Metaphony in Campidanian Sardinian: a domain-based analysis*

Chiara Frigeni
University of Toronto

In this paper I examine the metaphony found in Campidanian Sardinian (Romance variety), arguing for its phonological nature. This analysis requires that both the stem inventory and the desinence inventory of Campidanian Sardinian have five vowels underlyingly, contrary to the surface facts. Furthermore, I show that stem and desinential inventory are specified by different features. This result is allowed by a model in which inventories are relativized to paradigmatic domains. I claim that this relativization is not restricted to the number of segments present underlyingly (as argued by Dyck 1995), but that it is possible even on the macro-level of the feature configuration of inventories. This paper thus highlights a new level of the interaction between morphological and phonological modules of grammar.

0. Introduction

This paper presents an analysis of metaphony (i.e. tensing of stem mid lax vowels) in Campidanian Sardinian, a Romance variety spoken in the southern region of Sardinia, Italy, as reported by Bolognesi (1998) in his dissertation. In particular, I will show that the tensing of stem mid vowels is phonological and results from a rule that spreads the feature [ATR] leftwards, from the vocalic desinence onto the adjacent stem vowel. The Campidanian metaphony is interesting for several reasons. First, it instantiates a peculiar type of Romance metaphony, which I label sardo type. The sardo type shows only tensing of the stem mid lax vowels closest to the trigger. The well-known neapolitan and

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1. All data reported in this paper are from Bolognesi (1998), except for some of the pairs in (6), for which I am grateful to Clara Lecis.
2. ‘Desinence’ is a term of traditional grammar and refers to the morphological extensions of lexical bases. Thus, for instance, nominal desinences may encode gender, number, person, class, case; verbal desinences may encode person, tense/aspect, mood, Aktionsart. This paper mainly focus on nominal and adjectival desinences. A careful study of verbal desinences and of how they are involved in the process of vowel height harmony is beyond the scope of this paper and needs further research.
3. I use the traditional Romance term ‘metaphony’ to refer to a phenomenon which is better defined as vowel height harmony (Bolognesi 1998: 20).
arpinate types (Reiss 1982; Maiden 1991) both involve raising of the stressed mid tense vowels and differ in the treatment of the stressed stem mid lax vowels (see section 4.3. for details). Second, the rule of metaphony in Campidanian presents a puzzle with respect to the underlying feature specification of stem and desinential inventories, as outlined in sections 5 and 6. Third, Campidanian metaphony requires careful consideration of segmental complexity and of Head-Dependent asymmetries (Drescher and van der Hulst 1993, 1998) in order to explain the surface realization of the underlying inventories. Finally, the solution of the puzzle I propose reveals a fine-grained interaction between the morphological and the phonological components of the grammar of Campidanian Sardinian. The solution in fact relies on the assumption that phonological inventories can be relativized to morphological domains (as proposed by Dyck 1995), and, furthermore, it points out that this relativization is not limited to the number of segments present underlyingly (as in Dyck 1995), but that it can also inform the macro-level of the feature configuration of the inventories.

The paper proceeds as follows. In section 1, I present the surface stem and desinential inventories of Campidanian Sardinian. In 2, I clarify the theoretical assumptions that underlie my analysis. In 3, I discuss the predictions made by the model of contrast I am assuming. In 4, I argue for the phonological nature of Campidanian metaphony, providing synchronic, diachronic and cross-dialectal evidence. In that section, I claim that [ATR] is the feature involved in the rule and thus present underlyingly on the triggers. Consequently, I propose the underlying feature specification of the inventories in section 5. In 6, I show that if [ATR] is a feature of stems as well as of desinences, the wrong results are obtained when metaphony applies. In 7, I propose that a solution to this puzzle can be found if and only if the inventories are relativized to morphological domains. Furthermore, I argue that metaphony can be accounted for as either a tensing process (7.1.) or a lowering process (7.2.) and I discuss the realization of the surface inventories for both options, assuming neutralization as a strategy that minimizes complexity in the desinential inventory. In section 8, I touch upon markedness issues, since the tensing option implies a desinential feature configuration traditionally assumed to be marked. Section 9 is a brief conclusion.

1. Campidanian Sardinian surface vowel inventories

The surface stem vowel inventory of Campidanian Sardinian has 7 vowels [i, e, a, ò, o, u], in both stressed (1) and unstressed (2) positions. Note that the stem inventory has both tense and lax mid vowels.

(1)  [a] 'ak:u-a ‘water-F.SG’  [e] 'eða:o-i ‘age-F.SG’
     [e] pe'zær-i ‘pleasure-M.SG’  [æ] e's:-i ‘go out-INF’
     [e] o'bet:-u ‘open-M.SG’  [i] pě't:ok:-u ‘boy-M.SG’
     [i] e's:-i ‘go out-INF’  [ɔ] o'bet:-u ‘open-M.SG’
     [o] 'foj-u ‘fire-M.SG’  [u] un'fr-a-u ‘offended-M.SG’
(2)  [a] aβe:t:a:i ‘wait-INF’  [æ] e'da:o-i ‘age-F.SG’
     [æ] ø'et-u ‘open-M.SG’  [i] o'et:-u ‘open-M.SG’
     [i] pě't:ok:-u ‘boy-M.SG’  [ɔ] o'et:-u ‘open-M.SG’
     [o] 'foj-u ‘fire-M.SG’  [u] un'fr-a-u ‘offended-M.SG’
The surface desinential vowel inventory, on the other hand, is far more limited, with only three vowels, [i, a, u]. [i, a, u] are nominal desinences for gender (cf. (1) and (2)), where [-u] is a masculine singular desinence, [-i] is usually a masculine and occasionally a feminine singular desinence, and [-a] is usually a feminine and rarely a masculine singular desinence. The plural marker is [-s], which attaches to the vocalic desinence marking gender.4

Furthermore, the vowels [i, a, u] are also found as verbal desinences, as shown in (3):5

(3)

[-i] ben-i! ‘come-IMP.2SG’
[-i] pεξd-i ‘lose-INF’
[-u] ap:-u ‘have-PRES.1SG’
[-(m)u(s)] dep:e-u(z) ‘must-PRES.1PL’
[-u] trab:al:a-u ‘work-PP’
[-a(t)] sεy-a(t) ‘cut-PRES.3SG’
[-a] prep:ar-a! ‘prepare-IMP.2SG’
[-ai] aβe’t:-ai ‘wait-INF’

The following table illustrates the desinences [i, a, u] according to their grammatical functions, based on Bolognesi’s corpus (1998):

<table>
<thead>
<tr>
<th>category</th>
<th>desinence</th>
<th>meaning/function</th>
</tr>
</thead>
<tbody>
<tr>
<td>N, Adj</td>
<td>[-i]</td>
<td>M.SG; F.SG</td>
</tr>
<tr>
<td></td>
<td>[-a]</td>
<td>F.SG; M.SG</td>
</tr>
<tr>
<td></td>
<td>[-u]</td>
<td>M.SG</td>
</tr>
<tr>
<td>V</td>
<td>[-i]</td>
<td>INF. (1/2/3CONJUG); IMP.2SG(2/3CONJUG); SUBJUNC.</td>
</tr>
<tr>
<td></td>
<td>[-a]</td>
<td>IND.PRES.3SG; IMP.(1CONJUG)</td>
</tr>
<tr>
<td></td>
<td>[-u]</td>
<td>IND.PRES.1SG; IND.PRES.1PL</td>
</tr>
<tr>
<td>Adv</td>
<td>[-i]</td>
<td></td>
</tr>
</tbody>
</table>

To sum up, Campidanian Sardinian presents two very different surface vowel inventories: the stem inventory is a 7-vowel system ([i, e, è, a, ò, o, u]) and the desinential inventory is a 3-vowel-system ([i, a, u]).

The main goal of this paper is to come to an understanding of the underlying representations of each of these inventories. We will see that the surface inventories are deceiving, and that the underlying inventories present an intriguing puzzle as to how these underlying inventories are defined. Before presenting the puzzle and its solution, I make explicit my theoretical assumptions.

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4. Number is not marked by a different vocalic quality in Sardinian, unlike in Standard Italian (e.g. It. [–a] (F.SG) vs. [–e] (F.PL)).
5. This list is not exhaustive. It is however worthwhile to know that both northern and southern Sardinian conserve the Latin verbal desinences for person and number: (1sg -m), 2sg -s, 3sg -t, 1pl -mus, 2pl -tis, 3pl -nt.
2. Theoretical Foundations

2.1. Contrast

Since I attempt to find a solution to the puzzle of the Campidanian inventories I will present later in terms of contrastive specification of segmental inventories, it is worthwhile to briefly outline my set of assumptions with regard to this matter.

I assume that if a feature is predictable, derivable from other information, redundant in a phonological process, or unmarked, then this feature is absent from the lexical representation. That means that it is not specified underlyingly, and might be inserted in later stages of the derivation. I further assume that phonological features are privative (i.e. of the type [x]) and not binary (i.e. of the type [± x]).

Being unspecified within a system of specifications is radically different from being unspecified per se. In the former scenario, being unspecified does not mean to have no value, in the latter case being unspecified exactly means to have no value. The difference lies in having or not having an absolute inherent value, as Saussure (1916) first suggested with respect to linguistic elements. Recall Saussure’s analogy between the values of linguistic elements and chess pieces. A chess piece does not have an inherent value, but rather it inherits one from its own function within the system, from its relation with the other pieces, and from the configuration of each single game.

This is the intuitive base of the particular model of underspecification I am adopting for this analysis, that is the Modified Contrastive Specification model proposed by Avery and Rice (1989). Essentially, in such a model, contrast is accounted for in the system by feature specification, and according to principles of minimality and scope. This approach shares these two principles with a similar model proposed by Dresher (1998a,b) and Dresher, Piggott and Rice (1994), the Successive Binary Algorithm (see references for details).

In this section I discuss the minimality principle and I briefly outline the notion of scope. Both rule the way a feature is specified underlyingly.

The notion of scope is actually twofold: on the one hand, there is ‘configurational scope’ and on the other hand, there is ‘hierarchical scope’. The former refers to the elements within an inventory over which a feature specification takes scope, thus achieving a certain configuration. For instance, the two hypothetical vowel inventories in (5) show two different configurations, the one in (5a) is achieved by [low] taking scope over /A/, whereas (5b) is achieved by [low] taking scope over /A, E, O/; thus taking a wider scope over the inventory than in (5a):

\[
\begin{array}{c|c|c}
  \text{(5)} & \text{a.} & \text{b.} \\
  \hline
  \text{I} & \text{U} & \text{I} \\
  \text{E} & \text{O} & \text{E} \\
  \text{A} & \text{[low]} & \text{O} & \text{[low]} \\
  \text{A} & & \end{array}
\]

This notion of ‘configurational scope’ highlights that the phonemic distribution within an inventory does not entirely determine the phonological features specified

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6. For detailed reviews of underspecification in phonology see Steriade (1995) and Dresher, Piggott and Rice (1994).
underlyingly. Moreover, it is relevant for the prediction it makes with respect to the triggers of metaphony and will be discussed more in detail in section 7.2.1.

‘Hierarchical scope’, on the other hand, refers to the order/sequence in which the features take scope one over the other in specifying the elements of an inventory. This notion of scope, discussed by Dresher (Dresher and Zhang 2000; Dresher 2002), is relevant for the algorithm presented in (8) below which has been proposed by Dyck (1995) for the determination of height contrasts in Romance vowel inventories.

As for the principle of minimality, it requires that the minimal number of features necessary to achieve the actual contrasts within underlying representations is specified, thus implying underspecification. In other words, this principle requires to specify up to contrast; thus, it must be distinguished from the principle of minimality discussed by Archangeli & Pulleyblank (1994), which requires the segments themselves to be specified by the minimal number of features. Roughly, the principle of minimality I am assuming determines that the number of features is minus one with respect to the number of contrasts present underlyingly.

According to minimality, then, a two-height contrast within a vocalic inventory is achieved by the specification of one feature; a three-height contrast by the specification of two features, and so forth, the second and third specification in each respective case being redundant. The logically possible configurations of a two-height system organized by the specification of only one feature are in fact two, as in (6). After having discovered which feature is active in the system, the choice between (6a) and (6b) is made by considering which is/are the element of the \{E, O, A\} system which behave(s) as marked for that feature. These decisions can be made only after a careful study of the phonological processes of the language.

\[
(6) \quad \text{one feature: } [x] \quad \begin{array}{ccc}
E & O & [x] \\
A & & [x] \\
\end{array}
\]

\[\begin{array}{ccc}
E & O & [x] \\
\end{array}
\]

2.2. Domains

The analysis of Campidanian Sardinian metaphony that I propose relies strongly on the notion of domains, and on the assumption that phonological inventories can be relativized to morphological domains. In particular, I argue that Campidanian metaphony can be accounted for by assuming two separate underlying vowel inventories, one relative to the morphological domain of stem and one relative to the morphological domain of desinence.

The study of the phonological rules active in some Spanish and Italian dialects conducted by Dyck (1995) clearly shows the need to assume different vowel inventories according to either prosodic (e.g., stressed vs. unstressed, one prosodic constituent vs. another one) or morphological (e.g., stem vs. desinence) domains. In Pasiego (Santander, Spain), for instance, Dyck demonstrates that the domain of verbal prefixes, which can be defined prosodically, has a smaller underlying vowel inventory than the one occurring in the stem. On the other hand, the asymmetrical raising patterns found in some Italian dialects (e.g., that spoken in Calvello, Lucania), where only one phonetically high desinence triggers metaphony within the stem, are captured by assuming an underlying desinence inventory (4-vowel, 3-height, only one vowel specified for [high]) smaller than
the stem inventory (5-vowel, 3-height, two vowels specified for [high]) (for details see Dyck 1995).

My analysis of metaphony in Campidanian Sardinian highlights a new type of relativization of inventories to domains: that the interaction between the morphological and the phonological component of a grammar appears to be active even on the macroscopic level of the underlying feature specification.

I will show that the—in this case morphological—domains not only inform the number of elements present underlyingly in the correspondent inventories, as discussed by Dyck (1995), but also their underlying feature configurations. In the grammatical system of Campidanian Sardinian, in other words, the phonological inventory of the desinential vowels presents a feature configuration slightly different from the one that characterizes the stem inventory.

In section 8 I will consider the relevance of this difference between the two inventories. The difference between inventories tied to morphological domains, in fact, appears to be principled and thus extremely interesting for phonological theory.

Note that in this paper I will merely assume the notion of domain and of relativization to domains, without questioning whether there is a more general principle (e.g. prominence (Steriade 1993, 1995), or headness (Dresher and van der Hulst 1993, 1998)), according to which the notion of domain can be defined.

2.3. Complexity and neutralization

The analysis of the surface realization of the inventories I present in this paper strongly relies on the phonological notion of complexity, especially of complexity at the segmental level, as introduced and widely discussed by Dresher and van der Hulst (1993, 1998) and Rice and Avery (1993).

First of all, segmental complexity is relative to the contrast configuration of the inventory: it increases together with the number of contrasts within a given inventory. Since contrasts are achieved by feature specifications, segmental complexity is understood in terms of the number of features specified on a given segment of the inventory and their hierarchical organization (feature geometry). The larger the number of features specified (i.e. of nodes and branches in the feature geometry of the segment), the more complex the segment.

Second, the complexity of a segmental representations may be constrained by a Head-Dependent asymmetry requirement, as proposed by Dresher and van der Hulst (1993, 1998). This means that only segments that can be defined as heads (being, for instance, prosodically strong, either on the syllable level or on the word level, or morphologically definable as heads) can exhibit a greater degree of complexity than the segments that, according to the same prosodic parameters, can be defined as their dependents.

The Head-Dependent asymmetry requirement, for instance, is able to capture the common asymmetry between sets of stressed vowels (with more segments) and sets of unstressed vowels (with fewer segments) (for a cross-linguistics survey of such cases see Trubetzkoy 1969). In the unstressed sets, in fact, the more complex vowels are the ones that are systematically missing (Dresher and van der Hulst, 1993: 11-12): compare the minimal representations of vowel structure in (7a) with the stressed and unstressed vowel
inventories in Russian given in (7b) (this example is illustrated by Dresher and van der Hulst, ibid.):

(7)  

<table>
<thead>
<tr>
<th>Vowel structure</th>
<th>i</th>
<th>u</th>
<th>a</th>
<th>e</th>
<th>o</th>
</tr>
</thead>
<tbody>
<tr>
<td>front round low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. Russian vowel inventories
- In strong syllables: i, e, a, o, u
- In weak syllables: i, a, u

Less complexity in the dependent set is achieved by the neutralization of the height contrast between of the more complex segments, i.e. e and o, and their simpler correspondents i and u. The neutralization is resolved in favor of the less complex segments i and u.

Thus, in this framework, neutralization is viewed as a mean of minimizing complexity, if this operation is required. This implies that neutralization applies in a principled manner.

I claim that the surface asymmetry between the stem inventory (7 vowels) and the desinential inventory (3 vowels) of Campidanian Sardinian can be explained in the same fashion as the asymmetry in Russian, Bulgarian and many other languages between the stressed and the unstressed vowel sets. In particular, heads and dependents can be defined morphologically in Campidanian, with stems being heads and desinences being their dependents. 7

The Head-Dependent asymmetry principle requires dependents to show the same or less complexity than heads and thus to minimize complexity in the dependent system, yielding surface asymmetries between stressed and unstressed sets. In particular, I claim that Campidanian dependents must show less complexity than the heads. The discussion of the surface realization of Campidanian desinential inventories is presented in sections 7.1.1. and 7.3.

2.4. Enhancement

While contrasts within underlying inventories should be realized by the minimal number of features (roughly, number of contrast minus one) according to the minimality principle, contrasts within surface inventories should be perceptible (e.g., Cole and Kisseberth 1994; Balcaen 1998).

A way of ensuring the perceptibility of a certain contrast in a given dimension (e.g. height, or place) is to enhance this contrast. The enhancement of the contrast is achieved by inserting a redundant feature from that given dimension (Avery and Rice 1989; Avery 1996; Dyck 1995; Rice 1996) onto the element or the set of elements which constitutes the unmarked pole of the contrast. For instance, given the 3-vowel inventory /i, a, u/ and the two-height contrast achieved by the sole specification of [low] on /a/, this contrast is

7. In this paper I do not consider how heads and dependents could be defined prosodically in Campidanian.
enhanced by inserting a feature such as [high] onto /i/ and /u/. This is exactly the case of the surface inventory of Campidanian desinences (see 7.1.1. and 7.3.).

Enhancement takes place in the phonetic module of the grammar and aims to even the number of contrasts and the number of features, overriding the minimality principle which is valid underlyingly, and, most importantly, ensuring a greater degree of perceptibility of the contrast.

3. Predictions

As pointed out by Dyck (1995), such a model of contrast makes strong predictions as far as features active in the phonology are concerned. In her dissertation, Dyck outlines these predictions and shows their correctness, applying the model to the analysis of Romance varieties, mostly Spanish and Italian dialects. She does not discuss the case of Campidanian Sardinian.

Based on evidence from these Spanish and Italian dialects, Dyck (1995: 11) proposes that the first contrastive (i.e. underlying) specification for height in a Romance vowel inventory is due to the feature [low]. The same has been proposed by Ghini (2001: 192) for the northern Italian dialect spoken in the Ligurian village of Miogliola. That [low] should be the feature specifying the Romance vowel /a/ is confirmed by its phonetic character. As pointed out by Calabrese (1995: 399, footnote 21) with respect to southern Italian dialects, [a] presents a great degree of aperture.

Following the model of contrastive specification and according to Dyck’s and Ghini’s proposals, a second specification for height is required if and only if there is a contrast active within the unmarked domain, and it is due to the feature [high].

The algorithm for the contrastive determination of vowel height is given in (8); it clearly exemplifies the notion of hierarchical scope.

(8) Contrastive determination of vowel height:
1. low vs. non-low (i.e. unmarked) vowels
2. high vs. unmarked vowels

I illustrate (8) below. Assuming an inventory of more than one height, the first height specification in the vowel inventory, due to the feature [low], creates a two-way height contrast (i.e. [low] vs. unmarked), as shown in (9). Following Dyck, I use capital letters to designate the vocalic elements of the underlying inventory.

(9) specifying only one feature: [low] E O A [low]

Note that /E, O/ represent vowels not specified for height. These may surface phonetically as [i, u] due to phonetic enhancement (as discussed in 2.4.), as in quite a few cases discussed by Dyck.

Ignoring issues of abstractness, according to Dyck’s analysis, a three-vowel system such as the desinential inventory [i, a, u] of Campidanian Sardinian, given the inventory in (9), should not allow for phonological rules implying any other feature but [low], since this is the only feature specified in the system.
So far, I have presented the surface stem and desinential inventories of Campidanian Sardinian and discussed the predictions made by the model I adopt with respect to their underlying status. In the following section, I examine evidence for a phonological rule of metaphony in Campidanian Sardinian, showing that the inventories are not as transparent as they seem.

4. Metaphony in Campidanian Sardinian

While Campidanian Sardinian has a surface 7-vowel stem inventory, a careful examination of both distributions and alternations suggests that the stem inventory is actually smaller than this underlyingly, consisting of only 5 vowels. Similarly, I argue that the 3-vowel surface desinence inventory is also a 5-vowel system underlyingly. Note that an underlying 5-vowel inventory for Campidanian has also been claimed by Bolognesi (1998: 20-21). However, I propose to consider the stem and desinential inventories separately because of the insight this yields into the operation of metaphony (see 6).

The alternations and the distributional facts in (10), (11), (12) lead to a hypothesis that metaphony is present in Campidanian Sardinian, with tense mid vs. lax mid vowels in stems being dependent upon the phonological desinential context.

Alternations. The pairs in (10) show that the stem vowels [e, ç] alternate with [e, o] respectively if followed by a phonetically high vowel:

<table>
<thead>
<tr>
<th>TENSE</th>
<th>LAX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Campanian M.SG [-u]</strong></td>
<td><strong>Campanian F.SG [-a]</strong></td>
</tr>
<tr>
<td>ni'eq:-u</td>
<td>ni'eq:-a</td>
</tr>
<tr>
<td>'lent-u</td>
<td>'lent-a</td>
</tr>
<tr>
<td>'ver-u</td>
<td>'ver-a</td>
</tr>
<tr>
<td>'no-u</td>
<td>'no-a</td>
</tr>
<tr>
<td>'so-u</td>
<td>'soβ-a</td>
</tr>
<tr>
<td>'mot:-u</td>
<td>'mot:-a</td>
</tr>
</tbody>
</table>

Distribution. A mid-high vowel, i.e. [e, o], is always found in a phonetically high context, as shown in (11), and a mid-high vowel is never found in a phonetically low context, as in (12).

<table>
<thead>
<tr>
<th><strong>Campanian M.SG</strong></th>
<th><strong>gloss</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>'open.M.SG'</td>
<td>(11) 3βet: -u</td>
</tr>
<tr>
<td>'fire.M.SG'</td>
<td>'føy -u</td>
</tr>
<tr>
<td>'sky.M.SG'</td>
<td>'3eβ -u</td>
</tr>
<tr>
<td>'place.M.SG'</td>
<td>'loγ -u</td>
</tr>
<tr>
<td>'stupid.M.SG'</td>
<td>'lok: -u</td>
</tr>
<tr>
<td>'game.M.SG'</td>
<td>'dɔγ -u</td>
</tr>
<tr>
<td>'tin.M.SG'</td>
<td>'bot: -u</td>
</tr>
<tr>
<td>'sleep.INF'</td>
<td>'drom -i</td>
</tr>
<tr>
<td>'weave.INF'</td>
<td>'tes: -i</td>
</tr>
<tr>
<td>'harbour'</td>
<td>'pot: -u</td>
</tr>
<tr>
<td>'grass.F.SG'</td>
<td>(a)rɔβ -a</td>
</tr>
<tr>
<td>'hour.F.SG'</td>
<td>'fɔt -a</td>
</tr>
<tr>
<td>'time.F.SG'</td>
<td>'kɔs -a</td>
</tr>
<tr>
<td>'cherry.F.SG'</td>
<td>'kɔs -a</td>
</tr>
<tr>
<td>'thing.F.SG'</td>
<td>'ser: -a</td>
</tr>
<tr>
<td>'hill.F.SG'</td>
<td>'fɔje -a</td>
</tr>
<tr>
<td>'party.F.SG'</td>
<td>(a)rɔz -a</td>
</tr>
<tr>
<td>'rose.F.SG'</td>
<td>'pot: -a</td>
</tr>
<tr>
<td>'wheel.F.SG'</td>
<td>'door'</td>
</tr>
</tbody>
</table>
However, while for the distribution in (12) there is no counterexample, there are counterexamples to (11) in Campidanian, with lax mid vowels in the stem in a desinential high context (see (13) in the next section). This contrast between the distribution in (11) and (13) requires an evaluation of the hypothesis that metaphony is phonologically active in Campidanian.

4.1. Metaphony or not metaphony?

The stems in (13) have a lax mid vowel even if followed by a phonetically high desinence, contrary to what we saw in (11). In particular, (13a) presents some of the nouns which lack tensing of the mid stem vowel in the high context, (13b) some of the first person singular verbal forms which systematically lack tensing in this context, and (13c) some striking minimal pairs where both a tense vowel and a lax vowel occur in a high context:

(13) a. 'frò-i ‘flower-M.SG’  
pe'ger-i ‘pleasure-M.SG’  
'mek-i ‘honey-M.SG’  
'dcm-u ‘house-f.SG’  
'sòk-i ‘sun-M.SG’  
'mez-i ‘month-M.SG’  
'nèpòd-i ‘nephew-M.SG’  
'bòz-i ‘voice-f.SG’

b. 'bòl:-u ‘want-PRES.1SG’
'(b)otf:-u ‘kill-PRES.1SG’
'sè-u ‘be-PRES.1SG’
'tòk:-u ‘drive-PRES.1SG’
'teng-u ‘have-PRES.1SG’
'tued:-u ‘speak-PRES.1SG’
'pez-u ‘stand-PRES.1SG’
'(b)es:-u ‘go-out-PRES.1SG’

(13) c. metaphonized < /-I, -U/>  
'ben-i ‘come-IMP’  
'fet-i ‘only(Adv)’  
'ol:-u ‘oil-M.SG’  
'or-u ‘edge-M.SG’

non-metaphonized < /-E, -O/>  
'ben-i ‘good/well(Adv)’  
'fet-i ‘flour-M.SG’  
'(b)ol:-u ‘want-PRES.1SG’  
'or-u ‘gold-M.SG’

While the alternations in (10) strongly suggest metaphony, the distribution of tense and lax vowels in (11) through (13) make us question whether metaphony exists. The facts are summarized in (14).

(14) SURFACE DESINENCE | SURFACE STEM | METAPHONY (TENSING)
---|---|---
[-i, -u] | [-e-, -o-] | yes
[-i, -u] | [-e-, -o-] | no

It thus seems that there are phonetically high desinences triggering tensing, and phonetically high desinence not triggering it. Assuming that metaphony exists, how can this situation be captured if only three desinences are present underlyingly? Note that a mere phonetic explanation is not possible, as the minimal pairs in (13c) suggest: those

---

8. Old currency.
items differ only for the stem vowel quality and for nothing else in terms of phonetic environment: the phonetically high context is always present.

Again assuming metaphony, it appears that the only solution is to assume that the desinential inventory is not a three-vowel system, but rather a five-vowel inventory organized in three heights: one determined by the feature [low], one unspecified (and thus unable to trigger metaphony), and one specified for a tensing feature, likely [ATR], being the height which triggers tensing within the stem. Before discussing this option, however, it is necessary to examine the assumption that metaphony is indeed present in Campidanian Sardinian.

At first glance, the data presented so far suggest also another approach to explain the alternation pattern between tense and lax mid vowels in Campidanian stems. The following option is indeed the simplest, since it claims that surface and underlying inventories of both stems and desinences coincide. According to this approach, the underlying desinential inventory is indeed a three-vowel system, and, as far as stem vowels are concerned, there is no rule triggering surface alternations between mid tense and mid lax vowel. In other words, the underlying stem inventory is a seven-vowel system as given by the surface facts, and therefore the minimal pairs in (13c), for instance, are minimal pairs due to allomorphy in terms of underlying stem vowel quality, rather than due to the underlying desinence vowels. This option excludes metaphony being involved.

Thus, there are two possible ways of regarding the minimal pairs in (13c) in particular, and the data presented so far in general:

(i) no-metaphony hypothesis:
   • stem inventory /i, e, e, a, o, u/
   • desinential inventory /i, a, u/

(ii) metaphony hypothesis:
   • stem inventory /I, E, A, O, U/
   • desinential inventory /I, E, A, O, U/

Recall that capital letters are used to designate underlying vocalic elements, whose feature specifications will be discussed in the next sections.

As for the options (i) and (ii), is there any evidence in favor of one hypothesis over the other? Let us first reconsider the distributional facts, including this time also [-a] and the stem mid vowels that precede it:

<table>
<thead>
<tr>
<th>SURFACE DESINENCE</th>
<th>SURFACE STEM</th>
<th>METAPHONY (TENSING)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[-i, -u]</td>
<td>[-e, -o]</td>
<td>yes</td>
</tr>
<tr>
<td>[-i, -u]</td>
<td>[-e, -o]</td>
<td>no</td>
</tr>
<tr>
<td>[-a]</td>
<td>[-e, -o]</td>
<td>no</td>
</tr>
<tr>
<td>*[-e, -o]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If the alternation between tense and lax mid vowels in the stem is lexical, why is it the case that before the desinence [-a] no alternation between the two is found? The stem mid vowels, in fact, are always lax, with no exceptions, when the desinence is phonetically and phonologically [low] (see (12)). Moreover, stem tense mid vowels are
only found in a phonetically high desinential context (see (11)). This absolute distributional pattern would be only a coincidence under the no metaphony hypothesis. In order to strengthen the metaphony hypothesis I now examine the desinential inventory more closely. I provide synchronic, diachronic and cross-dialectal evidence that it is indeed a 5-vowel system underlyingly. This automatically implies that the stem inventory is an underlying 5-vowel system as well.

4.2. Evidence for metaphony

According to the metaphony hypothesis, the desinential inventory cannot be a three-vowel system, i.e. a two-height system, since some phonetically high desinences trigger tensing and some other phonetically high ones do not. Assuming metaphony to be active in the phonology of Campidanian, this scenario implies a three-height system for the desinential inventory, as already proposed by Bolognesi (1998). Note that this hypothesis is in line with the claim made by Dyck (1995: 99) that “the relevant Italian desinential inventories of fewer than five vowels derive from underlying /I, E, A, O, U/ inventories.” This claim is supported by the analysis of other central and southern Italian dialects, such as Neapolitan (Dyck 1995) and Salentino (Calabrese 1984). Dyck (1995: 107) argues for a five-vowel desinential inventory in Neapolitan based on evidence that not all desinences trigger metaphony, as summarized in the following table: 9

(16) 

<table>
<thead>
<tr>
<th>SURFACE DESINENCE</th>
<th>UNDERLYING DESINENCE</th>
<th>METAPHONIZING</th>
</tr>
</thead>
<tbody>
<tr>
<td>m.pl [-e]</td>
<td>/-I/</td>
<td>yes</td>
</tr>
<tr>
<td>2sg.ind [-e]</td>
<td>/-I/</td>
<td>yes</td>
</tr>
<tr>
<td>f.pl [-e]</td>
<td>/-E/</td>
<td>no</td>
</tr>
<tr>
<td>m.sg [-o]</td>
<td>/-U/</td>
<td>yes</td>
</tr>
<tr>
<td>n.sg [-o]</td>
<td>/-O/</td>
<td>no</td>
</tr>
<tr>
<td>1sg.ind [-o]</td>
<td>/-O/</td>
<td>no</td>
</tr>
<tr>
<td>f.sg [-a]</td>
<td>/-A/</td>
<td>no</td>
</tr>
</tbody>
</table>

As pointed out by Dyck (1995: 110), the no-metaphony hypothesis, which she labels a ‘morphologization’ approach to metaphony (as discussed in Maiden 1991), “predicts that metaphony will in general correlate with particular morphological classes.” On the other hand, the metaphony hypothesis, i.e. the phonological account, predicts that metaphony depends on the feature specification of the trigger, which, in the case of Romance varieties, is the desinence. As already outlined in the introduction, desinences are extensions and do not define morphological classes by their own. The morphological class is given by the base.

My argument for Campidanian follows exactly the same lines. Consider the table in (17). It collects all Campidanian desinences in Bolognesi’s corpus (1998), and shows their behavior with respect to metaphony, and thus their underlying correspondent. The last column will become intelligible after having considered the Italian loans (later in this section) and the Latin sources (4.2.1).

9. Note that the Neapolitan metaphony is of a different type, one which raises mid vowels to high vowels and diphthongizes the lax mid vowels rather than tensing. This is not relevant to the issue under discussion here.
Consider that the majority of Campidanian Sardinian masculine nouns end in [-u] < /-U/. The masculine nouns whose desinence does not trigger tensing, because of [-u] < /-O/, are Italian loans. Moreover, the infinitive desinence of the first conjugation is [-ai] < /-AI/, given that a form such as aβe'tai ‘wait.INF’ does not show a tense stem vowel, suggesting that the (in this case non-) trigger of metaphony is not the final vowel [-i], which itself marks the infinitive, but rather the thematic vowel -a- due to locality restrictions (to which I return below).

The metaphony hypothesis predicts that, apart from the desinences which trigger metaphony (/I/ and /U/), i.e. desinences that are underlying specified for the tensing feature (discussed in section 4.3.), there should be desinences which do not trigger it (/E/ and /O/), being underlyingly unspecified for the trigger feature.11 The prediction is confirmed not only by the data presented in (13), where the lax mid vowels surface in the absence of a feature on the desinence that can trigger metaphony, but also by plenty of other minimal pairs:

10. The discussion of this quite interesting issue is beyond the scope of this paper.
11. There are three words in which the trigger does not appear to be the final desinence (Bolognesi, p.c.): mendul-a (Lat. AMYGDAL-UM, -I (n., II)) ‘almond’, genug-u (Lat. GEN-U, -US (n., IV)) ‘knee’, omin-i (Lat. HOMO-ø, HOM-INS (m., III)) ‘man’. Historically, the bolded vowel is the desinence; whether a synchronic analysis along these lines is possible remains for further investigation.
It is worthwhile to note that Campidanian plural nouns always show lax mid stem vowels (Bolognesi, p.c.). Once more, it could be argued that the laxness of the stem vowel is the lexical marker for plurality in Campidanian. However, Italic Romance varieties, including Standard Italian, mark plurality by means of desinences, and thus Campidanian would be the only exception among them under the no-metaphony hypothesis. This scenario is not impossible, but metaphony can account for this straightforwardly. Both historical (see 4.2.1) and cross-dialectal (see 4.2.2) data confirm the plurality marker being desinential. Moreover, the following minimal pairs show that the singular/plural contrast is not always realized by the tense/lax contrast of the stem vowels:

(19)  
\[\begin{array}{ccc}
\text{Campidanian SG} & \text{Campidanian PL} & \text{gloss} \\
(\text{underlying mid vowel desinence}) & (\text{underlying mid vowel desinence}) & \\
\text{dom-u} & \text{dom-us} & \text{‘house’} \\
\text{nbt:-i} & \text{nbt:-is} & \text{‘night’} \\
\text{munt-i} & \text{munt-is} & \text{‘mountain’} \\
\end{array}\]

As for the N/V minimal pairs in (18b), see the Latin counterparts in (24).

Further synchronic evidence for the metaphony hypothesis is provided by the way Campidanian Sardinian incorporates Standard Italian words into its system. Italian singular desinences /-e/ and /-o/\(^{12}\) (cf. first column of (20) and of (21)) do not tense the lax mid vowels in the stem (cf. second column of (20) and of (21)), even though they surface as -[i] and -[u] in Campidanian, showing that they enter the Campidanian desinential system as underlying /E/ and /O/:

---

12. There is no Italian form ending in -u. Italian masculine nouns end in -i, but Campidanian plurals (i.e. -us/is) never trigger metaphony (Bolognesi p.c.).
### In Italian, there is no form, either noun or verb, ending in [-u]. As for Italian [-i], it is the desinence for plural masculine nouns (and of very few irregular feminine nouns), but it does not correspond to the Sardinian plural affix, which is [-s] attached to the vocalic gender desinence. Italian [-i] is also a desinence indicating the 2nd person singular within a verbal inflectional paradigm for all the conjugations in the finite tenses and the 2nd person singular and plural in the imperative of 2nd and 3rd conjugation. The correspondent Sardinian forms always show metaphony:

<table>
<thead>
<tr>
<th>Italian</th>
<th>Campidanian</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>vjen-i!</td>
<td>ben-i!</td>
<td>‘come.IMP.2sg(3CONJUG.)’</td>
</tr>
<tr>
<td>esc-i!</td>
<td>(b)es:-i!</td>
<td>‘go out.IMP.2sg(3CONJUG.)’</td>
</tr>
</tbody>
</table>

### Diachronic considerations

Historically, as already pointed out by Bolognesi (1998), there is evidence that Campidanian -/I/ and -/U/ derive from Latin -i and -u respectively, and that
Campidanian -/E/ and -/O/ derive from Latin -e and -o respectively, as shown in (23), (24) and (25):

(23) | Camp. SG | Latin | Camp. PL | Latin | gloss  
---|---|---|---|---|---
tempus | TEMPUS | tempus | TEMPORA (n., III) | ‘time’  
krop:us | CORPUS | krop:us | CORPORA (n., III) | ‘body’  
bet:j:u | VETUS | bet:j:us | VETERES (adj., II) | ‘old/parent’  
ot:u | HORTUM | ot:us | HORTOS (m., II) | ‘vegetable garden’  
oy:u | OCULUM | oy:us | OCULOS (m., II) | ‘eye’

(24) | Campidanian | Latin | Campidanian | Latin  
---|---|---|---|---
'beni | ‘come’ | VENI (V) | 'beni | ‘good/well’ | BENE (Adv)  
'feti | ‘only’ | EXCEPTIS (V) | 'feti | ‘flour’ | EXCEPTE (adj, II?)  
'ol:u | ‘oil’ | OLEUM (n., II) | '(b)ol:u | ‘want’ | VOLO (V)  
'oru | ‘edge’ | OS (n., II) | 'oru | ‘gold’ | It. òro (N, M.SG)  
'sonnu | ‘dream’ | SOMNIUM (n., II) | 'sonnu | ‘dream’ | SOMNIO (V)  
'sonu | ‘sound’ | SONUM (m., II) | 'sonu | ‘sound’ | SONO (V)

(25) | Campidanian | Latin | gloss  
---|---|---
ne'bɔ:r:i | NEPOTEM (m., III) | ‘nephew’  
nɔ:t:i | NOCTEM (f., III) | ‘night’  
mɔnti | MONTEM (m., III) | ‘mountain’  
bɔ:r:i | VOCEM (f., III) | ‘voice’  
frɔr:i | FLOREM (m., III) | ‘flower’  
mez:i | MENSEM (m., III) | ‘month’  
sɔ:r:i | SOLEM (m., III) | ‘sun’  
mɛr:i | MEL (n., III) | ‘honey’

The diachronic facts highlight that: (i) plurality is marked desinentially; (ii) Campid. –I –U < Lat. –i –u and Campid. –E, -O < Lat. –e, -o.

4.2.2 Cross-dialectal evidence

A surface contrast between high and mid desinential vowels is present in the dialects spoken in northern Sardinia (e.g. Nuorese), which are traditionally claimed to be more conservative than the southern ones. Where Campidanian has -[i] < /E/ and -[u] < /O/, Nuorese has -[ɛ] and -[ɔ] respectively:

(26) a. | Campidanian | Nuorese | gloss  
---|---|---|---
'frɔr:i | 'frɔr:e | ‘flower.M.SG’  
'mɛr:i | 'mele | ‘honey.M.SG’  
'dɔm u | 'dɔm:ɔ | ‘house.M.SG’
b.  | **Nuorese SG** | **Nuorese PL** | **gloss**  
--- | --- | --- | ---  
tempus | tempɔs | 'time'  
ɔt:u | ɔt:ɔs | 'vegetable garden'  
loγu | loγɔs | 'place'  
kentu | kentɔs | 'hundred'  

- compare (19b) to (13a) -

The data in (26) lead to the conclusion that Nuorese and Campidanian stems pattern exactly the same, the differentiation being in the surface form of the desinences. Where Campidanian desinences neutralize the contrast between mid and high vowels, Nuorese desinences do not.

### 4.2.3. Summary

In this section I outlined arguments for the metaphony hypothesis, mainly based on alternations, distribution, and diachronic and cross-dialectal considerations. Within the frame of the metaphony hypothesis, I have shown that not all desinences, i.e. not all [-i], [-a] and [-u], trigger metaphony.

This fact can be captured only by hypothesizing that the underlying desinential inventory is a three-height system consisting of five vowels, contrary to the surface facts. The presence of a third height in the system is supported by synchronic (4.2.), diachronic (4.2.1.) and cross-dialectal (4.2.2.) evidence. The metaphony hypothesis also implies that the stem inventory is a 5-vowel system as well, even though it surfaces as a 7-vowel one.

Having established the contrasts in the inventories, I now turn to the question of how to formalize the underlying inventories in terms of features. I assume, following Dyck (1995), Ghini (2001) and Calabrese (2000), that A is specified for [low]. It is now necessary to establish which feature characterizes the trigger of metaphony /I/ and /U/.

The question thus concerns the rule of metaphony itself: which feature is spreading?

### 4.3. Spreading [ATR]: towards the underlying desinence inventory

Note that in Campidanian Sardinian, metaphony affects only lax mid vowels, which tense in a phonetically high environment, thus differing from the two major types of metaphony found in Italian dialects, the *napoletano* type and the *arpinate* type (Reiss 1982), which both involve the raising of stressed tense mid vowels to high. The *napoletano* type (as found in the Neapolitan, Calvello and Salentino, all southern Italian dialects) raises the stressed tense mid vowels to high (e, o → i, u/ _-i, -u) and diphthongizes the stressed lax mid vowels (e, o → je, wo/ _-i, -u). The *arpinate* type (as found in the Servigliano dialect (Central Italy) among others) also raises the stressed tense mid vowels to high (e, o → i, u/ _-i, -u), and raises the stressed lax mid vowels to tense mid vowels (e, o → e, o/ _-i, -u) (for a discussion of the two types, see Kaze 1991 and Dyck 1995). I will not be concerned with the analysis of these types of metaphony in any detail, but it is worth pointing out that the metaphony rule regarded as responsible for *napoletano* and *arpinate* metaphony is usually formalized as ‘spread [high]’ (Calabrese 1984, 1993, 1995; Kaze 1989, 1991; Myers 1991; Dyck 1995).

As for the type of metaphony found in Campidanian Sardinian, which involves only a tensing of the mid vowels closest to the trigger, alternating tense mid vowels [e] and [o]
with lax mid vowels [ɛ] and [ɔ], I assume it is due to the spreading of the feature [ATR], and I will label this pattern the *sardo* type.

If the feature [high] were to spread in Campidanian, underlying mid vowels /E/ and /O/ would be expected to raise to high vowels [i] and [u] or [ɪ] and [ʊ] respectively; but they would not be expected to tense to [e] and [o] respectively. A different feature than [high] is required, and I propose here that this feature is [ATR].

How likely is it that [ATR] is involved in spreading?

There is literature about the active role of [ATR] in height vowel harmony. For instance, the height vowel harmony in Pulaar (West Atlantic), where the underlying 5-vowel system /i, e, a, ɔ, u/ becomes the surface 7-vowel inventory [i, ɛ, e, a, ɔ, o, u], essentially shows the same pattern found in Campidanian Sardinian. Paradis (1986) claims that in Pulaar the mid vowels /ɛ/ and /ɔ/ assimilate the redundant [+ATR] specification of the high vowels, yielding [ɛ] and [ɔ] respectively in the relevant context. Hyman (1988) also claims that the feature [ATR] is involved for vowel height in Esimbi (Bantu). Furthermore, Hyman (1988: 265-266) makes an interesting statement about the feature [ATR]: “it is likely that [ATR] should be viewed as a more general cover feature possibly involving different gestures in different languages (height, quality, pharyngealisation, centralizing, flattening, etc.).” In Esimbi, [ATR] is exploited for vowel height. I claim that this is the case in the southern Sardinian vowel system as well.¹⁶

Let us consider the feature that triggers metaphony from a different perspective. Calabrese (1995: 400) argues that metaphony in Romance dialects is all attributable to a single rule, ‘spread [high],’ with the dialect differences resulting from different simplification procedures that apply to repair disallowed configurations created by the application of a rule. For example, Southern Umbro has a metaphony process that is like that of Campidanian Sardinian. According to Calabrese, tensing in Southern Umbro is due to the application of a repair strategy which he calls ‘Negation.’ The configuration derived by metaphony, [+high, -ATR] violates a markedness constraint which disallows the co-occurrence of these two features with these values, and must be negated, yielding, ultimately, [+ATR, -high]. While Southern Umbro has ‘Negation,’ Salentino and Foggiano (spoken in Puglia, Southern Italy) require ‘Delinking.’

Calabrese’s analysis is certainly a possibility. However, my assumptions lead me to a different result. I assume that the feature [ATR] is directly involved in metaphony in Campidanian Sardinian, and is not the by-product of a repair strategy. Rather, dialect variation results from a general rule ‘spread [x],’ where the choice of [x] is constrained by the feature configuration of the inventory of the particular language. This claim follows from the assumption that inventories and their feature configuration are primitives of the grammar, which inform the phonological processes. Since primitives are not given to the linguist, the linguist observes the phonological rules to reconstruct the primitives.

I assume that metaphony in Campidanian is a rule which spreads [ATR] from desinences to the closest stem vowel, thus showing a locality constraint.

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¹⁶ As for the multi-faceted nature of [ATR] highlighted by Hyman (1984), note that Calabrese (2000) claims that [+ATR] is responsible for the fronting of the high rounded vowel /u/, which yields [y], in many Romance varieties (among others, French and the Gallo-Romance varieties spoken in North Italy). His claim is supported by the analysis of this sound change in the dialect of Altamura (Puglia, South Italy).
5. The underlying representation of the inventories

Having established that metaphony is active phonologically implies that the vocalic elements within the underlying stem and desinential inventories are five. A careful look at the rule of metaphony itself suggests that the feature spreading from the desinence onto the adjacent stem vowel is [ATR]. Furthermore, I assume, together with Dyck (1995), Ghini (2001) and Calabrese (2000), that A is specified for [low]. It is now possible to draw the feature configurations of the inventories of Campidanian Sardinian.

5.1 The underlying desinential inventory as a five-vowel system

Based on the evidence provided so far, the feature configuration of the desinential five-vowel inventory is as follows, where the phonological contrast between the unspecified vowels and the vowels specified for [ATR] is phonetically neutralized, yielding the surface three-vowel desinence system (see 7.1.1.).

(27) specifying two features: [low] and [ATR]

<table>
<thead>
<tr>
<th>I</th>
<th>U</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>O</td>
<td>[ATR]</td>
</tr>
</tbody>
</table>

5.2 The underlying stem inventory

According to the metaphony hypothesis, the stem inventory is a 5-vowel system, like the desinential one, even though it surfaces as a 7-vowel inventory. The metaphony hypothesis predicts the distribution of stem tense and lax mid vowels.

For now, I also assume that the five-vowel stem inventory has the same feature configuration of the desinential inventory:

(28) desinential and stem inventory

<table>
<thead>
<tr>
<th>I</th>
<th>U</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>O</td>
<td>[ATR]</td>
</tr>
</tbody>
</table>

I will show in section 6 that this assumption must be wrong because it makes the wrong predictions with respect to the metaphony rule. I will propose two possible solutions to this puzzle in section 7.

6. The feature configuration of the stem inventory: the puzzle

I now focus on the analysis of the feature configuration of the stem inventory and on the puzzle it presents for the metaphony rule.

If the stem inventory has the same feature specifications as the desinential inventory (see (29)), namely [low] and [ATR], the wrong predictions are made with respect to tensing (30). The tensed stem vowels should surface as [e] and [o] (see (30a)) and not as [i] and [u] (see (30b)) as the identical feature specification of the two inventories in (29) would predict.
(29) desinential and stem inventory

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>U</th>
<th>[ATR]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E</td>
<td>O</td>
<td>[low]</td>
</tr>
</tbody>
</table>

(30) a. AS FOUND

<table>
<thead>
<tr>
<th>stem</th>
<th>des.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-[e,o]-</td>
<td>-[i]</td>
</tr>
</tbody>
</table>

b. AS PREDICTED BY (29)

<table>
<thead>
<tr>
<th>stem</th>
<th>des.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-/E,O/-</td>
<td>-/I/</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>stem</th>
<th>des.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-[i, u]-</td>
<td>-/E,O/- -/U/</td>
</tr>
</tbody>
</table>

   | [ATR] | [ATR] | [ATR] |

The unspecified stem vowels /E/ and /O/, targeted by the spreading rule, become specified for [ATR] by rule. Thus, by rule, they become equivalent to the underlying stem vowels /I/ and /U/, which are lexically specified by [ATR]. Being identically specified for [ATR], they are expected to surface the same. This is not supported by the facts, since the stem targets of metaphony surface as tense mid vowels and underlying stem vowels /I/ and /U/ surface as high vowels. Thus, the configuration option in (29) is to be rejected since it fails to predict the occurring pattern.

To sum up, if the two inventories are specified for the same features, the spreading of [ATR] does not expand the stem inventory by one height, contrary to surface facts.

7. A domain-based analysis

I propose that this puzzle can be solved by assuming that feature specifications are relativized to paradigmatic domains, i.e. stem and desinential domains. As proposed by Dyck (1995) for her analysis of similar phenomena in Spanish and Italian dialects, the phonological component appears to be sensitive to morphological information not only with respect to phonological rules but also, interestingly, with respect to the organization of phonological inventories. I here reconsider the facts of Campidanian Sardinian metaphony discussed so far from this perspective.

The analysis I propose requires a further level of interaction between the phonological and morphological components, namely the macro-level of feature configuration of inventories. The Spanish and Italian dialects analyzed by Dyck (1995) suggest the relativization of inventories to morphological domains in terms of different domains-different inventories. For instance, the asymmetric metaphony pattern in Calvello (a southern Italian dialect spoken in Lucania), where metaphony in the stem is triggered only by desinential [-i] but not by [-u], is analyzed by Dyck (1995: 87-98) as due to the interaction between the stem 5-vowel inventory /I, E, A, O, U/ and the desinential 4-vowel inventory /I, E, A, O/. The desinential 4-vowel inventory is a three-height system where only /I/ is specified for the raising feature [high], thus accounting for the asymmetric pattern (for more details about the phonetic realization of the inventory see Dyck (ibid.)).
The situation in Campidanian is quite different. Even if both stem and desinential inventories have five vowels underlyingly, the metaphony pattern can be accounted for only by assuming that they are specified differently (see 7.1.).

The following analysis of Campidanian vowel inventories shows how the relativization of inventories to morphological domains can occur on this finer grained level. According to this analysis Campidanian vowel inventories are relativized to morphological domains by differing in feature specification rather than in number of segments. Essentially, given the exact same inventory for both stem and desinential domain in terms of number (five-vowel system) and nature of segment (\{I, E, A, O, U\}), they differ in terms of the specified features (stem: [low]/[high] vs. desinence: [low]/[ATR]). This result is even more striking since the geometry of the feature configuration is the same (with the same segments unmarked in both inventories and the same specification for one of the heights) and thus the relativization to the two morphological domains (i.e. stem and desinential) is achieved by the different specification of only one feature between them.

7.1. The analysis

In this section I argue that a solution to the puzzle presented in section 6 becomes available if it is assumed that these two inventories show two different feature specifications. Thus, both stem and desinential inventories of Campidanian Sardinian are 5-vowels systems, but, crucially, the stem inventory is characterized by the features [low] and [high], whereas the desinential inventory realizes the same ‘geometrical’ configuration by specifying [ATR] instead of [high], as given in (31):

\[
\begin{array}{ccc}
\text{underlying stem inventory} & \text{underlying desinential inventory} \\
\hline
I & U & [high] \\
E & O \\
A & [low] \\
E & A & [low] \\
O & [ATR] \\
\end{array}
\]

In this scenario, metaphony is still a rule which spreads [ATR] from desinential triggers to unmarked stem targets, yielding the stem tense mid vowels, as shown in (32). Note that [ATR] spreads only onto the adjacent stem vowel (if it is a possible target) and does not spread further: e.g. \( \betaet\text{-u} \) ‘open.M.SG’. This indicates that spreading is constrained by a locality principle.

\[
\begin{array}{ccc}
\text{stem} & \text{des.} & \text{stem} \\
/E, O/ & -/I/ & \rightarrow & [e, o] \\
[A TR] & & \\
\text{stem} & \text{des.} & \text{stem} \\
/E, O/ & -/U/ & \rightarrow & [e, o] \\
[A TR] & [A TR] & \\
\end{array}
\]

Thus, stem tense mid vowels [e] and [o] arise on the surface after the feature [ATR] has spread from the desinential vowel -/I/ or -/U/. Stem lax mid vowels arise by default, when [ATR] is not available for spreading, i.e. when the desinence is the unspecified vowel -/E/ or -/O/:
In other words, it is the spreading of [ATR] which, yielding the tensing of the stem targets, expands the stem vowel inventory by one height in its surface configuration. Note that the specification for [ATR] targets the subset of vowels that are unmarked for height, /E, O/.

(34)  

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<tr>
<td>IU</td>
<td>E</td>
<td>U</td>
<td>[high]</td>
<td>spreading [ATR]</td>
<td>surface stem inventory</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>i</td>
<td>u</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>O</td>
<td></td>
<td></td>
<td>e</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td></td>
<td>[low]</td>
<td></td>
<td>ε</td>
<td>ò</td>
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<td></td>
<td>a</td>
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</tbody>
</table>

7.1.1 The surface realization of the desinential inventory

As for the surface realization of the desinential inventory, the contrast [ATR]/Ø within the non-low region of the inventory (recall the desinential feature configuration in (31)), i.e. the contrast between /1,U/ and /E,O/, is phonetically neutralized. Both /1,U/ and /E,O/, in fact, surface as phonetically high vowels [i, u]. In particular, front /1/ and /E/ surface as the phonetically front high vowel [i], and round /U/ and /O/ as the phonetically round high vowel [u]. This same neutralization of the contrast underlyingly active in the non-low vowel space of the desinential inventory has been argued for other southern Italian dialects, namely Neapolitan (Dyck 1995) and Salentino (Calabrese 1984).

The surface realization of the desinential inventory thus proceeds as follows:

(35)

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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IU</td>
<td>desinential inventory</td>
</tr>
<tr>
<td>Underlying</td>
<td>U</td>
<td>[ATR]</td>
<td></td>
<td>neutralize</td>
<td>Surface</td>
<td>inventory</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>O</td>
<td></td>
<td>E</td>
<td>O</td>
<td>i</td>
</tr>
</tbody>
</table>

However, one must ask why neutralization occurs. Recall from section 2.3. that I assume that (i) Campidanian shows a Head-Dependent asymmetry (in particular dependents must show less complexity than heads in this grammar); and (ii) neutralization is nothing but a strategy of minimizing complexity when this is required by the Head-Dependent asymmetry principle. Also recall from the same section that in Campidanian desinences can be defined as dependents of stem heads.

The neutralization of the height contrast achieved by specifying [ATR] in the non-low vowel space of the inventory, i.e., the loss of the feature [ATR], makes the desinential inventory less complex than the stem one, thus satisfying the asymmetry requirement. As a result, the desinential inventory after neutralization is in fact a two-height system, where the [low] vowel A contrasts with the non-low vowels E and O. This minimal height contrast gets phonetically enhanced by the insertion of the feature [high].
Surface inventories, in fact, are not subject to the minimality principle. One of the characteristics of surface configurations is to enhance the underlying contrast by adding redundant features. Within the Campidanian desinential inventory, [high] can be redundant since it is not contrastive. Once more, this matches Dyck’s statement about Spanish and Italian dialects (1995:304): “the feature [high] could be used as an enhancement-feature when not contrastive.”

7.2. An alternative analysis

The puzzle outlined in 6, however, could be solved also by assuming a feature configuration for the desinential inventory different from the one proposed in (31). This second option implies that metaphony is a lowering process rather than a tensing one.

The option I am going to present arises in attempting to make the desinential inventory a subdomain of the stem one, rather than different from the stem inventory. I will show that this attempt fails; even though it is possible to eliminate the feature [ATR] from the desinential configuration, the need for two different inventories depending on the different domains, i.e., stem and desinential, remains. Specifically, the attempt to make the desinential inventory a subset of the stem one succeeds in terms of features (stem: [high]/[low] vs. desinential [low]), but fails in maintaining the same geometrical configuration ([low] specifies a wider area of the inventory space in desinences than in stems, see the discussion of ‘configurational scope’ in 2.1. and in 7.2.1.), as shown in (36):

\[
\begin{array}{cccc}
\text{stem inventory} & & \text{desinential inventory} \\
\hline
\text{I} & \text{U} & \text{[high]} & & \text{I} & \text{U} & \text{[low]} \\
\text{E} & \text{O} & & \text{E} & \text{U} & \text{[low]} \\
\text{A} & \text{[low]} & & \text{A} & & \\
\end{array}
\]

Assuming these specifications, metaphony can be formalized as a rule spreading [low] onto the unmarked stem vowel, and will be triggered not only by the /-E, -O/ desinences, but also by /-A/, as the data presented in the previous sections suggest (lax stem vowels occur with /-E, -O, -A/ desinences):

\[
\begin{array}{cccc}
\text{stem} & \text{des.} & \text{stem} & \text{des.} & \text{stem} & \text{des.} & \text{stem} \\
/E, O/ & -/E/ & \rightarrow & [\varepsilon, \sigma] & /E, O/ & -/O/ & \rightarrow & [\varepsilon, \sigma] & /E, O/ & -/A/ & \rightarrow & [\varepsilon, \sigma] \\
\end{array}
\]

According to this option, stem tense mid vowels arise by default:

\[
\begin{array}{cccc}
\text{stem} & \text{des.} & \text{stem} & \text{des.} & \text{stem} \\
/E, O/ & -/I/ & \rightarrow & [\varepsilon, \sigma] & /E, O/ & -/U/ & \rightarrow & [\varepsilon, \sigma] \\
\end{array}
\]

The surface four-height stem system is derived from the underlying three-height one not by adding a new feature specification by rule (i.e. [ATR] in (34)), but widening the scope of [low] by rule. Note that /A/ is the only stem vowel lexically specified for [low],...
as [ɛ] and [ɔ] are specified as [low] only by rule, after spreading from the [low] desinences has occurred.

\[
\begin{array}{c|c|c}
I & U & [high] \\
E & O & [low] \\
A & \\
\end{array}
\rightarrow
\begin{array}{c|c|c}
i & u & [high] \\
e & o & [low] \\
\varepsilon & \omega & [low] \\
\end{array}
\]

7.2.1. The relevance of the notion of ‘configurational’ scope

The alternative analysis of metaphony as a lowering process highlights the relevance of the notion of configurational scope introduced in section 2.1. Let us compare the two desinential configurations achieved by the specification of [low] presented in (40) and the respective predictions with respect of the triggers of metaphony they made.

\[
\begin{array}{c|c|c}
a.\text{ desinential inventory } \alpha & b.\text{ desinential inventory } \beta \\
I & U & I & U \\
E & O & E & O [low] \\
A & [low] & A & \\
\end{array}
\]

In (40a), [low] takes scope over A only, thus, if such a configuration is assumed, only A can trigger lowering. In (40b), on the other hand, [low] takes wider scope, specifying A, E and O, which then are the triggers of lowering. The two configurations clearly predict two different scenarios. As supported by the data of Campidanian metaphony presented in this paper, if the feature [low] is the metaphony trigger, the right underlying configuration for the desinences is (40b), since not only A but equally E and O cause lowering of the adjacent stem vowel under this hypothesis.

7.3. Tensing vs. lowering and further issues

At this time I know of no evidence pointing to the solution due to spreading of [ATR] (tensing hypothesis) rather than to the solution due to spreading of [low] (lowering hypothesis).

However, the neutralization of the underlying contrast between I and E and between U and O in the desinential inventory is simpler if one assumes the tensing hypothesis, i.e. the underlying configuration in (41a), than if one assumes the lowering hypothesis, i.e. the underlying configuration in (41b):

\[
\begin{array}{c|c|c}
a.\text{ des. invent. } <\text{tensing hp} & b.\text{ des.invent. } <\text{lowering hp} \\
I & U [ATR] & I & U \\
E & O & E & O [low] \\
A & [low] & A & \\
\end{array}
\]
As illustrated in 7.1.1., the neutralization in the case of the inventory in (41a) straightforwardly follows from the loss of the feature [ATR] in the non-low vowel space. Recall that this loss and the consequent neutralization make the desinential inventory less complex than the stem one, thus satisfying the Head-dependent asymmetry requirement active in the phonology of Campidanian.

On the other hand, neutralizing the underlying contrast between I and E and between U and O while maintaining the feature [low] on A in a feature configuration such as (41b) looks quite complicated and does not follow clearly from the assumptions made in this paper, thus giving rise to inconsistency. 17

However, both the tensing and the lowering analyses of Campidanian metaphony clearly reveal that what seemed to be a puzzle can be explained if and only if the specification of the inventories is relativized to the paradigmatic domains, i.e. stem and desinences.

Different morphological domains can have different inventories (as in Dyck) and, moreover, domain inventories with apparently the same number of contrast can, within a language, specify them differently, as highlighted in this analysis.

8. Markedness considerations

One possible objection to the tensing hypothesis is that a three-height system achieved by the specification of [low] and [ATR] is often considered to be marked in comparison with a system utilizing [low] and [high] (e.g., Goad 1993; Dyck 1995).

However, under the tensing hypothesis, the phonology of Campidanian clearly indicates that the metaphony rule spreads the feature [ATR], which thus has to be specified underlingly in the desinential inventory. This analysis opens up interesting questions about what markedness should be assumed to be. I have assumed that inventories are primitives, and this implies that they inform the contrast between marked and unmarked configurations within the grammar these inventories belong to. A configuration that appears marked on an absolute scale, as [low]/[ATR], is not marked if it reflects the phonology of the language it belongs to (in other words, a marked system is

17. One of the attempts might look as follows:

(2) US des. inventory

<table>
<thead>
<tr>
<th>E</th>
<th>A</th>
<th>O [low]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[fr]</td>
<td>[rd]</td>
<td></td>
</tr>
</tbody>
</table>

reorganize

contrast + neutralize

[fr] I [rd] U O

enhance

[fr] | [rd]

Surface des. inventory

<table>
<thead>
<tr>
<th>A [low]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[low]</td>
</tr>
</tbody>
</table>

Underlyingly, the height feature [low] is specified, taking scope over /E, A, O/, and the place features [front] and [round] are present on low vowels /E/ and /O/ respectively. The minimalnity principle à la Archangeli and Pulleyblank (minimal number of features on the segments in order to achieve contrast within an inventory) forces the reorganization of the contrast and thus /E/ and /O/ lose their specification for [low], which remains only on /A/, and maintain their place specifications. The place specification is redundantly extended to the whole non-low vowel space, thus neutralizing the contrast between front I and E, and between round U and O. No height contrast arises in the non-low space: in fact, in order to satisfy Head-Dependent asymmetry requirement, the desinential inventory becomes a two-height system. In the phonetic component this two-height contrast gets enhanced by the insertion of the feature [high] onto the non-low vowels. Thus, the front and round vowel surface as [i] and [u] respectively.
Grammars show variability in realizing contrasts. UG provides the contrastive schemas to achieve, and the particular grammars achieve them relying on different feature specifications.

Thus, the first observation to make regarding the presumed markedness of height system configuration due to the specification by [low] and [ATR] is a very general and indeed very intriguing one for phonological theory: systems often realize the same configuration by mean of different features.

In the case of Campidanian Sardinian, the two systems we are referring to, i.e. stem vowel system and desinential vowel system, are trying to achieve the same height configuration with two features which are both able to insert a further level of height contrast, i.e. [high] and [ATR].

As pointed out by Hyman (1988: 265-266), the feature [ATR], with its complex gesture, can be exploited for different achievements in different languages. In Esimbi (Bantu), for example, Hyman claims that [ATR] is directly involved in the vowel height harmony. I make the same claim for the Campidanian metaphony.

Moreover, Odden (1991: 280-285), examining the vowel harmony pattern in Kimatuumbi (Bantu), claims that [high] and [ATR] spread together and that this provides evidence that these two features form a constituent in the vowel feature geometry he proposes: they are the two branches of the node [Height]. I am not assuming Odden’s vowel geometry here but I am adopting his intuition in order to support my claim and to strengthen Hyman’s statement that [ATR] can be exploited for vowel height. In this paper I am not going to explore the relationship between [high] and [ATR] in terms of the vowel height systems found cross-linguistically (for this refer to Goad 1993; Rice & Avery 1993; Causley 1999; Casali 1995; Archangeli & Pulleyblank 1994).

Once it is assumed that both [high] and [ATR] can be used for vowel height, it appears that the stem and desinential feature configuration in Campidanian are strictly interdependent, and not just random variants, since they attempt to achieve the same height configuration.

This attempt can be interpreted in terms of competition for the best way of achieving a configurational schema through the selection of the best suitable features. I owe this idea to Bill Idsardi (p.c.), who was himself inspired by the theory of positional markedness elaborated by Kochetov (2002). According to Kochetov (2002: 3), positional markedness can be viewed “as an emergent phenomenon arising primarily from inherent limitations on speech production and perception.” Kochetov’s survey of the phonotactic patterns of palatalization attested in languages, together with production and perception experiments, highlight that positional markedness can be considered as an instance of self-organization. In particular, the best producible and the best recoverable pattern seem to arise as the less marked structure. Abstracting from the grammatical restructuring also at play in this process, markedness ultimately seems a result of a complex competition.

One could view the two vowel inventories of Campidanian as competing in terms of feature specifications: they both have to achieve a three-height contrast. From the data presented in this paper, it is clear that they cannot have the same specification, otherwise the surface facts cannot be derived. The stem inventory, being more prominent than the desinential one, takes precedence over the latter and thus picks the best possible feature, i.e. [high], for realizing the height contrast among the non-low region of the inventory.
space, i.e. the contrast between /I, U/ and /E, O/. The desinential inventory has to rely on the second best feature available to achieve the same contrast, i.e. [ATR].

9. Conclusion

In this paper I show that an analysis that relies on the morphological distinction between stem vs. desinential domains and on the relativization of inventories to those domains is able of capturing the facts concerning metaphony in Campidanian Sardinian (whether this is accounted for as a tensing or as a lowering process), being faithful to the principles of a model of contrastive specification.

Moreover, my analysis clearly indicates that inventories can be defined relative to morphological domains not only with respect to the number of segments present underlyingly (Dyck 1995) but also, and interestingly, with respect to the feature configuration of those inventories. The interaction between the morphological and the phonological component of the grammar then appears to be active even on such a fine-grained level as the feature configuration one. The case of Campidanian Sardinian is quite striking since stem and desinential inventories present exactly the same number of segments and the same three-height system underlyingly, but achieve it by exploiting two different features in the non-low vowel space: the feature [high] in the stem inventory and the feature [ATR] in the desinence inventory, within the tensing hypothesis; or by widening the scope of [low] in the desinential inventory within the lowering hypothesis.

Campidanian Sardinian enriches our understanding of language by pointing to the subtleties of just what ‘inventory’ means.

References


