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Rising and falling diphthongs in Romance languages: A study of the phonological string

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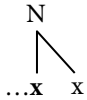
Abstract

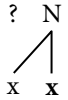
This article discusses the phonological status of diphthongs and their role in the melodic and rhythmic organization of vowel and consonant sequences. We examine the nature of rising diphthongs and their distribution in relation to syllabic structure. Structural approaches, such as GP, admit only falling diphthongs, insofar as only these respect the governing relation within the nucleus or rhyme, which requires the head to be on the left. However, rising diphthongs are widespread in languages and are subject to similar distributional constraints as falling diphthongs. The latter, in turn, also show realizations different from those generally considered canonical in the literature, such as English [ai] of my. Furthermore, not only rising but also falling diphthongs can occur in closed syllables. We argue for a model capable of unifying the treatment of diphthongs, aiming to achieve at least a descriptive adequacy. We adopt a CVCV approach, which aims to account for the organization of phonetic sequences and the licensing relations between vowels (and consonants) based on the melodic strength of the vowels.

Keywords: Diphthongs; stressed nucleus; CVCV model; relations in the sequence; phonological theory

1. Introduction

In metrical models and Government Phonology (GP) (Kaye 1990, Kaye et al. 1990), the vocalic sequences considered true diphthongs are associate with a falling melodic pattern, such as *ai, eu*, etc. of English [fain] *fine*, German [tsait] *Zeit* 'time', as in (1a). On the contrary, rising sequences, such as *wo, je,* etc., are analysed as contour segments or syllabic sequences. This approach allows for the fact that diphthongs typically occur in open syllables, where the head role in the branching nucleus is assigned to the first position, i.e. the fully vocalic part of the sequence. Thus, a binary nucleus with the head in the right position, as in (1b), is excluded.

(1) a. 

vs b. 

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Moreover, GP assumes that the nuclear head of diphthongs is an open vowel which governs a segment with a lower degree of sonority. Nevertheless, these requirements are frequently disregarded (Sections 1 and 2). Taking these points into account, we will investigate the nature and distribution of diphthongs, with the aim to define an adequate phonological framework, based on minimal phonetic requirements. The data we will analyze concern some Romance varieties[1] where stressed nuclei show various types of diphthongization:

- Rhaeto-Romance varieties, i.e. Romansh and Friulian
- Southern Italian varieties, where stressed nuclei show different realizations according to the syllabic structure
- Standard Italian and Spanish diphthongs
- Aromanian

These varieties provide counterexamples to the structural predictions of GP which show:

- falling diphthongs that, in addition to open syllables, also occur in closed syllables, as in (2a) for Romansh (cf. Section 4)
- types of falling diphthongs, in open and closed syllables, in which the nuclear head is a high vowel, as in (2b) for Friulian (cf. Sections 2 and 4),
- rising diphthongs in open syllables, as in (3a,a') for Italian, and in closed syllables, as in (3b,c), for Romansh and Spanish, discussed in Section 5.

(2)	a.	[daint]	'tooth'	Romansh (Zernez)
	b.	[vuarb]/[ˈvuarba]	'blind m/f'	Friulian (Vito d'Asio)
		[ˈpiaʃʃə]	'fish'	Ruvo (Apulia)
		[ˈmuaskə]	'fly'	

(3)	a.	[ˈmwɔve]	'(he) moves'	vs	[ˈmɔsso]	'moved'	Italian
	a'.	[ˈvjɛne]	'((s)he) comes'	vs	[ˈvɛŋgono]	'(they) come'	
	b.	[ˈswɔrda]	'deaf.f'				Romansh (Zernez)
	c.	[ˈhjerro]	'iron'				Spanish (Harris 1985)
		[ˈpwerta]	'door'				

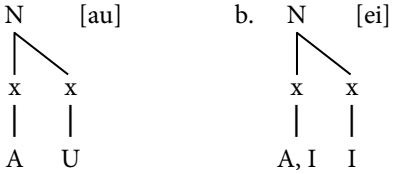
Section 6 illustrates a phenomenon of vowel hardening in a Romansh dialect and other types of diphthong reorganization that provide evidence in favor of the hypothesis that diphthongs are CV sequences, as we will discuss.

[1] All the data discussed and analyzed in this paper have been collected by the authors through field investigations with native speakers in recent years. We are very grateful to our informants for their irreplaceable and intelligent collaboration. They were aware of the type of research, knew the type of questionnaire and have given their consent to collaborate.

2. Rising diphthongs: a problem

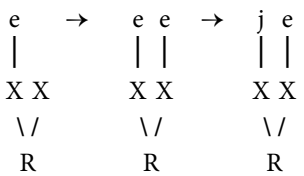
In Government Phonology (GP), the asymmetry between falling and rising diphthongs is derived from a universal constraint that requires left-right governing within constituents (Kaye 1986/1987, Kaye et al. 1990). Harris (1990) supports this solution by arguing that the head of the diphthong must be more complex than the element it governs, according to the Complexity Condition. Harris (1990: 276) considers only heavy diphthongs genuine, assuming that "in branching nuclei the governee can only ever be simplex"; so only nuclei as (4a,b) are true diphthongs.

(4) a. [au] b. [ei]



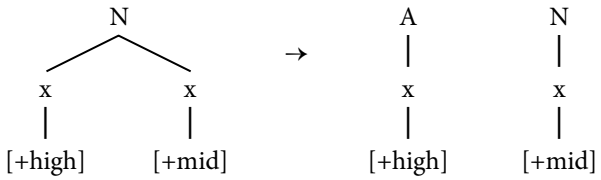
Nevertheless, in other approaches, complex nuclei including onglide sequences are admitted on the basis of general considerations concerning sonority prominence. For example, Harris (1985) analyses Spanish rising diphthongs, occurring both in open and closed syllables, cf. [ˈjerro] hierro 'iron', [ˈpwerta] puerta 'door', assuming that anyway the full vowel has the role of head in virtue of its sonority degree. Unlike Italian diphthongs, in Spanish, the sequences *ie* and *ue* also occur in closed syllable, cf. [ˈjerro] *hierro* 'iron', [ˈpwerta] *puerta* 'door'. Harris (1985) derives these sequences through a diphthongization rule which inserts a vocalic element *e/ o* in the second position of the complex rhymes in lexical bases that alternate between simple vowel and diphthong, as *njego/ negamos* '(I) deny/ (we) deny' e *pwedo / podemos* '(I) can/ (we) can'. A well-formedness constraint assigns to the syllable nucleus the highest sonority degree in the sequence, in (5), and to the second position of the nucleus the melodic prominence. As a consequence, the segment [e] of the Spanish diphthongs has the role of rhyme vocalic head, while the first segment is a semivowel. The result is that both the semivowel and the nucleus remain associated with the rhyme.

(5)



The data do not support a clear-cut distinction between rising and falling diphthongs based on their relationship with syllabic contexts. Booij (1989) faces the analysis of rising diphthongs/ sequences of Frisian, as for instance [bi̯emke] *beamke* 'tree+diminutive suffix', [fu̯otən] *fuotten* 'feet'. His proposal is based on the distributional properties that separate them from falling diphthongs, in [biəm] *beam* 'tree', [fuət] *foet* 'foot', etc. Booij notes that initial semivowel segments can combine with all vowels, also including long vowels and diphthongs, as in [fi̯ɔuər] *fjouwer* 'four'. This seems to suggest a special status of these sequences that can be accounted for by assuming a *breaking* rule that removes the first part [+high] from the nucleus and associates it with the onset, as in (6).

(6) (Booij, 1989: 326)



Needless to say, this analysis could also be applied to Spanish and Italian rising sequences. However, in Italian there is clear evidence that [i̯ɛ] and [u̯ɔ] depend on the syllabic structure. Thus, for example, [wɔ]/ [wo] in open syllables, as in [ku̯ɔtʃe] '(s)he cooks', in (7a), alternates with the simple nucleus [ɔ] in closed syllables, as in [kɔtto] 'cooked' in (7b). This supports the conclusion that the rising sequence is a true diphthong (Marotta 1988). The square brackets contain the segments corresponding to the syllable (σ).

(7) a. [σ x x x] [σ x x]
k u ɔ tʃ e

b. [σ x x x] [σ x x]
k ɔ t o

The fact that *ie* and *uo* have a distribution based on the nature of the rhyme, exactly as the falling diphthongs, leads to the conclusion that the structural constraints on the rhyme, specifically that its head is on the left, are inadequate.

3. Theoretical points

The basic principles of the phonological model proposed by Kaye (1990) and Kaye et al. (1990: 194, 211, 221) design phonetically based phonology, whereby 'Any mechanism that spreads 'something that isn't there' is banished' and any phonological process is motivated by its context. The intersegmental relationship is based on licensing, where a position licenses, i.e. authorizes another position based on the *Licensing Principle*: 'All phonological positions save one must be licensed within a domain. The unlicensed position is the head of this domain'. The so-called government is one form of licensing, which within complex syllabic constituents (Onset and Rhyme) works from left to right, while between constituents from right to left, as in the case of the coda-onset contexts. Only the nucleus (or its projection) can govern a constituent head, with the effect that only nuclei can influence each other.

An interesting point is that Kaye et al. (1990: 200) hypothesize a level of representation *Onset Rhyme*, understood as an arbitrary number of repetitions of the O R pattern. The idea is that a silent onset is also present between two adjacent nuclei, and that a consonant is followed by a nucleus, silent or realized, except in complex rhymes. Lowenstamm (1996: 14) extends the intuition that the basic elementary unit is CV, proposing that sequences are uniformly built by CV units (CVCV model). Therefore, consonant and vowel combinations include unrealized vowel nuclei and consonants. So, slightly reformulating Lowenstamm's representations, the geminate consonant [tt] of Italian word *latte* 'milk', has the representation in (8a), which differs from the more traditional metrical/ GP representation in (8b).

(8) a. [C V] [C ∅$_1$] [C V$_2$]
l a t e

b. [C V C] [C V]
l a t e

Empty nuclei are licensed by the following adjacent realized vowel, in the terms of requirement proposed by Kaye (1990); thus, in (9a), the vowel phonetically realized V_2 governs and licenses the preceding non-realized vowel $\varnothing_1$, making the geminate possible. Long vowels, such as [kɔ:rə] 'heart' (cf. (14b) in Section 4) are represented by the sequence in (9a) and not (9b). Again, V_2 makes the propagation of the content of V to the position $\varnothing_1$ possible, licensing this latter as an empty nucleus.

(9) a. [C V] [C $\varnothing_1$] [C V_2] b. [C V V] [C V]

k ɔ r ə k ɔ r ə

In (9) the government relation is limited to the relation between two adjacent positions, where a phonetically realized nucleus governs a left-handed V-position, licensing its content. Within the CVCV framework, Scheer (2004) distinguishes the government relation (Government, Gvt), which weakens or blocks the realization of the governed position, and licensing (Licensing, Lic), which supports or strengthens the licensed position (cf. Lai 2023). Furthermore, government prevails over licensing.

Scheer (2004: 4) notes that 'CVCV attempts at expressing all syllabic functions and syllable-related processes in terms of lateral relations, rather than with appeal to any kind of syllabic arborescence'. In the discussion that follows, we will adopt the model CVCV, in the direction of a minimalist analysis. In other words, we will avoid the structure-based approach to phonological analysis typical of metrical-syllabic models, in which structural constructions and specialized projections express melodic contents. We develop a minimalist analysis of strings substantially based on the operation of segment concatenation; in this, obviously, we are inspired by Chomsky's conceptualization (2020, 2021) in the direction of basic primitives. The combination of something like a C and something like a V seems to be able to trigger the recognition of sequences of syllables in the speaker's perception. This means that the structural representation of relations traditionally assumed as basic, between nuclei or between consonants and vowels, can be understood as introduced at the level of the SM (Sensory-Motor) system. Concretely, phonological sequences are organized around segments endowed with resonance/intensity properties that regulate the concatenation of consonants and vowels in order to favor their perceptibility.

Representations are formulated as autosegmental sequences of *x* positions associated with the melodic content of elements or segments[2]. The basic rule requires that in sequences of autosegments, of the type …*x x*…, a vowel is preceded by a consonant and a consonant is uniformly followed by a vowel. In the phonological string vowels determine rhythmic properties, realize the stress of the word or sentence and host tones and harmonic features. According to GP, each segment is licensed within CVCV domains by a licenser. Generally, a vowel licenses the a weak or

[2] As widely motivated in the first elaboration of the autsegmental model, the use of C and V for the positions in the string is redundant as it replicates the melodic content of segments. In other words, it is the melodic content that creates the position.

empty vowel in its field or, in some contexts, a consonant licenses the preceding consonant. In any case, licensing influences the phonetic properties of the licensee. The realized nuclei govern and license empty vocalic positions and the preceding adjacent consonant. Licensing underlies and regulates stress or diffusion/ propagation phenomena (cf. Savoia 2016, Savoia and Baldi 2016), and includes the legitimization/ authorization of ∅ positions. We must accept the idea that licensing is subject to parametric solution, in the sense that, for example, only in some languages processes such as syncope of weak vowel or harmonic assimilation are admitted. However, for the sake of clarity, we will use government for the licensing involving empty positions.

We note that the element analysis used in the representations is based on Backley (2011).

4. Diphthongs in closed syllables

As a first point, we address the issue of the presence of diphthongs, particularly falling diphthongs, in closed rhymes. This is a crucial counter-evidence to the structural requirement of the binarity of constituents, in this case rhyme. We begin by considering the distribution of stressed vowels in the Southern Italian dialect of Venosa (Basilicata), a classical vowel system sensitive to rhyme structure, where the stressed nuclei in closed rhymes are short vowels, mostly [-ATR], in (10a,a'), while in open rhymes falling diphthongs or long nuclei occur, as in (10b,b'). As in many other varieties, the stressed nucleus in antepenultimate position behaves as in closed rhymes, producing a short outcome, as in (10b"). In (10) the outcomes in open and closed syllables are compared (cf. Savoia and Carpitelli 2008, Savoia 2015).

(10) Venosa

a. Stressed vowels in open syllables

i:			u:	[+high, ATR] /	[I / U]
	e:	ə:	o:	[-high, ATR] /	[I, A / U, A], [A]
		ai au		[+low][+high]	/ [A, I], [A, U]

a'. [ai] [ˈrairə] '((s)he) laughs', [ˈmaisə] 'months'
[au] [ˈkraurə] 'raw', [ˈkausə] '(I) sew'
[e:] [ˈme:sə] 'month', [ˈme:tə] '(i) reap'
[o:] [nəˈpo:tə] 'nephew', [ˈʃo:kə] '(I) play'
[ə:] [ˈsə:lə] 'salt', [ˈlə:və] '(I) wash'

b. Stressed vowels in closed syllables

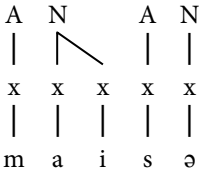
i	u	[+high, +ATR] /	[I / U]
ɪ	ʊ	[+high, -ATR] /	[I / U]
ɛ	ɔ	[-high, -ATR] /	[I, A / U, A]
	a	[+low] /	[A]

b' [ɪ] [ˈfɪʎʎə] 'son'
[ʊ] [ˈtʃʊttʃə] 'donkey', [ˈkʊrtə] 'short'
[ɛ] [aʃˈʃɛnnə] '((s)he) goes down', [auˈtʃɛrtə] 'lizard'
[ɔ] [ˈɔssərə] 'bones', [ˈvɔkkə] 'mouth'
[a] [ˈgaddə] 'cock'

b". [ˈrɪrənə] '(they) laugh'
[ˈkʊsənə] '(they) sew'

This distribution is a good example of the structural requirements of GP, where both diphthongs and long vowels cover two nuclear positions saturating the rhyme space, as in (11a,b). In the closed syllable the nucleus is simple, (11c).

(11) a.



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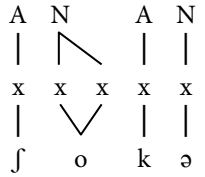
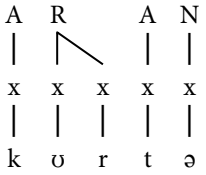


c.

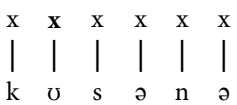


Length and complexity of the nucleus are the way to realize the stress; in other words, the stressed nature of a vowel is associated with two metrical positions, as captured by the Strong Rhyme condition, in (12), initially formulated by Chierchia (1982) for Italian stressed nuclei.

(12) *Strong Rhyme condition*: A stressed rhyme includes two positions

Authors generally consider (12) satisfied by the two positions of the nucleus or by the nucleus and the coda in its domain. However, the effect of the antepenultimate position seems to remain outside this explanation. On the contrary, it suggests that (12) is interpreted not so much by the syllabic structure as by the entire sequence. Thus, the interpretative role of the traditional syllabic structure is too restrictive. A further point of discussion is the definition of Foot, generally characterized as binary; once again, this goes against the distribution in (10b") which, instead, would seem to require a three-syllable foot (cf. The discussion in Bafile 1996, 1999). So, let us try to read the phenomena illustrated in (10) in terms of CV. What we see is that the three sequences have the same phonological organization, as in (13a,b,c). More precisely, on the basis of the hypotheses of Section 3, the empty nucleus in (13b) is licensed (governed) by the adjacent phonetically realized vowel on its right. In the case of (13c), two adjacent nuclei form a special domain, the diphthong.

(13) a.



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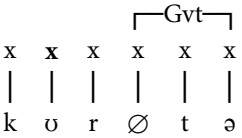

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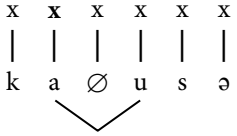


Thus, in these systems, (12) is satisfied by the context where the stressed head is followed by two CVs, or has two vowel units in its domain.

The interesting point is that this extension of the Strong Rhyme condition is not exhaustive. Indeed, there are systems in which the stressed nucleus is however complex,

regardless of the syllabic or Foot context. In the variety of Ruvo di Puglia (Apulia) complex nuclei such as [iɜ] / [iɐ], [uɐ] / [uɔ] in (14a,a') are the outcomes of etymological mid vowels in rhymes with a coda and in the anti-penultimate position of proparoxytones. In open syllable, we find long low-mid vowels [ɛː ɔː], or the diphthongs [ai au], as in (14b). The outputs of metaphony[3] [i(ː) u(ː)] are preserved with different duration in open and closed syllable, as in (14c). As shown by the examples in (14), where x in bold indicates the stressed vowel head, alternations such as [ai] ~ [iɐ], [ɛː] ~ [iɐ], [au] ~ [uɐ], [ɔː] ~ [uɐ] show up according to the syllabic context.

(14) Ruvo di Puglia[4]

a.	[ˈpiɐʃʃə]	'fish'	b.	[ˈmaisə]	'month'
	[ˈdiɐntə]	'tooth'		[ˈpɛːdə]	'footh'
	[ˈpiɐddə]	'skin'			
	[ˈvuɔkkə]	'mouth'		[ˈnauʃə]	'walnut'
	[ˈmuɔskə]	'fly'		[ˈkɔːrə]	'heart'
	[ˈkuɐrtə]	'short.f'		[ˈnɔːvə]	'new.f'
	[ˈnuɐttə]	'night'			
a'.	[ˈviɐnənə]	'they.come'		[ˈvɛːnə]	'(s)he.comes'
	[ˈviɐdənə]	'they.see'		[ˈvaidə]	'I.see'
	[nəˈpuɐtə-mə]	'nephew-my'		[nəˈpautə]	'nephew'
	[ˈsuɐrə-tə]	'sister-your'		[ˈsɔːrə]	'sister'

c. *Metaphonic outcomes of low-mid lexical stressed vow*els

[ˈviːnə]	'you.come'
[ˈdintə]	'teeth'
[ˈpiʃʃə]	'fishes'
[ˈnuːvə]	'new.m'
[ˈkurtə]	'short.m'

As illustrated by the data in (14), the falling diphthongs of the type [ai], [au], etc. and long vowels occur in rhymes devoid of the coda. On the contrary, the diphthongs with the second part [-high], as [iɜ] / [iɐ] / [uɐ] / [uɔ], are associated with rhymes closed by the coda, and with the stressed position of proparoxytones. This distribution, insensitive to the syllabic or Foot structure, shows that the requirement of Strong Rhyme for the stressed nucleus is satisfied by the prominent sonority of the vowel regardless of the presence of the coda in the tonic rhyme.

Diphthongs, then, exhibit specialized phonological properties to manifest the melodic pitch, tenseness, and duration of the stressed nucleus, rather than to reflect the structural organization of the sequence. Returning to the diphthongs in (14a), we see that the second part of the vowel group has the properties more usually associated with the rhyme head, in particular the degree of aperture. Indeed, as noted, in diphthongs such as [ai], of English

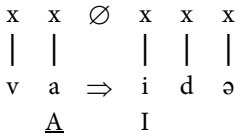
[3] Metaphony is a harmonic process widespread in the dialects of Southern Italy, which involves the assimilation of the height of the stressed vowel to the height of the final vowel. It presents different patterns, as discussed in Maiden (1991) and Savoia (2015, 2016); in the dialect of Ruvo, metaphony raises the original mid vowels to [i u] before the final /i u/.

[4] We are grateful to our main informant, Vincenzo Stragapede.

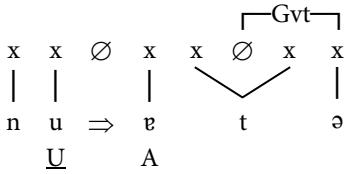
[mais] *mice*, [au] of [mauθ] *mouth*, etc., the second segment is [+high, -ATR], or, in terms of elements, [I / U].On the contrary, in the diphthongs like [iɐ]/ [iə], [uɐ]/ [uə] / [uɔ] in (14a), the first segment is [+high]/ [I / U] , while the second is [-high,+low] or [-high,-low], i.e. headed by [A], more open than the initial segment. The representations (15) provides the analyses of the two types of falling diphthongs: in (15a) we find sequence in open syllable with the (mid-)low vowel in head position, associated with the content [A]; in (15b) a falling diphthong with the head [I] in closed syllable, is represented. The positions indicated as ∅ are positions C not realized.

(15) Ruvo di Puglia

a.



b.



In discussing (13c), we have noted that the relation between two adjacent nuclei displays special properties between the two vowels. We express this by assuming that the falling diphthongs in (15a) and (15b) correspond to a domain in which the stressed nucleus, here on the left, licenses the following vocalic part (*Internuclear adjacency relation*). Such a specialized relation, expressed by the arrow ⇒, is able to license the intermediate position ∅. This implies the hypothesis that some contexts give rise a special licensing capacity, as, in the case of consonant sequences, the domain of *muta cum liquida* (cf. *Infrasegmental Government*, Scheer 2004: 37, Lai 2022: 36 ff.). In (15b), the intermediate vowel is governed by the final vowel and is not realized. The consonant content can be associated with two C positions and gives rise to a geminate.

In summary, we analyze diphthongs as vowel sequences, where one segment (the head) licenses the other. The nuclei have harmonic properties that depend on the melodic strength of the licensing element, which determines the direction of the relationship: left to right in falling sequences.

5. Rising diphthongs

We now address the problem of rising diphthongs. In Romansh spoken in Engadine and Surselva diphthongs occur both in the open position, (16a), __C#/ __CV#, and in the closed position, (16b). (cf. Savoia 2015, Baldi and Savoia 2017). The variety of Zernez (Engadine) distinguishes long vowels and diphthongs, [i:] < **i*, [y:] < **u*, [ai] < **e:*, [e(i)] < **ɛ*, [u:] < **o*, [ou] < **ɔ*, both associated with open contexts, __C(V)#, from short vowels, which occur in closed contexts, __CC(V)#. The latter also host the diphthongs [wɔ] (< **o*) and, before the sequence *nasal-C*, [ai] (< **e*). A subset of forms presents [ø] (< **ɔ*), giving rise to alternations as [uˈdzø:l]/ [uˈdzoulɑ] 'kid.m/f'. Finally, the outcome [ɔ] corresponds to /a/ in nasal contexts.

(16) Zernez

a. *open rhyme*

i:		u:
y:		
e(i)		ou
ø:		
		ɔ:
	aɪ	
	a:	

a'.	[na:s]	'nose'	[mais]	'month/s'
	[sait]	'thirst'	[ˈsaira]	'evening'
	[pe:]/[peis]	'foot/ feet'	[ˈleivrɑ]	'hare'
	[uˈdzø:l], [vø:t]	'kid', 'empty.m'	[ˈvø:dɑ]	'empty.f'
	[nouf]	'new.m'	[ˈnouvɑ]	'new.f',
	[vu:ʃ], [nu:ʃ]	'voice', 'walnut'	[ˈroudɑ]	'wheel'

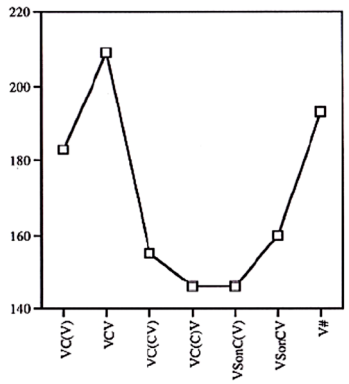
b. *closed rhyme*

i y	u	[LF1]
ø		
ɛ	ɔ	
	wɔ	[HF1]
aɪ		
a		

b'.	[lat]	'milk'	[sɛtʃ]/[ˈsɛtʃɑ]	'dry.m/f'
	[(ɛu) ˈmɛt]	'(I) put'		
	[pɛl]	'skin'		
	[fwɔrn(ts)]	'oven.sg/pl'	[ˈmwɔʃtʃɑ]	'fly'
	[swɔrt]/ [ˈswɔrdɑ]	'deaf.m/f.'	[ˈbwɔtʃɑ]	'mouth'

Significant differences based on the t-student test contrast the nucleus duration in open and closed contexts as the plot in (17)[5] highlights, where the Y axis reports the duration in msec. and the X axis the contexts, where Son = a pre-consonant Sonorant, *r*, *l* or *N*. The value of the oxytone context …ˈV# is aligned to the averages of open contexts. The strongest difference contrasts ˈVC(V)# and ˈVCV# with closed syllables, with and original geminate ˈVC(C)V# or with the sequence *coda-onset*.

(17) Zernez (Baldi and Savoia 2017: 66)



[5] In (17) the averages are calculated on the basis of a corpus of realizations collected throughout field investigations with a native speaker, and analyzed by means of the Multi-Speech, Model 3700.

As a first step, we analyze long vowels and falling diphthongs in canonical contexts __ CV, such as [saira] 'evening', using the same analysis given in (15a,b). Long outcomes in the contexts __C# can be analyzed as a sequence in which the final empty vowel is legitimized, as in (18b). The intermediate position ∅ is licensed by the internuclear relationship between the two adjacent left-headed vowels.

(18) Zernez

a.
x	x	∅	x	x	x
|	|		|	|	|
s	a	⇒	i	r	a
	A		I		

b.
x	x	∅	x	x	x
|	|		|	|	|
s	a	⇒	i	t	∅
	A		I		

The rising diphthong [wɔ] is limited to the only context of closed syllable, __CC(V)#. In the case of rising diphthongs, it is the right vowel that presents the most sonorous content including the A head, as in (19a,b)[6]. Therefore, in keeping with the idea that licensing and government are defined by the melodic properties, the second vowel is able to govern and license the left part of the diphthong. The semivowel part shows a more reduced content, devoid of a headed element, less fully vocalic.

(19) Zernez

a.
					┌Gvt┐		
x	x	x	x	x	x	x	x
|	|		|	|	|	|	|
s	u	⇐	ɔ	r	∅	d	∅
	U		U				
			A				

b.
					┌Gvt┐		
x	x	x	x	x	x	x	x
|	|		|	|	|	|	|
s	u	⇐	ɔ	r	∅	d	a
	U		U				
			A				

As suggested in (19a,b), the (empty) final nucleus in these varieties is able to govern and license the intermediate nucleus ∅. Again, exactly like falling outcomes seen in Section 4, these diphthongs implement the *Strong rhyme condition* in (12), whereby the sonority prominence is the relevant property. As a result, the two types of vocalic sequences can have the same distribution.

A similar distribution characterizes Friulian varieties, in which the context __CV#[7] determines short vowels, as closed syllables (Rizzolatti 1979, Vanelli 1979, Baldi and Savoia

[6] An anonymous reviewer asks 'how is (19) different from (14b)? what is the basis of the decision as to what is headed, and what direction of licensing is present? Is this analysis not circular?'. Our analysis is based on the phonetic properties of the sequences we are investigating. The direction of licensing reproduces the different phonetic strength of the two members of the diphthong, normally recognizable in many languages, including standard Italian and Spanish. Of course, we could assume that the different prosodic direction of diphthongs is a surface effect and reduce all diphthongs to an abstract head-dependent structure. But this is exactly what we do not want to do: phonological properties, such as phonetic contrasts, are phonetic and are part of the neurological level of phonetic competence.

[7] An anonymous reviewer asks for some explanation on this point. Friulian varieties, belonging to Rhaeto-Romance group, are characterized by this particular restriction, whereby the __CV# context selects the same set of stressed nuclei as closed syllable, as documented in the reported references.

2017). If we look at the diphthongs, we see that the ascending results occur both in the open original syllables (*__CV), (20a), and in the closed ones, (20b).The examples in (20a',b') illustrate sequences with the final vowel. (20c) provides the rising diphthong [ˈrweda] 'wheel', and (20d) the falling one [siat] 'thirst'. Falling diphthongs are very different from canonical patterns such as *ai*, *au*, *ei*, *eu*, etc., but, like other systems discussed in this paper, they generally show the more open element in second non-prominent position, such as in *ia, ua*, etc.

(20) Vito d'Asio

a.	[siat]	'thirst'	a'	[ˈsɛra]	'evening'
	[nouf]	'new.m'		[ˈnɔva]	'new.f'
	[kuaʃ]	'(I) cook'			
b.	[sjet]	'seven'	b'	[ˈpjera]	'stone'
	[kwel]	'neck'		[ˈrweda]	'wheel'

c.

x	x	x		x	x	x
|	|			|	|	|
r	u		⇐	e	d	a
	U			I		
				A		

d.

x	x	x		x	x	x
|	|			|	|	|
s	i		⇒	a	t	∅
	I			A		

The wide diffusion of rising diphthongs is, obviously, a proof of their unmarkedness. For example, they occur in many Sicilian varieties regardless the syllabic context, therefore in open and closed syllables, in (21a) and (21b).

(21) S. Marco d'Alunzio

a.	[ˈpjɛrɪ]	'foot/feet'	b.	[asˈpjɛttu]	'appearence'
	[ˈkwɔrɪ]	'heart/s'		[ˈrwɔrmu]	'(I) sleep'

In Daco-Romanian and Aromanian varieties, rising diphthongs appear as the result of the stressed mid vowels in non-metaphonic contexts, as for instance, in (22a) for the Fërshërot Aromanian variety of Korça (Albania). The diphthong alternates with a simple vowel in metaphonic contexts, as in (22b). We can assign the representation in (22c) to the vowel sequences.

(22) Korça (Aromanian)

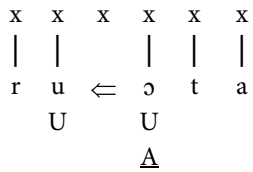
a.	[ˈfiat-a]	'the girl'	b.	[ˈfɛt-i-li]	'the girls'
	[ˈkuad-a]	'the tail'		[ˈkod-li]	'the tails'
	[ˈbuats-i]	'voice'			

c.

x	x	x		x	x	x
|	|			|	|	|
b	u		⇐	a	ts	i
	U			A		

Considering the previous discussion, it is natural to apply this analysis to Italian rising diphthongs [wɔ] and [jɛ], as in (23) (cf. Savoia and Baldi 2018). As noted, these diphthongs occur only in open rhymes, exactly like typical falling diphthongs.

(23)



We see that a sufficiently rich empirical basis shows that (i) not all falling diphthongs correspond to the canonical type adopted in the literature, (ii) rising diphthongs can present the same distributional restriction as falling ones, (iii) both falling and rising diphthongs can occur in closed rhymes. These data support a phonological model able to account for both types of diphthongs.

6. Hardening and other processes implementing CV sequences

The CVCV hypothesis finds interesting evidence in the phenomena that decompose diphthongs in CV units. The first example is the Surmiran varieties from the upper Engadin (Surses valley). In these dialects a hardening process changes the semi-vowel of the falling diphthongs [ei ɛi ou] and the second part of the long vowels [i: o:] into the obstruent [k]. A certain degree of variability emerges in the performance of informants. This process is documented in Gartner (1893), Haimann and Benincà (1972), and in Lutta (1923) for Bergün. Kamprath (1988) and Montreuil (1990, 1999) provide some proposals for analysis.

The data in (24)-(25) are produced by speakers of Mulegns and Rona, two villages of Surses Valley[8]. In the stressed position of open syllables, we find long vowels and the diphthongs [ei] and [ou]; note that [e] and [ei] are also the result of the original **u*. The second part of these diphthongs or long vowels is hardened into a velar stop, as exemplified for Mulegns in (24a,a') and for Rona in (25a,a') in the case of the front long vowels/diphthongs and in (24b)-(25b) of the back sequences. Hardening is generalized before [r] in (24a)-(25a) and [s ʃ t] in (24a',b)-(25a',b); it is also admitted before other obstruents, as in [nɛkf] 'snow', in (24a'). It is excluded before [l] and a final palatal nasal segment, as in (24d)-(25d). Comparison data in (24c)-(25c) show that the process is mostly limited to *__C(s)#* contexts, whereas in *__CV* contexts the diphthong or [i: u:] generally occur.

(24) Mulegns

a.	[nikr]	'to come'	c.	[(ia) viɲ]	'(I) come'
	[rekr]	'to laugh'		[(ia) rei]	'(I) laugh'
	[nɛkr(s)]	'black.m/s'		[ˈnɛira]	'black.f'
	[dekr(s)]	'hard.m/s'		[ˈdeira]	'hard.f'
a'.	[mɛks]	'month/s'			
	[vekt]	'empty.m'		[ˈveida]	'empty.f'
	[grikʃ]	'grey.m'		[ˈgri:ʒa]	'grey.f'
	[nɛkf]	'snow'		[(i) ˈnɛiva]	'(it) snows'
b.	[nokʃ]	'walnut'		[ˈoura]	'hour'
	[dokʃ]/ [ˈdokʃa]	'sweet.m/f'			
	[peiˈloks]/ [peiˈlous]	'hairy.m' /		[peiˈlouza]	'hairy.f'
d.	[mɛil]	'apple-tree'			
	[avjoul]	'bee'			

[8] We are grateful to our informants, in particular Niccolò Lotza (Rona) and Otto Poltera (Mulegns).

(25) Rona

a.	[vɛkr] / [vɛir]	'true.m'	c.	[ˈvɛira]	'true.f'
	[dekr(s)] / [deir(s)]	'hard.m/s'		[ˈdeira]	'hard.f'
a'.	[pɛks] / [pɛis]	'feet'		[pɛ]	'foot'
	[frɛkt] / [frɛit]	'cold.m'		[ˈfrɛida]	'cold.f'
	[grikʃ] / [greiʃ]	'grey.m'		[ˈgreiʒa]	'grey.f'
	[nɛkf]/ [nɛif]	'snow'		[(i) ˈnɛiva]	'(it) snows'
b.	[krokʃ]/ [krouʃ]	'cross'		[ˈɔura]	'hour'
	[flokr(s)] / [flour]	'flower/s'			
d.	[feil]	'thread'			

Kamprath (1988) and Montreuil (1990, 1999) propose that [k] is a parasitic segment inserted as the second part of the nucleus, i.e. as a sort of consonant *glide*, however included inside the nucleus. Although it is anomalous, this structure is supported, according to Kamprath, by the fact that this consonant is not subject to resyllabification and do not give rise to epenthesis. The latter is otherwise attested in sequences *C-Sonorant*, as in (26a), but not in sequences *Coda-Onset*, in (26b,c). Other contexts, in (26d) show variable outcomes. Moreover, these dialects lack the final cluster *kl*, because original *k-l* sequences have phonetically changed to *ʎ*, as in (26e), or show a different outcome, such as in [ˈʃpivəl] 'mirror', in (26a), where *v* replaced the original *k*.

(26) Mulegns

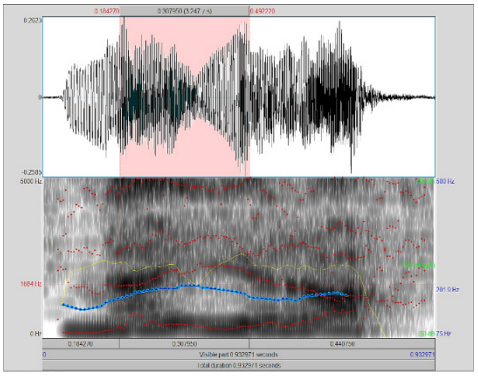
a. [ˈvɛdər(s)] 'glass/s', [ˈʃpivəl] 'mirror'
b. [furn] 'oven', [ia ˈdɔrm] 'I sleep'
c. [daint(s)] 'tooth/ teeth', [surt] / [ˈsurda] 'deaf.m/.f'
d. [ˈkotʃən]/ [ˈkotʃna] 'red.m/.f'
e. [viʎ] / [ˈviʎa] 'old.m/f'

The fact that the sequences *kr* created by hardening do not undergo epenthesis suggests that the structure of those clusters is different from that of clusters in (26a). In fact, we woud expect epenthesis before [r], i.e. *[ˈvɛkər] and not [vɛkr] 'true.m', as it is.

The spectrograms in (27a,b) compare the sequence [nɛkr] with hardening, and the corresponding diphthong in __CV context, in [ˈnɛira], (cf. (24a',c)). In (27c) the spectrogram of [la ˈnukʃ] is presented. Diphthongs have an average duration of 300 ms, for instance 307 ms in the case of [ˈnɛira] in (27a). In hardened realizations, the duration is divided between the vowel and the consonant. Thus, for example, in [nɛkr] in (27b) the vowel duration is about 138 ms and that of the consonant about 180 ms. [nukʃ] in (27c) shows similar values, i.e. 165 ms for the vowel and 190 ms for the consonant.

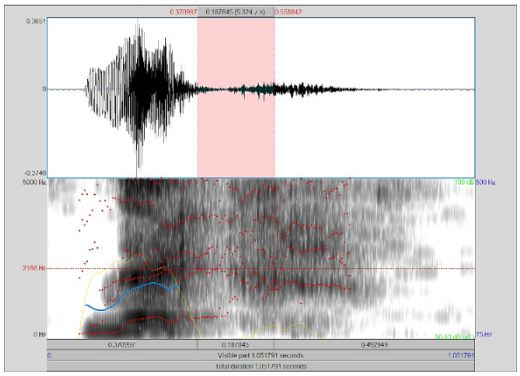
(27) Mulegns

a.



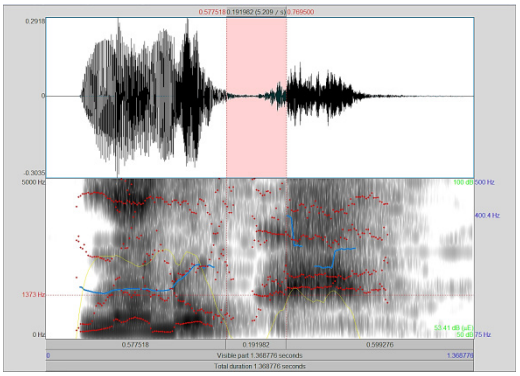
[n ɛ i r a]

b.



[n ɛ k r]

c.



[l a n u k ʃ]

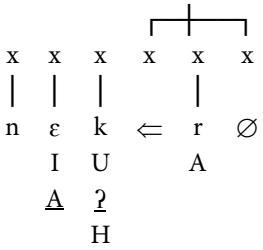
As shown by acoustic analysis, hardening is a way to realize the time extension of the diphthong or long vowel. It is realized by a velar stop [U ʔ H] in contexts where a coronal [r s t] or a postalveolar [ʃ] follow. Hardening is blocked in all other contexts (with velar, lateral and nasal segments); labials are in turn excluded except for the fricative [f]. The process, therefore, results in a sort of dissimilation. Indeed, the following segments with [U], i.e. labials and velar, are excluded and only coronals with the cavity element [A] and palatals with [I] are allowed (Backley 2011). The fricative [f] is however a possible target. This process seems to optimize the perceptibility of the two parts of the sequence and recalls the phenomena where a 'vulnerable' property of the sequence is augmented and maximized in contexts where its recognizability is relevant (cf. Kaun 2004, Nevins 2010).

However, other phonological factors are involved. In fact, in addition to the restrictions on place properties, manner of articulation is crucial, as it selects fricatives and, except for [t], excludes stops and voiced obstruents. In the framework we have outlined, the core domain created by hardening is the sequence *muta cum liquida*. Adopting the conclusion of Scheer (2004: 37) that in the *muta cum liquida* contexts the liquid licenses the obstruent (*Infrasegmental Government*), we obtain the representation in (28a). In this domain, the interconsonantal government relation licenses the empty intermediate nucleus. This may explain why hardening is associated with a context in which the final vowel is not realized and therefore cannot license the intermediate empty nucleus. In (28b), the corresponding

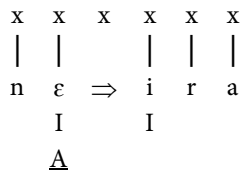
diphthong includes the *Internuclear adjacency relation* already explored in Section 4 as the basic property of diphthongs and vocalic sequences.

(28) Mulegns

a.



b.

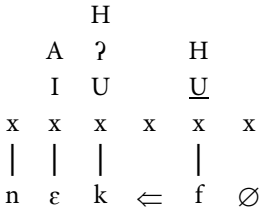


Hardening is admitted only with [r], whereas [l] is excluded; furthermore, ∅ is also allowed with *obstruent+obstruent* clusters, *…kf* and *…kf*. It is of note that in GP approach the obstruent and the liquid form a complex onset where it is the obstruent that governs the following segment; however, even GP would have a similar difficulty in accounting for the sequence *obstruent+∅+obstruent+∅#*. A possible explanation is that fricatives, as more sonorous than voiceless stops, are admitted, regardless of their cavity property. In other words, the interconsonantal relation can depend on the scale of sonority in (29), proposed for example by Kiparsky (1979: 432) to regulate syllabification.

(29) stops, fricatives, nasals, laterals, rhotics, glides, high vowels, mid vowels, low vowels

If sonority means 'perceptibility', as noted by Clements (1990), the higher sonority of [s ʃ f], that is particularly noisy obstruents, is derived. We can therefore expect them to govern [k], as in (30).

(30)



Nevertheless, the relative sonority of certain segments can vary. This is the case of the coronal [t], which many authors consider unmarked for the place specification, thus accounting for its transparency to vowel harmonies and its availability to assimilation phenomena (Paradis and Prunet 1989; cf. Clements 1990: 311 ff.). Backley (2011) notes that the coronal label includes different places, suggesting that what is common is the property [A], i.e. a high F1. This can justify the ability of [t] to present a special distribution in languages (Clements 1990: 312), and, in our contexts to follow a stop and govern it.

Finally, [l] does not work as a licensing element in the contexts we are examining. However, in these varieties, the cluster *kl* is admitted, as for instance in [i klɔman] 'they call, lit. SCl call-3pl', except for in final position. We must conclude that the melodic content of laterals as well as of nasals make them unsuitable as licensers. In the analysis of Backley (2011) they share the element [ʔ]. Hence, the coronal stop is licensed by virtue of its element [A], whereas the sonorants with [ʔ] are discarded as potential licensers. However, while nasals are

generally excluded from the second position of onsets, this does not hold for laterals. Hence we need to think that the following vowel can contribute to the interconsonantal relationship and that in the case of an empty vowel, the latter is unable to license *-l* because of its weak melodic content. As for sequences such as [ˈvɛdər(s)] 'glass/s' in (26a), they show a different organization, in which the intermediate vowel is realized in presence of an empty nucleus on its right. This metrical solution, attested in languages with the alternation syncope/ epenthesis (Kaye et al. 1990), is part of the lexical representation of the Consonant-Lateral sequences different from the diphthong contexts.

Other processes are documented that insert a segment, so as to yield a CV sequence. Limiting ourselves to the Romance domain, this is the case of those Southern Italian systems, as the Apulian dialect of Molfetta (Savoia 2015), where a second nucleus can be inserted with the result to change a sequence of two vocalic positions [$_{N}$ x x] to a sequence [x C x], and to give rise to alternations such as [ai] vs [ajə]. In the diphthongs in (31i) the head is [ɛ a], in those in (31ii) and (31iii) the head is [ə].

(31) Molfetta

i.	[frəmˈmɛikə] / [frəmˈmɛjəkə]	'ant'	ii.	[ˈpəitə] / [ˈpəjətə]	'feet'
	[ˈmaisə] / [ˈmajəsə]	'months'		[aˈpəirtə] / [aˈpəjərtə]	'open'
	[ˈkrautə] / [ˈkrawətə]	'raw'		[ˈprəivətə] / [ˈprəjəvətə]	'priests'
iii.	[ˈʃəukə] / [ˈʃəwəkə]	'((s)he) plays'			
	[ˈəuccə] / [ˈəwəccə]	'eye'			

Similar alternations emerge in other Italian southern dialects in contexts deriving from the velarization of an original lateral, where we have [au] / [awə] (from **lC*), as for instance in (32).

(32) Nocara (Calabria)

[ˈkawəðə] / [ˈkawðə] 'hot'
[ˈɣawətə] / [ˈɣawtə] 'high'

The CV model allows this process to be accounted for in a natural way, simply assuming the realignment between the alternants, as in (33a) and (33b). In (33a) the *Internuclear adjacence relation* is applied, generating a falling diphthong. In (33b) the melodic content of the semivowel segment is interpreted as the intermediate onset, and the following nucleus is licensed by the stressed head in its domain. This is realized as [ə], i.e. the canonical weak realization of pot-tonic nuclei in these varieties.

(33) a.

x	x	∅	x	x	x
|	|		|	|	|
m	a	⇒	i	s	ə

b.

x	x	x	x	x	x
|	|	|	|	|	|
m	a	i	ə	s	ə
	└	>	┘		

The model satisfies the Projection principle (cf. Section 2), which requires that the CV positions and their relations at the lexical level are preserved through the derivation (Kaye 1986/87, Kaye et al. 1990). Finally, the varieties we are considering show other processes able

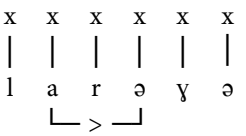
to restore CV, as the insertion of [ɣ] before initial vowels, in (34a), and the insertion of a weak nucleus in liquid-obstruent contexts, as in (34b).

(34) Nocara

a. [ˈɣawətə] 'high'
[ˈɣɛrəvə] 'grass'
b. [ˈlarəɣə] (from **largə*) 'large'
[ˈkuərəvə] (from **kuərvə*) 'raven'

In the cases in (34b), the sequence liquid+obstruent is provided with the intermediate nucleus, as in (35), according to the structure proposed by Scheer 2004 and Lai 2022.

(35) Nocara

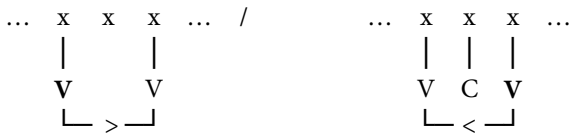


We can think that the licensing of a weak position by the stressed nucleus is sufficient to satisfy the Strong Rhyme requirement in (12).

7. Summary and conclusions

A first generalization based on the data discussed is that diphthongs, both falling and rising, appear to implement the Strong rhyme requirement regardless of the position of the prominent part, and of the sequence organization. In other words, in the systems where diphthongs are also realized in closed syllable the properties of the stressed nucleus realize the requirement of phonetic force independently from the nature of the rhyme or the Foot (Baldi and Savoia, 2017). As we have seen, taking the CVCV as the basic scheme of sequences allows us to transfer the difference between closed and open syllables to a CV domain to the right of the nucleus. This analysis has also the effect of unifying the sequences with a coda and proparoxytones. In other words, languages that require a long or complex vocalic structure in stressed position imply a different formulation of the Strong rhyme condition (cf. Section 4). The requirement relates to the ability of the stressed nucleus to license a second position, giving rise to a diphthong, as in (36a), when the intermediate position is not realized, or a bisyllabic string if the intermediate consonant is realized (cf. (35)), in (36a).

(36) a. b.



Returning to the topics covered in the article, we started from the observation that GP provides structural restrictions that exclude rising diphthongs. Nevertheless, the latter exhibit distributional properties very similar to those of falling diphthongs and long vowels. Our

conclusion is that a canonical GP analysis loses sight of the relationship between the diverse types of complex nuclei. GP possibly can represent the rising diphthongs as a hiatus sequence of two vowels where the head is on the right position at the nuclear projection level (cf. Charette 1991). This solution is not substantially different from the one proposed in this article.

We have adopted the CVCV model, which analyzes the sequence as a succession of elementary melodic units regulated and organized by their sonority properties and basic principles concerning perceptibility and degree of sonority of segments. This theoretical framework seems more suitable for dealing with important phonological phenomena concerning the sequence organization. In particular, we have explored the phonological nature of rising diphthongs and their distribution in some Romance languages. We conclude that long vowels and diphthongs can be analyzed as a sequence of vowels between which a licensing relation works that is able to authorize the intermediate silent C. The head role of vowels is based on its melodic content in relation to that of the other vowels in the relevant domain. Finally, we have discussed the interconsonantal relationship, where an empty vowel can be licensed.

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