Andrea Calabrese
METAPHONY

0.   Introduction
        The term metaphony, which was first used in French *(metaphonie)* as a translation for the German word *Umlaut,*[1] is traditionally used in Romance linguistics to refer to a process in which a high vowel has a raising influence on a preceding stressed mid or low vowel. Metaphony is one of the most characteristic phonological processes characterizing the Romance languages, and in particular Italian varieties, although not Tuscan, and therefore standard Italian, which is based on Tuscan. For example, in many Italian dialects, high-mid vowels are raised to high before a high vowel. In the same context, low-mid vowels can be raised to high-mid, or diphthongized. This has resulted in numerous alternations, as in the examples *vérde /vírdi* 'green sg/pl' , *péde / pédi or péde / pjédi* 'foot/feet ' , where the plural form shows metaphonic effects . Less commonly, a stressed low vowel may also be affected by metaphonic raising and other changes may take place a well (cf. Calabrese (1985, 1998); Maiden (1991)). The conditioning factor in the metaphonic alternations has been obscured in many dialects by the neutralization or deletion of final vowels. This has produced vowel alternations in nominal and verbal paradigms for which there is no overt trigger.
        As observed by Anderson (1980: 43), the formal mechanism characterizing metaphony is not distinct from that underlying other sorts of vowel harmony: it involves the spreading of a vowel feature from a given vowel to other vowels. As this term is used in Romance linguistics, however, the fundamental difference lies firstly in the feature that is spread: a height feature ([high], [low] or [ATR]) in the case of metaphony and secondly in the restriction on the target of the process: a stressed vowel. In 'normal" vowel harmony all vowels in a word can be targets of the harmonic process. In section 2.1.3., I will consider Walker's (2005) analysis of metaphony that accounts for the local properties of this phenomenon—i.e., for the fact that the target is a stressed vowel and the trigger a post-tonic high vowel—in a functional perceptual perspective. Also later (sect. 4) I will briefly discuss an analysis of metaphony in terms of domain of application.
        Other processes with the same restriction on a stressed target but spreading non-height features are found in other languages, starting obviously from Germanic Umlaut. In this article I will restrict my attention mostly to the phenomena that are traditionally referred to by the term metaphony. This is an arbitrary choice from the theoretical point of view, but this delimitation will allow a tighter and more adequate exposition of facts and analysis. However, in the section 4, I will briefly discuss these other processes and compare metaphony with them.

1.   Description of Italian metaphony
1.1   Types of vowel systems
In order to describe Italian metaphony adequately a brief description of the vowel systems found in Italian dialects is needed. In stressed syllables, the typical system of

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[1] The term umlaut was coined in 1774 by poet Friedrich Gottlieb Klopstock (1724-1803) but it was first used in its current sense in 1819 by the linguist Jakob Grimm (1785-1863) to refer to the modification of vowels under the influence of a neighboring vowel.

Standard Italian (Tuscan) and many Italian dialects is the seven vowel one in (1) which is given in (2) in terms of distinctive features.

(1)　　　　　　　*i*　　　　　　　*u*
　　　　　　　　　e　　　　　　　*o*
　　　　　　　　　ε　　　　　　　*ɔ*
　　　　　　　　　　　　　a

(2)　　　　　*i*　*e*　*ε*　*a*　*ɔ*　*o*　*u*
　　　high　+　-　-　-　-　-　+
　　　low　-　-　-　+　-　-　-
　　　back　-　-　-　+　+　+　+
　　　round　-　-　-　-　+　+　+
　　　ATR　+　+　-　-　-　+　+

An important assumption in (2) involves the use of the feature ATR to account for the distinction between mid-high and mid-low vowels. Ladefoged and Maddieson (1996) argue against the use of the feature [ATR] in the Romance (and Germanic) languages. However, Calabrese (2008) provides evidence in favor of the use of this feature in Romance.

　　　In many southern varieties, the system is the 5 vowel system in (3). It developed either through a neutralization of the [ATR] contrast in mid-vowels of (1) or through a different evolution of the Latin vowel system (Rohlfs (1966), Lausberg (1939), Weinrich (1958) a.o., and also Calabrese (2003)).:

(3)　　　　　　　*i*　　　　　　　*u*
　　　　　　　　　ε　　　　　　　*ɔ*
　　　　　　　　　　　　　a

Further changes in some dialects, both in the north and south of Italy, have introduced the round front vowels [*y, ø, œ*] or the low front [*æ*]. They will not be discussed here.

　　　In unstressed syllables, vowels are reduced in various ways across dialects, often depending of the position of syllable with respect to the stressed vowel (pretonic/posttonic). In Standard Italian (Tuscan) and many other Italian dialects there is neutralization of the ATR-opposition in mid vowels that become [+ATR] in an unstressed position. In other dialects they become high in this position, or schwas. Final unstressed vowels have become schwas or were lost in a large number of dialects throughout Italy.

1.2.　　Italian Metaphony

　　　In seven vowel systems, the typical targets of metaphony are the mid [+ATR] vowels /e, o/ that raise to /i, u/ when followed by a high vowel. [2] There is dialectal variation in the case of the mid [-ATR] vowels. In some dialects, they do not change in a metaphonic context. In others they diphthongize, in others they are raised to mid [+ATR] vowels.[3] Typical metaphonic systems are exemplified by the dialects in (4), (5) and (6).

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[2] In some dialect only /i/ triggers the change. This issue will be discussed later

[3]　　　In some other dialects they are raise to high [+ATR] vowels. The status of this change will be discussed later.

(4) Dialect of Calvello (Giosco (1985))
   Metaphonic alternations: *e,o→i,u; ɛ, ɔ→je, wo)*
   a. [+ATR]/*e/o/*
       i. Class I/II adjectives:

		Singular	Plural	
	Masc.	*'sulu*	*'suli*	'alone'
	Fem.	*'sola*	*'sulu*	
	Masc.	*'niru*	*'niri*	'black'
	Fem.	*'nera*	*'nere*	

       ii. Class III Adjectives and Nouns:

		Singular	Plural	
	Masc.	*ka'vrone*	*ka'vruni*	'charcoal'
	Masc.	*'mese*	*'misi*	'month'

   iii. Metaphonic alternations in the present singular of verbs

	'metto	*'korro*	1st
	'mitti	*'kurri*	2nd
	'mette	*'korre*	3rd
	'put'	'run'	

   b. [ATR]/*ɛ/ɔ/*
       i. Class I/II adjectives:

		Singular	Plural	
	Masc.	*'ɣrwossu*	*'ɣrwossi*	'big'
	Fem	*'ɣrɔssa*	*'ɣrɔsse*	
	Masc.	*'vjekkju*	*'vjekkji*	'old'`
		vɛkkja	*'vɛkkje*	

       ii. Class III Adjectives and Nouns:

		Singular	Plural	
	Masc./Fem.	*'pɛre*	*'pjeri*	'foot'
	Masc.	*'dɛnte*	*'djenti*	'tooth'

       iii. Metaphonic alternations in the present singular of verbs:

	'pɛntso	*'mɔvo*	1st
	'pjentsi	*'mwɔvo*	'2nd
	'pɛntsa	*'mɔve*	'3rd
	'feel'	'move'	

(5) The Dialect of Servigliano (Camilli (1929))
   (Metaphonic alternations: *e,o→i,u; ɛ, ɔ→e, o)*
   a. [ATR]/*e/o/*
       i. Class I/II adjectives:

		Singular	Plural	
	Msc.	*kurtu*	*kurti*	'short'
	Fem	*korta*	*korte*	

       ii. Class III Adjectives and Nouns:

		Singular	Plural
		Singular	Plural

4 These are intermediate forms. There is a low-level process that neutralizes unstressed vowels to [ə] in the final position of a phonological word so that there are alternations such as the following: *sandə* 'saint' vs. *sandu pjetrə* saint Peter'; *kwirə* 'that' vs. *kwiru kanə* 'that dog' (see Gioscio (1985), Kaze (1991).

		Masc.	*'fjore*	*'fjuri*	'flower'

Masc.　*'fjore*　*'fjuri*　'flower'
Fem.　*'botte*　*'butti*　'barrel'

    iii.　Metaphonic alternations in the present singular of verbs:

        'mitti　*'kridi*　2nd
        'mette　*'krede*　3rd
        'put '　'believe'

  b.　[ATR]/ɛ/ɔ/

    i.　Class I/II adjectives:

        Sg.　Pl.
    Msc.　*'veccu*　*'vecci*　'old'
    Fm.　*'vɛcca*　*'vɛcce*
    Msc.　*'pjottsu*　*'pjotsi*　'slow'
    Fm.　*'pjɔttsa*　*'pjɔtse*

    Msc.　*'fjeru*　*'fjeri*　'animal'
        'fjɛra　*'fjɛre*

    ii.　Class III Adjectives and Nouns:

        Sg.　Pl.
        pɛde　*pedi*　'foot'
        dɛnte　*denti*　'tooth'

    iii.　Metaphonic alternations in the present singular of verbs:

        'sɛnto　*'mɔro*　1st
        'senti　*'mori*　2nd
        'sɛnte　*'mɔre*　3rd
        'put '　'die'

(6)　The Dialect of Grado (Walker (2005))
  (Metaphonic alternations: *e,o→i,u*; No metaphony for *ɛ, ɔ*)
  a.　[ATR]/e/o/

    i.　Class I/II adjectives and nouns:

        Singular　Plural
    Msc.　*'vero*　*'viri*　'true '
    Msc.　*'negro*　*'nigri*　'negro'
    Msc.　*'tempo*　*'timpi*　'time
    Msc.　*'roso*　*'rusi*　'red'
    Msc.　*'sordo*　*'surdi*　'deaf '
    Msc.　*'tondo*　*'tundi*　'round'

    ii.　Class III Adjectives and Nouns:

        Singular　Plural
    Masc.　*'fjor*　*'fjuri*　'flower'
    Fm.　*a'mor*　*a'muri*　'love'

    iii.　Metaphonic alternations in the present singular of verbs:

        'meto　*'kre-o*　*'romp-o*　1st
        'mit-i　*'kri-i*　*'rump-i*　2nd
        'met-e　*'kre-e*　*'rump-e*　3rd
        'put'　'believe'　'break'

  b.　[ATR]/ɛ/ɔ/

    i.　Class I/II adjectives:

        Sg.　Pl.

Msc.	*'bɛlo*	*'bɛli*	'beautiful'
Fm.	*'bɛla*	*'bɛle*	
Msc.	*'mɔrto*	*'mɔrti*	'dead'
Fm.	*'mɔrta*	*'mɔrte*	

The metaphonic pattern with diphthongization is the most common one. The diphthongal outcome can vary slightly: [*je*], [*jɛ*], [*iə*] from [*ɛ*]; [*wo*], [*wɔ*], [*we*], [*wɛ*], [*uə*] from [*ɔ*]. The rising dipthongs [*je*], [*wo*] are characteristic of central Italy, whereas rising diphthongs of the type [*jɛ*, *wɛ*] are found in Salentino in southern Puglia. The falling dipthongs [*iə*], [*uə*] are found in many southern varieties (*kurtiəddu*] knife', [*ruərmi*] 'you sleep' (dialect of Buonabitacolo (Salerno (Savoia and Maiden (1997)). In several southern dialects there are alternations *ɛ/i*, *ɔ/u* where the mid [-ATR] vowels are raised to high[*i*, *u*] like the mid [+ATR] /*e*,*o*/. Traditionally (see Rohlfs (1966) the metaphonic outcomes [i, u] from mid [-ATR] vowels are assumed to be the result of the monophthongization of the metaphonic diphthongs. However, Calabrese (1985, 1998) argues that at least in some of the dialects characterized by these alternations (see the dialect of Foggia in (7) and the dialect of Teramo mentioned below) one can directly derive the outcome [i, u] from [*ɛ*,*ɔ*] without assuming a diphthongal stage followed by monophthongization:

(7)   Dialect of Foggia (Valente (1975))

'moʃʃa	*'muʃʃu*	'soft'`
'kjena	*'kjinu*	'full'
'pɛte	*'piti*	'foot/feet'
'grɔssa	*'grussu*	'big'`

Groups of dialects characterized by raising of the mid [-ATR] vowels [*ɛ*, *ɔ*] to the mid {+ATR] [e,o] as in the Servigliano dialect in (5) are found scattered among dialects were these vowels are diphthongized. Thus, they are found in an area between Rome and Ancona, in parts of western Abruzzo and in outcrops in northern Puglia, in southern Lazio/northern Campania and in a small area between Basilicata and Calabria. The dialectal distribution of this type of raising, which appears in geographically non contiguous and historically unrelated areas, seems to indicate that it may have arisen independently in the different areas.

Metaphony restricted to the mid [+ATR] vowels is mostly found in the northeast of Italy in the Veneto region, but also in some dialects of the Gargano promontory in the south-east of Italy (Maiden (1991:114). [5, 6]

In some dialects also the low vowel /a/ can be affected by metaphony, most commonly becoming [*ɛ*] or [*e*]. This occurs in southern Romagna (Maiden 1991:131). In some southern dialects, the metaphonic output of [a] is a diphthong [*je*, *jɛ*]. The Teramo dialect of the Abruzzo region shows an extreme case wherein all vowels become high in metaphony: vowels /*e*, *ɛ*, *a*/ raise to [i] and /*o*, *ɔ*/ raise to [u] in a metaphonic context (Maiden 1991:167).

The final vowel /u/ lowered to [o] in many Italian dialects. It follows that the

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[5]   There is also a small number of dialects where only the mid [-ATR] vowels and not the [+ATR] ones are affected in a metaphonic context where they undergo diphthongization (see Maiden (1991: 129) for a historical explanation of this dialectally unusual pattern)

[6] Maiden (1991) proposes, contra Rohlfs (1966), that metaphony can be sensitive to syllable structure and that there are dialects in which it applies in open syllables but not in closed syllables. However, the data he uses are not too robust (see Calabrese (1998: 33) for a possible account of such a situation)

trigger of metaphony in these dialects is only /i/. Historically there were two stages of metaphony: first it affected the [+ATR] mid vowel [e, o] and then the mid [-ATR] [ɛ, ɔ] (Mancarella (1974), Maiden (1991)). In some dialects, final [u] lowering occurred between these two stages. Therefore, in these dialects metaphony of the mid [+ATR] vowels is triggered by both /i/ and underlying /u/, but that of the mid [-ATR] vowels only by [i].

In many Italian dialects, further changes such as reduction to schwa, deletion, or raising have affected final vowels. In some dialects, the underlying nature of the final vowels can still be identified through alternations (see northern Salentino (Calabrese (1985)) or the dialect of Calvello (4)). In many other dialects, however, these changes have totally obscured the phonological conditions for the metaphonic alternations, and metaphony has become morphologized. A dialect of this type is Arpinate, the dialect of Arpino (Parodi (1892)). Arpinate has the seven vowel system in (1). In this dialect, the historical rule of metaphony was morphologized because of a process of vowel reduction that affected post-tonic non-low vowels and changed them into schwas. Metaphony is now a morphological process affecting the stressed vowel of a word in certain morphological categories, such as the masculine singular of the second nominal class, the plural of the second and third nominal class, the second singular of the indicative present, etc (see Calabrese (1998)). So that we have alternations such as the following:[7]

(8)   Class I/II adjectives:

		Singular	Plural	
	Masc.	*'sulə*	*'sulə*	'alone'`
	Fem.	ˌ'sola	ˌ'solə	
	Masc.	ˌ'nirə	ˌ'nirə	'black'`
	Fem.	ˌ'nera	ˌ'nerə	
	Masc.	*'bwonə*	*'bwonə*	'good'`
	Fem	*'bɔna*	*"bɔnə*	
Masc.		*'vjekkjə*	*'vjekkjə*	'old'`
Fem.		*'vɛkkja*	*'vɛkkjə*	

b.   Class III Adjectives and Nouns:

	Singular	Plural	
Masc.	ˌ'fyorə	ˌ'fyurə	'flower'
Masc.	*'mesə*	*'misə*	'month'
Masc./Fem.	*'fɔrtə*	*'fwortə*	'strong'
Masc.	*'vɛrmə*	*'vjermə*	'worm'

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[7] Arpinate also provides an example of the phenomenon that Maiden (1991) called hypermetaphony by Maiden (1991). In many Italian dialects where we observe the usual metaphonic alternations in the nominal system, we find--or at least we can reconstruct--a different metaphony pattern in the verbal system. Thus in Arpinate, metaphony in the verbal system, but not in the nominal one, also affects the low vowel /a/, e.g., *'parlə vs. 'pjerlə* 'speak1sg/2sg'.'

Another example of hypermetaphony come from the Alpine dialects of Loco and Intragna in Canton Ticino (Maiden (1991:180). In these dialects, the regular reflex of metaphony of the low mid back vowel /ɔ/ is /wo/ (which is then monophthongized in the mid front rounded vowel/œ/). However we find that the metaphonic reflex of /ɔ / in verbs is not the expected /œ/ but instead /u/, which is the metaphonic output of /o/.

Metaphonic alternations in the present singular of verbs:

'vedə	'korrə	'sɛntə	'mettə	'kɔʎʎə
'vidə	'kurr	'sjentə	'mittə '	kwoʎʎə
'vedə	'korrə	'sɛntə	'mettə	'kɔʎʎə
'see'	'run'	'feel'	'put'	'pick'

Another change that affected the phonological status of metaphonic alternations in many southern dialects is the elimination of mid [+ATR] vowels that became [-ATR], so that there is no longer a contrast in [ATR] values in mid vowels in stressed syllables. This change occurred in northern Salentino that now has the vowel system in (3). The neutralization in [ATR] values rendered the old metaphony system opaque as in (9) where the same set of phonetically mid [-ATR] vowels has two different phonological behaviors according to the metaphonic context. The additional raising of mid vowels in unstressed syllables (*sɛntu/sintimu* 'feel-Pres.1sg/1pl', *kanosku/kanuʃʃimu* 'know-Pres.1sg/1pl'' complicates the situation further (see Calabrese (1985) for an analysis):

(9)   Northern Salentino

Sg	Pl	
'mɛsi	'misi	'month'
'nɔtʃi	'nutʃi	'nut'
'pɛti	'pjɛti	'foot'
'kɔri	'kwɛri	'heart'

2.   Analyses of metaphony

The major theoretical problem characterizing Italian metaphony lies in the different phonological behavior of the mid [+ATR] and mid [-ATR] vowels. Remember that whereas mid [+ATR] vowels are consistently raised to high vowels across dialects in a metaphonic context (i.e., before high vowels), mid [-ATR] vowels may be dipthongized (see (4)), raised to mid [+ATR] (see (5)) or to high [+ATR] (see (7)) or even fail to undergo any change (see (6)) in the same context. As we will see below, there is substantial agreement in the literature with respect to the basic nature of the process affecting mid [+ATR] vowels: it essentially involves height assimilation between a high vowel and the preceding stressed vowel. In contrast, there is no such agreement with regard to the nature of the process(es) affecting the mid [-ATR] vowels in a metaphonic contexts. On one side, there are those who aim to achieve a unified account for metaphony and, therefore, propose that the very same process applies to mid [+ATR] and mid [-ATR] vowels. For these scholars, the different outcomes observed in the case of the mid [-ATR] vowels are due to further phonological operations that apply to the outputs of height assimilation. On the other side, there are those who propose that an adequate account of the different outcomes observed in the case of the mid [-ATR] requires the postulation of two independent processes: one of height assimilation applying to mid [+ATR] vowels, and a different one applying to mid [-ATR] vowels. In this section I will discuss the different proposals addressing the problem of the different phonological behaviors of the mid [+ATR] and mid [-ATR] vowels in a metaphonic context.

2.1 Metaphony as a unitary process
2.1.1 Calabrese (1985, 1998)

Calabrese (1985) was the first to analyze Italian metaphony in a generative and, more specifically, non-linear phonological framework. The dialect he studied was that of Francavilla Fontana (Ribezzo (1912)) in northern Salento where despite some obscuring surface changes, one can easily reconstruct 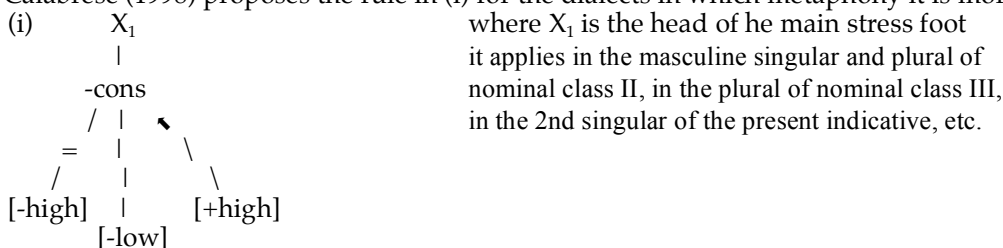a metaphony system like that of Calvello in (4) with raising of stressed mid [+ATR] vowels and diphthongization of the stressed mid [-ATR] ones. The main concern of Calabrese (1985) was that of achieving maximal simplicity and generality in the analysis of these processes. Proposing two different metaphony processes: one of raising applying to stressed [+ATR] mid vowels and one of diphthongization applying to stressed [-ATR] mid vowels meant for him failing to recognize that these two processes applied in exactly the same environment, and therefore overlapped strikingly in their structural description. To get out of this theoretical redundancy he proposed that the same rule in (10) raised all stressed mid vowels regardless of their [ATR] specification.[8]

(10) X_1 X_2 where X_1 is the head of he main stress foot

        -cons   -cons

    [-high]   [+high]
          [-low]
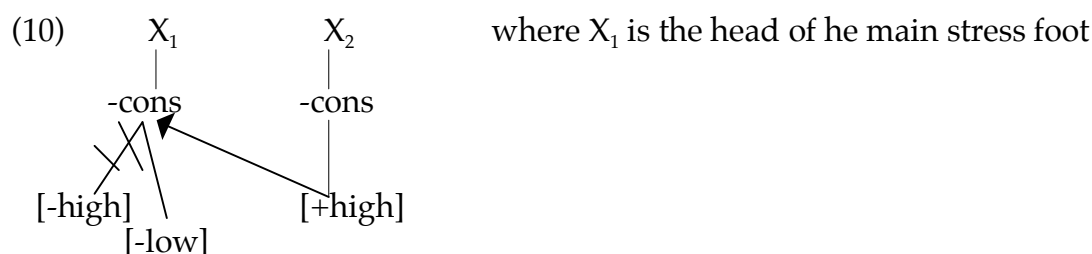
This rule directly raises mid [+ATR] vowels into high [+ATR] ones and thus accounts for the behavior of these vowels. However, in the case of the mid [-ATR] vowels this rule creates high [-ATR] vowels. Allowing the creation of this outcome was central for Calabrese's analysis. Although these segments can be found as surface variants of the high vowels in some dialects (see Loporcaro (1991)), they are consistently not phonemic in all Italian dialects. Adopting a variant of Kiparsky's (1985) structure preservation, Calabrese assumed that they were disallowed by the constraint *[+high, -ATR].[9] However, this constraint, instead of blocking the

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[8] Calabrese (1998) proposes the rule in (i) for the dialects in which metaphony it is morphologized:

  (i) X_1 where X_1 is the head of he main stress foot
           | it applies in the masculine singular and plural of
         -cons   nominal class II, in the plural of nominal class III,
                                        in the 2nd singular of the present indicative, etc.
      = | \
    / | \
  [-high] | [+high]
         [-low]

[9] Kaze (1989, 1991) proposes to replace the active marking statement [+high, -ATR] with *[+high, +low]. Kaze argues that relying on the prohibition *[+high, +low] instead of the constraint *[+high, -ATR] is preferable because the configuration [+high, +low] is universally impossible for obvious articulatory reasons. This move requires the following feature specification for the seven-vowel system :

(i)	*i*	*e*	*ɛ*	*a*	*ɔ*	*o*	*u*
high	+	-	-	-	-	-	+
low	-	-	+	+	+	-	-
back	-	-	-	+	+	+	+

generation of these illicit segments as in the original version of Kiparsky's structure preservation, triggered a repair adjusting them.[10] Calabrese proposed that the repair that occurred in this case was similar to the one that often adjusts the German or French vowel [ü] in the non native pronunciation of these language by changing it into the diphthong [yu] (cf. Trubetzkoy (1939: 135) Calabrese eventually called this repair fission in Calabrese (1988) (see Calabrese (1995, 2005 for further discussion of fission and for more examples). Fission takes a feature bundle containing an illicit combination of features and breaks it into two different feature bundles, each containing one of them. Application of fission to the high [-ATR] vowels created by the applying metaphony to mid [-ATR] vowels (see (11)a)) changes them into diphthongs as shown in (11)b. Further changes discussed in Calabrese (1985, 1998) account for the conversion of the high vowel into a glide and for other dialectal outcomes.

(11)   a)   X   (=[ɪ] (the output of the application of
            [-cons.]   metaphony to [ɛ])

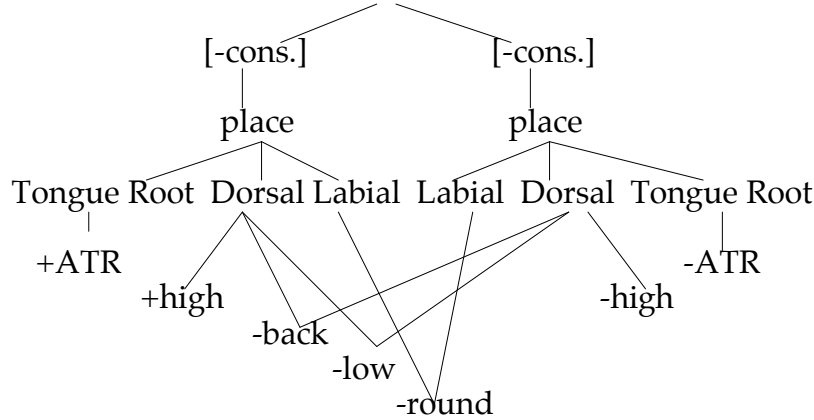   place

        Labial   Dorsal   Tongue Root

        [-round]
              [-back]
                 [-low]
                    [+high]
                         [-ATR]

        b)   X   (=[iɛ])

        [-cons.]   [-cons.]

          place   place

Tongue Root Dorsal Labial Labial Dorsal Tongue Root

    +ATR   -ATR
         +high   -high
              -back
                 -low
                   -round

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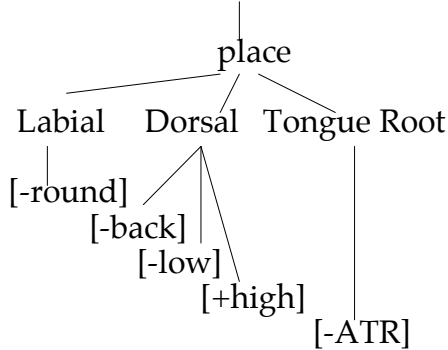
round   -   -   -   -   +   +   +

See Calabrese (1998) for discussion of Kaze' proposal and of the status of [+high, -ATR] vowes as marked, or complex phonological segmensts

[10] As mentioned above, high [-ATR] vowels are actually possible on the surface in many southern Italian dialects. They may be generated either by a process laxing vowels in closed syllables (cf. Lausberg (1939), Rohlfs (1966)) or by a process laxing high vowels in all positions (cf. Loporcaro (1991)). Calabrese (1998) argues that both processes apply very late in the derivation, obviously after metaphony.

Under this analysis, the metaphony rule is unitary and dipthongization results from an independently motivated process.

Calabrese (1985) furthermore extended this analysis to account for the dialectal variation observed when the metaphony targets are mid [-ATR] vowels. Remember that mid [+ATR] vowels are always raised; in contrast, mid [-ATR] vowels can be diphthongized, or tensed or raised to high [+ATR] vowels, depending on the dialect. Assuming that diphthongization was an instance of fission which repairs the disallowed configuration [+high, -ATR] created by the metaphony rule lead Calabrese to propose that the tensing and raising of mid-vowels in a metaphonic environment are also instances of application of other possible repairs. Thus, instead of postulating different rules of metaphony to explain this dialectal variation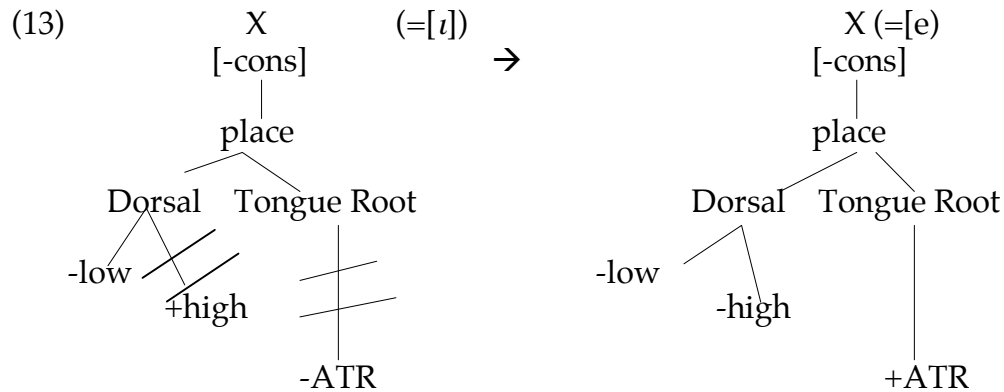, Calabrese proposed that the rule of metaphony was always the same across dialects and that the variation was due to the application of different repair rules. In historical terms, he hypothesized that the same rule of height assimilation spread across the southern Italian dialects. Each dialect reacted to the problem posed by the output of the application of this rule to the mid [-ATR] vowels in a different way.

The relevant repairs he proposed are delinking and excision.[11]   Delinking involves an operation that removes one of the feature specifications disallowed by an active marking statement. The opposite feature specification is inserted by convention. This operation accounts for metaphonic raising to high vowels. In this case the feature specification [-ATR] of the disallowed configuration [+high, -ATR] created by the metaphony rule is delinked and the opposite feature specification [+ATR] is inserted as shown in (12):

(12)   X   (=[ɪ])   X (=[i])
              [-cons]   ->(by Convention.)->   [-cons]
                 | |
              place   place

       Dorsal   Tongue Root   Dorsal   Tongue Root

   -low   -low
          +high   +high

                -ATR   +ATR
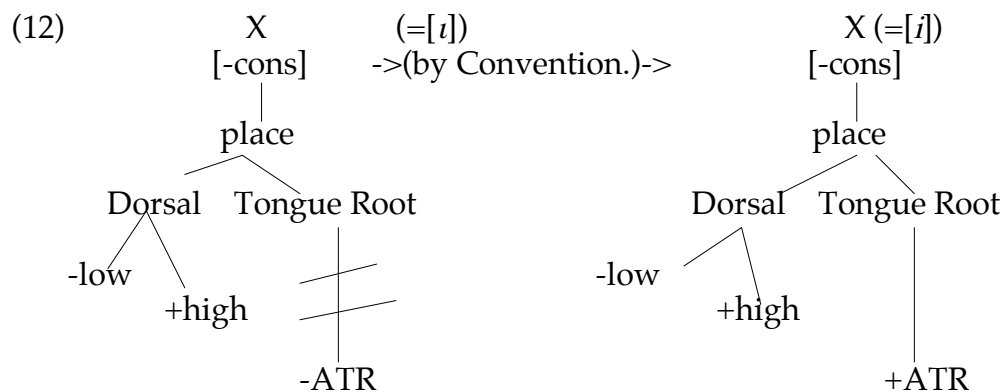
Excision involves removing both the feature specifications of the disallowed configuration and replacing them with their opposite specifications (see Calabrese (1995, and especially 2005, for further discussion of excision). If we assume that the rule of metaphony is the same across dialects and that the variation is due to the application of a different repairs, we can hypothesize that excision is the relevant repair in southern Umbro. Thus, we have a repair like the one in (13):

_____

[11]   Excision was called "negation" in Calabrese (1985, 1998).

(13)　　　　　X　　　　(=[ɪ])　　　　　　　　X (=[e])
　　　　　　[-cons]　　　　　⟶　　　　　[-cons]
　　　　　　　│　　　　　　　　　　　　　│
　　　　　　place　　　　　　　　　　　place
　　　　　╱　　╲　　　　　　　　　　╱　　╲
　　Dorsal　　Tongue Root　　　　Dorsal　　Tongue Root
　-low　╱　　　　　╫　　　　　-low　╲
　　　╳　　　　　　　│　　　　　　　　　-high
　　+high　　　　　│
　　　　　　　　　　-ATR　　　　　　　　　　　+ATR

That is, the high -ATR vowels produced by metaphony are changed into [+ATR] mid-vowels.[12]

　　Calabrese (1985) accounted for the metaphony system where only mid [+ATR] undergo metaphony but not the mid [-ATR] ones (see the dialect of Grado in (6)) by postulating that there was a parametrized option that governed the interaction between a rule and an active constraint. If applying the rule would generated a violation of the constraint, the application of the rule could be either 1) blocked (structure preservation) or 2) allowed to apply. Under option 2), a repair would then fix the illicit configuration that was so produced. The dialects discussed above selected this option. The dialects where metaphony did not apply selected option 1): so the rule in (10) was prevented to apply to mid [-ATR} because of the active constraint *[+high, -ATR] (see Calabrese (19988 for further discussion of this case).

　　I will now discuss two different accounts of Italian metaphony that essentially preserve Calabrese's hypothesis that there is a single metaphonic process raising all mid vowels to high ones and account for the different treatment found in the case of the mid [-ATR] vowels by resorting to independent processes. These are the analyses of Maiden (1991) and Walker (2005). Observe that only Walker accounts for the dialectal variation we find in the case of metaphony of the mid [-ATR] vowels. Maiden (1991) accounts only for the dipthongization observed in dialects such as the one of Calvello. In this section I will also consider Nibert's (1998) analysis of metaphony in Servigliano.

2.1.2　Maiden (1991)

　　Maiden (1991) provides a detailed study of metaphony in its diachronic development and in its synchronic phonological and morphonological aspects. In his analysis of the phonology of this sound change, Maiden treats metaphony as an assimilation in height, as Calabrese proposed; however, he disagrees with Calabrese's account of the diphthongization process found in lower mid vowels. In his account of metaphony, Maiden assumes the framework of Dependency Phonology. Following Dependency Phonology, he proposes that vowel height in a seven vowel system like that of the Italian dialects should be represented as in (14), where vowel space is characterized by four components: |i| (=palatality or acuteness); |a| (lowness or sonority); |u| (=roundness or gravity; |ə|(=centrality (not used here)):

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[12]　Calabrese (1985) uses excision to account for the metaphonic raising of /a/ to a mid-vowel [ɛ/ɔ]. The application of the metaphony rule to /a/ creates the disallowed configuration [+high, +low] which by excision becomes [-high, -low]

(14)　　　　　{|i|}　(=/i/)　　　{|u|}　(=/u/)
　　　　　　　{i;a}　(=/e/)　　　{u;a}　(=/o/)
　　　　　　　{a;i}　(=/ɛ/)　　　{a;u}　(=/ɔ/)
　　　　　　　{|a|}　(=/a/)
　　　　(where curly brackets indicate that the segment is characterized
　　　　phonologically by just that component or combination of
　　　　components, and ';' symbolizes asymmetrical right-to-left
　　　　'government' relationships between components)

He then proposes that the structural change involved in metaphony is the following:

(15)　V　　　→　　　-|a|

According to Maiden, this rule "is to be interpreted as a demotion of the |a|
component. Its causal relationship with the conditioning environment is manifested in
the fact that /i/ and /u/ are -|a| (i.e., lacking the |a| component [..])." Maiden
(1991:140). The structural change in (15) accounts for the change of higher mid vowels
to high vowels as can be seen in (16):

(16)　{i;a}　(=/e/) →　　(15)　　→　　　{|i|}　(=/i/)

The structural change in (15) cannot account for the diphthongization of the lower mid
vowels directly. He thus postulates that there is a special resolution" rule that changes
the output of the application of (15) to lower mid vowels into a diphthong, as in (17): [13]

(17)　{a;i} (=/E/)　→　　(15)　→ (Resolution)　　→　　{i}{i;a}　(=/ie/)

2.1.3　Walker (2005)

　　　　The most recent account of metaphony that preserves Calabrese's idea of the
unity of this phenomenon is provided by Walker (2005). The central feature of this
account is the attempt to identify the functional motivations behind metaphony.
Furthermore the account is set in Optimality Theory (Prince and Smolensky (1993)).
Walker adopts the hypothesis that the functional motivation for harmony is to extend
the duration of phonetic information which is phonologically important (i.e.
distinctive), but which is difficult to perceive (Kaun (1995). Steriade (1994, 1995),
Flemming (1995)). In "normal" vowel harmony systems , the harmony trigger belongs to
a "strong" position and the harmonic improvement is achieved by maximal duration of
the perceptually weak harmonic feature. In stress targeted harmony such as
metaphony, the trigger belongs to a prosodically weak position, and the improvement
is achieved through association with a prosodically strong syllable rather than maximal
duration.
　　　　In Walker's analysis, the functional motivation of metaphony lies in improving
the perceptibility of the height properties of high vowels in unstressed syllables.
According to her, high vowels in such a position are difficult to perceive because of the
paucity of cues in an unstressed syllable combined with the inherent comparative

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[13] See Calabrese (1998) for further discussion of Maiden (1991)

weakness of high vowels. As she proposes, "in extending to the stressed syllable, the height feature of the unstressed vowel becomes affiliated with a vocalic position that has increased duration, increased amplitude and more salient pitch. Duration of the feature is also increased by virtue of its continuation across more than one syllable.(Walker (2005: 932)" Metaphony, in other words, accomplishes improved perceptibility by extending the height features to the stressed syllable. She uses the positional licensing constraint in (18) to represent the need for high vowels to be associate with a prosodically strong position:

(18)   LICENSE([+high]post-tonic, σ'):
         [+high] in a post-tonic syllable must be associated with a stressed syllable.

The constraint in (18) is satisfied in (19)a) but not in (19)b). The alternative solution in (19)c) where the mid character of the stressed vowel overrides the post-tonic vowel would result in unstressed vowel lowering. Walker eliminates this solution by assuming a preference for minimized sonority in unstressed syllables

(19) a.   Licensing: satisfied   b.   Licensing: violated
            b í v i   b é   v   i
             | / | |
            [+high]   [-high]   [+high]

      c.   Licensing: satisfied . Sonority minimization in unstressed syllables
            violated.

            b é v e
             | /
            [-high]

        In the OT scheme Walker proposes, all height features of post-tonic high vowels ([+high], [±ATR], [-low]) of metaphonic systems require licensing. In all of these systems, the relevant constraint, i.e., LICENSE(height), is ranked above over IDENT(high), thus forcing spreading of the feature [high]. At the same time, *[+high, -ATR] is strictly enforced across patterns to block [I, U], as in Calabrese's analysis discussed in section 2.1.1.
        The dialectal variation we observe across the dialects is obtained as follows in Walker's OT analysis.
        In Veneto where metaphony metaphony applies only to [+ATR] mid vowels, the higher ranking IDENT(ATR) and IDENT(low) prevent [-ATR] vowels from being affected in metaphony. LICENSE(height) is ranked above over IDENT(high). Therefore the only allowed pattern is that in (6).
        In the Pugliese dialect of Foggia (see (7)), where /ɛ, ɔ/ raise to [i, u], licensing for all height features is also capable of overriding IDENT(ATR). Hence, in contrast to Veneto, LICENSE(height) dominates IDENT(ATR) in the dialect of Foggia.
        Like Pugliese, metaphony in southern Umbro (see (5)) has the capacity to violate IDENT(ATR), but it shows gradual raising. Walker follows Kirchner (1996) in accomplishing this by local conjunction of faithfulness constraints for height features, which moderates satisfaction of height licensing.

(20)   IDENT-IO(high) &*l* IDENT-IO(ATR)
        If a segment violates IDENT(high), it must not violate IDENT(ATR), and
        viceversa.

        This constraint will be violated by any vowel that changes its specifications for
both [high] and [ATR] in the input-output mapping. The conjunction dominates
LICENSE(height), which in turn outranks the nonconjoined height faithfulness
constraints, as shown in (21).

(21)   IDENT(high) &*l* IDENT(ATR) >> LIC(height) >> IDENT-IO(ATR), IDENT-IO(high)

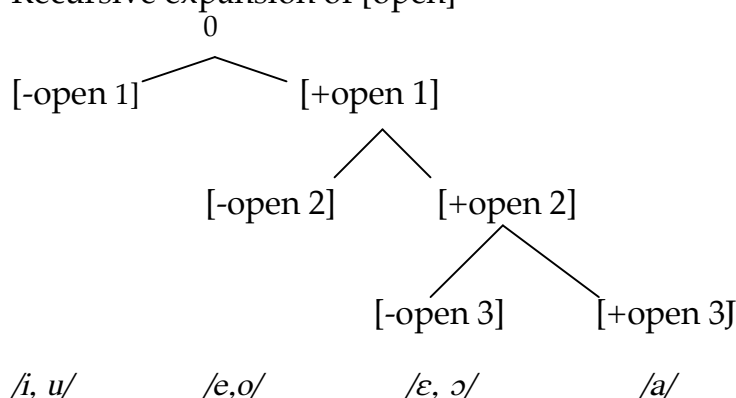| /nɔv-u/	IDENT(high)&*l*IDENT(ATR)	LIC(height)	IDENT(ATR)	IDENT(high)
a ☞ nóvu		*	*	
b. nɔvu		**!		
c. núvu	*!		*	*

The local conjunction rules out candidate (c), in which /ɔ/ changes to [u]. This
constraint is obeyed, however, in (a), in which / ɔ / changes to [o], and in (b), which is
fully faithful. Candidate (a) wins over (b), because it better obeys LICENSE(height), for
which a violation mark is shown for each unlicensed height feature: (a) violates
licensing for [+high] and (b) for both [+high] and [+ATR]. An alternative [nUvu] will be
eliminated by *[+high, -ATR].
        In Calvello (see ((4)), [ɛ, ɔ] become diphthongs. As in Calabrese's analysis,
diphthongization is regarded as driven by the constraint *[+high, -ATR]. Walker
assumes that in Calvello, the faithfulness conjunction, IDENT(high) & IDENT(ATR), is
strictly enforced, as in southern Umbro. However, in the Calvello dialect, licensing of
all height features is accomplished by affiliating [+high] with the glide portion of a
diphthong. The licensing constraint requires perceptually marked structure to be
associated with an element in a strong position. For Walker, association with one
element of a diphthong in a strong syllable is sufficient to satisfy the constraint.
Assuming that diphthongs are bisegmental, diphthongization in Calvello will violate
DEP-IO for the inserted root node (McCarthy & Prince 1995). Walker therefore proposes
that diphthongization patterns for [-ATR] mid vowels are distinguished from ones with
step-wise raising, as in southern Umbro, by the relative ranking of DEP-IO and
LICENSE(height).

2.1.4   Nibert (1998)
        A single operation for metaphony based on Clements's (1989) model of vowel
height is also proposed by Nybert (1998), although it is restricted to the analysis of
the Servigliano dialect of Italian. Clements (1989) proposes an alternative to the
analysis of vowel height in terms of the binary features [high] and [low]. He argues
that the vowel space is divided into height categories by a succession of binary
divisions. Clements employs a single binary height feature [open], which can appear
in a recursive structure such as (22), where each *[a* open] branch of the feature tree
can be further subdivided into [+open] and l-open] branches.

(22)   Recursive expansion of [open]

                        0
        [-open 1]   [+open 1]

                    [-open 2]   [+open 2]

                            [-open 3]   [+open 3J

    /i, u/   /e,o/   /ɛ, ɔ/   /a/

Servigliano has the 7-vowel inventory /i, e, ɛ, a, ɔ, o u/. Metaphony induces a one-step raising of both the high-mid vowels /e, o/ and the low-mid vowels /ɛ, ɔ/. Nibert specifies vowel height features for Servigliano as in (23). Note that this is a center-embedding structure, as opposed to the right-branching structure in (22). The choice between the center embedding and right-branching analysis of a four-height system depends on the behavior of the mid vowels in an individual language. (22) best represents a system in which the low-mid vowels pattern with the low vowel with respect to vowel height, while (23) is an appropriate specification for languages like Servigliano, in which the low-mid and high-mid vowels pattern together.

(23)   A 7-vowel system

	i	*u*	*e*	*o*	*ɛ*	*ɔ*	*a*
open 1	-	-	-	-	-	-	+
open 2	-	-	+	+	+	+	+
open 3	-	-	-	-	+	+	+

Nibert shows that under this analysis of vowel height, the raising of /e, o/ requires assimilation of [-open2] from the triggering vowels. But spreading [-open 2] onto /ɛ, ɔ/ yields the feature bundle [-open 1, -open 2, +open3], which doesn't correspond to any of the available vowel qualities. In order to raise /ɛ,ɔ/ of one step to /e, o/ it is the feature [-open3] that must be assimilated. Nibert argues that metaphony can spread either feature, [-open 2] or [-open 3], subject to structure preservation, which bans the spread of [-open 2] onto /ɛ, ɔ/. In order to guarantee that [-open 2] and not [-open 3] spreads onto /e,o/ since spread of [-open 3] would be vacuous, and would not accomplish raising. Nibert's rule must be modified to apply disjunctively, spreading [-open 2] 'unless' spreading is blocked, in which case [-open 3] will spread.[14]

2.2   Italian Metaphony as two different processes.
        The analyses that I consider in this section reject the idea that there is a unitary metaphonic process and propose to break metaphony into two distinct processes one targeting the mid [+ATR] vowels and rasing them to high ones and the other targeting

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[14] See Cole (1998) for further discussion of Nybert (1998) See also Zetterstrand (1998) for a criticism of Clements's (1998) approach to vowel height..
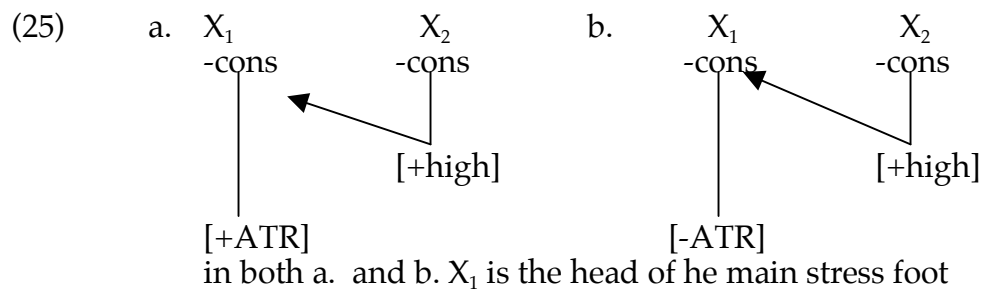
the mid [-ATR] ones leading to diphthongization or tensing. These are the analysis of Sluyters (1988) and Cole (1998).

2.2.1   Sluyters (1988)

Sluyter (1988) proposes a reanalysis of Calabrese's (1984) account of metaphony in the northern Salentino dialect of Francavilla Fontana   (see (9)).   He assumes Calabrese's rule (10) to account for height assimilation before high vowels. However, he proposes a different account of diphthongization in metaphony. Sluyters suggests that the metaphonic diphthongs /*iɛ, uɔ*/ are characterized by a second X-slot which is contextually determined by stress and introduced by a rule like that in (24):

$$
\begin{array}{c}
\text{[+stress]}\\
\end{array}
$$

(24)   Ø   ->   X/   X   _____
                                                    |
                                               [-cons.]

In Sluyters's analysis, rule (10) directly accounts for the raising observed in the case of mid [+ATR] vowels. According to him, however, (10) does not apply in the case of the mid [-ATR] vowels until after rule (24) has applied. However, the facts cannot accounted for by simply applying (10) before and after (24). The first application of (10) would also affect mid [-ATR] vowels. It is therefore necessary to split rule (10) into two different rules: one applying to mid [+ATR] vowels and the other to mid [-ATR] vowels as in (25).
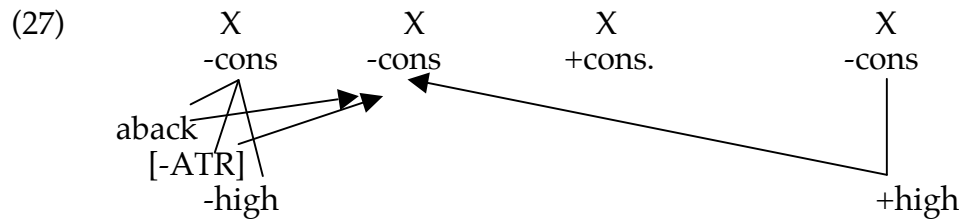
(25)   a. X_1 X_2 b. X_1 X_2
                -cons   -cons   -cons   -cons

                            [+high]   [+high]

                [+ATR]   [-ATR]
                in both a. and b. X_1 is the head of he main stress foot

(25)a) applies first. Then ((24)applies. After the application of (24), rule (25)b) fills in the empty X-slot with the feature [+high] as   shown in (26)(Tree structures are simplified):

(26)   X   X   X   X
                -cons   -cons   +cons.   -cons

            aback
            [-ATR]
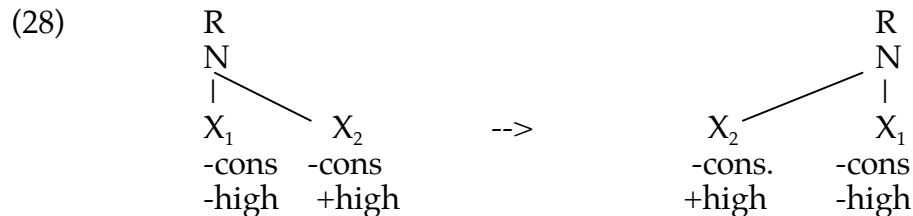   -high   +high
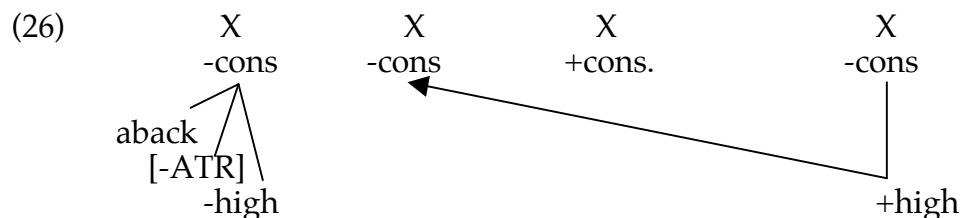
The other features of the inserted empty vowel are filled in by spreading from the preceding vowel according to Sluyter.

(27)

```
         X          X          X          X
       -cons      -cons      +cons.      -cons


  aback
  [-ATR]
       -high                            +high
```

Such an analysis produces the falling diphthongs /ɛj, ɔw/. In order to get the correct outputs, Sluyters assumes the rule of metathesis in (28):

(28)

```
        R                              R
        N                              N
        |                              |
       X₁      X₂          -->       X₂        X₁
     -cons   -cons                 -cons.    -cons
     -high   +high                 +high     -high
```

Application of (50) to the outputs of (27) generates the metaphonic outcomes /jɛ, wɔ/.[15]

2.2.2 Cole (1998)

Cole (1998) argues that the vowel raisings that define metaphony systems in Italian dialects do not result from a unified operation of height assimilation. Instead, metaphony is claimed to be the product of the assimilation of the mid [+ATR] vowels /e, o/ to the high vowels /i , u/ within the stress foot, and a subsequent vowel shift by which the non high /(a), ɛ, ɔ / are raised one step.

In the same way as Walker (2005), Cole views the height assimilation of the mid [+ATR] /e, o/ to /i, u/ in functional terms. Following Cole & Kisseberth (1994) she assumes that assimilation promotes perceptual salience by reducing or eliminating marginal contrasts between two phonetically similar segments. Small phonetic differences between the trigger and target of assimilation are resolved, and in many vowel harmony systems the target emerges as fully identical to the trigger. Thus, the assimilated target provides additional or extended acoustic cues for the identification of the triggering segment

Cole then proposes that the assimilation in height of the mid [+ATR] leaves a vacancy in the vertical dimension of the vowel space, and a vowel shift takes place to raise the lower mid [-ATR] vowels, and thereby fill the gap.[16] This accounts for the tensing of the mid [-ATR] vowel we observe in Southern Umbro.

According to Cole, diphthongization plays a role in maintaining contrast: by diphthongizing a raised low-mid vowel, the surface form unambiguously identifies the contrastive category of the vowel, countering the neutralization that would otherwise result from compressing four contrastive height categories into three.

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[15]   Sluyters's analysis was adopted by Durand (1990). See Calabrese (1998) for further discussion of it.

[16] Vowels shift is governed by two principles, according to Cole. One prohibits the neutralization of contrastive height categories, while the other one requires the preservation of the relative underlying height of raised vowels (see Cole (1998) for more discussion).

3.   Typological variation in metaphony as a height assimilation process.
The term metaphony is also used to refer to processes of height assimilation in which
feature different than [+high] are spread. In this section I will survey the variation we
find with respect to the features spread by metaphony across Romance.

**3.1   Non-Italian metaphonetic processes spreading [+high]: Metaphony in
Asturian dialects.**

In several varieties spoken in Asturias in north central Spain, one finds
metaphonic processes which are similar to the Italian ones in involving spreading of the
feature [+high].
Spanish dialects have the five vowel system in (3) in their phonemic system. As
discussed by Hualde (1989), mid vowels in Asturian dialects regularly undergo
metaphonic raising. Also /a/ is raised in these dialects. In the Asturian dialect of Lena,
in forms ending in /-u/ stressed mid vowels become high and the stressed low vowel
/a/ raises to /e/, as seen in (46a) vs. (46b). The data compare forms ending in /-u/ (m
sg) with counterparts ending in /-o/ (mass) or /-os/ (pl).[17]

(29)   Lena
        Unraised Raised
        'nenos   *'ninu*   'child (m pl/sg)'
        kor'deros   *kor'diru*   'lamb (m pl/sg)'
        'tsobos   *'tsubu*   'wolf (m pl/sg)'
        'kokos   *'kuku*   'worm (m pl/sg)'

        'gatos   *'getu*   'cat (m pl/sg)'
        'palos   *'pelu*   'stick (m pl/sg)
        tsa'margos   *tsa'mergu*   'muddy lake (m pl/sg)'

In the Asturian dialect of the Nalón valley, the mid vowels raise as in the Lena
dialect. However , /a/ in a metaphonic context becomes an allophonic "open" mid [ɔ]:

(30)   Nalón valley
        'osos   *'usu*   'bear
        'gordos   *'gurdu*   'fat
        kor'deros   *kor'diru*   'lamb (m pl/sg)'

        'gatos   *'gɔtu*   'cat (m pl/sg)'
        'palos   *'pɔlu*   'stick (m pl/sg)
        'blankos   *'blɔnku*   'muddy lake (m pl/sg)'

---

[17] Whereas in Lena metaphonic raising is structure preserving, in the sense that the metaphonic
counterpart of /e, o/ are identical to /i,u/ and the metaphonic counterpart of /a/ is identical to /e/, this
is not the case in the Asturian dialect spoken in Alto Aller, a region east of Lena. In this dialect mid
vowels in a metaphonic context are more raised than in other context still they are distinct from /i, u/ in
having a "dark and mixed quality" Rodríguez-Castellano (1952: 59). In the same way, the metaphonic
outcome of /a/ is a mid front vowel that is "open" Rodríguez-Castellano (1952: 59) and "with a throaty
quality" " Rodríguez-Castellano (1952: 35). Hualde (1998) represents it with [ɛ].

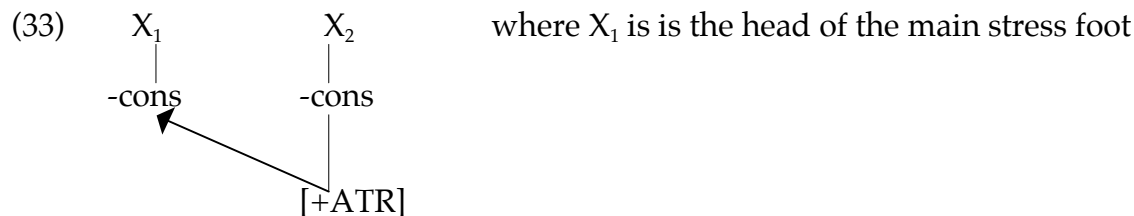### 3.2 Metaphonetic processes spreading [+ATR]: Sardinian Metaphony

It is generally agreed in the literature, at least when the targets are the mid [+ATR] vowels, that the metaphony process spreads the feature [+high] of high vowels. However, there are Romance varieties in which we find metaphonic alternations that are better analyzed as involving the feature [+ATR] of the high vowels.

Frigeni (2003) discusses the following examples from Campidanese and Nuorese, the main varieties of Sardinian (the Campidanese forms are intermediate: final mid vowel are raised by a late phonological process does not have). Sardinian has the vowels system in (3).

(31)　Campidanese
　　　a.　*M.SG [-u]*　　*F.SG [-a]*　　*gloss*
　　　　　'njeɖːu　　　'njeɖːa　　　'black'
　　　　　'lentu　　　　'lɛnta　　　　'slow'
　　　　　'veɾu　　　　'vɛɾa　　　　'true'
　　　　　'nou　　　　　'nɔa　　　　　'new'
　　　　　'sou　　　　　'soβa　　　　'lonely'
　　　　　'motːu　　　　'mɔtːa　　　'dead'

　　　b.　*SG*　　　　*PL*
　　　　　'tempus　　　'tɛmpos　　　'time'
　　　　　'kropːus　　　'krɔpːos　　　'body'
　　　　　'betʃːu　　　　'bɛtʃos　　　'old.M/parent'
　　　　　'otːu　　　　　'ɔtːos　　　　'vegetable garden'
　　　　　'oɢu　　　　　'ɔɢos　　　　'eye'

(32)　*Nuorese*
　　　SG　　　　　　　　　*PL*　　　　*gloss*
　　　'tempus　　　　　　　'tɛmpos　　　'time'
　　　'otːu　　　　　　　　'ɔtːos　　　　'vegetable garden'
　　　'loɢu　　　　　　　　'lɔɢos　　　'place'
　　　'kentus　　　　　　　'kɛntos　　　'hundred'

Frigeni accounts for the metaphonic alternations of these Sardinian dialect by hypothesizing the process in (33):

(33)　　X$_1$　　　　X$_2$　　　　　　where X$_1$ is is the head of the main stress foot

　　　　|　　　　　|
　　　-cons　　　-cons

　　　　　　[+ATR]

3.3 Metaphonetic processes spreading [-ATR].

The Cantabrian dialects of Pasiego and Tudanca are traditionally described characterized by a centralizing metaphony (Alonso et al. (1950), Navarro Tomas (1939) Penny (1969 a,b). Final unstressed high vowels are regularly centralized; this process is analyzed by Hualde (1989) as insertion of [-ATR]. As Hualde discusses, centralizing metaphony propagates [-ATR] up to the stressed syllable in Tudanca and to all the

syllable of the word, and even proclitics, in Pasiego. In instances of antepenultimate stress in Tudanca, intervening vowels are also centralized, as shown in (48b). The data in (34) and (35) compare forms ending in /-u/ (m sg) with counterparts ending in /-o/ (mass) or /-os/ (pl) where the final unstressed /u/ is realized as centralized [U]. Pasiego also has raising metaphony which applies to mid vowels, as seen in (35)a vs. (35)b. Thus, stressed mid and high vowels are neutralized in a metaphonic context (cf. *lixIrU/ lImpjU*)[18, 19]

(34) Tudanca
  a. 'pinta   'pintU   'calf (f/m)'
      'seka   'sEkU   'dry (f/m)'
      'kesos   'kEsU   'cheese (pl/sg)'
      '*θurdos*   '*θUrdU*   'left-handed (m pl/sg)'
      '*ohos*   '*ÓhU*   'eye (m pl/sg)'
      se'kalo   *se'kAlU*   'to dry it (mass)/to dry him'

  b. *anti'gwIsImU*   'very old'
      'pOrtIkU   'hall'
      or'EgAnU   'oregano'

(35) Pasiego
  A. *ba'beros*   *bA'bIrU*   'bib (m pl/m sg)'
      li'xera   *li'xIrU*   'light (fem/ m sg)'
      'limpja   'lImpjU   'clean (fem/m sg)'
      'gordo   'gUrdU   'thick (mass/m sg)'
      'floxa   'flUxU   loose (fem/ m sg
      ra'posos   *rA'pUsU*   'fox (m pl/m sg)'

  b. 'mala   'mAlU   'bad (fem/m sg)'
      'blanku   'blAnkU   'white'
      'gatu   'gAtU   'cat'
      'limpja   'lImpjU   clean

In Eastern Andalusian we find an other [ATR] harmony process with somewhat different properties from those of the Cantabrian Spanish dialects. In this area of southern Spain, final -s has been lost via aspiration s > h > Ø.   The singular/plural contrast is nevertheless maintained in this dialect by means of vowel quality. Thus, for instance, plural *pinos* 'pine trees' is realized with a final [-ATR] vowel [*pinɔ*], whereas its singular counterpart [pino] has a [+ATR] vowel. This [+/-ATR]distinction affects the low and mid vowels in final position and also propagates to a stressed low or mid vowel and perhaps also other vowels in the word, as in *conejo* [*koneho*] 'rabbit' vs .

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[18]   An indipendent process in Pasiego raises pretonic vowels to high when preceding a stressed high vowel:
i)   *kome're* 'I will eat'/ *kumi'ria*   'I would eat'
This pretonic rasing can be triggered by the vowels raised by metaphony:
    ii)   *kor'deros*   *Il kUr'dIrU 'lamb-Pl/the lamb-Sg'*
[19] As observed by Penny (1978), Hualde (1998), in Tudanca non high vowels, including /a/, are also raised in a metaphonic context. However, the outputs of the application of raising metaphony to the mid vowels are allophonic: mid vowels in a metaphonic context are distinct from /i, u/.

conejos [kɔnɛhɔ] 'rabbits' (Alonso et al. (1950), (Navarro Tomas (1939), Sanders (1998) Zubizarreta (1979))[20]

(36) *'perro*   *'pɛrrɔ*   'dog (sg/pl)'
      'βeso   *'βɛsɔ*   'kiss (sg/pl)'
      'solo   *'sɔlɔ*   'alone (sg/pl)'
      'poko   *'pɔkɔ*   'little/few/(sg/pl)'
      'masa   *'mą̦są̦*   'dough (sg/pl)'

3.4 Metaphonetic processes spreading [aATR].

A local [ATR harmony process targeting stressed vowels is also found in a number of southern Salentino dialects studied by Grimaldi (2003). Southern Salentino is an extremely conservative variety that was not affected by the historical rule of metaphony characterized by [+high] spreading and diphthongization of the mid [-ATR] vowel that affected all other Salentino dialects. It has the five vowel system in (3). The [+ATR] harmony rule is most probably a recent innovation and is subject to to a remarkable variation on the conditions for its application. Four different patterns of harmony are identified by Grimaldi. I give them below with the name of one of the dialects where they are found:

(37) a. Dialect of Acquarica: ɛ --> e / __ i
      'mɛtɛ   *'meti*   *'mɛtu*   'reap-Pr-3Sg/2Sg/1Sg'
      'bːɛɖa   *'bːeɖi*   *'bːɛɖu*   'beautiful-FSg/MPl/MSg.'

      'ʃɔka   *'ʃɔki*   *'ʃɔku*   'play-Pr-3Sg/2Sg/1Sg'
      'krɔsːɛ   *'krɔsːi*   *'krɔsːu*   'big-FPl/MPl/MSg.'

      b. Dialect of Patù: ɛ, ɔ --> e, o / __ i,
      'mɛtɛ   *'meti*   *'mɛtu*   'reap-Pr-3Sg/2Sg/1Sg'
      'bːɛɖa   *'bːeɖi*   *'bːɛɖu*   'beautiful-FSg/MPl/MSg.'

      'ʃɔka   *'ʃoki*   *'ʃɔku*   'play-Pr-3Sg/2Sg/1Sg'
      'krɔsːɛ   *'krosːi*   *'krɔsːu*   'big-FPl/MPl/MSg.'

      c. Dialect of Alessano: ɛ, ɔ --> e, o / __ i,   ɔ --> o / __ u

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[20] A harmony process similar to that of Eastern Andalusian is found in the Sicilian dialects of Villalba and Mussomeli analyzed by Cruschina (2008). In this dialect final high vowels become [-ATR]. This [-ATR] feature is then spread right-to-left to all other vowels of the word leading to alternations such as the following:
(i)   *pIttʃI 'ʃIɖɖU*   *pittʃi 'ʃiɖɖa*   'child M/F'
      pUr'ritU   *pur'rita*   'rotten M/F'
      lI 'mUnI   *i'muna*   'lemon sg/pl'
      fI 'lUnI   *fi'luna*   'loaf sg./pl'
      sIntI 'tIlU   *sinti'tilla*   'you pl. listen to it/M/F
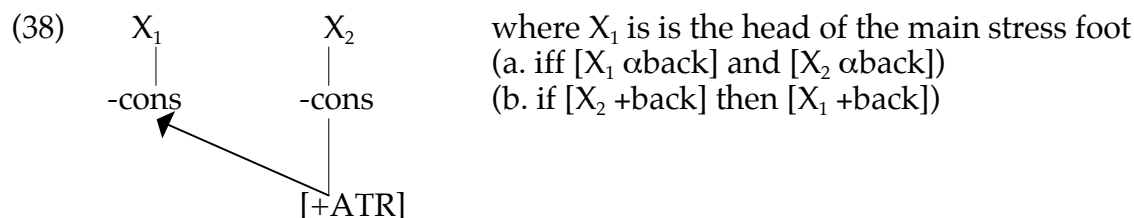Vowel /a/ is opaque and blocks the spreading:
(ii) *'fUmU*   *'fumamU*   'smoke Isg/pl'
      'mUnnU   *'munnamU*   'peel Isg/pl'
      'vIliɲU   *'viliɲamU*   'harvest Isg/pl'

'mɛtɛ	'meti	'mɛtu	'reap-Pr-3Sg/2Sg/1Sg'
'bːɛɖːa	'bːeɖːi	'bːɛɖːu	'beautiful-FSg/MPl/MSg.'
'ʃɔka	'ʃoki	'ʃoku	'play-Pr-3Sg/2Sg/1Sg'
'krɔsːɛ	'krosːi	'krosːu	'big-FPl/MPl/MSg.'

d. Dialect of Andrano: ɛ --> e / __ i,   ɔ --> o / __ u

'mɛtɛ	'meti	'mɛtu	'reap-Pr-3Sg/2Sg/1Sg'
'bːɛɖːa	'bːeɖːi	'bːɛɖːu	'beautiful-FSg/MPl/MSg.'
'ʃɔka	'ʃɔki	'ʃoku	'play-Pr-3Sg/2Sg/1Sg'
'krɔsːɛ	'krɔsːi	'krosːu	'big-FPl/MPl/MSg.'

Grimaldi provides accurate acoustic measurements for the different vocalic triggers, i.e., the unstressed post-tonic vowels, in the different vernaculars. These measurements show that when vowel /u/ is not a harmonic trigger as in the patterns found in the dialects of Salve (37)a) and of Patù (37)b) its first formant is on average much higher than when it is a harmonic trigger as in the other two patterns in (37)c, d). This indicates that in this case what is transcribed as a word-final [u] by Grimaldi is actually [-ATR] and even [-high] and therefore does not qualify as trigger. On the other hand, the patterns in (37) show that the harmony process is parasitic on the feature [back]. This is always true for the post-tonic [u] that triggers [+ATR] harmony as in (37)c, d) only if it shares the feature [+back] with the target. The same is true for the post-tonic [i] in the patterns in (37)a, d) where it must share the feature [-back] with the target to trigger [+ATR] harmony. No such restriction, however, occurs in the patterns (37)b, c).

The process we observe in (37) could be accounted for by the rule in (38) which spreads the feature [+ATR] and is governed by the two parametrized conditions on parasitic [back] in b) and c). (38)a) is active in the systems in (37)a) and (37)d). (38)b) is instead active in the case of (37)c). No condition is active in (37)b).

(38) X_1 X_2 where X_1 is is the head of the main stress foot
         | | (a. iff [X_1 αback] and [X_2 αback])
      -cons   -cons   (b. if [X_2 +back] then [X_1 +back])
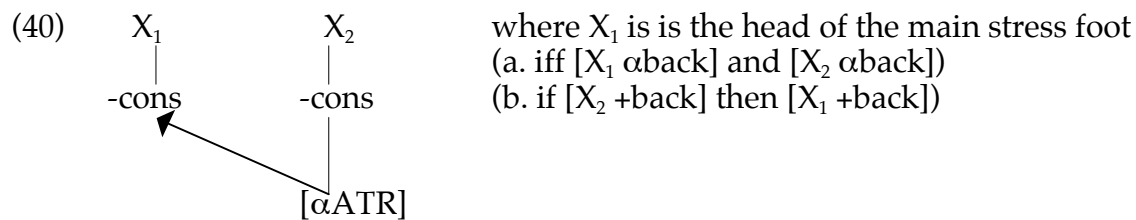
                  [+ATR]

The focus of Grimaldi's detailed acoustic analysis is the raising illustrated in (37). However he reports (p. 72-73) that in the same varieties where we find this raising process we also have metaphonic alternations triggered by non-high vowels and targeting high vowels. Sample cases are given in (39)

(39)
kan'tsuəne	kan'tsuni	'song sg/pl'
ku'luəre	ku'luri	'color sg/pl'
na'puəte	na'puti	nephew sg/pl'
pa'riəte	pa'riti	'wall sg./pl'
'kuəse	'kusu	'sow 3sg/1sg'
'miəna	'mini	'throw 3sg./2sg'

'viənne	'vinnu	'sell 3sg./1sg.'
'miənte	'minti	'put 3sg/2sg.'
'ruəssa	'russu	'red Fsg/Msg.'
'ruəsse	'russi	'red Fpl/Mpl.'
'uənta	'untu	'dirty Fsg/Msg.'
'uənte	'unti	'dirty Fpl/Mpl.'

If we assume that in a five vowel system the non-high vowels are [-ATR], we can account for the alternations in (39) by hypothesizing that the feature [-ATR] of the final non-high vowels is spread onto the stressed high vowel. The [+high, -ATR] vowels obtained by the this spreading operation would then undergo diphthongization as discussed in Calabrese's analysis of metaphony in section 2.1.1.[21]

Now it is unclear if the same conditions on parasitism hold for the alternations in (39). Grimaldi (pc) stated that he did not investigate whether or not there is dialectal variation across the southern Salentino varieties with respect to the process illustrated in ((39). He simply determined that similar alternations were present across these dialects without looking at their exact distribution. For the time being, I propose that the process accounting for the facts in (39) is identical to that accounting for the facts in (37) and hypothesize the rule in (40) spreading both specification of [ATR], assuming that the same cross-dialectal variation found the process in (39) is found for the process in (40). Future research will determine if this move is correct.[22, 23]

(40) X_1 X_2 where X_1 is is the head of the main stress foot
        | | (a. iff [X_1 αback] and [X_2 αback])
        -cons   -cons   (b. if [X_2 +back] then [X_1 +back])

              [αATR]

4.   Words with antepenultimate stress and the formal conditions on metaphony

Words with antepenultimate stress provide evidence in support of the idea that metaphony may not be characterized as targeting a domain such as the last foot but must be simply characterized as targeting stressed vowels. In fact, in dialects such as Neapolitan, metaphony in words with antepenultimate stress appears to apply regularly across the non high post-tonic vowel, although this occurs only when the final vowel is /i/   ('mɔnako/ 'muonatʃi 'mong sg/pl./, 'tʃɛfaro/'tʃiefari 'mullet sg/pl',

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[21] Observe that as mentioned in section 1.2, the falling diphthongs [iə, uə] are a quite common alternative to the rising diphthong [ye, wo] as metaphonic outcomes of metaphony of [ɛ, ɔ].

[22] Grimaldi (2003:73) observes that the process in (39) does not apply when the intermediate consonant between trigger and target is a palatoalveolar or palatal [ʃ, tʃ, ɲ, c] (e.g., 'fitʃe, 'kriʃʃe, 'kriʃu, 'ruɲɲa, ucche). These consonants are [Coronal, -Anterior, +distributed]. If Calabrese (2005, Chapter 4) is right, these consonant must also have a [Dorsal –back, +high] secondary articulation. If we assume that the presence of [+high] implies the presence of a default [+ATR] specification, we have an account of these exceptions. The presence of the feature [+ATR] in the consonant interferes with the spreading of [-ATR]. Grimaldi also mentions one example where [f] is the intermediate consonant ['skrufa]. It is unclear to me how to account for this case.

[23] An unusual metaphony system where all vowel features are spread is reported by Savoia and Marotta (1991:25) for Davoli where we have sample cases such as: 'piʷlu, 'hair', 'tʃřḍḍɛ 'star'.

ka'rɔfano/ka'ruofani 'carnation sg/pl', *'fekato/'fiekati* 'liver sg/pl' (Napoletano (Rohlfs (1966: 22)(Note that these are intermediate representations: final [-o/i] become [ə] due to a surface process of vowel reduction)). However, there are also cases in which it applies before /u/ (*muɔnaku* 'monk' (Centrache (Rohlfs (1966: 427, Lausberg (1939: 10). [24] What matters in these cases is the target of the process, the stressed vowel, and the element that appears in post-tonic position can be disregarded. This type of situation is even more clear in the Asturian dialects discussed section 3.1. In these dialects, metaphony targets /a/ which is raised to a mid vowel. In words with antepenultimate stress, metaphony can target a stressed /a/ leaving unaffected a post-tonic /a/, as illustrated in the following examples:

(41) a. Lena

'peʃaru	*'paʃarin/ 'paʃara*	'bird/little bird/female bird'
'pempanu	*'pampanos*	'old and decrepit personMsg/Mpl.'
'kendanu	*'kandanos*	'dry branch sg/pl'

b. Alto Aller (see footnote 17)

'pɛʃaru	*'paʃarin*	'bird/little bird/'
'teladru	*'taladros*	'drill sg/pl.'
'ɛbanu	*'abanos*	'snow embankment sg/pl'

c. Nalón Valley

'pɔʃaru	*'paʃaros*	'bird sg/pl/'
'mɔtulu	*'matola/ mato*	'I kill him/I kill her/I kill'
'mɔtalu	*'matala/ mata*	's/he kills him/s/he kill her/s/he kills'

If metaphony is characterized as applying to the last foot, one cannot explain why the intermediate vowel can be skipped over by this process. The best characterization of metaphony is not in term of domain of application, but in terms of target of application: metaphony applies to stressed vowels.[25, 26]

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[24] In many, perhaps most Italian dialects, the phonological conditions for the application of metaphony in words with antepenultimate stress are obscured by schwa-reduction of post-tonic vowels (*mɔnəkə/muonəkə* (Campobasso, Rohlfs (1966: 22)) or regressive total harmony between post-tonic vowels as in the following examples from northern Salentino (Francavilla Fontana (Ribezzo (1912), Calabrese (1985)

(i)   sing.   plur.

'mɔnuku	*'mwɛnitʃi*	"monk/s"
'stɔmuku	*'stwɛmitʃi*	"stomach/s"
'kɔfunu	*'kwɛfini*	"barrel/s"
'mjɛtucu	*'mjɛtitʃi*	"physician/s"

[25]   Note that under such an analysis we still have to account for why the non contrastive feature [-high] of the post-tonic vowel does not interfere with metaphonic spreading process: it must be either underspecified or one must assume that the metaphony rule access only contrastive feature as in Calabrese's (1995) reanalysis of underspecification theory (see also Nevins (2008).

[26] In many Italian dialects, metaphony is constrained by a further condition: it applies only between adjacent vowels. Therefore, in these dialects, it does not apply in words with antepenultimate stress, when the post tonic vowel is not high, cf. *'kɔfanu/kɔfani* 'chest' , *'mɔnaku/mɔnaki* 'monk' (Aprigliano (Rohlfs(1977: 189, 427). If the post-tonic vowel of the word with antepenultimate stress is [+high], metaphony applies as expected although no alternations are generally found in this case insofar as the trigger vowel is morpheme-internal: *pjettine* 'comb', *pjecura* 'sheep', *pjertica* 'pole', *dwonnula* 'ferret',

5. Umlaut and other cases of local harmony

The process traditionally called umlaut in Germanic is similar to metaphony in targeting a stressed vowel and in being triggered by an unstressed one.[27] However it is different in the feature that is spread. Whereas the term metaphony is traditionally used to refer to a process spreading a height feature ([high] or [ATR] in the Romance varieties discussed above), umlaut is usually used to refer to a process spreading the feature [-back], i.e., a process of fronting before front vowels or glides. Consider for example, umlaut in Old High German (Prokosch (1938:112, also Janda (1998))) where a stressed back /a/ fronts to [e] preceding an unstressed high front vowel or glide:[28]

(42) Old High German

Unfronted	Fronted
a. 'faran 'to go'	'ferit 'goes'
b. 'kalb 'calf'	'kelbir 'calves'
c. 'gast 'guest'	'gesti 'guests'

However, umlaut is also used to refer to a process spreading the feature [round]. In in Old Norse (Prokosch (1938:109-110)), for example, we find two umlaut processes: one of fronting (i-umlaut) and one of rounding (u-umlaut): vowels are fronted before front vocoids (vowels and glides) and rounded before round ones.[29]

(43) i-umlaut: Fronting before i/j

a	>	*e*	*gestr*	<	Runic: *gastir*		
ā	>	*æ*	*lætr*	<	*lātiz*	'let-2sg.' (cf. Inf. *lātan*)
o	>	*ø*	*døhtr*	<	Runic: dohtrir 'daughter'
ō	>	*ø̃*	*dø̃ma*	<	Got. *dōmjan*	'judge'
u	>	*y*	*þykkia*	<	Got. Þuckjan 'seem'
ū	>	*ȳ*	*mȳss*	<	Proto-Germ. **mūsiz*

b. u-umlaut: Rounding before u/w

a	>	ǫ	*mǫgr*	<	*magus*	'son'
		ǫ		<	*ahu*	'water'

---

fworfitʃe (Aprigliano (Rohlfs(1977: 509, 514, 520, 246, 284). Another possibility is that the final high vowel trigger raising of the preceding posttonic vowel, which subsequently triggers raising of the tonic vowels ('ordeno/'urdini 'order 1sg/2sg', 'ʃovene/ʃuvini 'young man sf/pl (dialect of Grado (Walker 2005:). Observe that in this dialect, raising is also triggered by post-tonic non final vowels: 'munig-a 'nun (f sg)'(cf. central Veneto: *mónega*,Trieste: *mòniga*, Std. Italian: *mònaca*), *turbi-o* 'cloudy (m sg)'(cf. Std. Italian: *tórbido*)

[27] As Robinson (1976) points out, the vowel which triggers umlaut must be unstressed, ex. [kráftlìh] 'strong' *[kréftlìh] .

[28] In later stages of German, final vowels were lost. Therefore, the umlaut fronting acquired an important grammatical role and it became the morphological marker of grammatical categories such as the plural (Prokosch (1938). It was then extended to Old High German words in which the plural did not differ from the singular such as *wort, turi, bruoder,man, naht*.

[29] While u-umlaut is mostly found in Old Norse (but also in Anglian), i-umlaut is widespread in the Germanic; in addition to OHG considered before is found in Old Frisian, Old Saxon and Old English; here are some examples from Old English: OE *nerian* 'save' , *settan* 'set' < Gothic *nasjan, satjan*; OE *dehter* (ø → e) < *dohtri* dative sg. of *dohtor* 'daughter'; *gylden* 'golden' <*guldīna; *mys* 'mice' <Proto-Germanic **mūsiz*.

e	>	ø	*røkkr*	<	Proto-Germ.*rekwes*
i	>	y	*tryggr*	<	Got. *triggws*

The effects of u-umlaut can still be seen in modern in Icelandic in the alternations in (44). Observe that the low rounded [ǫ] of Old Norse has become a front rounded [ö] in modern Icelandic :

(44) a. *barn*   nom.sg.   *baggi*   *kalla*   1sg.
          börn-um   dat.pl.   *bögg-ull*   *köll-um*   1pl.
          'child'   'bundle','parcel'   'call'

Old Norse has another process targeting a stressed vowel and triggered by a following unstressed vowel. This is a-Breaking. It is triggered by an unstressed /a/ and causes the diphthongization of a precedig stressed /e/ into [ia]. We can assume that it involves the spreading of the feature [+low]:

(45) e   >   ia   hiarza   <   OHG herza 'heart'
                   biarga   <   OHG bergan 'conceal'

Outside the Indo-European domain, an umlaut-like process spreading all the features of a vowels is found in the Jaqaru dialect of Aimara where a final unstressed vowel triggers assimilation of all its features into the stressed vowel (Cerrón-Palomino López (2003), Walker (2005)). The vowel inventory consists of /i, a, u/ and stress is penultimate in native words.

(46)   */palu-ri/*   *[pa'liri]*   'eater'
       /nuni-ja/   *[nu'naja]*   'to cause to rinse',
       /ima-ka-ʃu/   *[im'kuʃu]* [30] 'sewing'

Another case of a umlaut-like process applying right-to-left instead of left-to-right is provided by Chamorro (Topping (1968)). It has the vowel system in (47) and a vowel fronting process that converts [u, o, a] to [*i, e, æ*] in the first syllable of the root if a front vowel precedes, as in (48). The first root syllable is stressed:
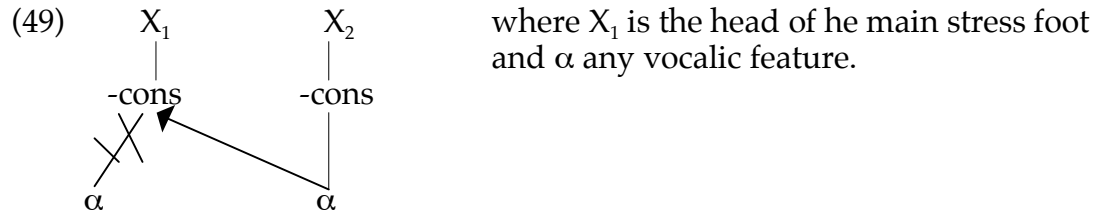
(47)   *i*   *u*
        e   *o*
        æ   *a*

(48)   *'gwihən*   'fish'   *i 'gwihən*   'the fish'
        'gumə   'house'   *i 'gimə*   'the house'
        'pecʋ   'chest'   *i 'pecʋ*   'the chest'
        'tomʋ   'knee'   *i 'temʋ*   'the knee'
        'lahı   'male'   *i 'læhi*   'the male'

6.   Conclusion
A generalization that can be drawn from this brief survey of umlaut in Germanic

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[30] In this example the root final vowel is deleted.

and other langages and the previous discussion of metaphony in Romance[31] is that in both cases we are dealing with the same formal process that can be roughly described as in (49) where α can be any vocalic feature, i.e., one of the following: [high], [low], [back], [round], [ATR]. This process can apply both right-to-left or left-to-right.

(49) X_1 X_2 where X_1 is the head of he main stress foot
                                     and α any vocalic feature.

       -cons   -cons

        α   α

It is an open issue whether or not the process in (49) can be motivated in functional terms as in Walker's (2005) or Cole's (1998) analyses discussed in section 2. Perhaps, it can diachronically as an historical innovation. Surely it can't synchronically at least for most Italian dialects where metaphony is morphologized or obscured by subsequent phonological processes (see section 1). Functional explanations by their nature must be surface-true. This is not the case in Italian metaphony (and also in Germanic Umlaut).

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[31] Given the definition of metaphony/umlaut as stress-target vowel harmony processes, my survey does not include processes such as the harmonic change observed in found in the Canals variety of Valencian Catalan where unstressed /a/ becomes [ɛ] or [ɔ] following stressed [ɛ] or [ɔ (Jiménez (1998), Walker (2005))(e.g., /tɛra/→['tɛrɛ]'land', /afɛkta/ → [a'fɛktɛ] 'it affects', /kɔza/ →['kɔzɔ] 'thing', /apɔrta/→[a'pɔrtɔ] 's/he brings'; raising of mid vowels in pretonic syllables in Pasiego (see footnote 18) or Servigliano dialect (e.g. kommoneˈka 'to communicate' kummuniˈkimo 'we communicate') (Camilli (1929)   or vowel height assimilation in Bantu languages such as NzEbi (Clements (1989) where root/stem vowels are targeted (e.g. -bɛt-/bit(-i) 'to carry, -kolǝn-/kulin(-i) 'to go down' -βɛɛd-/βeed(-i) 'to give', -niɔd-/niod(-i) 'to drink', -sal-/sɛl(-i) 'to work

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