Rhotics in Spanish: A New Look at an Old Problem

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1. Introduction

This paper presents a two-phoneme analysis of Spanish rhotics that explains the restricted nature of the synchronic contrast and its relation to the Latin geminate: the intervocalic contrast resulted from an earlier geminate representation through constraint re-ranking, merger avoidance, and Lexicon Optimization. In other words: that the contrast appears only in intervocalic position is not the result of perceptual distinctiveness or of the presence of an underlying geminate, as proposed by some authors (Bonet & Mascaró 1997, Bradley 2006), but of the contextual distribution of the original Latin geminates, combined with degemination and merger avoidance (Hualde 2004). An optimality-theoretic framework allows for the formalization of the historical developments that led to the current restriction in the distribution of the contrast. In addition to the synchronic contrast, the OT analysis proposed explains the distribution of the rhotic allophones. With the exception of word-final rhotics, the constraints and constraint ranking select the correct output regardless of the form of the underlying representation (trill or tap). For word-final rhotics, the analysis predicts that, if a trill appears in the input, the output will have a trill before a vowel-initial suffix. Although no native Spanish words exist with a trill in this position, the prediction is born out by Basque borrowings in the Spanish of the Roncal Valley, thus suggesting a gap in the underlying representations in the native lexicon.

2. Data and Previous Accounts

Despite some stylistic and dialectal variation, most varieties of Spanish have two non-lateral liquids, a trill and a tap. Phonemic in intervocalic position (1a-c), they are in complementary distribution in other contexts: the trill appears in word-initial position (2a) and after a heterosyllabic consonant (2b); the tap surfaces as the second element of a consonant cluster, (3a) and, in most dialects in coda position, (3b). Coda rhotics exhibit some cross-dialectal variation. [1] Because of space and time limitations, this analysis considers only those dialects with the coda facts in described in (3b).

(1)	a.	/karo/	‘car’	/kaɾo/	‘expensive’
	b.	/pera/	‘female dog’	/peɾa/	‘pear’
	c.	/pero/	‘dog’	/peɾo/	‘but’
(2)	a.	[ro.sa]	‘rose’	[ra.ta]	‘rat’
	b.	[en.ri.ke]	‘Henry’	[al.re.ðe.ðoɾ]	‘around’
(3)	a.	[bɾa.so]	‘arm’	[tɾen]	‘train’
	b.	[maɾ]	‘sea’	[maɾ.te]	‘Mars’

* I am grateful to Travis Bradley, Fernando Martínez-Gil and two anonymous reviewers for their comments. Any remaining errors are my own.

[1] A trill pronunciation appears in non-emphatic coda position in the Basque Country and some areas of Northwestern Spain (Hualde 2005, Alonso 1945).

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Traditionally, phonological analyses attempting to account for the facts in (1-3) have focused on:

(i) explaining why the contrast is restricted to intervocalic position;

(ii) the form of the underlying representation and on whether it consists of one phoneme or two.

Several generative analyses (Harris 1969, 1983, Harris 2002, Nuñez-Cedeño 1994, among others) propose one rhotic phoneme /ɾ/ along with an underlying geminate /ɾɾ/ and two rules: (i) 'tensing' of the rhotic after a heterosyllabic consonant and in word-initial position (4a-b) (Harris 1983, 2002) and (ii) deletion of a rhotic before a trill (generally resulting from tensing) (5) (Harris 1983, 2002). An elsewhere condition supplies the tap for other contexts (4c).

(4) a. ɾ ⟶ r / [+cons] _____
Rhyme

b. ɾ ⟶ r / $_{X}{}^{o}$[_____

c. ɾ ⟶ ɾ/ elsewhere

(5) ɾ ⟶ Ø / _____ r

Tensing (4a) and deletion (5) apply to an underlying intervocalic /ɾɾ/ resulting in a trill. Since the geminate is limited to intervocalic position, the contrast between the trill and the tap can then only surface intervocalically.

(6) /kaɾ ɾo/	/kaɾo/	
[kaɾ. ɾo]	[ka. ɾo]	syllabification
[kaɾ.ro]	[ka. ɾo]	(4a) and elsewhere condition
[ka.ro]	_____	(5)
[ka.ro]	[ka. ɾo]	output

Among those that argue for two underlying, non-geminate phonemes are Bonet & Mascaró (1997) and Bradley (2006). Bonet & Mascaró (1997) attribute the intervocalic contrast to sonority considerations related to the demisyllable and syllable contact. They argue that an underlying tap (the marked rhotic allophone in their analysis) can only be licensed in intervocalic position (preceded by a vowel). Bradley (2006), within a Dispersion Theory model, explains that the contrast occurs only in intervocalic position because this is the position that allows for the greatest perceptual distance.

One criticism leveled at the one-phoneme, geminate proposals and their account of the restricted nature of the contrast has to do with the rule of tensing. Harris (2002) himself admits that this rule may be an idiosyncrasy of Spanish. Bradley (2006) points out that two separate rules of 'tensing' (in syllable-initial postconsonantal and in word initial position), (4a-b), are needed to capture the simple generalization that syllable initial rhotics are trills, except for in intervocalic position. Bradley's proposal collapses the two contexts specified in the tensing rule (i.e., after heterosyllabic C and word-initially) into a single syllable initial context. [2] Other proposals for collapsing the postconsonantal and word-initial contexts are those of Lipski (1990), Bonet & Mascaró (1997) and Padgett (2003). Another important argument against the one-phoneme analysis is that it requires an underlying geminate that never surfaces in a language that has no geminates (Baković 2009; see also Baković 2009 for additional arguments against the geminate proposal).

[2] Because under the Uniform Applicability Condition (Schein and Steriade 1986) tensing cannot apply to the underlying geminate, Bradley argues for a third rule of tensing in which an underlying geminate tap becomes an onset trill.

The current proposal, a two-phoneme analysis of rhotics, argues that the contrast is limited to the intervocalic position because it resulted from the Latin geminate through constraint re-ranking, merger avoidance, and Lexicon Optimization, rather than because this is the position that allows for the greatest perceptual distance. Synchronically, the grammar has two underlying phonemes in intervocalic position, a tap and a trill. In addition, it is shown that: (i) 'r-tensing' is not stipulative, as it is motivated by the same principles governing consonant fortition in prominent positions (see Baković 1994) and is a direct consequence of a feature geometry model in which point of articulation dominates stricture features; (ii) the generalization that syllable initial rhotics are trills, except for in intervocalic position, is captured by means of independently required optimality-theoretic constraints; relatedly, that word-initial rhotics are always trills is a direct consequence of the presence of a lexical contrast; (iii) there is no need to pose an underlying geminate otherwise absent from the language.

3. Analysis

3.1. Intervocalic contrast

While it appears that the trill is clearly longer than the tap and thus duration can be seen as one difference between the two segments (Bradley 2006),[3] the trill cannot be considered a geminate since it syllabifies as an onset (Hualde 2004:18; cf. Italian *car-ro* vs. Spanish *ca.rro*).[4] Although it is unclear what distinctive feature(s) distinguishes the trill and the tap, trills pattern with non-continuant obstruents, appearing after homorganic nasals and laterals; they are also banned from the second member of an onset cluster (a more sonorous tap surfaces instead).

In intervocalic position, rhotic contrast is the result of the domination of IDENT over markedness. I refer to the relevant IDENT constraint as IDENT(tense), as a convenient cover term for whatever features distinguish the rhotics, without making any claims that [tense] is in fact the feature that distinguishes the tap and the trill. The other constraints in (7) are harmonic alignment constraints against the parsing of each rhotic in onset position (McCarthy 2002: 21-22).

(7) (a) IDENT(tense): a trill in the input must correspond with trill in the output; a tap in the input must correspond with a tap in the output.
(b) *[ɾ] /onset: no [ɾ] in onset position
(c) *[r]/onset: no [r] in onset position

(8) /karo/ [ka. ro] 'car'

	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.☞ka.ro			*
b. ka.ɾo	*!	*	

(9) /kaɾo/ [ka. ɾo] 'expensive'

	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a. ka.ro	*!		*
b.☞ka.ɾo		*	

As is customary in OT, the domination of faithfulness (IDENT(tense)) over markedness (*[ɾ]/onset, *[r]/onset) is responsible for the preservation of contrast. Thus, the candidates that are faithful to the form of the underlying representation, (8a) and (9b) (no IDENT(tense) violations), are selected as the winners in (8) and (9). *[ɾ]/onset dominates *[r]/onset because an onset trill is less marked than an

[3] There are also articulatory differences: trills are tenser and less sonorous (Recasens 1991; Recasens & Pallarès 1999) and involve vibration of articulators, as opposed to taps, which involve active muscular movements of the tongue (Solé 2002a). It is unclear what feature or features serve to contrast the tap and the trill. I speculate that lack of agreement on the issue is probably due to more than one feature being responsible for the perception of the contrast.

[4] For arguments against the geminate analysis, see Bradley (2006) and Baković (2009). For empirical evidence, see Hualde (2004).

onset tap (i.e. a trill makes a better onset than a tap): being less sonorous than the tap, a trill creates a sharper rise in sonority towards the nucleus. This in accordance with the Sonority Sequencing Principle (Clements 1990) that states that sonority rises toward the nucleus and descends toward the margins and that such a rise in sonority is maximal as we go from the onset to the nucleus and minimal from the nucleus to the coda (Sonority Cycle) (Clements 1990).

The synchronic grammar simply consists of two intervocalic underlying rhotics; yet, the diachronic facts offer an explanation for the distribution of the contrast. I argue that the reason why the rhotic contrast is limited to the intervocalic position is that this is the only position where a geminate/singleton contrast was possible in Latin. Unlike serial models of phonology, OT can straightforwardly incorporate this explanation into an analysis of the evolution of Latin rhotics into Spanish. The Latin geminate evolved into the modern day trill through the re-ranking of the constraint against geminates (*GEM) to a dominant position, which resulted in the ban against geminates (11c, d). A candidate with deletion of one half of the Latin geminate is ruled out (11b), since the resulting tap would merge with the singleton (*MERGE violation) (11b) (cf. Holt 2006 for a similar proposal for lateral and nasal geminates). In other words, [ka.ɾo] would correspond to both the geminate and the non-geminate inputs. As a result, a violation of IDENT(tense) is preferred and (11a) [ka.ro] is selected as the output. [5, 6]

(10)*MERGE: Two inputs cannot correspond to one output, i.e. maintain contrast (Padgett 2003, Holt 2006, Bradley 2006).
*GEM: No geminates.

(11) From an underlying geminate tap to an output intervocalic trill:
/kaɾɾo / [ka. ro]

	*GEM	*MERGE	IDENT(tense)	*[ɾ]/onset	*[r]/onset	MAX-IO
a. ☞ka.ro			*		*	*
b. ka.ɾo		*!		*		*
c.kaɾ.ɾo	*!			*		
d. kar.ro	*!		**		*	

Lexicon Optimization (LO) dictates that the learner faced with no geminates in the output will eventually opt for the underlying representation that most closely resembles the output, that is, a trill. This results in the subsequent restructuring of the underlying representation, from Latin /kaɾɾo/ to Modern Spanish /karo/. As a result, the synchronic grammar consists of two phonemic rhotics in intervocalic position, a trill and a tap. This proposal (no underlying geminate in Modern Spanish) is in consonance with the fact that Spanish has no geminates.

3.2. Trills in word-initial position

Latin consonants often underwent lenition, with the 'weak variant' in postvocalic position and the 'strong' one after a consonant in the same breath group, as, for instance, the voiced and voiceless realizations of /t/ in (12a) (Lloyd 1987: 245). Similarly, rhotics were probably also affected by lenition (Lloyd 1987: 246): thus, strong rhotics (trills) alternated with weak ones (represented here as taps) in word-initial position (12b).

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[5] It is reasonable to assume that, before the reranking of *GEM took place, (12c) would have been the winning candidate. According to phonetic studies on the nature of the tap and the trill (Recasens 1991; Recasens & Pallarès 1999), a geminate tap would not be a plausible articulation; thus, the geminate in (12c) would have been phonetically implemented as a phonetic trill (through the strengthening of a tap preceded by a rhotic, which is subsequently deleted). This may explain why the contrast was maintained (avoiding a *MERGE violation) by means of a trill rather than other rhotic sounds.

[6] Of course, the proposed account of the diachronic facts is not part of the competence of the speaker of Modern Spanish.

(12) a. illa terra [i:la der:a] 'that land'
illas terras [i:las ter:as] 'those lands'
b. illa rota [i:la ɾoda] 'that wheel'
illas rotas [i:las rodas] 'those wheels'

The alternation in rhotic realization would have been the result of the domination of a markedness constraint (possibly requiring agreement in stricture) over faithfulness. When the 'strong/weak' distinction became phonemic in word-internal position (as a result of the disappearance of the geminate contrast and the domination of IDENT(tense) over markedness constraints), the word-initial alternation could no longer be maintained without being interpreted by speakers as phonemic. I propose that this is prevented by the high ranking of the constraint responsible for avoiding the interpretation of a non-contrastive alternation as phonemic, *SPLIT, the mirror image of *MERGE:[7]

(13) *SPLIT: Two contrastive outputs cannot correspond to one input.

*SPLIT is the constraint that makes sure that outputs standing in an input-output correspondence have some content in the lexicon that is not part of another IO relationship. For instance, under the ranking IDENT(tense) >> *[ɾ]/onset >> *[r]/onset, two potential inputs /ratas/ and /ɾatas/ would have as outputs [ɾa.tas] [ra.tas], respectively; yet, they share the same lexical content, 'rats', thus violating *SPLIT. [8]

(14) /ratas / [ra.tas] 'rats'

	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.☞ra.tas			*
b. lɾa.tas[9]	*!	*	

(15) /ɾatas / [ɾa.tas] 'rats'

	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.☞lɾa.tas		*	
b. ra.tas	*!		*

*SPLIT requires each IO correspondence relation to have a unique correspondent in the lexicon (not shared by another IO) and it serves to relate the phonology to the lexicon. Its counterpart, *MERGE, preserves phonological expression (contrast) for separate items in the lexicon. Both *MERGE and *SPLIT are needed in addition to the ranking of markedness with respect to faithfulness to capture systemic phonological contrast. *SPLIT, like *MERGE, dominates IDENT(tense).

The restructuring of the underlying representation that results from disappearance of the geminates (i.e. reranking of IDENT(tense) over markedness constraints) creates violations of *SPLIT (vacuously satisfied before), as it is now possible to have two rhotic realizations in word-initial position, each one corresponding to a separate underlying representation; namely, the constraint ranking and evaluation in (14) and (15) results in two winners (one for each possible input). However, given that the outputs in (14) and (15) correspond to the same meaning ('rats'), the two winning candidates must contain violations of *SPLIT, resulting in a tie (the losing candidates would also incur *SPLIT violations, but they would be worse than the winners because they also violate IDENT(tense) (17-18). One way to satisfy *SPLIT is by eliminating one of the two winning candidates, (17a) or (18a): (18a) is eliminated (indicated with continuous shading), because it violates the more highly ranked *[ɾ]/onset, while (17a) has a violation of the lower-ranked *[r]/onset. After this, Lexicon Optimization

[7] Minkova & Stockwell (2003) use the cover term IDENT-IO(CONTRAST) (i.e. 'Preserve categorical contrasts') to refer to both *MERGE and *SPLIT.

[8] Note that Richness of the Base, which states that there are no restrictions on the form of the underlying representation, requires that evaluation consider inputs with both a trill and a tap (weak and strong versions of the Latin rhotics).

[9] A straight vertical line (l) marks the left edge of the stem.

guarantees that output [ra.tas] would always correspond to input /ratas/. In other words, although OT does not allow restrictions on the form of the underlying representation (Richness of the Base), I argue for the need for restrictions on how contrast relates to meaning: this is expressed by means of the constraint *SPLIT that bans the IO correspondence pairs/relations, ruling out more than one IO correspondence relation for the same meaning.[10]

(16) *SPLIT >> IDENT(tense) >> *[ɾ]/onset >> *[r]/ onset

(17) /ratas / [ra.tas] 'rats'

	*SPLIT	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.☞ra.tas	*			*
b. ɾa.tas	*	*!	*	

(18) /ɾatas / [ɾa.tas] 'rats'

	*SPLIT	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.☞ɾa.tas	*		*	
b. ra.tas	*	*!		*

There exists an alternative account of the word-initial facts that may appear technically simpler. I show, however that, despite capturing the facts, the explanatory power of this alternative analysis is inferior to that of the *SPLIT-account. One can argue that the presence of trills in word-initial position is in fact related to the preference for less sonorous segments in prominent positions, such as the onset; in this case, the word-initial position. Under this account, word-initial trills are the result of the high ranking of a constraint against non-trilled [ɾ] in stem-initial position, *ǀ[ɾ], that dominates identity. The fact that Spanish allows for a contrast in word-internal position between trilled and non-trilled [ɾ] indicates that the relevant Identity constraint dominates the constraints that ban [ɾ] and [r]. IDENT(tense) is dominated by *ǀ[ɾ], since any potential [ɾ] in stem-initial position will be replaced by a trill. *ǀ[ɾ] is not an alignment constraint in the sense of the ALIGN family, since these constraints are not usually formulated in the negative. *ǀ[ɾ] is a harmonic alignment constraint, closely related to constraints of the type *[X] /onset (where X=segment) that relate the phonetic inventory of a language to syllabic positions. *ǀ[ɾ] plays a similar role with respect to the edges of morphological constituents, in this case, the stem.

(19) *ǀ [ɾ]: no [ɾ] in stem-initial position.

Assuming an underlying representation with a tap (non-trill), candidate (20a) is optimal because, despite the violation of IDENT(tense), it satisfies the more-highly ranked constraint that bans taps from stem initial position, *ǀ[ɾ]. If a trill was posed for the underlying representation as in (21), the results of evaluation would be the same: in addition to the constraints violated by (b), (b) violates IDENT(tense); (a) only incurs a mark for *[r].

(20) / ǀ ratas / [ra.tas]

	*ǀ[ɾ]	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.☞ra.tas				*
b. ɾa.tas	*!	*	*	

(21) / ǀ ɾatas / [ra.tas]

	*ǀ[ɾ]	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.☞ra.tas		*		*
b. ɾa.tas	*!		*	

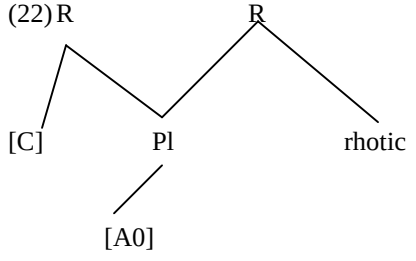
[10] As is the case with all constraints, *SPLIT can be violated under domination. In that case, the result is free variation.

One problem with this explanation is that it cannot easily account for the diachronic changes; in addition, it offers no explanation for the connection between the facts of intervocalic and word-initial position. While it is possible that word-initial strengthening is unrelated to the intervocalic contrast, one would still have to explain the differences between the behavior of rhotics (word-initial strengthening and intervocalic contrast) and that of voiced obstruents. As will be seen below, both rhotics and voiced obstruents select their 'stronger' (minimal aperture) allophone (trill and voiced stop, respectively) when preceded by a homorganic nasal or lateral; however, voiced obstruents alternate in word-initial position and lack an intervocalic contrast. Traditionally, the differences were attributed to rhotic strengthening being a lexical phenomenon and obstruent spirantization a postlexical one; yet, the lexical/postlexical distinction does not offer any insights into why rhotic strengthening should be lexical and spirantization postlexical. The *Split*-account shows that it is because of the presence of the intervocalic contrast that no alternation is possible in word-initial position (as the alternation would be interpreted as contrastive). In other words, that rhotics are trills in word-initial position is not necessarily connected to the word-initial position per se, but to the lexical domain and contrast preservation (within the word). In this sense the generalization proposed by some that onset rhotics are trills except when in intervocalic position can be better understood as: onset rhotics are trills unless contrast preservations is at stake (i.e., in intervocalic position). In the absence of an intervocalic contrast, as in voiced obstruent allophonic variation, word-initial alternations (continuant and non-continuant allophones) are possible.[11] Finally, given the role played by the degemination of Latin rhotics, the *Split*-account also explains the similarity in rhotic allophone distribution across many Romance languages.[12]

3.3. Trills preceded by a heterosyllabic consonant

When preceded by a heterosyllabic consonant, the trill surfaces in all varieties with a trill/tap alternation. Such an outcome (as well as the absence of cross-dialectal variation) can be accounted for if one assumes a fortition process similar to that of affrication of the palatal fricative or fortition of voiced obstruents when preceded by a nasal, with which it agrees in point of articulation, e.g. *conyuge* [koɲɟuxe] 'spouse' (Padgett 1994, Baković 1994). This outcome—a rhotic that shares its point of articulation with a preceding consonant also shares stricture features—comes about naturally in a feature geometry model, as that proposed by Padgett (1994) in which place dominates stricture (see Hualde 1989 for an analysis of continuancy assimilation in voiced obstruents in Spanish that also requires a shared PA node). According to Aperture Theory (Steriade 1993), stricture is represented in terms of oral aperture nodes, rather than with features such as [continuant]. Plosives (stops and affricates) and the trill share an oral closure zero (aperture zero) A0 (Baković 1994).

(22)



[11] Note that when geminate voiceless stops degeminated, merger was avoided through voicing and lenition; these alternatives were not available to the geminate tap.

[12] An anonymous reviewer points out that the 'historical facts' in (12) are Lloyd's conjecture and that there is "no historical evidence that suggests that a word initial (or perhaps stem-initial) trill across the board was not already the normal state of affairs in spoken Hispanic Latin, as it is today in al Ibero-Romance languages." It is crucial to notice that, even if this were the case, the synchronic analysis in which *SPLIT rules out a correspondence between an input and output flap (17-18) remains unaltered. See the text after (18) for arguments for a *SPLIT account versus a constraint against stem-initial flaps.

Since the heterosyllabic consonants that can precede /r/ are the homorganic, zero-aperture /n/ and /l/, the realization of the relevant rhotic must be a trill. While the continuancy status of laterals has been the topic of much controversy in Spanish, it is reasonable to assume that if stricture is dependent upon Place, and non-continuant /n/ is followed by a trill in a homorganic cluster, then the trill (and therefore the lateral) in homorganic /lr/ sequences must also be [-continuant]. (Holt 2002 also argues for a model of feature geometry in which stricture is dependent upon place; his proposal includes dual articulation for laterals with [-continuant] under the consonantal place and [+continuant] under a secondary a vowel place node; this explains why laterals are [-continuant] in homorganic clusters, and [+continuant] in non homorganic ones, when the lateral takes on its secondary vowel articulation). Additional evidence for this account lies in that in /sr/ clusters /s/ assimilates to the rhotic and then is deleted, /israel/ [i.ra.el].[13]

To capture the requirement in (22) that shared PA nodes also share stricture nodes and for clarity, I will use the shorthand notice AGREEPA/A0. Note, however, that the relevant constraint(s) here are in fact those responsible for assimilation of point of articulation. Assuming the representation shown above, the sharing of stricture nodes would be obtained automatically as a result of the domination of PA assimilation constraints. In (23), a candidate with a tap (23b) is ruled out because of a violation of the highly-ranked AGREEPA/A0. [14]

(23) /enɾike / [enrike]

	AGREEPA/A0	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.☞enrike		*		*
b. enɾike	*!		*	

3.4. Taps in syllable-final position

In syllable-final (including word-final) position, many dialects have a tap, with an optional trill under emphasis (Harris 1983). This seems to indicate that the trill is banned in the coda (highly ranked *[r]/coda).[15]

(24) /maɾ / [maɾ]

	*[r]/coda	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a. mar	*!	*		
b.☞maɾ				

(25) /mar/ [maɾ]

	*[r]/coda	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a. mar	*!			
b.☞maɾ		*		

(24) and (25) show evaluation for a coda rhotic assuming an underlying tap and an underlying trill, respectively. The tableaux demonstrate that the same output, (b), is selected, regardless of underlying representation, due to the domination of *[r]/coda over IDENT(tense) and in accordance with the postulate of Richness of the Base. Yet, I argue that the underlying representation for (24) and

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[13] Note that /sr/ sequences are the only ones that do not involve a [–continuant] segment as the first member of the cluster. They are extremely rare word-internally, 'Israel' being the only case mentioned in the literature. The constraint *[strident][vibrant] (proposed by Bradley [2006]; cf. Solé [2002b] for articulatory motivation) and the ranking *sɾ >> *sr are responsible for the lack of [s. ɾ] sequences in the output.

[14] An underlying representation with a trill means that the loser (candidate (b)) incurs one additional violation (IDENT(tense)).

[15] Some dialects have optional coda trills under emphasis, suggesting that a constraint requiring trills under emphasis dominates *[r]/coda. The process at stake is similar to that of coda fricatives becoming [-continuant] under emphasis, e.g., /fuDbol/ [futBol] (emphatic) ~ [fuDBol] (non emphatic (Colina 2006b). As predicted, the tap will surface when no longer in the coda, for instance, when a word-final rhotic is in prevocalic position and thus resyllabified to the onset.

(25) must be /maɾ/, since the ranking predicts that, if the input were /mar/, when followed by a vowel initial suffix, the output would be [mar + suffix]. There are no native Spanish words that exhibit this behavior because forms with an underlying trill retained a final *–e*, lost historically only when the preceding consonant was allowed in word-final position (see Colina 2003, Bonet 2006). In other words, Spanish has a gap in underlying representations in the native lexicon, with no underlying word final trills. If a trill appears in the input, the prediction is that the output will have a trill before a vowel-initial suffix.[16] This is precisely what happens in Basque borrowings in the Spanish of the Roncal Valley (Navarra) (Hualde 2004: 19): adjectives referring to towns in the Valley take the borrowed Basque suffix *–(t)ar*, whose final rhotic is a trill before a vowel in the Spanish feminine: *gardar/gardarra* 'person from Garde/woman from Garde'.

(26) /gaɾDar / [gaɾðaɾ]

	*[r]/coda	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a. gaɾðar	*!			*
b.☞gaɾðaɾ		*	*	

(27) /gaɾDara / [garðara]

	*[r]/coda	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.garðaɾa		*!	*	
b.☞garðara				*

3.5. Onset clusters

A tap surfaces as the second member of an onset cluster (3a). A constraint that requires maximal sonority distance between the two members of an onset cluster is responsible for this (MAXIMAL SONORITTY DISTANCE, [MSD], Colina 1995, Martínez-Gil 1997). (28) shows candidate evaluation assuming a trill in the underlying representation and (29) has a tap in the input. Regardless of underlying representation, MSD rules out candidates (28a) and (29a) with output trills since a trill is less sonorous than a tap (closer in sonority to that of the initial stop).

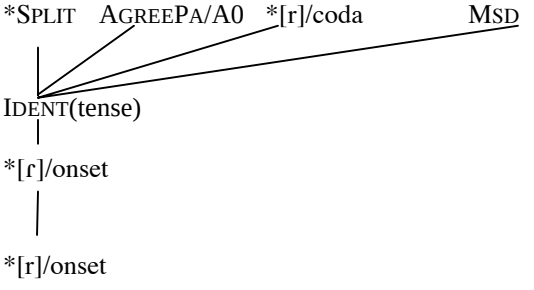
(28) /braso / [bɾaso]

	MSD	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.braso	*!			*
b.☞bɾaso		*	*	

(29) /bɾaso / [bɾaso]

	MSD	IDENT(tense)	*[ɾ]/onset	*[r]/onset
a.braso	*!	*		*
b.☞bɾaso			*	

Figure 1. Summary of constraints and constraint ranking proposed for rhotics



[16] Note that plural examples are not included; the plural may need a different analysis, since it has been argued that OO correspondence is involved (Colina 2006a).

4. Conclusions

As shown above, the current analysis does not need to resort to an underlying geminate that never surfaces in a language that lacks geminates;[17] in addition, it is argued that the restriction of the contrast to the intervocalic position is not related to sonority considerations (Bonet and Mascaró 1997), nor to the perceptual distinctiveness of the intervocalic position, as argued by Bradley (2006), but to the fact that trills have their origin in a Latin geminate rhotic through degemination, merger avoidance and Lexicon Optimization. Accounts of the restricted nature of the contrast that resort to sonority or perceptual considerations fail to provide an explanation for the lack of contrast between voiced stops and voiced fricatives/approximants in intervocalic position, since the same perceptual and sonority considerations that apply to rhotics should apply to voiced obstruents in intervocalic position.

As mentioned earlier, a criticism often leveled at geminate analyses of rhotics in Spanish is that they require two or three separate rules to capture the simple generalization that rhotics are trills in strong positions within the word, except for where contrastive (Bradley 2006, Baković 2009). The current OT analysis does not suffer from this deficiency as it makes use of independently required, universal constraints (vs. separate, language-specific rules). The relevant constraints are *[r]/onset (similar to $_{\sigma}$[r in Bradley), *SPLIT, *MERGE, *GEM, AGREEPA/A0, and IDENT(tense).

Bradley (2006) and Padgett (2003) propose relevant OT, Dispersion Theory analyses of rhotics, in Spanish and Catalan respectively. While Bradley (2006) focuses on the word-level only and does not intend to cover the postlexical level, his analysis makes the prediction that postlexically word-initial rhotics could be contrastive if preceded by a vowel-final word, since they would be in intervocalic position which perceptually favors the contrast. Since this is not the case in Spanish, an account of the trill vs. tap contrast based on the perceptual distinctiveness of the intervocalic position would have to be restricted to the lexical level. Padgett (2003) considers this issue regarding rhotics in Catalan dialects with a word-final trill, where he argues that there is a contrast at the postlexical level (e.g. *mar està* 'sea is' vs. *mà restà* 'hand remains'). In these dialects, the word-final trill surfaces unexpectedly as a tap when followed by a vowel initial word; also within a Dispersion Theory account that attributes the contrast to the perceptual distinctiveness of the intervocalic position, Padgett accounts for the contrast by resorting to a different postlexical ranking of the constraint *MERGE (i.e., *MERGE is ranked high postlexically (vs. SPACE). All things being equal, and given the controversial status of levels in OT, an analysis, like the current one, that does not resort to levels with different rankings should be preferable. In addition, the explanation that a contrast needs to be preserved postlexically is at odds with the known generalization that the output of the postlexical component typically is not assumed to produce a perception of difference (while the lexical component/level is) (Kaisse and Shaw 1985, Mohanan & Mohanan 1984). One must also bear in mind that an analysis of Catalan rhotics may be not entirely transferable to Spanish, as there are significant differences in the phonologies of the two languages (e.g. Catalan has many obstruents and obstruent clusters normally not allowed in Spanish [Hualde 1992, Wheeler 2005]).[18]

Dispersion Theory accounts succeed in expressing the generalization that rhotics are trills except for where contrastive, but fail to capture the connection between the intervocalic contrast --- a result of degemination of rhotics and the subsequent need to preserve contrast (*MERGE) – and its absence in word-initial position: namely, preventing the creation of non-existent contrast (*SPLIT). Both phenomena point toward the preservation of contrast (or the lack thereof). Trills in postconsonantal position (heterosyllabic) result from independent processes in the language that select a minimal aperture onset consonant when it is homorganic with a preceding consonant. This can be obtained from a feature geometry model in which stricture features are dominated by Place.

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[17] See Bradley (2006) for how the well-known Dominican Spanish data (often used to support an underlying geminate) can be accounted for without resorting to geminate rhotics.

[18] For obvious reasons, the comparison between the two analyses of rhotics in the two languages is beyond the scope of this paper.

Finally, it important to note that some of the contributions of the current analysis are OT-specific, while others are not. An OT-specific contribution of this account is that it does not need to determine a priori the form of the underlying representation, because under Richness of the Base, it is the constraints and constraint ranking, independently of underlying representation, that select the optimal candidate. The analysis proposed shows this to be true, thus obviating the need to decide which allophone is underlying as a prerequisite for the analysis. This is an advantage of an OT account, as in cases of partial contrast, it is usually difficult to decide the form of the underlying representation for all forms. Furthermore, I argue that such knowledge may not always be a crucial part of the speaker's competence and that an OT model takes advantage of this situation. Note that Richness of the Base does not mean that there are no underlying representations: it means that the correct UR is an epiphenomenon of constraint ranking and of Lexicon Optimization. For instance, in the current analysis, the constraints and constraint ranking predict that if a trill was posed in the UR in a coda position, it should surface as a trill; although no Spanish data exist to confirm this, Basque data show the prediction to be correct, which leads the analyst to hypothesize that there must be a gap in underlying representations in the Spanish lexicon. The historical facts confirm this hypothesis. Another example of an OT-specific contribution is that the proposed analysis can capture the generalization that syllable-initial rhotics are trills, except for in intervocalic position, by means of independently required optimality-theoretic constraints, showing that the word-initial trills are connected to the presence of a lexical contrast.

The explanation that that the restriction of the trill/tap contrast to the intervocalic position is not related to sonority considerations (Bonet and Mascaró 1997), nor to the perceptual distinctiveness of the intervocalic position (Bradley 2006), but to the fact that trills have their origin in a Latin geminate rhotic through degemination, is not OT-specific, although it is shown that OT can incorporate the historical developments into the analysis, through merger avoidance and Lexicon Optimization. Another non-OT specific contribution is showing that r-tensing in not speculative, but motivated by the same principles governing fortition in prominent positions.

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