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## The metathesis in the dialect of Suelli (CA): A descriptive analysis of the rhotic consonant

The paper aims at providing phonetic grounds to support the idea of Campidanese metathetic aberrant clusters (*mr*, *sr*, *tsr*, *tʃr*) as branching onsets. A phonological interpretation is presented, followed by the phonetic analysis of the rhotic consonant in marked clusters recurring in the dialect of Suelli (Campidanese Sardinian group). In spite of their intrinsic articulatory complexity, such clusters do not show acoustic differences as compared to cross-linguistically unmarked consonant clusters. Our analysis is focused on the rhotic consonant: its phonetic behaviour in such clusters is compared to that of /r/ in unmarked clusters and intervocalic environment. In particular, we looked for patterns analogous to those found in literature concerning marked clusters of the Campidanese typology. The analysis is based on fieldwork data and has showed that no particular acoustic pattern is at work when aberrant clusters are concerned. It will be claimed that the cross-linguistically systematic presence of a vowel portion preceding taps in *Cr* clusters and the high number of rhotic variants do not have phonological relevance in determining the syllabic status of Campidanese aberrant clusters.

*Key words*: rhotic consonant, Cr-cluster, metathesis, Sardinian, Campidanese.

### 1. Introduction

The metathesis of the rhotic consonant is a phonological phenomenon affecting all macro-varieties of Sardinian<sup>1</sup> (Logudorese, Nuorese, Arborense and Campidanese, according to the tetrapartition proposed by Viridis, 1988). In southern dialects<sup>2</sup> it has been systematic, while in central and northern dialects<sup>3</sup> its diffusion is much more limited (Lai, 2013a). In Campidanese dialects the rhotic consonant cannot occur in coda position: diachronically, every *CVrCV(CV)* lexical structure has been repaired to the form *CrVCV(CV)* as in /'purpu/ > ['prupu] “octopus”, /'porku/ > ['proku] “pig”. In south-western Campidanese area metathesis has produced a series of typologically marked clusters ([sreβi'ðəri] < SERVITOREM “servant”, ['mrekunizi] < MERCURI DIEM “Wednesday”, ['ʃreβu] < CERVUS “deer”, ['ʃrufuru] < SULPHUR “sulphur”). This phenomenon has been associated to rustic dialects (Wagner, 1941, Paulis, 2001, Viridis, 2013). Fieldwork data show that such clusters occur also in a

<sup>1</sup> We refer the reader to Wagner (1941) for a comprehensive picture of the kinds of metathesis that diachronically affected Sardinian dialects, and Lai (2013) for a phonological analysis.

<sup>2</sup> In most of the Campidanese group.

<sup>3</sup> Logudorese, Nuorese and Arborense.

more central area of Campidanese (such as the dialect of Suelli, cf. Cossu, 2017). In order to study patterns of Campidanese metathesis and the diffusion of aberrant clusters we have analysed an original dataset including recordings of elicited speech of the dialect of Suelli<sup>4</sup>. Speakers were asked to translate 26 sentences presented in Sardinian Italian to their own dialect. The situation in which recordings<sup>5</sup> took place was partially informal: speakers were informed that the purpose of our study was to document and store the *parlata* (dialect) of the village of Suelli. They were presented with sentences and after some moment during which speakers commented how Suelli's dialect is different than nearby varieties<sup>6</sup>, they produced the translation. We let speakers free to choose lexical forms judged most appropriate.

The aim of this paper is twofold. On one hand we want to determine the syllabic status of clusters in Campidanese Sardinian, whether etymological or metathetic (both unmarked and marked) by comparing *Cɾ* clusters to other consonantal clusters (e.g. *ɹC* or geminates) through a phonological analysis. On the other hand, a preliminary analysis of the acoustic behaviour of the rhotic in metathetic aberrant clusters is provided. The analysis aims at finding potential different acoustic patterns between the rhotic within aberrant clusters and within other consonant groups. Acoustic patterns of the rhotic in marked clusters are compared to other contexts (intervocalic singleton, intervocalic geminate and especially in unmarked clusters). For what concerns Sardinian rhotics, there is an alternation between taps [ɾ] and trills [r], the formers occurring in intervocalic singleton context (V/r/V) and the latters in intervocalic geminate context (V/r:/V) (Contini, 1987), but no articulatory description is provided when postconsonantal. Such complementary distribution of [ɾ] and [r] in intervocalic position is also found in Spanish, Catalan (Recasens, Pallarès, 1999) and in Sicilian (Celata, Meluzzi & Ricci, 2016).

At this stage, ultimate and general purpose of this paper is thus to describe the behaviour of the rhotic within Campidanese marked metathetic clusters, that we firstly try to prove being tautosyllabic. In fact, in the diachrony of French the occurrence of bilabial nasal /m/ followed by rhotic /r/ has determined the raising of an epenthetic plosive between these segments which is homorganic to the first consonant (CAM(E)RA > *chambre*<sup>7</sup>). Analogously, the Italian realisation of 'Israel' may

<sup>4</sup> The corpus used here is that created for Cossu's (2017) work.

<sup>5</sup> Recordings were carried out on the software Praat (version 6.0.27). The microphone employed is a Samson Meteor Mic. Sampling frequency: 44100 Hz.

<sup>6</sup> We would like to point that such comments were neither asked nor required by the researcher, but they have raised spontaneously. We suggest that this was due by the willing to highlight how different is a particular dialect compared to other Sardinian ones, those spoken in nearby villages too, even though, linguistically, no particular phonetic or syntactic difference is present. The only difference among dialects of the same area is the output of intervocalic Latin L: in Suelli's dialect the output is a voiced uvular fricative [ʁ] (or its deletion) as opposed to [β] of villages in the area. Viridis (1978) claims that such rhotacism, common to other areas, is not present in Trexenta (one of the historical sub-regions of Sardinia) where Suelli is located.

<sup>7</sup> Ségéral, Scheer (2005: 255) claim that plosive [b] emerged as the realization of /r/ in strong position, thus in onset position, since, due to syncope, a heterorganic [mr] sequence was created. The Authors also claim that new [br] cluster is an affricate, that is a complex segment, monosyllabic.

include an epenthetic [d] between the sibilant and the rhotic (Busà, 2013: 26). We would like to highlight that these Authors interpret such clusters as heterosyllabic. Our analysis of segmentally analogous Campidanese clusters, as it will be showed, do not report any epenthetic consonant.

## 2. Sardinian rhotic metathesis

Due to metathesis, the rhotic /r/ moves leftwards from coda position to word-initial position as the second segment of a *Cr* cluster, as in [fro'miɣa] < FORMIC(U) LA “ant”, [ˈproku] < PORCUS “pig”. Other patterns occur when the phonological environment is different from *CV̄rCV(CV)*:

- if the post-coda onset is a sonorant, except the bilabial nasal /m/, metathesis does not occur and a post-lexical vowel having the same quality of the preceding nucleus surfaces (/ˈpɛrɫa/ > [ˈpɛrela] “pearl”, /ɕɔɾˈnalɛ/ > [ɕɔɾɔˈnali] “newspaper”, Molinu, 1999);
- if the preceding onset is a sonorant, with the exclusion of /m/, the rhotic consonant moves from left to right (/ˈnɛɾbju/ > [ˈnɛβɾju] “nerve”, Molinu, 1999);
- if the following onset is a voiced alveolar plosive /d/, /r/ moves from left to right (/ˈkarda/ > [ˈkaðra] “blow struck with a stick”);
- if the following onset is a voiceless alveolar plosive /t/, instead of metathesis a total regressive assimilation occurs (/ˈmɔɾtu/ > [ˈmottu] “dead”);
- if there is no preceding onset, /r/ moves from left to right (/ˈɛɾba/ > [ˈɛβɾa] “grass”, /arˈɕɔɫa/ > [aˈʒɾɔɫa] “farmyard”).

Diachronically, Sardinian dialects has been affected by other kinds of metathesis of the rhotic consonant that will not be discussed in this paper (see Lai, 2013a for a review and analysis), since aberrant clusters do not surface as the output of such more ancient metatheses (*ibidem*). Synchronically, /r/ is able to migrate over the lexical edge in some phonological context<sup>8</sup>. The rhotic /r/ may in fact move from the underlying syllabic structure of a lexeme to the second position of a consonantal cluster in the preceding word (/s:a ˈɛɾba/ “the grass”, /nun tʃi at ˈɛɾba/ “there is no grass” (Viridis, 1978, Molinu, 1999) or /santu ˈjɔɾɕi/ “Saint George” surface as [sˈs-rɛβa], [nun tʃaˈðrɛβa], [santru ˈjoʒi], respectively<sup>9</sup>).

Campidanese aberrant clusters due to rhotic metathesis are basically four: [tʃr, tsr, mr, sr]<sup>10</sup>:

- [sr], as in /sirˈbɔnɛ/ > [sriˈβɔni] “wild boar”;
- [mr], as in /ˈmɛɾkunis/ > [ˈmɛɾkunizi] “Wednesday”;
- [tsr], as in /tˈtsɾufuru/ > [tˈtsɾufuru] “sulphur”;
- [tʃr], as in /ˈtʃɛɾbu/ > [ˈtʃɛɾβu] “deer”.

<sup>8</sup> A phenomenon which Lai (2013a) labels as Synchronic South-Western Metathesis (examples in the text).

<sup>9</sup> Surface forms are also characterized by apocopes and lenitions.

<sup>10</sup> Sequences such as [ɕɾ, ʒɾ, ʒr] are also a potential output but their diffusion is lexically much more restricted and therefore they are not part of the dataset analysed in this study.

The next section will deal with the phonological status of such consonantal sequences. If they are heterosyllabic, such consonantal groups should be interpreted as coda-onset sequences; if tautosyllabic, they should instead be analysed as branching onsets.

### 3. *Phonological status of the aberrant clusters*

Kaye, Lowenstamm & Vergnaud (1990) claim that neutral segments (such as sibilants and sonorants) cannot interact within a constituent, in other words there cannot be a branching onset, that is a tautosyllabic consonantal group, of the kind resulted from Campidanese metathesis (especially concerning [sr] and [mr]<sup>11</sup>). Campidanese Sardinian morphological rules in external sandhi provide useful clues in order to differentiate hetero- from tautosyllabic consonantal sequences. Along with *Cr* clusters, other sequences of two consonants may occur in word-initial position: *sC* clusters or the two parts of a geminate. In Sardinian, the voiceless alveolar affricate /ts/ and the voiceless postalveolar fricative /ʃ/ are underlyingly geminate (Bolognesi, 1998). The scenario is outlined as follows:

- a. voiceless obstruents are affected by lenition (Viridis, 1978, Bolognesi, 1998) in CV# #CV context, surfacing as voiced fricatives (/s:u 'panɛ/ > [s:u 'βani] “the bread”, /s:a 'tawla/ > [s:a 'ðawla] “the board», /s:u 'kanɛ/ > [s:u 'ɣani] “the dog”, /s:u 'tʃɛlu/ > [s:u 'zɛlu] “the sky”, /s:u 'fɔɣu/ > [s:u 'voɣu] “the fire” (Viridis, 1978);
- b. within the same context, voiced obstruents and the bilabial nasal /m/ surface as in the underlying form or are optionally lengthened (Viridis, 1978<sup>12</sup>, Ladd, Scobbie, 2003);
- c. voiceless obstruents in Vs# #CV contexts are maintained (Bolognesi, 1998, Lai, 2013); voiceless palatal affricate /tʃ/ is deaffricated and preceding /s/ is totally assimilated (/is 'tʃiðas/ > [iʃ 'ʃiðaza] “the weeks” vs /s:a 'tʃɛna/ > [sa 'zɛna] “the dinner”);
- d. voiced obstruents in Vs# #CV context are lenited and preceding /s/ is deleted (/is 'bratsɔs/ > [i 'βratsuzu] “the arms”; /is 'dentes/ > [i 'ðɛntizi] “the teeth”; /is ɕɛ'nuyɔs/ > [i zɛ'nuyuzu] “the knees”; /is 'gatɔs/ > [i 'ɣatuzu] “the cats”.
- e. intervocalic *sC* clusters and underlying geminates are not affected by lenition nor other processes;
- f. in Vs# #sC and Vs# #C.C contexts an epenthetic vowel is inserted between the first word's last consonant and second word's first consonant; the quality of this vowel is a copy of the preceding nucleus (/is s'kɔlas/ > [izi s'kɔlaza] “the schools”; /is ʃi'ved:as/ > [izi ʃi'ved:aza] “the basins”). Bolognesi (1998), Lai (2013b).

Of particular interest here is pattern (f). It concerns postconsonantal heterosyllabic clusters, that is a coda-coda-onset sequence, a syllabic structure illegal in many phonologies, such as in Italian (see Kaye et al., 1990 for details). The presence of a vowel is required between codas: in Italian this is solved by the choice of the determiner /lo/, which occurs in

<sup>11</sup> We refer the reader to the article cited and Government Phonology literature in general.

<sup>12</sup> Viridis (1978) claims that they may have a threeway output pattern: maintenance, deletion or they may lenit in fricatives. Ladd, Scobbie (2003) only report cases of maintenance and optional lengthening, which is also the output in this study's dataset.

complementary distribution with /il/ and /l/<sup>13</sup> (Marotta, 1993b; Kaye et al., 1990; Davis, 1987). An analogous pattern is shared by Campidanese phonology, as illustrated in (f).

The Vowel Intrusion Test (or Vowel-Zero Alternation: Lai, 2013b) is thus a valid diagnostic in order to verify the syllabic status of word-initial consonantal clusters in Campidanese. The presence/absence of an epenthetic vowel determines if a cluster is hetero- or tautosyllabic: Vowel Intrusion test is thus applied to aberrant clusters. External sandhi lenition patterns are checked too.

### 3.1 Vowel intrusion test

Recalling (f) in Section 3, a front high vowel [i] is expected between the plural determiner /is/ and the following noun beginning with *sC* or a geminate /tts, ʃʃ/ (Bolognesi, 1998):

- i. /is s'kalas/ > [izi s'kalaza] “the stairs”;
- ii. /is ʃ'jimprəs/ > [izi ʃ'jimpruzu] “the fools”;
- iii. /is t'tsuɣəs/ > [izi t'tsuɣuzu] “the necks”.

The interpretation will be that *sC* and geminates are heterosyllabic, or multiconstituent (coda+onset), sequences. Contrarily, no epenthesis occurs if the determiner /is/ precedes a single *C* or a *Cr* cluster<sup>14</sup>:

- iv. /is 'pʊrɔs/ > [is 'pʊpuzu] “the octopuses”;
- v. /is fɔr'miɣas/ > [is fɔr'miɣaza] “the ants”;
- vi. /is 'preðis/ > [is 'preðizi] “the priests”;
- vii. /is 'kanəs/ > [is 'kanizi] “the dogs”.

The patterns illustrate that examples (i-iii) concerns heterosyllabic sequences, and (iv-vi) are tautosyllabic clusters instead, that is branching onsets.

By the application of the same test to aberrant clusters it will be showed that we are dealing with branching onsets:

- viii. /is 'ʃɛrbəs/ > [iʃ 'ʃɛβuzu] “the deers”;
- ix. /is mɛr'ʒanis/ > [i mɛr'ʒanizi] “the foxes”;
- x. /is sir'bɔnəs/ > [is sri'βɔnizi] “the wild boars”.

External sandhi patterns in viii-x are those enucleated in Section 3 as regards simple onsets. In fact, such patterns apply to syllabic constituents, rather than to simple segments<sup>15</sup>. Being the voiceless alveolar affricate underlyingly geminate, the [i]-epenthesis is expected:

- xi. /is t'tsurɔs/ > [izi t'tsurɔpuzu] “the blind people”.

<sup>13</sup> /lo/ occurs before coda-onset sequences (#sCV or #C.CV), /il/ before (branching) onsets (#CV, #CRV), /l/ before onset-less nuclei (#VC(C)).

<sup>14</sup> Examples (iv) and (v) refers to metathetic unmarked clusters, (vi) is an etymological *Cr* cluster (<PRESBYTER) and (vii) is a simple onset.

<sup>15</sup> See Marotta (2008) for an analogous pattern in Tuscan varieties and Brun-Trigaud, Scheer (2010) for lenition in branching onsets in the diachronic evolution from Latin to Modern French.

Moreover, we would like to point that not all /s/ plus liquid clusters are to be interpreted as tautosyllabic. In fact, as reported by Lai (2015: 289), when in clusters of this kind the sibilant is post-lexical, in our case a negative verbalizer, the consonant group created this way is heterosyllabic. This is again inferable by the presence of an epenthetic [i] after the determiner /is/, as in the example:

- xii. /is slum'baus/ > [izi zlum'bauzu] “the cripples”.

### 3.2 Lenition patterns of aberrant clusters

To check lenition patterns of aberrant clusters in external sandhi may sound redundant, but we think it is crucial to corroborate the idea that *sC* sequences and [sr] clusters are different phonological items. The preconsonantal sibilant /s/ in coda position assimilates the voicing feature of the following segment:

- xiii. /sbal'laj/ > [zbal'laj] “to mess up” (Viridis, 1978).

On the contrary, in the metathetic aberrant clusters made up of an alveolar fricative and a rhotic, the former surfaces as voiceless (being its underlying form /s/) in post-pausal position or absolute initial position:

- xiv. ##/'sɔrga/ > ##['srɔɣa] “mother-in-law”;  
 xv. ##/sir'bɔne/ > ##[sri'βɔni] “wild boar”.

Such examples highlight that sibilants in *sC* sequences occupy the coda, while in [sr] clusters they are the first segment of a branching onset: just like in other branching or simple onsets, the voiceless segment surfaces as such, but as voiced [z] in intervocalic position.

A presumably satisfying amount of evidence has been provided concerning the tautosyllabicity of the marked consonantal groups in Sardinian by the application of the vowel intrusion test and the comparison of lenition patterns to those of hetero- and tautosyllabic consonantal sequences<sup>16</sup>. Next section will concern the phonetic characteristics of rhotic consonants of the Sardinian inventory.

## 4. Description of rhotics in Sardinian

Sardinian inventory is characterised by two rhotic consonants<sup>17</sup>. Singleton /r/ is prototypically realised as an alveolar tap [ɾ], while geminate /r:/ is phonetically realised as an alveolar trill [r] (Contini, 1987). The same scenario occurs in Spanish, Catalan (Recasens, Pallarès 1999) and Sicilian (Celata et al., 2016).

<sup>16</sup> See Loporcaro (2005) for a heterosyllabic interpretation of *muta cum liquida* clusters in Proto-Romance and Italian southern dialects and Lai (2013a) for Sardinian metathetic clusters as complex segments.

<sup>17</sup> Intervocalically, in complementary distribution.

#### 4.1 *Taps*

Alveolar taps are produced by a brief (15-25 ms in Busà, 2013; 15-30 ms in Recasens, 2007) contact between the tongue tip and the alveolar ridge. The movement is upwards and muscularly controlled (Ladefoged, Maddieson 1996, Recasens, 2007: 1). In Italian they are in allophonic variation with non-sibilant alveolar fricatives [ɹ] and alveolar approximants [ɹ̥]: the three of them realised with an apical tongue gesture (Spreafico, Celata, Vietti, Bertini & Ricci, 2015). Taps may also be produced with a burst or fricated release, the latter having a mean duration of 20-30 ms (Busà, 2013).

#### 4.2 Trills

Contrary to taps, the apical movement in trills is aerodynamically driven (Ladefoged, Maddieson, 1996): tongue tip vibration is “initiated when there is enough pressure difference across the apicoalveolar constriction” (Recasens, 2007: 1, see also Solé, 2002b). Closeness between articulators and intensity of the airflow must be maintained constant in order for a trill to occur: if such requirements are not met, a non-trilled output will occur (Laver, 1994). Solé (2002b) demonstrated that long fricative rhotics, approximants and voiceless trills may surface when proper tongue configurations (lax tip of the tongue and stiffness of the dorsum) or aerodynamic requirements are not satisfactorily set, for example in fast and spontaneous speech.

#### 4.3 Postconsonantal rhotics

Both trills and taps may occur in this position. The formers are fully voiced and produced generally with two apical contacts (Recasens, 2007, for Catalan dialects). More interestingly, postconsonantal taps are flanked by a svarabhakty<sup>18</sup>. A great number of studies reported the cross-linguistic occurrence of a vowel portion between a consonant and a tap (Navarro, 1963; Rochette, 1973; Harms, 1976; Massone, 1988; Blecua, 2001; Ramírez, 2006; Frigeni, 2009; Baltazani, Nicolaidis, 2011; Busà, 2013; Savu, 2012; Celata et al., 2016; Spreafico, Kaland, Galatà & Vietti, 2016 and others). The phonetic description is consistent along the studies reported for what concerns duration and quality<sup>19</sup>, but different scholars propose different interpretations as regards the reasons of its emergence. In sum, there are two main lines of studies: (a) the intrusive vowel is analysed as a post-lexical segment, that is as an epenthesis; (b) it is intended as part of the articulation of the tap, so phonologically irrelevant and phonetically (or physiologically) determined. For example, Busà (2013) claims it occurs in order to avoid /sr/ sequences in Italian (as in /isra'ele/); Savu (2012), concerning Slavic languages, claims that it is part of the articulation of the tap and it is present also when [r] is flanked by vowels. This study endorses the line that sees such vowel as the product of a phonetic mechanism.

<sup>18</sup> By svarabhakty it is meant the post-lexical vocalic insertion between two consonants.

<sup>19</sup> The intrusive vowel seems to be influenced by the following nucleus.

### 5. Description of the dataset and analysis

Seventeen speakers divided in three age groups (20-40, 41-60 and 61-85 years old) were recorded. Speakers come from the village of Suelli (40 km due north to Cagliari, central-western Campidanese dialectal domain<sup>20</sup> (Viridis, 1988). Description of this area is provided in Viridis (1978, 1988). Stimuli were elicited through a Sardinian-Italian to Sardinian translation task. Twenty-six sentences<sup>21</sup> in Sardinian-Italian were presented to the speakers. Twelve sentences were expected to include an aberrant metathetic cluster (*tfr* = 4 times; *tsr*, *mr*, *sr* = 3 times each), fourteen sentences included intervocalic rhotics and/or unmarked *Cr* clusters. In order to reduce the cognitive load<sup>22</sup>, some sentence included more than one target word, except those with an expected aberrant cluster (one per sentence). Sentences were presented in random order. Initially, unmarked clusters were not meant to be considered, but since six words included in word-initial position such sequences, /pr/, /kr/, /tr/ and /fr/ have also been analysed.

Aberrant clusters were expected in, e.g., <la carne di cinghiale è buona ma costa cara> (corresponding Campidanese translation [s:a 'βet:sa de zri'βɔni ε 'βɔna ma 'γɔsta 'm:ɛða] “wild boar meat tastes good, but it is expensive”), <verso le undici facciamo merenda a pane e formaggio> ([fa'tʃɔri de iz 'undizi mru'd:zauzu a 'p:ani e 'k:azu] “we are going to have bread and cheese for brunch around 11 a.m.”).

In this study, the parameters taken into account are: manner of articulation of the rhotic, duration of the rhotic (including the svarabhakti portion, when present), duration of the svarabhakti and closure portion separately. The annotation<sup>23</sup> system follows Celata, Vietti & Spreafico (2019). We have chosen such system since it is able to elegantly illustrate sub-portions of rhotics, particularly useful here in order to describe the vowel portion as part of the tap, that is a mere phonetic product, phonologically irrelevant.

#### 5.1 Intervocalic singleton /r/

As expected, in line with previous studies (Celata et al., 2016), three rhotic variants are found as allophones of singleton /r/: taps [ɾ], fricatives [ɹ] and approximants [ɻ]. Rhotics have been labelled as ‘approximants’ when they show a continuous formant structure and a reduced waveform. Busà (2013: 30), following Willing, Bradley

<sup>20</sup> Actually, given the rhotacised ([ʁ]) output of Latin intervocalic L, Suelli’s dialect should be associated to Central Campidanese as described in Viridis (1988). The Author inserts Trexenta, the area where the dialect *sub iudice* is spoken, within central-western Campidanese domain which is characterised by deletion of intervocalic /n/ and nasalisation of preceding vowels. Suelli’s dialect is devoid of such phenomena.

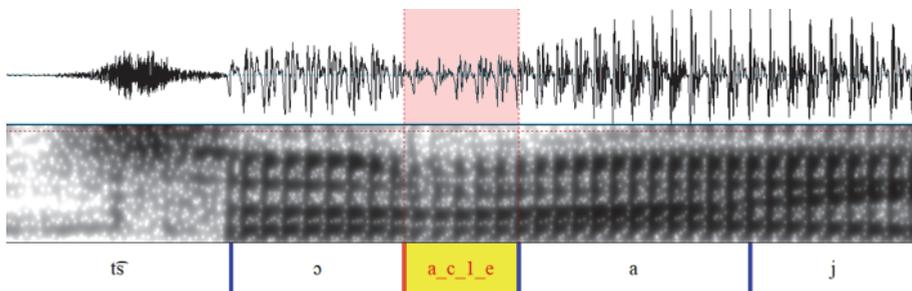
<sup>21</sup> Multiplied by number of speakers, a 440 sentences corpus was created.

<sup>22</sup> That is, to reduce the number of sentences to translate.

<sup>23</sup> The system conveys four pieces of information: (i) ‘r’ (trill), ‘t’ (tap), ‘f’ (fricative), ‘a’ (approximant); (ii) digits (that refer to the first, second, and so on, cycle of apertures/closures which are indicated by (iii) ‘a’ and ‘c’, respectively); (iv) ‘e’ (single-phase segment), ‘f’ (flanked by other infrasegmental rhotic portions), ‘r’ and ‘l’ (the last or first, respectively, portion of a multiple-phase rhotic).

(2008: 93), calls such variants ‘perceptual taps’, “produced like approximants”. Figure 1 shows a token of intervocalic [ɹ].

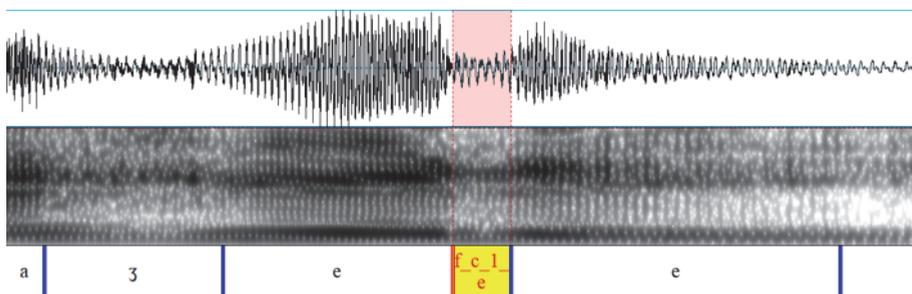
Figure 1- *Spectrogram of an approximant [ɹ] in the word Lotzorai, toponym*



Perceptually, they are indistinguishable from taps and speakers are not aware of the acoustic difference. It is strongly suggested that approximants and fricatives arise when there is no contact between articulators<sup>24</sup> during the realisation of an intended alveolar tap (see Celata et al., 2019: 114).

Rhotics fricatives are labelled as such if the formant structure is strongly reduced and the portion shows aperiodic noise (around 3000 Hz). They are exemplified in Figure 2.

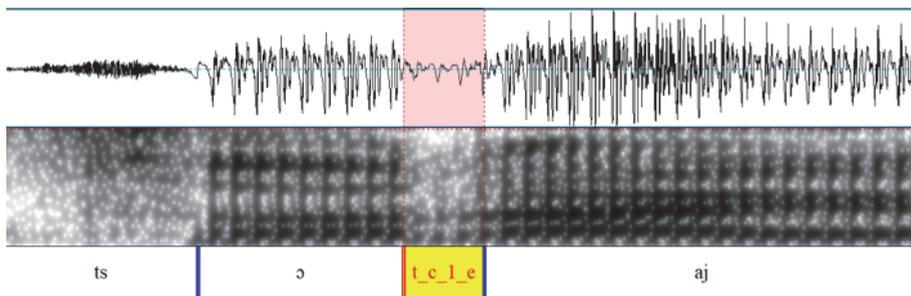
Figure 2 - *Spectrogram of a rhotic fricative in sa cereza “the cherry”*



In this case too, no perceptive difference is noticed, neither by the researcher, nor by the speaker.

In the dataset analysed, most of the rhotics labelled as a tap [ɹ] show a certain degree of frication or formant structure, even though very weak. Nevertheless, classification as [ɹ] has been chosen since the waveform is much more reduced than in approximants and fricatives, meaning that the tip of the tongue is extremely close to the alveolar ridge, even though this might sound arbitrary. Low accuracy of speech as that of this corpus might lead to the production of ‘incomplete’ taps as a general pattern. See Figure 3.

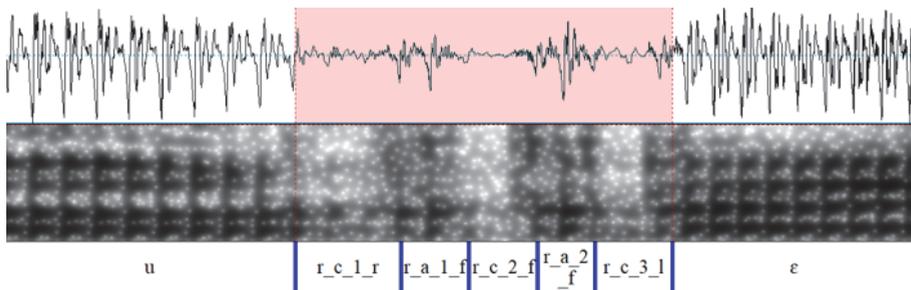
<sup>24</sup> In fricatives, the tongue tip sets closer to the alveolar ridge than in approximants.

Figure 3 - *Spectrogram of a tap [r] in Lotzorai, toponym*

No trilled rhotic occurs in singleton intervocalic environment, as expected (Contini, 1987). Considering all speakers and all occurrences of /r/, approximants are the most frequent tokens (39%), followed by taps (32%) and fricatives (29%). The mean duration of /r/ is 28 ms (st. dev. 10.7). There is anyway a great cross-individual variability as regards the rate of variants produced: some speakers never produced a tap, others produced only fricatives, one produced only taps, a few of them produced all variants. It seems then that speakers have individual patterns concerning the articulation of the rhotic and that this may not be influenced by the phonetic context, rather by speech accuracy. Further work should consider other variables in order to deeper understand the grounds of such scenario in Sardinian dialects.

### 5.2 Intervocalic geminate /r:/

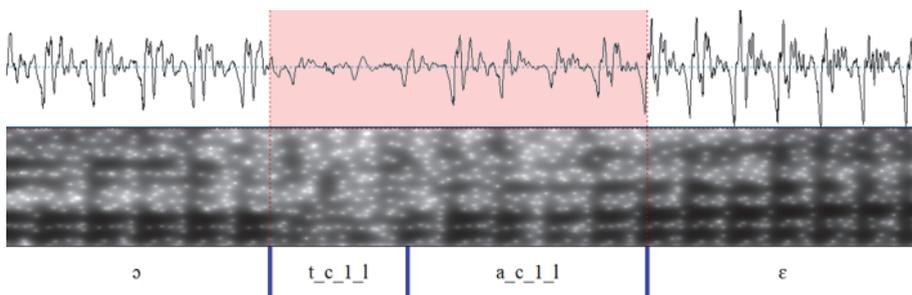
In this context, trills<sup>25</sup> are possible variants along with fricatives, approximants and taps; compound articulations are found too. By compound articulation it is meant a sequence of two rhotic variants ([rɹ], [r̥], [ɹ̥]). Articulations of this kind are reported also for Sicilian (Celata, Meluzzi & Ricci, 2016). Trills with an approximant ending have been labelled as trills [r] since this is the unmarked cross-linguistic pattern (Ladefoged, Maddieson, 1996). Only 5 tokens are single complete constriction rhotics, which have been labelled as taps (mean duration 27 ms). Voiceless trills are also found, as exemplified in Figure 4.

Figure 4 - *Spectrogram of a voiceless trill in su rei, “the king”*

<sup>25</sup> The unmarked rhotic allophone (Contini, 1987), for Italian see Bertinetto, Loporcaro (2005: 4).

Figure 5 represents a token of a compound rhotic articulation: a tap followed by an approximant [ɾ]. Articulations such as this one have been analysed as a sequence of rhotic consonants. They could be interpreted as trills in which the airflow energy quickly decreases or the tip of the tongue is not maintained close enough to the alveolar ridge for the whole duration of the segment, causing the failing in vibration.

Figure 5 - Spectrogram of a compound rhotic articulation [ɾ] in torrendi “coming back”



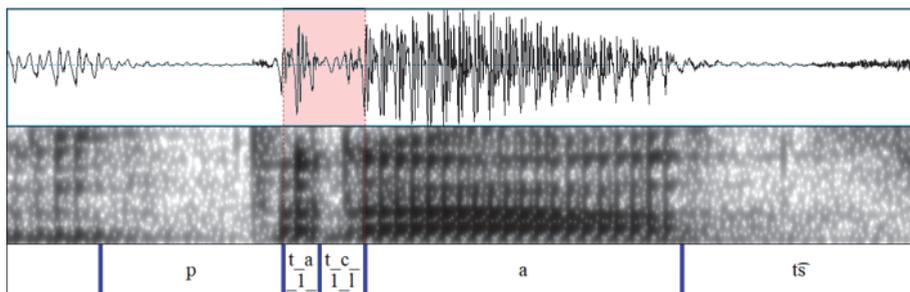
A reduced waveform is indeed visible in the middle of the approximant portion, indicating that the tongue preserves a certain degree of movement. Mean duration of intervocalic geminate rhotics is 77 ms (st. dev. 30.1). Trills and compound articulations are 27% and 26%, respectively, fricatives occur 34% and taps 5%. In this context too, the distribution of variants is cross-individually variable: two speakers produced only fricatives, two speakers realised only trills, others show a tendency towards compound articulations, the most of them produced more than two rhotic variants.

### 5.3 Postconsonantal rhotics

As regards unmarked *Cr* clusters, the pattern observed aligns with cross-linguistic data. Taps, approximants and rhotic fricatives are found (even though no trill) and two tokens of compound articulations. Concerning the latter variant, it is proposed the same description advanced in Section 5.2. Taps are always preceded by a vowel-like portion, which numerous other studies have defined as svarabhakti or the secondary product of the articulation of a tap (see Section 4.3 for a review). In the dataset, 52% are taps, 40% are approximants, 5% are fricatives, 3% are compound articulations (tap+approximants).

Nevertheless, special attention should be paid to the vowel portion preceding the rhotic closure. See Figure 6, which illustrates a tap.

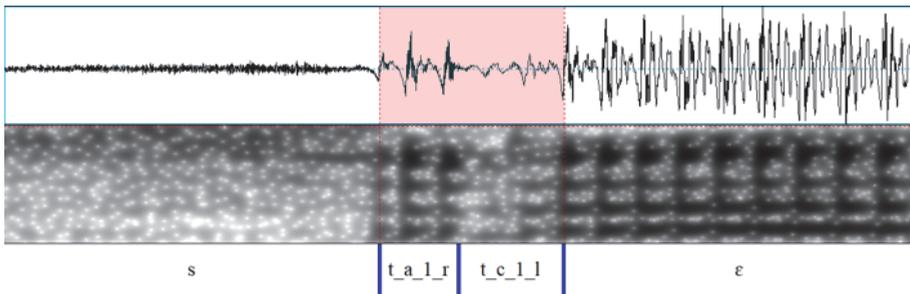
Figure 6 - Spectrogram of a tap in pratza “courtyard”



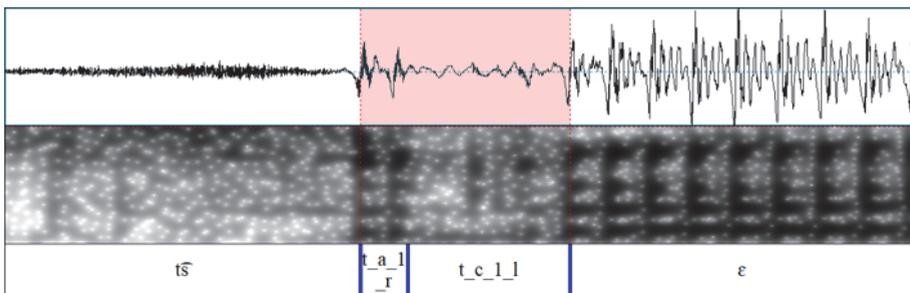
Postconsonant rhotics in unmarked clusters have a mean duration of 44 ms (st. dev. 15.4). Scarcity of tokens for this context do not allow for a deeper analysis of the behaviour of postconsonantal rhotics in Sardinian.

### 5.3.1 Postconsonantal rhotics in aberrant clusters

Data are presented analytically. The first cluster considered is *sr*. Sequences of alveolar fricatives and alveolar rhotics are characterised by antagonistic lingual configurations: fricatives require a tension of the tongue’s apical-laminal region and advanced dorsum, rhotics need a relaxed tip and retracted postdorsum (Solé, 2002a). In Spanish such complexity is repaired by the regressive assimilation of the fricative to the rhotic (Solé, 2002a); in Italian, an epenthetic voiced alveolar occlusion [d] between the two segments, along with an epenthetic vowel, may occur ([iz<sup>d</sup>ra’ele], [autobus<sup>d</sup>ros:o], Busà, 2013: 26). Based on the dataset analysed in this study, no particular pattern is observed in Sardinian (neither consonantal nor vocalic epenthesis is observed). Taps, fricatives, approximants and, rarely, trills occur as outcomes of the rhotic (46% fricatives, 27% taps, 14% approximants, 10% compound rhotics, 3% trills, total tokens: 42). Only rhotics with clear closure have been labelled as taps: those showing a slightly reduced waveform but having a formant structure indistinguishable from preceding vowel portion have been annotated as approximants (which has sometimes been called “perceptual taps”: Busà, 2013). Taps are always preceded by a vowel-like portion, which formant structure is very similar to that of approximants. Its mean duration is 34 ms, slightly longer than the closure phase (23 ms). An example is provided in Figure 7, where closure is longer than the svarabhakti.

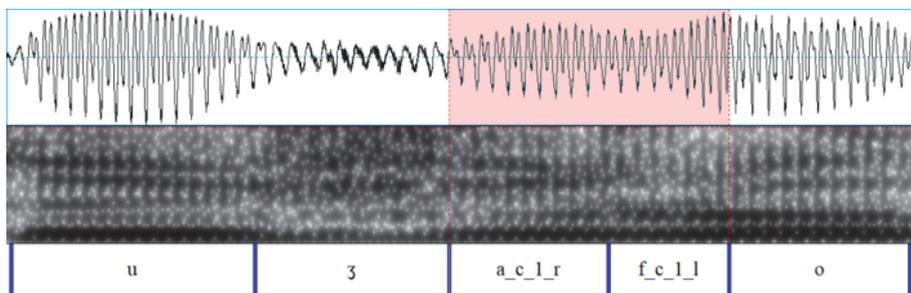
Figure 7 - *Spectrogram of a tap preceded by a vowel portion in cussreba “that grass”*

In *tsr* clusters the most occurring variant of the rhotic is the approximant (50%, total tokens 44). It is followed by taps (25%), fricatives (11%), trills and compound articulations (3% each). Taps are systematically preceded by a vowel-like portion. Its duration is variable across speakers, averaging from 10 ms to 50 ms. Figure 8 shows the realisation of a tap preceded by an extremely short vocalic portion (10 ms); closure phase is followed by a fricative release (33 ms in total).

Figure 8 - *Spectrogram of a tap in tzexpi “sprog”*

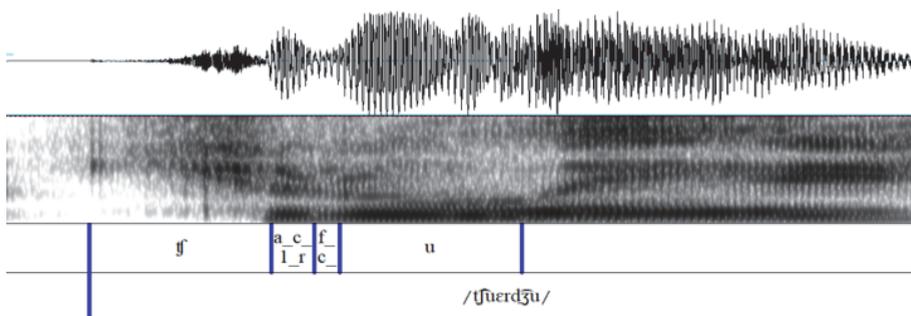
For what concerns *tʃr* clusters, to our knowledge, no study has ever dealt with the aerodynamics and articulatory characteristics of such consonantal group, maybe due to their high cross-linguistic markedness. The dataset at hand only concerns acoustic data: this implicates difficulties in determining the factors involved during the articulation of an alveolar rhotic preceded by a postalveolar affricate [tʃ]. Nevertheless, the aim of this paper is to investigate the presumably different spectrographically visible patterns of articulation of the rhotic in Campidanese Sardinian aberrant clusters. In this cluster, too, high variability is found: taps (22%), approximants (37%), fricatives (29%), trills (2%) and compound rhotics (10%) are attested. Recall from Section 3 that voiceless postalveolar affricate lenits to [ʒ] in intervocalic environment and to [ʃ] when preceded by /s/. So, tokens of actual [tʃr] clusters are very rare.

Figure 9 - Spectrogram of intervocalic [ʒr] in /sʊ tʃɔr'bed:u/ cluster resulted by the lenition of /tʃ/ in such position. The rhotic is analysed as made up of an approximant and a fricative portion



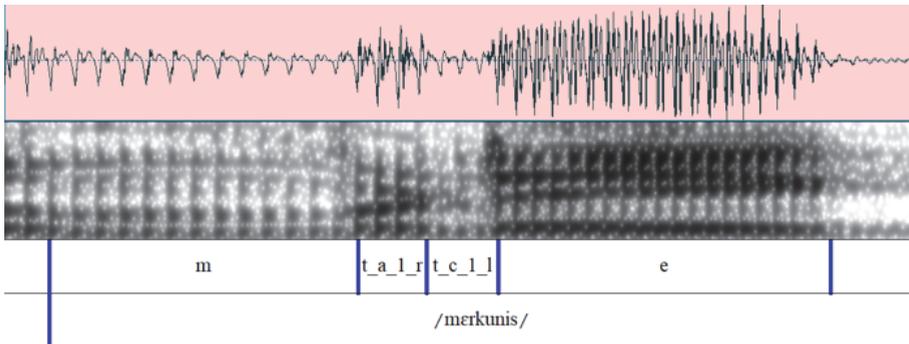
Actual [tʃr] realisations may only occur in absolute position or post-nasally. A token of this kind is shown in Figure 10. The female speaker produced the word [tʃru'eʒu] “oak” after a pause, so allowing the voiceless post-alveolar affricate to surface as such.

Figure 10 - Spectrogram of a post-pausal [tʃr] cluster in [tʃru'eʒu] “oak”



We finally consider *mr* clusters. Frigeni (2009) claims that after the bilabial nasal /m/, the rhotic consonant goes through nasalisation surfacing as [n]. We have not investigated such phenomenon in this study, since it seems to be only a phonetic sub-product and it does not have any phonological implication. Nevertheless, Frigeni (2009), too, reports that when the rhotic variant is a tap a small vowel between the preceding consonant and [r] occurs. She reports (*ibidem*: 113) that “some tokens [...] do not show either a disruptive vowel fragment or a rhotic portion”. What the spectrogram (Frigeni, 2009: 113) shows is an approximant of the same kind of those found in this study’s fieldwork data. The same set of variants described in previous sections is indeed observed also in nasal-rhotic clusters: taps (28%), approximants (56%), fricatives (7%), compound articulations (9%).

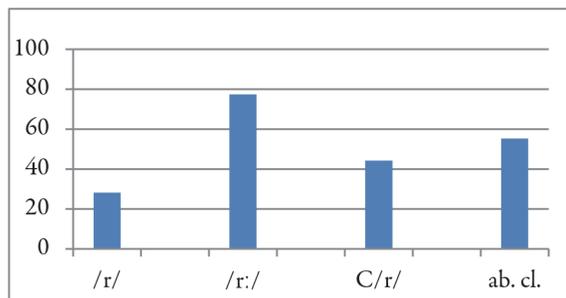
Figure 11 - Spectrogram of [mr] in /mrekunis/. Rhotic is produced as a tap



#### 5.4 Measurements and general considerations

In Table 1 we present the mean durations of rhotics in aberrant clusters, unmarked clusters and intervocalic context: aberrant clusters (general average is about 55,3 ms): fricative /s/+rhotics (58,8 ms), alveolar affricate /ts/+rhotic / (53,3 ms), post-alveolar affricate /tʃ/+rhotic (57,5 ms), bilabial nasal /m/+ rhotic (51,5 ms), unmarked clusters (44,2 ms), intervocalic singleton (28,2 ms), intervocalic geminate (77,3 ms).

Table 1 - Mean duration (ms) of the rhotic in all contexts considered



The mean duration of vowel portion and closure phase in taps is as follows, respectively: [sr] (34,6 ms; 23,7 ms), [tsr] (30,1 ms; 21,5 ms), [tʃr] (33,8 ms; 25,7 ms), [mr] (27,5 ms; 21,2 ms), unmarked clusters (25,3 ms; 19 ms).

For what concerns the quality of the vowel portion, no general consideration is possible since the dataset is not balanced: first, on a total of 261 postconsonantal rhotics, only 89 are taps. Vocalic context in which a tap may appear is highly variable, considered a seven vowel set ([i, u, ε, ə, e, o, a]) and 8 preceding underlying consonants plus their potential lenited form ([p, β, t, k, γ, s, z, f, v, m, ɲ, ʒ, ʃ, ts]). Such high variability in phonetic environments extremely reduces the possibility to assess an influence by the environment. No statistical analysis is thus possible. However, token by token measurement has been carried out. The data collected reveal a tendency for the vowel portion to be modulated accordingly to the following nucleus

(Busà, 2013). Due to space limitations, single values of first two formants of vowel portion and nucleus are not reported here.

### 6. Discussion and conclusions

This paper focused on the phonetic analysis of the rhotic consonant in Campidanese aberrant clusters compared to its phonetic behaviour in cross-linguistic unmarked clusters and in intervocalic environment (both singleton and geminate). Our aim was to find evidence corroborating the phonological analysis proposed, based on the rhotic behaviour described in other studies and concerning different languages which referred to analogous clusters (such as *mr* and *sr*). Unfortunately, the coda context is absent from the dataset. In fact, as we have claimed and illustrated in Section 2, rhotics in coda position have all been moved to the onset position. As a result, no heavy syllable including a rhotic in the rhyme is present in Suelli's dialect<sup>26</sup>.

Based on Suelli's dialect and literature data, we proposed a phonological analysis of typologically marked clusters as branching onsets. We hypothesised that if clusters have different phonological status, this could be mirrored in a different phonetic realisation. That is, if marked metathetic clusters are heterosyllabic (vs. tautosyllabicity of unmarked clusters, both metathetic or etymological), it is plausible to expect some different phonetic strategy, especially concerning what we called aberrant clusters. As it is claimed above, such hypothesis is justified by other studies' data on /sr/ and /mr/ clusters. As reported in Ségéral, Scheer (2005), in French, an epenthetic bilabial plosive [b] surfaced after that bilabial nasal /m/ and rhotic formed a consonantal cluster due to syncope of /e/ in e.g. the diachrony of CAM(E) RA > *chambre*. Authors analyse new [br] clusters as the realisation of /r/ in strong position, that is in post-coda position. According to the Authors, /mr/ clusters in French should have been interpreted as heterosyllabic. Analogously, Busà (2013) reports of an epenthetic alveolar plosive in the realisation of heterosyllabic /sr/ clusters in Italian, for example in *Israele* 'Israel'. Such patterns, attributed to the realisation of marked heterosyllabic clusters, are not observed in our corpus. We thus believe that absence of plosive epenthesis in [mr] and [sr] clusters (as well as in other sequences) in the dialect of Suelli may corroborate our conclusions concerning tautosyllabicity of metathetic marked clusters we presented in Section 3.

The phonetic analysis carried out shows that the same patterns of articulation of rhotics occur regardless of the markedness of the cluster. Four manners of articulation ([r, r̥, ɾ, ɽ]) plus compound rhotics have been found cross-contextually (post-consonantally and intervocalically). This does not tell us much about phonological status of Campidanese aberrant clusters, but it adds data on literature concerning Campidanese production of rhotics in consonantal clusters. Moreover, data show that trills and compound articulations may only occur as allophones of /r:/ or of cluster-internal /r/. We suggest that this fact might indicate that the gesture asso-

<sup>26</sup> With the exclusion of some very recent Italian loanword, not included in our corpus.

ciated to a postconsonantal rhotic in Campidanese dialect is an alveolar trill [r]. Recall from Section 5 that we have not found trills or compound rhotics in V/r/V context, but [r] may occur as an output of an intervocalic geminate rhotic.

In the postconsonantal environment, taps are always flanked by a short vowel, regardless of the clusters' markedness. This intrusive vowel is interpreted here as a phonetic sub-product arising during the movement of the tip of the tongue from its position in the preceding articulatory configuration to that required to produce a tap (or a trill, too). Data show that in homorganic clusters its duration is slightly longer than in heterorganic ones, increasing even more if *sr* or *tsr* clusters are concerned (supposedly, due to the antagonistic configurations of such segments). We suppose that, in clusters of this kind, more time is needed in order to set a sequential and different tongue configuration as compared to heterorganic clusters, resulting in a longer vowel portion. Speakers are not aware of its presence, neither in unmarked nor marked clusters. Further research is certainly needed to deeper investigate the patterns of occurrence of such vowel. A UTI or EPG study is strongly suggested. Nevertheless, the high variability concerning the set of rhotics inter-individually observed in all contexts<sup>27</sup> and the occurrence of a vowel portion in *Cr* clusters are interpreted as phonologically not pertinent. The phonological analysis along with the phonetic description proposed in this paper lead to homogeneously interpret unmarked and aberrant clusters in Campidanese as tautosyllabic. Therefore, Southern Sardinian (Campidanese dialectal group) may be considered a dialect having much looser phonotactic constraints in comparison with others Romance dialects.

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<sup>27</sup> In my corpus, variability concerning articulation of rhotics seems to depend on the speaker, rather than on phonetic context. Regardless of the vocalic context, some speaker tends to produce taps, others prefer approximants, but the most of them produce all variants in random-like fashion. We suggest that extralinguistic factors may have influenced the production of rhotics within our corpus.

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