

F. Martínez-Gil & A. Morales (eds.), Issues in the phonology and morphology of the Major Iberian Languages. Georgetown University Press, Washington D.C. 1997, pp. 103-126

## On the representation of contrasting rhotics\*

EULALIA BONET AND JOAN MASCARÓ

### 0. Introduction

It is well known that the phonetic realization of rhotics varies considerably from language to language, even from dialect to dialect. Rhotics can be realized as flaps, taps, trills (uvular, coronal or bilabial), or as assimilated or fricative variants. They can alternate with a lateral liquid, with glides, and in some cases, a flap can occur as the phonetic realization of a coronal stop in specific environments.

The aspect that has drawn most attention with respect to rhotics, however, is that often, different realizations of rhotics can contrast in a given language; in some environments their distribution is complementary, while in other cases rhotic variants contrast. In this paper we will concentrate on the problem posed by Iberian Romance languages (i.e. Catalan, Portuguese, and Spanish), and will leave aside the case of not so-well-studied languages (Somali, Ngezim, Lak, etc.), which have a somewhat different pattern, but which should be taken into consideration within a more comprehensive account of the phonology of rhotics. The main goal of this article is to draw attention to facts that have not been taken into account previously and to point to an approach of the problems posed by rhotics at a descriptive level. Implementation in a particular theoretical framework is left for further research.

### 1. The distribution of rhotics

The main concern in the analysis of rhotics in the Iberian Romance languages has been the fact that they appear in complementary distribution in all contexts but one.<sup>1</sup> In Catalan, Portuguese, and Spanish there is a contrast in intervocalic position between the flap and the trill (1). In all other environments, the

appearance of a flap or a trill is entirely predictable.<sup>2</sup> In word initial position (2a), and in onset position after a consonant (2b), the trill occurs; the flap appears in the second position of an onset (2c), while in syllable final position (3) the realization of rhotics shows a lot of variation across languages and dialects, and within a dialect it also varies depending on speech rate and other factors. The examples in (1) and (2) are from Catalan; in (3) the last column shows the phonetic value of the rhotic in the intervocalic contrast position:

(1) Contrast cases: Intervocalic position:

	Catalan	Portuguese	Spanish
a. trill:	[mirə]	[mirə]	[mirə]
b. flap:	[mirə]	[mirə]	[mirə]

(2) Predictable fixed cases: Non-intervocalic, Onset:

	Catalan	Portuguese	Spanish
a. Word initial: trill:	[rísk]	[rísku]	[rjézyo]
b. 1st in onset, /C__/: trill	[unrát]	[unráðu]	[omáðo]
c. 2nd in onset: flap	[frét]	[friú]	[frió]

(3) Predictable variable cases: Non-intervocalic, Coda: Intervocalic contrast

ma[r]	'sea'	Catalan (Valencian)	r / r
ma[r]		Spanish (Castilian)	r / r
ma[r], [r]		Spanish (Mexican)	r / r
ma[r]		European Portuguese	r / R, r
ma[r]		Catalan (Central)	r / r
ma[r]		Spanish (Nicaragua, El Salvador)	r / r
ma[x]		Brazilian Portuguese	r / x

The term intervocalic should be understood as including contexts with a preceding or following surface glide, as in Catalan *aura* [áwra] 'air' *glòria* [glóɾja] 'glory' (the same results are obtained with the corresponding words in Spanish and Portuguese). In the rest of the paper we will continue to refer to this

*intervocalic* context as *intervocalic*, and *after V*, *before V* has to be interpreted as *V = vowel, glide*.

## 2. Previous accounts of Iberian rhotics

In the traditional literature on rhotics, one of the main issues has been how to account for the contrast that appears, as already said, only in intervocalic position. We may distinguish two periods: a) works based on an SPE formalism, or earlier studies, and b) studies that introduce syllable structure. Câmara (1953) posits a single rhotic phoneme /r/ and uses the geminate/nongeminate /rr/ - /r/ contrast to account for intervocalic [r] - [r].<sup>3</sup> Within generative phonology, all authors,<sup>4</sup> starting with Harris (1969), also postulate an underlying geminate flap for the surface intervocalic trill. In Harris (1969) the geminate flap /rr/ becomes a trill through a specific rule. Wheeler (1979) derives the trill through an independent rule that interprets phonological geminates (i.e. /ll/, /nn/, /ss/) as [+tense, +long]. In Mascaró (1976) /rr/ → [r] is arrived at through independently motivated processes. The use of syllable structure introduces some simplifications in the set of rules accounting for the distribution of rhotics. The analysis changes partially when syllable structure is taken into account. In Harris (1983) /rr/ → [r] is now the result of processes that apply independently. All trills are obtained from underlying flaps through rules. Syllabic structure is incorporated for two environments: onset position after a consonant, and coda position (in emphatic speech), the contexts in (2b) and (3) above. Below, (4a) reproduces Harris' (3.45), and (4b) his (3.49) (we adapt the notation to the IPA).

- (4) a.  $r \rightarrow r / [+cons] \_\_ \text{ or } r \rightarrow r / [+cons] \sigma [ \_\_ ]$   
           |  
           R  
       b.  $r \rightarrow r \text{ (in emphatic speech)}$   
           |  
           R

In the case of underlying geminates (i.e., surface intervocalic trills, context (1) above), the rule in (4a) turns the second flap into a trill: /r r/ → [r r]. This rule precedes another rule that deletes a syllable final flap when followed by a trill, given that on the surface only a single trill occurs: [r r] → [Ø r]. This rule is needed independently to account for cases like the one illustrated in (5a), where a



- (8) a. *Catalan (Central)*  
 ma[r.] 'sea'  
 ma[r.] u]bert \*ma[r.] u]bert 'open sea'  
 ma[r.] t]ranquil 'quiet sea'
- b. *Brazilian Portuguese (Rio)*  
 ma[X.] 'sea'  
 ma[r.] a]zul \*ma[X.] a]zul 'blue sea'  
 ma[X.] t]ranquilo 'quiet sea'
- c. *Spanish (Nicaragua)*  
 ma[r.] 'sea'  
 ma[r.] a]zul \*ma[r.] a]zul 'blue sea'  
 ma[r.] t]ranquilo 'quiet sea'

In the onset, the choice of the rhotic depends on its onset internal position. The trill (never the flap) occurs in syllable initial position, when it is the only element of an onset. On the other hand, the flap (never the trill) occurs in second position of an onset. The fact that the opposite distribution is never found is understandable if one can relate the trill and the flap to different positions in the sonority scale. If the flap, like glides, is more sonorous than the trill, which could be considered close to obstruents in sonority, it is natural that the trill occurs as the only element of an onset, while the flap appears, like glides (or laterals), as the second element of an onset.<sup>5</sup> For Catalan we propose the implementation of the sonority scale in (9a). (9b) gives the restriction on onset complexity:

- (9) a. Sonority scale
- |   |   |   |   |   |
|---|---|---|---|---|
| 0   | 1 | 2 | 3 | 4 |
| obstruents - nasals - laterals - glides - vowels <sup>6</sup> |   |   |   |   |
| trill                      flap                               |   |   |   |   |
- b.  $[\sigma [\sigma ((C))]] \dots ]$  Catalan has maximally two consonants in the onset.

In the application of the sonority scale to syllabic wellformedness we follow Clements (1990), with some extensions to be discussed below.

Clements (1990) proposes that syllabification is based on two principles: *Core Syllabification*, reproduced in (10), ensures that syllables conform to a rising-falling sonority curve; *Dispersion*, reproduced in (11), ensures that the first demissyllable (onset + nucleus) shows maximal rise and uniform dispersion of

sonority distances among segments, and that the contrary obtains for the second demissyllable (nucleus + coda):

- (10) (=277) Core Syllabification Principle, revised (CSP):
- Associate each [+syllabic] segment to a syllabic node.
  - Given P (an unsyllabified segment) adjacent to Q (a syllabified segment), if P is lower in sonority rank than Q, adjoin it to the syllable containing Q (iterative).
- (11) (=199) Dispersion Principle
- The preferred initial demissyllable minimizes *D*.
  - The preferred final demissyllable maximizes *D*.

$$D = \sum_{i=1}^n \frac{1}{d_i^2} \quad \text{[given a sequence of segments } s_1, s_2, \dots, s_n, d \text{ is the sonority distance between any two different segments } s_i, s_j \text{ EB-JM]}$$

To illustrate (11), consider the sequence *la]p]a*. For the demissyllables *pa* and *la*, given the sonority scale in (9), we get sonority transitions 0-4 and 2-4, respectively. The sonority distance is hence  $d=4$  for *pa* and  $d=2$  for *la*. Applying (11c), we get  $D=1/16 = 0.625$  for *pa* and  $D=1/4 = 0.250$  for *la*. Hence *pa* is a better initial demissyllable than *la*, and *al* is a better final demissyllable than *ap*. This illustrates the relation of dispersion to maximal/minimal rise. Consider now cases in which several sonority distances have to be added, i.e. cases with more than one segment in the onset or in the coda. Let us compare *pna* and *pla*, *anp* and *alp*, where *pna* and *anp* show a lesser uniform dispersion in sonority, since the sonority of *n* is close to that of *p* and far from that of *a*. For *pna* and *anp* the sonority values are 0-1-4, and 4-1-0, respectively. Sonority distances are, for both cases, 1 (=1-0), 4 (=4-0), 3 (=4-1). The sum of the inverse squares of the distances is  $1/1 + 1/16 + 1/3 = 1.396$ . In the case of the more evenly distributed cases *pla* and *alp* we get 0-2-4, 4-2-0, respectively, and  $D=1/4+1/16+1/4 = 0.5625$ . Hence *pla* is a better initial demissyllable than *pna*, and *anp* is a better final demissyllable than *alp*. Instead of using directly the values of *D*, Clements (1990) ranks possible demissyllables, of different dispersion such that, e.g., *pa* > *na* > *la* > *ja*, and assigns accordingly complexity values to each of them as initial or final demissyllables. We reproduce in (12) his table 17.1 (*D* = dispersion; *C* = complexity value; *V* = vowel; *G* = glide; *L* = liquid; *N* = nasal; *O* = obstruent):

(12) (= Table 17.1) *Complexity rankings for demisyllables of two and three members based on the sonority scale*  $O < N < L < G < V$

	D	C
<hr/>		
a. Two-member demisyllables:		
i. initial:		
OV	0.06	1
NV	0.11	2
LV	0.25	3
GV	1.00	4
ii. final:		
VO	0.06	4
VN	0.11	3
VL	0.25	2
VG	1.00	1
<hr/>		
b. Three-member demisyllables:		
i. initial:		
OLV	0.56	1
ONV, OGV	1.17	2
NLV, NGV	1.36	3
LGV	2.25	4
ii. final:		
VLO	0.56	4
VGO, VNO	1.17	3
VLN, VGN	1.36	2
VGL	2.25	1

Consider now how this approach applies to the five different contexts in which rhotics appear (1-3). In (13), below, we repeat examples with a possible *r* in the left column and a possible *r* in the right column for all contexts. Application of *Core Syllabification* only has the effect of not syllabifying the first consonant in the complex onset \*[frɛt], since *f* has a sonority which is not lower than the sonority of the adjacent segment *r*; *r* is preferred in this context, as shown in (13d). Hence we assume that the choice of the rhotics *r* and *r* is governed by their best satisfaction of syllabic structure; more specifically, we choose the one which is preferable, given the Dispersion Principle and the complexity values it provides. The sequence *rV* (13a-c) has a complexity value 1, while *rV* has a

complexity value 4, in a syllable beginning with a rhotic, then, *rV* is preferred over *rV* because it has a lower complexity value. The sequence *Vr* (13e), on the other hand, has a complexity value 4 and therefore ranks worse than the sequence *Vr*, with a complexity value 1. In the second demisyllable, then, *Vr* is preferred over *Vr*. An asterisk before a form marks the unacceptable option, a check mark after a form marks the syllabically less complex one:

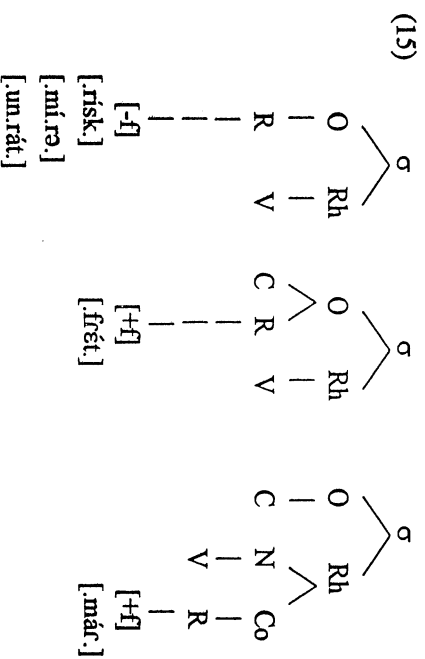
(13) Onset:	flap	trill
a. Intervocalic position	[mɪ.rɐ] 4	[mɪ.rɐ] ✓ 1
b. Word initial position	* [rɪsk] 4	* [rɪsk] ✓ 1
c. Onset initial, after a C	* [un.rát] 4	[un.rát] ✓ 1
d. 2nd position in onset	[frɛt] 2	* [(ð)frɛt] (unsyllab. by CSP) 4
e. Coda:	ma[r] ✓ 1	* ma[r] 4

The principle of the Sonority Cycle favors the observed distribution of flaps and trills. As a result, we find the trill in syllable initial position, since, compared to the flap, it will cause a sharper rise. We find only the flap in second position in the onset, given the fact that a trill would violate the minimal distance in the sonority scale. And finally we find the flap in coda position since it constitutes a more gradual fall in sonority than the trill.<sup>7</sup> This distribution is shown in (14):

(14)	[σ r V...]
	[σ C r V...]
	[σ ... V r...]

In the literature on rhotics it is not very clear what feature distinguishes flaps from trills. Harris (1969) and Wheeler (1979) assume that the trill is [+tense] while the flap is [-tense]. Mascaró (1976) claims that the trill is [+continuant] and the flap is [-continuant], while Bonet (1988) assumes exactly the opposite.<sup>8</sup> We will not discuss this issue here because we think that a broader study on rhotics and laterals which takes other languages into account is called for. For the sake of the argument we will assume that there is a feature [F] (suggesting *flap*), such that flaps are [+F], while trills are [-F]. Since in all cases but one the value of [F] is predictable, we can assume that the value of this feature is generally not present underlyingly. The value of [F] will be inserted when syllabification takes place. The value that will be inserted (or the one that will get a better evaluation,

in Optimality Theory terms, cf. Prince and Smolensky 1993) will be the one that better conforms to the Principle of the Sonority Cycle. (15) illustrates all the predictable cases (including [mɪrə], the normal, unmarked value for the contrasting environment). The underlying rhotic, not originally specified for [ɾ] is represented by R. C, V stand for consonant and vowel, and syllable boundaries are indicated by dots (·):



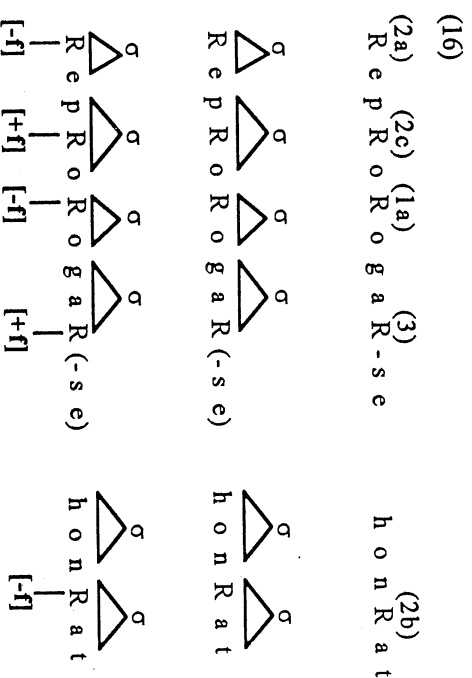
Rhotics in word initial position ([.rɪsk.] 'risk'), in syllable initial position before a consonant ([.un.rát.] 'honest'), and in intervocalic position for the cases with a trill ([.mí.rə.] 'myrrh') all constitute cases of a syllable initial rhotic. The trill will be preferred over the flap because the rise in sonority will be more abrupt.

When the rhotic appears in second position in the onset ([.frét.]), the feature [+ɾ] will be inserted because the flap is more sonorous than the trill. In syllabic structures like C<sub>1</sub>C<sub>2</sub>V..., C<sub>1</sub> must be a stop or the fricative *f* if C<sub>2</sub> is a rhotic. Given the sonority hierarchy, *Stop-trill-V* will cause a violation of the uniformity of the sonority rise.

In syllable final position, within a word or at the end of it ([.póç.ta.], [.mar.]) the flap will be preferred since it will cause a minimal fall in sonority. This specification of rhotics for [ɾ] is a word-level phenomenon. The fact that in phrasal phonology all word final rhotics followed by a vowel initial word are realized as a flap is a consequence of the fact that at the word level these rhotics were in coda position and, as such, they were specified as [-ɾ], that is, as flaps.

As mentioned above ((8) and corresponding discussion), in some varieties there is a postlexical process of tensing which applies to these coda [ɾ]s.

In (16) the word *reprorogar*-(se) 'to get an extension (for oneself)' and *honrat* 'honest' show the derivation of all the predictable cases:



The approach sketched above has two advantages. First, it answers the question posed earlier about the regular behavior of the distribution of flaps and trills across dialects and languages in fixed (2a,b) and variable (2c) non-contrasting environments. Second, it fully incorporates the crucial role played by syllabic structure, which makes it possible to collapse the three different environments proposed in earlier accounts into a single one: onset position.

#### 4. Intervocalic flaps

One case that remains to be accounted for is the occurrence of intervocalic flaps (1b), which contrast with trills in this position. An intervocalic flap, e.g. [mɪrə], occurs, like the trill, e.g. [mɪrə], in syllable initial position, but it does not surface as a trill, as would be expected under the analysis presented so far. As in other proposals, we assume that the contrast between flaps and trills in intervocalic position is the product of a representational difference, an underlying property that distinguishes surface [ɾ] from surface [r]. Contrary to those proposals, the exceptional, marked property is attributed to the flap, not to the

trill. Our claim is that the difference between intervocalic flaps and all other occurrences of rhotics is due to the fact that only intervocalic flaps are underlyingly marked with a property, [+f]. This is the only active value with respect to other rhotics: [-f] can never appear in an underlying representation. The underlying difference between the minimal pair [mɪrə] 'myrrh' and [mɪrɔ] '(s)he' looks at' is illustrated in (17):

- $$(17) \quad \text{míra} \quad \text{míra}_{[-I]}$$

Consider again the complexity values derived from dispersion that were assigned to syllables containing rhotics; we add to (18) the intervocalic *r/r* distinction:

- |                                      |             |                    |              |     |
|--------------------------------------|-------------|--------------------|--------------|-----|
| (18) <i>Onset:</i>                   | <i>flap</i> |                    | <i>trill</i> |     |
| a. Intervocalic [r]                  | * [mi.rə]   | 4                  | [mi.rə]      | ✓ 1 |
| b. Intervocalic [r]                  | [mi.rə]     | 4                  | * [mi.rə]    | ✓ 1 |
| c. Word initial position             | * [rɪsk]    | 4                  | [rɪsk]       | ✓ 1 |
| d. 1 <sup>st</sup> in onset, /C__:   | * [un.rát]  | 4                  | [un.rát]     | ✓ 1 |
| e. 2 <sup>nd</sup> position in onset | [frét]      | 2                  | * [(f)ré]    |     |
|                                      |             | (unsyllab. by CSP) |              |     |
| f. <i>Coda:</i>                      | ma[r]       | ✓ 1                | * ma[r]      | 4   |

In the unmarked case, an underlying syllable initial rhotic /R/ is interpreted as a trill. This is the case in (18a,c,d). In (18e) and in (18f) the insertion of the unmarked value for /R/ [-f] would give either an unsyllabifiable segment, and a considerably more complex final demissyllable, respectively. Therefore /R/ is supplied, for syllable structure reasons, with the marked value [+f], and /R/ is interpreted as [r] ([fɹɛt], ma[rɹ]). (18b) is the problematic case, since the actual form contains the more complex demissyllable ([rɹ] = 4).

Let us compare previous proposals to ours schematically:

- |      |         |                     |                  |
|------|---------|---------------------|------------------|
| (19) | Example | Harris (1983), etc. | Present proposal |
| (1a) | [míra]  | /r r/               | /R/              |
| (1b) | [míra]  | /r/                 | /R/ (= /r/)      |
|      |         |                     | —                |
|      |         |                     | [+f]             |

- |      |               |     |     |
|------|---------------|-----|-----|
| (2a) | [rɪsk]        | /r/ | /R/ |
| (2b) | [ʊmrət]       | /r/ | /R/ |
| (2c) | [frɛt]        | /r/ | /R/ |
| (3)  | ma[r] / ma[r] | /r/ | /R/ |

One might ask why the positive value of [1] appears underlyingly only in intervocalic position. At first sight this should be a problem because there does not seem to be a way of preventing this value to appear, for instance, in word initial position. The fact is, however, that there are no words starting with a flap in any of the languages considered. Under approaches such as Harris (1983), this specific problem does not arise: intervocalic flaps are subject to no rule (they are not considered to be an exceptional case), while intervocalic trills are assumed to be underlying geminate flaps. To obtain a geminate/nongeminate contrast in any other position would be impossible because a geminate flap would presumably not be allowed in any of the four non-contrasting contexts; hence, under this approach, the impossibility of initial, adconsonantal, or final geminates is due to general language-particular constraints on possible clusters.<sup>9</sup>

- (20) a. *\*/r isk/*      b. *\*/un rr át/*      c. *\*/frr ét/\*ma r r /*      d.

Under the present proposal such a straightforward solution is not possible. But if this proposal is on the right track, some additional factor must be responsible for the fact that syllable initial flaps are only possible in intervocalic position. (21) contains all the environments in which one might potentially find an underlying specification [+ʔ], the only source for a surface contrast:

- (21) a.  $\frac{\text{mir}\partial}{\text{mir}\partial} \quad \text{b. } \frac{*/\text{r}/\text{sk}}{*/\text{r}/\text{sk}} \quad \text{c. } \frac{*/\text{un R } \partial/\text{v}}{*/\text{un R } \partial/\text{v}} \quad \text{d. } \frac{/\text{f R } \acute{\text{E}}\text{t}/}{/\text{f R } \acute{\text{E}}\text{t}/} \quad \text{e. } \frac{/\text{ma R } /}{/\text{ma R } /}$

(21d,e) do not pose a problem because, independently of whether or not [+F] is present underlyingly, they will surface with [+F] anyway because the relevant segment is either in second position in the onset, in (21d), or in coda position, in (21e). In these two cases, then, a surface contrast would be impossible. In the rest

of the cases (21a,b,c) an underlyingly specified rhotic appears in onset position, but the result is ungrammatical whenever the rhotic is preceded by another consonant or when it is word initial. It seems, then, that an underlying flap is only possible in syllable initial position when it is preceded by a vowel. This brings us to the conclusion that a syllable initial [r] is licensed by a preceding V because they make a good syllable contact (21a), but not by a preceding C because they do not make a good syllable contact (21c).

The descriptive generalization that a flap *r* is licensed in syllable initial position only by a preceding V because it makes a good syllable contact with this vowel can be incorporated into the general framework of Clements (1990). He proposes two separate measures of complexity: the complexity of a given demissyllable, and the complexity of the contact between two syllables. The latter is derived from the former and it equals the sum of the complexities of the two demissyllables in contact. This gives a ranking of syllable contacts, from best to worse, between 1 and 9. In (22) (= (30) in Clements 1990) the rows correspond to the end of the first demissyllable making contact, and the columns to the beginning of the second demissyllable making contact:

(22) *Contact complexity* (= (30), Clements 1990)

	V	G	L	N	O
V	5	4	3	2	1
G	6	5	4	3	2
L	7	6	5	4	3
N	8	7	6	5	4
O	9	8	7	6	5

We will assume that there is, in addition, a measure of the *total complexity* of a demissyllable, which depends on its own complexity, as measured in table (12), and on the complexity of the syllable contact it makes, if any. More specifically, we propose that a bad (complex) syllable contact increases the total complexity of a demissyllable, and that a good contact decreases it. One of the important consequences of this approach to demissyllable complexity is that an asymmetry between peripheral and internal demissyllables is derived. Initial or final demissyllables (in a word, for instance) do not add or reduce complexity since they do not make any syllable contact.

In (23), below, we give a modified version of the *contact complexity* table given by Clements. In order to derive the measure of total complexity, we assume the following: a) V.V, G.G, L.L, N.N and O.O (the contacts with complexity value 5, according to Clements 1990) are contacts that do not add nor reduce complexity; b) contacts with values greater than 5 add complexity, and contacts with values smaller than 5 reduce complexity. Therefore, in our terms, the values to be added to the inherent complexity of a demissyllable are those in (22) minus 5:

(23) *Contact complexity* (modified)

	V	G	L	N	O
V	0	-1	-2	-3	-4
G	1	0	-1	-2	-3
L	2	1	0	-1	-2
N	3	2	1	0	-1
O	4	3	2	1	0

The total complexity of a demissyllable, then, equals its inherent complexity, which was given in the table in (12), plus the values in (23). The total complexity values are given below for the first demissyllable, (23a), and for the second demissyllable, (23b), both in boldface:

(23) a. *Total complexity* (first demissyllable)

	V	G	L	N	O
V	0	-1	-2	-3	-4
G	2	1	0	-1	-2
L	4	3	2	1	0
N	6	5	4	3	2
O	8	7	6	5	4

b. *Total complexity* (second demissyllable)

	V	G	L	N	O
V	5	3	1	-1	-3
G	6	4	2	0	-2
L	7	5	3	1	-1
N	8	6	4	2	0
O	9	7	5	3	1



To give an example, consider a demissyllable ending in a liquid, VL in VL.NV; according to (23a), VL has *total complexity* 1 when it is followed by a demissyllable starting with a nasal. Similarly, according to (23b), a demissyllable beginning with a glide, like GV in V.GV has a *total complexity* 3 when it follows a demissyllable ending in a V.

We can now return to the problematic cases in (21). Consider the predicted total complexity values for a demissyllable RV in word initial position and, word-internally, after a vowel and after a non-obstruent consonant (after an obstruent, a rhotic is syllabified in second position in the onset):

- (24)
- |    |   |   |          |
|----|---|---|----------|
| a. | #rV   | 4 | *[rɪsk]  |
| b. | V.rV  | 3 | [mɪrɛ]   |
| c. | L.rV  | 5 | *[fulrɔ] |
| d. | N.rV  | 6 | *[unrɔt] |
| e. | Maximal complexity of a demissyllable CV=3. |   |          |

We must conclude that in the languages examined a demissyllable CV cannot have total complexity values greater than 3, (24e). Therefore, underlying or derived structures #rV, with total complexity 4, L.rV, with total complexity 5, and N.rV, with total complexity 6 are ill-formed.<sup>10</sup>

Notice that if this approach is correct, there should be two environments where a contrast between flaps and trills would be *a priori* possible: syllable initial position before a vowel, where a contrast *does* occur, and also coda position after a vowel. In the latter case, the underlying flap (i.e., the rhotic with an underlying [+f] specification) in the coda could be licensed by a preceding V. However, a surface contrast cannot be found in this environment because coda rhotics will get the value [+f] anyway, precisely because of their position in the syllable (the Principle of the Sonority Cycle will prefer a minimal fall, therefore a flap).

In the next section we give evidence supporting the claim that only intervocalic flaps are underlyingly specified for the feature [+f] and that this feature can only be licensed, when it belongs to the only segment of an onset, by a preceding V. As will be shown, other approaches cannot give a satisfactory account for the data discussed in the next section.

## 5. Additional Evidence

Catalan furnishes additional evidence in favor of the approach based on the view that the underlying [+f] specification can only be licensed by a preceding V. The evidence comes from three sources, aphesis, hypochoristics, and future and conditional verbal affixation. Let us consider them in turn.

In many dialects of Catalan aphesis is very common: a word initial unstressed schwa can delete, as shown in (25a). Whenever a word initial impossible onset arises, like \*ps or \*dʒ in (25b), aphesis cannot take place. In the case of rhotics, there are two possibilities: if [r] appears after the initial schwa ([ərV...]) in the nondeleted form, aphesis is also possible (25c); but aphesis is impossible when the initial schwa is followed by an (intervocalic) flap in the nondeleted form ([ərV...], (25d)):

- (25)
- |    |               |   |                                |             |
|----|---------------|---|--------------------------------|-------------|
| a. | [ə]nar        | → | nar                            | 'to go'     |
|    | [ə]gafar      | → | gafar                          | 'to take'   |
|    | [ə]gulla      | → | gulla                          | 'needle'    |
| b. | [əps]urd      | → | *[ps]urd                       | 'absurd'    |
|    | [ədʒ]udicar   | → | *[dʒ]udicar                    | 'assign'    |
| c. | [ər]ibar      | → | [r]ibar                        | 'to arrive' |
|    | [ər]onsar     | → | [r]onsar                       | 'to shrink' |
|    | [ər]acada     | → | [r]acada                       | 'earring'   |
| d. | [ər]omatitzar | → | *[r]omatitzar or *[r]omatitzar | 'to flavor' |
|    | [ər]engada    | → | *[r]engada or *[r]engada       | 'herring'   |
|    | [ər]anya      | → | *[r]anya or *[r]anya           | 'spider'    |

The account of the contrast between (25c) and (25d) is fairly straightforward under the present proposal. The forms in (25c) do not have any underlying specification for [f] and they will get a value for this feature depending on their position in the syllable. Both in the form without aphesis and in the form with aphesis the rhotic is syllable initial and, therefore, it will get the value [-f] (a surface trill). In (25d), however, the underlying [+f] specification can only be licensed by a preceding V, the only way of getting an allowed syllable contact. If this vowel is deleted the licenser disappears, and the output is ruled out. Of course one could ask why the flap does not become a trill. Under our proposal this

possibility can easily be rejected, since it would imply getting rid of an underlying specification. The only process needed is specification of unspecified /R/, in other words, there is no rule like "delete [f]." <sup>11</sup>

In standard accounts (e.g. Mascarcó 1976, Wheeler 1979) this sort of data is difficult to account for. Surface intervocalic flaps are not the product of any rules; they are underlying flaps /r/, and they surface with their underlying form unchanged. One could then ask what would prevent apheresis to apply and be followed by the rule given in (6), which turns word initial flaps into trills. If one were to pursue this derivation, the ungrammatical form \*[θr]omatizar would be obtained. The only possibility of preventing this output would be to invert the ordering between the two processes: the tensing rule (6) would then precede the apheresis rule. However, in such a case we would not be able to rule out the other form in (17d), \*[θr]omatizar, given that there is no additional constraint specifically banning word initial flaps.

The other piece of evidence that favors our proposal comes from hypochoresitic formation in Catalan, studied in detail in Cabré (1993) (see also Cabré and Kenstowicz 1995). In Catalan, hypochoresitics are formed by isolating a trochee starting at the right edge of the word. (26a) contains some examples of this process. In (26b), hypochoresitic formation results in a word starting with a trill. Hypochoresitic formation is blocked, however, when the truncated form would start with a flap:

- (26) a. Josefina → Fina  
Francisco → Cisco  
Joaquim → Quim
- b. Montselfrat → [r]rat
- c. Au[r]ora → \*[r]ora or \*[r]ora

The argument in this case is identical to the argument given above based on apheresis. Under the present proposal, (26b) is well-formed because intervocalic trills are not specified as such underlyingly. In onset position they will become [-f], and this will be the case both in the full form and in the truncated form. The underlying flap (i.e., the underlying [+f] value) of the full form in (26c), however, is licensed by the preceding V. If truncation takes place, the preceding V

disappears and the underlying flap cannot be licensed. Therefore truncation is blocked in (26c). Again, in an approach in the line of Harris (1983), cases like these are very difficult to account for, unless some ad hoc stipulation is added to prevent *any* syllable initial flap to occur. It is also interesting to note that in a similar language but with no r/r contrast, like Italian, there is no problem constructing truncated hypochoresitic forms like Margherita → Rita, Caterina → Rina, Lorenzo → Renzo (Thornton 1996).

Another case that supports our analysis of intervocalic [r] regards future and conditional verbal affixation in Catalan and Spanish. These tenses have a tense/person morpheme sequence beginning in an underlying flap. The flap normally follows the thematic vowel, but in some cases it follows a stem ending in a consonant. Some Catalan examples of these suffixes appear in (27). In (27a), the suffix follows a vowel; in (27b), it follows a stem ending in a consonant. The suffix always appears in boldface:

- (27) a. Catalan Spanish
- |                      |                      |                      |
|----------------------|----------------------|----------------------|
| balla+ <b>[r]</b> à  | balla+ <b>[r]</b> à  | '(s/he) will dance'  |
| dormi+ <b>[r]</b> ia | dormi+ <b>[r]</b> ia | '(s/he) would sleep' |
| vin+ <b>[dɾ]</b> à   | ven+ <b>[dɾ]</b> à   | '(s/he) will come'   |
- b.

In the first two cases, the flap initial suffix is preceded by a vowel, the thematic vowel, and nothing happens. In (27b), however, the suffix is preceded by a bare root ending in the consonant /n/. In this case an epenthetic consonant [d] is inserted. Under the present proposal, the reason for this epenthesis is clear: the rhotic from the suffix is not /R/, but the marked /R, +f/, underlyingly specified as [+f]. This feature cannot be licensed as the only element in onset position unless it is preceded by a vowel; when the epenthetic consonant is inserted, the rhotic becomes the second element of an onset, whose first element is the epenthetic [d]; in this position the expected value is [+f], the one the rhotic already has underlyingly. Under the standard proposal, the suffix begins with /r/, which, being in syllable initial position after a consonant, should be tensed to [r] by rule (4a). This is not the case for all Spanish varieties and for almost all Catalan varieties. If there is a rule tensing /r/ in this context we should not expect d-insertion as the general solution <sup>12</sup>.

## 6. Concluding Remarks

Our proposal makes extensive use of syllabic information by assigning the flap and the trill to different points in the sonority scale and by claiming that in all cases but one the feature that distinguishes flaps and trills receives one value or the other depending on which one best satisfies Clements' principle of the Sonority Cycle. With respect to the contrast that we find in intervocalic position, our claim is that, contrary to previous proposals, the exceptional case is the flap, since the trill is what we generally expect in syllable initial position. Surface intervocalic flaps correspond to underlying flaps, that is rhotics with an additional underlying property, the specification [+f].

One of the arguments that has been advanced in the traditional literature on rhotics supporting the view that intervocalic trills are underlyingly geminate flaps is stress. The argument is based on the fact that there does not seem to be any words (in Spanish, Catalan, or Portuguese) with antepenult stress and with a trill after the vowel following the stressed vowel. Harris (1983) gives examples like the following, from Spanish:

- (28)
- |          |           |
|----------|-----------|
| señó[r]a | cána[r]a  |
| camó[r]a | *cána[r]a |

If the intervocalic trill is an underlyingly geminate flap, antepenultimate stress is impossible in cases like the last one in (28) because the penultimate syllable is heavy i.e. /ká.mar.ra/, and heavy syllables attract stress. In our account, it is not possible to relate stress attraction in these cases to syllable heaviness since for us the intervocalic trill is not a geminate, it is a single segment.

As a matter of fact, it is not at all clear why trills, which seem to attract stress, should be related to weight in this sense. If this were the case, we should also have to posit a similar type of structure for /N/, /X/, and /ɲ/, for instance, given that these segments also "attract stress." Notice that, in the context of this discussion, "attract stress" is a predicate meaning that no paroxytones can be found within the existing lexicon with any of these consonants joining the penultimate and the final syllable. There are no alternations showing stress attraction, and informant intuitions reported are inconclusive. Historically, it is easy to account for the fact that these segments, i.e. /N/, /X/, /ɲ/, and /r/, attract stress: etymologically, they all come from sequences of segments (/ll/, /jl/, /jn/,

/nj/ /rr/, etc.), and as such they did attract stress in Latin and, presumably, in Vulgar Latin and for some time afterwards (see Roca 1990). Synchronically, an account that covers all these segments, not just one of them, becomes necessary (in case the stress attraction effect is actually still active).

Another argument adduced for /rr/ is that in Catalan an underlying geminate flap causes final epenthesis in words like the ones in (29a), versus the ones in (29b) (Wheeler 1979: 193, Mascaró 1976: 49-50). For the word final rhotic, we have transcribed a flap, even though, as mentioned earlier, syllable final rhotics show a lot of variation:

- (29)
- |    |           |               |              |                        |
|----|-----------|---------------|--------------|------------------------|
| a. | esque[rə] | 'left'        | esque[rá]    | 'left-handed'          |
|    | col[rə]   | '(s/he) runs' | col[ría]     | '(s/he) used to run'   |
| b. | cal[r]    | 'expensive'   | cal[r]ot     | 'expensive' (augment.) |
|    | lidel[r]  | 'leader'      | lidel[r]atge | 'leadership'           |

If the words in the first column in (29a) were to have an underlying geminate final flap, an epenthetic vowel would be needed to properly syllabify the second half of the geminate (even though one could think of simplification as an alternative option). However, as it turns out, there are only two words (plus derivatives) of this type in Catalan, (i.e. (29a)). This constitutes fewer words than the ones that end in a flap plus a schwa (not related to feminine gender). Therefore, there is hardly any reason to think that the final schwa in the words in (29a) is an epenthetic vowel at all.

Finally, in spite of the fact that underlying geminate flaps have been rejected, a process of [r] deletion, similar to the one proposed by Harris (1983: 63, 70) (= (5b) above), or Mascaró (1976: 49-51) is needed. According to that rule, a rhotic is deleted when a trill follows. This postlexical deletion is an unquestionable process in our opinion, but it will affect only word final rhotics followed by a word initial rhotic.

## Notes

\* This paper was partially supported by grants 1995SGR 00486 (Generalitat de Catalunya) and PB93-0893-CO4.

1 Rhotics have been analyzed, among others, in Harris (1969, 1983), for Spanish, and Mascaró (1976) and Wheeler (1979), for Catalan.

2 In some dialects, instead of a trill there is some sort of alveolar fricative ([ʒ]), Canfield

- 1981, see also the description in Harris 1969: 46-56. In Portuguese the "strong" *r* is realized as an alveolar or uvular trill, or as a uvular fricative. We ignore here all these distinctions for simplification; see Angenot and Vandresen 1979, Barbosa 1962.
- 3 The same proposal appears in Bowen, Stockwell, and Silva-Fuenzalida (1956).
- 4 Like Wheeler (1979: 191-194), Mascaró (1978: 47-51), Mateus (1975).
- 5 The idea that the distribution of flaps and trills should be related to sonority appears in Bonet (1988). It is interesting to notice that many varieties of the languages studied here present variants that show more clearly the sonority differences: [ɾ] presents often an *approximant* realization [ɹ], [ɻ], and [ɹ] a *fricative* realization [ɹ̥], [ɹ̥̥], [s̥] (see Navarro Tomás 1971 117-119, 122-123, Canfield (1981), Recasens (1991: 324-328 Angenot and Vandresen (1979).
- 6 We have included glides and the flap in the same point of the sonority hierarchy for simplicity, but it might be the case that glides have no place in the sonority hierarchy (they might be considered non-nuclear vowels). We leave this issue for further research.
- 7 Given the account argued for here, the distribution of flaps constitutes a counterexample to Prince and Smolensky's (1992) Onset/Coda Licensing Asymmetry (their (258)): "There are languages in which some possible onsets are not possible codas, but no languages in which some possible codas are not possible onsets." In the Iberian Romance languages, the flap can occur in coda position, but it cannot be an onset.
- 8 Chomsky and Halle (1968:318) suggest that [ɾ] is [+cont] and that it is [+heightened subglottal pressure]. Kean (1975) uses [-flap], [-trill], flaps being less marked.
- 9 Although Harris' approach works, one might wonder why languages that hardly have any surface geminates do have underlying geminate flaps, which never surface as geminates, while other languages, like Italian, which do have surface geminates, do not show a contrast between rhotics. Catalan has only some (residual) cases of geminates (mainly *m*, *n*, *l*, and *ɲ*). Spanish has no geminates. In general, in these two languages geminates arise only through assimilation processes.
- 10 The only C.C contact with a value greater than 3 that might appear problematic at first sight is the sequence N.L. Within a word this combination is unattested in the native vocabulary of languages like Catalan. Moreover, in loans or acronyms, like *Chandler*, *Bentley* or *INLE* (Instituto Nacional del Libro Español), the nasal becomes a (nasalized) lateral: [ɫaʎaɾ], [beʎli], [ɫile]. Therefore, in this case the resulting total complexity is not 4 but 3.
- 11 In Optimality Theory terms this would mean that Rec-F (underlying features cannot be suppressed) is ranked higher than the constraint that allows for the deletion of the initial schwa.
- 12 Forms like *venrà*, *molrà* are restricted to some places in the Northern dialects.

## References

- Angenot, Jean-Pierre and Paulino Vandresen. 1979. The Portuguese [R]'s revisited. Manuscript. 23 p.
- Barbosa, Jorge Morais. 1962. Sur le /R/ portugais. *Estructuralismo e Historia. Miscelânea homenagem a André Martinet*, ed. Diego Catalán, vol. III, 211-226. La Laguna: Universidad de La Laguna.
- Bonet, Eulàlia. 1988. Trills and flaps in Catalan and Spanish. MIT, ms.
- Bowen, J. Donald, Robert Stockwell and Ismael Silva-Fuenzalida. 1956. Spanish juncture and intonation. *Language* 32. 641-665.
- Cabré i Monné, Teresa. 1993. *Estructura Gramatical i Lèxic: el Mot Mínim Català*. Doctoral dissertation, Universitat Autònoma de Barcelona.
- Cabré, Teresa, and Michael Kenstowicz. 1995. Prosodic trapping in Catalan. *Linguistic Inquiry* 26.4. 694-705.
- Câmara Jr., Joaquim Mattoso. 1953. *Para o Estudo da Fonémica Portuguesa*. Rio de Janeiro: Organização Simões.
- Canfield, D. Lincoln. 1981. *Spanish Pronunciation in the Americas*. Chicago: The University of Chicago Press.
- Chomsky, Noam, and Morris Halle. 1968. *The Sound Pattern of English*. New York: Harper and Row.
- Clements, George N. 1990. The role of the sonority cycle in core syllabification. *Papers in Laboratory Phonology I. Between the Grammar and Physics of Speech*, ed. by John Kingston and Mary E. Beckman, 283-333. Cambridge: Cambridge University Press.
- Harris, James W. 1969. *Spanish Phonology*. Cambridge, Mass.: MIT Press.
- Harris, James W. 1983. *Syllable Structure and Stress and Spanish*. Cambridge, Mass.: MIT Press.
- Kean, Mary-Louise. 1975 *The Theory of Markedness in Generative Grammar*. Doctoral dissertation, MIT.
- Mascaró, Joan. 1976. *Catalan Phonology and the Phonological Cycle*. Doctoral dissertation, MIT. [Bloomington: Indiana University Linguistic Club, 1978].
- Mateus, Maria Helena Míra. 1975. *Aspectos da Fonologia Portuguesa*. Lisboa: INIC, Centro de Linguística da Universidade de Lisboa. 2nd ed. 1984.
- Navarro Tomás, Tomás. 1971. *Manual de Pronunciación Española*. Madrid: Consejo Superior de Investigaciones Científicas. 16<sup>th</sup> edition.
- Prince, Alan and Paul Smolensky. 1992. *Optimality Theory: Constraint interaction in generative grammar*. Rutgers University and University of Colorado at Boulder, ms.
- Recasens, Daniel. 1991. *Fonètica Descriptiva del Català*. Barcelona: Institut d'Estudis Catalans.

- Roca, Iggy. 1990. Diachrony and synchrony in Spanish stress. *JL* 26, 133-164.
- Thornton, Anna M. 1996. On some phenomena of prosodic morphology in Italian: accorciamenti, hypochoristics and prosodic delimitation. *Probus* 8, 81-112.
- Wheeler, Max. 1979. *Phonology of Catalan*. Oxford: Basil Blackwell.
-