SONORANT RELATIONSHIPS IN TWO VARIETIES OF SARDINIAN

by

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Phonological interactions among sonorant sounds, and between sonorants and obstruents, are widespread in Romance languages. In this dissertation, I examine in detail such interactions in two dialects of Sardinian (Italo-Romance), Campidanese and Nuorese, showing that sonorant relationships differentiate the synchronic grammars of these dialects.

The synchronic patterning of nasals and liquids, and how these two sonorant subclasses interact with obstruents, is significantly different between the two dialects. In particular, nasals trigger phonological nasalization of vowels and of the rhotic in Campidanese but not in Nuorese. The arguments for a phonological analysis of vowel nasalization in Campidanese are reviewed, expanded, and tested against an acoustic study. The historical traces of interaction between /n/ and /r/ in this dialect are linked to the synchronic rhotic nasalization process highlighted by an acoustic study of fieldwork data. In Nuorese, on the other hand, /n/ does not initiate phonological nasalization either of vowels or of the rhotic, and it is the target of total assimilation when followed by any segments but an oral stop. Nasals in the two dialects thus pattern in two very different ways phonologically: nasals are process triggers in Campidanese and process targets in Nuorese. The rhotic also shows distinct patterns in the two dialects, interacting with /n/ in Campidanese and with /s/ in Nuorese. The two dialects, with those asymmetries, thus display complementary sonorant patterns.

I argue that a model able to capture such complementarity of patterns is the theory of the contrastive hierarchy (Dresher 2008).
The Campidanese and Nuorese sonorant patterns, so radically different, lead one to question whether sonorants form a homogeneous phonological class cross-linguistically. Campidanese and Nuorese show that the make-up of such a class appears to be language-specific. Since the sonorant class is a universal class of sounds, its heterogeneity, in turn, questions the notion of phonological classhood at large. The data and the analysis presented in this dissertation thus feed the debate around phonological classhood. According to the theoretical model adopted in the present dissertation, the language-specific make-up of a class of sounds is all that can be labeled a phonological class. Classes of sounds can be described in phonetic terms, but classes phonetically defined do not necessarily amount to phonological classes.
Acknowledgements

Sincere acknowledgments go to: my thesis supervisor, Keren Rice; the members of my thesis committee, Laura Colantoni and B. Elan Dresher; the external examiner, Stuart Davis; the additional voting member of the final oral examination, Yoonjung Kang and the chair for the final oral examination, George Rigg.

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Chapter 1

Introduction

The object of the present study is the phonology of sonorants in two dialects of Sardinian (Romance, Italy), Campidanese and Nuorese.

There are several reasons why a study of the phonology of sonorants in Sardinian is empirically and theoretically important.¹ I begin with empirical reasons, and then turn to the theoretical import. Later sections of this chapter preview the sonorant interactions discussed in this work, present the sources, and outline the thesis structure.

¹There are also two additional factors that make the linguistic study of Sardinian of importance. First, Sardinian is an endangered language, listed in the UNESCO Red Book on Endangered Languages (2003, http://www.tooyoo.l.u-tokyo.ac.jp/archive/RedBook/index.html). Documentation efforts and in-depth studies of languages in danger are of moral significance, as they enhance the perceived value of the language within and outside of the speaking community, and store and validate language records as universally shared intellectual wealth (e.g., Crystal 2000). Second, Sardinian is traditionally regarded as the Romance language that retains most archaic traits both lexically and grammatically, as summarized in chapter 2. However, while traditional Romance studies have concentrated on the archaic status of the language, insufficient attention has been paid to understanding the linguistic ties that Sardinian shares with other Romance languages (Rohlfs 1952). The language review in chapter 2 will highlight some of these formal relationships.
1.1 Rationale and contributions

There are two major reasons why a study of Sardinian sonorants is of empirical significance. First, the processes of assimilation, dissimilation and substitution affecting sonorants and voiced obstruents in Sardinian point to major dialectal differences that cannot adequately be treated with the traditional approaches to Romance phonology. Specifically, even the most systematic investigations of the interactions between sonorants and other types of segments (for example, Lloret 1997 and Pons Moll 2005) analyze the variation and alternation patterns as a single phenomenon across Romance languages, universally governed either by the lexical representations of the segments in question (Lloret 1997), or by their phonotactic constraints (Pons Moll 2005). The detailed study of the phonology of Sardinian sonorants presented in this work, however, demonstrates that the sonorant patterns cannot be reduced to one pool but must be differentiated across grammars; such patterns need to be understood within a specific phonology before being compared cross-linguistically. This dissertation carries out a systematic comparison between Campidanese, the dialect of Sardinian spoken in the south of the island, and Nuorese, the dialect spoken in the north-east of the island. This comparison shows that certain patterns of variation and alternation among sonorants and between sonorants and other phones are found in the grammar of one dialect but not in the other. For instance, [r] and [n] alternate in Campidanese but not in Nuorese. In the latter dialect, nasals are phonologically inert and the rhotic alternates with the alveolar fricative in specific contexts. Detailed analyses of individual Romance varieties are therefore needed to understand the phonological behavior of sonorants in each single grammar in order for a pan-Romance study to be truly revealing.

Second, while the traditional literature on Romance in general (see, for instance, Bourciez 1967, 480) and Sardinian in particular (Wagner 1941; Rohlf 1968 among many others) does indeed acknowledge differences between the grammars of the two major dialects of Sardinian, Campidanese and Nuorese, it relies primarily on historical evidence. The data on

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2Sardinian has been accorded the status of a single language in linguistic studies on Romance since the 19th
sonorants presented in this work shows that, in addition to the criteria traditionally identified as distinguishing Campidanese and Nuorese (section 2.4), there also exist substantial synchronic differences in the phonology of the two varieties which have previously received little or no attention (the relevant data are introduced in section 1.2 and analyzed throughout this dissertation).

Thus, this dissertation contributes both to the study of Romance languages in general and to the description and definition of the main varieties of Sardinian in particular.

There are, in addition, theoretical reasons for studying Sardinian sonorants; specifically, the notion of phonological classhood. How is it possible to capture the classhood of sonorants when they entertain such strikingly different relationships with other segments of the phonological inventory in each variety? The phonological and phonetic analyses of Sardinian sonorants conducted in this work support a model in which phonological grammars are fed by phonetics – to the extent that distinctive features and processes are substantially grounded – but they are ultimately self-contained autonomous systems, i.e., once substantially-grounded elements are computed upon, they obey grammar-internal laws. Within such a model, phonological classes are system-dependent; more precisely, they are a product of the contrastive configuration of a phonemic inventory. The list of theoretical questions to which this thesis contributes, together with the assumptions underlying the analysis of sonorant phonology in Campidanese century (Hoinkes 2003), albeit inconsistently. It is listed among the Romance languages in Meyer-Lübke 1910 but not in Diez 1836, according to Tagliavini 1972, 351-3. The Romance linguistic domain, traditionally referred to as Romania, constitutes in fact a maze of linguistic varieties, so much that, with the boundaries between one variety and another being often blurred, it has been called Romania continua, see, for instance, Lausberg 1976. The varieties that reached maximum prestige for political and/or cultural reasons have been granted the status of language. However, the sociolinguistic situation of most of the Romance-speaking territories is one of diglossia, where the national Romance language coexists together with Romance regional varieties, called dialects. In the case of Sardinian, as we shall see in chapter 2, the situation is more complicated, as there exists no dialect assumed to be standard Sardinian (Jones 1988; Blasco Ferrer 2002), and the pressure exerted by Italian on this minority language is strong (Loi Corvetto 1993).
and Nuorese, are presented and discussed in detail in chapter 3.

The next section of this chapter provides an overview of the processes targeting sonorants in Sardinian, followed by a survey of the sources consulted and an outline of the organization of this dissertation.

## 1.2 Sardinian sonorant interactions

Sardinian presents a prototypically Romance array of sonorant/sonorant and sonorant/obstruent alternations and assimilation and substitution patterns as will be detailed in chapter 2. However – and this is the major empirical contribution of this thesis – even though both dialects share the same sonorant inventory, given in (1a), the distribution of these patterns is complementary between the two major Sardinian varieties, Nuorese and Campidanese, as summarized in (1b).  

(1)  

<table>
<thead>
<tr>
<th>Sonorant inventory</th>
<th>Campidanese</th>
<th>Nuorese</th>
</tr>
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<tbody>
<tr>
<td>r/s alternation</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>r/n alternation</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>phonological nasalization</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

The phonemic inventories for Nuorese and Campidanese, from Contini 1987, 539 and 555, are given below in IPA (Contini uses a his own transcription system):

(1)  

**Nuorese phonemic inventory**

<p>| | | | | |</p>
<table>
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<tr>
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<tr>
<td>p</td>
<td>t</td>
<td>k</td>
<td>l</td>
<td>m</td>
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<tr>
<td>b</td>
<td>d</td>
<td>g</td>
<td>ñ</td>
<td>nn</td>
</tr>
<tr>
<td>f</td>
<td>(θ)</td>
<td>s</td>
<td>z</td>
<td>ɗk?</td>
</tr>
</tbody>
</table>

(2)  

**Campidanese phonemic inventory**

<p>| | | | | |</p>
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<tr>
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<td>b</td>
<td>d</td>
<td>g</td>
<td>ɗ</td>
<td>nn</td>
</tr>
<tr>
<td>f</td>
<td>s</td>
<td>z</td>
<td>ts</td>
<td>f</td>
</tr>
</tbody>
</table>
The dialects differ in several ways. First, Nuorese has an alternation between the rhotic and the alveolar fricative in coda position in derived environments, i.e., phrases, clitic groups and prefixed forms, as illustrated by the noun phrases in (2), from Pons Moll 2005. In Nuorese the word-final alveolar fricative becomes a rhotic before voiced stops, affricates, sonorants and non-coronal fricatives (2a), but not before voiceless stops and coronal fricatives (2b).

(2)  *Rhotic/sibilant complementarity in coda in Nuorese Sardinian*

<table>
<thead>
<tr>
<th>Nuorese</th>
<th>Standard Italian</th>
<th>Pronunciation</th>
<th>Meaning</th>
</tr>
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<tbody>
<tr>
<td>tres boes /tres boes/</td>
<td>tres boes</td>
<td>[tRER boes]</td>
<td>three oxen</td>
</tr>
<tr>
<td>tres domos /tres domos/</td>
<td>tres domos</td>
<td>[tRER domos]</td>
<td>three houses</td>
</tr>
<tr>
<td>tres gattos /tres gatos/</td>
<td>tres gatos</td>
<td>[tRER yatos]</td>
<td>three cats</td>
</tr>
<tr>
<td>tres jannas /tres janas/</td>
<td>tres janas</td>
<td>[tRER janas]</td>
<td>three doors</td>
</tr>
<tr>
<td>tres manos /tres manos/</td>
<td>tres manos</td>
<td>[tRER manos]</td>
<td>three hands</td>
</tr>
<tr>
<td>tres rosas /tres rosas/</td>
<td>tres rosas</td>
<td>[tRER rosas]</td>
<td>three roses</td>
</tr>
<tr>
<td>tres tzeccos /tres dzekos/</td>
<td>tres dzeckos</td>
<td>[tRER dzekos]</td>
<td>three blind men</td>
</tr>
<tr>
<td>tres fizo /tres fidos/</td>
<td>tres fidos</td>
<td>[tRER fidos]</td>
<td>three sons</td>
</tr>
<tr>
<td>tres panes /tres panes/</td>
<td>tres panes</td>
<td>[tRER panes]</td>
<td>three breads</td>
</tr>
<tr>
<td>tres taulas /tres taulas/</td>
<td>tres taulas</td>
<td>[tRER taulas]</td>
<td>three tables</td>
</tr>
<tr>
<td>tres canes /tres canes/</td>
<td>tres canes</td>
<td>[tRER canes]</td>
<td>three dogs</td>
</tr>
<tr>
<td>tres sores /tres sores/</td>
<td>tres sores</td>
<td>[tRER sores]</td>
<td>three sisters</td>
</tr>
<tr>
<td>tres tithulas /tres titulas/</td>
<td>tres titulas</td>
<td>[tRER titulas]</td>
<td>three mosquitoes</td>
</tr>
</tbody>
</table>

This relationship is moreover bidirectional: an underlying rhotic coda becomes an alveolar fricative before voiceless stops, as the comparison between the cardinal numerals /tres/ ‘three’ and /battor/ below shows (Pittau 1972, 33). (3a,b) show underlying word-final /s/ and /r/ surfacing as a partially voiced [z] and a tap respectively before a vowel. (3c) shows that both final /s/ and /r/ neutralize to [s] when a voiceless obstruent follows.

(3)  a.  [tRER amikos]## ‘three friends’
|  | [batɔːr amikos]## ‘four friends’ |
|  | 
| b.  [tRER]## |
|  | [batɔːr]## |
| c.  [tRER panes]## [batɔːs panes]## ‘three/four (pieces) of bread’ |
|  | [tRER kanes]## [batɔːs kanes]## ‘three/four dogs’ |
|  | [tRER taulas]## [batɔːs taulas]## ‘three/four tables’ |
In other words, the rhotic and the alveolar fricative are in complementary distribution in the syllable coda in Nuorese.\(^4\)

Strikingly, the phonological relation between the rhotic and the alveolar fricative proper to Nuorese is not instantiated in the phonology of the other major variety of Sardinian, Campidanese. Lexically, the rhotic is never found in coda position in this dialect, seemingly as a result of historical metathesis and deletion (data are presented and discussed throughout chapters 7 and 8). Postlexically, the rhotic is never found in this position either, and a morpheme-final /s/ in Campidanese may surface as [z] (4a), delete or trigger fortition (4b).\(^5,6\)

\[
\begin{align*}
(4) & \quad \text{a. } [z\# b]a\text{j}u & & \text{‘mistake’} \\
& & [z\# m]i\text{j}gwai & \text{‘to diminish’} \\
\quad & \text{b. } [i\# b]a\text{k}a\text{sa}/[i\# b:]a\text{k}a\text{sa} & & \text{‘the cows’} \\
& & [i\# d]o\text{m}u\text{su}/[i\# d:]o\text{m}u\text{su} & \text{‘the houses’} \\
& & [i\# r]w\text{e}r\text{a}\text{s}a/[i\# r:]w\text{e}r\text{a}\text{s}a & \text{‘the wars’} \\
\quad & \text{c. } [i\# p]i\text{p}i\text{i}u\text{su} & & \text{‘the children’} \\
& & [i\# t]a\text{m}a\text{t}i\text{y}a\text{s}a & \text{‘the tomatos’} \\
& & [i\# k]\text{a}r\text{u}\text{s}u & \text{‘the carriots’}
\end{align*}
\]

In contrast, in this dialect, the rhotic interacts with the alveolar nasal, both historically (5a) and synchronically (5b).\(^7\) In (5a), the historical coda \*L, realized as [r] in other dialects of Sardinian, including Nuorese, metathesizes with the vowel and is realized as a nasal adjacent to a nasal in Campidanese. In (5), [r] is the target of nasalization triggered by the word-initial bilabial nasal.

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\(^4\)For a complete set of examples see chapter 7.

\(^5\)In non-derived environments, the language presents only voiceless sC clusters.

\(^6\)For an analysis of the different patterns shown by morpheme-final /s/ in Campidanese, I refer the reader to Frigeni 2003b.

\(^7\)Chapter 6 explores the Campidanese R/N alternation in depth. An acoustic study of synchronic rhotic nasalization is also presented in chapter 6.
(5) a. Etymon Sardinian elsewhere Campidanese
   MULGERE 'muɾere' 'mn uyere' ‘to milk’

   b. [mɐatsu] ‘March’

The phonological activity of nasal segments is also apparent in the vowel system, where vowels are nasalized in certain nasal environments in Campidanese, as in (6), but not in Nuorese.8

(6) Campidanese
   [tʃaː] [tʃaˈneːts] ‘pan (made of clay)’, ‘little pan’
   [anˈʃiː] [anʃoˈneːts] ‘lamb’, ‘little lamb’
   [kaˈʃi] [kaʃoˈnisu] ‘rooster’, ‘little rooster’
   [tʃɛː] [tʃɛˈnaː] ‘dinner’, ‘to dine’

The patterns for the rhotic are distinctly different in Campidanese and Nuorese Sardinian. In the former the rhotic alternates with a sonorant, whereas in the latter it alternates with an obstruent. The specific case of the phonology of the rhotic in Sardinian illustrates the point to be made in this work. Sardinian is not a uniform system, rather, there coexist at least two different grammars.

The sonorant patterns found in Sardinian as well as in other Romance languages (section 2.2), then, cannot be reduced to a single phenomenon and analyzed as such (e.g., Lloret 1997 and Pons Moll 2005). Rather, they must be understood within the phonology of each language and dialect before drawing any meaningful crosslinguistic generalization.

1.3 Sources

The comparative study of Campidanese and Nuorese Sardinian carried out in the present dissertation relies on data from a wide variety of sources.

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8Evidence for a phonological rather than a phonetic analysis of vowel nasalization in Campidanese is provided in chapter 4.
The main source of historical data on Sardinian is the historical grammar by Wagner 1941. I refer to this work extensively both directly and indirectly. The descriptive and historical grammars of Campidanese (Virdis 1978) and Nuorese (Pittau 1972), in fact, to which I also make reference, are extracts from Wagner’s 1941 historical grammar. Although mostly focussing on Latin etyma and their realization in Sardinian, they contain useful, although brief, notes on borrowings – mostly from Italian, Catalan and Spanish.

More recent works I consulted are Bolognesi 1998 and Molinu 1998. Bolognesi’s 1998 work on Campidanese provides an overview of some of the major phonological processes active in this dialect of Sardinian within an Optimality Theory framework, with a primary focus on theory. Molinu 1998 investigates syllable phonotactics in Sardinian. However, the data are from different dialects and are analyzed as belonging to the same grammatical system, an assumption I show to be ill founded. Another source of synchronic data is Contini 1987, a phonetic description of the Sardinian varieties Contini came in touch with through his many years of fieldwork.

For Campidanese, I collected most of the data during fieldwork in Sardinia in September 2004 and June 2005. Details about the chosen communities are given in section 2.4.4 in chapter 2, while details about acoustic data as well as language consultants are provided in chapter 5. Acoustic data for Nuorese were made available to me by the VIVALDI project at the Humboldt Universität in Berlin, Germany (see chapter 5).

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9 Pittau’s and Virdis’ grammars are easier to consult than Wagner as they refer exclusively to Nuorese and Campidanese, respectively. Wagner’s grammar comprises examples from a vast array of Sardinian dialects.

10 Section 2.4 in chapter 2 gives some sociolinguistic background on Sardinian.

11 Bolognesi makes interesting claims about Campidanese phonology, but they are not completely fleshed out in terms of the data.
1.4 Structure of the thesis

A descriptive and socio-historical background of Sardinian and its two principal varieties is needed before laying out the theoretical core of the dissertation. Chapter 2 thus introduces the reader who is not familiar with Romance languages and linguistics to the classification of Sardinian within the Romance domain. The chapter also offers a synthesis of relevant information about Sardinian, gathered from a disparate set of sources, from philological works to sociolinguistic surveys, written in a variety of languages. This chapter in addition reviews the criteria traditionally used to distinguish between Campidanese and Nuorese in order to highlight the contribution to this topic made by this dissertation.

Chapter 3 focuses on the questions inherent to current debates in phonological theory to which the present work relates and contributes. At the same time, it clarifies the assumptions which inform the analysis of the sonorant phonologies of Campidanese and Nuorese Sardinian and the predictions tested in the phonological and phonetic studies of the two dialects carried out in the rest of the dissertation.

A study of vowel nasalization in Campidanese and Nuorese is presented in chapters 4 and 5 in order to set the stage for the comparison of the role of nasality in the phonologies of the two varieties, which forms the core of this work. Campidanese is shown to display phonological vowel nasalization, in contrast to the phonemic analysis of nasalized vowels proposed for this dialect by Sampson 1999, and to the patterns of phonetic vowel nasalization characteristic of Nuorese. Vowel nasalization in Campidanese is shown to be sensitive to prosodic conditioning in a more complex manner than what has been reported in the literature so far, on the one hand, and to present nasalized acoustic profiles that are not compatible with a phonetic analysis of the process, on the other hand. The comparison between the nasalized acoustic profiles in Campidanese and Nuorese vowels is, to my knowledge, the first one to have been conducted and opens up an interesting field of phonological and phonetic research in Sardinian, and in Romance in general (vowel nasalization is common in Romance, as briefly outlined in section 2.2.3). The findings of the acoustic studies of nasalization effects on vowels in Nuorese match
the patterns usually shown by phonetic vowel nasalization, thus differing from Campidanese.

Chapter 6 provides further support for the phonological activity of the nasal feature in Campidanese through its investigation of the nasalization of the rhotic in this dialect. Rhotic nasalization also points to a phonological relationship between coronal nasal and rhotic segments in Campidanese. Further evidence for this relationship is summoned through the collection of historical and synchronic data of assimilation, dissimilation and free variation between /n/ and /r/ in Campidanese.

Further data pointing to the phonological inactivity of the nasal feature in Nuorese are gathered in chapter 7. Specifically, asymmetries in assimilation patterns, where the coronal nasal is systematically the target, indicate its unmarked or inert status within the sonorant inventory in Nuorese compared with its active status in Campidanese. Moreover, the relationship between /n/ and /r/ that characterizes the sonorant grammar of Campidanese, is alien to Nuorese. In this dialect, the rhotic entertains a phonological relationship with the alveolar sibilant as seen in some of the data presented in this chapter.

Other relevant patterns characterizing Campidanese but not Nuorese are presented and discussed in chapter 8. Chapter 9 concludes the thesis.
Chapter 2

Background on Sardinian and its dialects

In this chapter, I address two main questions: first, the position of Sardinian within Romance, paying special attention to sonorant patterns; and, second, the differentiation of the two Sardinian dialects that are the object of this study.

2.1 Sardinian among Romance languages

Romance languages are traditionally classified in two major subgroups, Western and Eastern Romance (Wartburg 1950).

Western Romance comprises Ibero-Romance languages, i.e., Portuguese, Galician, Spanish, and Catalan, and Gallo-Romance languages, i.e., French, Francoprovençal, Occitan, and the Gallo-Italian dialects spoken in Northern Italy.

Eastern Romance comprises Italo- and Balkan-Romance (i.e., Romanian). Italo-Romance includes Italian, all the minority languages spoken in Central and Southern Italy,\(^1\) Rhaeto-Romance, Sardinian, and the extinct Dalmatian.\(^2\)

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1Among which are Neapolitan, Salentino and Sicilian, to cite just a few that have received particular attention in modern linguistic literature.

2For brief linguistic sketches of each of the Romance varieties that are granted the status of language, see Harris and Vincent 1988. For a thematic guide to Romance languages, including some of the similar and dissimilar
The major isoglosses responsible for this subdivision are concentrated approximately along
the line that divides Northern from Central and Southern Italy. This boundary is known in the
Romance literature as the *La Spezia-Rimini* line, referring to the two Italian coastal towns that
coincide with the western and eastern extremities of the line.

According to Wagner 1951, 59, the first scholar to publish on the linguistic features which
distinguish Sardinian within the Romance domain was Bartoli 1903. Bartoli claims that Sar-
dinian can be classified neither among the Western Romance languages nor among the Eastern
Romance ones, as it shares characteristics with both Romance macro-classes.\(^3\) The same clas-
sification is proposed for Sardinian by Lausberg 1969 and Tagliavini 1972.

Wagner 1951, 60-1, who is recognized as the most influential scholar of Sardinian, points
out that while certain phonological developments found in Sardinian parallel ones proper to
Southern Italian dialects (Eastern Romance),\(^4\) some major structural characteristics of Sar-
dinian strongly resemble those found in Western Romance, particularly in Ibero-Romance,
especially in the modules of morphology (e.g., the sygmatic plural, i.e., a plural desinence re-
alized as /s/ and not vocalically: e.g., Nuorese *domo*/*domos* ‘house.SG/PL vs. Italian *casa*/
*case* ‘house.SG/PL) and syntax (e.g., the prepositional accusative: e.g., Nuorese *atzéria* a babbu
tu, ‘Call your father!’ vs. Italian *chiama tuo padre* ‘Call your father!’).\(^5\) What Wagner 1951

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3 For a critical overview of the criteria referred to in the classification of Romance languages from the beginning of their historical and comparative study, see Hoinkes 2003.

4 He cites the development of retroflex consonants such as [ç] from Latin intervocalic LL, for instance. Retroflex consonants in the Romance domain are attested in Southern Italy (Salento, Southern Calabria, Sicily, Irpinia, parts of Abruzzi), North-Western Tuscany (Lunigiana and Garfagnana), Sardinia, Corsica and Western Asturias (Celata 2003).

5 The sygmatic plural, found in Sardinian, is a general trait of Western Romance; the prepositional accusative, also found in Sardinian, “is best known in Modern Spanish, where it is also called the ‘personal accusative’ because it is used normally with human objects” (Posner 1996, 119). The prepositional accusative is widespread, occurring in Southern Italian dialects (Vincent 1997, 102), Galician, colloquial Catalan, Majorcan Catalan, West-
puts forward as being peculiar to Sardinian is its archaism (he speaks of Sardinian as *Altromanisch*, ‘Early Romance’), which he defines as follows: some of the most characteristic traits of the synchronic grammar of Sardinian mirror early developmental stages attested in a variety of other Romance languages. The uniqueness of Sardinian therefore does not lie so much in specific linguistic features, but rather in its bundling of early Romance traits.6

Among the short list of features provided as evidence of archaism in Sardinian is its five-vowel system, derived from the neutralization of the length contrast in the Latin ten-vowel system, a developmental stage hypothesized as characteristic of proto-Southern Romance (Hall 1950). The origin of the five-vowel system of Sardinian is unique within the Romance panorama.7 A further archaic trait in the domain of the Sardinian sound system is the lack of palatalization of the velar stop /k/ when followed by front vowels – this is however only the case in Nuorese Sardinian, as we shall see in section 2.4.2 below. Morphologically, Sardinian conserves consonantal verbal endings (i.e., -t for 3.SG, and -s, synchronetically, for 2.SG and 1.PL), lost in the rest of the Romance domain. Syntactically, it tends to conserve the default Latin (S)OV word order. Lexical archaisms – such as Nuorese *domo/*Campidanese *domu* (Latin DOMUS) ‘house, home’ for instance are also well-known features of Sardinian.

This characterization of Sardinian as an archaic language is found throughout the literature on the language, based on a list of characteristics as short as the one provided in the above paragraph.

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6 “The conservatism is reflected in two ways: the preservation of many archaic features of Latin which are not found in other Romance languages and the absence of any significant influence from non-Romance languages” (Jones 1988, 314). We shall see in section 2.4.3, however, that the influence of other Romance languages has in fact been strong over the course of the centuries and that various degrees of permeability to the politically dominant languages may have been the cause of the strong differentiation between the Campidanese and the Nuorese dialects of Sardinian.

7 The ‘Sardinian’ five-vowel system “is commonly assumed also to be present on the [Italian] mainland, in the ‘archaic’ zone along the Basilicata-Calabria border” (Savoia 1997, 228). The dialects spoken in this narrow area show other phonological patterns close to the Sardinian ones, as will be pointed out below.
A detailed comparison of linguistic structures between Sardinian and other Romance languages has been carried out in the domain of morphosyntax (Wagner 1951; Blasco Ferrer 1986; Blasco Ferrer 2002), and such systematic studies identify the structures which are peculiar to Sardinian and those which are shared with Ibero-Romance languages (recall from above that Sardinian may be classified with Western Romance as far as its morphosyntactic features are concerned). Such a systematic comparative study, however, has not been carried out with respect to the phonological features of Sardinian. The present dissertation is also an attempt at framing the study of a specific topic in Sardinian phonology, i.e., sonorant patterns, within the larger Romance perspective. The Sardinian sonorant patterns that are the topic of this work were briefly reviewed in the introductory chapter. In the following section, I summarize the Romance sonorant patterns to which the Sardinian ones relate.

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8Blasco Ferrer 1986 isolates ten morphosyntactic features for Sardinian, six of which are peculiar to Sardinian, while four are shared with Ibero-Romance. Among the latter ones are: focalization of subject and object through use of vocative case and prepositional accusative respectively; full reduplication for superlative constructions; redundant double marking (dative case and preposition) of the indirect object; three-degrees of deixis (although now simplified to two). Proper to Sardinian are the following morphosyntactic features: post-nominal or post-adjectival modifiers (adjective or adverb); analytical verbal forms to express specific modality and aspect; use of the infinitive for most dependent clauses, independent of the identity of subject between matrix and subordinate clause; widespread topicalization; use of a morphological default form for participles (no concord); use of gerund for relative clauses. Further interesting features are discussed in Jones 1993 and Blasco Ferrer 2002.

9The above-mentioned scholars pursued a comparative study at the level of morphosyntax because this module of grammar is believed to change more slowly than the phonetic module, thus granting ’stability’ to the analysis and the resulting genealogical classification. However, as pointed out by Ohala 1993, phonetic pressure, while necessary, is not sufficient to change the coordinates of a phonological system. Phonology is also a relevant level on which to carry out systematic comparative studies between systems.
2.2 Romance sonorant interactions

The phonological interactions among sonorants and between sonorants and obstruents found in Sardinian (described in section 1.2 of the Introduction and repeated in table 7 below) reflect patterns found within the Romance linguistic domain throughout time.\(^{10}\)

\[(7)\] Sonorant relationships in Sardinian

<table>
<thead>
<tr>
<th></th>
<th>Campidanese</th>
<th>Nuorese</th>
</tr>
</thead>
<tbody>
<tr>
<td>r/s alternation</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>r/n alternation</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>phonological nasalization</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

In the development of all Romance varieties, assimilation, dissimilation and substitution among sonorants and between sonorants and obstruents have been frequent (Posner 1961; Rohlfs 1966; Bourciez 1967; Lausberg 1976; Lloret 1997), and they continue to play an important role in the synchronic grammars of many Romance languages. This section first presents historical patterns affecting sonorants before examining in some detail processes which are still currently active.

\(^{10}\)Throughout this work, small capitals indicate Latin etyma. The Romance items are not given in phonetic transcription but in the orthography used in the cited source(s). Very often traditional historical grammars do not adopt a unified transcription convention. Usually the graphemes correspond to phonetic symbols. When the graphemes used in the historical source do not match the phonetic alphabet, I substitute them with the corresponding IPA symbol. This substitution is made for ease of reading and for consistency and it is signalled by the use of squared brackets. As for the abbreviations referring to languages, I use the following conventions:

\[(1)\] It. Italian Sp. Spanish Rum. Romanian
Fr. French Pt. Portuguese Cat. Catalan
Lomb. Lombard Prov. Provençal Sic. Sicilian
Gasc. Gascon

Gasc.
2.2.1 Historical processes targeting sonorants

The following are a few examples of the above-mentioned historical processes referring to some of the Romance languages in which they occurred.\footnote{All the examples in (8a-d) are taken from Bourciez 1967. The examples of nasal assimilation in Sicilian in example (8e) are taken from Rohlfs 1966. An invaluable source on dissimilation and substitution processes in the Romance development is Posner 1961.} (8a) shows cases of dissimilation of etymological $R$ to [l] or [d] in the environment of a liquid. The examples in (8b-d) show that sonorants alternated with one another also in non-dissimilatory contexts; I therefore refer to such cases as ‘substitution’. (8e) presents examples of assimilation between sonorants and obstruents.

(8) a. Dissimilation of etymological $R$ to [l] and to [d]

\begin{tabular}{llll}
PEREGRINUS & It. pellegrino & Fr. pelerin & ‘pilgrim’
\end{tabular}

\begin{tabular}{llll}
PRURIRE & It. prudere & & ‘to be itchy’
\end{tabular}

\begin{tabular}{llll}
QUAERERE & It. chiedere & & ‘to ask’
\end{tabular}

b. Substitution of etymological intervocalic $L$ to [r]

\begin{tabular}{llll}
SOLE & Rum. soare & ‘sun’
\end{tabular}

\begin{tabular}{llll}
GULA & Rum. gurá & ‘sky’
\end{tabular}

\begin{tabular}{llll}
Milano & Lomb. Miran & ‘Milan’
\end{tabular}

c. Substitution of etymological coda $L$ to [w] and to [r]

\begin{tabular}{llll}
ALTU & Sic. autu & ‘tall.M.SG
\end{tabular}

\begin{tabular}{llll}
PALMA & Sic. parma & ‘palm’
\end{tabular}

d. Substitution of etymological intervocalic $N$ to [r]

\begin{tabular}{llll}
BENE & Rum. (North) bire & ‘good; well’
\end{tabular}

e. Assimilation of etymological MB and ND to [mm] $\sim$ [m] and [nn] $\sim$ [n] respectively

\begin{tabular}{llll}
LUMBUM & Sp. lomo, Cat. llo\text{\textit{m}}, Gasc. lom & ‘loin’
\end{tabular}

\begin{tabular}{llll}
LAMBERE & Sp. lamér & ‘to lick’
\end{tabular}

\begin{tabular}{llll}
PLUMBUM & Sic. kjummu & ‘lead’
\end{tabular}

\begin{tabular}{llll}
UNDAM & Cat. ona & ‘wave’
\end{tabular}

\begin{tabular}{llll}
MUNDUM & Sic. munnu & ‘world’
\end{tabular}
The above data are just a small showcase of the many patterns among sonorants attested in Romance. Sardinian presents a rich array of such patterns, as we shall see and discuss in chapters 6, 7 and 8.

2.2.2 Synchronic processes targeting sonorants

Romance languages also show instances of synchronic phonological alternations among sonorant segments and between sonorants and obstruents. A well known instance is the voiced stop/approximant alternation in Iberian languages (see, for instance, Mascaró 1991), illustrated in (9), adapted from Mascaró 1984, 288-9, which summarizes the contexts in which Spanish and Catalan voiced obstruents in syllable onset position surface as approximants.\(^{12}\)

(9) onset context | Catalan | Spanish
---|---|---
#. | [bɔ] | ‘good’ | [‘bwɛnɔ] | ‘good’
N. | [əŋ’gan] | ‘cheat’ | [eŋ’gaŋ]o | ‘cheat’
stop. | [subdit] | ‘subject’ | [suβðito] | ‘subject’
Id | [mɔldɾɔ] | ‘to grind’ | [kaldɔ] | ‘broth’
l. | [balβɔ] | ‘numb.F’ | [kalβo] | ‘bald’
r. | [korβɔ] | ‘curve’ | [kurβa] | ‘curve’
s. | [diz’γust] | ‘trouble’ | [diz’γusto] | ‘trouble’
V. | [kɔ’βελɔ] | ‘hair’ | [ka’βɛλɔ] | ‘hair’

The same phonetic and phonological characterization of the voiced obstruents allophones holds for Sardinian (e.g., Wagner 1941). Throughout the present work, I consistently use the IPA symbols [β, δ, χ] to represent the approximant series [β, δ, χ], following the custom of most literature on spirantization and lenition (most recently, for instance, Lavoie 2001, Kirchner 2001, Gurevich 2004).

\(^{12}\)Notwithstanding the traditional label of *spirantization*, the outputs of voiced stop spirantization in Spanish and Catalan are approximants [β, δ, χ] rather than voiced fricatives [β, δ, χ], as reported in Martinez Celdran 1991, Ladefoged 1993, Piñeros 2003 for Spanish; and Recasens i Vives 1991 and Hualde 1992 for Catalan. For a summary of the acoustic and articulatory characteristics of non-strident approximants [β, δ, χ] vs. non-strident fricatives [β, δ, χ] I refer the reader to Piñeros 2003, 1187.
This alternation is very well known in the phonological literature, especially within derivational models of phonology (Mascaró 1991; Harris 1993) which attempt to define the underlying representation of voiced obstruents in Ibero-Romance (whether obstruents or approximants), and, consequently, the nature of the rule and its context (whether intervocalic weakening or word-initial and post-consonantal strengthening) as well as of the relevant feature involved in the process.\textsuperscript{13}

The second array of synchronic alternations among sonorants and between sonorants and obstruents in Romance languages that has received some attention in the recent literature (Pons Moll 2005) are the manner alternation processes affecting consonantal segments in syllable coda position, particularly in Western Romance. A few examples of assimilation, rhotacism and gliding affecting consonants in coda position from Pons Moll 2005 are presented below. Assimilation patterns between a coda consonant and the following onset in Majorcan and Minorcan Catalan are given in (10). An underlying stop may alternate with a surface sonorant, as can be seen in (10a), an underlying voiced fricative with a surface sonorant (10b), and, among sonorants, an underlying nasal may alternate with a surface approximant (10c).\textsuperscript{14,15}

\textbf{(10) Synchronic assimilation of coda C with following sonorant onset in Balearic Catalan}

\begin{itemize}
\item[a.] \textit{cap mos} /kap mɔs/ [kam.ˈmɔs] ‘any bite’
\item[b.] \textit{cap llit} /kap ʎit/ [kɐʎ.ˈʎit] ‘any bed’
\item[b.] \textit{cap riu} /kap riw/ [kɐr.ˈɾiw] ‘any river’
\item[c.] \textit{cap iot} /kap jɔt/ [kaj.ˈjɔt] ‘any yacht’
\end{itemize}

\textsuperscript{13}A synthesis of the competing analyses offered by Mascaró 1991 and Harris 1993, with specific reference to Catalan, is provided in Bermúdez-Otero 2001, who examines the problem in terms of Stratal Optimality Theory (Kiparsky 2000). For a summary of this analysis, see Bermúdez-Otero 2006. See also Lavoie 2001, 168 for an analysis of the Spanish alternation proposed by in her extensive study of phonetic correlates of weakening and of its theoretical models.

\textsuperscript{14}In the latter set, (10c), notice that the coda nasal does not assimilate to a following rhotic onset, e.g., \textit{un riu}, /un riw/, [un.ɾiə], ‘one river’.

\textsuperscript{15}The same patterns are found in other varieties of Catalan (Central and Eivissian) and in Lenguadocian Occitan (Pons Moll 2005).
b.  
  dos llits  /doz ˈλıts/  [doˈl.ˈλıts]  ‘two beds’
  dos rius  /doz ˈriws/  [doˈr.ˈriws]  ‘two rivers’
  dos iots  /doz ˈjıts/  [doˈj.ˈjıts]  ‘two yachts’

c.  un llum  /ˈu:n ˈλım/  [uˈn.ˈlım]  ‘one light’
  un iot  /ˈu:n ˈjıt/  [uˈj.ˈjıt]  ‘one yacht’

The data in (11) exemplify the process of rhotacism of the alveolar fricative in Majorcan Catalan. In Pons Moll 2005, parallel data are also given for (Nuorese) Sardinian and Galician. As reported in Pons Moll 2005, 7, who cites Lorenzo 1975, “[a]lveolar fricative rhotacism is also found in other Romance languages and dialects, including Picard, Asturian Spanish, Andalusian Spanish, and South-American Spanish. The contexts where the process applies are ... systematically before a voiced consonant [stop or sonorant] and more sporadically before another fricative”. The contrast is between the data in (11a), where the second word begins with a voiced stop, a fricative, or a nasal, and (11b), where the second word begins with a voiceless stop.

(11)  Rhotacism of sibilant coda in Majorcan Catalan

a.  dos bous  /doz ˈbıwz/  [doˈr.ˈbıwz]  ~ [doˈr.ˈbıwz]  ~ [doˈr.ˈbıwz]  ‘two oxen’
  dos dits  /doz ˈdıtz/  [doˈr.ˈdıtz]  ~ [doˈr.ˈdıtz]  ~ [doˈr.ˈdıtz]  ‘two fingers’
  dos gots  /doz ˈɡıts/  [doˈr.ˈɡıts]  ~ [doˈr.ˈɡıts]  ~ [doˈr.ˈɡıts]  ‘two glasses’
  dos vins  /doz ˈvıns/  [doˈr.ˈvıns]  ~ [doˈr.ˈvıns]  ‘two wines’
  dos focs  /doz ˈfıks/  [doˈr.ˈfıks]  ~ [doˈr.ˈfıks]  ~ [doˈr.ˈfıks]  ‘two fires’
  dos mesos  /doz ˈmɛzos/  [doˈr.ˈmɛzos]  ~ [doˈr.ˈmɛzos]  ‘two months’
  dos nius  /doz ˈnıws/  [doˈr.ˈnıws]  ~ [doˈr.ˈnıws]  ‘two nests’

b.  dos pans  /doz ˈpans/  [doˈs.ˈpans]  ‘two breads’
  dos tocs  /doz ˈtıks/  [doˈs.ˈtıks]  ‘two knocks’
  dos cans  /doz ˈkans/  [doˈs.ˈkans]  ‘two dogs’

As discussed in section 1.2 in the introductory chapter, Nuorese Sardinian exhibits patterns of rhotacism very similar to the ones illustrated in (11) for Majorcan Catalan. However, as noted in 1.2, in Nuorese the relationship between the rhotic and the alveolar fricative in coda position is bidirectional: not only does the fricative become a rhotic before voiced stops, af-
fricatives, certain sonorants and fricatives, but the rhotic also becomes an alveolar fricative before voiceless stops – for examples see chapter 1; an analysis is given in chapter 7.

A less studied synchronic instance of phonological interactions among sonorants and between sonorants and obstruents in Romance are the patterns of dissimilation in colloquial and dialectal varieties. Lloret 1997 provides illustrations of these patterns in Ibero-Romance languages. The synchronic dissimilating alternations parallel the diachronic patterns of dissimilation found in Ibero-Romance. The following synchronic examples are taken from Lloret 1997, 128.\(^{16}\)

\[\begin{align*}
\text{(12) a. Standard Catalan} & \sim \text{colloquial Catalan} \\
\text{només} & \sim \text{domés} \ ‘\text{only’} \\
\text{faldilla} & \sim \text{fandilla} \ ‘\text{skirt’} \\
\text{b. Standard Spanish} & \sim \text{colloquial Spanish} \\
\text{peregrino} & \sim \text{pelegrino} \ ‘\text{wandering’} \\
\text{glándula} & \sim \text{grándula} \ ‘\text{gland’} \\
\text{c. Standard Portuguese} & \sim \text{colloquial Portuguese} \\
\text{nemhum} & \sim \text{denhum} \ ‘\text{no one’} \\
\text{nomear} & \sim \text{lomear} \ ‘\text{to name’}
\end{align*}\]

\(^{16}\)Since the Ibero-Romance patterns fall into the bigger pool of dissimilation patterns in Romance, similar data are expected in other Romance colloquial and dialectal varieties. While the Romance literature focuses on diachronic patterns of dissimilation (e.g., Posner 1961), I have not found any synchronic study of the phenomenon, except for the paper by Lloret 1997. Another interesting synchronic perspective on these patterns of dissimilation and substitution among sonorants is found in the acquisition of Romance languages. I have noticed synchronic dissimilation patterns in children’s production of Italian; for instance, *scheletro* ‘skeleton’ was systematically produced as *schenetro* by me as a child. Metathesis between sonorants and obstruents and among sonorants is also frequent in child language (e.g., child Spanish *vedera* \sim* vereda* ‘sidewalk’, and *caravela* \sim* calavera* ‘skull’; Colantoni, p.c.). A search through corpora of L1-acquisition data in Romance languages for instances of sonorant/sonorant and sonorant/obstruent alternations, in order to further substantiate the synchronic nature of the phenomenon in Romance, has never been conducted, to my knowledge.
2.2.3 Processes triggered by sonorants: nasalization

In addition to the sonorant interactions introduced above, Sardinian is among the Romance languages that exhibit vowel nasalization patterns. Most of the languages manifesting this trait belong to Western Romance.\(^{17}\) Thus, for instance, French and Portuguese have phonemic nasal vowels in their sound inventory.

\[
\text{French phonemic nasal vowels}
\]

\begin{align*}
/e/ & \text{ vs. } /\breve{e}/ \quad /\text{m}e/ \text{ ‘but’, mais} \quad /\text{m}\breve{e}/ \text{ ‘hand’, main} \\
/a/ & \text{ vs. } /\breve{a}/ \quad /\text{l}a/ \text{ ‘tired’, las} \quad /\text{l}"\breve{a}/ \text{ ‘slow’, lent} \\
/o/ & \text{ vs. } /\breve{o}/ \quad /\text{p}o/ \text{ ‘skin’, peau} \quad /\text{p}"\breve{o}/ \text{ ‘bridge’, pont}
\end{align*}

On the other hand, Galician, Andalusian Spanish, and Occitan, just to cite a few, present allophonic nasal vowels, i.e., vowels that are nasalized in nasal contexts, specifically, when followed by a nasal coda (e.g., Galician [ˈbẽnde] ‘he sells’, and [ˈpõŋ] ‘he puts’).

As discussed in the introduction, the fact that Sardinian is not uniform as far as vowel nasalization is concerned is fundamental to the inquiry pursued in the present work. The data presented in chapter 4 point to a phonologically conditioned vowel nasalization process in Campidanese but not in Nuorese Sardinian.

2.2.4 Processes triggered by sonorants: voicing

In Romance, voicing is triggered by voiced obstruents and sonorants alike (e.g., Lausberg 1976). This pattern is robust in Sardinian as well. The sound sequence in which voicing assimilation can be observed in Sardinian are /sC/ clusters.\(^{18}\)

\(^{17}\)Romanian (Eastern Romance) also shows allophonic variation between oral and nasal vowels. I refer the reader to Sampson 1999 for a pan-Romance survey of vowel nasalization, its structural conditioning and its phonologization (or not). For a study of universals in nasalization, I refer the reader to Hajek 1997, who focuses on eight Northern Italian dialects (Gallo-Romance) and one Romantsch dialect (Rhaeto-Romance).

\(^{18}\)The context is restricted as the only domain in which the appropriate sequence can occur is in word-initial position: word-internally /s/ forms /sC/ clusters only with voiceless obstruents. In Italian and the Italo-Romance
In Campidanese Sardinian, for instance, both voiced stops and sonorants transmit voicing to /s/ (Bolognesi 1998, 62,172; Molinu 1998, 55); [s] occurs only before voiceless stops and fricatives. The data in (14a) and (14b) (Bolognesi 1998, 62) illustrate that word-initial /s/ becomes voiced when preceding voiced stops and sonorants respectively. These data contrast with the forms in (14c,d) where /s/ remains voiceless if followed by voiceless stops and voiceless fricatives respectively.

(14) **Campidanese**

<table>
<thead>
<tr>
<th>Cluster Type</th>
<th>Example Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>/s + b, d, g/</td>
<td>[zb]al:ju ‘mistake’</td>
</tr>
<tr>
<td>/s + N, l, r/</td>
<td>[zd]or:ɔb:ai ‘to rob’</td>
</tr>
<tr>
<td>/s + p, t, k/</td>
<td>[sp]antu ‘wonder’</td>
</tr>
<tr>
<td>/s + f, s/</td>
<td>[st]ampu ‘hole’</td>
</tr>
<tr>
<td>/s /</td>
<td>[sk]oβa ‘school’</td>
</tr>
</tbody>
</table>

An interesting pattern with respect to voicing of word-initial sC clusters is reported in varieties. /s/ does not precede voiced obstruents in word-internal position ([z-] is exceptional and is found for instance in the Italianization of toponyms such as Straβburg or Regensburg — Stra[z]urbed and Rati[z]ona respectively). Word-internally, the fricative is voiced in sC clusters where C is a sonorant, usually a nasal (e.g., a[zm]a ‘asthma’, fant[aβ]a ‘ghost’), Rohlfs 1966, 382. In Latin, only sC clusters with C being a voiceless stop were possible in any position, see Tekavčić 1972, 242. Word-initial sC clusters are morphologically derived, either historically, from Latin forms prefixed with EX- ‘out of, from within, from’ (lexicalized #s- items), or synchronically, through the affixation of #s-dis- (a productive derivational process both in Sardinian and in Italian).

19 The alveolar sibilant undergoes voicing before voiced obstruents and sonorants (including r) in the entire Italian territory (Rohlfs 1966, 259). The example for the voicing of /s/ in front of the fricative in (14b) is derived through the widespread process metathesis of the fricative in Campidanese; cf. non-metathesized variant [sorgu] ‘father-in-law’.

20 In Campidanese, /s+s/ and /s+f/, in (14d), can also give [ʃ]: EX-SEPERARE, [ʃeβerai] ~ [ʃoβerai] ‘to select’; *EXFATATU(M), [ʃaβau]’miserable’; [is femiaza] ~ [i feμiaza] ‘the women’, (Virdis 1978:62).
Rohlfs 1966, 259-60. In the Italo-Romance varieties spoken in Calabria and Campania (south-west Italy) as well as of those spoken in Sicily and Sardinia (the two major islands off the west Italian coast), word-initial voiceless sC clusters become voiced if a sonorant is present within the word.\textsuperscript{21} If no sonorant segment follows within the same word, the word-initial voiceless sC cluster does not become voiced.\textsuperscript{22} Relevant examples are provided in (15).\textsuperscript{23} Most of the Sardinian examples taken from Wagner 1941, 194 are from Campidanese (15a), but there are a few examples that show that the process appears to be active on the entire Sardinian territory. In (15b) I include the only two examples from Nuorese I found in the above-mentioned source. The middle column in (15a,b) provides the Italian correspondent or a non-voiced alternant for comparison.

\begin{tabular}{llll}
\textbf{(15) a. Campidanese} & \textbf{b. Nuorese} \\
\[zg\]uma & \[sk\]iuma & ‘foam’ & i[rg]arda & \[sk\]ardasso & ‘card (textile)’ \\
\[zg\]annai & \[sk\]annare & ‘to kill’ & i[rg]annare & \[sk\]annare & ‘to kill’ \\
\[zd\]erriaì & \*STERILARE & ‘to prune’ & \\
\[zd\]robbare & di[st]urbare & ‘to disturb’ & \\
\end{tabular}

\textsuperscript{21}According to Rohlfs 1966, 259-60, this long-distance voicing agreement is an active process in the Italo-Romance varieties spoken in the south-west of Italy, while it is sporadic and limited to a restricted pool of lexical items in other Italo-Romance dialects as well as in the Gallo-Italian dialects spoken in northern Italy.

\textsuperscript{22}Rohlfs 1966, 260 cites a handful of exceptions, where /sk/ become [sg] when a voiceless alveopalatal affricate follows, e.g., Sicilian [zg]izzu vs. Italian [sk]izzo ‘sketch’; Neapolitan [zd]izza vs. Italian [st]izza ‘anger; irritation’. Since no further details are provided, it is impossible to interpret these exceptions properly.

\textsuperscript{23}The data from dialects spoken in Calabria, Campania and Sicily reported in Rohlfs 1966, 256-60 are parallel to the Campidanese ones, as shown by the following Sicilian items:

\begin{tabular}{llll}
\textbf{(1) Sicilian} & \textbf{Italian} \\
[zb]avintari & [sp]aventare & ‘to scare’ & \\
[zb]ennuri & [sp]lendore & ‘splendor’ & \\
[zg]erzu & [sk]erzo & ‘joke’ & \\
[zd]rigliari & [st]rigliare & ‘to curry’ & \\
\end{tabular}
2.3 Summary

So far in this chapter I have reviewed the Romance patterns of variation between sonorants and obstruents that point to a phonological relationship among the members of the sonorant set, and between the sonorant and the voiced obstruent set. They include both historical and synchronic patterns:

\begin{itemize}
\item \textbf{Historically}
  \begin{itemize}
  \item Dissimilation among liquids
  \item Substitution among liquids, glides and nasals
  \item Assimilation between nasals and voiced stops
  \end{itemize}
\item \textbf{Synchronically}
  \begin{itemize}
  \item Alternation between voiced stops and approximants
  \item Alternation between voiceless fricative and rhotic
  \item Dissimilation among liquids
  \item Dissimilation between voiced stops and nasals
  \end{itemize}
\end{itemize}

A few alternations among sonorants and between sonorants and obstruents in Sardinian were anticipated in section 1.2 in the previous chapter. The array of patterns found in Sardinian and to be discussed throughout the dissertation conform to the range of phenomena recognized in the Romance literature. Specifically, Sardinian shares features both with Western Romance and Italo Romance.

What the present in-depth study of Sardinian sonorant phonology indicates is the need for teasing these patterns apart and for considering carefully whether they belong to the same grammar or to different ones. Based on what has been presented so far, we anticipate that the sonorant patterns attested in Nuorese Sardinian are not documented in Campidanese, and those attested in Campidanese are not found in Nuorese. The core chapters of this dissertation explore the clustering of sonorant patterns within a grammar but not within another, and the theoretical considerations that this raises.
2.4 Two Sardinian varieties: Nuorese and Campidanese

I now introduce the major differences between Campidanese and Nuorese Sardinian. It must be noted that in the literature on Sardinian, the features that are identified as distinguishing the dialects are all historical. In contrast, this dissertation, although starting with historical evidence, defines the difference between Campidanese and Nuorese in synchronic terms.

2.4.1 Linguistic diversity in Sardinia

The Mediterranean island of Sardinia is a linguistically heterogeneous domain as different Romance varieties are spoken on its territory, as depicted in the map in figure 2.1.

While Sardinian, with all its different varieties, is spoken on most of the island, there are a few remarkable exceptions: the north-western town of Alghero is a Catalan-speaking community (Ibero-Romance); a variety of Ligurian (Gallo-Italian) is spoken in the offshore communities of Carloforte and Calasetta, off the south-western coast; Gallurese, a variety of southern Corsican, which is Tuscan-based, is spoken in the eastern part of the northern coast; Sassarese, “a hybrid dialect which evolved during the Middle Ages as a result of the close contact between the native Sardinian population of Sassari and the maritime powers of Pisa and Genoa” (Jones 1988) is found in the western part of the northern coast.24

2.4.2 General differences between Nuorese and Campidanese

There are two main varieties of Sardinian: Logudorese-Nuorese, spoken in the northern half of the island and Campidanese spoken in the southern half of the island. As indicated by the two bold lines crossing the middle of the island in the map in figure 2.1, there are two major isoglosses responsible for this dialectal sub-division. The bold dashed line corresponds to the

24The Tuscan influence on Sassarese and Gallurese is traceable, for instance, in the palatalized realization of Latin consonant+l. clusters (which became Cr in Sardinian, but Cj in Tuscan and thus Italian) and in the absence of metaphony (as in Tuscan, and in contrast with Sardinian).
Figure 2.1: Linguistic diversity in Sardinia
northern limit of the territory in which palatalization of velar stops preceding front vowels takes place. The bold solid line marks the northern limit of the reduction of the final-vowel inventory to a three-element system [i, a, u]. Since palatalization and vowel reduction are interpreted as advanced stages of change, the distinction between Campidanese and Logudorese-Nuorese is traditionally defined in terms of conservatism. Nuorese, the Logudorese dialect spoken in the central-eastern area around the town of Nuoro, is the most conservative variety of Sardinian (Wagner 1941). In 2005, the administration of the region of Sardinia appointed a committee of experts to identify the dialect of Sardinian which best embodies the core of sa Limba Sarda Comuna ‘the common Sardinian language’. The morphological and syntactic components of Sardinian grammar are quite stable across dialects, making the task of establishing a common Sardinian relatively easy at these levels. Given the phonological diversity across dialects we have begun to sketch out, however, the choice of the sound system to be translated into an orthographic norm for the recording of official acts of the regional government (since April 2006) and use in the press media was a daunting task. The experts consulted recommended the sound system of the conservative variant of Nuorese as the norm for the standardised Sardinian orthography. Campidanese, the other major dialect, is labeled as innovative, especially the variety spoken in the provincial capital, Cagliari, and in the areas in close contact with the town. The people living in the provincial capital have much more daily exposure to Italian, and thus the variety of Sardinian spoken in Cagliari is more ‘italianized’, as reported by the speakers I interviewed in the rural areas of Campidano. The expected stronger pressure of Italian on Cagliari and urban areas is reflected in the results of a sociolinguistic survey carried out by the Universities of Cagliari and Sassari and officially released on May 5, 2007. When Sardinian speakers were asked whether they “know and speak at least one of the variants of

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Sardinian”, 85.5% of the members of small communities and villages (fewer than 4,000 people) answered yes, in contrast to the 57.9% of the population of towns with more than 100,000 people, including Cagliari.

2.4.3 Development of the two dialects

The division of the varieties spoken in the island into two major ones, Logudorese-Nuorese and Campidanese, dates back to the earliest stages of the Roman colonization of the island. After the first period of intense latinization (between the III century BCE and the I/II century CE) that affected the entire Sardinian territory, the central-eastern mountanous area of the island (where Nuorese is spoken) remained culturally, economically and linguistically isolated from the south, as well as from the coastal areas, which, on the contrary, kept in touch with the Latin and late Latin world, thus assimilating linguistic innovations. This hypothesis was first put forward by Wagner 1928 based on a lexicographic study, and is accepted by most scholars.\(^\text{27}\) The division between Campidanese and Nuorese was crystallized during the Catalan and the subsequent Spanish occupation of the island (XIV-XVIII centuries C.E.; see Loi Corvetto 1993), which imposed the Iberic languages as official. A lexical analysis (Wagner 1951, 190) shows that only Campidanese received pressure from Catalan while both Camp-

\(^{27}\)Blasco Ferrer 1989, in a more recent and detailed study, supports Wagner’s proposed time-line of the first period of latinization of the island. He further argues that the Latin introduced through this first wave presented both archaic features (lexical, but also morphosyntactic, such as the widespread use of ablative constructions later lexicalized in Sardinian and early Latin word order templates) and many features of the Latin spoken in the African territory (Northern Africa, in particular modern Tunisia) of the Roman Empire. Blasco Ferrer also upholds Wagner’s claim that what then came to distinguish the Campidanese area, together with the north and north-western coasts of the island, from the interior and the eastern coasts (the Logudorese-Nuorese area), is continuous contact with the Roman and then Romance world. However, Blasco Ferrer 1989 points out that the eastern coasts also received a second, strong wave of latinization in the II and III century CE, through maritime contact with the population living on the coasts of Lazio and Campania. This second wave of latinization, though, did not penetrate into the interior, leaving Nuorese as the most archaic variety of Sardinian.
idanese and Nuorese were in contact with Castillian Spanish. Catalanisms are in fact found only in Campidanese, whereas hispanisms appear in both Sardinian varieties. It is not clear whether the contact with Ibero-Romance languages permeated the phonology of the two major Sardinian dialects; in other words, it is not certain whether the phonological traits that resemble Ibero-Romance result from language contact or are independent parallel developments. This historical investigation is not within the scope of this dissertation. While a more detailed account of the progressive differentiation of these two varieties is beyond the scope of this work, I refer the reader to Loi Corvetto 1993, Wagner 1951, and Blasco Ferrer 1984 for detailed discussion of the history of Campidanese and Nuorese.

2.4.4 Choice of communities studied

Note from the map in Figure 2.1 that both the Logudorese-Nuorese and Campidanese territories are characterized by dialectal variation. In order to carry out a detailed analysis of phonological patterns, a specific choice with respect to particular dialects had to be made. I concentrate on Nuorese (in the linguistic map of Sardinian in Figure 2.1, it corresponds to the area marked in narrow diagonal lines in the northern half of the island) and Western Campidanese (in the above-mentioned map, it corresponds with the dark area numbered ‘1’ in the southern half of the island). The choice of these two dialects is motivated by (i) the variety of sources available as references for each of these dialects, and (ii) the possibility for me to conduct fieldwork in the Western Campidanese area as well as to retrieve sound files for Nuorese through the VIVALDI project. The Western Campidanese dialect is particularly interesting as it possesses a robust pattern of vowel nasalization. Western Campidanese is the only Sardinian dialect with phonological vowel nasalization (Contini and Boë 1972; Virdis 1978; Bolognesi 1998).

The map in Figure 2.2 is adapted from Contini and Boë 1972 and presents the area in which vowel nasalization is attested. This area comprises Western Campidanese, the dialect spoken

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28The Western Campidanese variety is also referred to as Campidanese rustico ‘rural Campidanese’ in Wagner 1941, as the plain of Campidano where it is spoken is the farmland of the island.
in Sárrabus and a transitional zone between the two.\textsuperscript{29}

The location in which Contini and Böe 1972 conducted their research on nasalization in Sardinian is signaled by an asterisk on the map, and corresponds to the village of Sanluri, where I also recorded data from a sixty-year old male speaker. The other Sardinian speakers I interviewed come from the neighbouring village of Villasor (see 1.3 and 4).

\textsuperscript{29}In two subareas of the nasalization zone, Sárrabus and Isili, the nasal stop is maintained as a glottal stop, and the preceding tonic vowel acquires the nasal feature (Wagner 1941, 63): e.g., lůʔa ‘moon’, for etymological LUNA. Sárrabus Sardinian is documented in a monograph by Böhne 1950. Notably, the same glottal formation process is undergone by intervocalic \v{l} in this dialect. Worthy of consideration is that the ‘debuccalized’ lateral does not lend any specific feature to the adjacent vowels, in contrast to the ‘debuccalized’ nasal.
2.4.5 Phonological differences between Nuorese and Campidanese

As introduced at the beginning of this section, the distinction between Nuorese and Campidanese is well-established in the literature on Sardinian. Recall the two major isoglosses depicted in Figure 2.1 dividing the Sardinian territory between the Campidanese area in the south and the Logudorese-Nuorese area in the north. They correspond to the criteria in (17a) and (17b) in the table below. Together with absence/presence of palatalization of velar consonants before front vowels (17a) and absence/presence of reduction of the vowel inventory word-finally (17b), Logudorese-Nuorese and Campidanese also differ as far as the historical development of intervocalic stops is concerned (17c, d).³⁰

<table>
<thead>
<tr>
<th>(17)</th>
<th>(Latin) Etymon</th>
<th>Nuorese</th>
<th>Campidanese</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>{K, G} + front Vs</td>
<td>[k, g]</td>
<td>[ʔf, ʔʃ]</td>
</tr>
<tr>
<td>b.</td>
<td>Word-final Vs</td>
<td>[i, e, a, o, u]</td>
<td>[i, a, u]</td>
</tr>
<tr>
<td>c.</td>
<td>V{P, T, K}V</td>
<td>[p, t, k]</td>
<td>[β, ɗ, ɣ]</td>
</tr>
<tr>
<td>d.</td>
<td>V{B, D, G}V</td>
<td>[β, ɗ, ɣ]</td>
<td>⌀</td>
</tr>
</tbody>
</table>

The present work points to synchronic phonological differences between Campidanese and Nuorese Sardinian by exploring in depth their sonorant patterning. We shall see in detail how different Campidanese and Nuorese are with respect to the phonology of nasals and rhotics. Although data pointing to this major dichotomy are recorded in the literature, the grammatical significance has not been discussed, neither has its theoretical relevance.

In the present dissertation, I argue that the key to the phonological difference between Campidanese and Nuorese lies in the organization of the class of sonorants in each variety. The next chapter outlines the theoretical background which anchors this analysis.

³⁰For examples, I refer the reader to Wagner 1941.
Chapter 3

Theoretical background

While the previous chapter highlighted the empirical contribution of this work within Romance phonology, the present chapter identifies and summarizes the theoretical debate to which the thesis contributes. In order to do so, it re-presents the crucial set of facts concerning the phonology of sonorants in Campidanese and Nuorese Sardinian and the questions they raise, and it introduces the theoretical framework adopted in the analysis of the phonology of Campidanese and Nuorese sonorants to be discussed in the chapters to come.

3.1 Facts and questions

As introduced in chapter 1, in this thesis I analyze two varieties of the same language having the same sonorant inventory (18a) but showing different patterns among its members and between some of its members and the elements of other phonological classes (18b).

(18) a. Sonorant inventory
    - liquids /r/, /l/
    - nasals /n/, /m/
    - glides /j/, /w/

b. Sonorant relationships
    | | Campidanese | Nuorese |
    | r/s alternation | no | yes |
    | r/n alternation | yes | no |
    | phonological nasalization | yes | no |

The critical point to be investigated in the present work is the distribution of sonorant patterns between the two dialects of Sardinian under scrutiny. The distribution of the patterns,
summarized in (18b), gives rise to the following questions:

(19)  

a. why do nasals trigger nasalization in Campidanese but not in Nuorese?  
b. why does the rhotic member of the sonorant inventory bear a relationship with the 
nasal homorganic in place of articulation in Campidanese but not in Nuorese?  
c. and, on the other hand, why does the rhotic bear a relationship with the sibilant 
homorganic in place of articulation in Nuorese but not in Campidanese?

How do we account for these differences in the phonology of sonorants in Campidanese 
and Nuorese Sardinian? Are they random or are they systematic?

3.2 The assumption

The assumption made in the present work is that the different distribution of sonorant patterns 
between Campidanese and Nuorese Sardinian is systematic and not accidental. Specifically, 
this systematicity is a consequence of the way in which the phonemic contrasts are organized 
within the sonorant inventories of each of Campidanese and Nuorese.

Let us first consider the case of nasals. The fact that nasals are phonologically active in 
Campidanese, as they are triggers of phonological nasalization, opens up the possibility for 
the rhotic to be a target of phonological nasalization in this dialect but not in Nuorese, where, 
in contrast, the nasal segments are phonologically inert (chapters 4 and 5). The susceptibility 
of the rhotic to phonological nasalization (regressive, as in the case of vowel nasalization), in 
turn, gives rise to patterns of alternation and substitution between [r] and [n] in Campidanese, 
but not in Nuorese. In other words, the first two Sardinian sonorant patterns in the synopsis in 
(18b), repeated in (20) below, are interrelated.¹

¹Liquids are susceptible to nasalization cross-linguistically, although less frequently than vowels and glides. 
Cross-linguistic studies of nasalization such as Schourup 1972, Piggott 1992 and Walker 2000 garner evidence 
for the implicational nasalization hierarchy in (1).
CHAPITRE 3. THÉORÉTICAL BACKGROUND

(20) | Campidanese | Nuorese |
--- | --- | --- |
nasalization | yes | no |
r/n | yes | no |
r/s | no | yes |

In the case of Campidanese, the link between the presence of alternations between [r] and [n] and the phonological activity of nasals in the grammar is further supported by acoustic data of progressive rhotic nasalization in the language (chapter 6). In Nuorese, patterns of rhotic nasalization, whether progressive or regressive, are not found. In addition, in Nuorese, there are no historical traces of any interplay between rhotics and nasals, in contrast with what is documented for Campidanese (chapter 6).

Now, the open question as far as Campidanese is concerned is whether there is any interrelation between the phonological activity of nasals, their interaction with another member of the sonorant inventory, the [r], and the absence of any interaction between the [r] and [s]. This question mirrors one that can be formulated for the Nuorese system: is there any interrelation between the phonological inertness of nasals, the lack of interaction with [r], and the phonological patterns between [r] and [s] in this dialect?

In other words, are the sonorant patterns found in Campidanese complementary to those

(1)  \[
\text{HIGH} \leftarrow \text{compatibility with nasalization} \rightarrow \text{LOW} \\
\text{vowels} \gg \text{glides} \gg \text{liquids} \gg \text{fricatives} \gg \text{stops}
\]

A compatibility scale can also be formulated according to an acoustic parameter: “As the main effect of nasalization in sonorants is in the region of the first formant, we could take as a rule of thumb: the lower is the F1 of a segment, the less will it tolerate nasalization.” (Ohala 1975)[301]. The hierarchy in (1) makes the following prediction with respect to possible grammars showing phonological nasalization:

(2)  

| | Possible Grammars | Impossible Grammar |
--- | --- | --- |
vowel nasalization | yes | no |
approximant nasalization | no | yes |

Among the possible grammars, French corresponds to the first on the left, while Campidanese and Nuorese correspond to the second and the third from the left, respectively.
found in Nuorese Sardinian in a systematic fashion? The assumption underlying the present dissertation is that the patterns are complementary, and systematically so. I argue for a model that accounts for these differences, which I outline in the following section.

3.2.1 The model

I adopt a theory of contrastive specification as formulated by Dresher, Piggott, and Rice 1994, Dresher 2008 and in press. The two fundamental tenets of the theory are (i) that contrast is the organizational principle of any phonological system, and (ii) that contrast among the members of a phonological inventory is assigned according to principles of logic.

Within the framework of contrastive specification, features, although phonetically defined, act within a grammar as indexes of phonological contrast rather than as indexes of phonetic information. Phonological contrast is the core of language-specific phonology and the grammatical knowledge mastered through language acquisition. Contrast represents the major relationship holding between phonemes and thus contrast serves as the organizational principle of phonemic inventories and phonological patterns.

Within this theory, it is further assumed that feature specification obeys a principle of specification with features specified up to contrast. For instance, in an underlying three-vowel system such as the one exemplified in (21) below, it is sufficient to specify two features in order to capture its contrastive configuration exhaustively. This implies that one member of a sound inventory will always be unmarked by any feature. Through this principle, the model

---

2 For a historical and epistemological review of the theory I refer the reader to Dresher in press, while for a detailed discussion of the principles upon which the theory rest, I refer to Hall 2007.

3 Most of the phonological analysis carried out within the framework of contrastive specification rely on the Continuous Dichotomy Hypothesis by Dresher, Piggott, and Rice 1994 further elaborated in the form of the Successive Division Algorithm (SDA) by Dresher 1998. As discussed in detail in Dresher in press, the SDA builds on the work of Jakobson, Fant, and Halle 1952 and Jakobson and Halle 1956.

4 I use capital letters to mark the phonemic status of the elements under consideration. In this respect, capital letters amount to the use of slanted brackets around IPA symbols.
attempts to capture markedness patterns within a given grammar.\textsuperscript{5}

\begin{equation}
\text{phonemic inventory: } \{I, A, U\}
\end{equation}

\textit{contrast} \quad \text{three-way}

\textit{number of features:} \quad \text{two}

The model also needs to prescribe which features, among the universal pool, are responsible for the specific contrastive configuration of a given sound inventory. The principle informing the selection of contrastive features is phonological activity: those features that are active in the phonology of a given language are analyzed as being part of the contrastive make-up of its phonemic inventory. In essence, this is a corollary of the underspecification principle: there is no room for redundant features in the contrastive make-up of phonemes.\textsuperscript{6} Thus, for instance, if a given language presents patterns of rounding and raising among vowels, the two contrastive features in the vowel inventory will be [round] and [high]. These two features suffice if the vowel inventory is a three-way system as the one in (21) above.

What is unique to contrastive specification is that contrast within a given grammar is encoded not only by the features selected by that specific grammar as contrastive but also by the relations holding among the contrastive features. Feature specification within a phonemic inventory is organized hierarchically, with a higher feature, or a feature selected earlier, taking broader scope over the inventory, and a lower feature, or a feature selected later, specifying contrast within smaller and smaller subsets of phonemes. The order of selection of features thus serves to organize the sound system in subsets of phonemes. This ordering of features is known as the contrastive hierarchy, and it can vary from language to language depending on feature activity in the language. The effect of the contrastive hierarchy is that the relevance of a given contrastive feature is relative to the relevance of the other contrastive features in the system.

\textsuperscript{5}For the relationship between language-specific and cross-linguistic markedness I refer the reader to Rice 2007.

\textsuperscript{6}For an in-depth discussion of the role of redundant features in the phonological computation, see Hall 2007.
In order to illustrate the contrastive hierarchy, let us continue the analysis of the hypothetical language with a phonemic three vowel inventory as in (21), and phonological patterns showing vowel raising and rounding. Contrastive specification allows that the hypothetical three-vowel inventory \{I, A, U\} can present a feature specification derived by either the contrastive hierarchy in (22a) or the one in (22b) below.

\[
\begin{align*}
\text{a. hierarchy: } & [\text{high}] \succ [\text{round}] \\
\text{b. hierarchy: } & [\text{round}] \succ [\text{high}]
\end{align*}
\]

\[
\begin{align*}
\text{a. hierarchy: } & [\text{high}] \succ [\text{round}] \\
& [\text{high}] \downarrow \emptyset \\
& I, U \quad A \\
& [\text{round}] \downarrow \emptyset \\
& U \quad I \\
\end{align*}
\]

\[
\begin{align*}
\text{b. hierarchy: } & [\text{round}] \succ [\text{high}] \\
& [\text{round}] \downarrow \emptyset \\
& \quad U \quad I, A \\
& [\text{high}] \downarrow \emptyset \\
& \quad I \quad A
\end{align*}
\]

The hierarchy in (22a) corresponds to a grammar in which raising is triggered both by I and U and affects A. The hierarchy in (22b), on the other hand, corresponds to a grammar in which raising is triggered by I only and targets A. In both grammars, rounding is induced by U, the only phoneme marked by [round], and may affect both I and A, the unrounded segments.\(^7\) The patterns are summarized in the tables (23a) and (23b), respectively.

\[
\begin{align*}
\text{a. grammar: } & [\text{high}] \succ [\text{round}] \\
& \text{trigger(s) target(s)} \\
& \text{rounding} \quad U \quad I, A \\
& \text{raising} \quad I, U \quad A \\
\end{align*}
\]

\[
\begin{align*}
\text{b. grammar: } & [\text{round}] \succ [\text{high}] \\
& \text{trigger(s) target(s)} \\
& \text{rounding} \quad U \quad I, A \\
& \text{raising} \quad I \quad A
\end{align*}
\]

Despite having the same inventory in terms of its members (both in number and quality) and in terms of contrastive features, the grammars (23a) and (23b) above are substantially different systems. Which grammar of the two in (23) above corresponds to the language under analysis? The answer can be found by comparing the language patterns for raising with the

\(^7\)Notice, however, that rounding may be restricted to high segments only in the grammar in (22a), but not in the grammar in (22b).
two logical options in (23). If the language under scrutiny shows raising triggered by both I and U, it corresponds to grammar (23a) and not (23b).

The contrastive hierarchy predicts that both systems may be found among natural languages, and research in this framework has demonstrated that this prediction is in fact borne out; see, for instance, Dresher and Zhang 2004 on Manchu vowel systems, Dyck 1995 on Romance vowel systems, and Mackenzie 2009 on consonant harmony processes.8

To return to Sardinian, what is fundamental here is that the model outlined in this section is the one that predicts that phonological patterns in a language are not only a function of the number of elements in the inventory and the content of the features contrastively specified in the system. It is also a function of the hierarchical relationship between the contrastive features. The table below summarizes the parameters taken into account within contrastive specification in order to determine phonemic contrast. Note that since specification dictates that the number of contrastive features is a function of the number of phonemes, those two comprise a single parameter (24i).

(24) **Contrasive Underspecification: parameters for phonemic contrast**

i. Number of phonemes \(\sim\) number of features;

ii. Feature content;

iii. Feature hierarchy

I examine in section 3.2.2 how such a model of phonemic contrast predicts the complementarity of the sonorant patterns between Campidanese and Nuorese Sardinian.

---

8The contrastive hierarchy is a powerful tool: how to constrain it so that it does not generate unattested grammars? In other words, are there any restrictions on the various hierarchical relationships that features may enter in to? I refer to Hall 2007 for a discussion of how to constrain the contrastive hierarchy, especially, pp. 35-36, and section 4.3.3.
3.2.2 Sonorant relationships in Sardinian: hypotheses and predictions

Let us now consider how feature specification through the contrastive hierarchy predicts the complementarity of sonorant patterns between Campidanese and Nuorese Sardinian to be systematic.

As discussed in section 3.1 in this chapter, the Campidanese and Nuorese sonorant subinventories show the same number of phonemes and thus the same number of contrastive features, while presenting quite different patterns. According to the model of contrastive specification outlined in the previous section, systemic differences are a function of the feature content and of the hierarchy according to which contrastive features are organized, with relevant contrasts and the contrastive hierarchy being identified through feature activity.

In the case of the two Sardinian dialects under scrutiny, the major difference between them lies in the phonological behaviour of nasals. The difference between Campidanese and Nuorese with respect to the phonology of nasals is the empirical base for the analysis outlined in the next paragraphs.

In Campidanese, [nasal] is a phonologically active feature and as such is assumed to be contrastive within the sound inventory of this dialect. In Nuorese, on the other hand, no process is initiated by nasal segments, as we shall see in chapter 7, and the feature [nasal] is thus analyzed as inert and not part of the contrastive make-up of its sound inventory. Thus, the parameter of ‘feature content’ (24ii above) is set differently between the two Sardinian varieties.

If [nasal] is not present phonologically in Nuorese, the question then arises of how to dis-
tinguish between nasal and non-nasal segments within the set \{R, S, N\} in this dialect. In
Campidanese, the answer is trivial as the feature \[nasal\] is available for building contrast among
the members of the set along this dimension: N is specified by \[nasal\] in contrast to R and S. In
Nuorese, on the other hand, such a possibility is absent as \[nasal\] is not part of the contrastive
make-up of the language.

As discussed in Mielke 2005, nasals comprise a class of segments that is phonetically
natural – nasal airflow and resonance in the nasal cavity are the aerodynamic and acoustic
correlates – but phonologically ambivalent with respect to the feature \[continuant\]. While
the contrast between stop and continuant sounds is universal, the boundary between the two
classes is variable crosslinguistically. Liquids and nasals are two classes that show variability in
patterning phonologically as stops or continuants across languages. I build on this observation
to put forth the hypothesis that nasals are contrastively defined as non-continuant segments in
the grammar of Nuorese while in Campidanese they are sonorants. In Nuorese, then, R and S
are specified by \[continuant\] in contrast to N. The data presented in chapter 7 show that N does
not pattern with continuants in Nuorese.

The hypothesis that I put forth with respect to the contrastive hierarchies characterizing
Campidanese and Nuorese is illustrated in (25). Sonorant Voicing ([SV] in the diagrams below)
is the feature characterizing sonorants and it is assumed here because it allows parametric
variation with respect to the feature \[nasal\]. Note moreover that S(onorant) V(oicing) is also
argued to be the best representation of the voicing contrast in Sardinian (see Molinu 1998 and
Frigeni 2005b).  

---

10Recall that capital letters denote the phonemic status of the segments. The capital letters convention is used
when working on the contrastive hierarchy informing an inventory or a subset thereof.

11SV is also a voicing feature as discussed at length in Rice and Avery 1989, Rice 1993 and Avery 1996.
In Campidanese – the grammar corresponding to the hierarchy in (25a) – the phonemes R and N are sonorants, and contrast with the obstruent S. They are kept separate from one another by means of the feature [nasal]. In Nuorese – the grammar corresponding to the hierarchy in (25b) – N is primarily a stop within the phonemic system of the language and in contrast with continuant phonemes S and R; those are distinguished from one another by means of the feature [SV], with R being the sonorant and S the obstruent segment.

The contrastive hierarchies in (25a,b) amount to the hypotheses built on the asymmetry between Campidanese and Nuorese Sardinian with respect to vowel nasalization. These hypotheses make strong predictions with respect to the grammars of the two Sardinian dialects, some of which have been anticipated in the above discussion. In the following paragraphs I present the predictions in a systematic fashion.

Within the grammar instantiated by the hierarchy in (25a), i.e., Campidanese, nasals trigger nasalization and R may be targeted by the process. S is not affected because it is not specified by [SV]. Within SV theory (see for instance, Rice and Avery 1989, Rice 1993 and Avery 1996), the specification of [nasal] depends upon the specification of [SV] and thus nasalization effectively targets only SV segments. This prediction, as anticipated, is borne out: Campidanese R shows nasalization in nasal contexts and, moreover, alternations between R and N are found historically as well as synchronically in this dialect (see chapter 6). A second prediction is that voicing in Campidanese may be triggered by R and N as both are marked by [SV], and target S. In chapter 2, instances of such a pattern were presented. Further predictions for this grammar may be formulated when considering that R shares the non-nasal voiced specification with D in the inventory of Campidanese (not illustrated in (25a)): how does D pattern in a
system such as the one derived by the hierarchy in (25a)? By being voiced and thus sharing
the SV specification with R, D is expected to interact with R. By the same token, D is also
expected to be a potential target of nasalization in Campidanese. Both predictions are tested
against Campidanese patterns in chapter 8; in the same chapter I also discuss how D fits in the
Campidanese contrastive hierarchy. The table in (26) summarizes the scenario outlined above
for Campidanese:

(26) Campidanese sonorant patterns

<table>
<thead>
<tr>
<th>pattern reported in the literature</th>
<th>analyzed in</th>
</tr>
</thead>
<tbody>
<tr>
<td>vowel nasalization</td>
<td>chapter 4 and 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>predicted patterns</th>
<th>analyzed in</th>
</tr>
</thead>
<tbody>
<tr>
<td>R nasalization</td>
<td>chapter 6</td>
</tr>
<tr>
<td>R/N alternation</td>
<td>chapter 6</td>
</tr>
<tr>
<td>R/D interaction</td>
<td>chapter 8</td>
</tr>
</tbody>
</table>

As evidence for the complementarity of sonorant patterns between Campidanese and Nuorese,
we shall see that the patterns predicted for Campidanese are not found in Nuorese.

Within the grammar instantiated by the hierarchy in (25b), i.e., Nuorese, the absence of
phonological vowel nasalization trivially predicts no other nasalization patterns in the the lan-
guage. No nasalization of R occurs in the language, thus validating the predication. R and S are
expected to interact with one another since both are [continuant]; in particular, one might ex-
pect S to voice to R. Nuorese shows a different patterning, yet still conforming to the structural
relationship between the two segments, as we shall see in chapter 7.

Given that N is the unmarked element relatively to R and S in the system in (25b), it is
further predicted that N may undergo assimilation triggered by R and S, i.e., by the feature
[continuant]. In chapter 7 this prediction is shown to be borne out and to be sharply in contrast
with the Campidanese data, where N does not assimilate to R or S.

Further predictions for this grammar may be formulated when considering that N shares
the non-continuant specification with T and D in the inventory of Nuorese (not illustrated in
Within the subset \( \{T, D, N\} \), T contrasts with D and N in terms of voicing: D and N are specified by [SV] whereas T is not. In Nuorese, in fact, voicing is triggered by voiced and sonorant segments alike, as in Campidanese.\(^{12}\) The question is how D and N are distinguished feature-wise in Nuorese. What we expect is some kind of assimilation or alternation patterning between these two segments in Nuorese, except for nasalization of D in nasal contexts (i.e., assimilation) since N in this grammar is not phonemically specified for [nasal]. The table in (27) summarizes the scenario outlined above for Nuorese:

(27)  **Nuorese sonorant patterns**

<table>
<thead>
<tr>
<th>Pattern Reported in the Literature</th>
<th>Analyzed in</th>
</tr>
</thead>
<tbody>
<tr>
<td>no vowel nasalization</td>
<td>chapter 4 and 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Predicted Patterns</th>
<th>Analyzed in</th>
</tr>
</thead>
<tbody>
<tr>
<td>no R nasalization</td>
<td>chapter 7</td>
</tr>
<tr>
<td>R/S alternation</td>
<td>chapter 7</td>
</tr>
<tr>
<td>N assimilating to R and S</td>
<td>chapter 7</td>
</tr>
<tr>
<td>no D nasalization</td>
<td>chapter 8</td>
</tr>
</tbody>
</table>

The complementarity of the sonorant patterns between Campidanese and Nuorese, apparent by comparing the tables in (26) and (27) is predicted by feature specification through the contrastive hierarchy.

### 3.3 Framing the Assumption

The present section addresses the major concepts that underlie the analyses presented.

\(^{12}\)I argue elsewhere (Frigeni 2005a) that the analysis of Campidanese and Nuorese Sardinian as SV systems is the correct one.
3.3.1 Phonological inventories, patterns and classes

The model adopted here assumes a strict relationship between the shape of the inventory, understood as the contrastive configuration that makes up the phonemic system, and the patterns attested in the language.\(^\text{13}\)

As discussed in section 3.2, contrast is encoded in features, whose content is primarily defined in phonetic terms. Thus, an understanding of the relationship between phonology and phonetics is crucial for any work carried out within the framework of contrastive specification.

Furthermore, since contrastive specification models language-specific phonological classes – they are in fact a reflex of a specific contrastive configuration – it faces the question of phonological classhood. Any question around phonological classes pertains to the debate on whether there is an interface between phonetics and phonology, and, if so, how this interface should be modeled. A review of the model of the phonetics/phonology interface adopted here is thus in order.

3.3.2 Phonetics and phonology

The nature of the relationship between phonetics and phonology assumed here is formulated in section 3.2.1. Within the framework of contrastive specification, features, although phonetically defined, act within a grammar not as indexes of phonetic information, but rather as indexes of phonological contrast. What the model recognizes and captures is that the function of the phonetically-defined features within a grammar may not be dictated by their phonetic content. In other words, a natural class defined from the perspective of the phonology may

\(^{13}\)This relationship is bidirectional: the language, as the computational system that generates patterns, relies on the contrastive information encoded in the inventory. The learner of the language, in order to master it as a generative system, must master the knowledge of the contrastive make-up of the sound inventory - the only traces on which she can rely are the phonological patterns she extracts from the raw language input.
differ from a natural class defined from the perspective of the phonetics.\textsuperscript{14}

The goal of this section is to clarify a view of the phonetics/phonology interface that grants autonomy to abstract phonology through a review of the historical debate around this interface.

According to the traditional view of generative phonology (\textit{Sound Patterns of English}, SPE, Chomsky and Halle 1968) there exists a modular distribution of labor between phonetics and phonology. In SPE terms, phonetic forces are universal and automatic and thus not encoded in the grammar, i.e. they are not part of the knowledge of language. On the other hand, phonology is language-specific, and is thus part of the grammar of that language; it is a specific instantiation of Universal Grammar, programmed through the exposure of speakers to a particular set of linguistics data.\textsuperscript{15}

\textsuperscript{14}In order to respond to the need for capturing universal and language-specific patterns, Mielke 2005 proposes the severing of ‘featurally natural phonological classes’ from ‘phonological active classes’ from ‘phonetically grounded phonological classes’ (Mielke’s labels). Severing the second and the third types of classes is in fact a way of modelling the state of affairs that phonetically similar segments behave differently in the phonologies of different languages. Mielke 2005, moreover, builds on phonological ambiguity and phonetic ambivalence to push for emergent features. In this work I am not concerned with features’ innateness versus emergence.

\textsuperscript{15}The nature of the relationship between phonetics and phonology has been a constant core theme in phonological theory, starting from the debate around the role of abstractness in underlying representations (see, for instance, Kenstowicz and Kisseberth 1977). As Kingston 2007, 401 effectively summarizes, “[p]honetics interfaces with phonology in three ways. First, phonetics defines distinctive features. Second, phonetics explains many phonological patterns. The two interfaces constitute what has come to be called the ‘substantive grounding’ of phonology (Archangeli and Pulleyblank 1994). Finally, phonetics implements phonological representations” [emphasis added]. The theoretical perspectives on the phonetic/phonology interface present a continuum ranging between two poles: on one extreme, phonetics and phonology blend together, on the opposite one, phonetics and phonology complement each other. The former pole is embodied by the paradigm elaborated by Ohala 1990, according to which, since phonetics completely informs phonology, phonology is redundant. Phonetically-grounded Optimality Theory (OT) (Steriade 2000; Kirchner 2001; Flemming 2001; Hayes, Kirchner, and Steriade 2004) falls on to this pole, as OT models the way constraints interact to give rise to a certain surface form, but the content of the constraints is purely dictated by the mechanics of speech perception and production. The second pole coincides to the modular view put forth by SPE and discussed in the main text.
These premises of the modular theory of the phonetics/phonology interface have been challenged by research in laboratory phonology (e.g., Pierrehumbert, Beckman, and Ladd 2000). The crosslinguistic aerodynamic study on nasalization by Cohn 1990, for instance, reveals that phonetics may also be language-specific (for a review of Cohn’s work, see chapter 4). Due to work like Cohn’s, the language-specificity of phonology is no longer a tenet for the complementary modularity between phonetics and phonology, as put forward in the SPE framework. Automaticity of phonetics then becomes the sole discriminant between the two modules. However, this tenet also is challenged by research in laboratory phonology. The crosslinguistic study of voicing by Kingston and Diehl 1994 reveals that phonetic implementation and interpretation are not merely automatic, but can be controlled by a speaker according to contexts or languages, thus pointing to what the authors call ‘phonetic knowledge’. If language-specificity and speakers’ knowledge are not exclusive to phonology as originally assumed, but appear to be characteristics of phonetic implementation too, what, if anything, distinguishes phonetics and phonology? Kingston and Diehl 1994, 425 argue that “[c]ontrastiveness rather than language-specificity [or speaker’s knowledge] should be the criterion for assigning a phonetic attribute of an utterance to the phonology.”

Kingston and Diehl’s contrastiveness corresponds to contrast, the core principle of the phonological model adopted in this work. Phonology is the study and theory of contrast (or, contrastiveness), and contrast is language-specific, as in grammar/system-specific. Kingston and Diehl’s conclusion is fully in alignment with the view of the phonetics/phonology interface assumed in this work where the phonetic content alone does not determine the phonological contrast.\(^{17}\)

\(^{16}\)While contrastiveness as a defining criterion of phonology is necessary, it is not sufficient. Hyman 2008, 4-5 shows in fact that phonologization – the assignment of a certain phonetic attribute (or not) to the phonology – does not necessarily depend on contrastiveness. Other kinds of pressure may also be at work, for instance, templatic distributional constraints.

\(^{17}\)The most recent perspective on the phonetics/phonology interface (e.g., Pierrehumbert, Beckman, and Ladd 2000 and Kingston 2007) rejects both the strict modularity model (generative phonology) and the absolute determinism of phonology by phonetics (e.g., Ohala). These extremes are labelled as reductionist models of the
3.3.3 Distinguishing between phonetic and phonological processes

A theory that grants autonomy to abstract phonology should also include parameters for categorizing processes as phonological in contrast to phonetic. In this section I introduce the parameters discussed in the literature for distinguishing between phonetic and phonological processes. They are essential tools for the analysis of Sardinian vowel nasalization conducted in chapters 4 and 5.

The laboratory phonology tradition has developed criteria to distinguish between phonetic and phonological processes. In this section I specifically refer to the work by Keating 1988, Cohn 1990 and Pierrehumbert 1990. The standard discriminator between phonetic and phonological processes is the nature of the effect that a process has on a segment or on a string of segments. Studies have pointed out that sounds can be affected by a given process in two distinct ways: (i) gradually, or (ii) categorically. In a gradient pattern, one traces a gradual increase or decrease of a given phonetic feature over time throughout a segment or string of phonetics/phonology interface. Non-reductionist models recognize the multifaceted interplay of phonetics and phonology in defining distinctive features, explaining sound patterns and implementing sounds (Kingston 2007). Non-reductionist models thus hypothesize a non-uniform interface between phonetics and phonology. Notice that a consistent boundary between phonetics and phonology is a necessary premise to serial computation where phonological rules work out more detailed representations to be fed to phonetic implementation. Models advocating for a complex interface reject seriality in favor of parallel computations: “[r]eplacing serial derivation by parallel evaluation removes the barrier to phonetic constraints being interspersed among and interacting with phonological constraints.” (Kingston 2007, 434). Above all, notice that non-reductionist models of the phonetics/phonology interface recognize phonology as a system which, despite being also moulded by phonetic forces, cannot be reduced to the set of effects producted by such forces: “Synchronically, phonological systems emerge as a balance between the various demands placed on the system, but the evidence suggests that phonology cannot be reduced to the sum of these influences.” (Cohn 2003, 8). Thus, with respect to the legitimacy of phonology, non-reductionist models concord with the generative tradition, and contrast with a deterministic substantive model.

For a clear picture of the foundations, goals and contributions of laboratory phonology, I refer the reader to Pierrehumbert, Beckman, and Ladd 2000.
segments, or within only a portion thereof. In a categorical pattern, a steady implementation of a given phonetic feature throughout a segment or a string of segments is detected.

Since the phonetic domain is physical and thus defined along continuous dimensions such as time and space, gradience is assumed to be the defining character of phonetic implementation: “By ‘gradient’, we mean that a continuous scale of phonetic values is related to some continuous dimension of expression or interpretation” (Pierrehumbert 1990, 377). In contrast, since the phonological domain deals with abstraction and handles discrete elements, categorical outputs are assumed to correspond to outputs of phonological rules.

Pierrehumbert 1990, 376-7 formulates the distinct characteristics of phonological versus phonetic representations in the terms summarized in table (28) and commented upon in the paragraph to follow.

(28) **Phonological vs. phonetic representations** (Pierrehumbert 1990)

<table>
<thead>
<tr>
<th>a.</th>
<th>Concerned with . . .</th>
<th>PHONOLOGICAL</th>
<th>PHONETIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>b.</td>
<td>Perform . . .</td>
<td>qualitative distinctions</td>
<td>gradient distinctions</td>
</tr>
<tr>
<td>c.</td>
<td>Evaluate complexity . . .</td>
<td>in syntactic terms</td>
<td>through calculus</td>
</tr>
<tr>
<td>d.</td>
<td>Accessible to introspection</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

The objects represented phonologically are cognitive and thus accessible to introspection, whereas the objects represented in phonetic terms, being physical, are not. Since the distinctions captured in phonological terms are qualitative, and thus discrete, well-formedness of complex forms is computed and evaluated in syntactic (algebraic) terms. Physics, on the other hand, models complex forms through calculus. While algebra studies structures, relations and quantities, calculus is the branch of mathematics that models change.

The gradient vs. categorical distinction for identifying phonetics vs. phonological processes has been challenged since its formulation in the early 1990s (for an insightful review and relevant examples, see Cohn 2006). This is why it is better supplemented by additional distinctive properties. I value the ones proposed by Myers 2000, 259, which are outlined in (29) below, to be significant as they translate into the contrast between being structure-dependent
(phonological) and being structure-independent (phonetic).

(29) a. Properties of phonological patterns
   a. Uniqueness of underlying (or input) representations
   b. Sensitivity to structural boundaries and/or domains determined by other modules of grammar (morphology, syntax)
   c. Sensitivity to grammatical categories
   d. Sensitivity to lexical identity

b. Properties of phonetic patterns
   a. Gradient factors (not only effects!)
   b. Dependency on speaking rate
   c. Dependency on speaking style/carefulness
   d. Dependency on interspeaker anatomical differences

When phonetics and phonology are modeled as two distinct modules, variance due to extra-grammatical factors is not part of the phonology. Thus, when manifested, this type of variance is an index of the phonetic status of that given process.

The diagnostics discussed here are exploited in the investigation of vowel nasalization in Campidanese and Nuorese Sardinian in chapter 4 and 5.

3.4 Summary

I have reviewed the sonorant patterns in Campidanese and Nuorese and the theoretically relevant questions they raise, explaining how the complementarity of the sonorant patterns between the two dialects of Sardinian follows from the model of feature specification through the contrastive hierarchy adopted in the present work. I assume this hypothesis to be correct and in this chapter I elaborated on the other phonological patterns predicted by such an hypothesis.

In chapters 4 and 5, I set out to demonstrate that the patterns of vowel nasalization on which I constructed the hypothesis are solid. I compare the historical data on vowel nasalization found in the literature on Sardinian with syncronic data from my field work. In chapter 4, I verify that structural conditioning on the vowel nasalization process is active in Campidanese and not in Nuorese. According to Myers’ criteria (29) structural dependency is an index of the
phonological nature of a process. In chapter 5, I test whether a quantitative acoustic analysis strengthens the qualitative analysis presented in chapter 4. In chapters 6, 7, and 8, I demonstrate that the patterns predicted by the contrastive hypothesis for [nasal] in Campidanese and Nuorese, presented here in section 3.2.2, are borne out.
Chapter 4

Vowel nasalization in Campidanese and Nuorese

Throughout this dissertation, I examine some phonological processes involving sonorants in the grammar of the Nuorese and Campidanese Sardinian. As introduced in the previous chapters, a crucial difference between the two dialects involves the phonological activity of the feature [nasal]: it appears to be phonologically active in Campidanese but not in Nuorese. The following chapters explore the phonology of nasals in the two dialects in detail. In the present chapter, I focus on the patterns of vowel nasalization.

Phonetic nasalization of a vowel adjacent to a nasal consonant has more than one possible source synchronically. It arises from the spontaneous and apparently universal process of nasal airflow leakage caused by either an anticipatory or a protracted articulatory gesture of lowering the velum (Ladefoged 2001, 180). Some languages encode in their grammar (as phonological rules) or in their lexicon (as phonemes) the spontaneous and articulation-dependent nasalization effect on vowels, especially but not exclusively (Hajek 1997, 82) upon the loss of the adjacent nasal, the original source of nasality.

Campidanese is one of the languages in which vowel nasalization appears to be a phonological process, in contrast with Nuorese.
The evidence supporting this analysis for the two Sardinian dialects which is presented in this chapter comes from a systematic literature review. In the chapter to follow I present evidence garnered through two pilot acoustic studies.

## 4.1 Campidanese

Vowel nasalization triggered by an alveolar nasal in onset position is a well-established fact about Campidanese (Wagner 1941; Contini and Boë 1972; Virdis 1978; Contini 1987; Bolognesi 1998; Sampson 1999). However, there is a debate regarding the nature of the vowel nasalization process in this dialect. Sampson 1999 assumes that nasal vowels are phonemic in Campidanese Sardinian. The phonemic status of nasal vowels in Campidanese has been questioned and a variety of sources suggest a phonological account, describing nasalization as being synchronic and phonologically governed (Wagner 1941; Contini and Boë 1972; Virdis 1978; Contini 1987; Bolognesi 1998). In this section, I review the arguments in favor of a phonological analysis of vowel nasalization in Campidanese,\(^1\) as opposed to a phonemic or phonetic analysis. Throughout this chapter, I refer to a three-way distinction between phonemic, phonological and phonetic nasal vowels. Phonemic nasal vowels are lexically in contrast with oral vowels. Phonological nasalized vowels are nasal allophones of oral vowels in nasal contexts depending on specific structural requirements such as prosodic ones. Phonetic nasalized vowels are nasal variants of oral vowels in nasal contexts not constrained structurally.

While Wagner 1941 and others referenced the above claim that vowel nasalization in Campidanese is phonological rather than phonetic, this analysis is not well developed in the literature. In the next sections I present a systematic review of the environments in which nasalization is found in this dialect.

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\(^1\)For some words, since there is only historical data available, it is not possible to argue for a phonological analysis.
4.1.1 Sketching the rule: A specific context

Vowel nasalization in Campidanese occurs almost exclusively in heterosyllabic V.N sequences where a nasal onset (alveolar) nasalizes the adjacent preceding vocalic nucleus. The examples in (30) are historical data reported in the literature on the language.\(^2\) Synchronic alternations are provided in (32b) below.

\[
\begin{array}{ccc}
\text{Etymon} & \text{Campidanese} & \text{gloss} \\
MA\text{.\,NU} & [\mathring{m}a\grave{u}] & \text{‘hand’} \\
LU\text{.\,NA} & [\mathring{l}\grave{u}a] & \text{‘moon’} \\
\end{array}
\]

The Campidanese pattern contrasts with patterns of vowel nasalization found in other Romance languages where it is usually a nasal in coda position, either word-internally or word-finally, that gives rise to phonological alternations of nasal and oral vowels (Sampson 1999, 286).\(^3\)

What is relevant for the present discussion is the fact that vowels in Campidanese also have a certain degree of nasalization in tautosyllabic NV sequences, as reported in Wagner 1941, 64 and Sampson 1999, 284, and in tautosyllabic VN sequences, as acoustically evident from the data recorded in fieldwork. However, only the nasalized vowels arising from heterosyllabic V.N sequences are nasal vowel allophones in Campidanese. Thus, whereas the phonetic nasalization of vowels is a general phenomenon in the language as a whole, only vowels in a highly restricted prosodic domain become nasalized allophones.

\(^2\)Recall that small caps show the Latin source.
\(^3\)Sampson 1999, 286 also reports that when vowel nasalization is triggered by a nasal onset, Romance languages also necessarily show vowel nasalization triggered by a nasal coda, thus suggesting a markedness hierarchy to which Campidanese Sardinian is a relevant exception. What Sampson labels as being exceptional may be explained if we take into consideration the observation made by Hajek 1997, 92 that vowels in closed syllables are extra-short in Sardinian and therefore not perceivable as nasalized when followed by nasal coda. Experimental evidence for a direct correlation between vowel duration and perceptibility of nasalization is summarized in Hajek 1997, 89-92.
The data in (31) (Sampson 1999, 284) illustrate two further points with respect to the prosodic constraints on nasalization:  

(31) [sɔ′nədʊ] ‘sound it’
[so′nai] ‘to sound’
[fe′nuɣu] ‘fennel’
[frʊnɛsta] ‘window’

First, if the vowel followed by a heterosyllabic alveolar nasal is unstressed, as in the first syllable of the words listed in 31, then no nasalization occurs. Second, if the vowel with primary stress is preceded (not followed) by an N onset, as in the second syllable of the words in 31, then no nasalization takes place.

Vowel nasalization occurs when the nasal follows the primary stressed vowel. The structural restriction on vowel nasalization in terms of primary stress placement, as seen in (31), is confirmed by data from Wagner 1941, 63 (32a) and from Contini 1987, 457 (32b). The alternations between \( \tilde{V}V \) and \( V'N \) are evident in the forms in (32b):

(32) a. CENA PURA ka′nабara \( \sim \) tʃe′naʃara ‘Friday’

\( ^4 \)See also the data in (35) from Bolognesi 1998, 26.
\( ^5 \)There are a few counterexamples to the general conservation of the etymological/underlying alveolar nasal when this is the onset of the syllable bearing main stress. Most of those seem to be dialect-specific: (1a,b) refer to the Campidanese nasalizing variety spoken in Villacidro and Muravera respectively (Wagner 1941, 64); (1c) refers to the varieties spoken in Cabras and Milis (Sampson 1999, 285); (1d) to the glottalizing variety of Isili (Sampson 1999, 285). An item-specific exception is the one in (1e), which appears with a pretonic nasalized vowel in all the Campidanese nasalizing varieties.

(1) a. [sa vʊ̆r̚sta] \( \sim \) [sa vo̊r̚s̅ta] ‘the window’ \( \sim \) FENESTRA
b. [tʃe′nuɣu] versus the usual [ʥe′nuɣu] ‘knee’
c. [frʊ̆r̚sta] versus the usual [frʊ̆r̚n̥sta] ‘window’
d. [fɨ̊ʔŭn̥u] versus the usual [fe′nuɣu] ‘fennel’
e. [kɔ̊l̥l̥u] \( \sim \) Cat. conill ‘rabbit’
b. ['tjàːʊ] ['tja'неːdʊ] ‘pan (made of clay)’, ‘little pan’
   ['an̥ŋɔi] ['an̥ŋǒ̞ neːdʊ] ‘lamb’, ‘little lamb’
   ['kaβɔi] ['kaβo'ниску] ‘rooster’, ‘little rooster’
   ['tʃɛː] ['tʃɛ'не] ‘dinner’, ‘to dine’

In sum, the context for vowel nasalization in Campidanese appears to be structurally defined in two ways: (i) it occurs across syllables, and (ii) it is sensitive to stress placement. Structural dependence is the parameter that defines a process as phonological in contrast to phonetic (chapter 3). Furthermore, the fact that structural requirements appear to be active in the synchronic grammar, as the data in (32) show, defines at best some of the Campidanese nasalized vowels as phonological and not phonemic.

4.1.2 Sketching the rule: Loss of initial trigger

Another parameter that defines Campidanese vowel nasalization as not phonetic is the absence of an immediate nasal trigger in the context of nasalized vowels. The data provided in the previous section show that in Campidanese, the trigger is deleted upon vowel nasalization.

Some evidence that in Campidanese the nasalization trigger is lost after vowel nasalization can be marshaled from the following set of data where Campidanese is compared to the variety spoken in Sárrabus:

(33)    Etymon    Sárrabus    Campidanese

LANA(M) ['l̥a̞?] ['l̥a̞] ~ ['l̥a̞] ‘wool’
Sp. gana ['ɡ̥a?a] ['ɡ̥a̞] ~ ['ɡ̥a] ‘will, desire’
UNU(M) ['u̞u] ['u̞] ~ ['u] ‘one’ (unstressed: ‘a’)
Cat. plana ['pr̥a?a] ['pr̥a̞] ~ ['pr̥a] ‘plane’

In Campidanese, there is variation that arises from VnV sequences where the vowels are identical: both ŃV and V are possible.

In the Sárrabus variety, no vowel contraction takes place because no sequence of identical vowel results from the nasalization process: the nasal stop appears to debuccalize after it lends its nasal feature to the preceding vowel, thus the onset position of the post-tonic syllable is still
In Campidanese, in contrast, since the sequence of identical vowels arising from vowel nasalization may simplify, it is legitimate to assume that no syllabic structure intervenes between the two. In other words, the trigger can be analyzed as not present for phonetic contextual nasalization. Thus, the underlying/etymological nasal consonant is completely lost in Campidanese.

### 4.1.3 Arguing for the rule: No lexicalization

In sections 4.1.1 and 4.1.2 above, I marshaled some evidence for vowel nasalization in Campidanese as a non-phonetic process. In this section, I review the argument for assuming that nasalized vowels in Campidanese are not phonemic.

In Campidanese there exists surface minimal pairs where nasal vowels phonemically contrast with oral vowels. The instances in (34) are from Contini and Boë 1972, 186. In all the items below, the main stress is word-initial:

(34)  

<table>
<thead>
<tr>
<th>Oral vowels</th>
<th>Nasal vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td>mau ‘bad.M.SC’</td>
<td>măâ ’hand’</td>
</tr>
<tr>
<td>biu ‘I live’</td>
<td>biū ‘wine’</td>
</tr>
<tr>
<td>fui ‘I flee’</td>
<td>fūī ‘rope’</td>
</tr>
<tr>
<td>lua ‘euphorbia’ (plant)</td>
<td>lūā ‘moon’</td>
</tr>
</tbody>
</table>

Minimal pairs are generally interpreted to indicate the phonemic status of the discriminating element in each pair, and nasalized vowels in Campidanese are thus interpreted as phonemic

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6Once more, the nasalization trigger is analyzed as etymological in case of historical data and as underlying in case of synchronic data.

7At least those for which it is possible to demonstrate so. For some data, in fact, there are only historical sources available.

8Note that Contini consistently transcribes the entire diphthong as nasalized for all the relevant Campidanese items (Contini and Boë 1972; Contini 1987) while this is not the practice of other authors. I myself transcribed those items in the same way when listening to speakers of Campidanese. However, the acoustic measurements point to quite a different picture, as we shall see in section 5.4.
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by Sampson 1999.

However, the fact that there exists a robust corpus of allophonic alternation between nasalized and oral vowels suggests a different analysis, pointing to a phonological rule of vowel nasalization (Contini and Boë 1972; Contini 1987; Bolognesi 1998). The morphologically-derived pairs in (35) illustrate the synchronic oral/nasal vowel alternation (Bolognesi 1998, 26):

(35) a. \((\sigma \sigma)_{Ft}\)
   [p[o]i] ‘put-IMP’
   [têj(õi)] ‘have.3SG’
   [mâu] ‘hand’
   [pi:lâ] ‘bird’
   [gâa] ‘desire/will’

   b. \((\sigma \sigma)_{Ft} (\sigma \sigma)_{Ft}\)
   [p[õ]ndi] ‘put-GER’
   [tên(õa)] ‘have.3SG.IMPERF’
   [m[am]i] ‘hand+DIM’
   [pi[l]ô] ‘bird+DIM’
   [g[am]i] ‘desire/will+DIM’

Each row in (35) contains two forms (with their corresponding glosses) derived from the same stem, with the boxes highlighting the relevant alternation. When the stem V is stressed, as in column (35a), it is nasalized. When the same stem V is unstressed, it is followed by a nasal onset, as in (35b). This latter form is the stem underlying representation.\(^9\)

The third example in (35) is the item [‘mâu] ‘hand’, which, in its basic form, forms a minimal pair with [‘mau] ‘bad.M.SC’ in (34). In these cases, where there is stem alternation (\(Vn\) versus \(\tilde{V}\)), it is possible to refer to an underlying /n/. For a few items with some speakers, however, a nasal consonant never surfaces in morphologically-derived paradigms and the nasal trigger can only be referred to as etymological N.\(^10\) In this section I thus address the nasal

\(^9\)Note that Bolognesi 1998 transcribes nasalization only on the first vowel, the one originally or underlingly preceding the alveolar nasal, in contrast to Contini 1987.

\(^10\)Under the process of standardization for all Sardinian varieties (see www.limbasarda.it), the orthography preserves the nasal onset more likely out of conservatism than of phonological awareness. For instance, <pilloni>–[pîl:3i] together with <pilloneddu> [pîl:oneã:u], Contini and Boë 1972, 189). Nevertheless the fact is noteworthy.

\(^11\)For instance, [‘mani]‘little hand’ in (35) is always uttered as [‘mâi]‘little hand’ in one of the villages where I conducted my interview (personal communication of one of my language consultants), i.e., the nasal trigger never surfaces in the stem. However, in other Campidanese nasalizing varieties it does.
trigger as ‘underlying (and)/(or) etymological N’.

Based on the alternations in (35a,b), Bolognesi 1998 concludes that the nasalization rule is synchronic and prosodically conditioned, with main stress triggering the process: a vowel inherits the nasal quality from a following alveolar nasal stop when it is the nucleus of the syllable bearing primary stress within a word. As also commented on by Contini and Boë 1972 and Contini 1987, these alternations suggest the synchronic derivation of at least some nasalized vowels in Campidanese.

In the following sections I turn to loanword phonology and to a detailed investigation of the prosodic context of vowel nasalization in Campidanese in order to corroborate the phonological analysis.

4.1.4 Arguing for the rule: Loanwords

Support for the synchronic activity of the vowel nasalization rule in Campidanese comes also from its manifestation in loanwords. Some of the data in (36) are from Virdis 1978, 53 while others were collected during fieldwork.\footnote{Contini and Boë 1972, 186, however, report that recent borrowings do not show nasalization:}

\begin{align}
(1) & \quad \text{It. } \textit{treno} \quad \text{[’trenu]} \quad \text{‘train’} \\
& \quad \text{Cat. } \textit{trona} \quad \text{[’trona]} \quad \text{‘pulpit’} \\
& \quad \text{Cat./Sp. } \textit{gana} \quad \text{[’gana]} \quad \text{‘will/desire’} \\
\end{align}

Contini and Boë 1972 worked with two speakers from the village of Sanluri. My own language consultant from the same village produced all the instances of the words \textit{trona} ‘pulpit’ and \textit{gana} ‘will/desire’ in their nasalized form, i.e., [’trɔː] and [’ɡaː] (or [’ɡaː]) respectively. In contrast, and thus conforming to what is stated by Contini and Boë, the same consultant never produced the word for ‘train’ with a nasalized vowel and no [n], neither did other informants speaking nasalizing varieties of Campidanese. Noteworthy also is the fact that when speaking in Italian, the Italian borrowings undergoing nasalization in Campidanese as shown in (36) were never nasalized. This fact points to the diglossic competence of Sardinian speakers in general (Sardinian variety and Italian) and to the trademark status of nasalized vowel allophones in the Campidanese grammar.
These borrowings from Italian, Catalan and Spanish are all an integral part of the Sardinian lexicon and show nasalization of stressed vowels preceding an etymological alveolar nasal onset, thus conforming to the two structural requirements for vowel nasalization outlined in section 4.1.1 above.

4.1.5 Arguing for the rule: Domain of application

Another piece of evidence for the phonological nature of vowel nasalization comes from the systematicity of the domain in which it applies; this domain is complex but nevertheless predictable. With regard to stress and syllable structure, paroxytonic forms in which the stressed vowel is followed by an alveolar nasal onset generally show nasalization, while in proparoxytonic forms, stressed vowels in the same nasal context are generally not nasalized.

Hajek 1997 cites a few (Campidanese) Sardinian nasalization data as additional evidence for the stress parameter (p. 99) and the foot parameter (p. 110) which, he proposes, constrain the development of distinctive nasalization in languages. Vowel nasalization and deletion of the nasal trigger seem to occur in a stressed syllable first (stress parameter), and in a penultimate stressed syllable before they occur in an antepenultimate stressed syllable (foot parameter).14

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13 Paroxytonic words carry main stress on the second to last syllable, whereas proparoxytonic words carry main stress on the third to last syllable.

14 Foot type seems to affect the length of the stressed vowel, and length, in turn, affects perceptibility of nasalization on the vowel (Hajek 1997, 89-92) which is the precondition to the rise of nasalization in a grammar, according to Hajek 1997.
Counterexamples to these tendencies exist, however, suggesting that the domain of application of the rule of vowel nasalisation may be more complex than it would seem at first glance.

The only attempt to identify the domain of application of vowel nasalization in Campidanese that I know of is made by Sampson 1999 in his pan-romance study of vowel nasalization. The survey of Campidanese nasalized forms to follow is organized according to their prosodic configuration, as in Sampson 1999, and discussed with respect to Bolognesi’s 1998 proposal as well as with respect to data gathered from both detailed sources such as Wagner 1941 and Contini 1987 and from fieldwork.

4.1.5.1 Paroxytonic forms

By considering a pool of data that is prosodically heterogeneous, Sampson 1999, 284 concludes that a stressed vowel undergoes nasalization triggered by the following nasal onset only in words in which the main stress falls on the penultimate syllable (i.e., paroxytonic words).

In the following sets of examples, nasalized items appear in contrast to etymological forms or to forms appearing in a few non-nasalizing varieties of Campidanese. This is the case for all paroxytonic forms, whether these are bisyllabic (schematically, /CV.NV/, as in (35a) and in the first column of (39) below), trisyllabic (/CV.CV.NV/, as in (37a) from Virdis 1978, 53 and (37b) from Contini 1987, 455) or quadrisyllabic (/CV.CV.CV.NV/, as in (37c). Note that I follow the sources in using ˜VV or ˜V ˜V – they are not contrastive.

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15 As noted above the loanwords in (36) all fall under this category.
16 Recall from chapter 2 that nasalization takes place in a rather large subset of Campidanese varieties but not in all.
17 With regard to trisyllabic words with stress on the penultimate syllable, Contini 1987, 455 says that nasalization may also target the pretonic vowel. Thus, [mõıyordu]/[müɨɨɨ] ‘mill’, et cetera. Notice moreover that in the nasalizing varieties of Campidanese under scrutiny, etymological intervocalic l drops in the context of non-low vowels: e.g. SOLU ⊲ [ˈsou] ‘alone.M.SG’ vs. SOLA ⊲ [ˈsəʃa], and MOLINU ⊲ [mõɨɨ] ‘mill’ vs. SALE ⊲ [ˈsaʃi] ‘salt’.
    *PULLEONE(M) [pˈlɔi] ‘bird’
    *AGNIONE(M) [anˈʣɔi] ‘lamb’
    COCINA(M) [koˈʒia] ‘kitchen’

    [moˈlinu]/[muˈlinu] [mʊˈiʊ]/[mʊˈiʊ] ‘mill’
    [pruˈinu] [prʊˈiʊ] ‘dust’
    [ɔˈljońi] [ʒiˈʒii] ‘arbutus’

    [ˈprdinjɑnui] [ˈprdrinjɑnui] “eggplant”

The above data are sharply in contrast with those in (38) (Contini 1987, 455) where the main stress falls on the antepenultimate syllable. Here, nasalization of the tonic vowel preceding an [n]-onset does not occur:

(38) [ˈduˈminiŋa], *[ˈduˈmiŋa] ‘sunday’
    [ˈmanıŋa], *[ˈmaŋa] ‘sheaf (of wheat)’ (also quoted in Sampson 1999)

Proparoxytonic forms are considered in section 4.1.5.4 below, but first, some remarks on secondary stress in longer words are in order.

4.1.5.2 Sensitivity to secondary stress

Quadrisyllabic words show that the nasalization process may affect not only vowels bearing primary stress, but also those bearing secondary stress.18

(39) *Etymon Nasalizing Camp.
    SONU [ˈsʊəˈziŋu] ‘sound it to him’
    CANE [kəˈʒeŋu] ‘little dog’
    CANISTELLU(M) [kəˈisˈteŋu] ‘wicker basket’

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18 The first two examples in (39) are from Sampson 1999, 284; the last one from Virdis 1978, 53. As mentioned earlier, Virdis and Bolognesi, in contrast to other authors, mark nasalization only on the first vowel within the sequence raising from the loss of the nasal trigger.
The data reported in Sampson 1999 vis-à-vis the ones in Bolognesi 1998 suggest variability as far as the condition of secondary stress is concerned. Note in fact that the quadrisyllabic forms in (35b) in section 4.1.3, where the vowel bearing secondary stress does not undergo nasalization, are produced invariably nasalized by one of my language consultants, and are reported to vary between nasalized and non-nasalized in neighbouring villages (40a). This variation is recorded for two of my consultants for the form in (40b) as well:

(40) a. ['mâu] ‘hand’ [ˌmani'zɛqːa] ∼ [ˌmâi'zɛqːa] ‘hand+DIM’
    [ˈgâa] ‘desire/will’ [ˌgani'zɛqːa] ∼ [ˌgâi'zɛqːa] ‘desire/will+DIM’

b. [ˈkâi] ‘dog’ [ˌkani'zɛqːu] ∼ [ˌkâi'zɛqːu] ‘dog+DIM’

4.1.5.3 Interim summary

As far as paroxytones are concerned, the vowel in the strongest prosodic position within a word (primary stress) phonologizes the nasalized quality inherited from the following underlying/etymological alveolar nasal systematically, provided the vowel and the nasal consonant are heterosyllabic. The vowel in the second strongest prosodic position within a word (secondary stress) shows nasal allophony variably. When the vowel carrying the primary stress and the nasalizing source are in the same syllable, either in a onset-nucleus or nucleus-coda configuration, no nasalization process usually takes place. Unstressed vowels preceding the syllable bearing primary stress and whose onset is an alveolar nasal do not usually undergo phonological nasalization. The few exceptions to these latter prosodic constraints recorded in the literature appear to be dialect-specific.

4.1.5.4 Preparoxytonic forms

In preparoxytonic forms, the data provided in (38) (repeated in (41) below) show that even though the stressed vowel is followed by a heterosyllabic alveolar nasal (the canonical configuration for vowel nasalization in paroxytonic words), vowel nasalization does not occur when primary stress falls on the third to last syllable:
One wonders whether the nasalization triggered by N in these cases might be blocked by the presence of another nasal segment, /m/, preceding the vocalic target, although some dialects do show nasalization for at least one of these words, as shown below:19

(42) ['máiya] ‘sheaf (of wheat)’

Sampson 1999, 285 writes that patterns of vowel nasalization and nasal loss such as the ones in (41) and (42) – that is outside of the canonical stress conditioning – seems to occur in those dialects in which the process seems more systematic than in others. Note, however, that a thorough cross-dialectal survey is missing and the traditional literature such as Wagner 1941, for instance, quotes examples from a number of different dialects spoken within the nasalizing area. Without a serious cross-dialectal and variationist study of vowel nasalization in Campidanese, statements such as the one by Sampson reported above remain vague.

There is a second proparoxytonic scheme to consider, ‘CV.CV.NV, where the alveolar nasal onset, although heterosyllabic with respect to the stressed vowel, is not adjacent to it.20 For

19Interestingly, in the nasalizing Campidanese dialects under scrutiny, a string such as /nV.g/ often shows metathesis, thus giving rise to a [Vŋ.g] sequence, regardless of the prosodic make-up of the lexical item – examples from Wagner 1941, 64 and Virdis 1978, 53 (the syllable in brackets is assumed to be extrametrical because the final V is not lexical, but rather is a suffix):

(1) Non-nasalizing Camp. Nasalizing Camp

[ˈmaniya] [ˈmaɪŋga] ‘sheaf (of wheat)’
[pistiˈnaya] [pistiˈiŋga] ‘carrot’
[ordiˈnaya(zu)] [ordiˈiŋɡu(zu)] ∼ [ɔðɾiˈiŋɡu(zu)] ‘reins’
[tʃeˈnuˈyu] [tʃeˈiŋɡu] ‘knee’

One could hypothesize that in the nasalizing Campidanese varieties the coronal nasal seems to prefer a structural position closer to the vocalic nucleus: either as a coda (metathesis – in this case it can inherit the place feature from the following consonantal onset), or as a feature on the nucleus (vowel nasalization).

20Both Wagner 1941, 63 and Böhne 1950, 21 (the latter describes the variety spoken in the area known as Sàrrabus, where vowel nasalization phonologizes, but the nasal trigger debuccalizes instead of dropping) report
this prosodic configuration, the literature (Wagner 1941, 63 and Contini 1987, 455-56) records variable outcomes which appear to be dialect-dependent. Contini 1987, 455-56 also reports that nasalization, while targeting the stressed vowel on the left edge of the morpheme, can also affect the post-tonic nucleus in between. Furthermore, if nasalization takes place, it is reported to be weaker and maybe therefore often prone to denasalization, either complete or of either vowels (tonic or post-tonic), hence all the different variants in (43) below:21

\[(43)\]

ACINA \([\tilde{a}\tilde{z}ia] \sim [\tilde{a}\tilde{zi}\text{na}] \sim [\text{\'a}\tilde{z}ia] \sim [\text{\'a}\tilde{z}ia]\) ‘grape’

ALINU \([\tilde{a}\tilde{\beta}i\text{u}] \sim [\tilde{a}\betai\text{u}] \sim [\text{\'a}\betai\text{u}] \sim [\text{\'a}\betai\text{u}]\) ‘alder’

[kavuna] \([\text{\'kav}\tilde{u}\text{a}] \sim [\text{\'kav}\text{u}\text{a}] \sim [\text{\'kav}\text{u}\text{a}] \sim [\text{\'kav}\text{u}\text{a}]\) ‘pruning knife’

### 4.1.5.5 Summary: Prosodic domains at a glance

In conclusion, the general picture distilled from the literature and supplemented by field data is as outlined in 44:

<table>
<thead>
<tr>
<th>Prosodic context</th>
<th>Vowel nasalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘V,N</td>
<td>(i) systematic in all nasalizing varieties in paroxytones</td>
</tr>
<tr>
<td></td>
<td>(ii) variable upon dialect(/speaker?) in proparoxytones</td>
</tr>
<tr>
<td>‘V,[…],N</td>
<td>variable upon dialect(/speaker?)</td>
</tr>
<tr>
<td>,V,N</td>
<td>variable upon dialect/speaker</td>
</tr>
<tr>
<td>V,N</td>
<td>not applying (few exceptions, dialect(/speaker?)-dependent)</td>
</tr>
<tr>
<td>’NV</td>
<td>not applying (few exceptions, dialect(/speaker?)-dependent)</td>
</tr>
<tr>
<td>V,’N</td>
<td>not applying (few exceptions, dialect(/speaker?)-dependent)</td>
</tr>
</tbody>
</table>

the obligatoriness of the nasalization rule to weaken the further away the stressed vowel (target) is from the nasalization trigger.

21 The following quote is from Wagner 1941, 63; the English translation follows: “Wenn der Ausfall des -n- von der Tonsilbe ziemlich entfernt ist, was in Proparoxytonis der Fall ist, so kann man eine Schwächung der Nasalität beobachten, die oft zum vollkommenen Schwund, d.h. zur Entnasalierung führt.” ‘When -n- is lost in a syllable which is further away from the stressed one, as in the case of preproparoxytones, one can observe a weakening of the nasalization effect, which often results in complete loss of the nasal quality (denasalization).’ [my own translation]
A vowel bearing primary stress systematically undergoes nasalization and phonologizes with the loss of the nasal trigger in all nasalizing varieties when this tonic vowel belongs to a paroxytonic structure (i.e., [...]V.NV#). This is in alignment with Hajek’s 1997 parameters (section 4.1.5). The rule appears to apply variably if the vocalic target carries primary stress but is in a proparoxytonic structure (i.e., [...]V.NV.CV#) or if it is not adjacent to the nasal trigger. The nasalization rule also appears to apply variably if the vocalic target carries secondary stress. If the vowel preceding the alveolar nasal onset is unstressed, then nasalization does not usually occur. If the alveolar nasal trigger is the onset of the syllable with primary stress, then it is usually preserved and thus no allophonic vowel nasalization rule applies either to the tautosyllabic vocalic nucleus, or to the heterosyllabic preceding vowel. The exceptions to the domain of non-application recorded in the literature refer only to some dialects and a handful of items.22 The distilled picture points to prosodic conditioning and to a phonological analysis of vowel nasalization in Campidanese. Further evidence for this phonological position comes from a completely different source, namely an acoustic pilot study described in detail in 5.4.

Campidanese thus has nasalized vowels, at least some of which arise through synchronic nasalization.

22 For the prosodic contexts in which variability is recorded, systematic cross-dialectal and variationist studies are in need. Do certain dialects show systematic nasalization of stressed vowels independently from stress hierarchy (primary versus secondary stress) and from relative distance between trigger and target, as Sampson 1999, 285 suggests? In other words, are there varieties of Campidanese which nasalize vowels across the board, provided they are followed by a heterosyllabic alveolar nasal? If those strongly nasalizing dialects exist, are they concentrated in a specific zone within the nasalizing area, or are they scattered throughout this territory? Is the variability also speaker-dependent? If so, is there any meaningful pattern linked to certain speakers when grouped by age, for instance? Is the more constrained domain of application of the nasalization rule tied to the older or to the younger generation, for example? What does either trend tell us about this sound change and its path of phonologization? Answers to the above questions require a detailed cross-dialectal quantitative study, which is beyond the scope of the present work.
4.2 Nuorese

I now turn to Nuorese, where a different picture emerges. Vowel nasalization in Nuorese does not present a pattern of allophonic alternations between nasal and oral vowels as is the case in Campidanese (Wagner 1941; Pittau 1972; Contini 1987). In (45) I compare the relevant examples from the two Sardinian dialects.

<table>
<thead>
<tr>
<th></th>
<th>Campidanese</th>
<th>Nuorese</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>‘bad.M.SG’</td>
<td>‘hand’</td>
</tr>
<tr>
<td></td>
<td>[ˈmaʊ]</td>
<td>[ˈmahu]</td>
</tr>
<tr>
<td></td>
<td>vs. [ˈmahu]</td>
<td>[ˈmaunu]</td>
</tr>
<tr>
<td>b.</td>
<td>‘hand’ vs.</td>
<td>‘little hand’</td>
</tr>
<tr>
<td></td>
<td>[ˈmaʊ] vs.</td>
<td>[ˈmaniʂɛːə]</td>
</tr>
<tr>
<td></td>
<td>[ˈmanu] vs.</td>
<td>[ˈmani kerɛːa], [ˈma nerɛːa]</td>
</tr>
</tbody>
</table>

The partially nasalized vowels found in Nuorese neither contrast with oral vowels in minimal pairs such as the one presented in (45a), nor vary allophonically with oral vowels (45b), as in Campidanese.

While the relevant Nuorese vowels are not perceived as nasalized by speakers of Campidanese,23 there are hints that Nuorese stressed vowels preceding an alveolar nasal in onset position do nevertheless show some degree of nasalization. For instance, nasal and nasalized vowels are reported to be longer than oral vowels cross-linguistically (Delattre 1965, 101). Nuorese stressed vowels are significantly longer when followed by a nasal consonant than when followed by an oral one.24 It is not only the stressed vowels followed by an alvolar nasal

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23 While I did not conduct perceptual studies, when I was interviewing my language consultants for Campidanese, four out of six of them spontaneously commented on the absence of vowel nasalization in Nuorese. I myself realized that the stressed vowels preceding an alveolar nasal in Nuorese were partially nasalized only through their spectrograms rather than by listening to the acoustic samples. On the other hand, Campidanese nasalized vowels are a prominent trait for the novel listener of the dialect.

24 The length of 19 stressed vowels in nasal context, and of 31 stressed vowels in oral context from one speaker of Nuorese was measured. A univariate analysis of variance (ANOVA) was then performed. The ANOVA revealed that the vowel duration values are significantly dependent on the factor Context (F(1,44) = 70.851, p < .001) while
onset that show partial nasalization in Nuorese but any vowel adjacent to any nasal. Remember that this state of affairs is true also of Campidanese, as briefly commented upon in section 4.1.1. What then distinguishes the two dialects of Sardinian is that in a specific syllabic and prosodic position (i.e., stressed vowels followed by heterosyllabic nasal) Campidanese shows phonologization of the phonetically grounded nasalization process, whereas Nuorese does not.

To sum up, vowels in nasal context show a degree of nasalization in Nuorese, a state of affairs evident only through acoustic investigation and not recorded in any source on the language as they do not alternate with oral vowels in any structurally-conditioned manner.

### 4.3 Summary

This chapter compared patterns of vowel nasalization in Nuorese and Campidanese Sardinian. Nuorese does not have a phonological rule of vowel nasalization, and thus the phenomenon is not reported in the literature, in contrast to Campidanese. In this latter dialect, it has been shown that the vowel nasalization rule appears to be phonological and synchronic, despite the lack of allophonic alternations for some items and the idiosyncrasy in terms of domain of application across Campidanese varieties. A systematic review of the nasalization facts reported in the literature on Campidanese outlined in the chapter highlights the need for a thorough variationist study of the nasalizing varieties in order to trace the path of phonologization of vowel nasalization.

Given my assumptions, the asymmetry in the patterns of vowel nasalization between Campidanese and Nuorse suggest phonological activity of the feature [nasal] in the former dialect and inertness from a phonological perspective in the latter one. As argued in chapter 3, one way to think about this is that Campidanese has the feature [nasal] present in lexical representation not dependent on Vowel quality ($F(2,44) = .235, p = .792$). Thus, even when nasalization on a stressed vowel in nasal context in Nuorese does not seem to be perceived, a phonetic correlate of nasalization (longer duration) is present on that vowel. For details, see the acoustic study of Nuorese stressed vowels in section 5.3.
of nasal segments whereas Nuorese does not. If so, one might also expect that there could be some phonetic differences between the dialects. This is the topic of the following chapter.
Chapter 5

Acoustic Studies

In the previous chapter, we examined evidence for the phonological nature of Campidanese vowel nasalization, the evidence being constraints of syllabic and prosodic structure. The same evidence can be used to argue that vowel nasalization in this dialect is not phonemic, or at least not totally phonemic, as proposed by Sampson 1999. Only a handful of minimal pairs are lexicalized, and only in some varieties of Campidanese. With respect to the Nuorese dialect, vowel nasalization is not reported in the literature, and neither minimal pairs nor allophonic alternations found in this grammar. I have shown that vowels in nasal contexts seem nasalized and that vowel nasalization in this dialect is phonetic.

Why is it worthwhile to look at the phonetics now, having determined this difference?

Nasalization has been one of the most fruitful areas of investigation in laboratory phonology. Aerodynamic and articulatory studies of nasalization have been successful in showing the relationship between phonetic implementation and gradient effects, and between phonological rules and categorical outputs.

Would an acoustic study of vowel nasalization in Sardinian strengthen the findings of the qualitative analysis of the process presented in the previous chapter? Would an acoustic study of vowel nasalization in Sardinian contribute to the definition of phonetic versus phonological outputs elaborated in laboratory approaches to phonology?
I believe these are two legitimate questions that are worthy of study and I thus set out to examine the acoustics of vowel nasalization in Campidanese and Nuorese Sardinian, with the premise that the process has been demonstrated to be different in the two dialects based on the data discussed in the previous chapter.

The acoustic study of Nuorese vowels in nasal and oral contexts is discussed in 5.3. A parallel acoustic study is conducted of Campidanese vowels in 5.4. The results of both studies are interpreted in section 5.5.

Before introducing in detail the methods and outcomes of the two acoustic studies carried out on Nuorese and Campidanese Sardinian, I review the aerodynamic studies of nasalization carried out by Cohn 1990 and 1993 in section 5.1. Her results are assumed as the baseline for my own analysis since they display clearly distinctive patterns of phonetic versus phonological vowel nasalization. As my phonetic studies of vowel nasalization in Sardinian are acoustic and not aerodynamic, section 5.2 explains which acoustic correlates of nasality were chosen and why.

5.1 Patterns of phonetic and phonological vowel nasalization

The goal of this section is the formulation of predictions for the acoustic studies of vowel nasalization in Campidanese and Nuorese Sardinian (5.1.2). These predictions are directly informed by the findings of aerodynamic (Cohn 1990; Cohn 1993a) and articulatory studies (Solé 1992; Solé 1995) of vowel nasalization, and thus their review is in order (5.1.1). These predictions will be evaluated in the discussion of the findings of the acoustic studies (section 5.5).

5.1.1 Review of experimental studies of nasalization

Cohn 1990 demonstrates that both underlying nasal segments and outputs of phonological nasalization processes are marked by an airflow plateau – i.e., steady nasal airflow throughout
the duration of the relevant segment(s) – whereas the outputs of phonetic nasalization processes show *cline*-like patterns – i.e., transient increase of nasal airflow throughout the relevant segment resulting from interpolating between the phonologically oral segment preceding it and the phonemic nasal one following it.\(^1\)

Solé 1995 shows that the phonetic nasalization of a vowel preceding a nasal stop may result from nasal airflow leakage. What is measured is the variation in the timing of the peak of velum-lowering in phonemic nasal consonant triggers. The velo-pharyngeal maximal opening is realized at the nasal consonant onset across speech rates and, thus, the nasalized character of the preceding vowel arises by airflow leakage. However, phonological vowel nasalization correlates with a peak velo-pharyngeal aperture in the middle of the vowel preceding the nasal consonant across speech rates. In this case, the nasalization of the vowel is not due to nasal airflow leakage but rather to a programmed gesture, and it is thus interpreted as phonological.\(^2\)

The table in 46 summarizes the findings of the phonetic studies by Cohn 1990; Cohn 1993a (46a) and Solé 1995 (46b).\(^3\)

<table>
<thead>
<tr>
<th>(46)</th>
<th>Phonetic nas Vs</th>
<th>Phonological nas Vs</th>
<th>Phonemic nas Vs</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Airflow profile</td>
<td>cline</td>
<td>plateau</td>
<td>plateau</td>
</tr>
<tr>
<td>b. Velum-lowering</td>
<td>external to V</td>
<td>internal to V</td>
<td><em>Not Available</em></td>
</tr>
</tbody>
</table>

What is relevant for discussion of the acoustics of vowel nasalization in Campidanese and

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\(^1\)In Cohn’s studies, the phonetic pattern of nasal airflow is found to be characteristic of Sundanese glides and American English vowels adjacent to nasal consonants; the phonological pattern of nasal airflow is found in Sundanese vowels; and, the phonemic patterns in all segments that are underlyingly nasal, i.e., nasal consonants in Sundanese, American English, and French, and in phonemic nasal vowels in French.

\(^2\)In Solé’s studies, the phonetic pattern of the nasal gesture is found in Spanish vowels adjacent to a nasal consonant, while the phonological pattern is found in American English vowels in the same context.

\(^3\)The parameter ‘velum-lowering’ in (46b) refers to the timing of the peak of aperture of the velum-pharyngeal port. As for the labels on the top of the table, ‘Phonetic nas Vs’ are phonetically nasalized vowels, ‘Phonological nas Vs’ are vowels that are nasalized through the application of a phonological rule, and, finally, ‘Phonemic nasal vowels’ are vowels that are contrastively nasal.
Nuorese Sardinian is that aerodynamic and articulatory studies find different patterns for phonetically and phonologically nasalized vowels.\footnote{Cohn’s and Solé’s results contrast with respect to the analysis of vowel nasalization in American English. It is phonetic according to Cohn and phonological according to Solé. A study should be conducted in order to establish whether the outputs of aerodynamic and articulatory analyses of different patterns of vowel nasalization are isomorphic or not. Is there a correlation between a certain timing of the peak of velum-lowering and a certain nasal airflow profile? This question appears relevant considering Cohn and Solé’s opposite analyses of the status of vowel nasalization in American English.}

5.1.2 Predictions for the acoustic studies

The message from Cohn and Solé’s studies is that phonetic nasalization shows gradience and locality effects due to interpolation. A vowel, for instance, flanked by a nasal consonant and an oral one, shows a higher degree of nasalization the closer to the nasal, and the nasalization gradually lowers the closer to the oral segment. We expect the same profile when phonetically nasalized vowels are studied acoustically. The acoustic parameters of nasalization measured throughout the duration of the segment undergoing nasalization will show gradience, with a higher value of nasalization the closer to the nasal source.

The acoustic studies to be presented here are dynamic, measuring nasalization at different points in time, as are the aerodynamic and articulatory studies by Cohn 1990, 1993 and Solé 1995. The temporal dimension is included in order to distinguish the categoricity of nasalization, as gradience corresponds to change over time, and I assume that the presence and the degree of an acoustic feature over time is parallel to the presence and degree of airflow over time. The expectation for the outputs of the dynamic acoustic analysis of nasalization is thus to pattern like the dynamic nasal airflow profile. This profile is plateau-like in the case of phonemic nasals and phonologically nasalized segments, while a cline-like profile occurs in the case of phonetic nasalized vowels. If Nuorese vowel nasalization is phonetic, as I have argued, it is expected to show a cline-like profile. In Campidanese, since vowel nasalization appears to be
the result of a synchronic phonological rule, the expected profile will be plateau-like.

Concerning what constitutes a plateau-like profile, Cohn 1993a, 61 suggests, “[i]n characterizing these patterns, slope, amplitude of airflow, and context must be considered”. The results of aerodynamic measurements for phonemic nasal segments, and phonologically derived nasalized vowels, are basically slopeless, and of significantly high airflow amplitude in comparison to the narrow flat airflow traces of oral segments, and these characteristics hold consistently across contexts (onset, coda, word-initial, -medial and -final). In Cohn’s studies, the airflow traces of phonemic nasal consonants in English, although marked by a certain degree of slope, also show significantly high airflow amplitude, and have the same directionality in the inclination of the cline across contexts. Thus, the crucial characteristics of dynamic profiles expressing lexically encoded information (phonemic features) are a high degree of phonetic correlates and the consistency of the pattern – sloped or not – across contexts.

Refining the expectation with respect to the nasalization patterns in the two Sardinian dialects, Nuorese nasalized vowels are expected to show a gradient and context-dependent profile, whereas Campidanese nasalized vowels are predicted to show a consistent and context-independent one.

The discriminatory parameter of Context is not available for the Sardinian studies because the nasalization rule in Campidanese takes place only in one context: it affects stressed vowels preceding a heterosyllabic (alveolar) nasal. The vowel nasalization studies discussed in sections 5.3 and 5.4 compare stressed vowels in nasal and non-nasal contexts in Nuorese and Campidanese.

5.2 **Acoustic correlates of nasality**

In this section, I present a simplified picture of the acoustics of nasal vowels and consonants with the goal of providing a backdrop to the acoustic correlates of nasality referred to in the

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5Thus, the transition between a nasal and oral segment is abrupt.
sections to come. Neither airflow nor velum-lowering timing measurements have been performed for the pilot quantitative analysis of vowel nasalization in Sardinian that is discussed in this section. The only material available for analysis was acoustic, thus, the studies are acoustic, with the relevant parameter being the bandwidth of the first formant (section 5.2.3).

5.2.1 Acoustics of nasality

The acoustics of nasal and nasalized sounds is complex, as discussed in Johnson 1997 and in Stevens 1998 in great detail.\(^6\)

The oral tract coupled with the nasal tract is equivalent to a single complex resonance system rather than to the simple combination of two resonators. However, the model of two parallel resonators, “though an oversimplification, is convenient and for many purposes, sufficient. It is the approach taken in much of the work on the acoustics of nasalization” (Krakow and Huffman 1993, 42).\(^7\)

\(^6\)The main focus of this section is onnasalized sounds, in contrast to nasal sounds (Ladefoged and Maddieson 1986; Cohn 1993b). Nasal sounds correspond to nasal stops: they involve full oral closure and thus airflow only through the nasal cavity. Nasalized sounds are generally vowels and approximants and the airflow passes through both the nose and the oral cavity. The non-existent or minimal constriction of the oral cavity characteristic of those sounds amounts to simultaneous airflow through the oral and the nasal tracts.

\(^7\)The research around the phonetics of nasality is extensive and has shown the complexity of the articulation and acoustics of nasal quality. In order to appreciate such complexity I refer to three simplifications made in the standard descriptions of the phonetics of nasal segments, as elucidated by Laver 1980, 78-86. The first simplification is that nasality is a function of the lowering of the velum. In reality, even in normal speech, the pharyngeal passage is not completely sealed off to the nasal cavity by a raised velum. The second simplification is that nasality is a function of nasal airflow. Nasality appears to be a matter of resonance, and “the nasal cavity can resonate without the passage of air through it; one has only to think of the possibility of very marked nasality where the nostrils are held tightly closed, for example” (Laver 1980, 80). The third simplification is that nasality is a function of nasal resonance only. It seems that the crucial resonance for nasality is the one produced in a side chamber, this may be the nasal cavity or the oral one.
5.2.2 Acoustic correlates

One method of studying nasalization involves spectral analysis. Although the spectral analysis of nasalization is attractive as it is not invasive and it is readily available, “it has been difficult to arrive to a single reliable spectral measure of nasalization” (Krakow and Huffman 1993, 41). The reason is twofold: nasal coupling gives rise to very complex acoustics and the nasal cavity shows great speaker-dependent variability, preempting the chance of a steady acoustic correlate across speakers. The acoustic correlates of nasalization of vowels, evidenced through two pioneering studies (House and Stevens 1956; Hattori, Yamamoto, and Fujimura 1958) and later confirmed by more technically sophisticated studies (Krakow and Huffman 1993, 42-45), concern changes in the frequency, amplitude and bandwidth of the first vowel formant (F1) especially. These effects on F1 are “due to an additional resonance-antiresonance pair near F1” (Krakow and Huffman 1993, 43) which is dependent on vowel quality. Maeda 1993, 153-55, through the elaboration of an abstract model, has calculated that the resonance-antiresonance pair due to nasal coupling highly affects the amplitude of F1 in the case of mid and low vowels especially. This finding supports the typologically- and historically-based vowel height parameter (Hajek 1997, 116) for vowel nasalization according to which low vowels usually undergo the process first, followed by mid vowels, and lastly, by high vowels.

The challenge posited by the acoustic correlates of nasality has led researchers to investigate nasalization processes largely through aerodynamic parameters such as nasal airflow (for instance, Cohn 1990; Cohn 1993a and subsequent work) and articulatory parameters such as the activity of the velo-pharyngeal port (e.g., Solé 1992; Solé 1995), discussed in section 5.1. Beddor 2007 measures nasalization acoustically concentrating on the F1 bandwidth and amplitude.

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8See also Feng and Castelli 1996: “[I]t seems clear that the main low-frequency peak, linked to the pharyngonal nasal tract [ultimate gestural target for nasal sounds, thus informing nasalized sounds since tending towards that target], plays a fundamental role for a nasalized sound” (p. 3704).
5.2.3 The present study

In the present investigation, the data available for analysis are acoustic in nature. While acoustic measurements present the problems noted above, they are useful as a starting point for the phonetic study of nasalization in Sardinian. The principal acoustic correlate of nasality I make reference to for the investigation of vowel nasalization in Nuorese and Campidanese is the bandwidth of the first formant (F1 BW).

One main acoustic feature of nasal sounds is a great resonance damping. The large resonance damping is the result of the coupling of the acoustic system through the aperture of the nasal cavity during the production of nasal sounds, as elucidated, for instance, in Johnson 1997, 143: “The formant bandwidths during nasal sounds are wider than those in nonnasal sounds, because the vocal tract with the [nasal tract] open has greater surface area and greater volume.” Since “[t]he formant bandwidths are determined by the acoustic losses in the vocal tract” (Stevens 1998, 258) the damping proper of nasal sounds is reflected in wider formant bandwidths. Ladefoged 2005, 180-1, comparing oral versus nasalized English vowels (as in [bi:d] vs. [mi:n], for instance), remarks that in the oral vowels, “the first formant is well defined and has a greater amplitude (the first dark band is narrower and darker)”. Nasalized vowels show a lighter and wider band as the visual correlate of their F1. A very similar visual contrast between a narrow and dark F1 versus a wide and light one is observable in the spectrogram of a Nuorese vowel partially nasalized and shown in Figure 5.1 in section 5.3 below.⁹

As far as nasal vowels are concerned, the widening of the first formant bandwidth is not only due to the greater damping effect proper of nasal sounds, but also to “the interplay of formants and anti-formants in the F1 region (this is because there are usually two formants in the region, rather than one)” (Johnson 1997, 159) (see also Stevens 1998, 310).

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⁹Narrow formant bandwidths are characteristic of a signal in which the energy losses are minimal. For instance, they are typical of the phonation type known as tense voice, whose tight glottal configuration preempts energy losses and has then the perceptual effect of loudness (acoustically, higher amplitude) (Gobl and Chasaide 1992, 488).
The choice of F1 bandwidth as a valid parameter for acoustic analysis is reinforced by the perceptual effects of a widened F1 bandwidth in vowels. Vowels whose F1 bandwidth is acoustically increased by a preceding glide, glottal or pharyngeal consonant or an aspirated or noisy consonant can in fact be perceived as nasalized. This percept has given rise to ‘spontaneous’ (i.e., not induced by the vicinity to a nasal segment) vowel nasalization in some languages (Matisoff 1975; Ohala 1987 as cited in Sampson 1999, 27). Ohala and Ohala 1993, 239-41 give examples from Indo-Aryan, partially reproduced in (47) below. Nasalization in Old Hindi (47a) and Modern Hindi (47b) is not contextual to an historical nasal consonant, as it can be seen by the Sanskrit and Prakrit etyma.

\[(47) \quad \text{Sanskrit} \quad \text{Prakrit} \quad \text{Old Hindi} \quad \text{Modern Hindi} \quad \text{gloss} \]
\[
a. \quad \text{satya-} \quad \text{sačča-} \quad \text{sāč-} \quad \text{‘truth’} \\
b. \quad \text{sarpa-} \quad \text{sappa-} \quad [sāp] \quad \text{‘snake’} \\
\]

Since F1 BW is an important acoustic characteristic of vowel nasalization and induces nasalization effects on vowels even in the absence of a nasal source, I select it as the relevant parameter for pilot acoustic studies of vowel nasalization in Nuorese and Campidanese. It must be kept in mind, however, that bandwidths “are notoriously difficult to estimate accurately” (Gobl and Chasaide 1992, 488). For the mini-studies presented in the following sections, I rely on the automatic bandwidth extraction calculated by Praat (Boersma and Weenink 2006, version 4.4.13 for Mac OS X version 10.4.6).¹¹

¹⁰Ohala and Ohala 1993, 240 put forward the following explanation for the percept of nasality in the proximity of high airflow segments. Those segments are produced with a “greater than normal glottal opening”. “This slightly open glottis creates acoustic effects due to some coupling between the oral and the subglottal cavities that mimic the effects of coupling of the oral and nasal cavities, i.e., lowered amplitude and increased bandwidth of F1.” Note that this is in line with Laver’s 1980 observation that the crucial resonance for nasality is the one produced in a side chamber – in the case at hand, the subglottal chamber. For a phonetic explanation of why there can be no pharyngeal or glottal nasal consonants, see Ohala 1975.

¹¹For future broader studies of vowel nasalization in Sardinian dialects, it would be appropriate to also check for the relative intensity of F1 as both Delattre 1965, 101 and Maeda 1993, 153-55 argue for its relevance. F1 intensity is the other property, together with F1 BW, measured in the acoustic studies of vowel nasalization by
The methodological details of the acoustic analysis performed on nasalized vowels in Nuorese and Campidanese are outlined in section 5.3 and 5.4 respectively.

5.3 Acoustic study of vowel nasalization in Nuorese

As reported in 4.2, Nuorese is said to not have phonemic nasalized vowels nor a phonological process of vowel nasalization. However, a certain degree of nasalization is predicted, given the universal nature of gestural overlap and nasal airflow leakage. Two questions emerge from this prediction. Trivially, are Nuorese stressed vowels preceding a nasal consonant indeed nasalized? Non-trivially, which dynamic profile do they present?

As previously discussed, patterns of nasalization can only be captured in an analysis along the time dimension (Krakow and Huffman 1993, 45). That this is true of Nuorese is evident from a spectrogram of a stressed vowel in a nasal context, such as the [a] in the noun phrase [su#kan] ‘the dog’ given in Figure 5.1.

Figure 5.1: Nasalized portion of pre-nasal vowel [a] in the DP [sukane] ‘the dog’

Beddor 2007.
Compare the last portion of the stressed vowel [a], highlighted by a dashed rectangle, with the first two thirds of the stressed vowel. The focus is on the low frequency region, especially the first formant (F1).

In the highlighted portion, the intensity of the first formant is dropped (F1 is less marked and less dark than in the first portion of the vowel). Also, the distinction between the first and second formant is not clear in this portion of the vowel, in contrast with its clear definition in the first two thirds of stressed [a] as well as in word-final unstressed [e]. Recall from section 5.2 that coupling the nasal to the oral cavity introduces both additional resonance and antiresonance in the vicinity of F1. This has the effect of blurring the distinction between F1 and F2 in the spectrogram. Coupling the cavity surface means greater energy damping as well, and this is reflected in wider bandwidths, especially for F1. In the third vowel portion, the energy correlated to F1 does not appear as a compact and well-defined band as in the first two thirds of the vowel spectrogram, rather it is visibly spread within the low frequency region.

The nasalization on the stressed vowel [a] in Nuorese as represented in Figure 5.1 appears to conform with patterns of phonetic rather than phonological nasalization with the nasalizing effect on the stressed vowel detectable only on the portion of the vowel closest to the source of nasality. In other words, it is a local effect, and thus, phonetic.

5.3.1 Data and methods

How robust is the vowel nasalization pattern shown in Figure 5.1 in Nuorese? In order to answer this question, I performed an acoustic study of a small corpus recorded from one native speaker of Nuorese.\(^\text{12}\)

\(^{12}\)The acoustic data were in .WAV format and they have kindly been shared with me by Prof. Kattenbusch of the Humboldt Universität in Berlin, Germany. Prof. Kattenbush, together with Carola Kühler, a colleague of his in the Institut für Romanistik at the Humboldt Universität in Berlin, Germany, and Marcel Lucas Müller of Freiburg, Germany, have developed an on-line acoustic database for Italian dialects and minority languages spoken on the Italian territory, the VIVALDI Project (the acronym VIVALDI stands for VIVAio Acustico delle Lingue e
Given the small size of the VIVALDI corpus and the fact that it was not collected for the specific purpose of an acoustic study of vowel nasalization, it was impossible to obtain a nasal- plus non-nasal context pool of data that is prosodically isomorphic for each of the five vowels in the Nuorese inventory. Some tokens also had to be discarded because of poor acoustic quality. An appropriate pool of stressed vowel tokens in nasal and non-nasal context was attained for the vowels /a/, /e/ and /o/ only.\(^{13}\) The size of the samples is small and thus their statistic assessment is discussed in some detail below. The best sample to be extracted from the VIVALDI acoustic corpus of Nuorese was the one for stressed /a/, with thirteen tokens for each of the nasal and non-nasal contexts. The sample for both pre-nasal stressed [e] and [o] is small, with three tokens only. The sample for stressed [e] preceding a non-nasal onset is of ten tokens, that for stressed [o] in the same context is of eight tokens. In (48), I report the types included in each sample.

\(^{13}\)Mid vowel allophones [e] vs. [ɛ] and [o] vs. [ɔ] occur, due to the metaphonic process active in Sardinian phonology (Bolognesi 1998; Frigeni 2003a). Vowel quality affects F1 bandwidth values (Stevens 1998), as is shown in Figure 5.3. However, since ATR and non-ATR alternants are present in both the pre-nasal and non-prenasal pools, they may not have any significant effect on the measured average F1 BW values. Of course, a targeted study of vowel nasalization in Sardinian must also control for this variable. Recall from section 5.2 that Maeda 1993 suggested that the effects of nasal coupling on the energy of F1 are more significant for the non high vowels. Thus, the small sample seems to be a felicitous one nevertheless.

\begin{align*}
\text{(48) } & \text{a. Stressed /a/} \\
& \text{Nasal context } \quad \text{[kane] ‘dog’, [pane] ‘bread’, [gana] ‘will/desire’} \\
& \text{Non-nasal context } \quad \text{[fava] ‘fava bean’, [faket] ‘he does’, [bakka] ‘cow’} \\
\text{b. Stressed /o/} \\
& \text{Nasal context } \quad \text{[bònà] ‘good.F.SG’ also in PL form} \\
\text{c. Stressed /e/} \\
& \text{Nasal context } \quad \text{[fenu] ‘straw’, [vèna] ‘vein’, [ka’ðìna] ‘chain’} \\
& \text{Non-nasal context } \quad \text{[bel:u] ‘beautiful’ in M/F, SG/PL forms}
\end{align*}
version 4.4.13 for Mac OS X (version 10.4.6)). In order to perform a dynamic analysis of nasalization, the stressed vowel in each of the relevant tokens was divided into three equal thirds, as shown in Figure 5.2.

![Figure 5.2: Pre-nasal vowel divided in three equal portions](image)

The acoustic correlate of nasalization selected for the present analysis is F1 bandwidth, as discussed in section 5.2. The bandwidth of F1 was automatically calculated by Praat from the middle of each selected third. The extracted measurements were recorded in a spreadsheet where average and standard deviation values were calculated.

### 5.3.2 Predictions

These measurements allow the test of two main predictions: (i) nasalized vowels show a F1 BW profile different from non-nasalized vowels (i.e., dynamic F1 BW measurements are an indicator of nasalization, at least in vowels); and (ii) the F1 BW profile of nasalized vowels is cline-like, with the F1 BW value rising closer to the nasal source. Such pattern would characterize the process of vowel nasalization in Nuorese as gradient, and therefore phonetic (recall from section 5.1 that gradience is the tantamount character of physical processes, as the
5.3.3 Measurements and nasalization profiles

The dynamic bandwidth profiles of stressed vowels preceding an alveolar nasal in onset position (nasal context) were compared to ones extracted from stressed vowels preceding non-nasal onsets (non-nasal context). This comparison is necessary in order to show that the adjacent nasal consonant affects the F1 bandwidth values. The descriptive statistics (mean and standard deviation) are presented in (49a-c):

(49) a. F1 BW measurements for stressed [a] in Nuorese

<table>
<thead>
<tr>
<th>Context</th>
<th>Pre-[n] (i.e., nasal)</th>
<th>Pre-non-[n] (i.e., non-nasal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>13 tokens</td>
<td>13 tokens</td>
</tr>
<tr>
<td>Vowel Portion</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>Average (Hz)</td>
<td>110.06</td>
<td>198.67</td>
</tr>
<tr>
<td>Std Dev</td>
<td>34.05</td>
<td>93.53</td>
</tr>
</tbody>
</table>

b. F1 BW measurements for stressed [o] in Nuorese

<table>
<thead>
<tr>
<th>Context</th>
<th>Pre-[n] (i.e., nasal)</th>
<th>Pre-non-[n] (i.e., non-nasal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>3 tokens</td>
<td>10 tokens</td>
</tr>
<tr>
<td>Vowel Portion</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>Average (Hz)</td>
<td>114.76</td>
<td>115.71</td>
</tr>
<tr>
<td>Std Dev</td>
<td>30.01</td>
<td>21.36</td>
</tr>
</tbody>
</table>

c. F1 BW measurements for stressed [e] in Nuorese

<table>
<thead>
<tr>
<th>Context</th>
<th>Pre-[n] (i.e., nasal)</th>
<th>Pre-non-[n] (i.e., non-nasal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>3 tokens</td>
<td>8 tokens</td>
</tr>
<tr>
<td>Vowel Portion</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>Average (Hz)</td>
<td>61.59</td>
<td>96.79</td>
</tr>
<tr>
<td>Std Dev</td>
<td>38.95</td>
<td>28.14</td>
</tr>
</tbody>
</table>

In Figure 5.3, I present the dynamic profiles of the F1 bandwidths plotted from the average values calculated for each of the three portions in which the stressed vowel tokens were divided (see Figure 5.2).
a. Average F1 Bandwidth for stressed vowel preceding non-[n] onset

<table>
<thead>
<tr>
<th>Hz</th>
<th>/a/</th>
<th>/o/</th>
<th>/e/</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1st V portion 2nd V portion 3rd V portion

b. Average F1 Bandwidth for stressed vowels preceding [n] onset

<table>
<thead>
<tr>
<th>Hz</th>
<th>/a/</th>
<th>/o/</th>
<th>/e/</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1st V portion 2nd V portion 3rd V portion

Figure 5.3: F1 BW in Nuorese stressed vowels: a. non-nasal context vs. b. nasal context

The bandwidth profiles of the stressed vowels preceding non-nasal onsets reported in Fig.5.3a are steady. The relative differences among the bandwidth profiles for /a/, /o/ and /e/ may depend on the quality of the vowel, as discussed in section 5.2. On the other hand, the bandwidth profiles of the stressed vowels preceding an alveolar nasal onset in Fig.5.3b show an upwards cline. This indicates that the average value for the bandwidth of the first formant is higher, with a wider bandwidth in the portion immediately preceding the nasal onset than in the first portion of the stressed vowel. This is the general pattern that emerges from the pilot acoustic study conducted here. The fact that the cline presents different shapes — with /a/ showing a gradual increase of F1 bandwidth throughout its duration, and with /o/ and /e/ showing a gradual increase along the same dimension only in their second and first half respectively — cannot be further investigated in the present work.\footnote{It may be the case that the different patterns for the vowels in the pre-nasal context are a product of the small size of the samples analyzed here. If the acoustic analysis of a more robust corpus for all the five vowels of Nuorese still present different patterns of increase in F1 bandwidth, it should be examined on which factors they depend. This is beyond the scope of the present dissertation. The important point here is that F1 BW is relatively invariant in the non-nasal context and increases in the pre-nasal context.}

While in Figure 5.3 the bandwidth profiles are displayed according to the context in which the analyzed stressed vowels were embedded (non-nasal (a) versus nasal (b) environment), in...
Figure 5.4 below, each chart compares the bandwidth profiles of one type of vowel in the two different contexts (bandwidth profiles for stressed /a/ (a), /o/ (b) and /e/ (c)).

The descriptive statistics and the profiles derived from it show different patterns for vowels in nasal and oral contexts. The significance of the context variable needs assessing. Nevertheless, the difference in F1 BW between oral and nasalized vowels is striking.

5.3.4 Statistical assessment

A univariate analysis of variance (ANOVA) was conducted in order to assess which factors, among type of vowel (Vowel = /a/, /o/, /e/), context (Context = nasal vs. non-nasal), portion of
The main effect of Vowel is highly significant (F(2,132) = 17.203, p < .001). A post-hoc test (Games-Howell) indicates that each vowel affects the F1 bandwidth value in a significantly different way. This is not surprising, given that different formant frequencies correspond to different formant bandwidth values (Stevens 1998, 258-60). Notice that neither the Vowel x Context (F(2,132) = .574, p = .565) nor the Vowel x Portion (F(4,132) = .918, p = .456) interactions are significant. In other words, the difference in F1 BW values depending on the vowel quality has no weight when related to the context (nasal or non-nasal) or the portion of the vowel. Thus, the effect of vowel type is neutralized across contexts and vowel portions.

The main effect of Context is highly significant (F(1,132) = 11.675, p = .001): the type of segment (nasal versus non-nasal) following the stressed vowel greatly affects the F1 BW value thereof. The significance of the effect of Context on F1 BW confirms, on the one hand, the relevance of this parameter as an acoustic correlate of nasality in vowels, and, on the other hand, the hypothesis about the meaningful difference of the F1 BW profile for stressed vowel in oral versus nasal context.

The main effect of Portion is also significant (F(2,132) = 3.669, p = 0.028). The post hoc test here indicates that the difference in F1 BW value is marginally significant (.058) between the first and the third portion of the vowel. However, there is a significant Context x Portion interaction (F(2,132) = 4.892, p = .009). In the nasal context, the main effect of Portion on the F1 BW values is highly significant. In particular, the post-hoc test reveals that the difference between the F1 BW values in the first and second portion as well as in the first and third portion is significant, but not between the second and third portion. F1 BW increases significantly between the first and second portion of the stressed vowel and it then remains steady. In the non-nasal context, the main effect of Portion on F1 BW is not significant and the profile is consistently steady.

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15I thank Prof. Ron Smyth for his assistance with the statistical analysis.
The ANOVA assessment of this preliminary acoustic study of Nuorese stressed vowels indicates that the contrast between the steady profile of the F1 bandwidth in a stressed vowel preceding a non-nasal onset and the rising profile of the same parameter in a stressed vowel preceding a nasal onset is robust, even when the study itself was conducted on a handful of data.

5.3.5 Summary

In conclusion, vowel nasalization in Nuorese is not recorded in any of the traditional sources on the dialect. This is no accidental gap in the literature: vowel nasalization in Nuorese is not reported because it is not phonologized.

A preliminary acoustic analysis shows that vowel nasalization is indeed present on stressed vowels preceding an alveolar nasal in this dialect. However, this nasalization process gives rise neither to allophonic alternations between an oral vowel and its nasalized counterpart in morphologically related forms nor to minimal pairs, as presented in (45). Dynamic measurements of the bandwidth of the first formant, the acoustic correlate of nasalization selected in the study, confirm that vowel nasalization is purely phonetic in this dialect. The value of the acoustic correlate of nasalization increases closer to the nasal source, parallel to the cline-line pattern in cases of phonetic vowel nasalization observed by Cohn 1990 in her aerodynamic studies.

5.4 Acoustic study of vowel nasalization in Campidanese

In Campidanese Sardinian, a stressed vowel followed by an alveolar nasal onset in paroxytonic forms is nasalised and the nasal trigger is deleted.

Contini 1987, 454 lists all the possible surface vowel-vowel sequences arising from the nasalization process in Campidanese. These include (transcribed as in the original source): ĩi, āã, ūu, āĩ, āũ, ĩũ, ũũ, ẽĩ, ẽũ, ĩĩ, ĩũ, ẽũ, ẽũ, ũũ, ẽũ, ĩũ, ĩũ. Contini and Boë 1972 put forward
as an argument for the phonological status of the vowel nasalization process in Campidanese the fact that such a number of phonemic nasal diphthongs were cross-linguistically an oddity. If, on the other hand, they were sequences of two phonemic single vowels one would expect to find these nasal singletons in the language; but this never occurs, according to Contini 1987 and Contini and Boë 1972. The loss of the nasal consonantal trigger gives rise to nasalized diphthongs.\footnote{Wagner 1941, Virdis 1978 and Bolognesi 1998 transcribe only the vowel preceding the underlying or historical nasal trigger as nasalized. The dynamic acoustic study performed in this dissertation, however, shows that nasalization is rather concentrated in the final portion of the diphthong, a state of affairs in contrast with both transcription traditions mentioned above.}

Unlike Nuorese, the vowel nasalization process in Campidanese has become part of the grammar: the evidence summarized in section 4.1 favours a phonological rather than a phonetic analysis. The acoustic study presented in this section gives more insight into the situation.

### 5.4.1 Data and methods

Diphthongs in an underlying or historical nasal context were compared to the same kind of diphthongs in an oral context. The distribution of tokens by type of diphthong and by speaker is given in (50):

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Diphthong type</th>
<th>Nasal tokens</th>
<th>Oral tokens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female 1</td>
<td>[ɛj]</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Male 1</td>
<td>[aj]</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Male 2</td>
<td>[e\textipa{w}]</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22</td>
<td>10</td>
</tr>
</tbody>
</table>

Wagner 1941, Virdis 1978 and Bolognesi 1998 transcribe only the vowel preceding the underlying or historical nasal trigger as nasalized. The dynamic acoustic study performed in this dissertation, however, shows that nasalization is rather concentrated in the final portion of the diphthong, a state of affairs in contrast with both transcription traditions mentioned above.
The set in (51) lists the types corresponding to each diphthong:

(51) a. /ɛj/ in nasal context vs. /ɛj/ in oral context
   [bɛj] ≺ BENE ‘well’      [braˈɛj] ≺ VERVEX ‘sheep’

   b. /aj/ in nasal context vs. /aj/ in oral context
   [kɑj] ≺ /kane/ ‘dog’   [faj] ≺ /fare/ ‘to do’

   c. /ew/ in nasal context vs. /ew/ in oral context

The position of the diphthong under analysis with respect to stress is fixed. They belong to the tonic syllable.

For the diphthong [ɛj], (51a), produced by a female speaker from the village of Villasor (Female Speaker 1), there are ten tokens in the historical/underlying nasal context (lexical item on the left) and three tokens in the non-nasal context (lexical item on the right). For the diphthong [aj], (51b), produced by a male speaker from the village of Villacidro (Male Speaker 1), there are eight tokens in the historical/underlying nasal context (lexical items on the left) and five in the non-nasal context (lexical items on the right). For the diphthong [ew], (51c), uttered by a male speaker from the village of Sanluri (Male Speaker 2), there are four tokens in the historical/underlying nasal context (on the left) and two tokens in the non-nasal context (on the right) – the latter ones are actually tokens of the diphthong [ɛw] in the non-nasal context.  

A dynamic acoustic analysis of Campidanese nasalized diphthongs was performed according to the same methods developed for the acoustic analysis of nasalized vowels in Nuorese (see section 4.2).

The diphthongs were divided into three equal portions rather than into the three standard diphthong portions – onset, transition, offset. This method was chosen so that the results of the acoustic analysis of Campidanese diphthongs is comparable with those of the acoustic analysis...
of the Nuorese vowels. The value for the first formant bandwidth (F1 BW) was automatically extracted in the middle of each third by the acoustic analysis software *Praat* 4.4.13.

The data for this preliminary phonetic study were extracted from the corpus of digital recordings made during fieldwork. The recordings were made by the author with a portable SONY DAT recorder at 44.1 kHz and a head-mounted unidirectional noise-cancelling microphone (Sennheiser PC140) in quiet rooms. The speakers were asked to perform a translation task. The acoustic files were then downsampled to 22.05 kHz and normalized for noise threshold.

Since the data were gathered with different goals in mind at the time of the fieldwork, the corpus available for this specific study is small and its internal organization is not optimal for obtaining an exhaustive picture. For instance, the types of diphthongs on which the acoustic analysis was performed were only three, namely, [aj], [ej] and [ew]. Moreover, each type of diphthong is uttered by a different speaker: all tokens of a given type are uttered by a single speaker. Thus, the factors *Diphthong* and *Speaker* in the univariate ANOVA performed on the extracted values do not interact, subtracting a dimension of variance from the statistical assessment.18

### 5.4.2 Predictions

Given that nasalization is phonological in Campidanese, two predictions can be formulated. The first is that the dynamic F1 BW profile of diphthongs in a nasal context should be both similar across diphthong type and speaker, and similarly contrastive to the dynamic F1 BW profile of diphthongs in oral context, as in Nuorese. The second is that, unlike Nuorese, where the dynamic F1 BW profile is a non-steady nasal effect throughout the stressed vowel, reflecting the fact that nasalized vowels are the result of a phonetic process, in the case of Campidanese diphthongs, since the process is phonological, the dynamic F1 BW profile is expected to be

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18A systematic study of Campidanese diphthongs to verify the results of this pilot study must check for such an interaction and must thus be designed accordingly.
a steadily high F1 BW value throughout the diphthong in nasal contexts. In other words, nasalization informs the entire diphthong and not only the portion of the diphthong closest to the nasal source. This prediction is built on what has been found through aerodynamic study of vowel nasalization (Cohn 1990; Cohn 1993a – as discussed in 5.1).

5.4.3 Measurements and nasalization profiles

The F1 BW average values for all three diphthong portions of nasal and oral diphthong tokens were calculated and are plotted in the charts in Figures 5.5 and 5.6. These charts present the dynamic F1 BW profiles of the Campidanese diphthongs [ɛj, aj, ew] in oral and nasal context.

The first prediction about the specificity of the F1 BW profile in the case of diphthongs in the nasal context is confirmed: the profile is steady in the oral context (a. chart in Figure 5.5) and rising in the nasal one (b. chart in the same Figure). The second prediction, however, relative to the specific shape of the F1 BW profile for nasalized diphthongs in Campidanese, is not validated given the rising profiles in chart b. of Figure 5.5. A steady value for F1 BW was predicted, mimicking the plateau effect of aerodynamic measurements in the case of phonological vowel nasalization in Sundanese (Cohn 1993a). The interpretation of this pattern follows in section 5.5, after the statistical assessment summarized in the next paragraphs.

Figure 5.5: F1 BW in Campidanese diphthongs: oral vs. nasal context
The rising F1 BW profile for the diphthong [ɛj] in nasal context appears less marked than the ones for [aj] and [ew] in the same context. This is visible also in Figure 5.6, which collects the profiles diphthong by diphthong. The small size of the corpus, together with the lack of an independent speaker and diphthong dimension, do not allow me to comment in any meaningful way on the results for [ɛj].

The descriptive statistics (mean and standard deviation) are presented in (52a-c).

(52) a. F1 BW measurements for stressed [ɛj] in Campidanese (Female Speaker 1)

<table>
<thead>
<tr>
<th>Context</th>
<th>Pre-/n/ (i.e., nasal)</th>
<th>Pre-non-/n/ (i.e., non-nasal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>10 tokens</td>
<td>3 tokens</td>
</tr>
<tr>
<td>Diphthong</td>
<td></td>
<td></td>
</tr>
<tr>
<td>portion</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>Average (Hz)</td>
<td>76.72</td>
<td>92.46</td>
</tr>
<tr>
<td>Std Dev</td>
<td>36.29</td>
<td>32.08</td>
</tr>
</tbody>
</table>
b. F1 BW measurements for stressed [aj] in Campidanese (Male Speaker 1)

<table>
<thead>
<tr>
<th>Context</th>
<th>Pre-/n/ (i.e., nasal)</th>
<th>Pre-non-/n/ (i.e., non-nasal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>8 tokens</td>
<td>5 tokens</td>
</tr>
<tr>
<td>Diphthong portion</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>Average (Hz)</td>
<td>126.97</td>
<td>172.03</td>
</tr>
<tr>
<td>Std Dev</td>
<td>48.59</td>
<td>48.58</td>
</tr>
</tbody>
</table>

In order to evaluate statistically the patterns derived through plotting the F1 BW average values and depicted in the charts presented in the Figures above, a univariate analysis of variance (ANOVA) was performed.

5.4.4 Statistical assessment

Recall from the discussion of the corpus that the variables related to speaker and type of diphthong do not interact, thus, the latter factor was arbitrarily chosen to be maintained over the former.

The value of F1 BW is affected significantly by: (i) the Context (oral vs. nasal) (F(1,78) = 46.658, p ≪ .001); (ii) the type of Diphthong ([ej] vs. [aj] vs. [ew]) (F(2,78) = 19.468, p ≪ .001); and, (iii) the Portion (F(2,78) = 15.891, p ≪ .001). As far as the interactions between single factors are concerned, the interaction of Context and Portion affects the bandwidth values significantly (F(2,78) = 9.209, p ≪ .001), as well as the interaction of type of Diphthong and Context (F(2,78) = 4.836, p = .01). The interaction of Diphthong and Portion is marginally significant (F(4,78) = 2.439, p = .054). In linguistic terms, the main effect exerted by Context

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19If Speaker had been chosen instead of Diphthong then the variable Speaker would have been significant.
Chapter 5. Acoustic Studies

confirms the hypothesis about significant difference in terms of F1 BW profiles between nasalized and non-nasalized diphthongs – parallel to the significant difference between nasalized and non-nasalized vowels in Nuorese. The main effect of the type of Diphthong is not surprising either, as bandwidth values for formants are different according to vowel quality (Stevens 1998, 258-260) – also this result resembles the effect of vowel quality on F1 BW values found in Nuorese.\textsuperscript{20} The main effect of Portion is, however, surprising in Campidanese, as a steady F1 BW profile for non-nasalized diphthongs was expected to be matched by an equally steady F1 BW profile, although with higher average frequency values, for nasalized diphthongs since nasalization appears to be phonological in this dialect.

The significant asymmetry between the interactions of Portion and Context opposed to the only marginally significant asymmetry between Portion and type of Diphthong suggests that Context is important. The main effect of Portion with respect to the predicted on the specific shape of the F1 BW profile for the nasalized Campidanese diphthongs can be assessed in more detail when considering the F1 BW value for the oral and nasal contexts separately.

An ANOVA was thus run for the two contexts, oral versus nasal, independently. In the non-nasal context, the main effect of the type of Diphthong is significant (F(2,21) = 5.897, p = .009), and as previously mentioned, this is not surprising.\textsuperscript{21} Crucially, in the oral context, neither Portion (F(2,21) = 1.546, p = .236) nor the interaction of Diphthong and Portion (F(4,21) = 1.270, p = .313) are significant. In other words, across diphthongs in oral contexts, the F1 BW profile is steady (no significant difference with respect to its value depending on the portion of the diphthong – as in chart a. in Figure 5.5).

In the nasal context, type of Diphthong is also significant (F(2,57) = 28.751, p ≪ .001),

\textsuperscript{20}The main effect of the type of diphthong should be thoroughly assessed through a systematic study of nasalization in Campidanese diphthongs based on a comprehensive corpus.

\textsuperscript{21}According to the post hoc and homogeneity tests there are two significantly different subsets within the pool of three diphthongs ([rj]) (Female Speaker 1) and [ew] (Male Speaker 2) versus [aj] (Male Speaker 1). However, it is not possible to discuss these results in any meaningful way because each diphthong was uttered by a single speaker.
but this result is expected\textsuperscript{22} and thus the parallel with the oral context is not surprising either.\textsuperscript{23}

In contrast to the F1 BW values in the oral context, however, the main effect of *Portion* in the nasal context is highly significant (F(2,57) = 30.893, p < .001) as well as the interaction between *Diphthong* and *Portion* (F(4,57) = 4.229, p = .005).

### 5.4.5 Summary

The significant effect of portion indicates that, in the case of Campidanese diphthongs, the effect of nasality is not consistently distributed throughout the vowel-glide sequence. The post hoc and homogeneity tests point to a significant difference between the first two portions of the diphthong, on the one hand, and the third and last one, on the other hand. In other words, the statistical assessment confirms the profile depicted in the above charts (in particular, chart b. in Figure 5.5), where the cline increases towards the end of the diphthong. Wider F1 BW indicated stronger nasalization effect, thus, the nasalization effect in Campidanese is greater towards the end of the diphthong.

This result contrasts sharply with what is reported by Contini and Boë\textsuperscript{1972, 186} in their study of nasalized diphthongs in Campidanese (variety spoken in Sanluri, same village as one of my subjects, namely Male Speaker 2, diphthong [ew]): “L’analyse acoustique révèle une structure nasale assez nette pour les deux voyelles en contact, mais qui tend à s’affaiblir sur la 2°.” Notice however that Contini and Boë\textsuperscript{1972} did not perform a dynamic acoustic analysis of the nasalized diphthongs: they measure the first three formants of the nasalized diphthongs and their relative intensity (I(F2)/I(F1) and I(F3)/I(F1)) but not at different points in time. Thus, it is not possible to verify their claim about whether the final portion of a nasalized diphthong is more nasalized than the second.

The dynamic acoustic analysis presented here and the statistical assessment thereof indi-

\textsuperscript{22}An effect of vowel type was found in Nuorese as well and linked to the vowel height parameter in Hajek 1997.

\textsuperscript{23}Post hoc and homogeneity tests indicated three different subsets, corresponding to the three different diphthongs (or speakers).
cate that the specific F1 BW profile for Campidanese nasalized diphthongs is a rising slope. This rising contour is unexpected under the assumption of a plateau effect, a constant effect throughout the target of the process or of a consistent effect in phonological nasalization and phonemic nasal specification. This assumption was coded in the formulation of the prediction about the nasal effect-contour posited for Campidanese diphthongs prior to the actual analysis, i.e. an even contour.

5.5 Discussion

In Nuorese, the nasalization cline is consistent with a pattern of phonetic nasalization because the cline translates a gradient and local nasalization effect (i.e., F1 BW increases closer to the nasal source).

The dynamic acoustic profiles for Campidanese, on the other hand, are rather puzzling given the literature discussed in 5.1.2. Vowel nasalization in Campidanese has been demonstrated to be phonological in nature, yet the results of the acoustic study do not match the prediction for a steady nasalized profile.

The question to ask at this point is the following: is the nasalization cline-line in Campidanese a sign of nasalization being a phonetic process, as it is in Nuorese? Should the cline line patterns displayed by Campidanese diphthongs be interpreted in the same way?

Gradient effects are assumed as tantamount to phonetic processes because they are derived by a certain value as dependent upon another dimension, usually time (which, in the case at hand, correspond to proximity to the source of nasalization). Phonological processes are assumed to not manifest gradient effects because they operate on abstract units (segments, features, suprasegmental elements) whose value is not informed by any other dimension. Can other parameters be invoked in order to interpret the rising F1 BW profile in Campidanese nasalized diphthongs as phonological despite its gradient nature?

I argue that the answer to this question is yes. The Uniqueness Hypothesis (i.e., that phono-
logical representations are unique and, thus, do not encode variation in the realization of a given item) entails that effects of phonological processes do not vary with speaking rate and style (e.g., articulatory carefulness), as discussed in Myers 2000, 265-6 and summarized in section 5.1. Recall from section 5.4 that the ANOVA assessment points to a consistent pattern for the F1 BW of nasalized diphthongs in Campidanese across the three types of diphthongs (which correspond to three different speakers): there is a significant increase in F1 BW only in the third portion of the diphthongs. If further measurements confirm this specific profile, and, crucially, this cline does not show significant variation across different speech rates and degree of articulatory carefulness, then the cline-like nasalization profile for Campidanese diphthongs can be read as corresponding to a phonological pattern.

While this is material for future research, in the next two subsections I examine how the gradient nasal profiles exhibited by Campidanese diphthongs can be derived in a phonological analysis, and how this can be phonetically implemented. In order to do so, I analyze the source of the locality effect found in the dynamic nasal profiles of the Campidanese diphthongs. Is this effect by any means comparable to the one found in the dynamic nasal profiles of Nuorese vowels?

### 5.5.1 The puzzle of Campidanese nasalized profiles

The interpretation of a rising F1 BW profile in the case of Campidanese nasalized diphthongs cannot be the same as the interpretation of a rising F1 BW profile of Nuorese nasalized vowels because the relative position of the trigger and the peak of nasalization in the two dialects is not isomorphic. In Nuorese, the vowel that undergoes phonetic nasalization precedes a heterosyllabic coronal nasal consonant. The nasal effect within the vowel is greater the closer to the nasal source (third and rightmost vowel portion – see 5.3). In Campidanese, the diph-

---

24 However, the structural relationship between trigger and targets of nasalization in Campidanese and Nuorese is isomorphic. Structural identity of the input to the process was controlled for in order to compare the dynamic acoustic results obtained for the two dialects.
thongs that appear nasalized do not precede a coronal nasal consonant, nor do they follow one. In Campidanese, nasalized diphthongs arise from the deletion of the nasal source in intervocalic position: underlying /V.nV/ and etymological V.nV give rise to (an alleged) [VV] on the surface. This further step in the process, i.e., nasal loss, typical only of the Campidanese dialect, is interpreted as being an index of phonologization (an underlying contrast is displaced). The vowel-vowel sequence bears stress as a unit, and it thus is a diphthong. Under these conditions, to expect proximity effects in comparing Nuorese and Campidanese outputs of nasalization seems not to be legitimate.

If Campidanese nasalization is a phonetic process as nasalization is in Nuorese, where proximity to the nasal source matters, a peak-shaped contour is expected in Campidanese (53b): the closer to the nasal source, the greater the nasalization effect (rising line, as in the case of the first vowel in the sequence) the farther from the nasal source, the smaller the nasalization effect (falling line, as in the case of the second vowel in the sequence).

The attested Campidanese nasalization profile (53c) does not align with the one expected under a phonological analysis (53a), and, crucially, neither to the one expected under a phonetic analysis (53b).

(53) Nasalization (F1 BW) profiles of Campidanese diphthongs

\[ F1 \text{ BW contour of } VV < V.nV \]

a. expected if phonological process    [plateau
b. expected if phonetic process        \[\wedge\] clines peaking towards source
c. attested                           \[\wedge\] cline

How should the maximum of nasalization effect at the end of the Campidanese diphthongs be interpreted, then, when it is not an index of proximity to the nasal source? What we see is a pole of low or zero nasalization on the portion of the diphthong that was originally the stressed heterosyllabic vowel preceding the nasal source versus a pole of high nasalization on
the portion of the diphthong that was originally syllabified together with the nasal source.25

The hypothesis put forward here on how to interpret the nasalization cline in Campidanese diphthongs is that the maximum on the right edge of the diphthong flags the original syllabic position of the nasal consonant trigger (V.nV).

### 5.5.2 Analysis

How can the cline-like pattern of nasalization obtained for Campidanese diphthongs through this preliminary study correspond to a phonological process? Keating 1988 shows that segments that are analyzed as being unspecified for a given feature in the phonology can remain unspecified for that feature in the phonetics (other relevant sources are Pierrehumbert 1980; Pierrehumbert and Beckman 1988). If no rule supplies a feature specification for a phonological underspecified segment by the time phonetic implementation occurs, the unspecified feature value for this segment is realized by interpolation, i.e. as a transition from the values for that feature specified in the segment preceding and following the unfilled one. This is exactly the way in which Cohn 1990, 1993 interprets the nasal airflow profiles for nasalized vowels in American English (recall the discussion in section 5.1). Since they show a gradient profile, the feature [nasal] is not specified for the vowel at any point in the phonology, and the phonetic component implements the nasal profile of the vowel as interpolation between a preceding oral segment and a following nasal one. Within this view, it is possible to refine the previously sketched hypothesis on how to interpret the gradient profile of nasalization in the

25A systematic acoustic study and possibly a parallel aerodynamic one are in order to confirm that the nasal airflow in Campidanese nasalized diphthongs cumulates toward their end across different contexts (i.e., not only morpheme-finally as in the corpus of the pilot study – recall, however, from section 4.1 that nasalization occurs systematically only when the target, a stressed vowel, is the nucleus of the second-to-last syllable in the word.) Given the nature of the present pilot study, it is not evident whether the cline-like profile is real or is an artifact of the small corpus, or of the nature of the acoustic parameter selected (F1 BW), or of the morpheme-final position of the nasalized diphthongs analyzed, or of an interaction of all of the above factors.
Campidanese diphthongs as follows. The phonological nasalization rule is active (for the items showing the allophonic alternation between [V.nV] and [VV]) or was once active (for the items not showing such alternation) in Campidanese. The output of this rule is not a sequence of nasalized vowels or a consistently nasalized diphthong (both of which would give a plateau or a consistent high profile). Rather, the output of phonological nasalization in Campidanese is a nasal feature specified on the edge of the diphthong. With a diphthong being a continuous sequence of two vocalic elements, the only way to signal the original position of the nasal source is for the feature [nasal] to flag the edge of the diphthong adjacent to the original position of the nasal consonant. The diagrams in (54) propose a phonological hypothesis for how this state of affairs may have come to be: after the nasal melodic material ([n]) has lost its timing slot (C₂), and the vowel sequence (V₁,V₂, where ‘.’=syllable boundary) has undergone diphthongization (V₁,₂), [n] (i.e., the feature [nasal]) stays put, flanking the right edge of the diphthong.

(54) **Campidanese nasalized diphthongs: Phonological hypothesis**

\[
\begin{array}{c|c|c|}
[n] & [n] & [n] \\
C₁ V₁. C₂ V₂ & \rightarrow & C₁ V₁. V₂ & \rightarrow & C₁ V₁₂.
\end{array}
\]

This phonological configuration is phonetically implemented as follows. The rising F₁ BW of nasalized diphthongs in Campidanese is the interpolation between the beginning of the diphthong (the left edge of V₁₂), where no feature [nasal] is specified, and the end of the diphthong (the right edge of V₁₂), where the feature [nasal] is specified. Phonologization of a displaced nasal feature does not give rise to phonemic nasal vowels in Campidanese, as claimed by Sampson 1999 (see section 4.1), because the nasal feature is not anchored to a segment root (C or V) through the timing tier, but rather to the righthand edge of the derived diphthong.

---

26I do not have Nuorese diphthongs in nasal contexts for a comparison which is in order in future studies.

27Phonologization of a displaced nasal feature does give rise to phonemic vowels in French since re-anchored to a V root, and French phonemic nasal vowels display a plateau profile.
In fact, nasalized vowels in Campidanese are not nasal phonemes, and thus, as such, they are actually not expected to display a plateau contour. The displaced nasal feature is not phonologized as one of the diphthong’s inherent features. Rather, it is phonologized in the only way that can flag the original position of the nasal source: on the relevant edge of the diphthong. The feature [nasal] does not inform the segments within the diphthong, rather it informs one of its edges, almost like a relic of V.nV or /V.nV/.

5.6 Summary

The two pilot acoustic studies of vowel nasalization in Campidanese and Nuorese strengthen the findings of the qualitative analysis of the process presented in chapter 4. The F1 BW profile for nasalized vowels in Nuorese conforms to a phonetic analysis of the process in this dialect, according to the parameters defined by Cohn 1990, 1993 (discussed in section 5.1). The F1 BW profile for nasalized diphthongs in Campidanese, on the other hand, does not conform to either of the patterns interpreted as phonological by Cohn 1990, 1993: either plateau-like or consistently high. The F1 BW profile for nasalized diphthongs in Campidanese is markedly gradient throughout, with a statistically significant increase of the nasalization acoustic trace in the last portion thereof. A hypothesis for how to interpret such a profile was put forward, which rests on the absence of phonemic nasal vowels in the Campidanese inventory. The Sardinian acoustic studies presented here, while confirming that the effects of phonetic processes are local and gradient in Nuorese, question the nature of the measurable effects of phonological processes. In the case of Campidanese, in fact, the gradience of the effect due to interpolation may still be interpreted as a phonological output, as I suggest in 5.5.

An in-depth analysis of vowel nasalization patterns in the two dialects was in order as I claim that the contrast between phonetic and phonological patterns of nasalization (the table in (55) provides a summary thereof) is the crux of the analysis of the underlying contrastive configurations of the Nuorese versus the Campidanese sonorant inventory.
(55)  

<table>
<thead>
<tr>
<th></th>
<th>Nuorese</th>
<th>Campidanese</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. phonological V nasalization</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>b. phonetic V nasalization</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

How do these patterns relate to the features discussed in chapter 3, repeated in (56)?

(56)  

a. Campidanese: [SV] ≻ [nas]  

b. Nuorese: [cont] ≻ [SV]

Nuorese could not have phonological nasalization of vowels given that the feature [nasal] is argued to be inactive in this dialect. In Campidanese, on the other hand, this feature is active, so, the fact that phonological nasalized vowels can arise is not surprising. In the following chapters, I pursue additional predictions of the different configurations in (56) through a study of the interaction of nasals with other sonorants and with non-sonorants in various processes.

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28Capital letters stand for phonemes as considered within a contrastive hierarchy.
Chapter 6

Rhotics and nasals in Campidanese

In chapters 4 and 5, I compared data and acoustic patterns of vowel nasalization in Campidanese and Nuorese Sardinian. This comparison revealed an asymmetry between the two dialects. Namely, vowel nasalization is phonological in Campidanese, whereas it is phonetic in Nuorese. I put forward the hypothesis that this asymmetry with respect to the vowel nasalization patterns in the two dialects reflects a difference in the phonological specification of the feature [nasal] in the two grammars. This hypothesis follows automatically from the theoretical assumption made in chapter 3 that phonological activity of a feature indicates its contrastive (i.e., phonemic) specification.

Vowels in both Campidanese and Nuorese are affected by phonetically natural nasalization when adjacent to a nasal sound. However, the context of nasalization is constrained by grammatical structures such as prosodic domains only in Campidanese. Given the activity of [nasal] in one dialect and not the other, one might ask if there is any other evidence for the activity of the feature [nasal] in Campidanese independent of the vowel nasalization patterns reported in the previous chapters.

If the feature [nasal] is phonologically active, we might expect nasal segments to be triggers of assimilation, with vowels being clear targets, as seen in chapter 4. But there are also other segments which undergo nasal assimilation in Campidanese. Campidanese presents patterns of
rhotic nasalization both historically and synchronically and this chapter focuses on them. I then show in chapter 7 that Nuorese patterns very differently. In particular, nasal segments in the Nuorese dialect do not trigger nasal assimilation but rather they are targets for the assimilation of other features. The asymmetry between the two dialects with respect to the feature [nasal] is realized in a variety of ways.

The present chapter has two purposes. First, it provides further evidence of the activity of the feature [nasal] in Campidanese through an examination of rhotic nasalization, which is phonetically and phonologically robust in this dialect. Second, it gives more insight into the organization of sonorants in Campidanese given the relationship that the rhotic and nasals bear to one another in this dialect.

Section 6.1 presents and analyzes data in which the rhotic assimilates the nasal quality from neighboring nasal segments. Patterns of alternation between a rhotic and a coronal nasal in dissimilating and assimilating contexts are described in section 6.2. This section also presents data on rhotic-nasal substitution patterns (i.e., of alternation between the two segments independent of context). There is then an interim summary presented in section 6.3. Finally, section 6.4 proposes an abstract representation of the phonological relationship between these two segments in the grammar of Campidanese.

### 6.1 Rhotic nasalization

The nasalization of rhotics is an important part of the phonology of Campidanese sonorants for several reasons.\(^1\) In general, it demonstrates a phonological relationship between nasals

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\(^1\)The literature on Sardinian has no consistent transcription. The transcription of rhotics is no exception. For the purpose of clarity, in this and the following two chapters on Campidanese and Nuorese, rhotics will be transcribed phonetically, even if this deviates from the way the lexical items are transcribed in the various sources. The symbols used are: [r] represents a trill which is phonetically long, while [r] represents a tap which is phonetically short. For a systematic study of the distribution of trill and tap in Campidanese, see chapter 8. For a systematic study of trill and tap cross-linguistically, see Banner Inouye 1995.
and rhotics. More specifically, the fact that the rhotic is the target of the assimilation triggered by nasals indicates an asymmetry between these two segments. If assimilation patterns are interpreted as a diagnostic for markedness (Rice 2007), the nasal trigger should be analyzed as more marked than the rhotic target.

There are two distinct processes of rhotic nasalization in Campidanese recorded in Wagner 1941 which are discussed in this chapter. The first one is a particular instance of the regressive nasalization analyzed in the previous chapter. A post-tonic alveolar nasal onset causes the nasalization of the preceding heterosyllabic tonic vowel. If the latter is preceded by a tautosyllabic rhotic, this is also nasalized and further lexicalized as /n/, at least in those Campidanese varieties reported in Wagner 1941.

The second process of rhotic nasalization arises from progressive assimilation of the feature [nasal]. A few historical examples are found in Wagner 1941, and the spectrographic analysis of /mr/ clusters from my fieldwork data reveals that this process is synchronic in Campidanese, as will be discussed in section 6.1.3. A pilot acoustic study comparing the ≺r≻ portion in Campidanese /mr/ versus /br/ clusters was conducted in order to test the systematicity of the rhotic nasalization process in this environment. The methods and results are presented in section 6.1.4.

6.1.1 Methodological note on historical data

A brief methodological note is in order here about how historical data are used and interpreted in this chapter as well as in the next ones. In the sections to follow, Campidanese historical data are not proxies of the synchronic processes taking place in the language. However, when compared to the historical data of other varieties of Sardinian they amount to, and thus may be interpreted as, relevant traces of the peculiarity of Campidanese phonology within the Sardinian system. Phonetic pressure operates over time, and, thus, diachronic phonology should

\(^2\)See de Lacy 2006 for a different perspective.
not be confused with synchronic phonology.\textsuperscript{3} However, historical data document the choice made by a grammar at a certain point in time with respect to a phonetic or perceptual drift exerting pressure on the system \textit{(Diachronica proponit, synchronica disponit!)} (Hyman 2005, 5). Thus, they are informative and should not be disregarded. In this chapter as in the ones to come synchronic data supplement historical data whenever possible.\textsuperscript{4}

\textbf{6.1.2 Regressive rhotic nasalization}

Rhotic nasalization has been reported for the dialect of Campidanese discussed in this chapter (Wagner 1941, 231). The context of rhotic nasalization is the same as that for vowel nasalization (chapter 4). In particular, the nasal stop in the onset of a post-tonic syllable causes the nasalization of the tonic vocalic nucleus (57a); if the onset of the tonic syllable is a rhotic, this becomes an alveolar nasal (57b).

\begin{align}
\begin{array}{c}
(57) \quad \text{a.} & \quad (CV)C\acute{\nu}n(CV) \rightarrow (CV)C\acute{\nu}\tilde{\nu}(CV) \\
& \quad (CV)r\acute{\nu}n(CV) \rightarrow (CV)\tilde{n}\tilde{\nu}(CV)
\end{array}
\end{align}

Crucially, when the feature [nasal] targets /r/, this results in [n] and the new nasal becomes part of the lexical representation for that item (thus, /n/), at least for those varieties of Campidanese which Wagner 1941 and Virdis 1978 discuss (see below).

The examples in (58) are from Wagner 1941, 130-1 and the ones in (59) are from Virdis 1978, 74.\textsuperscript{5} The non-nasalized form in the central column in (58) and (59) is supplied by Wagner without any mention as to its source. For this reason, the column is labeled ‘Campidanese:

\textsuperscript{3}For a thorough discussion see Kiparsky 2004 arguing against Blevins and Garrett 2004 and Blevins 2004, as well as Hyman 2001.

\textsuperscript{4}For similar methodological considerations, see Hajek 1997, 37-39 on the so-called principle of ‘diachronic extrapolation’.

\textsuperscript{5}The examples from Virdis 1978, 74 repeat some of the items found in Wagner 1941, except for the last one in (59).
elsewhere’ meaning the non-nasalizing varieties of Campidanese.\(^6\) The items in (58) are organized according to the village in which they were recorded.\(^7\)

\[(58)\]
\[
a. \text{Camp: Mógoro} \quad \text{Camp: elsewhere} \\
\begin{align*}
\text{su be}\overset{\text{r}}{\text{n}}\overset{\text{a}}{\text{ù}} & \quad \text{be}\overset{\text{r}}{\text{j}}\overset{\text{a}}{\text{ù}} \quad \text{‘the spring’ (season)} \\
\text{s uttu}\overset{\text{r}}{\text{n}}\overset{\text{ù}}{\text{u}} & \quad \text{guttu}\overset{\text{r}}{\text{j}}\overset{\text{ò}}{\text{u}} \quad \text{‘the narrow alley’} \\
\text{ko}\overset{\text{r}}{\text{a}} & \quad \text{ko}\overset{\text{r}}{\text{j}}\overset{\text{ò}}{\text{a}} \quad \text{‘crown’} \\
\text{su βiβa}\overset{\text{r}}{\text{n}}\overset{\text{i}}{\text{ì}} & \quad \text{It. pepe}\overset{\text{r}}{\text{j}}\overset{\text{ò}}{\text{ò}n} \quad \text{‘the sweet pepper’} \\
\text{s a}\overset{\text{r}}{\text{e}} & \quad \text{a}\overset{\text{r}}{\text{j}}\overset{\text{ò}}{\text{e}} \quad \text{‘the sand’}
\end{align*}
\]
\[
b. \text{Camp: Villacidro} \quad \text{Camp: elsewhere} \\
\begin{align*}
\text{su ba}\overset{\text{r}}{\text{n}}\overset{\text{a}}{\text{ù}} & \quad \text{be}\overset{\text{r}}{\text{j}}\overset{\text{a}}{\text{ù}} \quad \text{‘the spring’ (season)} \\
\text{su sa}\overset{\text{r}}{\text{n}}\overset{\text{ù}}{\text{u}} & \quad \text{se}\overset{\text{r}}{\text{j}}\overset{\text{ù}}{\text{u}} \quad \text{‘the dew’} \\
\text{su va}\overset{\text{r}}{\text{n}}\overset{\text{ù}}{\text{u}} & \quad \text{ve}\overset{\text{r}}{\text{j}}\overset{\text{ù}}{\text{u}} \quad \text{‘the poison’}
\end{align*}
\]
\[
c. \text{Camp: Terralba, S. Giusta} \quad \text{Camp: elsewhere} \\
\begin{align*}
\text{s yotto}\overset{\text{r}}{\text{n}}\overset{\text{ù}}{\text{u}} & \quad \text{guttu}\overset{\text{r}}{\text{j}}\overset{\text{ò}}{\text{u}} \quad \text{‘the narrow alley’} \\
\text{\text{(in lo)u} be}\overset{\text{r}}{\text{n}}\overset{\text{ù}}{\text{ù}} & \quad \text{ve}\overset{\text{r}}{\text{j}}\overset{\text{ù}}{\text{u}} \quad \text{‘(in) any (place)’} \\
\text{ka}\overset{\text{r}}{\text{n}}\overset{\text{à}}{\text{à}} & \quad \text{ka}\overset{\text{r}}{\text{j}}\overset{\text{ò}}{\text{à}} \quad \text{‘gilthead bream’} \\
\text{ma}\overset{\text{r}}{\text{n}}\overset{\text{ù}}{\text{u}} & \quad \text{ma}\overset{\text{r}}{\text{j}}\overset{\text{ù}}{\text{u}} \quad \text{‘of the sea’}
\end{align*}
\]
\[
d. \text{Camp: Serrenti} \quad \text{Camp: elsewhere} \\
\begin{align*}
\overset{\text{g}}{\text{ù}} & \quad \text{un (g)}\overset{\text{r}}{\text{j}}\overset{\text{à}}{\text{ù}} \quad \text{‘a grain’} \\
\overset{\text{r}}{\text{ù}} & \quad \text{ve}\overset{\text{r}}{\text{j}}\overset{\text{ù}}{\text{u}} \quad \text{‘nothing’}
\end{align*}
\]

\[(59)\]
\[
\overset{\text{r}}{\text{ù}} \quad \overset{\text{r}}{\text{ù}} \quad \overset{\text{r}}{\text{ù}} \quad \overset{\text{r}}{\text{ù}} \quad \overset{\text{r}}{\text{ù}} \\
\overset{\text{r}}{\text{ù}} \quad \overset{\text{r}}{\text{ù}} \quad \overset{\text{r}}{\text{ù}} \quad \overset{\text{r}}{\text{ù}} \quad \overset{\text{r}}{\text{ù}}
\]

\[
\overset{\text{G}}{\text{RANU(M)}} \quad \overset{\text{RANU(M)}}{\text{V}} \quad \overset{\text{RANU(M)}}{\text{A}} \quad \overset{\text{cucia}}{\text{Rin}}
\]

The example in (60) is also from Virdis 1978, 74. It is an interesting instance of rhotic nasalization and subsequent lexicalization. Although not aligned with the items in (58) and (59) in terms of the nasalization rule —the nasal trigger for the item in (60) is in coda position

\(^{6}\)Except for the Italian loan in (58a).

\(^{7}\)Wagner 1941, 130 does not report the nasalization of the tonic and post-tonic vowels by means of the appropriate diacritic on the listed items – or at least it is very unclear in the text. The nasalization of the vowels is stated in prose in the introduction to the examples. For sake of consistency and explicitness I supply the nasal diacritic on the vowels in (58).
and does not drop after nasalization takes place—, it clearly shows that the rhotic is targeted by nasal assimilation, together with the vowel between nasal trigger and rhotic target.

(60) (B)RUNCHUS \( \triangleright \) nūŋku ‘snout’

Note that this process of nasalization of the rhotic no longer appears to be synchronic in those varieties of Campidanese for which it is reported. However, this historical process and its lexicalization are still meaningful for the analysis of the relationship among sonorant segments in Campidanese presented here. Not only did the rhotic become nasalized, it is realized as an alveolar nasal. This fact points to a strict phonological relationship between /r/ and /n/ in Campidanese. More precisely, /n/ and /r/ seem to be nasal/oral counterparts. The acoustic analysis of synchronic rhotic nasalization presented in section 6.1.4 below indicates that the same kind of relation between these segments.

### 6.1.3 Progressive rhotic nasalization

An instance of synchronic nasalization of the rhotic segment occurs in /mr/ clusters, as discussed in this section and in section 6.1.4. Note that two examples of this type of rhotic nasalization are listed in the historical grammar (Wagner 1941, 236) as typical for Campidanese, as reported in (61) below. The rhotic in the coda position of the first syllable of the etymon first undergoes metathesis in Campidanese, creating an /mr/ onset word-initially; the rhotic then assimilates with the preceding bilabial stop in nasality, yielding word-initial [mn] clusters:

(61) | Etymon | Sardinian elsewhere | Campidanese |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>It. ma[r]chese</td>
<td></td>
<td>[mn]a kezu ‘marquis’</td>
</tr>
<tr>
<td>MULGERE ‘mu[r]t̪ere</td>
<td></td>
<td>[mn]uyere ‘to milk’</td>
</tr>
</tbody>
</table>

Interestingly, Wagner 1941, 236 reports also the reverse process, at least in the following item:

(62) | Etymon | Reconstructed change | Campidanese |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sp. mancha *[mn]atʃ'a</td>
<td></td>
<td>[mr]atʃ'a ‘stain’</td>
</tr>
</tbody>
</table>
As the examples in (61) can be considered instances of nasal assimilation, so the example in (62) can be considered an instance of dissimilation where an etymological nasal surfaces as rhotic in the context of the preceding /m/. The rhotic and the nasal interact both in assimilatory and dissimilatory processes not only in this local domain of a complex onset but they appear to interact in the exact same way in the wider domain of the word, as discussed in section 6.2. Both assimilation and dissimilation processes involve similarity and/or a specific relationship between segments: assimilation patterns are a manifestation of what can and cannot be a target given a certain trigger; dissimilation patterns appear to indicate what is the closest substitute for a given segment. Whether this similarity and/or relationship is concrete or abstract is a matter of debate between models of substantive and abstract phonology. When this relationship is lexicalized as in the historical instances shown in sections 6.1.2 and 6.1.3 and manifested context-independently, as in examples discussed in section 6.2.3 below, it can be assumed that this relationship is (has become) abstract. These examples indicate a historical relation between a nasal and /r/. Such a relationship is found synchronically as well. In order to verify the nasalization of the rhotic in the nasal context of word-initial /mr/ clusters reported in Wagner 1941, I perform an acoustic comparison of a Campidanese /mr/ token with a Campidanese /br/ token.

Word-initial /mr/ clusters show two characteristics when examined spectrographically (see Figure 6.1). First, the /mr/ sequence is actually interrupted by a vowel fragment (traditionally referred to as svarabhakti, Whitney 1889), transcribed here as [ə]. A svarabhakti vowel appears within /rC/ clusters in Spanish (Malmberg 1965; Bradley 2004), as well as in /Cr/ clusters in Spanish and French (e.g., Colantoni and Steele 2005). Second, the alleged rhotic after the svarabhakti is actually a short nasal segment, phonetically [n]. Since this is what I am

8In Sanskrit svarabhakti literally means ‘loyal vowel’, i.e. ‘helping vowel’: it is an epenthetic vowel that is usually said to be inserted for ease of pronunciation of complex clusters.

9Colantoni and Steele 2005 show that this vowel fragment is more likely to appear when the two segments constituting the /Cr/ cluster are phonetically similar to one another; whether Sardinian follows this principle when disrupting /Cr/ clusters is an open question for phonetic investigation.
going to demonstrate systematically in 6.1.4, the sonorant segment after the vowel fragment is not transcribed in I(nternational) P(honetic) A(lphabet) under the spectrogram in Figure 6.1, but it is referred to as the \(<r>\) portion.

At first glance, the formant profile of the \(<r>\) portion in the spectrogram in Figure 6.1 is very similar to that of the preceding [m]: the nasal murmur is clear at the lowest frequency, the intensity curve drops, while the formants remain visible even if not as marked as throughout vowels.

A word-initial \(/br/\) cluster, followed by a low central vowel as well, and in a pre-tonic syllable – parallel to the case of the word-initial \(/mr/\) cluster discussed above – also presents a vowel fragment disrupting the bilabial stop-sonorant sequence, as shown in Figure 6.2.

The \(<r>\) following the vowel fragment in the case of the \(/br/\) cluster appears more approximant-like than the one following the vowel fragment in the \(/mr/\) cluster: the formants through the \(<r>\) portion in Figure 6.2 are darker than those in the \(<r>\) portion in Figure 6.1, and the drop in the intensity curve is less dramatic. A mere visual comparison through spectrograms, even though important, is not sufficient to determine the nasal nature of the \(<r>\) portion in the \(/mr/\)
Figure 6.2: The phonetic realization of /br/ in *sa brabei* ‘the sheep’

cluster in contrast to the one in the /br/ cluster. A F(ast)F(ourier)T(ransform) analysis was thus performed in order to compare the sine wave components of the sonorant segments within the complex onsets. The FFT spectra for the sonorant portion of the /mr/ and /br/ cluster are depicted in cell a. and b. in Figure 6.3 respectively. The ≪r≫ in the /mr/ cluster presents an antiformant – a pronounced spectral valley corresponding to subtracted energy, indicated by an arrow in Fig. 6.3. a – which is a trademark of nasality. The FFT spectrum of the ≪r≫ in the /br/ cluster, on the other hand, does not (Fig. 6.3.b). Furthermore, the FFT spectrum for ≪r≫ in /mr/ (Fig. 6.3.a) strongly resembles the FFT spectrum for [m] in /mr/ (Fig. 6.3.c), whereas the FFT spectrum for ≪r≫ in /br/ (Fig. 6.3.b) does not. The ≪r≫ portion of /mr/ thus appears to be a nasal segment in contrast to the ≪r≫ portion of /br/.

Further information can be gathered through a comparison of the FFT spectrum of ≪r≫ in /mr/ (Fig. 6.3.a) and that of [m] in the same cluster (Fig. 6.3.c). The first antiformant for the sonorant portion in the /mr/ cluster appears around 1900~2000 Hz, which is closer to the first antiformant of [n] than to that of [m]. The frequency at which the first antiformant appears in the spectrum depends on the length of the mouth cavity (Johnson 1997; Stevens 1998). The
shorter oral cavity attained through closure at the alveolar ridge produces the first antiformant at frequencies usually between 1600 and 1900 Hz for an adult speaker (Stevens 1998, 499). Through closure of the lips, the oral resonator is at its maximal length and the first antiformant is found at lower frequencies, usually between 1000 and 1200 Hz for an adult speaker (Stevens 1998, 494). The FFT spectrum for the middle portion of [m] in the /mr/ cluster (Fig. 6.3.c) shows the first antiformant – indicated by a short arrow – at circa 1575 Hz, crucially at a lower frequency than the first antiformant for the [n] portion of the same /mr/ cluster (Fig. 6.3.a) which appears at circa 2000 Hz.

In sum, the comparison of spectrograms and FFT spectra of one token of an /mr/ cluster with one token of a /br/ cluster reveals that the \textless{}r\textgreater{} portion of /mr/ is a nasal, while the \textless{}r\textgreater{} portion of the /br/ cluster is not; in the latter context, the \textless{}r\textgreater{} rather resembles a short approximant. It thus seems that what spreads onto the \textless{}r\textgreater{} portion of the complex /mr/ onset is nasality, void of any place of articulation features (i.e., it is not a copy of [m] as pointed out in
the discussion of the spectra in Figure 6.3). Phonologically, this might be interpreted as /n/ and /r/, belonging to the same class, i.e., sonorants, differing only as far as nasality is concerned, and thus reinforcing the claim made at the beginning of section 6.1 for the relationship between these two sounds. A systematic acoustic analysis of the <r> portion in /mr/ and /br/ clusters in Campidanese is presented in the next section. The outcome of the phonetic analysis and the statistical assessment thereof substantiate the [n] profile of the <r> portion in /mr/ clusters. The results also demonstrate that the only significant difference between <r> in /br/ and /mr/ clusters respectively is nasality (i.e., [r] and [n]).

6.1.4 Systematic analysis of /mr/ and /br/ clusters

An acoustic analysis of the sonorant portion of /mr/ clusters and /br/ clusters was performed in Praat (Boersma and Weenink 2006, version 4.4.13 for MacOSX) and is motivated as follows. First, the nasality of the sonorant portion of the /mr/ clusters as disclosed by the FFT spectrum analysis in Figure 6.3 needed to be confirmed with a larger pool of data. Second, a systematic comparison of the sonorant portion of /mr/ and /br/ clusters should help determine whether the sonorants in the two clusters differ along any other relevant dimension in addition to nasality.

6.1.4.1 Data and methods

This section presents the result of a comparison of /mr/ and /br/ clusters for four speakers of Campidanese, two women and two men. The recordings were made by the author with a portable SONY DAT recorder at 44.1 kHz and a head-mounted unidirectional noise-cancelling microphone (Sennheiser PC140) in quiet rooms. The speakers were asked to perform a translation task. The acoustic files were then downsampled to 22.05 kHz and normalized for noise threshold.

The samples are small: twenty-two tokens of the /mr/ cluster and seventeen tokens of the /br/ cluster. The /mr/ tokens were all taken from instances of the word *mragiai* /mraˈʒai/ ‘fox’, while the /br/ tokens were all taken from instances of the word *brabei* /braˈbei/ ‘sheep’. 
The homogeneity of the samples was ensured by controlling for the following parameters: (i) position of cluster within the word (word-initial), (ii) position of cluster with respect to stress (pretonic), and (iii) quality of the vowel following the cluster ([a]). All tokens presented a svarabhakti vowel disrupting the complex onset. The variable Speaker, however, was not controlled for because it is assumed as not relevant.

One could object that the choice of extracting the /mr/ tokens for the present study from the word [mra’zai] ‘fox’ is not appropriate, since this item has an etymological word-internal alveolar nasal: MARIANE (Virdis 1978, 68). However, the nasalization of the ≪r≫ portion in /mr/ is independent of this etymological post-tonic N, as it also systematically occurs in instances of [‘mratsu] ‘March’ where no word-internal etymological or underlying alveolar nasal exists. Compare the spectrogram for [‘mratsu] ‘March’ in (63a) below with the one for [mra’zai] ‘fox’ in Figure 6.1. Note that the vowel disrupting the /mr/ cluster is not a fragment: it is long (approximately 0.05 sec, in contrast with the 0.01 - 0.02 sec of a svarabhakti) and it is a copy of the following nuclear vowel, as one can infer by comparing its formant trajectories with the ones of the following nuclear vowel. It is furthermore nasalized, as is the first portion of the following nuclear vowel. Some tokens of /mr/ from [mra’zai] present a similar profile. The length of the disrupting vowel is variable across Cr tokens for all the speakers I recorded.

(63) a. m a <r> a ts u /ringunder

b. m a ˜ a /tildeunder ts u

Some tokens of /mr/ clusters from both [mra’zai] ‘fox’ and [‘mratsu] ‘March’ (three and three respectively; five out of six in the case of the same male speaker) were not included in the calculation of average and standard deviations as they do not show either a disrupting vowel.

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10In the dialects spoken in the eastern area called Ogliastra, for instance, the same word presents no metathesis of the rhotic and no nasal loss: [mar’zani] ‘fox’.
fragment or the \(<r>\) portion – (63b). Observe that the intensity curve after the word-initial bilabial stop rises in a peak within the nuclear vowel and there is no sudden short drop in intensity, \(<r>\), to be seen. Those tokens are nevertheless interesting since they display a long nuclear vowel whose first portion is strongly nasalized.

6.1.4.2 Acoustic parameters and methods

The acoustic parameters selected for the study are listed in (64) below.

(64)  
\( \begin{align*}
\text{a. Intensity} \\
\text{b. F1} \\
\text{c. Bandwidth of F1}
\end{align*} \)

The question about the significance of the dimension of manner of articulation (i.e., is the \(<r>\) portion in /mr/ and /br/ clusters a sonorant?) led to the selection of intensity as measure, while the question relative to nasalization of the \(<r>\) portion or lack thereof suggested the selection of F1 and F1 BW. I review the parameters in the following paragraphs and elucidate the measuring methods adopted for each of them.

**Intensity**, (64a), is “a plausible correlate of sonority that functions linguistically”, and “it patterns by manner of articulation” (Lavoie 2001, 164). It is thus relevant for purposes of the present comparison. The hypothesis formulated by Lavoie 2001 about intensity being the significant acoustic correlate of sonority is backed up by the acoustic and aerodynamic studies carried out by Parker 2002. The phonetic-based sonority hierarchy that Parker 2002,

---

11 Although differences in duration have been demonstrated to signal a contrast between a stop and an approximant (Zakia 1992) and between voiced fricatives and approximants (Romero 1996), this acoustic parameter is not taken into consideration in this study, although measured. The reason for this methodological choice is that, despite the studies cited above, patterns with respect to the length dimension are not consistent when measuring segments across manners of articulation.

12 The five parameters studied are correlated with typical phonological sonority scales in the following order (from strongest to weakest): intensity, intraoral airpressure, F1 frequency, total airflow, and duration” (Parker 2002, 197). Through statistical assessment, “we have established that sonority is best characterized as a function of intensity.” (Parker 2002, 217).
236 derives from the results of his phonetic measurements and their statistical evaluation is consistent with the sonority hierarchy assumed by most phonologists and discussed thoroughly in Lavoie 2001. Within the \( \prec r \succ \) portion of the /mr/ and /br/ clusters under scrutiny, the intensity curve shows a valley and its value was measured at the lowest point of this slope. The intensity values were normalized through the ratio with the intensity value of the following nuclear vowel (consistently [a], as outlined above). The intensity for the nuclear vowel was measured at the peak of the intensity curve within the nuclear vowel window. The crucial question relative to this parameter is the same as for the duration dimension: is the intensity of the two \( \prec r \succ \) portions similarly close to the intensity of the following nuclear vowel, thus indicating their approximant-like profile, or not?

The value of the first formant (\( F_1 \)), (64b), is usually low for nasal segments (Johnson 1997, 151), thus making this acoustic parameter relevant in the study of the phonetics of the \( \prec r \succ \) portion. As far as \( F_1 \) is concerned, is there any statistically significant difference between the \( \prec r \succ \) portion of /mr/ and /br/ clusters? From the comparison of spectrograms and FFT spectra reported in the preceding section, the \( \prec r \succ \) portion in /mr/ is expected to show a lower \( F_1 \) average value than the \( \prec r \succ \) portion in /br/. The value for \( F_1 \) was automatically extracted by Praat when the cursor was positioned within the \( \prec r \succ \) window at the lowest point of the intensity curve. The \( F_1 \) value of \( \prec r \succ \) was normalized through the ratio with the \( F_1 \) value of the following nuclear vowel ([a]), automatically calculated at the peak of the intensity curve within this segment.

A larger bandwidth of \( F_1 \), (64c), is also an acoustic correlate of nasality as it instantiates the resonance damping characteristic of nasal sounds, as discussed in section 5.2. The table in (65) below summarizes the values of the first formant bandwidth for oral vowels (a), glides and liquids (b), and nasal vowels (c) as reported in Stevens 1998 (specific page references are given at the bottom of (65)). The degree of resonance damping for each of the segments in (65) is directly proportional to the \( F_1 \) bandwidth value and it is a function of an open vocal tract in the case of oral vowels (a), of a narrow vocal tract in the case of approximants (b), and of nasal
coupling in the case of nasal vowels (c). The F1 BW values for oral vowels range from 39 to 73 Hz. According to Stevens 1998, approximants show values 60–80 Hz higher than oral vowels, and nasal vowels 100–200 Hz higher than oral vowels; the corresponding ranges are given in the third row of (65).

(65) a. F1 BW Oral Vs ≻ b. F1 BW Approximants ≻ c. F1 BW Nasal Vs

39–73 Hz + 60–80 Hz + 100–200 Hz

(119–159 Hz) (239–273 Hz)

(Stevens 1998, 259) (p. 534) (pp. 193, 310)

In the case of a nasal stop, “the bandwidth of [F1] is expected to be somewhat greater than the F1 bandwidth for a high vowel [80 Hz, (Stevens 1998, 264)] because of additional losses at the walls of the nasal passage, and is estimated to be about 100 Hz” (Stevens 1998, 489). Thus, a nasal stop would fall between oral vowels and approximants within the scale in (65) as far as its average F1 bandwidth value is concerned. Reference to F1 bandwidth on a scale such as the one in (65) may enable one to detect which type of segment the portion in /mr/ clusters is. If intensity confirms its approximant-like profile, we would not expect its average F1 bandwidth to fall in the range of F1 BW values characteristic of a nasal stop. In deductive terms, a nasalized approximant is expected to show F1 bandwidth values around those of nasal vowels, if we assume the average F1 BW value of a nasal consonant to be added to the F1 BW range of 119–159 Hz for approximants, when an approximant undergoes nasalization in the context of a nasal stop. It is not odd to expect the F1 bandwidth values for nasalized approximants to be on the pole of nasal vowels. The scale in (65) may be implemented as in (66). Note that these scales are not proposed by Stevens, but they are derived from his measurements and assumed here as a reference.

---

13 “Average values of the bandwidths of the first three formants for several vowel configurations were 54, 65, and 70 Hz, respectively, with the first formant bandwidth varying from 39 to 73 Hz for different vowels” (Stevens 1998, 259).

14 Whether this rather simplistic model is correct or not is a topic for empirical research.
If ≪r≫ in /mr/ clusters (nasal context) is a nasalized approximant, we expect its F1 BW value to be higher than the F1 BW value for ≪r≫ in /br/ clusters (oral context). As far as the sample for the present study is concerned, the F1 bandwidth was automatically calculated by Praat in the middle of the selected time window for the ≪r≫ portion.

To sum up, the following table is a reference for interpretation of the results that follow.

<table>
<thead>
<tr>
<th></th>
<th>approx stop</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>higher</td>
<td>lower</td>
</tr>
<tr>
<td>F1</td>
<td>higher</td>
<td>lower</td>
</tr>
<tr>
<td>F1 BW</td>
<td>lower</td>
<td>higher (reference scale in (66))</td>
</tr>
</tbody>
</table>

### 6.1.4.3 Results and discussion

The results of the acoustic analysis performed on the homogeneous /mr/ and /br/ samples in terms of descriptive statistics (average value and standard deviation) are reported in the table in (68) and depicted in Figure 6.4. The intensity and F1 values of ≪r≫ are not absolute but relative to the intensity and F1 values of the following nuclear vowel (V<sub>nu</sub>). This normalization allows a comparison of the obtained intensity and F1 values across tokens and across contexts. It also allows for a comparison with the intensity and F1 values of a vowel which enables a straightforward interpretation of the intensity and F1 values for the ≪r≫ portion: the closer the intensity value to the vocalic one, the more approximant-like the ≪r≫; the closer the F1 value to the vocalic one, the less likely the ≪r≫ to be nasalized.

<table>
<thead>
<tr>
<th></th>
<th>≪r≫ portion in /mr/ (22 tokes)</th>
<th>≪r≫ portion in /br/ (17 tokens)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>average (standard deviation)</td>
<td>average (standard deviation)</td>
</tr>
<tr>
<td>Intensity (&lt;≪r≫/V&lt;sub&gt;nu&lt;/sub&gt;)</td>
<td>0.97 (0.01)</td>
<td>0.96 (0.02)</td>
</tr>
<tr>
<td>F1 (&lt;≪r≫/V&lt;sub&gt;nu&lt;/sub&gt;)</td>
<td>0.72 (0.11)</td>
<td>0.78 (0.07)</td>
</tr>
<tr>
<td>F1 BW (Hz)</td>
<td>304.44 (154.21)</td>
<td>169.36 (51.68)</td>
</tr>
</tbody>
</table>
In each chart in Figure 6.4, the left-hand pair of histograms refers to the \(<r>\) portion in the /mr/ clusters, while the right-hand pair of histograms refers to the \(<r>\) portion in /br/ clusters.\(^{15}\) The average is depicted in light grey while the standard deviation is in dark grey. The standard deviation values are minimal in the case of intensity and F1, or contained within the reasonable threshold of half of the average value in the case of the F1BW.

The statistical significance of the average values for \(<r>\) in /mr/ and /br/ clusters in table (68) were assessed through univariate analyses of variance (UNIANOVA). Intensity, F1 and F1BW values were in turn evaluated in dependency with the Context factor (nasal: /mr/ vs. oral: /br/).

First, the \(<r>\) portions in /mr/ and /br/ clusters do not show significant differences (F(1,36) = 1.922, p=.174) as far as the intensity values are concerned. In both cases, the average intensity

\(^{15}\)In the charts, the \(<r>\) portion of /mr/ clusters was labelled \(n\) in order to distinguish it from the \(<r>\) portion of /br/ clusters (labeled as \(r\)).
value for \(<r>\) is very close (over 95%) to the average intensity value of the following nuclear vowel (consistently [a]). The \(<r>\) portion thus appears to be equally markedly sonorous both in the nasal and oral context.

Second, the \(<r>\) portion in /mr/ clusters has a marginally (F(1,36)=3.730, p=.061) lower F1 value than in the /br/ clusters. Recall that the values were normalized through the ratio with the F1 value of the following nuclear vowel.\(^{16}\) A lower F1 is consistent with nasalization having occurred (recall the synopsis in (64)).

Third, the \(<r>\) portion in /mr/ clusters shows a highly significant (F(1,36)=11.906, p=.001) wider F1BW than in the /br/ clusters. As the pair of histograms in the bottom right in Figure 6.4 indicates, the average value of the F1 bandwidth for the \(<r>\) portion in the /mr/ clusters is almost twice the value of the F1 bandwidth for the \(<r>\) portion in the /br/ clusters. A larger bandwidth is a robust acoustic correlate of nasality, as shown in the F1 bandwidth comparative table in (65) above. The \(<r>\) portion in /mr/ can fairly be interpreted to be a nasal variant of the \(<r>\) portion in /br/. The latter also appears to be an approximant in terms of F1 bandwidth, as its average value is higher than the F1 BW range for oral vowels and it fits within the reference range provided by Stevens 1998, 534.\(^{17}\) The \(<r>\) portion in /mr/ clusters thus is

\(^{16}\)The F1 value for nasal consonants is in the range between 300 to 900 Hz “depending on the vowel configuration and the gender of the speaker” (Stevens 1998, 489). Since the following vowel is low, and thus shows a high F1 value (vowel height is inversely correlated with F1 frequency), the F1 value for the nasal consonant is expected to be in the upper half of the range indicated by Stevens. However, for this parameter to be informative in any way as far as the present data are concerned, the measurements of F1 for the \(<r>\) portions should have been compared, for instance, to F1 average values for nasal stops in the same vocalic context. I reserve a more detailed acoustic analysis for future research.

\(^{17}\)The variation for the bandwidth value is greater than the variation found along the other three acoustic dimensions, as the standard deviation values point out. Variability in F1 bandwidth value is not surprising as the glottal configuration can also contribute to energy damping (Stevens 1998, 259-60): “Average values of the bandwidths of the first three formants for several vowel configurations were 54, 65, and 70 Hz, respectively, with the first formant bandwidth varying from 39 to 73 Hz for different vowels. […] It is not unusual for the bandwidth at low frequencies to be two to three times the value given [above] if the glottal configuration for the speaker is such that
definitely nasalized, in contrast with the same portion in /br/ clusters. Specifically, with an average value of 304 Hz for the F1BW, the ≪r≫ portion of the /mr/ cluster places itself on the pole of nasalized approximants along the F1BW reference scale given in (65) and (66). The F1BW average value for the ≪r≫ portion of /br/ clusters, 169 Hz, on the other hand, falls close to the range of F1BW for approximants.

To sum up, with respect to the acoustic parameter relative to manner of articulation, i.e., intensity, the ≪r≫ portion of both /mr/ and /br/ clusters appears to be a sonorant: its intensity is very close to the intensity of the following nuclear vowel. With respect to the acoustic parameters relative to nasality, i.e. F1 and F1BW, and, in particular, to the latter one, the ≪r≫ portion of /mr/ clusters appears to be nasalized. The acoustic study of /mr/ and /br/ clusters reported in this section has shown (i) that the ≪r≫ portion in these two clusters are both phonetically approximants, given their vowel-like intensity, and (ii) that the approximant in /mr/ clusters appears to be the nasal correspondent of the approximant in /br/ clusters. Thus, not only vowels but also the rhotic segment is a target of synchronic nasal assimilation in Campidanese.

In the next section I return to phonological patterning and focus on the relationship between the rhotic and the alveolar nasal. A wealth of patterns of assimilation, dissimilation and substitution between the two segments are reported in the literature on the language. I interpret these patterns as further evidence of the tight relationship between the rhotic and the alveolar nasal in Campidanese Sardinian.

6.2 Rhotic-nasal assimilation, dissimilation and substitution

Patterns of assimilation, dissimilation and metathesis between nasals and liquids and among liquids themselves is a property of the entire Sardinian territory, as well as of the Italian (Rohlfs 1966; Tekavčić 1972) and Romance (Posner 1961) linguistic domains in general, as summa-
rized in chapter 2. A few examples are provided below.\textsuperscript{18}

Dissimilation of the alveolar nasal and substitution through the rhotic in a nasal (i.e., dissimilating) context takes place in Romance, for instance, in [mn] clusters arising from the syncope of an unstressed vowel (mid column in (69)). In those cases, as is often the case in sonorant clusters, a transitional voiced stop, homorganic in place to the preceding nasal, is inserted (righthand column in (69); Jensen 1999, 295-6).

\begin{align*}
\text{(69)} &
\begin{array}{llll}
\text{HOM(1)NE} & \rightarrow & *\text{homre} & \rightarrow \text{Sp. hombre} \quad \text{‘man’} \\
\text{FEM(1)NA} & \rightarrow & *\text{femra} & \rightarrow \text{Sp. hembra, Cat. fembra} \quad \text{‘woman’} \\
\text{SEM(1)NARE} & \rightarrow & *\text{semrare} & \rightarrow \text{Sp., Cat. sembrar} \quad \text{‘to seed’}
\end{array}
\end{align*}

In Romance there also exist examples of the rhotic being substituted by the alveolar nasal in rhotic (i.e., dissimilating) contexts:

\begin{align*}
\text{(70)} &
\begin{array}{llll}
\text{reto\underline{n}ica} & \text{for reto\underline{r}ica} & \text{‘rhetoric’} & \text{Andalusian} \\
\text{suspi\underline{n}are} & \text{for suspi\underline{r}are} & \text{‘to sigh’} & \text{Romanian}
\end{array}
\end{align*}

Finally, metathesis between liquids and between the alveolar nasal and the rhotic is also part of the array of context-dependent alternation among sonorants in Romance. The following examples are collected from different varieties of Sardinian. (71a) presents instances of

\begin{align*}
\text{(71a)} &
\begin{array}{ll}
\text{reto\underline{n}ica} & \text{for reto\underline{r}ica} \quad \text{‘rhetoric’} \\
\text{suspi\underline{n}are} & \text{for suspi\underline{r}are} \quad \text{‘to sigh’}
\end{array}
\end{align*}

\textsuperscript{18}In Romance, the alveolar nasal is generally substituted by the rhotic and the lateral in dissimilation processes. The lateral “is the most usual substitute for dissimilated [n] in all positions in the French dialects, in Spanish and Portuguese, Rhetian and most of the Italian dialects” (Posner 1961, 161) – two examples are given in (69). The lateral/nasal alternation are predicted within a phonetic model, such as the one developed by Ohala 1975[296]: “[n] and [l] alternate. This would follow from their very similar perceptual cues; both have transitions next to vowels which involve sudden spectral and amplitude discontinuities, both maintain voicing and pitch unperturbed, and both have spectra containing anti-resonances.” In those areas of the Romania (the Romance linguistic domain) in which etymological l is replaced by the rhotic in intervocalic position, the substitute for the dissimilated [n] is the rhotic rather than the lateral (Posner 1961, 161). Those areas are Rumania, Piedmont, and the Franco-Provençal speaking regions. Sardinian is one of the Romance languages in which the contrast between the rhotic and the lateral is neutralized in all word-internal positions (onset and coda). Linguistic areas in which the dissimilation output for the alveolar nasal can be either the rhotic or the lateral are Catalunya and areas in North Italy (cf. Lombard in (69b)) (Posner 1961, 163).
metathesis between the rhotic and the lateral, i.e., between the segments belonging to the class of liquids. The data in (71b), on the other hand, illustrate that metathesis also occurs between the rhotic and the nasal homorganic in place of articulation.

\[(71)\]
\[
a. \begin{array}{c}
\text{rōtu} \sim \text{lōDu} \\
\text{mu} \sim \text{mu}l
\end{array}
\begin{array}{c}
\text{‘to roll’} \\
\text{‘molar’}
\end{array}
\]
\[
b. \begin{array}{c}
\text{ne} \sim \text{re} \\
\text{nu} \sim \text{nu}
\end{array}
\begin{array}{c}
\text{‘kidneys’} \\
\text{Pre-Roman tower-like building typical of Sardinia}
\end{array}
\]

Dissimilation can be described as a process of substitution of a segment \(x\) with a segment \(y\) in a context which already contains an instance of \(y\). Metathesis is the process of segments \(x\) and \(y\) switching their positions within a lexical item. In both cases, the relationship between \(x\) and \(y\) is described in terms of phonetic similarity or phonological classhood, depending on the explanatory model adopted.\(^{19,20}\) The fact that the rhotic and the homorganic in place nasal not only alternate in assimilatory and dissimilatory contexts but also substitute for one another in non-assimilatory and dissimilatory contexts is interpreted here as evidence for a phonological analysis, more specifically, for the phonologization in the Campidanese system of a pattern that was originally informed phonetically and/or perceptually.\(^{21}\)

Campidanese Sardinian shows a wealth of examples of assimilation and dissimilation between the alveolar rhotic and nasal and I review them in 6.2.1 and 6.2.2 respectively. The substitution patterns between the alveolar nasal and the rhotic that are not conditioned by dissimilating context are discussed in 6.2.3. This is a striking characteristic of Campidanese and one that strengthens the evidence for the tight relationship between rhotic and nasals in this dialect, in contrast with Nuorese.

\(^{19}\)Recall from section 6.1.3 that similarity is often called upon as the explanation for assimilation processes as well.

\(^{20}\)For a review of the notion of similarity in phonological theory and its evaluation within grammars, see Mackenzie 2009.

\(^{21}\)“[...] what begins as an intrinsic byproduct of something, predicted by universal phonetic principles, ends up unpredictable, and hence, extrinsic” (Hyman 1976, 408).
6.2.1 Assimilation patterns

As presented in (72), Latin RN clusters developed as [rr] across all dialects of Sardinian. According to Rohlfs 1966, 340, this assimilation is characteristic of both Sardinian and South Corsican. It is also found sporadically in Southern Italian dialects.

\[(72)\]

| FORNU(M) | ‘forːu’  | ‘oven’ |
| CORNU(M) | ‘korːu’  | ‘horn’ |
| HIBERNU(M) | ‘jerːu’  | ‘winter’ |
| TORNARE | tɔ:rːai | ‘to come back; turn’ |
| SATURNU(M) | saðɔrːu | ‘Saturn’ |

The historical assimilation patterns for the rhotic and the alveolar nasal presented in (72), i.e., the alveolar nasal assimilating to the rhotic, conflict with the synchronic process of rhotic nasalization discussed in 6.1.2 and 6.1.3 which show /r/ becoming [n] in nasal contexts and eventually /n/ due to phonologization. So, what happens in heterosyllabic /rn/ clusters in the synchronic phonology of Campidanese?

Later borrowings into Campidanese from Spanish, Italian and Catalan do not show the historical assimilation pattern RN to [rː]. In these cases, the /rn/ sequence is either maintained or disrupted by an epenthetic vowel (Virdis 1978, 60).\(^\text{22}\)

\[(73)\]

| Sp. fornera | fornɛra | ‘kiln’ |
| It. giornata | dʒɔ:rːnaða | ‘day’ |
| Cat. carnici | karʼnɪts̥eri | ‘butcher’ |

The lack of assimilation of the nasal with the rhotic in later loans into Campidanese and the rhotic nasalization facts discussed in the previous sections seem to indicate that the correct underlying representation for a word like Campidanese ['forːu] is /forru/ rather than the etymologically faithful /fornu/. This amounts to an argument that there is no synchronic assimilation

\(^{22}\) A comparison of the Catalan item in (73) with the Campidanese instance of etymological TORNARE in (72) above suggests that position of stress is not significant in the rise of the two different patterns (assimilation in (72) and lack thereof in (73)). The literature does not report any other later loan for which a direct comparison in terms of prosodic structure can be drawn, however.
of /n/ to [r] in Campidanese; on the contrary, it has been demonstrated in 6.1.2 and 6.1.3 that there is a synchronic pattern of assimilation of /r/ to [n] in the language.

The data in (74) below are further evidence for the assimilation of /r/ to [n] (and its further phonologization to /n/) in the context of another nasal segment in Campidanese:

(74)  

<table>
<thead>
<tr>
<th>Etymon</th>
<th>Campidanese</th>
<th>Sardinian elsewhere</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sp. meרecer</td>
<td>meרֶפֶּא, miרֶפֶּא</td>
<td>meרֶפֶּא</td>
</tr>
<tr>
<td>AMARICOSUS</td>
<td>maרֶפֶּא, יָזוּשֶּא</td>
<td>maרֶפֶּא יָזוּשֶּא</td>
</tr>
<tr>
<td>Sp.-Cat. maרֶפֶּא</td>
<td>maרֶפֶּא בֹּזֶא</td>
<td>maרֶפֶּא בֹּזֶא</td>
</tr>
<tr>
<td>kuרֶפֶּא</td>
<td>kuרֶפֶּא</td>
<td>‘cucumber’</td>
</tr>
<tr>
<td>‘p לטֶא</td>
<td>‘p לטֶא</td>
<td>‘hamper’</td>
</tr>
</tbody>
</table>

Word-internal heterosyllabic /nr/ clusters are a systematic gap in most Romance languages (Bourciez 1967; Jensen 1999), including Sardinian. However, instances of this cluster can be found across morphemes, i.e., in the phrasal phonology. We shall see in chapter 7 that in this environment, /n/ undergoes total assimilation to a following morpheme-initial /r, l, s, f/ in Nuorese. In Campidanese, on the other hand, a morpheme-final /n/ does not assimilate to the following /l, s, f/ but rather remains. As far as a following morpheme-initial /r/ is concerned (the data relevant for this section), Campidanese shows a systematic distributional gap: no morpheme begins with /r/ in this dialect, in contrast to Nuorese. No heterosyllabic /nr/ across morphemes can be found in Campidanese.

The synchronic assimilation patterns for Campidanese are summarized in the following table. Assimilation data in Campidanese point to an asymmetry between /r/ and /n/, with /r/ undergoing assimilation to /n/ but not vice versa.

---

23The distribution of /r/ in Campidanese is discussed in chapter 7.
(75) **Campidanese**


<table>
<thead>
<tr>
<th>context</th>
<th>process</th>
</tr>
</thead>
<tbody>
<tr>
<td>heterosyllabic /rn/ clusters</td>
<td>no assimilation</td>
</tr>
<tr>
<td>heterosyllabic /nr/ clusters</td>
<td>N/A</td>
</tr>
<tr>
<td>/r/ in nasal contexts</td>
<td>nasalization</td>
</tr>
<tr>
<td>/n/ in rhotic contexts</td>
<td>no assimilation</td>
</tr>
</tbody>
</table>

### 6.2.2 Dissimilation patterns

The rhotic and the nasal segments further participate in dissimilative alternations with one another in Campidanese. Dissimilation processes are usually referred to as diagnostics of phonological classhood, since “[d]issimilation is defined as the loss or change of one or more features, including whole segments, when the same feature is distinctive at another site within a word” (Ohala 1993, 249).  

Typical of Campidanese is the dissimilation of the alveolar nasal to the rhotic in the final unstressed syllable of proparoxytones (i.e., stress on the third to last syllable) when a nasal stop precedes within the word, as a comparison with the Logudorese variety in (76a) shows (Wagner 1941, 132).  

This dissimilation pattern, however, is not confined to this specific prosodic position, as (76b) illustrates. Notice also that an alveolar nasal in the last syllable of a word bearing stress on the third-to-last syllable may dissimilate to a rhotic also in the absence of a preceding lexical nasal stop, as given in (76c). This last example is a case of context-free substitution rather than dissimilation and will be discussed in detail in 6.2.3. Whether cases such as (76c) arise because of analogy to the items in (76a), given the prosodic isomorphism,

---

24 The classical example of dissimilation involves the rhotic and the lateral in Latin morphophonemics (e.g., Kenstowicz 1997; Walsh-Dickey 1997), pointing to the phonological class of liquid. For a discussion of the relavance of the rhotic-nasal dissimilation patterns from the point of view of the phonetic model of sound change see Ohala 1981; Ohala 1993; Ohala 2003.

25 An unstressed alveolar nasal may also dissimilate to the lateral, which in Campidanese undergoes further changes to, under most circumstances, a bilabial voiced fricative or approximant (Virdis 1978, 55-8): e.g., Logudorese [ˈrundeːse] vs. Campidanese [arˈrundɪʃi], (Wagner 1941, 132).
is not relevant here: the meaningful pattern is that [r] substitutes for /n/ both in dissimilating and non-dissimilating contexts in Campidanese.

\[(76)\]

a. **Sardinian elsewhere**  
Campidanese

\[\text{'le[n]di[n]c} \sim \text{'li[n]di[r]} \quad \text{‘nit’}\]
\[\text{'gra[n]di[n]c} \sim \text{'la[n]di[r]} \quad \text{‘hail’}\]

b. **Sardinian elsewhere**  
Campidanese

\[\text{tu[n]h}a \sim \text{tu[r]h}a \quad \text{‘tuna’}\]
\[\text{ka[n]h}a \sim \text{ka[r]h}a \quad \text{‘gilthead seabream’}\]

c. **Sardinian elsewhere**  
Campidanese

\[\text{'peti[n]c} \sim \text{'peti[r]} \quad \text{‘comb’}\]

A few other examples of dissimilation of /n/ to /r/ in nasal contexts in Campidanese are found in the on-line Sardinian lexicon [www.ditzionariu.org](http://www.ditzionariu.org): the dissimilating and non-dissimilating items in (77) seem to be in free alternation in the dialect.

\[(77)\]

\[\text{a’nanti} \sim \text{a’ranti} \quad \text{‘ahead, in front of’}\]
\[\text{panne’nanti} \sim \text{pane’ranti} \quad \text{‘apron’}\]
\[\text{ani’maBi} \sim \text{ari’mai} \quad \text{‘animal’}\]

Not only does the rhotic substitute for the nasal in dissimilation contexts, but also the nasal substitutes for the rhotic in those contexts (Wagner 1941, 131), as shown in (78).\(^{26}\)

\[(78)\]  
**Sardinian elsewhere**  
Campidanese

\[\text{‘pruy[e]r}, \text{‘prue[e]} \quad \text{‘prui[n], prui[j], prui[n]} \quad \text{‘dust’}\]
\[\text{pa[r]tordza} \quad \text{pa[n]tordja} \quad \text{‘woman in labour’}\]
\[\text{ao[r]tire} \quad \text{a[n]tiri} \quad \text{‘to have a miscarriage (of animals)’}\]
\[\text{a[r]tsjare} \quad \text{a[n]tsjai} \quad \text{‘to lift’}\]

### 6.2.3 Context-free substitution

Furthermore, in Campidanese, substitution of the alveolar nasal for the rhotic is also found in non-dissimilating contexts – (79a) and (80). The context-free substitution of the rhotic for the

\(^{26}\)As it will be discussed in 7.2.1, the rhotic is not allowed in coda position in Campidanese. Dissimilation of /r/ to [n] in this position functions as a repair in this case.
alveolar nasal seems to be less frequent, yet it is attested, as in (76c), repeated here in (79b).

(79)  a. Etymon  Campidanese  Sardinian elsewhere
      CA\[
\begin{array}{l}
\text{CAR} \\
\text{ka} \\
\text{ka}
\end{array}
\] ya  \text{ka ya}  \text{‘dried fig’}

b.  Campidanese  Sardinian elsewhere
      \text{pet\text{\textsuperscript{\textit{\textsc{i}}}}}  \text{pet\text{\textsuperscript{\textit{\textsc{e}}}}}  \text{‘comb’}

Interestingly, most of the examples of the alveolar nasal substituting for the rhotic in non-dissimilating contexts document that the process takes place in coda position, as shown in (80).\(^{27}\)

(80)  Campidanese  Sardinian elsewhere
      \text{pa\text{\textsuperscript{\textit{\textsc{n}}}}}e\text{\textsuperscript{\textit{\textsc{l}\text{\textsuperscript{\textit{\textsc{u}}}}}}}  \text{pe}\text{\textsuperscript{\textit{\textsc{e}}}}\text{\textsuperscript{\textit{\textsc{l}\text{\textsuperscript{\textit{\textsc{u}}}}}}}  \text{‘shutter’}

\text{\textit{\textsc{a}}}\text{kuza}  \text{\textit{\textsc{a}}}\text{kuza}  \text{kind of recipient for lamp oil}

\text{Campidanese}  \text{Catalan}
      \text{ka\text{\textsuperscript{\textit{\textsc{n}}}}}\text{\textit{\textsc{ofa}}}  \text{ca\text{\textsuperscript{\textit{\textsc{r}}}}}\text{\textit{\textsc{fofa}}}  \text{‘artichoke’}

Due to historical processes of assimilation and metathesis, the rhotic is absent from syllable coda position in Campidanese.\(^ {28}\) Usually heterosyllabic etymological \texttt{R.T} clusters (the majority

\(^{27}\)In Posner’s 1961 reference book for Romance dissimilation patterns I did not find any description or discussion of consonantal substitutions/interchanges in non-dissimilating contexts. Posner, however, mentions substituting a dissimilated rhotic with a nasal in coda position. She argues that this might be the outcome of a two-step process in which the coda rhotic undergoes total dissimilation – i.e., drops in the presence of another rhotic within the word – followed by the epenthesis of a nasal in the same syllabic position, the latter being a frequent phenomenon in Romance languages. “[E]penthesis of \texttt{[n]} before a consonant is extremely common. In this circumstances it is not surprising to find \texttt{[n]} frequently replacing dissimilated \texttt{[l]} or \texttt{[r]}, in implosive [i.e., coda] position: in some of the cases the liquid may even have fallen by dissimilation, and then epenthetic [n] may have been introduced: e.g. Appendix Probi \textit{cunetellu} for \texttt{CULTELLU} (similar forms in Sursilvan, Agone, Catalan)” (Posner 1961, 176). In this section I put forward the hypothesis that the substitution of the rhotic by the nasal in coda position results from phonotactic constrains in Campidanese.

\(^{28}\)The only instances of a rhotic in coda position have a trill intervocally, e.g., \texttt{carru}, \texttt{[caru]}, ‘wagon’. The Campidanese intervocalic trill can be analyzed as ambisyllabic, as its distribution corresponds to the one attested in the languages for which this analysis was first proposed (Banner Inouye 1995). In this case, the rhotic is then systematically absent from syllabic codas in Campidanese Sardinian.
in (80)) were repaired through total regressive assimilation in this dialect (i.e. PORTA becomes [pɔtːa]). The examples in (80) suggest that another repair strategy was available, namely, the realization of the rhotic in coda position as a nasal, a segment that is tolerated in this syllabic position in the language. The absence of a nasal segment in the word makes this substitution process non-dissimilatory, and, the syllabic position in which it occurs, banned to the rhotic but available to the nasal, signals the systematic response to a phonotactic constraint. Therefore, I analyze this substitution pattern as phonological.

### 6.3 Summary

The review conducted in section 6.2 of the interaction between the rhotic and the alveolar nasal reported in the literature on Campidanese points to a tight relationship between these two segments in the phonology of this Sardinian dialect. In contrast to the historical assimilation of etymological RN clusters to rr [r], synchronic patterns show the rhotic assimilating to the nasal in nasal contexts (6.2.1), a process aligned with the phonetic facts brought to light by the acoustic study of rhotic nasalization in /mr/ word-initial clusters presented in 6.1.4. The study also substantiates the historical data on rhotic nasalization reviewed in 6.1. The collection of dissimilation data from the literature on Sardinian (6.2.2) reveals that not only does the alveolar nasal dissimilate to the rhotic in the context of nasals, but also the rhotic dissimilates to the alveolar nasal in the context of rhotics. The interchangability of the alveolar rhotic and nasal in dissimilation indicates the tight relationship between these two segments. The substitution of [n] for /r/ in an array of processes all aiming to fulfill a distributional requirement in the phonology of Campidanese (6.2.3) points not only to this tight relationship between these two segments, but also to its phonological nature.

Recall from chapter 3 the prediction that /n/ and /r/ form a class in Campidanese and thus might be expected to interact with one another. The data discussed in this chapter support this analysis.
The next section proposes a representational analysis of the relationship between alveolar rhotic and nasal in Campidanese.

### 6.4 Representing the rhotic-nasal relationship in Campidanese

In chapter 3, I put forward the hypothesis that the phonemic specification for the segments \{R, S, N\} in Campidanese is as follows.

\[(81) \textit{Campidanese hierarchy: } [SV] \succ [\text{nas}]\]

\[\begin{array}{c}
\emptyset \\
\downarrow \\
S \\
\downarrow \\
R \quad N \\
\end{array}\]

The phonemes R and N are sonorants, and thus contrast with the obstruent S, and, they are kept separate from one another by means of the feature [nasal].

From the contrastive hierarchy proposed for Campidanese it follows that the feature make-up for R and N in this dialect is as depicted in (82). In SV theory [nasal] is coded as a dependent of SV and thus represented as such.

\[(82) \textit{Campidanese} \\
N \quad R \\
\begin{array}{c}
[SV] \\
\downarrow \\
[\text{nasal}] \\
\end{array} \\
\]

The patterns of rhotic nasalization, and those of assimilation, dissimilation and substitution between R and N in Campidanese point to a tight relationship between these two sonorants and the representations in (82) from the hierarchy in (81) model those patterns straightforwardly. The realization of R as a nasal, whether in assimilatory or dissimilatory contexts or neither of the two, can be modeled as the assimilation of the feature [nasal] on to the SV node. The
realization of N as a rhotic, whether in assimilatory or dissimilatory contexts or neither of the two, is attained through the loss of the feature [nasal] under the SV node.

Further evidence for the analysis depicted in (81) is presented in the next chapter where assimilation patterns between Campidanese S, R, and N are examined and contrasted to those found in Nuorese.
Chapter 7

Rhotics and nasals in Nuorese

Chapter 4 brought to light an asymmetry in the phonology of nasals between Campidanese and Nuorese Sardinian through an in-depth study of vowel nasalization in the two dialects. This asymmetry is further substantiated by the phonological patterning of nasals with another sonorant segment, the rhotic. As shown in detail in chapter 6, the rhotic is susceptible to nasalization in Campidanese. Moreover, the alveolar rhotic and nasal participate in assimilation, dissimilation and substitution patterns in this dialect, pointing to the phonological tie between these two segments. In contrast, the Nuorese data presented in this chapter indicate that (i) the rhotic nasalization process is alien to this dialect (7.1.1), (ii) the rhotic and the nasal do not alternate with one another (7.1.2), and (iii) nasals appear phonologically inert in general in this dialect, being targets rather than triggers of assimilation (7.1.3).

The rhotic in Nuorese has a wider distribution (7.2) than that of Campidanese and it alternates synchronically with the alveolar sibilant in coda position, not only in phrasal contexts but also word-internally (7.2.2), while the rhotic in Campidanese fails to show such patterning. In this chapter, I present data from Campidanese and Nuorese side by side whenever possible. In this way, the present chapter offers additional complementary information to that in chapter 6 about the distribution of nasals and rhotics in Campidanese.
7.1 Inactive nasals

Recall from chapter 4 that, in contrast with Campidanese, Nuorese nasal segments appear to trigger phonetic patterns of vowel nasalization, but not phonological ones. The pilot phonetic study of Nuorese vowels in oral and nasal contexts (section 4.2) demonstrated that the nasalization effect is present in the nasal context and that this effect is local and gradient. According to parameters elaborated in laboratory phonology (section 3.3.3), I interpret the locality and gradience of the effect as distinctive of the outputs of phonetic and not phonological processes.

Vowel nasalization in Nuorese, in fact, does not yield prosodically and morphologically-driven alternations between oral and nasalized vowels, neither does it give rise to lexical nasal vowels.

The Nuorese facts concerning vowel nasalization are sharply in contrast with the vowel nasalization facts in Campidanese, where the phenomenon is phonological. Unlike Nuorese, Campidanese presents prosodically and morphologically-driven alternations of oral and nasal vowels with a few lexical items that have lexicalized the nasal vowel alternant. The pilot acoustic study on Campidanese diphthongs (section 5.4) moreover reveals a dynamic nasal profile that seems plausibly accounted for through a phonological analysis (section 5.5). As seen in chapter 6, the phonological nasalization process in Campidanese affects not only vowels and glides (as members of the nasalized diphthongs), but also a less vocalic element on the sonority scale: the rhotic segment.

The data presented in that chapter highlighting the phonological and phonetic relationship between the rhotic and the nasal segment in Campidanese consist of (i) patterns of rhotic nasalization locally and at a distance, synchronically and diachronically; and (ii) patterns of assimilation, dissimilation and context-free substitution between the rhotic and the nasal. In the first half of the present chapter, I show that these processes are alien to Nuorese, providing further evidence for the asymmetry in the phonology of sonorants between the two dialects of Sardinian.
7.1.1 No rhotic nasalization

With respect to the patterns of rhotic nasalization, Nuorese does not have any of those observed in Campidanese.

First, the regressive assimilation of /r/ to [n], and the subsequent phonologization thereof, found in the same environment in which vowel nasalization takes place in Campidanese (for a reminder see (83) below), is not attested in Nuorese.

(83)  

\[ \text{Campidanese} \]

\[
\begin{align*}
& \text{a. (CV)frvn(CV) } \rightarrow \text{ (CV)hnv(CV)} \\
& \text{b. Non-nasalizing varieties} \quad \text{Nasalizing varieties} \\
& \text{befránu} \quad \text{bêhnáũ} \quad \text{spring’ (season)}
\end{align*}
\]

The Nuorese forms of the items which undergo rhotic nasalization in the nasalizing varieties of Campidanese are identical to the forms of the non-nasalizing varieties of Campidanese, as shown in (84).

(84)  

\[ \begin{array}{lll}
\text{Nuorese} & \text{Campidanese} \\
\text{Non-nasalizing} & \text{Nasalizing} \\
\hline
\text{beránu} & \text{beránu} & \text{beñáũ} & \text{‘spring’ (season)} \\
\text{gutturínu} & \text{gutturínu} & \text{uttunũũ} & \text{‘narrow alley’} \\
\text{koróna} & \text{koróna} & \text{konũũ} & \text{‘crown’} \\
\text{piperóne} & \text{It. peperóne} & \text{pišanũũ} & \text{‘sweet bell pepper’} \\
\text{aréna} & \text{aréna} & \text{anũũ} & \text{‘sand’} \\
\text{selénu} & \text{serénu} & \text{sauñeũũ} & \text{‘dew’} \\
\text{belénu} & \text{verénu} & \text{vanẽũũ} & \text{‘poison’} \\
\text{perúnu} & \text{verũu} & \text{beñũũ} & \text{‘nobody/nothing’} \\
\text{granu} & \text{(g)ránu} & \text{náũũ} & \text{‘grain’}
\end{array} \]

Second, Nuorese does not present any underlying or derived bilabial nasal-rhotic clusters (/mr/ or [mr]). In Campidanese, word-initial \( \text{mr} \) clusters are the context for a synchronic process of rhotic nasalization (see 6.1.4). These \( \text{mr} \) clusters are derived by the metathesis of the rhotic which was historically in coda position within the same syllable or in a word-internal syllable. This type of rhotic metathesis does not take place in Nuorese; the rhotic is allowed in coda position in this variety, as we shall see in section 7.1.2 below (consider, for instance, Nuorese [parma] ‘palm’ in contrast with Campidanese [prama]), and, thus, \( \text{mr} \) clusters are not found.
The context for synchronic progressive rhotic nasalization thus is not part of the Nuorese lexicon and phonology.

### 7.1.2 No rhotic/nasal interaction

With respect to patterns of assimilation, dissimilation and context-free substitution, the rhotic and the nasal segment in Nuorese do not interact as they do in Campidanese (section 6.2) since in Nuorese none of the above mentioned processes creates an alternation between the two segments. Nuorese is part of the *Sardinian elsewhere* category in the examples of dissimilation (85a,b) and substitution (85c) between rhotic and nasal in Campidanese, repeated below from section 6.2.

\[(85)\]
\[
a. \quad \textit{Sardinian elsewhere, including Nuorese} & \quad \textit{Campidanese} \\
   \text{‘lendine} & \quad \text{‘lindiri} & \quad \text{‘nit’} \\
   \text{‘grandine} & \quad \text{‘landiri} & \quad \text{‘hail’} \\
\]
\[
b. \quad \textit{Sardinian elsewhere, including Nuorese} & \quad \textit{Campidanese} \\
   \text{tu'nina} & \quad \text{tu'rina} & \quad \text{‘tuna’} \\
   \text{ka'nina} & \quad \text{ka'rina} & \quad \text{‘gilthead seabream’} \\
\]
\[
c. \quad \textit{Sardinian elsewhere, including Nuorese} & \quad \textit{Campidanese} \\
   \text{‘pEt:ine} & \quad \text{‘pEt:iri} & \quad \text{‘comb’} \\
\]

Furthermore, nasal segments in Nuorese are not recorded as participating in processes of dissimilation or substitution with segments other than the rhotic. Thus, for instance, in Nuorese, alternations between \[\text{n}\] and \[\text{l}\] are not found, despite their phonetic naturalness and cross-linguistic robustness.\(^1\)

---

\(^1\)As discussed in chapter 6, an alveolar nasal shows cross-linguistically robust patterns of alternation with an alveolar lateral. In Romance, the lateral is the usual substitute for dissimilated [\text{n}] (Posner 1961, 161). According to a phonetic model of nasal patterns such as the one proposed by Ohala 1975, the alternation of [\text{n}] and [\text{l}] is phonetically natural as they have similar perceptual cues (see chapter 6).
7.1.3 Nasal coda: assimilation target

A further difference between Campidanese and Nuorese as far as nasal segments are concerned exists, this one regarding nasal codas.

In all Sardinian varieties, a nasal in coda position is homorganic in place of articulation with the following onset. In Campidanese, this is the case both when the consonant in onset position is a stop (86) and when it is a fricative (87). In Nuorese, however, while heterosyllabic nasal-stop clusters are homorganic in place (86), a nasal coda is not found before the fricatives /l/ and /s/ (Contini 1987, 138, 140, and Molinu 1998, 101). As shown in (87), where Campidanese has nasal-fricative clusters homorganic in place, Nuorese presents assimilation of the nasal coda to the following fricative onset, yielding a geminate.3

(86) *Nasal-stop heterosyllabic clusters*

a. **Campidanese** | **Nuorese**
---|---
`te[mp]us` | `te[mp]us` 'time'
`ka[n]ai` | `ka[n]are` 'to sing'
`ko[ŋ]a` | `ko[ŋ]a` 'head'

b. **Campidanese** | **Nuorese**
---|---
`u[mb]rai` | `u[mb]rare` 'to shadow'
`la[ŋ]{l}iri` | `la[ŋ]{l}e` 'acorn'
`u[ŋ]a` | `u[ŋ]ra` 'nail'

---

2 The phonetic realization of the /nd/ clusters in most of the Sardinian territory is retroflex, [ŋ], as shown in (86b), e.g., Contini 1987, 160-1. The literature on Sardinian does not report Campidanese and Nuorese as having complete nasal assimilation of /nd/ and /mb/ clusters, yielding geminate [n:] and [m:] respectively. This type of assimilation is characteristic of the Romance varieties spoken in Southern Italy (Rohlfs 1966), and found only in a very restricted area of the Sardinian territory (Blasco Ferrer 1989). My fieldwork data, however, suggest that assimilation occurs in /nd/ heterosyllabic clusters in Campidanese. I refer to chapter 8 for details and discussion.

3 Nasal-fricative sequences are phonetically constrained by aerodynamic requirements, as the lowering of the velum is precluded during the production of fricatives (Schourup 1972; Ohala 1975; Cohn 1993b). Assimilation of the nasal to the following fricative may be interpreted as the phonological reflex of the avoidance of such a production challenge.

4 Etymological heterosyllabic /nv/ clusters are phonologized as /mb/ clusters in the entire Sardinian territory (Wagner 1941, 181): e.g., involvere is imborvere in Nuorese, and Italian investire is imbistiri in Campidanese.
(87) Nasal-fricative heterosyllabic clusters

a. Campidanese Nuorese
   i[ŋf]erru    i[f:]erru   ‘hell’
   u[ŋf]rai    u[f:]jarè ‘to inflate/swell’
   ku[ŋf]essai    ku[f:]essarè ‘to confess/admit’

b. Campidanese Nuorese
   pe[ns]ai ∼ pe[nts]ai  pe[ss]arè ‘to think’

As shown in (87b), in free variation with the [ns] realization, Campidanese also allows [nts]. This option is relevant and thus incorporated into the discussion because the epenthesis of a voiceless stop homorganic in place, as found in [nts], also occurs in the case of etymological /rs/ clusters in Campidanese (section 7.2.2). This is thus another process in which /r/ and /n/ show a parallel pattern in Campidanese Sardinian.

Campidanese and Nuorese also treat etymological heterosyllabic /ns/ clusters in loanwords and in phrasal phonology differently (Wagner 1941, 181). Let us first consider the borrowings (phrasal-internal assimilation is discussed a few paragraphs below). In Nuorese, a nasal in syllable coda position undergoes total assimilation when followed by an alveolar fricative (88), thus replicating the patterns observed in (87) above.

(88) Italian Nuorese
   [k{o|n}s]erva    ku[ss]èrba ‘tomato sauce’
   [k{o|n}s]istere    ku[ss]istere ‘to consist’
   Mo[ns]ignore    Mu[ss]enore word used to address a Bishop

In Campidanese, on the other hand, etymological /ns/ from borrowings is realized as [nts]:

(89) a. Italian Campidanese
   [k{o|n}s]olare    ku[nts]olai ‘to give comfort’
   se[ns]ale    se[nts]ali ‘middleman’

5Note that the simplification of /ns/ cluster to [s(s)] was already a widespread process in Vulgar Latin, e.g., Contini 1987, 139.

6Examples are from Wagner 1941, 181 and Virdis 1978, 78, in (89a) and (89b) respectively.
b. **Catalan**  **Campidanese**

<table>
<thead>
<tr>
<th>Catalan</th>
<th>Campidanese</th>
<th>Transcription</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ca[n]sar</td>
<td>[sɛu ɣa[n][ts][au]]</td>
<td>‘I am tired’</td>
<td></td>
</tr>
<tr>
<td>come[n]sar</td>
<td>['tui ɣu'me[nts][aza]</td>
<td>‘you begin’</td>
<td></td>
</tr>
<tr>
<td>pi[n]ell</td>
<td>[su β[nts][elu]</td>
<td>‘the brush’</td>
<td></td>
</tr>
</tbody>
</table>

In Nuorese, the coda assimilation pattern found morpheme-internally, as in the previous examples, also occurs across a morpheme boundary. Campidanese contrasts sharply with Nuorese in this, with the nasal coda not undergoing total assimilation either word-internally (examples above) or phrase-internally (examples to follow below). Let us consider the Nuorese data first. (91a,b) shows function words with final /n/: the prepositions *kin* ‘with’ and *in* ‘in’, and the negation particle *non* ‘not’.

When the final /n/ is followed by a stop, place of articulation is shared (90b,c), i.e., the same pattern surfacing morpheme-internally and seen in (86).

(90) **Nuorese**

<table>
<thead>
<tr>
<th>Nuorese a.</th>
<th>no[m p]ikkes! ‘do not take!’</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ki[n t]ekus ‘with you’</td>
</tr>
<tr>
<td></td>
<td>i[n k]elu ‘in the sky’</td>
</tr>
<tr>
<td>Nuorese b.</td>
<td>ki[m b]abbu ‘with dad’</td>
</tr>
<tr>
<td></td>
<td>i[n q]omo ‘at home’</td>
</tr>
<tr>
<td></td>
<td>no[n g]alu ‘not yet’</td>
</tr>
</tbody>
</table>

A word-final coda /n/ is the target for total assimilation when followed by words beginning with one of the following segments /s, f, r, l/ (Pittau 1972, 36). Trivially, total assimilation patterns also surface when the word-final coda nasal is followed by a word beginning in a nasal segment, i.e., /n/ and /m/, (90c).

(91) **Nuorese**

<table>
<thead>
<tr>
<th>Nuorese a.</th>
<th><strong>Morphemes</strong> Prosodically: Clitic groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kin+su kissu ‘with theM.SG’</td>
</tr>
<tr>
<td></td>
<td>in+su issu ‘in theM.SG’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nuorese b.</th>
<th><strong>Morphemes</strong> Prosodically: Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>non+sias! no ssias! ‘don’t be!’</td>
</tr>
<tr>
<td></td>
<td>non+facas! no ffacas! ‘don’t do!’</td>
</tr>
<tr>
<td></td>
<td>non+llasses! no lllasses! ‘don’t let!’</td>
</tr>
<tr>
<td></td>
<td>non+rugas! no rrugas! ‘don’t fall!’</td>
</tr>
</tbody>
</table>
Recall that in Sardinian, historically, RN becomes \( rr \), i.e., an alveolar trill \([r]\). The last example in (91b) shows that this pattern is also found synchronically in Nuorese, whereas in Campidanese, as I demonstrated in chapter 6 based on evidence from loanwords, the same assimilation is no longer synchronic.

Let us now consider the assimilation patterns for morpheme-final /n/ in Campidanese. The final nasal of the function words kun ‘with’ and in ‘in’ does not assimilate to the following /s/: preposition plus determiner sequences recorded during fieldwork show \([n#s]\) sequences, and, in fast speech, the final nasal is heard as strong nasalization on the preceding vowel (92a) for all the speakers I interviewed.\(^7\) A few tokens of prepositional phrases showing an \([n#s]\) sequence are given in (92b), while in (92c) I provide an example with \([n#f]\).\(^8\) A couple of more examples of Campidanese \([n#s]\) and \([n#f]\) sequences are given in (87a,b) above. The morpheme-final nasal is also not targeted by assimilation when followed by a morpheme beginning with a lateral (92d).\(^9\) It is not possible to derive phrases in which the morpheme-final nasal is followed by a rhotic in Campidanese, as a rhotic never appears morpheme-initially in this dialect (see 7.2.1).

(92) **Campidanese**

<table>
<thead>
<tr>
<th>Morphemes</th>
<th>Phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>kun+su</td>
<td>ku[n]s(\sim k[\tilde{u}]s)(\sim ku[nts]u) ‘with the M.SG’</td>
</tr>
<tr>
<td>in+su</td>
<td>i[n]s(\sim i[\tilde{s}]u)(\sim i[nts]u) ‘in the M.SG’</td>
</tr>
</tbody>
</table>

---

\(^7\)The option of nasalizing the preceding vowel may be available in these cases, because determiners in Sardinian form clitic groups rather than phrases (see also the examples from Nuorese in (91a)), and vowel nasalization appears to be a word-internal phonological phenomenon. Clitic groups behave like phonological words rather than phrases in Romance in general, e.g., Nespor and Vogel 1986.

\(^8\)These examples are all taken from my fieldwork.

\(^9\)The data in this case are from Bolognesi 1998, 237.
b. [ìn saðru] ~ [ìn tsəðru] ‘in Sardinian’
   [ìn sakwa fria] ‘in cold water’
   [biʃiɔ ìn seʃɔri ] ‘he lives in Sanluri’
   [kũn soŋu ledʒjuzu] ‘with light sleep’

c. [poDi brolifErai iM fruttu BuRu] ‘it can mature in a fruit too’

   [kũn luiza] *[ku l:uiza] ‘with Luisa’

As happens morpheme-internally (86), the morpheme-final nasal assimilates to the place of articulation of the following morpheme-initial segment when this is a stop (93a,b). When the morpheme-final nasal is followed by a morpheme-initial nasal, the surface output appears assimilatory (93c), as it does in Nuorese.

(93)  
Campidanese

   a. [im pratsa] ‘in the courtyard’
      [iŋ koɔia] ‘in the kitchen’
   b. [kũn biu] ~ [kũ bui] ‘with wine’
   c. [kũ n:ɔzu] ‘with us’

In summary, in Campidanese, the nasal in coda position assimilates in place of articulation to a following stop, and, in contrast with Nuorese, also to a following fricative. Also in contrast with what happens in Nuorese, the coda nasal in Campidanese does not undergo total assimilation when followed by the lateral. The table in (94) summarizes the patterns for nasal codas in both varieties of Sardinian under investigation and depicts that these patterns are asymmetrical.\(^\text{10}\)

\(^{10}\)Is there further evidence for the asymmetrical patterns of nasal codas in Campidanese and Nuorese? In all Sardinian varieties nasal epenthesis in coda position is reported as being frequent (the epenthesis of nasal consonants in coda position is a frequent phenomenon in Romance, Posner 1961, 176; examples from Italian dialects can be found in Rohlfis 1966, 466.) One could predict that Nuorese would allow nasal epenthesis only in front of stops, whereas Campidanese would also allow it in front of fricatives. From the data provided in Wagner 1941, 219-ff., however, it is not possible to evaluate if the asymmetry between patterns of assimilation targeting nasal segments in coda position in Nuorese and Campidanese is mirrored in the pattern of nasal epenthesis along the lines drawn by the above prediction. Unfortunately, the data in the source are scattered and not presented system-
While assimilation with respect to place of articulation targets a nasal in coda position in both dialects of Sardinian, fricative segments and the laterals are triggers of place assimilation in Campidanese but not in Nuorese. In contrast, fricatives and laterals trigger total assimilation in Nuorese and not in Campidanese. To summarize, the nasals in Nuorese are more susceptible (or less resistant) to total assimilation than the nasals in Campidanese.

Examples of nasal insertion before bilabial stops and fricatives, as well as before velar stops are also frequent. The examples in Wagner 1941 where the nasal is inserted in front of a fricative are mostly from Campidanese. Through the literature on the language, I was not able to verify whether this is an accidental gap in the source or a systematic gap in Nuorese. I leave this question for future research.
7.1.4 Interim summary

The assimilation patterns examined in the previous section strengthen the evidence for an asymmetry in the nasal phonology of Campidanese and Nuorese Sardinian. Evidence for this asymmetry was previously garnered through the examination of the processes of vowel and rhotic nasalization in the two dialects. The synopsis in (95) captures the extent of the asymmetrical phonological patterns for the feature [nasal] between Nuorese and Campidanese Sardinian.

(95)

<table>
<thead>
<tr>
<th></th>
<th>Nuorese</th>
<th>Campidanese</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOWEL NASALIZATION</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>RHOTIC NASALIZATION</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>RHOTIC/NASAL INTERACTION</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>total assimilation of nasal coda (except when followed by stops)</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Phonological status of [nasal]</td>
<td>Inactive</td>
<td>Active</td>
</tr>
</tbody>
</table>

First, the nasalization of vowels (chapter 4) and of the rhotic (chapter 6, section 6.1) are phonological processes in Campidanese but not in Nuorese. I thus argue that the feature [nasal] is phonologically active in Campidanese but not in Nuorese Sardinian.

Second, the rhotic and the nasal participate in assimilation, dissimilation and substitution patterns with each other in Campidanese (chapter 6, section 6.2) but not in Nuorese (section 7.1.2 in this chapter). According to the model of phonology adopted in this work, the phonological interaction of /r/ and /n/ in Campidanese is a function of a structural relation between the two segments in this grammar. In section 6.4, I proposed that the underlying structure for Campidanese /r/ and /n/ are the same except for specification of the feature [nasal], absent in the case of /r/ and present in the make-up of /n/. Since the alternations between /r/ and /h/ in Campidanese are systematically missing from the phonology of Nuorese, a similar structural relationship between rhotics and nasals cannot hold in this dialect.

Third, a nasal in coda position undergoes total assimilation when followed by any segment but a stop both morpheme- and phrase-internally in Nuorese but not in Campidanese (as the
data in the previous section illustrate). The degree of susceptibility to assimilation of a segment can also be analyzed in terms of its structural make-up, which can be referred to as markedness. As discussed in detail in Rice 2007, the more marked a segment the more likely it is to be a trigger of assimilation, and, the less marked a segment the more likely it is to be a target of assimilation. In other words, the more structure one segment has underlyingly, the more resilient it is to assimilation. According to this model, nasals in Nuorese are less marked, or have less structure, than nasals in Campidanese. Consequently, as I suggested that nasals in Campidanese bear the feature [nasal] (section 6.4), nasals in Nuorese should not present this featural specification. This conclusion is aligned with the evidence that the feature [nasal] is inactive in the phonology of Nuorese.

The representational implications of this analysis for Nuorese are presented in the final section of this chapter. Before that, I focus on the phonological patterns of the rhotic in this dialect.

### 7.2 Rhotic patterns

In this section I investigate the phonology of the rhotic in Nuorese by first considering its phonotactics (7.2.1), and then by exploring in which alternations it participates (7.2.2). We shall see that (i) the distribution of the rhotic segment is strikingly different between Nuorese and Campidanese, and (ii) the rhotic in Nuorese alternates with the alveolar sibilant in specific contexts, while it does not entertain any kind of relationship with the nasal, as we have seen in the previous section.

#### 7.2.1 Phonotactics

As far as the phonotactics of the rhotic segment are concerned, the difference between Nuorese and Campidanese is twofold.

First, the rhotic is allowed word-initially in Nuorese but not in Campidanese, as shown in
(96). The rhotic is phonetically a trill in this position.

(96)  

<table>
<thead>
<tr>
<th>Campidanese</th>
<th>Nuorese</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a[r]ui</td>
<td>[r]uere</td>
<td>‘to fall’</td>
</tr>
<tr>
<td>a[r]iri</td>
<td>[r]iere</td>
<td>‘to laugh’</td>
</tr>
</tbody>
</table>

Campidanese presents a prothetic vowel in lexical items that begin with a rhotic in the Latin etymon (97a) as well as in later borrowings (97b, c, d) (Wagner 1941, 54 and (Virdis 1978)).

(97)  

a. Campidanese | Latin     |
| [ar]o[a]     | ROTA ‘wheel’ |
| [ar]u[j]u     | RUBEU ‘red’ |
| [ar]iu       | RIVU ‘river’ |
| [ar]iri     | RIDERE ‘laugh’ |

b. Campidanese | Italian |
| [ar]efu[dai] | rifiutare ‘to deny’ |
| [ar]e[ʒ]ni  | ragione ‘reason’ |

c. Campidanese | Catalan |
| [ar]e[ʃ]a  | reixa ‘fence’ |

d. Campidanese | Spanish |
| [ar]etsai   | rezar ‘to prey’ |

Second, in the synchronic grammar of Nuorese the rhotic segment is allowed in syllable coda position, whereas the rhotic is not found in this syllabic position in Campidanese. Contini 1987, 415, fn. 82 remarks that in Nuorese both tautosyllabic Cr and heterosyllabic rC clusters show an epenthetic vowel and a tap for the rhotic. Sound changes such as assimilation and metathesis yielded this systematic distributional gap for the rhotic in the synchronic grammar.

---

11“Ce phénomène apparaît donc comme typiquement méridional et il est perçu comme tel par tous les habitants de l’île” (Contini 1987, 399). A prothetic vowel in front of a trill is also characteristic of Basque and Gascon as well as some Spanish varieties. In Campidanese the insertion of a prothetic vowel is an early development according to Contini 1987, 399, as it was already recorded in early written texts in the dialect (Carte Volgari (1070-1226 C.E.), Condaghe di Santa Maria di Bonarcado (1120-1146 C.E.).

12Contini comments that while the presence of a svarabhakti vowel in consonant-rhotic and rhotic-consonant clusters is characteristic of Nuorese, it is frequent in the entire Sardinian territory. See chapter 6, section 6.1.3.
of Campidanese. Etymological coda rhotics in this variety totally assimilated to the following segment when this was coronal.\textsuperscript{13}

\begin{equation}
\text{(98) Etymological r.C} \_\text{coronal assimilation in Campidanese}\textsuperscript{14}
\end{equation}

\begin{tabular}{cccc}
\hline
a. & b. & c. & d. \\
\hline
R.T \succ tt & R.S \succ ss & R.N \succ rr & R.D \succ ŏr \\
‘field’ & ‘to bite’ & ‘oven’ & ‘thistle’ \\
\hline
\end{tabular}

The other historical process that resulted in the absence of a rhotic in coda position in Campidanese is metathesis. While assimilation took place when the coronal rhotic was homorganic in place with the following onset, metathesis occurred when place homorganicity was not met. Metathesis of the rhotic is attested both at a short (99a) and at a long distance (99b) — i.e., when the original position and the landing site for the segment moving are tautosyllabic or heterosyllabic, respectively.

\textsuperscript{13}The long-distance metathesis of a rhotic coda exemplified below also involved etymological -r.C\_\text{coronal}- heterosyllabic clusters that usually underwent assimilation.

\begin{equation}
\text{(1) Lat. COOPERTURA krojetura ‘roof’}
\end{equation}

\begin{equation}
\text{It. governo gruven:u ‘government’}
\end{equation}

\begin{equation}
\text{It. divertimento drivetimentu ‘fun, entertainment’}
\end{equation}

\begin{equation}
\text{Old Sp. conortado akrun:utau ‘brave’}
\end{equation}

\textsuperscript{14}I give the phonetic transcription of the assimilation data. Post-vocalic non-lenited voiceless obstruents are phonemically transcribed as singletons by Virdis 1978, and this practice has been extended to the orthography, at least by some scholars involved in the normalization of Sardinian orthography. In the case of the etymological R.D sequence, some Campidanese dialects maintain it, i.e., they do not show the metathesis recorded in (98). The [őr] outcome of the metathesis of historical R.D is characteristic also of the Judeo-Spanish variety spoken in Instanbul discussed by Blevins and Garrett 1998 as an output of coarticulation.
Metathesis of etymological coda rhotic in Campidanese

a. Etymological CVr.CV → CrVCV

<table>
<thead>
<tr>
<th>Etymon</th>
<th>Nuorese</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palma</td>
<td>[prama]</td>
<td>‘palm’</td>
</tr>
<tr>
<td>Dulce</td>
<td>[dirji]</td>
<td>‘sweet.m.sg’</td>
</tr>
<tr>
<td>Calcina</td>
<td>[kratina]</td>
<td>‘lime’</td>
</tr>
<tr>
<td>Palpare</td>
<td>[prapi]</td>
<td>‘to touch’</td>
</tr>
<tr>
<td>Porcu</td>
<td>[pron]</td>
<td>‘pig, pork’</td>
</tr>
<tr>
<td>Dormire</td>
<td>[dromi]</td>
<td>‘to sleep’</td>
</tr>
<tr>
<td>Curvare</td>
<td>[krui]</td>
<td>‘to bent’</td>
</tr>
<tr>
<td>Formica</td>
<td>[frumi]</td>
<td>‘ant’</td>
</tr>
<tr>
<td>Verbex</td>
<td>[brebei]</td>
<td>‘sheep’</td>
</tr>
<tr>
<td>*Toc(u)lare</td>
<td>[trayai]</td>
<td>‘to spin (a thread)’</td>
</tr>
</tbody>
</table>

b. Etymological CV.CVr.CV → CrVCV.CV

- It. Palermo [pralemru] ‘Palermo (Sicilian city)’
- Lat. Absconsorium [skruzoru] ‘hidden treasure’
- Old Sard askusorgu

In Nuorese, as mentioned above, the rhotic does occur in coda position: not only is the etymological rhotic maintained in this position, but also the etymological lateral developed as a rhotic in this position. In Nuorese, in contrast to what we have seen in Campidanese in the previous examples, the diachronic processes of assimilation and metathesis affected the etymological rhotic coda in a limited way or not at all. In Nuorese, in fact, total assimilation involved only historical R.S and R.N sequences (which gave rise to [s:] and [r] respectively, as shown in (100a)), but not R.T and R.D (100b), in contrast to Campidanese.

(100) Etymon       Nuorese

a. Persicu [pesike] ‘peach’
   Fornu [foru] ‘oven’

b. Altu > artu artu ‘tall’
   Sardu sardu ‘Sardinian’

Moreover, metathesis never affected the rhotic in a syllabic coda in this variety of Sardinian; compare Nuorese in (101) with Campidanese in (99a) above.
The outcome of etymological /rs/ clusters in recent loanwords also set Campidanese and Nuorese Sardinian apart. In Campidanese, in fact, etymological /rs/ clusters variably present the epenthesis of a voiceless coronal stop, as shown in (102). The source of these data, Wagner 1941, 172, states that this is not the case in Nuorese. In this dialect no stop epenthesis occurs and the realization of etymological /rs/ varies between an assimilated ([s:]) and a non-assimilated output ([rs]).\(^{15}\)

(102) \(\begin{array}{lll}
\text{Italian} & \text{Campidanese} & \text{Nuorese} \\
\text{forse} & [\text{fɔr'sis}] \sim [\text{fɔrtsis}] & [\text{fɔrsi}] \sim [\text{fɔsi}] & \text{‘maybe’} \\
\text{orso} & [\text{ursu}] \sim [\text{urtusu}] & [\text{ursu}] & \text{‘bear’} \\
\text{discorso} & [\text{diskurtsu}] & [\text{diskurtsu}] \sim [\text{diskusu}] & \text{‘discourse’}
\end{array} \)

As discussed in section 7.1.3, Wagner 1941 (paragraph 310) reports that the epenthesis of a voiceless stop homorganic in place of articulation also occurs within ns clusters in Campidanese, while this is not the case in Nuorese. A similarity between /n/ and /r/ in Campidanese but not in Nuorse thus surfaces also through this optional epenthetic process.

In sum, the Nuorese and Campidanese data compared in this section show that the distribution of the rhotic is different in the two dialects. I take these distributional facts to be further evidence for different contrastive profiles of the rhotic in the inventories of Campidanese and Nuorese, in addition to the different relationship between the rhotic and the nasal in the two dialects discussed in chapter 6 and in section 7.1 of the present chapter.\(^{16}\) In Nuorese, the rhotic bears a relationship with the fricative homorganic in place of articulation, as the alternation patterns presented in the next section show.

\(^{15}\)It is not clear what informs the variation in the items in (102), but it is very likely that the maintenance of the rhotic in coda position in Campidanese, for instance, is a function of register, as such maintenance is connotated as Italian-sounding by Campidanese speakers (my language consultants, p.c.).

\(^{16}\)Phonotactic restrictions on the rhotic in Campidanese and its phonetic realizations are also discussed in 8.1.2.
7.2.2 Alternations

In Nuorese, the alveolar sibilant and the rhotic are in complementary distribution in both phrase- and word-internal syllable coda contexts.\(^{17}\)

The data presented in this section – all from Nuorese unless otherwise indicated – are from Wagner 1941, 186-7, Pittau 1972, 32-5, Contini 1987, 259-270, Molinu 1998, 100-112, and Pons Moll 2005, 2. They have been merged and reorganized for presentation purposes.

Let us first consider word-final /s/ and /r/ as exemplified by the ordinal numerals /trEs/ ‘three’ and /batOr/ ‘four’.\(^{18}\) Word-final /s/ and /r/ surface as [s] and [r]\(^{19}\) respectively when followed by a vowel-initial word (103a) and in utterance-final position (103b), in which case, the rightmost vowel is copied after the final consonant.

\[(103)\]
\[\text{a. } [\text{trEs amikOsO}]## \quad \text{‘three friends’}\]
\[\text{[bat:O amikOsO]}## \quad \text{‘four friends’}\]
\[\text{b. } [\text{trEs}]##\]
\[\text{[bat:O]}##\]

First, word-final /s/ and /r/ neutralize to [s] when followed by a word beginning in a voiceless stop, and, trivially, in an /s/.

\[(104)\]
\[\text{/trEs/} \quad \text{/batOr/}\]
\[\text{[trEs panEsE]}## \quad \text{[bat:O panEsE]}## \quad \text{‘three/four (pieces) of bread’}\]
\[\text{[trEs kanEsE]}## \quad \text{[bat:O kanEsE]}## \quad \text{‘three/four dogs’}\]
\[\text{[trEs tawlasa]}## \quad \text{[bat:O tawlasa]}## \quad \text{‘three/four tables’}\]
\[\text{[trEs sakoso]}## \quad \text{[bat:O sakoso]} \quad \text{‘three/four sacks’}\]

The alternation of word-final [s] and [r] is not a peculiarity of the morphemes /trEs/ ‘three’

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\(^{17}\)The alternation rhotic-sibilant is also attested in some dialects of Castilian Spanish (Romero and Martín 2003) and in Mallorcan Catalan (Pons Moll 2005).

\(^{18}\)In Campidanese, the word for ‘three’ is /trEs/ and the word for ‘four’ is /kwatru/. No morpheme ends in /t/ in Campidanese.

\(^{19}\)I transcribe the Nuorese rhotic in coda position as a tap following Contini’s 1987, 400 observation that the rhotic in coda presents only one short closure. However, a systematic study of the phonetic realization of rhotics across Sardinian dialects is needed.
and /batɔr/ ‘four’. The following data show that verb infinitival forms also present the alternation of the morpheme-final rhotic with an alveolar sibilant when followed by word-initial voiceless stops.

(105) a. /fakɛr/, [fakɛre]## ‘to do/make’
    [fakes kure] ‘to make run’
    [fakes pɛdɪɾe] ‘to makes ask’
    [fakes trunkare] ‘to make cut’
  b. /ɛsɛr/, [ɛsɛre]## ‘to be’
    [ɛsɛs kurtu] ‘to be (in a hurry)’

Word-internally, a coda rhotic is found in free variation with [s] in front of a voiceless stop in the adjacent syllable onset (Wagner 1941, 187).

(106) aurtire ∼ austire ‘to miscarry/to have an abortion’
    karkare ∼ kaskare ‘to press’
    burteq[u] ∼ busteq[u] ‘knife’
    kertu ∼ kestu ‘argument’

Second, word-final /s/ and /r/ neutralize to [r] when followed by a word beginning in a voiced stop. The following voiced stop is phonetically realized as an approximant after the coda rhotic, an alternation found in post-vocalic context in Nuorese.

(107) [tɛr ɛɾɛs]## [batɛɾ ɛɾɛs]## ‘three/four oxen’
    [tɛr ɗɛɾɛsɛɾ]## [batɛɾ ɗɛɾɛsɛɾ]## ‘three/four houses’
    [tɛr ɣatɛɾs]## [batɛɾ ɣatɛɾs]## ‘three/four cats’

The examples in (108) show that this alternation is not lexically-determined for the numerals ‘three’ and ‘four’, but involves any word-final /s/ and /r/ (recall (105) above). Morpheme-final /r/ is found as infinitival ending (105). Morpheme-final /s/ is found as plural marker on noun, pronouns, adjectives and determiners, and as verbal person endings, e.g., second person singular and first person plural.

---

20The data in (106) are listed here the way they are reported in Wagner, thus, not in IPA.
(108) a. /sas/, /sɔs/ ‘the F., MPL’ [sar dɔmɔsɔ]## ‘the houses’
    b. /semus/ ‘we are’ [semur bɛniɔsɔ]## ‘we have come/we came’
    c. /es(t)/ ‘is’ [er ōe malu grabu]## ‘he has bad manners’
    d. /sɔres/ ‘sisters’ [sɔɾɛr meas]## ‘my sisters’

The alternation between ses and ser for /sEs/ ‘you are’ in the following options for wording the question ‘Did you ever come to Nuoro?’ (Pittau 1972, 143-144) (provided below in Pittau’s orthography) illustrates the same point:

(109) Mai benniu bbi ses a NNúgoro?
Mai bbi ser benniu a NNúgoro?
Bi ser mai benniu a NNúgoro?

Third, the same neutralization to [r] takes place when coda /s/ and /ʃ/ are followed by a word beginning in a sonorant segment: /m, n, l, j/, and, trivially, /ɾ/ (Contini 1987, 487-ff.) as shown in (110). The word-final sibilant and rhotic optionally undergo total assimilation when followed by word-initial coronal /l/ and /ɾ/ (110b), Pittau 1972, 34.

(110) a. [tɾer manɔsɔ]## [batɔɾ manɔsɔ]## ‘three/four hands’
    [tɾer jænasæ]## [batɔɾ jænasæ]## ‘three/four doors’
    [tɾer rɔsæsæ]## [batɔɾ rɔsæsæ]## ‘three/four roses’

b. [tɾer/batɔɾ litrɔsɔ]## ~ [tɾe/batɔɾ litrɔsɔ]## ‘three/four liters’
    [tɾer/batɔɾ nukɾesæ]## ~ [tɾe/batɔɾ nukɾesæ]## ‘three/four walnuts’

The labio-dental voiceless fricative may show the alternative pattern of total assimilation attested for word-initial /l/ and /ɾ/, (112a).

(111) [tɾer/batɔɾ fɪdɔsɔ]## ~ [tɾe/batɔɾ fɪdɔsɔ]## ‘three/four children.m’

Fourth, coda /s/ also becomes [ɾ] before the voiceless labio-dental fricative as well as in front of affricates, which in the Nuorese inventory are alveolar, voiceless and voiced. Notice that the affricates /ts/ and /ʤ/ do not show weakening (either in the form of voicing or loss of the stop portion) in post-vocalic and post-rhotic position (Pittau 1972, 23), in contrast to what happens to voiced stops in the same environment.
In sum, an underlying word-final /s/ becomes a rhotic in front of words beginning with any consonant but the voiceless stops (and, trivially, /s/). Complementarily, an underlying word-final /r/ surfaces as [s] before words beginning with a voiceless stop or /s/. As anticipated with the examples in (106) above, this is the case not only phrase-internally but also word-internally. Further examples for this domain are given below.

In Nuorese, etymological morpheme-final /s/, from prefixes DIS ≻ /dis-/ , EX ≻ /s-/ , is realized as [r] in front of all consonants but the voiceless stops and /s/. The data in (113a) (Wagner 1941, 187), where such prefixes are followed by a root beginning in a voiced stop (realized as an approximant after [r]) and a nasal, should be compared with the data in (114), where the same prefixes are followed by a root beginning in a voiceless stop. The data in (113a) (Wagner 1941, 187) should also be compared with the data in (113b) (Pittau 1972, 34), where the etymons are available.

(113) a. [dir]yras:ja ‘misfortune’
   [dir]maja:re ‘to faint’
   [ir]bentja:re ‘to refresh(?)’
   [ir]dentare ‘to pull teeth off’

   b. Nuorese
      It. bisbetico [berbetiku] ‘bad-tempered’
      Old Sp. pantasma [pantarma] ‘ghost’
      FORAS MALE [forarmale] ‘just as well’

In (114a,b) (Molinu 1998, 55), the data from Nuorese are contrasted to data from Campidanese: a prothetic vowel is the norm in Nuorese, but not in Campidanese. The examples in (114a), moreover, show that the etymological sibilant surfaces as such in front of a voiceless stop.

(114) a. Nuorese Campidanese
   [is'pur̪ana] [spr̪unya] ‘they purge’
   [isturi̯d̪ari] [sturi̯dai] ‘to sneeze’
b. [iɾbaˈʎaɾe] [zbaˈʎai] ‘to be mistaken’
   [iɾɣaˈɲɛɾe] [zgaˈɲai] ‘to cut the throat of’
   [irmaˈɲɛɾe] [zmaˈɲai] ‘to prune the vine’

When preceding vowel-initial stems, /s/ surfaces as [z] ((115a) Molinu p.c.; (115b) Pittau 1972, 144):

(115) a. i[z]#alenatu ‘without breath’
   alenu ‘breath’

b. A Nnúgor bénniu mmai bbi sese? ‘Did you ever come to Nuoro?’
   /səs/ ‘you are’

Contini 1987, 254-255 remarks that in Nuorese the sibilant is only partially voiced in inter-vocalic position. In sum, in Nuorese, a post-vocalic /s/ is realized as [z] in onset position and as [r] in coda position. The distribution of the allophones [z] and [r] across syllable positions is explained in perceptual terms by Romero 2008 as summarized in section 7.2.3 below. There, however, it is also discussed how a phonetic approach to [z] ∼ [r] may fall short in Nuorese.

The data presented in this section show that S and R in Nuorese neutralize in coda position, both word- and phrase-internally. As pointed out throughout this section, this is not the characteristic of specific lexical items, but a systematic phonological process in Nuorese Sardinian. In this dialect, R and S form a phonological class, in contrast with the class of R and N in Campidanese. In the following section, I argue that while the origin of the R/S neutralization may be perceptually motivated, the specific patterns found in Nuorese appear to elude a purely substantive explanation.

7.2.3 Analysis

The alternation between coronal sibilant and rhotic in syllable coda position is captured in perceptual terms by Romero 2008. In general, a segment in coda position is acoustically shorter than a segment syllabified in onset position.\(^{21}\) In a perceptual study of American English,

\(^{21}\)Contrast neutralization in syllable coda position may often stem from perceptual difficulties due to segment shortness in this position (e.g., Steriade 2001).
Romero shows that a short voiced sibilant is perceived as a rhotic. Since a voiced sibilant is short in a coda, it is in this syllabic position that it can be perceived as a rhotic. The coda sibilant followed by [p, t, k] is not perceived as a rhotic (even if maybe as short) because it is not voiced. While this perceptual phenomenon is likely the source of the alternation between the rhotic and sibilant in coda in Nuorese, the synchronic patterns discussed throughout this section point to its phonological nature.

First, it is not only S that becomes [r] in coda, we saw that also R surfaces as [s] in this syllabic position; in other words, the phonemic contrast between R and S neutralizes in syllable coda.

Second, the contexts for coda [r] comprise not only the voicing environment, as in the perceptual model by Romero, but also dissimilation contexts. Coda S becoming [r] before non-coronal fricative as well as affricates, in fact, can be interpreted as a dissimilatory process. The substitution of [r] for S in these instances can be analyzed as evidence for R and S being a phonological class within the Nuorese inventory: when S needs dissimilating because another fricative (a partial fricative in the case of affricates) follows (immediately or not), it is substituted by the segment to which it minimally contrasts.

The dissimilation between the rhotic and sibilant in coda position does not necessarily fit a phonetic/perceptual explanation put forth by Ohala 1993 and adopted by Blevins and Garrett 2004). Briefly, this substantive model of dissimilation states that when the speech signal for a word contains two subsequent, not necessarily adjacent, acoustic cues which are identical, the listener may interpret one of those as the conditioning environment, basically as an assimilation trigger and may hyper-correct by eliminating this cue from the phonological representation of the morpheme (Ohala 1993, 249). The phonetic model for dissimilation identifies the perceptual mechanism that triggers dissimilation but it confines the likelihood of dissimilation to

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22 A possible contributing factor to this perceptual phenomenon is the fact that crosslinguistically a rhotic in coda position shows a high degree of unconditioned phonetic variation (Banner Inouye 1995) and that one of the common realizations of a rhotic in this position is a fricative.
those segments that have inherently long acoustic cues (Ohala 1993, 251). There are two reasons why Nuorese R and S could not be easily accommodated in the class of segments with inherently long acoustic cues and thus do not fit the phonetic model of dissimilation. First, it is reasonable to assume that Nuorese R and S are specified by the feature [continuant], which encodes a cross-linguistically robust contrast (Mielke 2005). Stevens 1980 proposes that cross-linguistically robust phonemic contrasts are built through phonetically robust features, which, he remarks, are characterized by a rapid articulatory gesture and abrupt acoustic cues. He bases this proposal on the observation that phonemic inventories across languages appear to use up phonetically robust features in building contrast before resorting to less phonetically robust ones, characterized by a slow articulatory gesture and acoustic cues that stretch over time (Ohala 1993, 254). Nuorese R and S, as continuants, are specified by a phonetically robust feature. Since Ohala 1993, 254 identifies ‘stretched out’ acoustic cues with phonetically less robust features, dissimilation of Nuorese R and S cannot be easily captured by a phonetically grounded model.

Second, Nuorese R and S dissiplate in syllable coda position. Segments in coda, as

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23 The list compiled in (1) includes the features mentioned by Ohala 1993, 251-253 and the corresponding inherently long acoustic cues he discussed (see also Blevins and Garrett 2004, 123):

(1)  
<table>
<thead>
<tr>
<th>Feature</th>
<th>‘Stretched out’ acoustic cue; Ohala (1993: 251-253)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. labialization:</td>
<td>“lower resonance and overall amplitude […]; 100 msec or more”</td>
</tr>
<tr>
<td>b. aspiration</td>
<td></td>
</tr>
<tr>
<td>c. retroflexion</td>
<td></td>
</tr>
<tr>
<td>d. pharyngealization</td>
<td></td>
</tr>
<tr>
<td>e. glottalization</td>
<td></td>
</tr>
<tr>
<td>f. place of articulation:</td>
<td>“formant transitions […]] from 30 to 80 msec or more”</td>
</tr>
<tr>
<td>g. nasalization:</td>
<td>“increased bandwidth of the formants of adjacent vowels (i.e. vowel nasalization) […]] over at least 50 msec, sometimes longer”</td>
</tr>
<tr>
<td>h. lateralization:</td>
<td>“long F2 and F3 transition (Lehiste 1964)”</td>
</tr>
</tbody>
</table>

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24 According to this observation, simple consonant inventories may be viewed as proper subsets of complex ones, with the latter expanding through the phonemic exploitation of less robust features such as secondary places of articulation, retroflexion, aspiration, glottalization, pharyngealization, and so on. See also Lindblom 1990.
ported by Romero, are short. This position-conditioned shortness may obliterate the effect of inherently long acoustic cues, if any. Thus, even assuming that R and S have inherently stretched out acoustic cues, a phonetic model does not explain the Nuorese pattern of dissimilation in this position.

### 7.2.4 Interim summary

The following table summarizes the phonological patterns of rhotics in both Sardinian dialects under scrutiny:

\[
\begin{array}{|c|c|c|}
\hline
\text{Rhotic Distribution} & \text{Nuorese} & \text{Campidanese} \\
\hline
\text{Morpheme-initial position} & \text{yes} & \text{no} \\
\text{Syllable coda} & \text{yes} & \text{no} \\
\hline
\text{Rhotic/Nasal Interaction} & \text{no} & \text{yes} \\
\text{Rhotic/Sibilant Interaction} & \text{yes} & \text{no} \\
\hline
\end{array}
\]

Through (116) it is clear that the only process that defines the rhotic in Campidanese in positive terms is its relationship with the nasals, and that this state of affairs is sharply in contrast with the phonology of the rhotic in Nuorese.

Thus, not only are the phonological systems of Campidanese and Nuorese asymmetrical with respect to the processes involving nasal segments, but also with respect to the distribution of the rhotic and the alternations in which it participates.

The implication for the representation of rhotics and nasals in Nuorese are discussed in the section which concludes this chapter.

### 7.3 Representations

Recall that the starting hypothesis formulated in chapter 3 put forth the following contrastive hierarchies for Campidanese and Nuorese \{R, S, N\}.
(117)  

a. Campidanese: $[SV] \succ [\text{nas}]$

b. Nuorese: $[\text{cont}] \succ [SV]$

The segment representations in (118) below translate the contrastive hierarchies in (117), taking the features $[SV]$, $[\text{nasal}]$ and $[\text{continuant}]$ into account:

(118)  

a. Campidanese $N \ R \ S$

b. Nuorese $N \ R \ S$

As discussed in chapter 3, the phonological inactivity of the feature $[\text{nasal}]$ in Nuorese can be represented in terms of its absence from the underlying specification of nasal segments in this dialect. The unmarked structure for $N$ in Nuorese ($N$ in (118b)) is further supported by the susceptibility of this segment to assimilation, in contrast to Campidanese ($N$ in (118a)), as discussed in section 7.1.4 of this chapter. The rhotic in Nuorese, on the other hand, appears to be a more stable segment than the rhotic in Campidanese, as it has a broader distribution across contexts. The narrow distribution of $R$ in Campidanese is due to a series of historical processes, including total assimilation and metathesis, which this segment underwent. Markedness approaches (Rice 2007) equate the less stable segments within a grammar to less articulated underlying structure: compare the underlying structure for Campidanese and Nuorese $R$ in (118a) and (118b), respectively.

The data analyzed in this chapter concern $R$, $S$ and $N$ in syllable coda position and thus it is in order to discuss the representations of these segments relatively to the coda inventories in Campidanese and Nuorese. Both Campidanese and Nuorese have a very restricted inventory in this position. Campidanese has $N$ and $S$, since $R$ is banned from syllable coda. Nuorese has $N$ and $R/S$, where $R/S$ means that the contrast between $R$ and $S$ is neutralized in this position. The coda inventory is a two-element set in both dialects, thus, the number of feature needed to
specify contrast, according to the theoretical assumptions discussed in chapter 3, is one. The data point to an asymmetry between Campidanese and Nuorese with respect to nasals in this specific domain: coda nasals undergo assimilation to other manners of articulation in Nuorese but not in Campidanese. Assuming that markedness is determined relative to domains, as summarized above, Campidanese coda N is the marked element in the two-element inventory, whereas in Nuorese coda N is the unmarked element:

(119)  

a. *Campidanese codas*  
N  
[SV]  
∅  

b. *Nuorese codas*  
N  
R/S  
∅  
[cont]

The specification of [SV] is sufficient to distinguish coda N from S in Campidanese. [nasal] is not contrastively specified in this domain-specific inventory of the language. Remember that phonological vowel nasalization in Campidanese is triggered by an alveolar nasal in onset position, and not in coda position, a state of affairs sharply in contrast with vowel nasalization in Romance, as Sampson 1999 remarks. The representation of Campidanese coda N in (119a) and of Campidanese onset N in (118a) captures this pattern.25 Note that, in terms of the contrastive hierarchy, the coda subinventories both of Campidanese and Nuorese in (119) exploit the specification of the highest feature in the contrastive hierarchy of each dialect: [SV] for Campidanese and [continuant] for Nuorese.

This chapter concludes the systematic comparison of Campidanese and Nuorese {R, N, S}, supporting further the asymmetry between the two dialects with respect to the phonological patterns exhibited by these segments. In the next chapter I set forth to evaluate the analysis proposed thus far by extending the {R, S, N} set to other coronal sounds.

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25Note, however, that Campidanese offers no evidence for considering the syllable coda to be its own domain for contrastive specification purposes. Campidanese coda N does not need to lack the feature [nasal] in order to capture that coda N does not trigger the phonological nasalization of the preceding vowel in this dialect. Vowel nasalization is analyzed as phonological only when the trigger is lost, and this happens only with an onset N in Campidanese.
Chapter 8

Further relationships

The hypothesis about the contrastive configurations of Campidanese and Nuorese sonorant inventories formulated in chapter 3 and repeated in (120) below must also be evaluated within the larger set of coronal consonants in the grammars of Campidanese and Nuorese.¹

(120)  a. *Campidanese*: [SV] ≻ [nas]  b. *Nuorese*: [cont] ≻ [SV]

If we extend the hypothesis in (120) to the other relevant coronal segments in the languages, the contrastive configurations for Campidanese and Nuorese are as in (121a) and (121b), respectively:²

---

¹Recall that capital letters are a convention to signal that phonemes are analyzed in terms of contrastive hierarchy.

²While Contini 1987 includes Z in the phonemic inventory of both Campidanese and Nuorese Sardinian (section 1.2), I question his analysis given that voicing of S is predictable in the two dialects: it occurs before voiced consonants, including sonorants, and intervocally. Word-internally, though, (near) minimal pairs exist where [z] and [s:] appear contrastively. I analyze the phonemic contrast in these cases to be one of length rather than voicing. Short [s], in fact, may be perceived as voiced intervocally.
Phonemic contrast is defined for all the Campidanese coronal segments in (121a) except for R, D and L, and for all Nuorese coronal segments in (121b) except for N and D. Campidanese R, D and L all pattern as \([SV]\) segments. Nuorese N and D both are specified as \([SV]\) within the non-continuant class.

This chapter investigates the contrastive relationship among R, D, and L in Campidanese, and between N and D in Nuorese. In particular, I look at the voiced stop, proposing that it is a segment specified by the feature \([SV]\) in both dialects but that it patterns with traditional sonorants in Campidanese and with stops in Nuorese. This claim stems from the relationship this segment entertains with N and R in each dialect, and by the fact that N and R show remarkably different patterning in the Campidanese and the Nuorese phonology.

### 8.1 Campidanese

This section investigates the contrastive relationship among R, D, and L in Campidanese. I argue in section 8.1.1 that L is not a coronal segment in Campidanese. The extended contrastive hypothesis for Campidanese thus requires revisions as in (122b):
The focus is then narrowed to the contrastive relationship between R and D (section 8.1.2), and D and N (section 8.1.3) in this dialect.

### 8.1.1 Non-coronal lateral

There are several arguments for considering the lateral as not being part of the coronal SV subsystem in Campidanese.

First, distributional considerations point to the non-coronality of Campidanese L. Second, the patterns of intervocalic lenition together with asymmetric patterns in the interaction with vowels suggest that L may be specified as [back] or [DORSAL] in Campidanese.³

#### 8.1.1.1 Distribution

The subset of segments that can appear in a word-internal syllable coda in Nuorese and Campidanese was discussed in section 7.3 in the previous chapter. They are all coronal,⁴ and crucially for our current purposes, L is not a member of this subset in either dialect.

![Table](123)

<table>
<thead>
<tr>
<th>Campidanese codas</th>
<th>Nuorese codas</th>
</tr>
</thead>
<tbody>
<tr>
<td>N S [SV]</td>
<td>N R/S [cont]</td>
</tr>
</tbody>
</table>

A historical lateral in coda position was systematically substituted by a rhotic in both dialects.⁵ (125) shows examples from Campidanese (Virdis 1978, 58), where the columns to

---

³I use the features [back] and [DORSAL] interchangeably here as a distinction between the two in the present analysis does not seem relevant, at least as far as the data discussed in the dissertation are concerned.

⁴The subsets of word-final syllable codas are the same plus a coronal stop for both dialects.

⁵This took place on the entire Sardinian territory, actually, except for the varieties spoken in the area known as Barbagia (Virdis 1978, 58). Wagner 1941, 190 reports that in the varieties spoken in the Central eastern region of the island, an area known as Planargia, the rhotic in etymological rC clusters became a lateral. In some Sardinian varieties in the north of the island (Contini 1987), any etymological liquid in coda position is realized as a voiced lateral fricative [ɣ] or a palatal glide.
compare are the Latin etyma on the left with the reconstructed Campidanese forms in the middle.

In Campidanese, as discussed in detail in chapter 7, section 7.2.1, coda constraints also refer to R, which underwent historical metathesis or assimilation in this position, thus the two forms in the middle column (*reconstructed form > actual form).

(124) Latin | Campidanese
---|---
**ALTU** | *artu > atɔu<br>‘tall’
**VOLTA** | *(b)ɔrta > (b)ɔta<br>‘time’
**FALCE** | *farʃi > fraʃi<br>‘sickle’
**CULTELLU** | *(g)urteːu > (g)utːeːu<br>‘knife’
**PALMA** | *parma > pramːa<br>‘palm’
**DULCE** | *durʃi > druʃi<br>‘sweet’
**CALCINA** | *karʃina > kraʃina<br>‘lime’
**AUSCULTARE** | *askurtai > askutai<br>‘to listen to’

Etymological L neutralizes with the rhotic not only in heterosyllabic L.C clusters, but also in tautosyllabic CL ones, both in Campidanese and in Nuorese. Examples from Campidanese (Virdis 1978, 69) are given in (125) below.

(125) Latin | Campidanese
---|---
**PLUS** | prus<br>‘more’
**PLENU** | prenu<br>‘full’
**PLATEA** | pratsa<br>‘court’
**PLANTARE** | prantai<br>‘to plant’
**CLAVE** | krai<br>‘key’
**CLAMARE** | kramai<br>‘to call’
**FLORE** | frɔri<br>‘flower’
**FLUMEN** | frumini<br>‘river’

Thus, in both dialects, synchronically, the lateral never appears in those contexts in which the other coronal liquid, R, is the only option (an in tautosyllabic clusters) or one of the very few options (as in heterosyllabic clusters). In the following sections, we shall see that Campidanese L patterns with non-coronals in the environments in which it surfaces.
8.1.1.2 Lenition patterns

In intervocalic position, the historical lateral became a labial or labiovelar approximant in most of the Campidanese inventory.

(126) MALE 'maði ~ 'mawi 'badness; badly'
VOLEBA (b)o'bia ~ (b)o'wia 'he wanted'
SOLE 'sɔβi ~ 'sɔwi 'sun'
MALE HABITU mo'baðiu ~ mo'waðiu 'sick'

The same pattern appears synchronically in phrase-internal position.6

(127) [ũ ū'u:Jul oŋgũ] 'a long knife'
##[oŋgũ] 'longM.SG

Intervocalic L, whether historical (morpheme-internally) or synchronic (at morpheme boundary), is characterized by different phonetic realizations among the different dialects spoken in the Campidanian territory. While in (126) and (127) I gave only the more widespread outputs, a complete list of phonetic variants is given in (128) (Virdis, 1978:55-60; Wagner, 1941:120-131).7

(128) a. [β/w] in most of the central and western area
b. [ı] in the eastern area, and south-western area (Sulcis)
c. [ʔ] in a small eastern area on the coast (Sarrabus)
d. [gʷ] in Gesturi (a village in the north)
e. [l] low/popular variety spoken in Cagliari (the capital), almost lost now

6The strong pressure of Italian, where historical intervocalic l was maintained, creates further variation in the realization of the intervocalic lateral: a phonomically long [l] (Virdis 1978, 57): e.g., ['sɔβi] ~ ['sɔhi] 'sun'. Wagner 1941, 125 remarks that other sonorants are also realized as long intervocally even when phonemically singletons. This pressure due to the diaglossia of Italian and Sardinian greatly contributes to the neutralization of the length distinction for sonorant intervocally (Contini 1987, Map 100: Neutralization of length distinction for intervocalic N when in post-tonic syllable in Campidanese; Contini 1987, Map 109: Neutralization of length distinction for intervocalic R in Campidanese).

7Note that the geographical coordinates provided in the list in (128) are relative to the southern part of the island rather than to the entire island.
Beside the widespread labial and labiovelar approximants (128a), there are a voiced uvular trill (128b), a glottal stop (128c), a labialized velar stop (128d), and a velar lateral approximant (128e). This array of phonetic variants for intervocalic L can be captured by the feature [back] or [DORSAL], but crucially not by the coronal specification.8

8.1.1.3 Interaction with vowels

The hypothesis that L is underlyingly specified for [back] or [DORSAL] in Campidanese receives further support from an asymmetry in the historical deletion patterns presented by the data in (129).

mela ['mɛβa] ∼ ['mɛwa] ‘apple’ PILU ['piu] ‘hair’

As (129) shows, etymological intervocalic L lenites (for lenition outputs, recall (128) in the previous section) if followed by the low central vowel [a], which corresponds to the feminine singular ending for nouns and adjective. Etymological intervocalic L deletes if followed by the high back vowel [u], which corresponds to the masculine singular ending for nouns and adjectives. This asymmetry is likely to be lexicalized in Campidanese. Nevertheless, the sound change from which it originates is worth discussing as it points to some interesting asymmetry with respect to place of articulation. I take this asymmetry to support a dorsal analysis of the lateral segment in Campidanese.

Articulatory weakening affecting intervocalic consonants is a robust path of sound change crosslinguistically. It affected intervocalic Campidanese L as well, independent of the nature of the vowel flanking the sonorant. However, perception may have played a role in shaping the asymmetric outcomes shown in (129). If L is analyzed as a dorsal segment, its lenited outcome is likely to be dorsal as well as far as place of articulation is concerned. This segment

---

8 The labial approximant [β] is an alternate of the labiovelar approximant [w] and thus the backness analysis can be extended to it as well.
thus comes to share similar acoustic cues with the following vowel if this is back or dorsal, such as [u]. The signal may be interpreted by the listener as not containing lenited L, as its acoustic cues might be blended to those of the following dorsal vowel. This is less likely to happen if lenited dorsal L is followed by a vowel with non-dorsal acoustic cues, such as [a]. This scenario is what phonetics may have fed to the grammatical system over time and what Campidanese encoded in its lexicon or grammar, thus the stem allomorphy in (129) above.

8.1.1.4 Historical and crosslinguistic remarks

If L is assumed to be non-coronal, and specifically dorsal, as the data considered above suggest, L and R contrast in terms of place of articulation rather than manner.

Thus, while L is generally thought to be coronal, it does not in fact pattern with coronals in Campidanese. It patterns rather as a dorsal. This is not surprising when taking into consideration historical and crosslinguistic facts.

A velar realization of the lateral in syllable coda position or after another consonant was characteristic of Latin and Vulgar Latin and it is a common trait among Romance languages. Wagner 1941, 126 comments that this articulatory feature of the lateral in Sardinian can be a reflex of the Latin and Romance trend in exactly the same environments, i.e., syllable-finally and after a consonant. However, he further comments that in Campidanese, and specifically in the varieties of Campidanese we are concerned with in this work, the lateral is produced in the back of the oral cavity systematically across all contexts.

Crosslinguistically, laterals pattern either as coronal or dorsal (Sagey 1988; Walsh-Dickey 1997). In the phonology of many languages laterals pattern together with dorsals: they are found to affect phonological change together with velar segments, and/or to alternate with dorsals both synchronically and historically, and/or to trigger velarization (Walsh-Dickey 1997).

---

9So-called SONUS PINGUIS ‘fat sound’, by the early grammarians; cf. ‘dark l’ in English.
8.1.2 R and D

Having argued that Campidanese L is not coronal, I now turn to the structural relationship between D and R in the language, excluding L from any further consideration.

I first examine the distribution of the allophones of D and R. Much of this section traces historical developments of these sounds and the resulting synchronic distribution. A summary is provided in the table in (130), and it suggests complementary distribution between R and D in Campidanese.\(^{10}\)

\[
\begin{array}{|c|c|c|}
\hline
\text{Post-position} & \text{D} & \text{R} \\
\hline
\text{post- } V \text{ onset} & \text{[}\text{D}\text{]} & \text{[}\text{R}\text{]} & \text{[}\text{D}\text{]} & \text{[}\text{R}\text{]} \\
\hline
\text{post- } C \text{ onset} & \text{yes} & \text{no} \\
\hline
\text{coda} & \text{no} & \text{no} \\
\hline
\text{C}_2 \text{ in tauto- } C_1 C_2 & \text{no} & \text{yes} \\
\hline
\end{array}
\]

In word-initial position, (130a), only D, as [d], is present. The rhotic never appears in word-initial position in Campidanese, as discussed in section 7.2.1. Additional examples are given in (131). What is a word-initial rhotic in Nuorese is a trill preceded by a prothetic vowel in Campidanese (131a).\(^{11}\) The peculiarity of Campidanese in this respect is evident also through the comparison with Latin etyma (131b) as well as with later borrowings from other Romance languages (131c).

\[
\begin{align*}
\text{Campidanese} & \quad \text{Nuorese} \\
\text{[ar]\#ui} & \quad \text{[r]\#uere} \quad \text{‘to fall’} \\
\text{[ar]\#iri} & \quad \text{[r]\#iere} \quad \text{‘to laugh’}
\end{align*}
\]

\(^{10}\)I am leaving for future research an investigation of the phonological status of trill and non-trill rhotics in the language. Some authors show that the contrast between these two sounds, which is limited to the intervocalic position, is neutralizing in some areas of Sardinian, including some varieties of Campidanese that are the object of this work (Contini 1987, Map 109). For a general discussion about the phonological status of trills, I refer the reader to Banner Inouye 1995.

\(^{11}\)The prothetic vowel never receives stress.
b. **Campidanese** *Latin*

<table>
<thead>
<tr>
<th>Campidanese</th>
<th>Latin</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ar]oða</td>
<td>ROTA</td>
<td>‘wheel’</td>
</tr>
<tr>
<td>[ar]uðiu</td>
<td>RUBEU</td>
<td>‘red’</td>
</tr>
<tr>
<td>[ar]iu</td>
<td>RIVU</td>
<td>‘river’</td>
</tr>
<tr>
<td>[ar]iri</td>
<td>RIDERE</td>
<td>‘laugh’</td>
</tr>
</tbody>
</table>

c. **Campidanese** *Italian*

- [ar]eufuðai  | rifiutare  | ‘to deny’ |
- [ar]eζɔni  | ragione  | ‘reason’ |

**Campidanese** *Catalan*

- [ar]ɛtʃa  | reixa  | ‘fence’ |

**Campidanese** *Spanish*

- [ar]ezai  | rezar  | ‘to prey’ |

As a word-internal post-vocalic onset, (130b), etymological D and R show the same allophones: a tap [ɾ] or, less frequently, a short alveolar approximant [ɹ].\(^\text{12}\) The contrast between D and R is neutralized intervocally for the Campidanese varieties that are the focus of the present work (Wagner 1941, 131, Virdis 1978, 59, Piras 1995, 106).

(132) **Etymon** | **Campidanese** | gloss |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. MARE</td>
<td>[maði] ∼ [mani]</td>
<td>‘see’</td>
</tr>
<tr>
<td>LA(B)ORE</td>
<td>[laði] ∼ [lɔri]</td>
<td>‘corn’</td>
</tr>
<tr>
<td>b. It. prete</td>
<td>[preði] ∼ [preri]</td>
<td>‘priest’</td>
</tr>
<tr>
<td>It. brodo</td>
<td>[brɔðu] ∼ [bɾɔru]</td>
<td>‘broth’</td>
</tr>
<tr>
<td>c. MERIDIARE</td>
<td>[ameðjai] ∼ [amerjai]</td>
<td>‘to have a siesta’</td>
</tr>
</tbody>
</table>

The items in (132a) and in (132b) show etymological R and D respectively realized freely as [ð] or [ɾ]. In (132c), etymological D is onset of the syllable bearing primary stress (and thus less likely to delete while the Rs in unstressed syllables do) and surfaces as [ð] or [ɾ] as well. Confusion as to how transcribe the Campidanese words with historical intervocalic R or D is reported throughout the literature on the dialect (Contini 1987, 397, who also cites Wagner 1941).

\(^{12}\)Recall from 2.2 that I use [ɹ] for [ɹ].
1941, 70-71 and Pellis 1934).

After a word-internal nasal coda (130c), we find [d] for D, while R never appears in this position (i.e., heterosyllabic nasal-rhotic clusters are not found either morpheme-internally or a morpheme-boundary as discussed in 7.1.3). Heterosyllabic nasal-D clusters are examined in 8.1.3.

In syllable coda position (130d), neither D nor R are found synchronically. The sound changes that led R to be excluded from syllable codas were discussed in 7.2.1 and 8.1.1.1. Since Sardinian shows strong constraints on syllable codas, it is not surprising that D does not appear in this position.

Several facts thus lead to the conclusion that D and R may be considered allophones in Campidanese. The hypothesis of complementary distribution of R and D in Campidanese put forth here, however, must be checked against the phonetic and phonological nature of DR clusters (130e). Historical DR clusters show two realizations in the Campidanese data collected during fieldwork: [ðr], often broken up by an epenthetic [a], and [r] ∼ [ð]. These are the synchronic outputs of historical heterosyllabic RD clusters as well (section 7.2.1). A pressing question as far as DR clusters are concerned is whether they are indeed clusters in the synchronic grammar of Campidanese. If they are phonetic and phonological singletons and they thus show that the contrast between historical D and R is neutralized also in their context, R/D should be analyzed as a unique phoneme in synchronic Campidanese. I leave the question open for future research.

### 8.1.3 N and D

If the structural relationship between N and D is similar to the one between N and R, with N showing more structure than R by virtue of the underlying specification of the feature [nasal], then an asymmetry in assimilation patterns, similar to the one between N and R, is expected.

---

13Recall that Campidanese has two segments in coda position, S and N, and that S does not appear in coda followed by voiced onsets in non-derived environments.
also between N and D. If any assimilation process takes place between the two segments, it is D that is expected to assimilate to N.

In the language, the only context in which N and D are in a configuration for assimilation is the heterosyllabic sequence ND, with N in coda and D in the following onset.

In section 7.3, I point out that given the fact that the inventory of segments in syllable coda position is reduced to two, only one feature is needed for phonemic contrast. In Campidanese, I argue that this one feature is [SV], minimally contrasting coda N and S, the only two segments found in this position in the language.

\[(133)\]  
\[
\text{Campidanese codas} \\
N \quad S \\
[SV] \quad \emptyset
\]

According to this domain-sensitive analysis, coda N in Campidanese is not underlingly specified by [nasal], while onset N is. Interestingly, in the language, onset N triggers phonological vowel and rhotic nasalization, while coda N does not. By the same token, we thus do not expect D to assimilate to a preceding coda N in Campidanese, and this prediction is borne out by the literature on the language which does not register assimilation in heterosyllabic ND clusters.

### 8.1.4 Campidanese coronals: Overview

In the light of the Campidanese data presented so far in this dissertation, the array of coronals \( \{R, D, N, S, T\} \) in this dialect appears to split into two major subsets by the specification of the feature [SV], with \( \{S, T\} \) not being specified for this feature.

\[(134)\]  
\[
\text{Campidanese coronals:} \ \{S, T\} \ vs. \ \{R, D, N\}
\]

I review the [SV] class of \( \{R, D, N\} \) first. I analyzed in detail the relationship between R and N in Campidanese in chapter 6, and put forth an analysis of N as R, i.e., [SV], plus the specification of the feature [nasal] (for onsets; see (133) on codas). The assimilation, dissimilation and context-free substitution patterns between these two segments, both historically and
synchronically, are the evidence for such an analysis. In section 8.1.2, I questioned whether R and D are to be considered two separate phonemes in Campidanese based on their distribution, which appears to be, or is on the way to being, complementary. The question of whether R/D is a unique phoneme in Campidanese was formulated and not answered here; it makes an interesting future study in context-free neutralization, the methods of which I also leave for future research. In section 8.1.3, I pointed to the prediction made by the hypothesis of a unique R/D phoneme: that D is to N what R is to N, that is, a target of [nasal] assimilation. However, the only context in which this process could take place is in heterosyllabic ND clusters, where N is a coda. N in this domain-specific inventory is not specified by [nasal]; in fact, it does not trigger vowel or rhotic nasalization when in a coda. Thus, nasalization of D by means of a preceding coda N is not to be expected either. The data confirm this prediction.

With respect to the non-[SV] class of \{S, T\}, I focused on S in chapter 7.\textsuperscript{14} That this segment is separated from \{R, N, D\} by a feature very high in the contrastive hierarchy defining the contrasive make-up of the Campidanese inventory is supported by the fact that S does not appear to interact with any of the elements of \{R, N, D\}, as discussed in chapter 7. In particular, S never triggers regressive assimilation in NS and RS clusters synchronically, in sharp contrast with Nuorese. Synchronous SD clusters show S undergoing voicing, which is taken as evidence for the [SV] specification of D, together with the other voiced stops and sonorants in the system (Frigeni 2005b).

In sum, the Campidanese sound system is primarily divided between non-sonorant versus sonorant segments. The contrast within each of these two major subsets is discussed in section 8.3.

\textsuperscript{14}The contrast between T and D is analyzed in terms of [SV] specification in the present work. However, another interesting research question is about the phonetic realization of the contrast between voiceless and voiced obstruents across contexts. For a preliminary investigation I refer the reader to Frigeni 2003b.
8.2 Nuorese N and D

The contrastive make-up among \{R, D, N, S, T\} in Nuorese is quite different than in Campidanese, as the analysis of the phonology of nasals and rhotics in the two dialects conducted in this dissertation shows.

The array of coronals \{R, D, N, S, T\} in this dialect appears to split into two major subsets by the specification of the feature [continuant] rather than by [SV] as in Campidanese. This yields a different subgrouping (135a) than the one put forth for Campidanese (135b), with \{T, D, N\} classified as stops and \{R, S\} as non-stops.

(135)  

a. *Nuorese coronals*: \{T, D, N\} vs. \{R, S\}  

b. *Campidanese coronals*: \{S, T\} vs. \{R, D, N\}

In Nuorese, R and S are the segments specified as continuants: they form a class found to neutralize in coda position either through assimilatory or dissimilatory processes. They show the same patterns also when in the context of N: the nasal undergoes assimilation both in NS and RN heterosyllabic clusters. I interpreted these facts in terms of N not being specified by the feature [continuant], in contrast to both R and S in Nuorese.\(^{15}\) The question about the nature of the relationship between N and D, the other voiced coronal stop in the Nuorese inventory, is thus in order. Specifically, on which dimension do they contrast underlyingly if they share voicing, place and manner?

In this section, I put forth the hypothesis that what distinguishes the nasal and oral stop from one another in Nuorese is the phonemic specification of place of articulation. Crucially, no D nasalization is reported for Nuorese: this state of affairs follows naturally from the phonological inertness of nasals in this dialect for which I gathered relevant evidence throughout this work. Nuorese N is not [nasal] and thus the contrast with D is not due to this feature in this dialect. What we observed in all Sardinian dialects, including Nuorese, is that a coda N as-

\(^{15}\)N is interpreted as a stop as its patterning contrasts with non-stop segments. Evidence of N patterning with stops, however, is missing in this work. I leave this question for future research.
simulates the place of articulation of the following onset. Also heterosyllabic /nd/ clusters show homorganic place: they are said to be realized always as retroflex, [ŋt], in all Sardinian varieties (for instance, Wagner 1941, 179 and Contini 1987, 93). I thus propose that the contrast between N and D in Nuorese is achieved by place specification for D. This hypothesis can be developed in two ways. One possibility is to analyze D as specified as a coronal, whereas N is unspecified for place, with N being realized as coronal by default, or inheriting its place specification from the following stop onset when syllabified in coda position. N in /nd/ clusters thus inherits coronal specification from D and their retroflexion may be due to phonetic enhancement. Alternatively, both N and D are coronal but D is further specified as retroflex underlyingly. This second hypothesis could be tested by observing D interacting with the other possible coda segment in the language, R: if RD clusters in Nuorese show retroflexion, this could be a viable analysis for D, and thus for D and N, in this dialect.

Once more, Nuorese calls for fieldwork, as a real understanding of its synchronic phonology cannot depend only on historical grammars.

8.3 Sonorant relationships in Campidanese and Nuorese

Let us compare the contrastive configurations for Campidanese and Nuorese coronal consonants \{R, D, N, S, T\} proposed on the basis of the phonological patterns exhibited by the two Sardinian dialects and analyzed in the present dissertation.

The relationships holding among \{R, D, N, S, T\} in Campidanese are summarized by the hierarchy in (136a). The diagram in (136b) translates in terms of classes the hierarchy in (136a).

---

16In Nuorese, this onset must be a stop, as we saw in chapter 7; if it is a fricative, total assimilation occurs which we interpreted in terms of N not being specified for [continuant].
a. *Campidanese, features:*

\[
\begin{array}{c}
\emptyset \\
[SV] \\
\emptyset \ [\text{cont}] \ \emptyset \ [\text{nas}] \\
T \ S \ R/D \ N
\end{array}
\]

b. *Campidanese, classes:*

non-sonorants \\
sonorants \\
stops \\
non-stops

The feature [SV] is the highest in the contrastive hierarchy in Campidanese, and it immediately splits the sound inventory between non-sonorants and sonorants. Since Campidanese appears to exploit [SV] as a voicing feature (Frigeni 2005b) this split equates to the inventory being immediately divided between non-voiced and voiced segments. The non-sonorant segments are further contrasted along the dimension of manner of articulation between non-continuant and continuant segments. Among the sonorants, on the other hand, the feature [nasal] attains a parallel subdivision between non-nasal and nasal segments. In the hierarchy in (136a) proposed for Campidanese, N minimally contrasts with R and D, since R and D were analyzed as the same phoneme by means of the seemingly complementary distributions of their allophones. The contrastive hierarchy model predicts that segments that minimally contrast interact phonologically. In Campidanese, we find N nasalizing R and D.

The proposed relationships holding among Nuorese \{R, D, N, S, T\} are given in (137). (137a) shows the proposed contrastive hierarchy, while (137b) translates it in terms of classes:

a. *Nuorese, features:*

\[
\begin{array}{c}
\emptyset \\
[\text{cont}] \\
[SV] \\
\emptyset \\
T \ N, D \ S \ R
\end{array}
\]

b. *Nuorese, classes:*

non-sonorants \\
sonorants \\
non-stops \\
non-sonorants \\
sonorants

The manner feature [continuant] is the highest in the Nuorese hierarchy. The inventory is thus split between stops and non-stops first. [SV], which amounts to voicing as well also in this dialect, sub-divides the stop and non-stop subsets into sonorants and non-sonorants. Sonorant stops include oral and nasal stops. Among the non-stops, S is non-sonorant, while R is
sonorant. In the hierarchy in (137a) proposed for Nuorese, R and S contrast minimally by means of the feature [SV], and R and N contrast minimally by means of the feature [continuant]. The contrastive hierarchy model predicts that segments that minimally contrast interact phonologically. In Nuorese, we find R and S neutralizing in syllable coda position, and coda N assimilating to a following R onset, since R is more marked than N by means of [continuant].

The analysis proposed for Nuorese, summarized in (137), is built around the fact that [nasal] is phonologically inactive in this grammar. Note, however, that the hierarchy proposed for Campidanese in (136a) could also accommodate a grammar in which [nasal] is inactive if contrast among sonorants is attained through the feature [approximant], instead of the feature [nasal].

(138) a. **Nuorese alternative, features:**

```
   ∅            [SV]
   /\          /\
∅ [cont]   ∅ [approx]
|    |      |    |
T    S    N    R/D
```

b. **Nuorese alternative, classes:**

```
  non-sonorants           sonorants
          stops  non-stops  non-approximants  approximants
```

In (138a), N is a sonorant unspecified for [nasal]. If phonological activity or inactivity of [nasal] were the only trait distinguishing Campidanese and Nuorese, the analysis in (138) for Nuorese would be appropriate. Notice, moreover, that the analysis in (138) also accounts for the patterns found between R and N in Nuorese. (138) in fact predicts interactions between R and N as both sonorants; in particular, R would be marked ([SV, approx]) with respect to N ([SV]), and thus N is expected to undergo assimilation to R, which is what we see in Nuorese (chapter 7). However, (138) does not predict any interaction between R and S, because the former is a sonorant approximant and the latter is a non-sonorant non-stop in that configuration.
In other words, they are not members of the same phonological class. Thus, the analysis in (137), where both R and S belong to the class of non-stops in Nuorese is to be preferred. Their classhood justifies their phonological patterning. Moreover, (138) predicts complementary distribution for R and D in Nuorese. While the Campidanese data point to R/D as a unique phoneme as they seem in complementary distribution, I found no such distributional patterns in Nuorese.\footnote{It is possible to modify the hierarchy in (138a) with N and D as [SV] and R as [SV, approximant]. This option predicts N and D to alternate in Nuorese, and this pattern is not attested in the language. Thus, this contrastive hierarchy is also discarded.}

The flexibility in capturing phonological classhood proper of the contrastive hierarchy, with its option of encoding language-specific phonemic relations, models the asymmetries found between the grammar of Campidanese and Nuorese in a straightforward manner. Moreover, the contrastive hierarchy, as discussed in this section, is able to link the presence or absence of a phonological pattern to the presence or absence of another pattern, within a dialect as well as across dialects.
Chapter 9

Conclusions

To conclude, I briefly comment on the contributions made by the dissertation.

9.1 Contributions to the study of Sardinian

The present work highlights substantial synchronic differences in the phonologies of Campidanese and Nuorese Sardinian which are related to the make-up of the class of sonorants in the two dialects.

The first avenue of investigation was the process of vowel nasalization, reported in the literature for Campidanese and not for Nuorese. I argue that vowel nasalization is present in both dialects but the process is phonological in Campidanese and phonetic in Nuorese. I show that the strikingly different vowel nasalization patterns are linked to further asymmetries in the phonology of nasals in the two dialects: nasals are process triggers in Campidanese and process targets in Nuorese. These patterns, in turn, relate to asymmetries in the phonology of rhotics and in the relationship with non-sonorant segments in the two dialects. The asymmetries in the phonology of Nuorese and Campidanese rhotics and nasals are summarized in the table below.
The phonological activity of the feature [nasal] in Campidanese is supported by the processes of vowel nasalization, rhotic nasalization, and assimilation, dissimilation and substitution patterns between R and N. Such patterns are absent in Nuorese. Moreover, when N is syllabified in coda position, it undergoes total assimilation if followed by fricatives in Nuorese, whereas it undergoes place assimilation in the same context in Campidanese. Among the nasal patterns, then, there is a clear complementarity between the two dialects. The asymmetry extends to the patterns of R, with this segment neutralizing with D across contexts in Campidanese, while neutralizing with S in coda position in Nuorese.

I argue that these constellations of properties are not random, but relate to differences in the phonological representations of the sonorants in these dialects (140).

(140) a. Campidanese  
\[
\begin{array}{cccc}
T & S & D/R & N \\
\text{[cont]} & \text{[SV]} & \text{[SV]} & \text{[nas]} \\
\end{array}
\]

b. Nuorese  
\[
\begin{array}{cccc}
T & S & N, D & R \\
\text{[cont]} & \text{[SV]} & \text{[SV, cont]} \\
\end{array}
\]

The class of sonorants, or [SV] class, comprises the segments \{N, D, R\} in both dialects, but the contrast among those segments is encoded differently. In Campidanese, the more marked sonorant is N, by means of [nasal] being present underlingly, and N bears the same relationship both with R and D. The sonorant vs. non-sonorant distinction is principal in this grammar, as sonorants are not found interacting with non-sonorants. The contrastive hierarchy models this precedence straightforwardly. In Nuorese, on the other hand, the more marked sonorant among \{N, D, R\} is R, and R relates to N through the feature [SV] and to S through
the feature [continuant]. Sonorant R interacts with sonorant N and with non-sonorant S in this dialect. Thus, the distinction between sonorants and non-sonorants in this grammar is not primary. The contrastive hierarchy encodes this state of affairs by not having [SV] as the highest organizing feature in the contrastive make-up of the Nuorese phonemic inventory.

The detailed study of Sardinian sonorant patterns presented in this work has consequences for Romance phonology as well. As discussed in the introduction, Romance languages show a wide pool of phonological patterns involving sonorants either as triggers or targets. Two relevant synchronic studies (Lloret 1997 and Pons Moll 2005) analyze the complex range of patterns as a single phenomenon across Romance languages, universally governed either by the lexical representations of the segments in question (Lloret 1997), or by their phonotactic constraints (Pons Moll 2005). The case studies of Nuorese and Campidanese Sardinian indicate that the phonemic representations of segments is different between the two dialects, as the phonological patterns they manifest are significantly different. The studies also indicate that phonotactic constraints active in each of the Sardinian dialects are to be analyzed each on its own, as distinct. Moreover, collapsing the Nuorese and Campidanese phonotactic constraints into a single homogeneous pool would result in the loss of important information about the phonology of sonorants in the two systems. The Sardinian work thus indicates the need to reassess the previous work on Romance sonorant patterns. The in-depth analysis of Sardinian suggests that there is still a lot to be understood about the phonology of sonorants in Romance, and this is by itself an exciting outcome of this thesis.

### 9.2 Theoretical contributions

As just highlighted, sonorants make up a class within the grammars of both Campidanese and Nuorese, yet this class is not homogeneous between the two dialects. The Sardinian data as analyzed in this work thus contribute to the debate around the definition of phonological classhood, which, in turn, dovetails with the larger question relative to the relationship between
In considering classes of sounds such as nasals and liquids which are phonologically ambivalent across languages, Mielke 2005 proposes to revise the notion of phonological classhood in heterogeneous terms. Phonologically classes are considered universal according to two different parameters: phonological classes can be referred to as ‘featurally natural’, when the focus is on cross-linguistic phonological patterns, or as ‘phonetically-grounded’, when universality is encoded in phonetic terms. The model that attempts to link featurally natural and phonetically-grounded classes is feature geometry. Phonological classes, however, can also be considered in language-specific terms as ‘phonologically active classes’. The need for distinguishing these three definitions of a phonological class stems from the observation that often a class of sounds that is defined as featurally natural is not also necessarily phonetically-grounded and/or phonologically active.

In this work, I refer to phonological classes in Sardinian exclusively as ‘phonologically active classes’, i.e., in grammar-specific terms, because the class of sonorants in Campidanese is strikingly different from the class of sonorants in Nuorese. This dissertation thus shows that reference to ‘phonologically active classes’ in an important piece of phonological theory. Cross-linguistic tendencies and phonetic constraints generate a pool of possible phonological classes (see Hall 2007 for a discussion) but those are ultimately organized within every single grammar in terms of the relationships holding among the members of a class and of the relationships among the classes themselves. Such relationships are informed by contrast only. In fact, the members of the sonorant class in Campidanese and Nuorese are the same, namely \{N, D, R\}, but how contrast is organized within this class is different, as discussed in the previous section. Moreover, the distinction between the sonorant and the non-sonorant class is primary in Campidanese, but not in Nuorese. The evidence in support of ‘phonological active classes’ provided by the Sardinian case thus confirms the theoretical import of the contrastive hierarchy.

Since sonorant patterns are distributed so differently between two dialects of the same language, this dissertation also warns against cross-linguistic studies not based on detailed analy-
ses of individual grammars. This is an important methodological consideration as the discrepancy between ‘featurally natural phonological classes’ and ‘phonologically active classes’ in some instances may be a by-product of cross-linguistic studies based on incorrect analyses of language-specific phonological patterns. It is necessary for the advancement of phonological theory to identify the real discrepancies between ‘featurally natural phonological classes’ and ‘phonologically active classes’ and to understand to what they amount to.


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