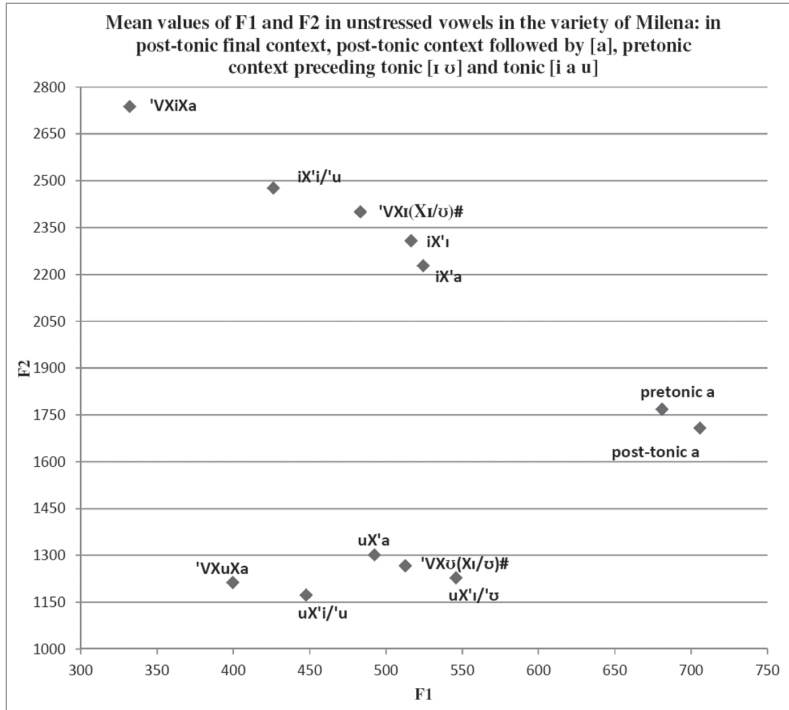
(33)⁷



6 A complete statistical analysis of the data is presented in Savoia (2015).

7 The means for *Milena* in the scatterplot in (33) are detailed in (a) and (b)

- | | | | | |
|----|-------|-----------------------------|-----------------------|----------------------------|
| a. | i(ə) | F1 318,62 Hz, F2 2818,18 Hz | u(ə) | F1 366,28 Hz, F2 885 Hz |
| | iXa | F1 348,21 Hz, F2 2826,28 Hz | uXa | F1 366,28 Hz, F2 1046,7 Hz |
| | ɪXɪ/ʊ | F1 537,52 Hz, F2 2464,56 Hz | ʊXɪ/ʊ | F1 547,6 Hz, F2 1046,7 Hz |
| | eXa | F1 479,16 Hz, F2 2469 Hz | oXa | F1 596,25 Hz, F2 1232,5 Hz |
| | εXɪ/ʊ | F1 620,44, F2 2241,88 | ɔXɪ/ʊ | F1 609,25 Hz, F2 1143 Hz |
| | | a | F1 826,17, F2 1658,35 | |
| b. | ɪ# | F1 533,3 Hz, F2 2462,3 Hz | ʊ# | F1 565,8 Hz, F2 1047,12 Hz |

(34)⁸

As regards the significance level of differences between the means carried in the graphs, we note that critical values of the Student's *t* distribution are satisfied for $P < 0,01$ in the case of the most important contrasts. Thus, the contrast between vowels [+ATR], with higher mean values for F1 and lower mean values for F2, corresponds to significant differences. The difference is stronger in the [–back] series, which therefore realizes in a more recognizable and perceptible way the contrast between [+ATR] and [–ATR]. In the case of unstressed realizations, we

8 The values of F1 and F2 for *Milena* in (34) are reported in a–b.

a. **post-tonic context**

'VXiXa	F1 332 Hz, F2 2738,5 Hz	'VXuXa	F1 399,5 Hz, F2 1213 Hz
'VXi(Xi/ʊ)	F1 483,31 Hz, F2 2400,29 Hz	'VXu(Xi/ʊ)#	F1 512,61 Hz, F2 1266,31 Hz
	a		F1 705,68 Hz, F2 1708 Hz

b. **pretonic context**

iX'i/u	F1 426,18 Hz, F2 2476,09 Hz	uX'i/u	F1 447,6 Hz, F2 1173,4 Hz
iX'i	F1 516,5 Hz, F2 2307,62 Hz	uX'i/ʊ	F1 546 Hz, F2 1227,33 Hz
iX'a	F1 524,5 Hz, F2 2228 Hz	uX'a	F1 492,4 Hz, F2 1302,2 Hz
	a		F1 680,93 Hz, F2 1767,81 Hz

note that they are generally less clearly differentiated in the different contexts and that they tend to more centralized and laxer realizations (Cruschina 2007). In particular in the pretonic context $__ X'a$ a realization occurs which is more centralized than stressed alternants before post-tonic [a]. This is the general case for the [+ATR] realizations. The mean values of F1 and F2 in pretonic [i] and stressed [i] are significantly different for $P < 0,01$; in fact, pretonic [i] is on average more centralized than stressed [i]. Again, the differences for [u] do not gain the significance level for Student's *t*.

The table in (35) schematizes this distribution, where [+high, +ATR] realizations occur only in stressed position, in the context of final [a], as in [ˈfiʎʎa] ‘daughter’ and in the domain of a [+ATR] stressed vowel, in (30’c), as [ˈfimmina] ‘woman’, i.e. when they are followed by [a]. In the pretonic domain [+high] vowels are normally more centralized; [+ATR] realizations are preferred before a [+ATR] stressed vowel, as in [miˈluna] in (30’b). In other stressed contexts, including stressed [a], outcomes are basically [-ATR], as in [liˈvati] ‘you.pl take off’.

(35) [+high] stressed vowels	[+high] post-tonic vowels	[+high] pretonic vowels
[+ATR]/ $__ Xa$	[+/-ATR]/ $__ Xa$	[+/-ATR]/ $__ X'i/u/'a$
[-ATR]/ $__ [-ATR]$	[-ATR]	[-ATR]
[-ATR]#		

My informants of *Milena* favour [i ʊ] in pretonic contexts independently of the aperture degree of the stressed vowel. Data from *Sutera*, although generally analogous to those of *Milena*, show a stronger variation. We can think that acoustic properties of unstressed realizations are at least partially governed by prosodic devices, whereby the vowels in weak position tend to neutralize. The clearest generalization is that [+ATR] stressed nuclei are able to control the realization [+ATR] in pretonic contexts, whereas stressed [a] seems to lack or limit this ability. In other words, the fact that tonic [a] and tonic [+ATR] nuclei lack the capability of licensing [+ATR] suggests that the harmonic domain includes the stressed nucleus and the weak vowels on its right. The occurrence of [+ATR]/ [-ATR] is licensed in the immediate domain of the stressed nucleus, i.e. its foot (paroxytones/oxytones) or an enlarged span including its foot (proparoxytones).

Let us now consider the phonological mechanism which governs harmony in these dialects. Evidence in favour of the hypothesis that the [-ATR] pronunciation of [+high] vowels is basic, is provided by oxytone contexts in (30’d) where the final [+high] stressed vowel is realized as [-ATR]. In this context there is no following vowel which could spread the [-ATR] property to the stressed nucleus. Moreover this suggests that harmony is not a spreading

process right-to-left and that stressed nuclei introduce autonomous aperture specifications.

As a first step, the restriction in (36) accounts for the fact that these systems authorize only a sub-set of vowels in unstressed positions, excluding mid vowels, as pointed out in (31).

(36) *Vowels in unstressed position*

A weak (unstressed) vowel in the word domain licenses [-low] if it is [+high]

As we saw in (30)–(30') in final position vowels [-ATR], [ɪ a ʊ], occur. This would seem to suggest that a process of [-ATR] spreading is at work. In the literature, spreading of [-ATR] in centralization/ laxing processes is a traditional solution, applied, for example, in Hualde (1989) in the case of harmony with centralization of all vowels in word domain in the Montañas of Tudanca (Cantabria). A similar solution is adopted by Cruschina (2007), which assumes that [+high] final vowels become [-ATR] in word final position and [-ATR] spreads on all [+high] vowels in the domain with the exception of [a]. The data in (30)–(30') show that occurrence of [-ATR] is authorized in the domain including the stressed nucleus and the following vowels, while pretonic nuclei have variable behaviour. In contexts in (30'b) where the stressed nucleus is [-ATR], as in [niɫ'ʃivʊ] *went out.1ps*, a [+high] pretonic vowel is generally [-ATR]. In contexts where a [+ATR] tonic nucleus is realized, as in [fʊr'mikula] *ant*, a [-ATR] pretonic vowel is favoured. If [-ATR] was spread from right to left we would not expect [-ATR] in pretonic vowel preceding a [+ATR] stressed vowel.

Summing up, the behaviour of pretonic nuclei and that of stressed [-low] vowels in oxytones suggest that the realization of [-ATR] is fixed not by spreading but in virtue of a different mechanism. The different explanation that we propose is that the value of [ATR] is determined by the stressed nucleus, as in the constraint in (37a). The comparison between (33) and (34) points out that in weak positions a general reduction of contrasts shows up; on the contrary in stressed nuclei the difference between [+ATR] and [-ATR] is fully recognizable. This suggests that harmony takes into account the contrastive nature of [ATR] specifications in [-low] vowels, in particular opposing [i]/ [u] to [ɪ]/ [ʊ]. In conclusion, [-ATR] is selected only in vowels in which it is contrastive, i.e. high and possibly (for some speakers) mid vowels, as in (37a). [-ATR] stressed nuclei precede post-tonic [-ATR] nuclei, as in (37b), while [+ATR] stressed nuclei precede final [a], as in (37c).

(37) a. [-ATR] contrastive in the stressed nucleus licenses [-ATR] in the following vowel.

to be distinguishable from the outcomes [i u] introduced by metaphony. As a consequence, the original contrasts of the type **muəru* ‘I die’ vs. **muru* ‘wall’ are re-created like /*muru*/ ‘I die’ vs. /*muru*/ ‘wall’. Indeed this link does not seem to be so crucial, in that in many varieties, including that of *Milena*, metaphony triggers a diphthongized outcome (Ruffino 1984), as in (30d). However, Mocchiari (1980) captures at least the other face of metaphonic distribution, i.e. the fact that in the context __a, where metaphony does not apply, [+ATR] vowels can freely occur, merging with the monophthongized outcomes of metaphony.

In Sicilian varieties metaphony affects only stressed low-mid vowels [ɛ ɔ], since high-mid vowels are absent in these systems. The possible phonetic outcomes alternate between a diphthong [iə uə], as in *Milena* in (30d), (38), and a simple nucleus [i u], as in *Villapriolo* in (39). Both these outcomes escape harmony, occurring before following post-tonic [ɪ ʊ]. As for unstressed vowels, original mid vowels changed to [+high]; so, in post-tonic position we find only [+high] vowels. This has obscured the original distribution of metaphony, deleting the difference between original post-tonic mid vowels and high ones. As a consequence, in Sicilian systems metaphony is totally or partially morphologized, as shown by the data in (38)–(39). What we see is that the alternation between low-mid and diphthongized outcomes is not due to phonetically distinct properties, given that, except for [a], in post-tonic position only [+high] vowels occur and both metaphonic outcomes and low-mid stressed nuclei alternate in the same contexts with post-tonic [ɪ ʊ]. In varieties like that of *Villapriolo* both metaphonic outcomes [i u], in (39b), and stressed harmonized nuclei, [ɪ ʊ], in (39a), can occur before post-tonic [ɪ ʊ].

(38) *Milena*

[ˈpiəðɪ] ‘feet’	[ˈpɛðɪ] ‘foot’
[kʊˈtiədqʊ] ‘knife’	[kʊˈtɛdqɑ] ‘knives’
[ˈniəʃʊ] ‘I go out’ / [ˈniəʃɪ] ‘you go out’	[ˈnɛʃʃi] ‘s/he goes out’
[ˈpiəkura] / [ˈpiəkʊɪ] ‘ewe/ ewes’	
[ˈduərmʊ] ‘I sleep’ / [ˈduərmɪ] ‘you sleep’	[ˈdɔrmɪ] ‘s/he sleeps’
[ˈduərmɪnʊ] ‘they sleep’	
[ˈtuəkkʊ] ‘I touch’ / [ˈtuəkkɪ] ‘you touch’	[ˈtokkʷa] ‘s/he touches’

(39) *Villapriolo***a. harmonized outcomes**

[ˈjɪtʊ] / [ˈjɪta] ‘finger/ fingers’
[ˈfiɫɫʊ] / [ˈfiɫɫa] ‘son/ daughter’
[fʊrˈmɪkʊɪ] / [fʊrˈmɪkula] ‘ants/ ant’
[ˈpɪɫɫʊ] / [ˈpɪɫɫa] ‘I take/ s/he takes’

b. metaphonic outcomes

[ˈpɛðɪ] / [ˈpiðɪ] ‘foot/ feet’
[ˈdɛndɪ] / [ˈdɪndɪ] ‘tooth/ teeth’
[kuˈtiqʊ] / [kuˈtɛdqɑ]
‘knife/ knives’
[ˈpɪrdʊ] / [ˈpɪrdɪ] / [ˈpɛrdɪ]
‘I/ you lose/ s/he loses’
[ˈpɪrdɪnʊ] ‘they lose’

[af'tutʊ] / [af'tuta] 'I put out/ s/e put out'	[durmʊ] / [durmɪ] / [dɔrmɪ]
	'I/you sleep/ s/he sleeps'
[mʊrʊ] 'wall'	[murʊ] / [muri] / [mɔri]
	'I die/ you die/ s/he dies'
[furnʊ] / [furnara] 'oven/ ovens'	[nuvʊ] / [nɔva] 'new.m.sg./ f.sg.'
[mʊ'lʊni] / [mu'luna] 'melon/ melons'	[ɔmʊ] / [ummɔni] 'man/ men'
	b' . [pikura] / [pikuri] 'sheep.sg./pl.'

Hence, metaphony is no longer connected with the phonetic content [+high] in the post-tonic vowel, but is governed by morphological information, as suggested in (40a) where metaphonizing properties are associated with the morphological content. As in the case of *Settimo S. Pietro* in (12)–(14), inflectional categories, specifically II class masculine (msg), 1st sg., 2nd sg. and III class 3rd pl., assign metaphonizing properties to the stressed nucleus, which externalizes them.

Let us consider the different outcomes of metaphony, i.e. [iə uə] in (38) and [i u] in (39). As in the other types of metaphony we have investigated, the stressed nucleus subsumes and licenses [+high, +ATR]. The specification [+high, +ATR] is realized as the first part of the diphthong, in (38) for *Milena*; in the recessive second-position a low-mid element [–high, –ATR] is realized. Otherwise the simple vowel [i u] is realized, independently of the [–ATR] nature of post-tonic vowels, as in (39) for *Villapriolo*⁹. This metaphonic outcome implements a complete reversal from [–high, –ATR] to [+high, +ATR], which cannot be obtained through the simple propagation of [+ATR] or [+high]. We assume that metaphony in these varieties requires licensing of [+high] and [+ATR] by the stressed nucleus in morphologically fixed contexts, as in (40). By virtue of (40) relevant inflectional categories introduce [+high, +ATR] as a floating phonological specification of the inflectional morpheme. The prominent nucleus in the string licenses it by subsuming. In the case of the diphthong, we can expect that it is its head position which realizes the phonological content [+high, +ATR] to be licensed. Metaphonic outcomes in proparoxytones, like (39b'), can be dealt with as lexicalized forms. Differently, 3rd pl. proparoxytones in the 2nd and 3rd verbal class trigger morphologized metaphony

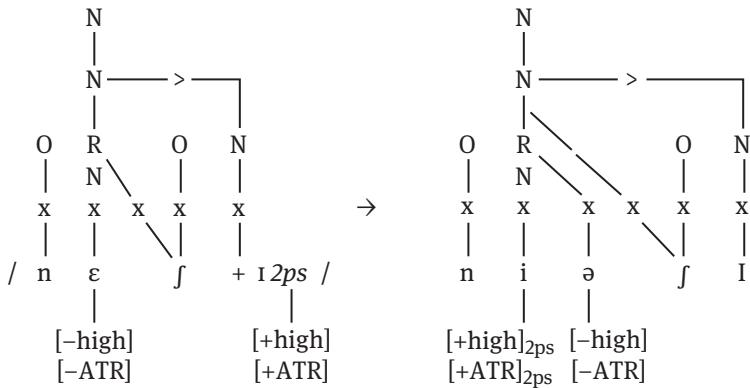
(40) *Metaphony*

Contrastive [+high] and [+ATR] are licensed in the stressed nucleus associated with II class masculine (msg/ mpl), 1st sg, 2nd sg and III verbal class 3rd pl of the present.

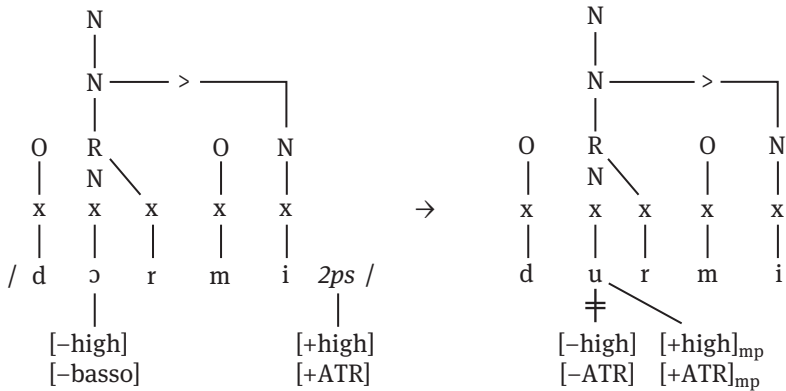
⁹ Metaphonic [i u] deriving from original low-mid vowels ε, ɔ, characterize many Southern Italian varieties.

Unlike the diphthong in (41a), the outcome [i u] in correspondence to underlying low-mid vowels is derived through delinking of the lexical content of the stressed nucleus. More precisely, the stressed nucleus is required to realize the specification introduced by the metaphony, which replaces its incompatible lexical content, as in (41b).

(41) a. *Milena*



b. *Villapriolo*



Metaphony interacts with harmony introducing outcomes which cannot be interpreted by the harmonizing process. The fact that metaphonic [i u] do not undergo harmony confirms the fact that the stressed nucleus is involved in both harmony and metaphony. As we saw, in the discussion in pf. 2, these processes improve and increase the perceptibility of particular properties within a phonological domain. In the case of harmony [-ATR] is extended along the entire span governed by the stressed nucleus, which licenses it. Metaphony associates the

contrastive [+high, +ATR] specification with the strong nucleus in the domain. We note that metaphony does not work in the contexts where the underlying stressed vowel is [+high], like in (42) for *Villapriolo*.

(42) *Villapriolo*

[ˈpɪλλʊ] ‘I take’, cf. *[ˈpɪλλʊ]	vs.	[ˈpɪrdʊ] ‘I lose’	<i>metaphony</i>
[aʃˈtʊtʊ] ‘I put out’, cf. *[aʃˈtʊtʊ]		[ˈdʊrmʊ] ‘I sleep’	<i>metaphony</i>

We must conclude that in these varieties metaphony is selected by a sub-set of lexical entries which can be characterized in phonological terms, i.e. as [–high, –low] stressed nuclei. More precisely, metaphony takes into account the phonological content of the stressed nucleus in the lexical representation. This prevents metaphony from affecting underlying nuclei [+high], excluding them as potential inputs. Underlying contexts [+high] license [–ATR] independently of metaphony.

The fact that the stressed nucleus can license only once in its domain seems to be parametrical, in the sense that we could expect grammars where this is not true. Nevertheless, generally, metaphony overcomes other possibly competing processes blocking them, as in some one among the propagations examined by Manzini and Savoia in this volume. Similarly, in many Southern Italian varieties laxing of the [+high] stressed nuclei is prevented when [+high] realizes metaphony (Savoia 2015). We can think that the relation between metaphony and inflectional categories it externalizes overcomes phonetic requirements, like harmony in Sicilian varieties. So, the externalizing procedure could represent the more specific process that precedes the application of the harmonic rule. More precisely, the strings that undergo metaphony are a specialized sub-set of those that undergo the harmonic rule in the terms of the ‘elsewhere’ condition proposed in Kiparsky (1973) (see also Harris 1974 for an application). Nevertheless, the child has to learn that metaphony excludes other processes.

5 Metaphony and harmonic processes in the element framework

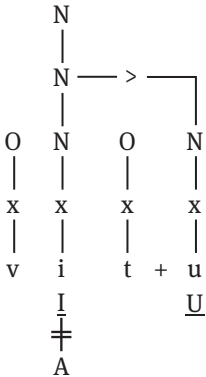
A model based on elements (Kaye, Lowenstamm & Vergnaud 1985; Harris 1994b; Harris & Lindsey 1990, 1995, 2000; Backley 2011) involves a different formalization of processes. In particular, the notion of contrastivity is subsumed by the very nature of the elements as monovalent privative properties. Thus, coming to metaphonic processes examined in section 2, they can be interpreted in terms of alignment inducing [ɪ]/[ʊ] heads in the post-tonic nucleus to co-occur with [ɪ]/[ʊ] in

the tonic nucleus. The tonic nucleus licenses the whole autosegmental content of the vowel position in its foot, as in the constraint in (43a). More precisely, (43a) assumes a complete alignment whereby only [I]/[U] are admitted in the stressed position and in unstressed ones. This analysis is available for all metaphonies introducing the outcomes [i u], independently from the aperture degree of the lexical mid vowel. Thus, the constraint in (43a) is operating not only in varieties like that of *Mascioni* in (43b) where /e o/ alternate with [i u], but also in metaphonies which raise /ε ɔ/, [I/U, A], to [i u], like in many Southern Italian varieties, as *Villapriolo* in (43d), or introduce a diphthong [ie/ə ue/ə], as in *Iacurso*, (43c), and *Milena*, (43e). The aperture element [A] is delinked, as in (43b, d) or preserved and interpreted as the governed part that diphthongs realize in the strong nucleus, as in (43d).

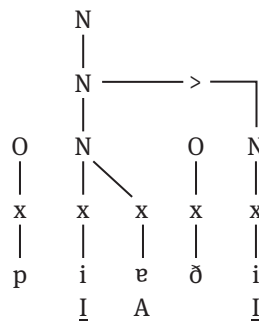
(43) a. *Metaphony*

The head position licenses [I/U] in the prosodic (foot) domain.

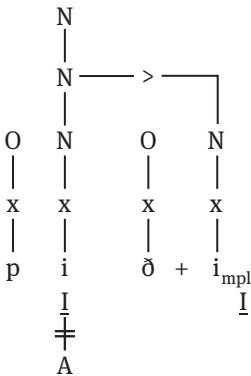
b. *Mascioni*



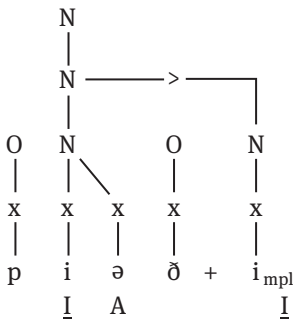
c. *Iacurso*



d. *Villapriolo*



e. *Milena*



traditional approaches there is neither feature-changing nor spreading of phonological material.

5.1 Harmonies

Sicilian harmony examined in section 4 involves the distribution of [–ATR]/[+ATR] specifications in the domain of the stressed nucleus. In the element framework [ATR] can be interpreted in terms of headedness (Bacley 2011). The expressions including a head element correspond to [+ATR] vowels, like [I], [U] for [i], [u], and [I, A], [U, A] for high-mid [e] and [o]. [–ATR] vowels lack the head, like [I], [U] for [ɪ] and [ʊ], [I, A], [U, A] for [ɛ ɔ]. [a] is in turn characterized by a headed expression [A], whereas the non-headed [A] corresponds to a centralized lax vowel, like [ɐ ə].

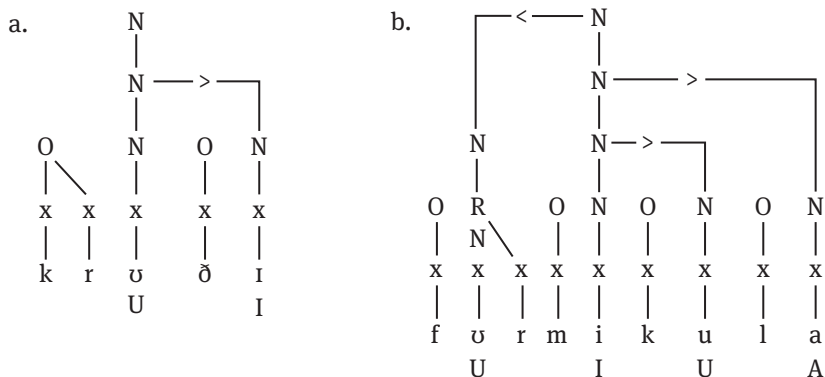
We can analyze the harmonic process of Sicilian varieties as a constraint on the occurrence of the headedness in vowels, both in the stressed nucleus and in intermediate vowels in proparoxytones, as in ['nivika] in (30c). As seen in section 4, in these varieties in unstressed position, including the post-tonic position, high vowels or [a] occur; this constraint is interpreted by (45a). Nevertheless, while [i u], i.e. [I]/ [U], alternate with [ɪ ʊ], i.e. [I]/ [U], [a] has no non-headed alternate like [A]. In other words the only low vowel in the vocalic system is the headed [A] expression, as in (45b).

- (45) a. Unstressed positions authorize vocalic expressions including only one element.
 b. [a] is headed, [A].

In harmonizing varieties of *Milena* and *Sutera* the behaviour of [a] directly follows if we assume that the headed/ or non-headed nature of the unstressed (post-tonic) vowels must align to headedness of the stressed nucleus, as in (46). Thus, a post-tonic [a] can be licensed only by a headed stressed vowel, namely [I]/ [U], [A], or the metaphonic diphthong [iə uə], where the prominent vowel of the diphthong is a headed expression. This imposes alignment on the head role of cavity elements. For some informants, mid vowels are realized as high-mid in the context of a following [a] (in (30a)) as well, as we saw. In the other contexts only non-headed vowels [I]/ [U] occur, as suggested in the representations in (47a, b).

(46) *Alignment in the internal structure of vowels (harmony)*

An unstressed headed vowel, [I]/ [U], [A], is licensed by a stressed headed vowel; an unstressed non-headed vowel, [I]/ [U], is licensed by a stressed non-headed vowel.

(47) *Milena*

The gist of this analysis is that alignment of [a] with [I/U] headed nuclei realizes the fundamental vocalic cavity properties, [i a u], namely the segments endowed with the unmarked intrinsic content in Chomsky & Halle 1968; Kaye, Lowenstamm & Vergnaud 1985, 1990. In particular, [a] is able to subsume the resonance properties within the domain of the stressed nucleus, including the foot and first metrical projection on its right. In other words, [a] can control the harmonizing effect in the domain of the stressed nucleus. The positions preceding the stressed nucleus are basically insensitive to harmony, and, as *Milena's* data show, we normally find [I θ], even if it is not excluded that [ATR] harmony can extend to the string preceding a harmonizing the stressed nucleus, as (36'b) shows. In other words, the domain of the stressed nucleus includes the entire word in the grammar of some speakers. As a consequence, the headed outcomes occur on its left as well. This is true not only in sequences in which [a] is in post-tonic position, as in (36a), but also systematically in contexts where [a] is the stressed nucleus preceded in its turn by a high vowel, as in [li'vati] 'you take off' in (36'b) and (37'b). In these grammars, (46) also includes the sequence on the left of stressed [a].

In metaphonic contexts [I]/ [U] occur in the stressed nucleus independently of the headed/ non-headed nature of the post-tonic vowels in the string, as we saw in (43). In particular, [I]/ [U] contrast with mid vowels, including [A], and, crucially, with lax [I]/[U] stressed nuclei. In other words metaphonic stressed nuclei manifest a specialized content that separate them from other possible stressed nuclei, including harmonizing ones. As suggested in section 3, we observe that metaphony affects a sub-set of the strings that otherwise could undergo harmony, thus configuring an 'elsewhere' order of rule application in the sense of Kiparsky (1973). As a consequence, metaphony excludes [-ATR] harmony. Hence, licensing ability of the stressed nucleus can work only once.

Like the preceding metaphonies and harmonies, Central Sardinian harmony discussed in section 3 for the varieties of *Àllai* and *Làconi* in (17)–(18) can also be

dealt with as a type of head alignment. These varieties exclude a [I/U, A] expression from the post-tonic position, but, differently from the Campidanian varieties, they lack the neutralization of the post-tonic original mid vowels to [I/U], as in (47a). A low-mid vowel in final position is admitted in the context of a low-mid stressed vowel, as in (47b). Finally, it is a [I/U] stressed vowel which selects a simple headed expression [I/U] in the post-tonic position, as in (48).

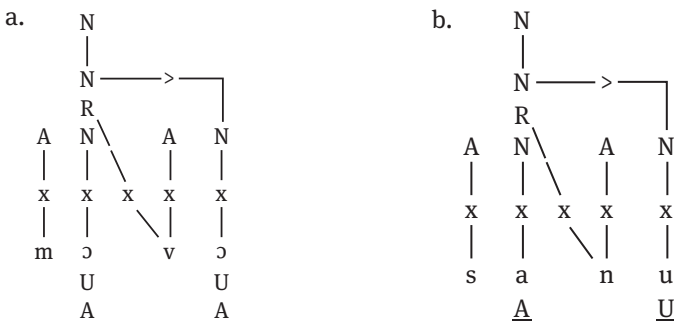
- (47) a. A post-tonic position legitimates simple expressions [I/ U]/ [A] or non-headed complex expressions.
 b. [A] in a complex expression in post-tonic position is legitimated by [A] in a complex expression in stressed position.
- (48) The [I/U] head in the stressed nucleus prominent in its prosodic domain legitimates the [I/U] head in a post-tonic position.

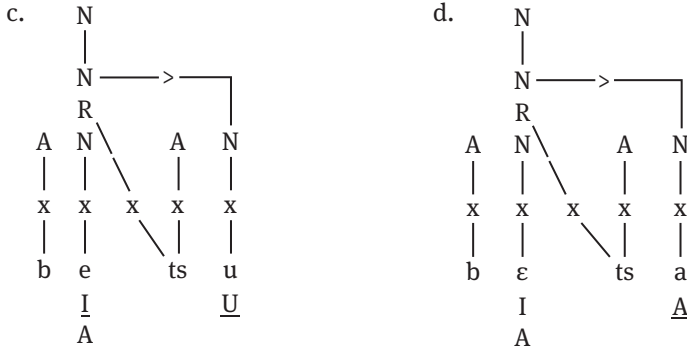
Again, the identical behavior of [i u] and [a] is the surface result of the distributional constraints that limit the occurrence of the possible final vowels. More precisely, (47a) authorizes in post-tonic contexts only [i a u] or [ɛ ɔ]; (47b) authorizes post-tonic [ɛ ɔ] only if the stressed vowel is [ɛ]/ [ɔ] in its turn. Finally, (48) fixes the specific distribution of [I/ U], whereby stressed [i u] and the metaphonic outcomes [e o] legitimate final/ post-tonic [I/ U]. [a] simply escapes these constraints.

(47) and (48) satisfy a complexity principle generally involved in prosodic systems requiring that the segments in a weak/ governed position are not more complex than their governing segments (Harris 1990a, 1997, 2005). Actually, this requirement seems to implement a substantial property whereby licensing capacity manifests itself as the intrinsic phonetic properties of the prosodic head.

In virtue of (47a, b), a vowel in a governed position cannot be more complex than the stressed vowel that licenses it, as in (49a–d). The distribution determined by (47)–(48) undergoes metaphony, in (43a).

(49) *Làconi*





On the basis of this analysis, the fact that [i u] and [a] appear to have identical behaviour (cf. section 3) in selecting post-tonic [i u], is the surface result of the distributional constraints in (47), limiting the occurrence of the possible final vowels.

6 Concluding remarks

The analysis of metaphony is a real testing ground for phonological theory. For Italo-Romance kinds of metaphony, the crucial point is the difference between raising metaphony of high-mid vowels and [ATR] metaphony of low-mid vowels. Current studies try to unify them both from a descriptive (Calabrese 1998) and historical point of view (Barbato 2008; Loporcaro this volume). Contrary to these approaches, this article, as a first step, proposes that the two types of metaphony can be adequately interpreted, allowing for their specific phonetic implementation separating [+high] metaphony from [+ATR] metaphony and involving contrastivity (Nevins 2011). This solution can work without having recourse to expensive formal devices like markedness requirements and re-adjustment rules. In the analysis I present here, the prosodic and autosegmental organization of the string concur to point out the role of the stressed nucleus in metaphony. A second issue discussed in this article is the relation between metaphony and harmonic processes. Metaphony, height harmony in Central Sardinian varieties and [ATR] harmony in Central Sicilian can be seen as a licensing procedure where the stressed nucleus authorizes height degree of vowels in the string. It is no accident that these phenomena coexist in the same systems and interact in influencing the overall distribution of the vocalic aperture properties inside the domain of the stressed nucleus.

The comparison between the feature-based analysis and the treatment in the element theory highlights interesting differences in the explanations they give rise to. A feature-based model allows characterization of the metaphonic and

harmonic processes in a descriptively adequate way. An explanatory difficulty shows up when the link between metaphony and harmony must be expressed. In particular, a traditional feature treatment separates the two types of metaphony, whereby raising metaphony is based on [+height] spreading while [ATR] metaphony depends on [+ATR] spreading. Moreover, this approach is not able to connect harmony and metaphony which work within the same language. Thus, harmony in Central Sicilian varieties in section 4 is explained in terms of [–ATR] spreading, while metaphony spreads [+high]. Analogously, in Central Sardinian varieties in section 2, harmony is explained in terms of [+high] while metaphony involves [+ATR]. This result seems to derive from the splitting of the height properties in different features. On the contrary, the element analysis concurs to throw light on the substantial affinity between harmony and metaphony explaining them both as alignment on the properties [I/U] of the stressed nucleus

The interaction between metaphony and harmony is especially evident in the fact that height harmony in Central Sardinian varieties and [ATR] harmony in Central Sicilian ones are blocked (bled) by metaphony. This bleeding relation seems to depend on the fact that metaphony and harmony answer complementary requirements implied in the externalization procedure that connects morpho-syntactic information to Sensory-Motor (SM) interpretation, in the sense of Berwick & Chomsky (2011). In fact, metaphony introduces a specialized phonological characterization in the stressed nucleus in the context of the inflectional exponents; harmony concurs in its turn to make certain vocalic qualities (aperture degree) associated to the phonological organization of the word more recognizable. In other words, these phonological mechanisms increase perceptibility of phonological properties which have a crucial interpretive role within a prosodic domain (Kaun 2004; Walker 1995, 2001, 2011). Thus, both the harmonic and metaphonic outcomes are required to show up in the strings in correspondence of morpho-phonological properties which must be legible to SM.

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