Chapter 3

A Phonetically-based Optimality-theoretic Analysis of Spanish Rhotics

In this chapter, I develop an OT analysis of the rhotic duration typology, with Spanish serving as the primary example. Inspired by recent proposals of Flemming (1995), Kirchner (1997, 1998), and Steriade (1995a, 1997, 1999a, 2001a,b), the analysis posits that phonetic and phonological constraints interact directly to determine the surface distribution of rhotics without reference to syllable boundaries. Since reference to syllable structure is unnecessary, the analysis developed here does not face the same difficulties as existing prosodic accounts when data beyond general Spanish are taken into account. In Chapter 4, the analysis is shown to make the right predictions with respect to other languages of the typology.

3.1 Phonetic Properties of Coronal Tap and Trill

The representations and constraints posited in a phonetically-based OT analysis are motivated to the extent that they are grounded in the phonetic properties of the patterns they are meant to explain. This section explores the articulatory and perceptual characteristics of the coronal tap and trill, thereby laying the groundwork for the representations and constraints to be proposed and illustrated in subsequent sections.
3.1.1 Tap

3.1.1.1 Perception

The coronal tap is characterized by an extremely short constriction period. Quilis (1993:337-342) observes that for Castilian Spanish, the average duration of contact is 20 ms, and that the constriction is seldom a complete closure. Walsh (1997:96) notes that cross-linguistically, the tap is characterized by two perceptually-driven tendencies, inter-sonority and anti-peripherality. That is, taps exhibit a preference for intervocalic position and tend to avoid word-edges in order to maintain sonority and enhance perceptibility.

*Figure 3–1* illustrates the intervocalic tap with an example from Spanish:23

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23 The tokens under spectrographic analysis in this chapter were taken from recordings of literary readings done by native Spanish speakers from Ecuador.
Acoustically, the intervocalic tap of the sequence [eɾa] constitutes a brief disruption (approximately 20 ms) of the surrounding vocalic formant structure. *Figure 3–1* provides visual confirmation of Walsh's (1997) description of the tap as “a quick coronal interruption of surrounding segments” (141).

It should be noted that the cross-linguistic preference for intervocalic position is a tendency rather than an absolute, as evidenced by languages in which taps surface in non-intervocalic position. Even in these cases, however, it is still possible to observe a preference for the tap constriction to be flanked by periods of greater sonority. In

*Figure 3–1: Intervocalic tap in Spanish *fuera* 'were'
consonant clusters, a svarabhakti vowel fragment typically intervenes between the tap and the adjacent consonant.\textsuperscript{24} This fragment has formant structure similar to the nuclear vowel that appears on the opposite side of the tap constriction (see Quilis 1993:337-342 for a detailed discussion of the acoustic properties of svarabhakti in Spanish consonant clusters). The spectrogram in \textit{Figure 3–2} illustrates svarabhakti in the Spanish word \textit{muerte} 'death'. (N.B.: A superscript is used in narrow phonetic transcription to represent the svarabhakti vowel fragment.)

\textsuperscript{24} Whitney (1889) employs the term \textit{svarabhakti} to denote the vowel-like fragment that intervenes between the retroflex rhotic and an adjacent stop or spirant in Sanskrit. Early references to svarabhakti in the Hispanic literature are found in Gili Gaya (1921), Lenz (1892, 1893), Malmberg (1965), and Navarro Tomás (1918).
The formant structure of the vowel fragment is essentially a continuation of the full vowel preceding the 20 ms constriction period of the tap. Whereas inter-sonority is ensured by two flanking vowels in intervocalic position, as shown in Figure 3–1, only one vowel—that preceding the tap constriction—is available to provide flanking periods of greater sonority in tap + consonant sequences. The same holds true of phrase-final position, where word-final svarabhakti is a continuation of the vowel preceding the word-final tap, as shown in Figure 3–3:

*Figure 3–2: Svarabhakti vowel fragment in Spanish *muerte* 'death'*
In the following section, I examine the articulatory properties of the coronal tap. It will be argued that the presence of svarabhakti in non-intervocalic positions depends on the degree of gestural overlap between the tap and the tautosyllabic vowel. The preference for intervocalic position stems from the greater likelihood that svarabhakti will be perceptually compromised in non-intervocalic positions due to variability in gestural timing.

Figure 3–3: Svarabhakti vowel fragment in Spanish ayer 'yesterday'

[Image: Figure 3–3: Svarabhakti vowel fragment in Spanish ayer 'yesterday']
3.1.1.2 Articulation

Articulation of the tap involves a ballistic gesture whereby the tongue tip is thrown up against the alveolar ridge (Ladefoged 1993:168). In order for this articulation to be successful, both the approach and release phases must be properly implemented (Inouye 1995:55-6). The tongue tip must be "cocked" back from neutral position to gain momentum for tapping, and it must move away quickly from the point of contact if extra-short constriction is to be achieved. Inouye invokes the metaphor of throwing a baseball, which also involves a ballistic gesture with similar approach and release phases. The throw will be more effective if one's arm is cocked back from rest position in order to gain momentum and if it is also allowed to follow through on its movement trajectory after the baseball is released. As in the case of throwing a ball, the ballistic tapping gesture is most effective when approach and release phases are properly executed.

When the tap occurs in intervocalic position, the flanking vowels provide periods of greater aperture which facilitate implementation of the approach and release phases of the tapping gesture. In those languages in which taps surface in non-intervocalic position, a svarabhakti vowel fragment was shown to intervene between the tap and an adjacent consonant or phrase boundary in order to ensure perceptibility of the tap as a brief interruption of surrounding sonority. The preference for intervocalic position stems from the fact that the svarabhakti vowel fragment may be perceptually compromised in non-intervocalic positions by differences in gestural timing.

The gestural model of Browman and Goldstein (1986, 1989a,b, 1990, 1992) provides a framework within which to examine issues of gestural timing. This framework
posits that phonetic timing is intrinsic to the phonological representation, and gestures are to be taken as phonological primes, as well as units of articulation. However, others have argued that gestural representations contain more detail than is needed to capture possible categorical alternations and contrast (see Clements 1992, Kingston and Cohen 1992, Nolan et al. 1996, Steriade 1990, and Zsiga 1993, 1995). Cohn (1990), Keating (1988, 1990) and Pierrehumbert (1990) propose that both qualitative and quantitative representations are motivated and should exist independently. In this dissertation, however, I assume that phonological contrast is enforced by constraints directly in the surface representation. The implication is that phonological representations may be specified with much richer detail than typically assumed, including non-contrastive information such as the inherent duration of articulatory gestures or properties such as consonantal release. Since the well-formedness of phonological contrasts is governed independently by the constraint system, the inclusion of non-contrastive detail in representations no longer poses the threat of generating spurious contrasts. (See the discussion in Section 1.2.2 of Chapter 1.)

The claim that gestural timing determines svarabhakti rests on two assumptions about the timing of consonant and vowel gestures, namely that (1) the vocalic gestures in a /VCV/ sequence are articulatorily contiguous, and (2) consonantal gestures are superimposed on vocalic gestures (Öhman 1966). Gafos (1999) makes the following observation with respect to /VCV/ sequences:

"During the consonantal constriction the vowel is not heard because the acoustic signal produced by the vocal tract is dominated by the narrowest constriction (silent during a stop, noisy during a fricative, and so on). Thus, the vowel formants, or the acoustic effects of the vowel, are..."
necessarily absent during the consonant. However, the gesture of the vowel, being a positioning of the tongue body, still overlaps with the gesture of the consonant” (32).

The overlap between consonant and vowel gestures explains why svarabhakti in non-intervocalic positions is always a continuation of the formant structure present on the opposite side of the tap constriction. Both the full vowel and the vowel fragment stem from the same tongue body gesture, and the superimposed tapping gesture produces a brief interruption separating the two.

Steriade (1990) proposes a gestural analysis to explain the presence of vowel fragments in tautosyllabic onset clusters of the form consonant + rhotic. Specifically, the tongue tip gesture for the rhotic moves to a non-peripheral position in the syllable, thus creating a sequence in which the overlapping vowel gesture begins to appear between the consonantal gestures. I refer to this scenario as *non-peripheral* timing, meaning that the rhotic gesture moves toward the center of the full vowel. Non-peripheral timing is also a possibility for rhotic + consonant sequences. The gestural representation in *Figure 3–4* shows how non-peripheral timing in a /V₁rCV₂/ sequence uncovers the acoustic identity of V₁ before the following dental stop gesture is initiated:
Figure 3–4: Non-peripheral timing of tap and V₁ gestures produces svarabhakti vowel fragment in Spanish *muerte* 'death'

The formalism in *Figure 3–4* provides a visual representation of gestures, which are linguistically significant articulatory movements that produce a constriction in the vocal tract (Browman and Goldstein 1986, 1989a,b, 1990, 1992). The activity of each articulator is depicted on a separate tier, whose labels appear at the left. Boxes represent gestures, and the length of a box denotes the period of time during which the articulator is under active control. Gestures that overlap on the same articulatory tier are indicated by dotted lines (e.g., the contiguous tongue body gestures of V₁ and V₂). Finally, the waveform appearing at the top is taken from *Figure 3–2* and illustrates the acoustic results of the articulatory configuration.
Let us consider the opposite scenario, namely *peripheral* timing, whereby the rhotic gesture moves away from the center of the full vowel. A slight delay in the initiation of the alveolar tongue tip gesture in *Figure 3–4* would result in the perceptual masking of the tap's release phase by the following consonant. No svarabhakti vowel fragment would be audible under this timing scenario, as *Figure 3–5* demonstrates with the same example from Spanish:

*Figure 3–5*: Peripheral timing of tap and $V_1$ gestures results in perceptual masking of svarabhakti vowel fragment in Spanish *muerte* 'death'

The absence of svarabhakti under peripheral timing is demonstrated in the waveform, from which the amplitude of the vowel fragment has been spliced in order to show the
acoustic effects of consonantal overlap with the following stop gesture. Loss of the svarabhakti vowel presumably diminishes the perceptibility of the tap, which may subsequently be interpreted by the listener as reduced or, in the extreme case, elided. \(^{25}\)

Differences in gestural timing also determine the presence of svarabhakti when the tap surfaces adjacent to a phrase boundary, as demonstrated in Figures 3–6 and 3–7:

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\(^{25}\) To my knowledge, no perception-based studies exist in the literature to support the hypothesis that the loss of svarabhakti leads to diminished perceptibility of the tap. I shall not pursue the issue at present, but see Section 5.4.2.2 of Chapter 5 for a discussion of how such a perceptual experiment might be carried out.
In Figure 3–6, non-peripheral timing uncovers the acoustic identity of the final portion of the vowel before the cessation of voicing in phrase-final position. In Figure 3–7, peripheral timing hides the audible release of the tap, thereby compromising its perceptibility.

In order to understand the inter-sonority and anti-peripherality preferences observed by Walsh (1997), we must compare the non-intervocalic taps shown above with the intervocalic tap shown in Figure 3–8:
In non-intervocalic positions, svarabhakti vowel fragments are subject to perceptual masking under peripheral timing scenarios. Intervocally, however, there is no such threat because the lexically specified full vowels automatically guarantee flanking periods of greater sonority. With respect to ensuring the perceptibility of the tap, a full vowel is better than a vowel fragment, since the realization of the latter may vary as a function of gestural timing.

*Figure 3–8: Full vowels ensure flanking sonority in Spanish *fuera* 'were'*
3.1.2 Trill

3.1.2.1 Perception

In contrast to the extra-short tap, the alveolar trill is characterized by a sustainable duration. The average overall duration of the trill in Castilian Spanish is approximately 85 ms with 3 occlusions (Quilis 1993). Harris (1983:62) notes that the Mexican Spanish trill may be realized with 2 to 10 vibrations, although the longer realizations are typical of emphatic speech. Perceptually, the trill has an inherently salient acoustic structure, consisting of vocalic formant values briefly interrupted by periods of stop-like silence (Widdison 1997:190). The spectrogram in Figure 3–9 illustrates the intervocalic trill with an example from Spanish:
The intervocalic trill shown above is approximately 96 ms in total duration and exhibits three occlusions. The alternation of vocalic formant structure and periods of constriction makes the trill perceptually salient. This contrasts with the alveolar tap, which requires some degree of surrounding sonority to ensure the perceptibility of its brief constriction.

*Figure 3–9*: Perceptually salient acoustic structure of intervocalic trill in Spanish *mediterráneos* 'Mediterranean'
3.1.2.2 Articulation

Whereas the tap involves a ballistic tongue tip gesture, the trill requires a tensed, controlled, and precise gesture in order to initiate passive vibration of the articulator by virtue of the Bernoulli effect (Catford 1977, Ladefoged and Maddieson 1996). The principal articulatory difference between the two rhotics is that the tap involves a momentary constriction, while that of the trill may be sustained. As Catford (1977) argues, the trill is not simply a sequence of taps because the two rhotics involve completely different production mechanisms:26

"A flap … is a single ballistic flick or hit-and-run gesture. A trill … is a maintained and prolongable posture: the vibrations that occur in a trill are aerodynamically imposed on the posture. Any idea that a trill is a 'rapid series of flaps', or that a flap is just an 'ultra-short trill' is quite wrong. The frequency of alveolar and uvular trills [r] and [R] is of the order of 30 cycles per second. This is much higher than the maximum rate at which one can produce a series of [r]-flaps (about five or six per second)" (130).

This is true even for languages in which the tap and trill appear to stand in a singleton-geminate relationship:

"… [T]here are languages in which flap and trill, for example, [r] and [R], are opposed to each other as the 'short' and 'long' members, respectively of a phonological correlation of duration or 'quantity' as it is often called; but … from a rigorous phonetic point of view a trill is not a lengthened flap" (196).

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26 Catford (1977) uses the term flap in referring to lingual articulations of extra-short constriction duration. In addition, he distinguishes between flicks and transient flaps, which differ primarily with respect to the position of the tongue tip upon completion of the gesture. For present purposes, I collapse this distinction and continue to employ the term tap.
Figure 3–10 contrasts in diagrammatic form the articulatory trajectories of the tongue tip in both the coronal tap and trill. While the active articulator makes a single strike against the alveolar region in the former, multiple contacts arise in the latter as the result of passive vibrations imposed on a held posture:

![Diagram of articular trajectories]

Figure 3–10: Articulatory trajectories of the tongue tip in coronal tap versus trill (from Catford 1977:134)

That the trill is not an articulatory sequence of individual tapping gestures is captured in gestural representations by the fact that there is only one tongue tip gesture responsible for passive vibratory movement.²⁷ Unlike the shorter tapping gesture shown in Figure 3–8 above, the duration of the gesture for the trill may be sustained long enough to initiate passive vibration of the tongue tip. Figure 3–11 demonstrates the intervocalic trill in Spanish:

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²⁷ On the basis of electropalatographic and acoustic measurements of VrV and VrV sequences in Catalan, Recasens and Pallarès (1999) also argue that the trill is not a geminate correlate of the tap due to differences observed in lingual articulation and C-to-V coarticulation effects.
Figure 3–11: Passive vibration of tongue tip produces inherently salient acoustic structure of trill in Spanish *mediterráneos* 'Mediterranean'

3.1.3 Perceptibility Scale for Rhotic Duration Contrast

The phonetic properties of the coronal tap and trill examined in Section 3.1 are summarized and contrasted in *Table 3–1* below. The extremely short duration of the tap was shown to motivate the perceptual and articulatory requirements of this segment. These requirements are best satisfied in intervocalic position, where the surrounding full vowels provide an optimal acoustic backdrop and facilitate the approach and release phases of the ballistic tapping gesture. On the other hand, the inherent salience of the trill ensures perceptibility in any context, albeit at a greater articulatory price since more precision is required to ensure trilling.
Taken together, the perceptual and articulatory considerations relevant to the tap and trill motivate the following perceptibility scale for rhotic duration contrast:

(3.1) Perceptibility scale for distinctive rhotic duration (to be revised)

\[ V_V > \#_V, C_V, V_#, V_C \]

According to this scale, rhotic duration is more perceptible in intervocalic position than in positions where rhotics surface adjacent to a word edge or a consonant. The weighting of these contexts directly reflects the inter-sonority and anti-peripherality preferences of the tap, which were discussed in detail in the preceding sections.

Of the consonant- and word-adjacent contexts grouped together in (3.1), one context merits further discussion, namely word-initial position. Cross-linguistic evidence suggests that this position benefits from inherent perceptual prominence in that more phonological contrasts tend to be licensed there.\(^{28}\) In addition to the phonological

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\(^{28}\) In an OT approach such as Beckman's (1998) positional faithfulness, input-output correspondence constraints can target those syllabic or prosodic positions that are more prominent, such as root- or onset-initial positions (e.g., the constraint \textsc{Contrast}(voi/onset), which was discussed in Section 1.2.3.1 of Chapter 1).
evidence, there is also psycholinguistic motivation for the perceptual salience of word onsets (see Hawkins and Cutler 1988 and the studies cited therein). The greater perceptibility of word-initial contexts can be captured by increasing its rank along the scale of (3.1). The result is shown in (3.2):

\[
V_V \triangleright \#_V \triangleright C_V, V_C, V_#
\]

This final scale encapsulates the speaker's knowledge that contrast between the tap and trill is most perceptible between vowels. Similarly, the perceptual prominence of word onsets places word-initial above the elsewhere contexts. It is precisely this knowledge that motivates the universal ranking of contrast maintenance constraints in the grammars of languages that exhibit a phonological contrast between the tap and trill. The remainder of this chapter provides a formal characterization of these grammars, with Spanish serving as the primary example.

### 3.2 Constraints of The Analysis

In this section, I present an analysis of rhotic duration contrast and neutralization in terms of ranked and violable OT constraints. The analysis incorporates two general types of constraint. Contrast maintenance constraints strive to preserve phonological contrast between the tap and trill in different positions. Articulatory markedness constraints interact with contrast maintenance, thereby generating different patterns of neutralization as a function of ranking.
3.2.1 Contrast Maintenance

The special nature of intervocalic and word-initial contexts can be captured by relativizing CONTRAST(F) constraints to these positions and ranking them higher than context-free CONTRAST(F). Specifically, the CONTRAST(duration) constraints in (3.3) seek to maintain rhotic duration contrast between vowels (3.3a) and word-initially (3.3b) over all other positions (3.3c), as formalized by the universal ranking in (3.3d).

(3.3) Constraints on the preservation of tap/trill contrast

a. CONTRAST(dur/V_V)
   Maintain rhotic duration contrast between vowels

b. CONTRAST(dur/#_V)
   Maintain rhotic duration contrast word-initially

c. CONTRAST(dur)
   Maintain rhotic duration contrast

d. Tap/trill contrast preservation hierarchy
   CONTRAST(dur/V_V) » CONTRAST(dur/#_V) » CONTRAST(dur)

The hierarchy in (3.3d) results from the alignment of constraints to the perceptibility scale for rhotic duration contrast shown in (3.2).29

The constraint ranking directly captures the implicational relationships among contrastive positions across the languages of the rhotic duration typology discussed in Chapter 1, which are repeated for convenience in (3.4):

29 The notion of aligning constraints to harmonic scales was discussed in Section 1.2.4 of Chapter 1.
Both the ranking of constraints in (3.3d) and the empirical generalization captured in (3.4) are argued to follow from the perceptibility scale in (3.2), which derives in turn from the physiological and physical properties of speech production and perception (see Section 3.1).

3.2.2 Articulatory Markedness

Interacting with the CONTRAST(duration) hierarchy in (3.3d) are two types of markedness constraint on the articulatory representation of rhotics. Below, I present the representations and show how the constraints govern different aspects of their structure.

3.2.2.1 Representations

The analysis developed here captures the duration contrast between the tap and trill in terms of Aperture Theory, which encodes stricture via three degrees of aperture: oral closure $A_0$, release $A_{\text{max}} (A_m)$, and an intermediate aperture $A_t$ generating fricative turbulence (Steriade 1993, 1994). I follow Inouye (1995:348) in positing a degree of aperture responsible for trilling that is intermediate between stops and fricatives, formalized here as $A_{\text{trill}} (A_t)$. Finally, $A_v$ denotes vocalic aperture. The complete aperture scale is shown in (3.5):

- $A_0$: stop
- $A_t$: trill
- $A_f$: fricative, fricative trill
- $A_m$: approximant
- $A_v$: vowel

On the assumption that stricture is dominated by Place in the feature geometry (Padgett 1994, 1995), I propose (3.6a) and (3.6b) as the correct representations of the tap and trill, respectively:

(3.6) Aperture-theoretic representations of tap and trill

a. Tap: cor

\[
\begin{array}{c}
A_m \cap A_t \\
A_m A_t \cap A_m \\
& = \text{approach + constriction + release}
\end{array}
\]

b. Trill: cor

\[
\begin{array}{c}
A_t

& = \text{constriction}
\end{array}
\]

The above representations closely follow the formalisms proposed by Inouye (1995), although my assumptions diverge somewhat. First, Inouye employs a numerical, multi-valued aperture scale, whereby integer values are assigned to different stricture degrees (e.g., [0] for stops, [1] for trills, [2] for fricatives, and [3] for fricatives). In contrast, the formalisms in (3.6) are cast in terms of the aperture scale shown in (3.5), which also incorporates an aperture position denoting vowels, $A_v$. Second, with respect to the location of aperture positions within the feature geometry, Inouye states that "it is not clear whether the APERTURE feature should replace the entire manner node, or whether it is an articulator-specific feature that resides under the active articulator node (e.g., CORONAL). The repercussions of such a proposal need to be considered carefully. We will conservatively assume for now that it resides under the MANNER node" (91).
My proposal diverges crucially in that aperture positions are assumed to be featural dependents upon the Place node, in accordance with Padgett (1994, 1995). This assumption is motivated by the behavior of rhotics in Place-sharing clusters (see Section 3.2.2.1 below). Finally, despite the differences between Inouye (1995) and the present proposal, both analyses converge on the assumption that aperture positions constitute privative features.30

The representations in (3.6) treat distinctive rhotic duration as a segmental property by directly encoding the articulatory phases of tap and trill segments. The peripheral Am positions of the structure in (3.6a) denote the approach and release phases of the coronal tap gesture. They make possible the ballistic articulatory maneuver necessary for a momentary At constriction at the alveolar ridge. In contrast, peripheral Am positions are absent from the representation of the trill in (3.6b). As a result, the single At constriction of the trill may be prolonged sufficiently to initiate passive vibration of the tongue tip by the Bernoulli effect.

A question arises here as to what exactly determines the relative duration of the At constriction in (3.6a) versus that in (3.6b).31 Rather than positing the existence of some violable, grammatical constraint that dictates the duration of the At nodes in these configurations, I claim instead that these durational differences are a consequence of

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30 Privative features differ from binary features in that the latter may be specified with either a + or – value (e.g., a [+F] specification contrasts with a [–F] specification). In contrast, privative features lack binary specifications and are simply either present or absent with respect to a given representation (e.g., the presence of [F] contrasts with its absence).

31 Thanks to Eric Bakovic for raising this issue.
universal phonetics. Under the proposed representations, both the tap and trill are treated as single segments dominated by a single timing slot. Let us assume that a phonological timing slot is assigned some unspecified interval of time for the phonetic realization of the segment with which it is associated. Now, if this interval is held constant across different subsegmental configurations, it follows that the time span allotted to a single Am node will be greater relative to the time span allotted to an At node that must share its timing slot with two adjacent Am nodes.\(^\text{32}\)

The relative duration of the At constriction in the tap versus the trill configuration is illustrated in Figure 3–12 (N.B.: Boxes represent the total time interval assigned to a single timing slot, while shading denotes the duration of the At constriction relative to this interval.)

![Figure 3–12: Schematic relative duration of At constriction in tap versus trill](image)

These schematic diagrams illustrate how the flanking Am nodes of the tap preclude a longer constriction duration of the At node vis-à-vis the trill. In sum, the aperture-

\(^{32}\) See Inouye (1995:97-98) and Sagey (1986:86) for a similar discussion of the relative duration of singly-linked stops and fricatives versus their affricate-contour counterparts.
theoretic representations in (3.6) reflect the articulatory properties of the extra-short tap as a ballistic gesture and of the longer trill as an articulatory posture upon which vibratory cycles are aerodynamically imposed (see Section 3.1).

3.2.2.1.1 Evidence for Tap as Aperture Contour

Evidence in support of the contour representation of the tap in (3.6a) comes from alternations among taps, coronal stops, and trills. The cross-linguistic survey of Inouye (1995) reveals processes whereby stop and trill lenite to tap between vowels, as well as the opposite process of fortition of tap to stop or trill in non-intervocalic environments. Aperture Theory provides a formal representation—the tap as an aperture contour—which captures the complementary nature of lenition and fortition. "Where lenition is spreading of aperture, fortition is the delinking of the approach branch and/or failure to project the release branch of the three-branched tap" (Inouye 1995:156). This section focuses on these lenition and fortition processes.

Inouye's autosegmental analysis presupposes an input-output mapping, as made evident by notions such as "spreading," "delinking," and "failure to project." Recall, however, that under the Dispersion-theoretic assumptions of this dissertation, constraints operate directly on surface representation without reference to underlying representation. Input forms are considered unnecessary and are omitted from tableaux (see Section 1.2.2.2 of Chapter 1). In the following discussion, I shall not attempt a formal reanalysis of Inouye's accounts of lenition and fortition processes involving taps, coronal stops, and trills. For present purposes, therefore, let us focus on the aperture representations while
acknowledging the differences between assumptions with respect to input-output mappings. The goal here is simply to motivate the representations of the tap as an $A_mA_rA_m$ contour and of the trill as a single $A_t$ position.

### 3.2.2.1.1 Lenition as Spreading of Aperture

In American English, coronal stops /t, d/ are lenited to tap [ɾ] under certain prosodic conditions in contexts where surrounding aperture is approximant or greater: *batting* [bæɾɪŋ] versus *banter* [bæntər] and *Betsy* [bɛtsi] (Inouye 1995:55-59). In Aperture Theory, plosives are represented as bipositional sequences of closure + release, $A_0A_m$ (Steriade 1993, 1994). In prevocalic position, the $A_m$ release position of a plosive undergoes merger with the $A_v$ position of a following vowel. This is the representational equivalent of the statement that plosives are released into following vowels. When plosives undergo tapping, a contour representation is derived by the spreading of surrounding vocalic aperture onto the intervening $A_0$ stop closure, as shown in (3.7):

(3.7) Temporal lenition of stop as spreading of vocalic aperture

\[
/VtV/ \quad \rightarrow \quad [VrV]
\]

\[\text{cor} \quad A_v \quad A_0A_m \quad A_v \quad \text{cor} \quad A_v \quad A_0 \quad A_v\]

Differences between the representation of the underlying tap in (3.6a) and the derived structure in (3.7) involve both the central and peripheral aperture positions. While an underlying tap has a central $A_t$ constriction flanked by phonologically-specified $A_m$
release and approach branches, tapping of an underlying stop yields a structure in which flanking $A_v$ positions have spread onto the central $A_0$ position. In both cases, the extra-short duration of the central constriction is ensured by the association of surrounding aperture values of approximant or greater (i.e., $A_m$ or $A_v$). The aperture contour is derived in the tapping of stops but phonologically specified in the case of phonemic tap.

Inouye (1995, Ch. 4) reports a common cross-linguistic pattern whereby surface tap is derived from underlying intervocalic trill in a manner similar to the spreading analysis of American English tapping. Assuming the representation of the trill in (3.6b), derivation of tap from intervocalic trill may be captured as an instance of aperture spreading:

(3.8) Temporal lenition of trill as spreading of vocalic aperture

\[
/V_rV/ \rightarrow [V_rV]
\]

\[
\begin{align*}
\text{cor} & \quad \text{cor} \\
A_v & \quad A_1 & \quad A_v \\
\end{align*}
\]

As with the lenition of intervocalic stops in American English, lenition of intervocalic trills results in an aperture contour derived by spreading. When the flanking $A_v$ positions come to associate to the intervening trill, the duration of the central $A_t$ constriction is reduced enough to prevent passive vibration of the tongue tip.

In sum, the temporal lenition of coronal stops and trills constitutes evidence in favor of the contour representation of the tap in (3.6a). In both cases, spreading of surrounding vocalic aperture onto the central aperture position reduces the duration of the latter, thereby preventing longer duration of stops and passive vibration of trills.
3.2.2.1.1.2 Fortition as Delinking of Aperture

If lenition is the spreading of aperture, then it is plausible to view fortition as its formal counterpart, namely delinking. Inouye (1995, Ch. 2) identifies the contexts in (3.9) as typical phonetic environments in which phonemic taps undergo fortition to stops cross-linguistically:

\[(3.9)\] Typical fortition environments

\[
/\theta/ \rightarrow [t, d, n] / \# \_ \\
C \_ \# \\
\_ C
\]

The contour representation of phonemic tap provides a natural account of fortition in these contexts. In those languages exhibiting alternations between taps and stops, Inouye assumes that the tap is phonologically specified as an aperture contour in which a central \(A_0\) position is flanked by \(A_m\) positions. When the branching structure of the tap is adjacent to another consonant or word-boundary, delinking of the adjacent \(A_m\) position may take place. This is schematized in Figure 3–13:

\[
/\theta/ \rightarrow [t, d, n]
\]

Typical Fortition Environments

\[
\# \_ \rightarrow \text{delink} \ \text{(1)} \\
\_ \# \rightarrow \text{delink} \ \text{(3)} \\
C \_ \rightarrow \text{delink} \ \text{(1)} \\
\_ C \rightarrow \text{delink} \ \text{(3)}
\]

*Figure 3–13: Fortition of phonemic tap as delinking of aperture (cf. Inouye 1995:136)*
The result of delinking a peripheral $A_m$ position would not sound like a tap because the closure duration is lengthened to that of a normal stop (oral or nasal). This analysis of fortition also applies to those languages in which phonemic taps strengthen to trills, except that in this case the tap would be phonologically specified with a central $A_t$ constriction (versus the $A_0$ for stops shown in Figure 3–13 above).

3.2.2.1.2 Comparison with Bakovic (1994)

It is useful now to compare the aperture-theoretic representations in (3.6) with those proposed by Bakovic (1994), whose analysis was examined in Section 2.2.5 of Chapter 2. The representations are shown in Figure 3–14:

![Figure 3–14: Comparison of aperture-theoretic representations of coronal tap and trill](image)

The representations proposed here differ from those of Bakovic in several respects. One crucial difference is that the representations of the tap as a single $A_m$ and of the trill as a plosive $A_0A_m$ sequence do not directly reflect the articulatory properties of these segments. In Section 3.1, the tap was shown to involve a ballistic gesture consisting of approach, constriction, and release phases. Similarly, the trill does not have complete
closure like a plosive, but rather it is an articulatory posture of intermediate stricture between fricatives and stops upon which passive vibrations are aerodynamically imposed.

Furthermore, Bakovic's representations do not capture the formal symmetry between lenition and fortition processes as spreading and delinking, respectively. In Section 3.2.2.1.1, lenition was argued to result from the bidirectional spreading of aperture values of approximant or greater, which derives the contour representation of the tap from an underlying stop or trill. Conversely, fortition results from the delinking of a peripheral aperture position, which permits an increase in the duration of the central constriction. In contrast, Bakovic's analysis views lenition and fortition as the underparsing and insertion, respectively, of an A₀ closure position. However, as argued above, the aperture configurations resulting from underparsing and insertion, namely A₀ and A₀Am, respectively, do not reflect the articulatory properties of tap and trill segments.

Having motivated the articulatory representations of the coronal tap and trill in (3.6), I now turn to a discussion of constraints on the aperture structure of these rhotics.

### 3.2.2.2 Constraints on Coronal Transitions

The peripheral Am nodes of the tap in (3.6a) function as articulatory transitions between the central At constriction and the aperture specifications present in the surrounding segmental context. I argue that the presence of Am in coronal articulations is penalized by
*FAST constraints, which dislike rapid transitions.\textsuperscript{33} The context-free *FAST constraint in (3.10) encodes a general preference for the single position of the alveolar trill over the tripartite aperture contour of the alveolar tap:

\[
\begin{align*}
\text{(3.10) } & *\text{FAST} \\
& \text{Avoid faster-than-usual articulatory transitions in constrictions involving the tongue tip}
\end{align*}
\]

\[
\begin{array}{c}
\checkmark & r \\
\text{cor} & \text{cor} \\
A_t & A_m A_c A_m
\end{array}
\]

The tap is additionally penalized by two positional FAST constraints, one targeting Place-sharing configurations and the other phrase-initial position. These constraints are motivated in the following sections.

\subsection*{3.2.2.2.1 Place/stricture-sharing in Homorganic Clusters}

As previously mentioned, it is assumed that stricture is dominated by Place in the feature geometry (Padgett 1994, 1995). This is demonstrated by the fact that the coronal place node dominates the aperture nodes in the representations of the tap and trill in (3.6). The benefit of this assumption is that it allows formal capture of the obligatory neutralization to trill in homorganic clusters in languages such as Kairiru, Ngizim, and those of the

\textsuperscript{33} The context-free *FAST constraint in (3.10) is taken from Steriade (1995a), but the context-specific *FAST/SAME SITE in (3.11) and *FAST/INITIAL in (3.15) originate with the present account.
Iberian Romance family (see Section 1.1 of Chapter 1). The \( \text{*FAST/SAME SITE} \) constraint in (3.11) bans the rapid \( A_m \) approach phase when it intervenes between two aperture positions of greater stricture under the same Place node. (N.B.: Place-sharing in homorganic clusters is denoted by the \( \alpha \text{Place} \) subscript.)

\[
\text{\textbf{(3.11)}} \quad \text{\textit{*FAST/SAME SITE}} \\
\text{Avoid faster-than-usual articulatory transitions in Place-sharing clusters involving the tongue tip}
\]

\[
\begin{array}{c}
\checkmark \ [\text{nr}]_{\alpha \text{Place}} & * \ [n^\gamma r]_{\alpha \text{Place}} & \text{cf.} \ [p^\gamma r] \\
\text{cor} & \text{cor} & \text{lab cor} \\
A_0 A_t & A_0 A_m A_t A_m & A_0 A_m A_t A_m
\end{array}
\]

When a rhotic surfaces next to a consonant with which it shares Place, \( \text{*FAST/SAME SITE} \) will ensure neutralization to trill. If the rhotic and adjacent consonant have separate Place nodes, as in the heterorganic \( [p^\gamma r] \) cluster shown above, then the intervening \( A_m \) transition is not penalized by the constraint in (3.11).

The claim that Place-sharing prohibits an articulatory transition between homorganic consonants finds precedence in Clements' (1985) analysis of consonantal transition phenomena in Sierra Popoluca, a Zoquean language spoken in Mexico (Elson 1947, 1956; Foster and Foster 1948). Consonant clusters in this language are realized with an intervening open transition if the consonants are heterorganic, while homorganic clusters lack such a transition, as shown in (3.12):
(3.12)  Open transition realized between heterorganic consonants in Sierra Popoluca

a.  \( \text{k}\text{ê}k^b\text{pa}? \)  'it flies'
    \( \text{mi}\text{n}^n\text{pa}? \)  'he comes'

b.  \( \text{k}\text{ê}\text{gak}\text{ê}^b\text{pa}? \)  'it flies again'
    \( \text{aŋ.ki}? \)  'yard'

In (3.12a), the open transition is realized as aspiration after the voiceless velar stop and as a short schwa-like vowel after the palatal nasal. The homorganic sequences of \( [k.g] \) and \( [ŋ.k] \) in (3.12b) lack an open transition.

Clements analyzes the open transition as an oral release feature, represented by a 'floating' occurrence of the feature [+continuant]. Specifically, the rule in (3.13) inserts this feature between two stops:

(3.13)  \( \emptyset \rightarrow [+\text{cont}] / [-\text{cont}] \_ [-\text{cont}] \)

The application of this rule generates surface forms such as \( [k\text{ê}k^b[+\text{cont}]\text{pa}?] \) and \( [\text{mi}\text{n}^n[+\text{cont}]\text{pa}?] \), and the realization of [+cont] as voiceless or voiced is assumed to be the result of universal phonetics. The rule fails to apply in the homorganic clusters of (3.12b), however, because these consonants are linked to the same Place node. To see this, consider the geometric representations of heterorganic \( [kp] \) and homorganic \( [kg] \) in (3.14). (N.B.: In accordance with Padgett's (1994, 1995) proposal regarding Place/stricture dependency, I adapt Clements' original formalism by depicting [cont] features as dependent on the Place node.)
In heterorganic clusters such as [kp], the two consonants have independent Place nodes. On the other hand, the identity of Place specifications in homorganic clusters such as [kg] is represented by the fact that these consonants are both linked to the same Place node. The shared Place node in turn dominates a single [–cont] specification, on the assumption that the merger of identical nodes also entails the merger of identical dependent features. This is the explanation for why [+cont] may be inserted in [kp] but not in [kg]: only the former cluster meets the structural description of rule (3.13).

Although both Clements’ analysis and the *FAST/SAME SITE constraint proposed in (3.11) ensure the absence of release in homorganic clusters, the two approaches differ with respect to the representation of stricture. While Clements assumes the binary feature [continuant], the present account represents stricture in terms of aperture positions. The

---

34 See the Shared Features Convention of Steriade (1982) and Clements’ (1985) reformulation of it under different feature-geometric assumptions.
shared Place node of the homorganic [kɡ] cluster in (3.14) dominates a single [–cont] feature. The merger of [–cont] specifications under Place is crucial in blocking the release insertion rule, which requires flanking values of [–cont] for its application. This contrasts with the aperture-theoretic representation of the homorganic [nr] cluster in (3.11), which dominates an A₀A₁ sequence. The aperture positions for the nasal and the rhotic are different, so they fail to merge. The constraint *FAST/SAME SITE simply forbids an intervening Aₘ from appearing between two positions of greater stricture (e.g., A₀ and A₁) under the same Place node. The trill is obligatory under Place/stricture-sharing configurations because it lacks the marked Aₘ transition.

3.2.2.2 Phrase-initial Fortition

The other positional constraint on articulatory transitions in coronal constrictions is *FAST/INITIAL, which disfavors the initial Aₘ position of the tap in phrase-initial position, as seen in (3.15):

(3.15)  *FAST/INITIAL
Avoid faster-than-usual articulatory transitions in phrase-initial constrictions involving the tongue tip

\[
\begin{align*}
\text{cor} & \quad \text{cor} \\
A_t & \quad A_{m-A_t-A_m} \\
\checkmark & \quad * \\
|| & \quad ||'r
\end{align*}
\]

This constraint mandates that phrase-initial coronal consonants should not begin with an Aₘ aperture position and thus prefers the Aₗ position of the trill. (3.15) is a specific
instantiation of the more general phenomenon of articulatory strengthening in initial position. Keating et al. (1999) have demonstrated a cross-linguistic tendency for lingual articulations to exhibit an increase in closure duration and extent of contact in domain-initial positions, especially at the beginning of an utterance. The *FAST/INITIAL constraint is the formal expression of phrase-initial fortition with respect to coronal constrictions. By prohibiting the initial Am position of the tap, it prefers the longer Ai constriction of the trill, which allows passive vibration of the tongue tip to occur under an applied airstream.

3.2.2.3 Constraint on Coronal Constrictions

The final articulatory markedness constraint necessary in the present account is *HOLD, shown in (3.16). This constraint prefers the shorter Ai constriction of the tap to the longer one of the trill.

35 Other examples of initial fortition in Spanish include the failure of phrase-initial voiced stops [b,d,g] to undergo spirantization and the presence of glottal stop before word-initial vowels in the same context. The fact that bilabial and velar voiced obstruents are also strengthened in phrase-initial position suggests that initial fortition may stem from a constraint more general than *FAST/INITIAL in (3.15), which targets only coronal articulations. I will not pursue this possibility here, but see Bakovic (1994) for relevant discussion and analysis under different theoretical assumptions.

36 See Figure 3–12 and the surrounding discussion, in which differences in the constriction duration of the tap versus trill were argued to follow as a consequence of universal phonetics.
Cross-linguistic evidence suggests that the longer constriction of the trill is more marked in some positions than in others. First, as noted previously in Section 3.2.2.1.1.1, intervocalic position is a typical cross-linguistic lenition environment in which the stops and trills tend to undergo a reduction in duration. In other words, there is greater impetus for constrictions to lenite between vowels than in other environments. With respect to intervocalic position, Kirchner (1998) argues the following: "All else being equal, lenition is more likely to occur the more open the segments which flank the target… lenition occurs more readily in [intervocalic] contexts … because greater effort is required to achieve a given constriction target…” (179). Second, the phonetic studies of Inouye (1995) reveal that trills are especially prone to reduced duration in postconsonantal contexts. Romanian, Lithuanian, Icelandic, Lugbara, and Indonesian all possess a single coronal trill in their phonological inventories. Measurements of the duration and number of lingual contacts of the trill in these languages show a clear tendency for lenited allophones to surface postconsonantally (see Inouye 1995:245-255).

The common property of intervocalic and postconsonantal contexts is that they are both prevocalic contexts. The greater impetus to reduce the duration of coronal trills in prevocalic (i.e., intervocalic and postconsonantal) position can be captured by having *HOLD evaluate the duration of the $A_t$ constriction more stringently for trills surfacing
before vowels. Therefore, I assume that this constraint assigns two violation marks to a trill when it surfaces in prevocalic position versus one mark when it surfaces elsewhere, as shown in (3.17):\textsuperscript{37}

\textbf{(3.17)} \hspace{1cm} *HOLD is violated twice by the longer $A_t$ constriction of trill in prevocalic positions, but once in non-prevocalic positions

\begin{center}
\begin{tabular}{cc|cc|c|c}
 & & & & & \\
\textbf{cor} & \textbf{lab} & \textbf{cor} & \textbf{cor} & \textbf{lab} & \textbf{cor} \\
\textbf{A}_v & \textbf{A}_t & \textbf{A}_v & \textbf{A}_v & \textbf{A}_t & \textbf{A}_v \\
\end{tabular}
\end{center}

The aperture-theoretic representations that *HOLD favors are shown in (3.18):

\textsuperscript{37} Another way to guarantee such stringency effects is to tease apart a positional variant of the *HOLD constraint targeting prevocalic contexts—a move similar to that taken above with respect to the context-specific *FAST/INITIAL and *FAST/SAME SITE versus context-free *FAST. Under a ranking such as *HOLD/_V » *HOLD, *HOLD/_V would guarantee prevocalic taps, while the domination of lower-ranked *HOLD by CONTRAST(dur) or *FAST would yield contrast or neutralization to trill, respectively, in non-prevocalic positions. However, this approach creates a potential problem with respect to capturing the implicational relation among contrastive positions, shown in (3.4). Specifically, nothing rules out the possibility of a ranking such as *HOLD/_V » CONTRAST (dur/V/V) » CONTRAST(dur/#_V) » CONTRAST(dur) » \{other markedness constraints\}, which would neutralize contrast to tap between vowels and word-initially while allowing contrast elsewhere. This is an undesirable result insofar as all of the languages surveyed maintain tap/trill contrast at least intervocically. Nonetheless, some principled motivation must be found for the fact that *FAST seems to admit positional variants while *HOLD cannot. I leave this issue for future research. Thanks to Eric Bakovic and Richard Page for discussion on this matter.
(3.18) \(^{\ast}\)HOLD prefers the shorter \(A_t\) constriction of the tripartite contour representation of tap

\[
\begin{align*}
\checkmark V r V & & \checkmark p^r v V & & \checkmark V r^p & & \checkmark V r^v || \\
\begin{array}{c}
cor \quad lab \quad cor \\
A_v \quad A_t \quad A_v \\
A_0 A_m \quad A_t \quad A_v
\end{array} & &
\begin{array}{c}
cor \quad lab \\
A_v \quad A_t A_m \quad A_0 A_m
\end{array} & &
\begin{array}{c}
cor \\
A_v \quad A_t A_m
\end{array}
\end{align*}
\]

As shown in (3.18), this constraint favors the contour representation of the tap by ensuring the association of the rhotic's Place node to an adjacent \(A_v\) or \(A_m\) position. In contrast, the trills in (3.17) are all single \(A_t\) positions. In representational terms, the lack of an association line between the rhotic's Place node and a following \(A_v\) is more marked than the lack of association to a preceding \(A_v\) position. This directional asymmetry may derive from a greater preference for consonantal articulations to have a release phase than an approach phase when either is potentially available via association to an adjacent vowel.\(^{38}\) Whatever the motivation is for this asymmetry, its effects are appropriately reflected by the extra violation of \(^{\ast}\)HOLD when trills are prevocalic.\(^{39}\) In Section 3.3.3, the assumption regarding the double violation of \(^{\ast}\)HOLD is shown to be crucial in

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\(^{38}\) This is admittedly a speculative possibility, although it is vaguely reminiscent of Steriade's (1993:404) release projection rule, which ensures that \(A_0\) plosives universally project an \(A_m\) release position. In other words, the preference for plosives to have a following release mirrors the preference for \(A_t\) rhotics to associate to a following vowel.\(^{39}\) Richard Page (personal communication) raises an important issue regarding the stringency of \(^{\ast}\)HOLD with respect to prevocalic trills. Specifically, this claim would seem to entail the unlikely pattern that trills should be more common cross-linguistically in word-final position than in word-initial position in languages that permit coda consonants. The entailment does not hold, however, given that there is another constraint, \(^{\ast}\)FAST/INITIAL, which may be ranked above \(^{\ast}\)HOLD. The ranking of \(^{\ast}\)FAST/INITIAL \(\gg\) \(^{\ast}\)HOLD would ensure trills in word-initial prevocalic contexts but still allow taps to occur in word-final position, assuming, of course, that context-free \(^{\ast}\)FAST ranks below \(^{\ast}\)HOLD.
accounting for neutralization to tap after heterorganic consonants and in word-final prevocalic position in Spanish and Catalan.

3.3 Analysis of Spanish Rhotics

The remaining sections of this chapter illustrate how the Spanish pattern is accounted for by the phonetically-based OT analysis developed above. Relevant data from other Iberian Romance languages are taken into consideration as necessary. The analysis is then compared with existing prosodic accounts in Section 3.3.5.

Table 3–2 below presents a summary of the Spanish pattern, using examples from the data presented in Chapter 2. Shaded cells in the center column denote positions of contrast neutralization. The realization of rhotics in each position is accounted for in the following sections, in which I provide constraint evaluations to justify the necessary rankings.
3.3.1 Intervocalic Contrast

In Spanish, the tap and trill are phonologically contrastive between vowels because
\textsc{Contrast}(\textsc{dur}/V\_V) outranks the two markedness constraints with which it interacts,
namely \textsc{Hold} and \textsc{Fast}, as shown in tableau (3.19):
(3.19) Maintenance of intervocalic contrast

<table>
<thead>
<tr>
<th></th>
<th>CONTRAST (dur/V_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST(dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. VrV ≠ VrV</td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. VrV</td>
<td>*!</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c. VrV</td>
<td>*!</td>
<td>**</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

The neutralizing candidates (3.19b,c) fail to maintain rhotic contrast in word-medial intervocalic position and are ruled out by CONTRAST(dur/V_V). The winning candidate is (3.19a) because the tap and trill are contrastive between vowels, satisfying the highest-ranked constraint.

Some comments are in order with respect to the nature of the candidates being evaluated in tableau (3.19). An important research goal for Dispersion Theory is to further refine our understanding of what candidates are and how they are evaluated in a theory that assumes no underlying representation. Here, I follow Flemming (1999) and Ní Chiosáin and Padgett (2001) in assuming that candidates are idealized, possible surface forms of languages. Candidate (3.19a), therefore, expresses the generalization that two surface forms are contrastive in Spanish if they contain the sequences VrV and VrV, respectively, where the exact nature of V is irrelevant. Accidental gaps are, of course, possible. For example, *pero 'but' vs. perro 'dog' constitute a minimal pair, but acera 'pavement; sidewalk' cannot because the form *acerra is not an actual word in

---

40 Flemming’s (1995) surface-oriented Dispersion Theory of contrast was discussed in Section 1.2.2.2 of Chapter 1.
Spanish, although a possible grammatical one. I shall continue to employ hypothetical, idealized candidate forms throughout the remainder of this dissertation, although on some occasions, actual words will need to be evaluated (see, for example, tableaux (4.13) and (4.22) in Chapter 4).

### 3.3.2 Neutralization to Trill

In non-intervocalic positions, the decision falls to the lower-ranked markedness constraints, which collectively favor the neutralization of contrast. In Spanish, high-ranked *FAST/SAME SITE and *FAST/INITIAL ensure trills after homorganic consonants and in phrase-initial position, respectively, as the following tableaux demonstrate. (N.B.: Place/stricture-sharing in homorganic clusters is denoted by the use of brackets.)

(3.20) Neutralization to trill in homorganic cluster

<table>
<thead>
<tr>
<th></th>
<th>*FAST/ INITIAL</th>
<th>CONTRAST (dur/#_V)</th>
<th>*FAST/ SAME</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. {C'v}V ≠ {Cr}V</td>
<td></td>
<td>*!</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. {Cr}V</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. {Cr}V</td>
<td></td>
<td></td>
<td></td>
<td>**</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>
Neutralization to trill in phrase-initial position

<table>
<thead>
<tr>
<th></th>
<th>*FAST/INITIAL</th>
<th>CONTRAST (dur/#_V)</th>
<th>*FAST/SAME</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
<td>^rV ≠</td>
<td></td>
<td>rV</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>^rV</td>
<td>*!</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td>rV</td>
<td></td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

The ranking of *FAST/SAME SITE » *HOLD » CONTRAST(dur) predicts trills in homorganic clusters, as in (3.20c). Similarly, the ranking of *FAST/INITIAL » CONTRAST(dur/#_V) » *HOLD makes the same prediction for phrase-initial position, as in (3.21c). In each case, the trill is optimal because it lacks an Am approach in a marked position.

The reader may have already noticed a potential problem in the analysis thus far with respect to initial fortition. Since *FAST/INITIAL specifically targets phrase-initial rhotics, how do we explain the fact that the trill is obligatory in any word-initial position at the phrasal level? In fact, the constraint ranking makes the wrong predictions regarding word-initial postvocalic and word-initial postconsonantal positions. Since *FAST/INITIAL has nothing to say about rhotics in these contexts, the top two constraints of the CONTRAST(duration) hierarchy incorrectly predict phonological contrast. The tableaux in (3.22) illustrate this problem:
Rhotic duration contrast incorrectly licensed in word-initial postvocalic and word-initial postconsonantal positions

<table>
<thead>
<tr>
<th></th>
<th>CONTRAST (dur/V_V)</th>
<th>*FAST/INITIAL</th>
<th>CONTRAST (dur/#_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>V</td>
<td>rV ≠ V</td>
<td>rV</td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>b.</td>
<td>V</td>
<td>rV</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>V</td>
<td>rV</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The analysis fails to account for the generalization that all word-initial rhotics at the phrasal level must be trills, regardless of the final segment of the previous word. A potential solution would require some mechanism for ensuring that the effects of phrase-initial markedness become generalized as word-initial effects. I develop such an account in the following sections.

3.3.2.1 Lexical Conservatism

Working on the basis of facts from English Level 2 phonology and French liaison, Steriade (1999b) proposes lexical conservatism as a class of grammatical conditions "promoting the use of pre-existing, familiar expressions, or parts or properties of such expressions" (244). A simple example involves stress in morphologically derived words
in English. The nonce word *aspiratory* [æsəpɪrətəri] with stress on the initial syllable would be seen as lexically related to *aspire*, while [əs'pɪərətəri] with stress on the second syllable would relate to *aspire*, but not vice-versa. A lexical conservatism condition is argued to enforce similar stress configurations in lexically listed forms and novel forms. In the interpretation of the nonce words, English speakers employ phonological similarity to pre-existing words as a guide.

Several important theoretical issues arise with respect to lexical conservatism: What counts as a lexically listed form? How are lexical conservatism conditions to be expressed formally? What types of phonological properties are subject to these conditions? In Steriade (1999b), lexical conservatism guarantees phonological similarity between a morphologically derived word and its lexically listed base form, thereby creating uniform morphological paradigms, e.g., {*aspire, aspiratory*} and {*aspire, aspiratory*}. Another type of paradigm is a set of phrases sharing the same word, such as {*flower, the flower, the flower is a tulip, Mary picked a flower*}. It is the phrasal paradigm that concerns us here. Specifically, I propose that phrasal paradigms are subject to lexical conservatism conditions which ensure phonological similarity between the phrase-level realization of a word and its lexically listed form.

### 3.3.2.1.1 Lexically Listed Forms

With respect to what counts as the lexically listed form of a word for the purposes of lexical conservatism in phrasal paradigms, I assume it to be the *citation form* of that
word, i.e., the form of the word as it is realized in isolation. Given a word such as \{flower\}, lexical conservatism constraints may be posited to enforce similarity between the citation form of \{flower\} and its realizations at the phrasal level with respect to a given phonological property. In other words, the citation form stands in correspondence with forms of the same word appearing across different phrase-level contexts, as demonstrated in (3.23):

(3.23) Correspondence relations between the citation/lexically listed form of \{flower\} and its phrasal realizations

Citation/lexically listed form: \{flower\}

Phrasal realizations:

\{the flower\}  
\{the flower is a tulip\}  
\{Mary picked a flower\}

The proposal to relate citation forms with their phrase-level realizations via correspondence constraints is not new. In her discussion of retroflexion in apical consonants in Sanskrit, Steriade (1995a) observes that distinctive retroflexion is disallowed stem-internally after a consonant but maintained word-initially across different phrasal contexts—even after a consonant. According to her analysis,

"such discrepancies between the word-internal and the phrasal distribution of contrasts result from the effect of highly ranked correspondence constraints mandating that the retroflexion value of an apical be identical to the value displayed in the allomorph identifiable as the \forme de fondation\ (Kurylowicz 1949) of the paradigm. Here we will equate the \forme de fondation\ with the isolation form. If the initial apical in the \forme
If the morpheme-initial apical in the _forme de fondation_ is neutralized, then the neutralized quality will be preserved across contexts, even after vowels" (30).

In connecting this analysis with the present proposal regarding lexical conservatism at the phrasal level, let us note that the notions of _forme de fondation_, citation/isolation form, and lexically listed form are essentially equivalent.

### 3.3.2.1.2 Lexical Conservatism Constraints

Having established the relevant correspondence relation between the citation/lexically listed form of a word and its phrasal instantiations, I now turn to the formal expression of lexical conservatism conditions. Specifically, I propose that lexical conservatism constraints on words at the phrasal level follow the schema in (3.24):

(3.24) **Formulation of lexical conservatism (LEXP) constraints (adapted from Steriade 1999b:346)**

Let T(W) be the form of a word W appearing under evaluation.
Let L(W) be the lexically listed form of W.
Let P be some phonological property.

Every instance of P in L(W) is conserved in T(W).

At first glance, the definition of LEXP constraints in (3.24) is highly reminiscent of the featural input-output correspondence constraint of McCarthy and Prince (1995), which I repeat below for comparison:

(3.25) **IDENT–IO(F)**

Output correspondents of an input [γF] segment are also [γF].
The faithfulness constraint \( \text{IDENT–IO(F)} \) in (3.25) ensures that underlying specifications for some feature \( F \) will surface faithfully in the output.\(^{41}\)

There are non-trivial differences between LEXP constraints and \( \text{IDENT–IO(F)} \), however. First, the lexically listed form \( L(W) \) to which LEXP constraints make reference is not the same as the underlying or input form of \( \text{IDENT–IO(F)} \) constraints. The correspondence relation that holds between \( L(W) \) and \( T(W) \) is essentially one of the output-output variety. That is, \( L(W) \) is taken to be the surface realization of a word \( W \) as it appears in isolation as opposed to an abstract, underlying input form. Similarly, \( T(W) \) is the surface realization of word \( W \) embedded within a specific phrasal context. From the perspective of input-output correspondence models, then, \( L(W) \) and \( T(W) \) both constitute "output" forms. That these two surface forms should be related via LEXP constraints is congruent with other proposals in the Optimality-theoretic literature, e.g., Anti-allomorphy and Multiple Correspondence (Burzio 1994, 1997), Output-Output Correspondence (Benua 1995, 1997), Paradigm Uniformity (Flemming 1995; Steriade 1995a, 2000), and Uniform Exponence (Kenstowicz 1996, 1997).

Second, the set of phonological properties to which LEXP constraints can potentially refer extends beyond those properties typically assumed under Correspondence-theoretic analyses. In the account developed here, I propose that the variable \( P \) in the schematic formulation of LEXP constraints in (3.24) can include the property of \textit{phonological contrast} itself, or the absence thereof. That is to say, LEXP constraints are capable of generalizing contrasts or neutralizations present in a lexically

\(^{41}\) See the discussion of Correspondence Theory in Section 1.2.2.1 of Chapter 1.
listed form $L(W)$ to its phrasal instantiation $T(W)$. In contrast, the $\text{IDENT–IO}(F)$ constraint in (3.25) simply enforces identity to underlying feature values, regardless of whether $F$ participates in a phonological contrast. This difference is ultimately related to the fact that Dispersion Theory evaluates phonological contrasts directly among output forms, while input-output correspondence evaluates identity to particular feature values in the input form. The importance of this aspect of $\text{LEXP}$ constraints will be made clear in the analyses to follow, where rhotic duration contrasts and neutralizations are generalized from the lexically listed forms of words to realizations of these words at the phrasal level.

3.3.2.2 Lexical Conservatism Effects on Word-initial Rhotics

Following the schema in (3.24), I adopt the lexical conservatism constraint on rhotic duration in (3.26):

(3.26)  \[ \text{LEX(duration)} \]
\[ \text{Given } T(W), \text{ the form of a word } W \text{ appearing under evaluation, and } L(W), \text{ the lexically listed form of } W, \text{ the contrastive/neutralized quality of rhotic duration in } L(W) \text{ is conserved in } T(W). \]

In the present analysis, $\text{LEX(duration)}$ guarantees that the contrastive or neutralized status of the tap and trill in lexically listed forms is generalized to their corresponding phrase-level forms. As anticipated in the discussion following tableau (3.22) in Section 3.3.2, this is precisely the type of mechanism required to ensure that the effects of phrase-initial markedness become generalized as word-initial effects, which I will demonstrate below.

Now, when a word appears in isolation, word-initial position is necessarily also phrase-initial—exactly the context in which $\text{*FAST/INITIAL}$ ensures neutralization to trill,
as shown in tableau (3.21) above. When ranked high enough, \( \text{LEX}(\text{duration}) \) generalizes the lexically listed initial trill to all word-initial positions at the phrasal level. In Spanish, \( \text{LEX}(\text{duration}) \) dominates the entire \( \text{CONTRAST}(\text{duration}) \) hierarchy, as shown in the following tableaux. (N.B.: The lexically listed form \( L(W) \) is provided above the tableaux as a convenient reminder of the property that \( \text{LEX}(\text{duration}) \) seeks to conserve in \( T(W) \), in this case, neutralization to trill.)

(3.27) Lexical conservatism ensures neutralization to trill in word-initial postvocalic and word-initial postconsonantal positions

\[ L(W) : rV = (3.21c) \]

<table>
<thead>
<tr>
<th></th>
<th>LEX (dur)</th>
<th>CONTRAST (dur/V_V)</th>
<th>*FAST/INITIAL</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. V</td>
<td>rV ≠ V</td>
<td>rV</td>
<td>*!</td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>b. V</td>
<td>rV</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. V</td>
<td>rV</td>
<td>*</td>
<td></td>
<td>**</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>LEX (dur)</th>
<th>*FAST/INITIAL</th>
<th>CONTRAST (dur/#_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>d. C</td>
<td>rV ≠ C</td>
<td>rV</td>
<td>*!</td>
<td></td>
<td></td>
<td>**</td>
</tr>
</tbody>
</table>
| e. C|rV | *! | * | | | *
| f. C|rV | | | * | ** | * |

In both evaluations, \( \text{LEX}(\text{dur}) \) assigns the same violation marks to candidates as \*FAST/INITIAL does in the evaluation of phrase-initial forms in tableau (3.21). Since lexically listed, i.e., phrase-initial, forms exhibit neutralization to trill in word-initial position, the ranking of \( \text{LEX}(\text{dur}) \) » \( \text{CONTRAST}(\text{dur/V_V}) \) » \( \text{CONTRAST}(\text{dur/#_V}) \) ensures
word-initial trills both postvocally in (3.27c) and postconsonantally in (3.27f). The functioning of LEX(dur) with respect to word-initial postvocalic position is formally illustrated in (3.28):

(3.28) **LEX(duration)** ensures that the neutralized status of word-initial trill in the lexically listed form L(W) is conserved postvocally in the phrasal form T(W)

Only in candidate (3.27c) is the neutralized trill of lexically listed forms preserved at the phrasal level. The contrastive candidate (3.27a) and the neutralized tap candidate (3.27b) fail to conserve the lexically listed word-initial trill and, therefore, violate LEX(dur). The same formal relations expressed in (3.28) for word-initial postvocalic contexts are assumed to hold for word-initial postconsonantal contexts (3.27d–f) as well.

To summarize, *FAST/INITIAL is ultimately responsible for the absence of word-initial taps. LEX(dur) makes the phrase-initial trill an invariant word-initial property, even when the larger syntactic context might have otherwise licensed a rhotic duration contrast.
3.3.2.3 Word-initial Geminate Stops in Swiss German

In this section, I examine the patterning of word-initial geminate stops in Swiss German, which appears to pose problems for the LEX(duration) analysis developed above. Swiss German possesses word-initial geminate stops that surface phrase-medially but never phrase-initially or in citation forms. Steriade’s Licensing-by-Cue framework offers a viable explanation for the neutralization of the singleton-geminate contrast in phrase-initial stops. If the primary phonetic correlate of geminate stops in Swiss German is closure duration, then it is plausible to think that the singleton-geminate distinction is neutralized in phrase-initial position, where stop closure is less perceptible, while the distinction is maintained phrase-medially, where the preceding syntactic context provides richer cues to stop closure duration.

The hypothetical tableau (3.29) below illustrates a possible analysis in accordance with the Dispersion-theoretic approach espoused in this dissertation. Here, I assume that the ranking of $\text{CONTRAST}(\text{duration}_{\text{stop}}/V_V) \gg \text{CONTRAST}(\text{duration}_{\text{stop}})$ encodes the greater perceptibility of closure duration of stops in intervocalic positions versus elsewhere (e.g., phrase-initially). For expository convenience, I take $\ast\text{GEMINATE}$ to be a markedness constraint that prefers singleton consonants over their geminate counterparts. Finally, $C$ and $C$: denote singleton and geminate stop consonants, respectively, in the candidates under evaluation.

---

42 Thanks to Richard Page for bringing this case to my attention and for motivating my attempts to provide a potential solution. I assume responsibility for any shortcomings in the proposed analysis.
(3.29) Maintenance of Swiss German singleton-geminate stop contrast between vowels, but neutralization to singleton stops in phrase-initial position

<table>
<thead>
<tr>
<th></th>
<th>CONTRAST (dur\textsubscript{stop}/V_V)</th>
<th>*GEMINATE</th>
<th>CONTRAST (dur\textsubscript{stop})</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>VCV ≠ VC:V</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>VCV</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>VC:V</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>d.</td>
<td>∥CV ≠ ∥C:V</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>∥CV</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>f.</td>
<td>∥C:V</td>
<td>*!</td>
<td>*</td>
</tr>
</tbody>
</table>

Candidate (3.29a) best satisfies high-ranked CONTRAST(dur\textsubscript{stop}/V\_V) by maintaining the singleton-geminate contrast in intervocalic stops. This constraint is irrelevant in phrase-initial position, so lower-ranked *GEMINATE optimizes (3.29e) by neutralizing the singleton-geminate contrast to the singleton member of the pair.

While the cue-based account of degemination in Swiss German initial stops appears to be on the right track thus far, it becomes problematic with respect to word-initial phrase-medial contexts. Specifically, the assumption made in Section 3.3.2.1.1 that the lexically listed form of a word is equivalent to its citation form makes the incorrect prediction that all word-initial stops should be singletons. However, word-initial geminates do, in fact, surface in phrase-medial positions in Swiss German. To see this, let us assume the constraint in (3.30), which refers specifically to stop closure duration:

(3.30) \(\text{LEX(duration}_{\text{stop}})\)
Given \(T(W)\), the form of a word \(W\) appearing under evaluation, and \(L(W)\), the lexically listed form of \(W\), the contrastive/neutralized quality of stop closure duration in \(L(W)\) is conserved in \(T(W)\).
On the assumption that LEX(duration\textsubscript{stop}) outranks the CONTRAST hierarchy for distinctive stop closure duration (cf. the tableaux in (3.27) above), tableau (3.31) illustrates the incorrect prediction of this ranking with respect to phrase-medial word-initial stops appearing after vowels:

(3.31) Degemination of Swiss German stops incorrectly predicted in word-initial postvocalic position

L(W): CV (=\,(3.29e))

<table>
<thead>
<tr>
<th></th>
<th>LEX(dur\textsubscript{stop})</th>
<th>CONTRAST (dur\textsubscript{stop}/V\textsubscript{V})</th>
<th>*GEMINATE</th>
<th>CONTRAST (dur\textsubscript{stop})</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. V</td>
<td>CV ≠ V</td>
<td>C:V</td>
<td>*/</td>
<td>*</td>
</tr>
<tr>
<td>b. V</td>
<td>CV</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. V</td>
<td>C:V</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Since stops are neutralized to singletons in the lexically listed, i.e., phrase-initial, form in (3.29e), high-ranked LEX(duration\textsubscript{stop}) has the ill effect of generalizing phrase-initial degemination to all word-initial positions at the phrasal level—contrary to the empirical facts.

Note that this problem is the exact opposite of that encountered in the analysis of obligatory word-initial trill in Spanish. In the tableaux in (3.22) above, it was shown that the CONTRAST hierarchy for distinctive rhotic duration was incapable of ensuring neutralization to trill in word-initial postvocalic and postconsonantal positions at the phrasal level. LEX(duration) in (3.26) was proposed as a way to generalize phrase-initial trill—guaranteed by *FAST/INITIAL—to all word-initial positions. However, the case of initial geminate stops in Swiss German now seems to require the opposite results, namely
that the singleton-geminate distinction be *recovered* in phrase-medial contexts, despite its neutralization in phrase-initial position in (3.29e).

A potential solution to this paradox is available if we accept a fundamental distinction between stop duration and rhotic duration. With respect to the paradigmatic extension of sound properties, Steriade (2000) speculates that

"any sound property or any cluster of properties may give rise to paradigmatic leveling but that the categorical or variable nature of the effect will depend on the perceptibility of the property being generalized through leveling. The less perceptible the contrast generated in this way, the harder it will be to detect and enforce uniformity in each and every relevant token" (332).

It is plausible to think that the alveolar trill differs from a geminate stop with respect to the perceptibility of duration. While a geminate stop involves complete closure, the trill has an inherently salient acoustic structure consisting of vocalic formant values briefly interrupted by periods of stop-like silence (Widdison 1997:190). As a result, it is natural to expect a phrase-initial trill to be inherently more perceptible than a phrase-initial geminate stop because the internal durational cues are more salient in the former than in the latter segment type.

One possible account of the distinct behavior of word-initial trills in Spanish versus word-initial geminate stops in Swiss German is to posit a correlation between the ranking of \text{LEX}(duration) constraints and the relative perceptibility of closure duration in each case. Since closure duration is inherently less perceptible in geminate stops than in trills, the lexical conservatism constraint on stop closure duration, \text{LEX}(\text{duration}_{\text{stop}}), has a

\footnote{See Section 3.1.2.1 on the perceptual properties of the alveolar trill and specifically \textit{Figure 3–9} and the surrounding discussion on its inherently salient acoustic structure.}
lower ranking with respect to the CONTRAST(duration\textsubscript{stop}) constraints.\footnote{See Steriade's (2001) P-map proposal for a similar although somewhat distinct analysis in which perceptibility conditions dictate the relative ranking of correspondence constraints.} Under this ranking, CONTRAST(dur\textsubscript{stop}/V\textsubscript{V}) is now able to permit recovery of the singleton-geminate distinction when a preceding vowel at the phrase level provides the necessary acoustic cues. This solution is illustrated in tableau (3.32):

(3.32) Low ranking of LEX(dur\textsubscript{stop}) ensures recovery of singleton-geminate stop contrast in word-initial postvocalic position in Swiss German

L(W): CV (=\textup{(3.29e)})

<table>
<thead>
<tr>
<th></th>
<th>CONTRAST (dur\textsubscript{stop}/V\textsubscript{V})</th>
<th>*GEMINATE CONTRAST (dur\textsubscript{stop})</th>
<th>LEX(dur\textsubscript{stop})</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>V</td>
<td>CV ≠ V</td>
<td>C</td>
</tr>
<tr>
<td>b.</td>
<td>V</td>
<td>CV</td>
<td>*!</td>
</tr>
<tr>
<td>c.</td>
<td>V</td>
<td>C</td>
<td>V</td>
</tr>
</tbody>
</table>

Since LEX(dur\textsubscript{stop}) is safely ranked below the CONTRAST(dur\textsubscript{stop}) hierarchy, phrase-initial degemination is no longer obligatorily generalized from the lexically listed/citation form to all word-initial positions at the phrase level. CONTRAST(dur\textsubscript{stop}/V\textsubscript{V}) successfully licenses the contrastive candidate in (3.32a) in accordance with the richer cues made available by the preceding word-final vowel. The reader may verify that the same ranking also accounts for phrase-initial degemination in (3.29e) above.

To sum up, the constraint reranking solution developed here successfully explains the distinct behavior of Spanish trill versus Swiss German geminate stops in word-initial
position. Therefore, the Swiss German data do not constitute counterevidence to the proposal that the lexically listed form of a word is equivalent to its citation form.\textsuperscript{45}

### 3.3.3 Neutralization with Variation

In Spanish, the contrast between the tap and trill is neutralized to tap after heterorganic consonants, although the trill may surface in highly emphatic speech. Before any consonant and word-finally, contrast is neutralized with variation between the tap and trill as a function of speech style. (Refer to Table 3–2 for sample data illustrating these patterns.) Absence of contrast in these positions stems from the fact that context-free *HOLD and *FAST both outrank context-free CONTRAST(dur). Specifically, the appearance of the tap after heterorganic consonants stems from the fact that *HOLD evaluates a trill more stringently when it surfaces before vowels (for the reasons discussed in Section 3.2.2.3). Variable realization in preconsonantal and word-final contexts is predicted by the fact that *HOLD and *FAST are left unranked with respect to one another.\textsuperscript{46} As a

\textsuperscript{45} This statement should be tempered with the caveat that further research is required to verify the broader range of empirical predictions made by such an analysis. Furthermore, a similar account may also provide an explanation as to why Spanish voiced obstruents harden to stops [b,d,\textgreek{g}] in phrase-initial position but are realized as continuants [\textgreek{b},\textgreek{d},\textgreek{y}] in word-initial postvocalic contexts (Harris 1969, Hualde 1989). I will not pursue this here, but see Bakovic (1994) for an existing proposal involving distinct theoretical assumptions.

\textsuperscript{46} Reynolds (1994) develops a theory of "floating constraints" to account for facts of variation within speech communities (cf. also Anttila 1997, Anttila and Cho 1998, Kang 1997, Nagy and Reynolds 1997, \textit{inter alia}). According to this theory, the grammar comprises a single constraint hierarchy in which constraints governing the effects of variation are ranked relative to some constraints but not others. In the present analysis of Spanish rhotics, *HOLD and *FAST both rank higher than CONTRAST(duration) but are
result, either rhotic may surface non-contrastively. Evaluations are shown in tableau (3.33):

(3.33) Neutralization to tap after heterorganic consonants, but variation before any consonant and phrase-finally in Spanish

<table>
<thead>
<tr>
<th></th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST(dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. C^rV ≠ CrV</td>
<td>**!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. C^rV</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c. CrV</td>
<td>**!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>d. Vr^C ≠ VrC</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>e. Vr^C</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>f. VrC</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>g. Vr^∥ ≠ Vr∥</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>h. Vr^∥</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>i. Vr∥</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Since *HOLD is violated twice by prevocalic trill, candidate (b) is preferred over candidates (a) and (c) because it has the fewest combined violations of the unranked constraints *HOLD and *FAST. In preconsonantal and phrase-final contexts, however, these two constraints rule out contrastive candidates (d) and (g). The remaining candidates have the same number of violations of markedness and lower-ranked CONTRAST(dur). Since the constraints fail to rule out neutralization candidates (e,f) and (h,i), they are, therefore, equally optimal. Together, the constraint ranking ensures the tap after heterorganic consonants, but variation before consonants and pause.

unranked with respect to each other. See Morris (1998) for an analysis of stylistically-controlled variation in Spanish phonology using partially-ranked, floating constraints.
As discussed in Section 2.1 of Chapter 2, Morales-Front (1994:167) observes that the trill can surface in complex onsets in Spanish under conditions of highly emphatic speech (e.g., ¡inc[r]eíbles p[r]ecios! ‘incredible prices!’). This is accounted for on the assumption that on such occasions, speakers momentarily fix the ranking between context-free markedness such that *FAST comes to dominate *HOLD, as shown in tableau (3.34):

(3.34)  Trill surfaces in clusters and phrase-finally under highly emphatic speech conditions in Spanish

<table>
<thead>
<tr>
<th></th>
<th>*FAST</th>
<th>*HOLD</th>
<th>CONTRAST(dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. C\textsuperscript{r}V \neq CrV</td>
<td>*!</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>b. C\textsuperscript{r}V</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c. CrV</td>
<td></td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>d. Vr\textsuperscript{r}C \neq VrC</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>e. Vr\textsuperscript{r}C</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>f. VrC</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>g. Vr\textsuperscript{r}\parallel \neq Vr\parallel</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>h. Vr\textsuperscript{r}\parallel</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>i. Vr\parallel</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The observation made by Harris (1983:144, Fn. 14) that a trill in /Cr/ onsets is not representative of normal speech styles is captured by the fact that *HOLD and *FAST are usually unranked in Spanish, as in (3.33). Only in highly emphatic speech mode is *HOLD temporarily demoted below *FAST, as in (3.34). In sum, the possibility of trills after heterorganic consonants in (3.34c) stems from the fact that *FAST may fall into a
categorical ranking relation with respect to *HOLD, i.e., *FAST » *HOLD, whereas these two constraints are otherwise unranked, i.e., {*HOLD, *FAST}, in normal speech styles.

The realization of rhotics in consonant clusters deserves further commentary. In tableau (3.20) above, rhotics neutralize to trill after homorganic (i.e., alveolar) consonants because *FAST/SAME SITE ensures the absence of an intervening Am position in Place/stricture-sharing configurations. Since the clusters in (3.33a–c) do not share Place, *FAST/SAME SITE is irrelevant with respect to rhotics appearing after heterorganic consonants. The decision falls to the freely-ranked markedness constraints *HOLD and *FAST, which collectively favor the tap, as shown in (3.33b). The representations of homorganic and heterorganic clusters optimized by this ranking are contrasted in (3.35):

(3.35) Trill after homorganic consonants versus tap after heterorganic consonants

a. \([nr]_\alpha\text{Place} \quad \text{cf.} \quad *[n^\gamma r]_\alpha\text{Place}\)

\[
\begin{array}{c}
\text{cor} \\
\text{A}_0\text{A}_t
\end{array}
\quad
\begin{array}{c}
\text{cor} \\
\text{A}_0\text{A}_m\text{A}_n\text{A}_m
\end{array}
\]

b. \([t^\gamma r] \quad \text{cor} \quad \text{cor} \quad \text{cor} \quad \text{dent} \quad \text{cor} \quad \text{cor} \quad \text{cor} \quad \text{A}_0\text{A}_m\text{A}_n\text{A}_m\)

The behavior of preconsonantal rhotics differs from that of rhotics in postconsonantal position. In Spanish and in those dialects of European Portuguese that have an alveolar trill, the alveolar tap can surface before other alveolar consonants, as illustrated by the examples in (3.36):
Tap surfaces before alveolar and non-alveolar consonants in Standard Spanish and European Portuguese

a. Standard Spanish
   \[ca[r \sim r]ne\] 'meat'
   \[ba[r \sim r]co\] 'boat'

b. European Portuguese (Mateus and Andrade 2000)
   \[o[r]nar\] 'to adorn' (p. 59)
   \[a[r]co\] 'arch, arc' (p. 15)

Why is the alveolar trill obligatory after other alveolar consonants (e.g., Spanish honra 'honor', alrededor 'around', Israel 'Israel') but not before other alveolar consonants, as seen in (3.36a,b)? Since I have argued that consonants of homorganic clusters share Place and stricture in the feature geometry, one would expect neutralization to trill both before and after other alveolar consonants.\(^{47}\)

A logically possible explanation for the variable appearance of the alveolar tap before any consonant in Spanish (3.36a) is that sequences of rhotic + consonant do not constitute Place/stricture-sharing configurations, even when the consonant is itself alveolar. The representations of preconsonantal rhotics in Spanish are shown in (3.37):

\[
\text{(3.37) No Place/stricture-sharing in any rhotic + consonant cluster}
\]

a. \[ [rn] \sim [r'n] \]
   \[
   \text{cor cor cor cor}
   A_t A_0 A_m A_t A_m A_0
   \]

b. \[ [r'k] \sim [rk] \]
   \[
   \text{cor dor cor dor}
   A_m A_t A_m A_0 A_m A_t A_0 A_m
   \]

\(^{47}\) Thanks to Carlos Piñeros for raising the issue of taps before homorganic consonants.
Motivation for the difference between the representations in (3.35a) and (3.37a) may be found in independent but related facts involving Place assimilation. Among the sonorants appearing in preconsonantal position in Spanish, nasals and laterals typically assimilate in Place to the following consonant while rhotics do not (Harris 1969, 1984a,b; Hualde 1989). If assimilation is assumed to result in the Place-sharing configuration of (3.35a), then the fact that preconsonantal rhotics do not undergo assimilation correlates well with the independence of Place nodes in rhotic + consonant clusters, as shown in (3.37a,b). To be sure, an explicit account is necessary in order to explain the failure of rhotics to undergo Place assimilation in preconsonantal position. I shall not attempt an exhaustive analysis here. However, it should be noted that relative perceptibility is most likely a significant factor. It may be that nasals and laterals assimilate more readily because they lack an audible release and are, therefore, less perceptible with respect to Place in preconsonantal position. On the other hand, rhotics are more perceptible—and consequently less prone to assimilation—due to the posited Aₘ release position of the tap and the inherently salient acoustic structure of the Aₜ trill (see Section 3.1).
Neutralization to tap in preconsonantal position in European Portuguese

<table>
<thead>
<tr>
<th></th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST(dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. VtC ≠ VtC</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>≠</td>
<td>b. VtC</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>c. VtC</td>
<td>*!</td>
<td>*</td>
</tr>
</tbody>
</table>

High-ranking *HOLD penalizes the longer At constriction of the trill in candidates (3.38a,c) and favors the shorter At constriction of the tap in (3.38b).

The realization of clusters in Catalan is similar to the realization of those in Spanish. Most researchers claim that only the trill appears before a consonant in Catalan (Barnils 1933:97, Hualde 1992:374, Mascaró 1978:48, Wheeler 1979:191-2). Badia (1965:277-84), however, attests to preconsonantal tap. Recasens (1991:326-8) represents the middle ground in observing a very short syllable-final trill of variable length and tension, depending on speech rate and other factors. I interpret these empirical reports as evidence that Catalan, like Spanish, exhibits neutralization with variable realization before any consonant. With respect to postconsonantal positions, the trill appears after alveolar consonants, while the tap appears after heterorganic ones. To my knowledge, no variation has been reported in the latter context. The overall distribution of the tap and trill in Catalan clusters is summarized in (3.39):
(3.39) Distribution of tap and trill in Catalan clusters

a. Neutralization to trill after homorganic C
   hon[r]a 'honor'
   fol[r]o 'lining'
   Is[r]ael 'Israel'

b. Neutralization to tap after heterorganic C
   [pr]ometre 'to promise'
   [tʃ]es 'three'
   [kr]eu 'cross'

c. Neutralization with variation before any C
   ca[r ~ r]n 'meat'
   ca[r ~ r]bó 'coal'

This pattern suggests that like Spanish, Catalan has a partial ranking between

*HOLD and *FAST, which both dominate CONTRAST(dur). While the higher-ranking

*FAST/SAME SITE predicts neutralization to trill after homorganic consonants in (3.39a),

*HOLD and *FAST collectively ensure neutralization to tap after heterorganic consonants

in (3.39b) and neutralization with variation before any consonant in (3.39c). Tableau

(3.40) illustrates how the constraints account for the behavior of rhotics in Catalan

clusters:
Neutralization to trill after homorganic consonants, tap after heterorganic consonants, and variation before any consonant in Catalan

(3.40) Neutralization to trill after homorganic consonants, tap after heterorganic consonants, and variation before any consonant in Catalan

<table>
<thead>
<tr>
<th></th>
<th>*FAST/SAME</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. {C^v_r}V ≠ {Cr}V</td>
<td>*!</td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. {C^v_r}V</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. {Cr}V</td>
<td></td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. C^v_rV ≠ CrV</td>
<td></td>
<td></td>
<td>**!</td>
<td></td>
</tr>
<tr>
<td>e. C^v_rV</td>
<td></td>
<td></td>
<td></td>
<td>**!</td>
</tr>
<tr>
<td>f. CrV</td>
<td></td>
<td></td>
<td></td>
<td>**!</td>
</tr>
<tr>
<td>g. Vr^vC ≠ VrC</td>
<td></td>
<td>*</td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>h. Vr^vC</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>i. VrC</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

The above ranking ensures the trill after consonants with which it shares Place, as shown by the optimal (3.40c). Since lower-ranked *HOLD penalizes the trill more stringently in prevocalic position than before other segments, rhotics neutralize to tap after heterorganic consonants in (3.40e). In preconsonantal position, the partial ranking of *HOLD and *FAST results in neutralization with variation by ruling out the contrastive candidate (3.40g). Since (3.40h,i) tie on the remaining constraints, both the tap and trill are predicted to be possible variants in this context.

49 The putative absence of trills after heterorganic consonants suggests that Catalan normally maintains the free ranking between *HOLD and *FAST. If the effects of emphatic strengthening were to be attested in this position, however, then the same account proposed for Spanish in (3.34) may be readily invoked for Catalan.
3.3.3.1 Lexical Conservatism Effects on Word-final Rhotics

As was shown in tableau (3.33), the ranking of *HOLD, *FAST » CONTRAST(dur) predicts neutralization with variation between the tap and trill in phrase-final position in Spanish. The same ranking also makes the correct prediction for word-final preconsonantal position, as illustrated in tableau (3.41):

(3.41) Neutralization with variation correctly predicted in word-final preconsonantal position in Spanish

<table>
<thead>
<tr>
<th></th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST(dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Vr</td>
<td>C ≠ Vr</td>
<td>C</td>
<td>*</td>
</tr>
<tr>
<td>b. Vr</td>
<td>C</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c. Vr</td>
<td>C</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Since there are no higher-ranking constraints that target word-final position, the context-free markedness constraints collectively favor non-contrastive variation word-finally before a consonant-initial word at the phrasal level.

With respect to word-final prevocalic position, however, the highest-ranked CONTRAST(dur/V_V) constraint once again makes the incorrect prediction that the tap and trill should contrast. This is the same problem that we saw regarding word-initial postvocalic rhotics in (3.22a). Tableau (3.42) illustrates the word-final prevocalic case:
175

(3.42) Rhotic duration contrast incorrectly licensed in word-final prevocalic position

<table>
<thead>
<tr>
<th>CONTRAST (dur/V_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST(dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Vr</td>
<td>V ≠ Vr</td>
<td>V</td>
<td>**</td>
</tr>
<tr>
<td>b. Vr</td>
<td>V</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>c. Vr</td>
<td>V</td>
<td>*!</td>
<td>**</td>
</tr>
</tbody>
</table>

This result runs counter to the empirical observation that word-final rhotics are neutralized to tap when the following word begins with a vowel (e.g., ma[r] azul vs. *ma[r] azul 'blue sea').

A solution comes once again in the form of lexical conservatism. Recall our assumption that the lexically listed form of a word is equivalent to its realization in isolation. Since the final segment of a word occurring in isolation is necessarily a phrase-final (i.e., prepausal) one, we should expect both the tap and trill to be possible in the word-final position of lexically listed forms. To make this point clear, I repeat the relevant portion of tableau (3.33) in tableau (3.43) below:

(3.43) Variation between tap and trill in phrase-final position in Spanish (repeated from (3.33g–i))

<table>
<thead>
<tr>
<th></th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST(dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Vr^c</td>
<td>V ≠ Vr^c</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. Vr^c</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c. Vr</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

The contrastive candidate (a) is ruled out because it has a greater number of collective violations of high-ranked markedness constraints than its competitors. Since the
remaining candidates (b) and (c) receive the same number of violations of markedness and lower-ranked CONTRAST(dur), they are both equally optimal. The result of this ranking is neutralization with variable realization in phrase-final position. If the lexically listed form of a word is equivalent to the form of the word as realized in isolation, then it follows that the neutralization depicted in tableau (3.43) is encoded as part of the lexically listed form. That is to say, the lexically listed form of a rhotic-final word may correspond to either (3.43b), with neutralized tap, or (3.43c), with neutralized trill, but not to (3.43a), in which the tap and trill are contrastive.

The effect of high-ranked LEX(duration) is that the neutralized quality of final rhotics will be generalized to all word-final positions at the phrasal level. This is formally illustrated in (3.44) for word-final prevocalic position:

(3.44) LEX(duration) ensures that the neutralized status of word-final tap and trill in the lexically listed form L(W) is conserved prevocally in the phrasal form T(W)

L(W):

\[ \begin{array}{c}
\text{LEX(duration)} \\
\text{Vr}^{\sim} \sim Vr \text{\ neutralization with variation (3.43b,c)}
\end{array} \]

T(W):

\[ \begin{array}{c}
\text{* Vr|V} \neq \text{Vr|V} \text{\ contrast} \\
\text{✓ Vr|V} \text{\ neutralization to tap} \\
\text{✓ Vr|V} \text{\ neutralization to trill}
\end{array} \]

What is important to notice with respect to the functioning of LEX(duration) in (3.44) is that this constraint prefers the same rhotic realizations in word-final prevocalic position as it does in phrase-final position. In tableau (3.43), the markedness constraints *HOLD
and *FAST collectively rule out the contrastive candidate (3.43a), yielding neutralization with variation between the tap and trill. As shown in (3.44), LEX(duration) achieves the same result at the phrasal level by ruling out the contrastive candidate $V_T|V \neq V_r|V$.

Thus far, the analysis is only partially complete. Left to its own devices, high-ranked LEX(duration) potentially generalizes both neutralized tap and neutralized trill to word-final prevocalic positions. This is incorrect, however, since a word-final trill does not appear when the following word begins with a vowel (e.g., $ma[r]\ azul$ vs. *$ma[r]\ azul$ 'blue sea'). To complete the analytical picture, let us examine the role of the lower-ranked markedness constraints *HOLD and *FAST. Specifically, these two constraints, in conjunction with the effects of LEX(duration), prefer the tap over the trill in word-final prevocalic position, as illustrated in tableau (3.45):

(3.45) Lexical conservatism and lower-ranked articulatory markedness ensure neutralization to tap in word-final prevocalic position in Spanish

$L(W): V_r \sim V_r (= (3.43b,c))$

<table>
<thead>
<tr>
<th></th>
<th>LEX(dur)</th>
<th>CONTRAST (dur/V_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST(dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>V_T</td>
<td>V $\neq$ V_r</td>
<td>V</td>
<td>*!</td>
<td>**</td>
</tr>
<tr>
<td>b.</td>
<td>V_T</td>
<td>V</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>V_T</td>
<td>V</td>
<td>*</td>
<td>**!</td>
<td>*</td>
</tr>
</tbody>
</table>

LEX(dur) rules out the contrastive candidate (3.45a). Thus far in the evaluation, LEX(dur) has achieved the same results that *HOLD and *FAST do in the evaluation of phrase-final forms in (3.43b,c) above, namely neutralization with variation. Since the remaining
candidates (3.45b,c) tie on CONTRAST(dur/V\_V), the decision is then passed to the lower-ranked markedness constraints.

Now, recall that *HOLD assigns one violation mark per trill in non-prevocalic positions, but that it evaluates prevocalic trills more stringently by assigning two marks. In Section 3.2.2.3, the assignment of multiple violations by *HOLD was motivated as a way to capture the greater impetus of trills to lenite to taps in prevocalic contexts. In tableau (3.45), the second violation of *HOLD serves to rule out candidate (c), and the remaining candidate (b) with word-final prevocalic tap emerges as optimal. In sum, the fact that *HOLD has stringency built-in with respect to the prevocalic trill permits a uniform account of the behavior of Spanish rhotics in two distinct environments, namely after heterorganic consonants and in word-final prevocalic position.\(^50\)

\(^50\) As Eric Bakovic (personal communication) points out, one aspect of this analysis remains problematic. Recall that the sporadic appearance of trills in /Cr/ onsets was accounted for on the assumption that *FAST may fall into a categorical ranking relation with respect to *HOLD under conditions of highly emphatic speech (see tableau (3.34) and the surrounding discussion). However, if *FAST were to dominate *HOLD in tableau (3.45), then candidate (3.45c) would become optimal—clearly an undesirable result. Two responses to this criticism come to mind. First, it may be the case that claims in the empirical literature regarding the absence of word-final prevocalic trill are in fact based on data reflecting formal or careful speech styles (which correspond to the partial ranking of *HOLD and *FAST) as opposed to data representative of speech situations that are truly highly emphatic (which correspond to the ranking of *FAST » *HOLD). Second, the fact that the appearance of trills in /Cr/ onsets is so sporadic may also explain the lack of reports attesting to word-final prevocalic trills. Both phenomena result from a temporary demotion of *HOLD that occurs so infrequently as to be virtually impossible to detect in running speech. Clearly, further empirical research is required in order to investigate the possibility of word-final prevocalic trill under highly emphatic speech conditions as opposed to formal/careful styles.
3.3.3.2 Word-final Prevocalic Tap as The Emergence of The Unmarked

The obligatory neutralization of word-final rhotics to tap in prevocalic position may be viewed as a case of what McCarthy and Prince (1994) call the emergence of the unmarked (TETU). When a constraint C is crucially dominated by a higher-ranked constraint in some language, the effects of C are generally not visible. However, under those conditions where C is rendered irrelevant by some other dominant constraint, the effects of C become visible, and the output candidate unmarked with respect to C emerges as optimal. In Spanish, the ranking of CONTRAST(dur/V_V) » *HOLD generally ensures contrastive tap and trill between vowels. In word-final intervocalic position, high-ranked LEX(duration) nullifies the effects of intervocalic contrast by ruling out the contrastive candidate in (3.45a). Since CONTRAST(dur/V_V) is made irrelevant in this context, lower-ranked *HOLD favors neutralization to tap, which emerges as the unmarked rhotic between vowels in the optimal candidate (3.45b). The absence of word-final prevocalic trills is, therefore, a TETU effect.

In those dialects of European Portuguese that have alveolar trills, the ranking of *HOLD » *FAST, CONTRAST(dur) ensures phrase-final tap, thereby making word-final tap a property of lexically listed forms. High-ranking LEX(dur) generalizes the lexically listed form of tap-final words to all phrasal contexts, as shown in tableau (3.46):
Lexical conservatism ensures neutralization to tap in word-final prevocalic and word-final preconsonantal positions in European Portuguese.

L(W): Vr

<table>
<thead>
<tr>
<th></th>
<th>LEX(dur)</th>
<th>CONTRAST (dur/V_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST(dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Vr</td>
<td>V ≠ Vr</td>
<td></td>
<td>*!</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>b. Vr</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c. Vr</td>
<td></td>
<td></td>
<td>*</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>a. Vr</td>
<td>C ≠ Vr</td>
<td></td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. Vr</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c. Vr</td>
<td></td>
<td></td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

In contrast to word-final prevocalic TETU effects in Spanish, LEX(dur) ensures neutralization to tap right off the bat in European Portuguese because lexically listed forms of rhotic-final words all contain final taps.51

In Catalan, there is a deletion process that affects word-final rhotics (Hualde 1992:406-7, Mascaró 1972:65-8, Morales 1995:43-45, Wheeler 1979:275-8). Although I will not attempt to provide an account of final deletion here, it is relevant to note that there are several lexical exceptions to final rhotic deletion (see Wheeler 1979:275-8 for a more complete discussion). In this small set of words that retain a final rhotic, we observe the same TETU effects in word-final prevocalic position as we do in Spanish. That is, despite variation in preconsonantal and phrase-final contexts, neutralization to tap is

51 The ranking of LEX(dur) » CONTRAST(dur/V_V) in European Portuguese also makes the correct prediction that the trill should surface word-initially regardless of the final segment of the preceding word, exactly as in Spanish (see Mateus and Andrade 2000:11, 15).
obligatory when the following word begins with a vowel. The distribution of final rhotics in Catalan is shown in (3.47):

(3.47) Realizations of word-final rhotics immune to deletion in Catalan

<table>
<thead>
<tr>
<th>Example</th>
<th>Realization</th>
<th>Pronunciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>ma[r ~ r][]</td>
<td>'sea'</td>
</tr>
<tr>
<td>b.</td>
<td>ma[r ~ r] blau</td>
<td>'blue sea'</td>
</tr>
<tr>
<td>c.</td>
<td>ma[r] antic</td>
<td>'ancient sea'</td>
</tr>
<tr>
<td></td>
<td>*ma[r] antic</td>
<td></td>
</tr>
</tbody>
</table>

This behavior is not surprising given the fact that *HOLD and *FAST are unranked with respect to one another in Catalan as they are in Spanish. The analysis of word-final TETU effects in Catalan is exactly the same as in Spanish, shown in tableau (3.45) above.

3.3.4 Lexical Conservatism Effects on Word-medial Rhotics in Dominican Spanish

Thus far in the analysis of Spanish rhotics, lexical conservatism has been shown to account for their asymmetrical behavior at the edges of words. High-ranking LEX(duration) cancels out the undesired effects of CONTRAST(duration) constraints on edge-adjacent rhotics at the phrasal level by generalizing properties of lexically listed forms. As a result, the phrase-initial trill is generalized as a word-initial property, while phrase-final variation gives way to word-final prevocalic tap as a TETU effect. Now, it is reasonable to ask whether lexical conservatism might have any visible effects in another intervocalic context, namely word-medially between vowels. In this section, I focus on
hypercorrection and preaspiration in Dominican Spanish and argue that lexical conservatism is at work in this position as well.

3.3.4.1 Blocking of Hypercorrective /s/-epenthesis

First, let us briefly review the facts of hypercorrection in Dominican Spanish, which were first discussed in Section 2.2.2 of Chapter 2. In this dialect, consonantal reduction in the syllable rhyme is so severe that syllable-final /s/ is arguably absent from the lexical representations of illiterate speakers (Terrell 1986). Núñez Cedeño (1988, 1994) documents a hypercorrection phenomenon in the speech of some Dominicans whereby /s/ is inserted in the syllable rhyme, yielding forms such as those in (3.48):


\[
\begin{array}{ll}
  asbogado & < abogado \quad \text{'lawyer'} \\
  abosgado & \\
  abogasdo & \\
  abogados & \\
  bosfe & < bofe \quad \text{'lung'} \\
  bofes & \\
\end{array}
\]

One restriction on epenthesis stems from the lack of hypercorrect forms in which [s] appears immediately before intervocalic tap or trill, as shown in (3.49) and (3.50):
(3.49) Epenthetic [s] unattested before intervocalic tap
a. caros < caro 'expensive; dear'
b. *casro

(3.50) Epenthetic [s] unattested before intervocalic trill
a. carresta < carreta 'cart'
carretas
b. *casrreta

While caros in (3.49a) and carresta/carretas in (3.50a) are possible hypercorrect forms for caro and carreta, respectively, *casro in (3.49b) and *casrreta in (3.50b) are totally unattested.

I argue that lexical conservatism is responsible for the blocking of hypercorrective /s/-insertion before intervocalic rhotics in Dominican Spanish. In the isolation form of a word, the tap and trill are in contrast word-medially between vowels, as guaranteed by the high ranking of CONTRAST(dur/V_V). I repeat tableau (3.19) below as a convenient reminder of the effects of this ranking:

(3.51) Maintenance of intervocalic contrast in word-medial position (repeated from tableau (3.19))

<table>
<thead>
<tr>
<th></th>
<th>CONTRAST (dur/V_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>VrV ≠ VrV</td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>VrV</td>
<td>⬆️</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>VrV</td>
<td>⬆️</td>
<td>**</td>
<td>*</td>
</tr>
</tbody>
</table>
If the isolation form of a word counts as its lexically listed form, then rhotic duration contrast in word-medial intervocalic position, as shown in (3.51a), is also a property of lexically listed forms. The effect of high-ranked LEX(duration) is that the contrastiveness property of word-medial rhotics in the lexically listed form of a word will be conserved in the phrasal realizations of the word. This is illustrated in (3.52):

(3.52) LEX(duration) ensures that the contrastive status of word-medial intervocalic tap and trill in the lexically listed form L(W) is conserved word-medially in the phrasal form T(W)

L(W): \[ V_r V \neq V_r V \]

LEX(duration)

T(W): \[ \checkmark V_r V \neq V_r V \]

contrast (3.51a)

* V_r V neutralization to tap

* V_r V neutralization to trill

The blocking of epenthesis before intervocalic tap and trill results from the fact that insertion of /s/ would neutralize the contrast in this position, as ensured by

*FAST/SAME SITE. This is illustrated in tableau (3.53):
Lexical conservatism and *FAST/SAME SITE ensure failure of epenthesis before word-medial intervocalic rhotics

L(W): \( VrV \neq VrV (=3.51a) \)

<table>
<thead>
<tr>
<th></th>
<th>LEX (dur)</th>
<th>CONTRAST (dur/V_V)</th>
<th>*FAST/ SAME</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>CONTRAST (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ( V{s'r}V \neq V{sr}V )</td>
<td>*!</td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ( V{s'r}V )</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ( V{sr}V )</td>
<td>*!</td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. ( VrV \neq VrV )</td>
<td></td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. ( VrV )</td>
<td>*!</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. ( VrV )</td>
<td>*!</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Candidates (3.53a–c) are otherwise identical to candidates (3.53d–f) except that epenthetic \([s]\) appears in the former set.\(^{52}\) LEX(duration) rules out the neutralization candidates (b,c) and (e,f) because they fail to maintain a lexical property, namely the contrast between tap and trill in word-medial intervocalic position of lexically listed forms.\(^{53}\) *FAST/SAME SITE rules out candidate (a) because the tap is disallowed under

---

\(^{52}\) Hypercorrection presumably stems from the action of other constraints not shown in the tableau. However, instead of attempting a formal analysis here, I shall simply assume that candidates such as (3.53a–c) denote potential hypercorrected forms.

\(^{53}\) It is important to note here that while the rhotics in candidates (3.53a–c) are postconsonantal due to the presence of the preceding \([s]\), they are in fact intervocalic in lexically listed forms. Recall the claim of Terrell (1986) that syllable-final /s/ is absent from the lexical representation of illiterate speakers. This means that in (3.52), \([s]\) is absent from L(W), which thus encodes the property of word-medial rhotic duration contrast. In tableau (3.53), LEX(duration) seeks to conserve the contrastiveness property, even though the rhotics are, strictly speaking, no longer intervocalic in T(W) due to hypercorrection. Contrast the functioning of LEX(duration) with that of the positional
Place/stricture-sharing configurations (see (3.20c)). Although (3.53c) satisfies *FAST/SAME SITE by ensuring a postconsonantal trill, it does so at the expense of neutralizing the tap/trill contrast, thus violating highest-ranked LEX(duration). Candidate (d)—without epenthized [s]—is optimal since it is the only set of surface forms in which the tap and trill contrast without incurring a violation of *FAST/SAME SITE. The "blocking" of /s/-epenthesis, then, emerges as an effect of lexical conservatism, which strives to maintain the lexical property of word-medial intervocalic contrast.

### 3.3.4.1.1 Comparison with Correspondence Theory

A comparison of the present account with an input-output correspondence analysis lends support to the surface-oriented Dispersion Theory of contrast. In Flemming's (1995) Dispersion Theory, constraints demand phonological contrast directly in the output, thereby obviating the need for underlying representations (see Section 1.2.2.2 of Chapter 1). This is evident, for example, in tableau (3.51) above, in which candidates are idealized surface forms, and no reference to an underlying input form is required. On this analysis, CONTRAST(dur/V_V) simply favors those candidates in which the tap and trill are contrastive, such as VrV ≠ VrV in (3.51a), while the same constraint penalizes those candidates which exhibit neutralization, such as VrV and VrV in (3.51b) and (3.51c), constraint CONTRAST(dur/V_V), which is irrelevant in candidates (3.53a–c) precisely because the rhotics are no longer intervocalic after epenthetic [s].
respectively. In (3.52) and the surrounding discussion, it was argued that lexically listed forms encode the property of word-medial rhotic duration contrast, and that \text{LEX}({\text{duration}}) acts to conserve this property in phrasal realizations.

In Correspondence Theory, on the other hand, \text{IDENT–IO(F)} constraints do not evaluate the goodness of surface contrast. Rather, they merely check the faithfulness of output forms to input forms with respect to some feature value. Since surface contrasts are not evaluated directly in this approach, the blocking of hypercorrective /s/-epenthesis cannot be explained in terms of contrast maintenance. To see this, first consider the tableaux in (3.54) below. (N.B.: Surface-oriented \text{CONTRAST(duration)} constraints are replaced by input-output faithfulness \text{IDENT–IO(duration)} constraints, and hypothetical input forms are shown in the first cell of each tableau.)

(3.54) Input-output correspondence ensures faithfulness to underlying tap and trill in word-medial intervocalic position

<table>
<thead>
<tr>
<th>/\text{VrV}/</th>
<th>\text{IDENT–IO} (dur/V_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>\text{IDENT–IO(dur)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{a. VrV}</td>
<td>\text{*}</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>\text{b. VrV}</td>
<td>\text{!*}</td>
<td>\text{**}</td>
<td>\text{**}</td>
<td>\text{*}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/\text{VrV}/</th>
<th>\text{IDENT–IO} (dur/V_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>\text{IDENT–IO(dur)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{c. VrV}</td>
<td>\text{!*}</td>
<td></td>
<td>\text{*}</td>
<td>\text{*}</td>
</tr>
<tr>
<td>\text{d. VrV}</td>
<td>\text{**}</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Given an input tap, high-ranking IDENT–IO(dur/V_V) ensures its faithful realization between vowels in the optimal output candidate (3.54a). Similarly, IDENT–IO(dur/V_V) preserves an input trill between vowels in (3.54d).

Recall our assumption that the isolation form of a word counts as its lexically listed form. If the optimal forms in (3.54a) and (3.54d) are taken to represent isolation forms of words containing word-medial intervocalic rhotics, then they also count as the lexically listed forms of these words. The effect of high-ranked LEX(duration), then, will be to conserve the tap of (3.54a) and the trill of (3.54d) at the phrasal level, as illustrated in (3.55):

(3.55) LEX(duration) ensures that a word-medial intervocalic rhotic in the lexically listed form L(W) is conserved word-medially in the phrasal form T(W)

\[
\begin{align*}
\text{L(W):} & \quad \text{V}_r\text{V} & \quad \text{V}_r\text{V} \\
& \quad \text{(3.54a)} & \quad \text{(3.54d)} \\
\text{T(W):} & \quad \checkmark \text{V}_r\text{V} & \quad * \text{V}_r\text{V} \\
& \quad * \text{V}_r\text{V} & \quad \checkmark \text{V}_r\text{V}
\end{align*}
\]

The functioning of LEX(duration) in an input-output correspondence-theoretic model, as shown in (3.55), is different from its functioning in the surface-oriented Dispersion-theoretic model shown in (3.52) above. On the input-output conception, it is the realization of individual rhotics that LEX(duration) seeks to generalize from L(W) to T(W). That is, lexical conservatism ensures faithfulness to the rhotic duration value present in L(W). In contrast, the Dispersion-theoretic conception of LEX(duration) allows
this constraint to generalize the property of surface contrast itself, or the lack thereof, precisely because contrast is enforced directly between surface forms in this theory.

Herein lies the shortcoming of an input-output correspondence analysis. Since the goodness of surface contrast is not evaluated, such an analysis is incapable of ruling out all output candidates in which epenthetic [s] appears before an intervocalic rhotic. This is demonstrated in tableaux (3.56) and (3.57) below:

(3.56) Input-output correspondence approach correctly predicts absence of hypercorrective [s] before word-medial intervocalic tap

L(W): VrV (= (3.54a))

<table>
<thead>
<tr>
<th></th>
<th>LEX (dur)</th>
<th>IDENT–IO (dur/V_V)</th>
<th>*FAST/SAME</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>IDENT–IO (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>*!</td>
<td></td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
<td>*!</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Since L(W) contains an intervocalic tap, LEX(duration) in tableau (3.56) eliminates output candidates (b) and (c) because the surface trill is unfaithful. *FAST/SAME SITE rules out candidate (a), in which the tap appears in a Place/stricture-sharing configuration. This analysis correctly guarantees the absence of epenthetic [s] before a word-medial intervocalic tap. However, a problem arises with respect to intervocalic trill:
Input-output correspondence approach incorrectly predicts possibility of hypercorrective [s] before word-medial intervocalic trill

L(W): VrV (=3.54d)

<table>
<thead>
<tr>
<th>/VrV/</th>
<th>LEX (dur)</th>
<th>IDENT–IO (dur/V_V)</th>
<th>*FAST/SAME</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>IDENT–IO (dur)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. V{sr}V</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. V{sr}V</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. VrV</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. VrV</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Here, L(W) contains an intervocalic trill, and LEX(duration) rules out candidates (a) and (c) because the surface tap is unfaithful. LEX(duration) does not penalize candidates (b) and (d) because the surface trill is faithful to the trill present in L(W) in each case. Since (b) satisfies *FAST/SAME SITE by ensuring a trill under Place/stricture-sharing, and since no other constraints act to distinguish between (b) and (d), both of these candidates should be possible surface realizations. In other words, this analysis cannot rule out the possibility of epenthesis before a word-medial intervocalic trill, as shown by the symbol before candidate (b).

The failure of an input-output correspondence analysis to account for the Dominican Spanish facts is summarized by the diagrams in (3.58) and (3.59):
In (3.58), epenthesis before an intervocalic tap is successfully ruled out because the resulting surface trill is unfaithful to the lexically listed tap. In (3.59), epenthesis before an intervocalic trill does not yield the same breach of faithfulness because the lexically listed trill is maintained in the hypercorrected output form.

The surface-oriented Dispersion-theoretic model does not face the same problem. Since the contrast between the tap and trill is evaluated directly between surface forms, LEX(duration) is able to "see" the deleterious effect that epenthesis has with respect to rhotic contrastiveness in word-medial intervocalic position, as shown in (3.60):
The effect of epenthesis is that the lexically listed contrast in L(W) is neutralized at the surface in T(W). On the other hand, the absence of hypercorrective [s] allows the contrast to be conserved. The result emerging from this discussion is that an adequate account of the Dominican Spanish facts must be built upon a surface-oriented model of phonological contrast, which lends support to Flemming’s (1995) Dispersion Theory approach.

3.3.4.1.2 An Alternative Analysis Based on Phonotactic Restrictions

Let us consider another possible analysis of the Dominican Spanish hypercorrection facts that incorporates a brute-force phonotactic constraint against /s/ + rhotic clusters. As Richard Page (personal communication) points out, such clusters appear to be rather marked cross-linguistically. For example, English contains many /sC/ clusters, but yet /s/ fails to cluster with a following rhotic. Additionally, /sr/ clusters are often lost historically through assimilation or epenthesis, as in Indo-European *sr > Germanic *str (e.g., stream).
Two pieces of evidence coming from Spanish dialects that retain syllable-final /s/ also hint at the markedness of /sr/ clusters. In both cases, however, counterarguments exist to suggest that a phonotactic constraint against such clusters is not responsible for the Dominican Spanish hypercorrection facts. First, /sr/ is often realized in many dialects as a coalesced retroflex fricative [z], e.g., Israel [izael] 'Israel' (Harris 1969).

Presumably, coalescence is a way to repair the phonotactically illicit cluster. If this is indeed the case, then one must wonder why coalescence is unattested in Dominican Spanish. That is, why do hypercorrecting Dominicans not insert /s/ before a rhotic and then repair the phonotactic violation by realizing the cluster as a retroflex fricative?54

A second argument in favor of positing a phonotactic restriction is that the number of monomorphemic /sr/ clusters in the Spanish lexicon is admittedly scarce, with Israel 'Israel' and its derivatives israelí 'Israeli' and israelita 'Israelite' being virtually the only examples.55 It is plausible to think that the lack of /s/-epenthesis before rhotics stems from the fact that hypercorrecting Dominicans are rarely, if ever, exposed to such words in the speech of those whom they seek to imitate via /s/-epenthesis. Recall, however, that

---

54 Of course, this counterargument may be countered in turn by positing that the Dominican grammar contains a higher ranking markedness constraint banning retroflex fricatives such as [z]. However, it is not clear what motivation would exist for such an argument other than the need to explain why coalescence is an unattested repair for phonotactically illicit /st/ clusters.

55 Thanks to Eric Holt, John Lipski, and Ana Teresa Pérez-Leroux for independently reminding me of this fact.
hypercorrective epenthesis is essentially a sporadic phenomenon in which speakers attempt to redress the lack of syllable-final /s/ by reinserting it into some syllable-final position. That is to say, epenthesis is motivated by an awareness that some words pronounced by speakers of more conservative lects do exhibit syllable-final [s], but the process is hypercorrective in nature due to an uncertainty about which words should, in fact, contain syllable-final [s]. Given this general uncertainty, it is unclear why hypercorrecting Dominicans should happen to single out only words that contain intervocalic rhotics as being immune to /s/-epenthesis in the syllable rhyme.

To sum up, the fact that (1) coalescence of /sr/ to [z] is a logically possible but nonetheless unattested repair and that (2) hypercorrection stems from a general uncertainty regarding the proper placement of syllable-final [s] both suggest that the explanation for the lack of epenthesis before intervocalic rhotics must involve something other than a phonotactic constraint against /s/ + rhotic clusters. In this section, I have developed such an explanation in terms of lexical conservatism: epenthesis is blocked in order to conserve a property of lexically listed forms, namely word-medial rhotic duration contrast.

3.3.4.2 Devoicing and Preaspiration

Further evidence in favor of lexical conservatism comes from other phenomena involving rhotics in Dominican Spanish. The tap and trill are reported to be voiceless in the speech
of many Dominicans (Jiménez Sabater 1975:86-87; Núñez Cedeño 1987). For many Caribbean Spanish speakers, the durationally longer intervocalic rhotic seems to have two phases of articulation: it begins with an aspirate moment followed by a voiceless alveolar tap, as shown in (3.61). Intervocalic tap is devoiced but never preaspirated, as in (3.62).

(3.61) Devoicing and lenition of intervocalic trill to preaspirated tap (Núñez Cedeño 1994:31)

<table>
<thead>
<tr>
<th>Original</th>
<th>Lengthened</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>piza[ɾa]</td>
<td>*piza[ɾ]a</td>
<td>'blackboard'</td>
</tr>
<tr>
<td>entie[ɾ]o</td>
<td>*ente[ɾ]o</td>
<td>'burial'</td>
</tr>
<tr>
<td>bu[ɾ]o</td>
<td>*bu[ɾ]o</td>
<td>'donkey'</td>
</tr>
<tr>
<td>ba[ɾ]iga</td>
<td>*barriga</td>
<td>'belly'</td>
</tr>
<tr>
<td>ba[ɾ]io</td>
<td>*barrio</td>
<td>'neighborhood'</td>
</tr>
</tbody>
</table>

(3.62) Devoicing (but no preaspiration) of intervocalic tap (Núñez Cedeño 1994:31)

<table>
<thead>
<tr>
<th>Original</th>
<th>Lengthened</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>piza[ɾa]</td>
<td>*piza[ɾ]a</td>
<td>'he would step'</td>
</tr>
<tr>
<td>entie[ɾ]o</td>
<td>*ente[ɾ]o</td>
<td>'whole'</td>
</tr>
<tr>
<td>bu[ɾ]ó</td>
<td>*bu[ɾ]ó</td>
<td>'bureau'</td>
</tr>
<tr>
<td>va[ɾ]io</td>
<td>*va[ɾ]io</td>
<td>'several'</td>
</tr>
</tbody>
</table>

According to Zlotchew (1974), the aspirate percept arises in intervocalic voiceless trills because the glottal devoicing gesture comes to precede the lingual gesture responsible for trilling, which is itself temporally reduced.

"The amount of time expended in producing the glottal fricative … followed by the [tap] is roughly equivalent to the time element involved in the realization of the multiple trill; however, the muscular effort has been reduced in that the tongue need be kept in position for the shorter duration of the simple vibrant [tap] only" (83).

In other words, devoicing of the trill combines with alternate oral-glottal gestural timing in such a way as to allow preservation of rhotic duration contrast, despite temporal reduction of the lingual trill gesture. The crucial point to understand here is that without
the concomitant devoicing gesture, reducing the duration of the trill would make this rhotic perceptually equivalent to a tap, thereby neutralizing the contrast between the two.

Zlotchew's account of devoicing-cum-reduction provides an important basis upon which to construct an analysis of the preaspiration data presented above. This analysis requires two additional constraints. I assume that the constraint in (3.63) forces sonorants, including rhotics, to be voiced:

\[(3.63) \quad \text{SONVOI (Itô, Mester, and Padgett 1995)}\]
\[
\begin{align*}
\text{[sonorant]} & \supseteq \text{[voice]} \\
\text{(Sonorants are voiced.)}
\end{align*}
\]

The constraint in (3.64), adapted from Steriade (1997:70), encapsulates the timing scenario responsible for preaspiration.56

\[(3.64) \quad \text{T IMING} \]
\[\text{The peak of glottal abduction must lead or coincide with the onset of oral constriction.}\]

Timing is satisfied by... but violated by...

\[
\begin{align*}
\text{h} & \quad \text{C} \\
\text{[-----glottal abduction-----]} & \quad \text{[-----oral constriction-----]} \\
\text{h} & \quad \text{C} \\
\text{[-----glottal abduction-----]} & \quad \text{[-----oral constriction-----]}
\end{align*}
\]

The TIMING constraint disfavors postaspirated consonantal articulations, in which glottal devoicing extends beyond the offset of oral constriction.

For those speakers who pronounce rhotics as voiced, SONVOI outranks *HOLD, as shown in tableau (3.65):

\[\text{------------------------}\]

56 In Steriade (1997), a constraint similar to TIMING in (3.64) is proposed for Tarascan, in which tense stops are realized with preaspiration postvocalically.
The ranking of $\text{SONVOI} \gg *\text{HOLD}$ ensures voicing of contrastive tap and trill

$L(W)$: $VrV \neq VrV \ (=(3.51a))$

<table>
<thead>
<tr>
<th></th>
<th>LEX(dur)</th>
<th>CONTRAST (dur/V_V)</th>
<th>$\text{SONVOI}$</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>TIMING</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td></td>
<td><em>!</em></td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td></td>
<td></td>
<td><em>!</em></td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f.</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g.</td>
<td></td>
<td></td>
<td><em>!</em></td>
<td>**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Candidates (3.65a,b) contain voiced rhotics, while candidates (3.65c–g) contain voiceless ones. High-ranking LEX(dur) rules out the neutralization candidates (b), (d), and (f) because they fail to maintain rhotic duration contrast, which is a property of lexically listed forms.\(^{57,58}\) Of the remaining contrastive candidates, $\text{SONVOI}$ rules out (c), (e) and (g) because the rhotics are voiceless, leaving candidate (a) as optimal. What matters under the ranking of LEX(dur) $\gg$ SONVOI $\gg$ *HOLD is that rhotics are voiced and in contrast intervocally.

---

\(^{57}\) LEX(dur) refers only to the durational property of rhotics in L(W) and not to their laryngeal status. Both the voiceless rhotics in (3.65d,f) and the voiced one in (3.65b) are penalized by LEX(dur) precisely because voicing is irrelevant to this constraint.

\(^{58}\) Strictly speaking, CONTRAST(dur/V\_V) achieves the same effects as LEX(dur) in tableau (3.65) as well as in tableau (3.66) below, which makes the latter constraint redundant. However, the need for LEX(dur), as well as its ranking above the CONTRAST(dur) hierarchy, is independently motivated by the behavior of rhotics in word-initial position (Section 3.3.2.2), word-final position (Section 3.3.3.1), and word-medial position with respect to Dominican Spanish hypercorrection (Section 3.3.4.1).
The opposite ranking *HOLD over SONVOI is appropriate for those speakers who pronounce voiceless rhotics. The combined effect of devoicing, oral-glottal timing, and lenition in generating preaspiration is illustrated by tableau (3.66):

(3.66) The ranking of *HOLD » SONVOI, TIMING yields preaspiration of intervocalic trill

\[
\text{L(W): } VrV \neq VrV \text{ (=3.51a))}
\]

<table>
<thead>
<tr>
<th></th>
<th>LEX(dur)</th>
<th>CONTRAST (dur/V_V)</th>
<th>*HOLD</th>
<th>*FAST</th>
<th>SONVOI</th>
<th>TIMING</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. VrV ≠ VrV</td>
<td></td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. VrV</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. VrV ≠ VrV</td>
<td></td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. VrV</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. VrV ≠ Vh(\text{r})V</td>
<td></td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Vh(\text{r})V</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Vh(\text{r})^hV ≠ Vh(\text{r})^hV</td>
<td></td>
<td>**</td>
<td></td>
<td></td>
<td>**</td>
<td>(^h)!</td>
</tr>
</tbody>
</table>

As in tableau (3.65), high-ranking LEX(dur) rules out the neutralization candidates (b), (d), and (f) in (3.66) because they fail to maintain lexically-specified rhotic duration contrast. Of the remaining candidates, (a) and (c) fair the worst on lower-ranked markedness and are ruled out collectively by *HOLD and *FAST. Finally, candidate (g) violates TIMING, such that (e) emerges as optimal.

Observe that candidates (b) and (d) satisfy articulatory markedness by reducing the trill to a tap. However, this satisfaction comes only at the expense of neutralizing the duration contrast, as indicated by their fatal violations of LEX(dur). Now, if glottal abduction leads oral constriction, then the trill may reduce to a tap without loss of rhotic
duration contrast, as in candidate (e). In sum, candidate (e) is optimal because it is the only set of surface forms in which temporal reduction can affect the trill without neutralizing the tap/trill contrast. Similarly, candidate (f) shows why speakers never preaspirate intervocalic tap: to do so would result in neutralization.

3.3.5 Neutralization of Postlexical Rhotic Clusters

In Iberian Romance languages, a word-final tap is deleted when it precedes a word-initial alveolar trill. Harris (1983:63) cites the examples in (3.67) to show that postlexical sequences of tap + trill are neutralized to trill in Spanish:

(3.67)  Postlexical rhotic sequences in Spanish (Harris 1983:63)

- **a.** salí rápido  [sali rápiðo]  'I left rapidly'
salir rápido  [sali rápiðo]  'to leave rapidly'
- **b.** gamba rara  [gamba rara]  'strange shrimp'
ambar raro  [amba raro]  'strange amber'

Mateus and Andrade (2000:145) show that the deletion of a word-final rhotic in European Portuguese depends on what kind of word-initial rhotic speakers use. The data in (3.68) demonstrate that a word-final tap is deleted only when the following word-initial trill is homorganic (i.e., alveolar):

- **a.** sali rapide  [sali rapiðo]  'I left rapidly'
salir rápido  [sali rapiðo]  'to leave rapidly'
- **b.** gamba rara  [gamba rara]  'strange shrimp'
ambar raro  [amba raro]  'strange amber'
Postlexical rhotic sequences in European Portuguese (Mateus and Andrade 2000:145)

a. Tap deleted before alveolar trill
   \[ \text{\textit{por regra}} \quad [\text{\textipa{pu r\textipa{\textdegree}r\textthreevert}}] \quad \text{\textquoteleft by rule\textquoteright} \]

b. Tap retained before uvular trill
   \[ \text{\textit{por regra}} \quad [\text{\textipa{pu \textonevert r\textipa{\textdegree}r\textthreevert}}] \quad \text{\textquoteleft by rule\textquoteright} \]

3.3.5.1 Rhotic Cluster Neutralization and Phonotactic Constraints

The neutralization of postlexical rhotic sequences in Iberian Romance appears to be part of a broader phonotactic restriction on the clustering of these segments cross-linguistically. Walsh (1997:92) observes that "[r]hotic clusters are exceedingly rare and almost universally prohibited," citing two Australian languages as the only attested examples. She proposes a constraint against clusters of two coronal rhotics, which I adapt in (3.69):

(3.69) Rhotic clustering constraint (adapted from Walsh 1997:93)\textsuperscript{59}

\[
\begin{array}{c|c}
\text{\textquoteleft\textquoteright} & \\
\text{\textipa{rho}} & \text{\textipa{rho}} \\
\mid & \\
\text{cor} & \text{cor}
\end{array}
\]

According to this constraint, two root-adjacent segments may not be specified for [rhotic] if they are both coronal. As it is currently formulated, however, this constraint in itself does not explain why deletion affects the first rhotic and not the second one in (3.67) and (3.68a). To see this, let us also assume the constraint \textit{LEX(segment)} in (3.70), which

\textsuperscript{59} Walsh (1997:93) notes that an alternative formulation of this constraint might depict both rhotics as being linked to a single coronal Place node.
reflects a lexical conservatism condition enforcing the preservation of lexically specified segments:

(3.70) \text{LEX(segment)}

Given $T(W)$, the form of a word $W$ appearing under evaluation, and $L(W)$, the lexically listed form of $W$, every segment of $L(W)$ is conserved in $T(W)$.

This constraint essentially forbids the deletion of segments that are present in the listed form of a given word (cf. the MAX–IO family of constraints in McCarthy and Prince 1995). The fact that neutralization of postlexical clusters involves deletion suggests that \text{LEX(segment)} is dominated by the cluster constraint in (3.69). However, this in itself does not achieve the desired results, as tableau (3.71) demonstrates:

(3.71) Rhotic clustering constraint unable to rule out deletion of word-initial trill

<table>
<thead>
<tr>
<th></th>
<th>*[rho]</th>
<th>[rho]</th>
<th>LEX(segment)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cor</td>
<td>cor</td>
<td></td>
</tr>
</tbody>
</table>

a. VrVrV *!

b. VrV *

c. VrV *

While the clustering constraint penalizes the intervocalic tap + trill sequence in (3.71a), \text{LEX(segment)} fails to rule out either remaining candidate. This analysis predicts that when a word-final tap abuts a word-initial trill at the phrasal level, the cluster should neutralize with variable realization between a single tap or trill—contrary to the empirical facts in (3.67) and (3.68a). The problem is that either of the two rhotics may be deleted in order to satisfy the clustering constraint.
3.3.5.2 Rhotic Cluster Neutralization and Targeted Constraints

Here I develop an analysis which reformulates the phonotactic restriction in (3.69) as a targeted markedness constraint in the sense originally proposed by Wilson (1999). Targeted constraints have a substantive basis in perceptual similarity, as illustrated by the principle in (3.72):

(3.72) Weak Element Principle (Wilson 1999:16)
A representation $x$ that contains a poorly-cued (or 'weak') element $\varsigma$ is marked relative to the representation $y$ that is identical to $x$ except that $\varsigma$ has been removed.

Wilson (1999) explains the intuition behind this principle as follows: "given two surface representations that sound basically the same (and which could therefore be easily confused by the hearer), the more complex representation is marked relative to the less complex representation" (16). Targeted constraints mark candidates containing perceptually weak elements that are not easily distinguishable from otherwise identical candidates lacking those weak elements.

Before recasting the constraint in (3.69) as a targeted markedness constraint, let us examine the aperture-theoretic representations in (3.73) to understand why a word-final tap is perceptually weak before an alveolar trill:

(3.73) Word-final tap before alveolar versus uvular trill

\[
\begin{align*}
\text{a.} & & V \text{[rho]} & [\text{rho}] V \\
& & \text{cor} & \text{cor} \\
& & A_v & A_t A_m A_t & A_v \\
\text{b.} & & V \text{[rho]} & [\text{rho}] V \\
& & \text{cor} & \text{dor} \\
& & A_v & A_t A_m A_t & A_v
\end{align*}
\]
The articulatory representation in (3.73a) presumably yields an acoustic representation in which the single constriction period of the word-final alveolar tap is directly adjacent to the multiple (i.e., two or more) constrictions of the following word-initial alveolar trill. Since the duration of the trill is sustainable, it is plausible that speakers would interpret the entire sequence of multiple contacts resulting from (3.73a) as perceptually equivalent to a single trill. That is to say, a sequence of tap + alveolar trill is not easily distinguishable from a single alveolar trill.

The hypothetical Figures 3–15 and 3–16 below illustrate the perceptual equivalence of a tap + alveolar trill sequence and a single prolonged trill. In Figure 3–15, the $A_VA_TA_M$ sequence of the postvocalic tap abuts the single $A_T$ position of the prevocalic trill, which in this case consists of two alveolar contact periods. The schematic trajectory of the tongue tip resulting from the combined aperture sequence yields an overall acoustic representation consisting of three interruptions of surrounding vocalic aperture. In contrast, Figure 3–16 depicts a single intervocalic trill whose duration is prolonged such that the passive vibration of the tongue tip produces three alveolar contacts, unlike the two-contact trill of Figure 3–15. A comparison of both configurations reveals that the acoustic results are essentially equivalent. That is to say, a tap + two-contact alveolar trill sequence and a single three-contact alveolar trill both produce a total of three stop-like moments alternating with greater periods of sonority. Therefore, the claim that a tap is perceptually weak before an alveolar trill is motivated by the fact that the acoustic representation in Figure 3–15 is not easily distinguishable from that shown in Figure 3–16.
Given the perceptual weakness of the tap before an alveolar trill, the Weak Element Principle motivates the formulation of the targeted constraint shown in (3.74), with which I replace the constraint in (3.69) above:
(3.74) **NoWeakRhotic**

Let \( x \) be any candidate and \( \zeta \) be any rhotic in \( x \) that is perceptually weak. If candidate \( y \) is exactly like \( x \) except that \( \zeta \) has been removed, then \( y \) is more harmonic than \( x \).

In order to see how the ranking of NoWeakRhotic » Lex(segment) ensures deletion of the word-final but not of the word-initial rhotic in (3.73a), it is necessary to consider how optimal candidates are arrived at under an order-based approach to optimization. When a pair of candidates is evaluated by some constraint, that constraint selects one member of the pair as being more harmonic than the other member. That is, the constraint asserts an *harmonic ordering* between the two candidates, such as \( x \succ y \), which denotes that candidate \( x \) is more harmonic than candidate \( y \). As constraint evaluation proceeds down the hierarchy, a *cumulative ordering* among candidates is progressively established. Crucially, the harmonic ordering asserted by some higher-ranked constraint is never changed by a lower-ranked one. After all constraints have had their turn in the evaluation, the most harmonic candidate in the cumulative ordering emerges as optimal. A more formal definition of order-based optimization is given in (3.75):
Order-based optimization (adapted from Wilson 1999:22)

a. **Ordering**
   Starting with the highest-ranked constraint in the hierarchy, if the current constraint asserts the ordering \( x \succ y \), then add \( x \succ y \) to the cumulative ordering \( O \), except when the opposite ordering (i.e., \( y \succ x \)) is in \( O \). Repeat for the next highest-ranked constraint in the hierarchy.

b. **Transitive Closure**
   For any candidates \( x, y, \) and \( z \), if both \( x \succ y \) and \( y \succ z \) are in the cumulative ordering \( O \), then \( x \succ z \) is also in \( O \) (i.e., \( x \succ y \) & \( y \succ z \) \( \Rightarrow \) \( x \succ z \)).

c. **Optimality**
   A candidate is optimal iff it is not worse than any other candidate in the final cumulative ordering (i.e., when the loop in (a) ends).

The tableau in (3.76) shows how the targeted constraint `NOWEAKRHOTIC` guarantees the deletion of word-final taps. (N.B.: The arrow symbol \( \succ \) denotes a targeted constraint. The 'cumulative ordering' row at the bottom of the tableau helps to keep track of the entire set of harmonic orderings established by the constraint hierarchy thus far.

The comparison symbol \( \succ \) signifies 'is more harmonic than'.)

(3.76) Targeted contextual markedness ensures deletion of word-final tap before alveolar trill

<table>
<thead>
<tr>
<th></th>
<th>( \succ ) NO\textsc{WEAKRHOTIC}</th>
<th>LEX(segment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. VlrV</td>
<td>VlrV ( \succ ) VlrV !</td>
<td></td>
</tr>
<tr>
<td>b. VlrV</td>
<td>(VlrV ( \succ ) VlrV)</td>
<td></td>
</tr>
<tr>
<td>c. VlrV</td>
<td>VlrV ( \succ ) VlrV !</td>
<td></td>
</tr>
</tbody>
</table>

**Cumulative ordering:** VlrV \( \succ \) VlrV VlrV \( \succ \) VlrV \( \succ \) VlrV
Candidate (a) violates \textsc{noweakrhotic} because the word-final tap appears in a perceptually weak position, i.e., before an alveolar trill. Since this constraint is targeted, it asserts that candidate (b) is more harmonic than (a), i.e., \( VlrV \succ VrlrV \), because the two are otherwise identical except that the perceptually weak word-final tap is absent from the former. This harmonic ordering is added to the cumulative ordering in the bottom row.

Next, the anti-deletion constraint \textsc{lex(segment)} is violated by candidates (b) and (c) because in each case, a segment present in the listed form of a word does not have a correspondent in the form under evaluation. \textsc{lex(segment)} asserts that the non-deleting candidate (a) is more harmonic than candidate (b), in which a lexical segment has been deleted, i.e., \( VrlrV \succ VlrV \). Observe that this ordering is the exact opposite of the one asserted by higher-ranked \textsc{noweakrhotic}, \( VlrV \succ VrlrV \). According to the order-based optimization procedure in (3.75a), an ordering is added to the cumulative ordering except when the \textit{opposite} ordering is already there by virtue of some higher-ranked constraint.

Since \( VlrV \) was already deemed more harmonic than \( VrlrV \) by \textsc{noweakrhotic}, \textsc{lex(segment)} cannot change the relative harmony of the two candidates. In the third row of tableau (3.76), parentheses are used to indicate that the harmonic ordering \( VrlrV \succ VlrV \) is not added to the cumulative ordering.

With respect to candidate (c), \textsc{lex(segment)} again asserts the greater harmony of the non-deleting candidate (a), i.e., \( VrlrV \succ VrV \). When this ordering is added to cumulative ordering, we see the effects of transitive closure, defined in (3.75b). Thus far
in the evaluation, NOWEAKRHOTIC has already placed candidate (b) over (a) in the cumulative ordering. When LEX(segment) places candidate (a) over (c), then (b) is also more harmonic than (c) by transitivity. Thus we arrive at the final cumulative ordering VlrV > VrlrV > VrlV. Since candidate (b) is the most harmonic of the three candidates, it emerges as optimal according to (3.75c).

A comparison with the non-targeted approach to the neutralization of postlexical rhotic clusters demonstrates why the constraint in (3.69) fails. The following tableau repeats the evaluation carried out in (3.71) above, but with harmonic orderings indicated instead of constraint violations:

(3.77) Why the non-targeted anti-cluster constraint fails

<table>
<thead>
<tr>
<th></th>
<th>*[rho] [rho]</th>
<th>LEX(segment)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cor cor</td>
<td></td>
</tr>
</tbody>
</table>

| a. VrlrV       | VlrV > VrlrV ! |
|                | VrlV > VrlrV ! |
| b. VlrV        | (VrlrV > VlrV) |
| c. VrlV        | (VrlrV > VrlV) |

**Cumulative ordering:**

VlrV > VrlrV
VrlV > VrlrV

Only candidate (a) violates the cluster constraint. Unlike NOWEAKRHOTIC, however, the cluster constraint asserts that both (b) and (c) are more harmonic than the non-deleting candidate (a). Since it is not grounded in the Weak Element Principle, this constraint cannot ensure that deletion of the perceptually weak word-final tap will be the only possible repair to the phonotactic violation. The harmonic ordering of both deletion
candidates (b) and (c) over the non-deleting (a) enters the cumulative ordering, and evaluation continues with the next constraint. \text{LEX(segment)} asserts exactly the opposite harmonic orderings, which cannot be added to the cumulative ordering, as indicated by shading in the final cell. In the end, the final cumulative orderings of $V\text{r}V \succ V\text{r}\text{r}V$ and $V\text{r}\text{r}V \succ V\text{r}\text{r}V$ collectively predict that either rhotic may be deleted in order avoid the cluster violation.

The final piece of data to account for is the fact that in some European Portuguese dialects, word-final taps fail to delete when the following word-initial trill is uvular, i.e., heterorganic. It was argued above that the multiple contacts resulting from the alveolar tap + trill sequence in (3.73a) are not easily distinguishable from those of a single alveolar trill. On the other hand, the multiple contacts resulting from the alveolar tap + uvular trill sequence in (3.73b) are plausibly distinguishable because the two rhotics possess different cues to place of articulation. Since a word-final tap is not in a perceptually weak position before uvular trills, \text{NOWEAKRHOTIC} does not come into play in the evaluation. This is demonstrated in tableau (3.78):

(3.78) Targeted contextual markedness is irrelevant in the case of word-final tap before heterorganic trill

<table>
<thead>
<tr>
<th></th>
<th>\text{NOWEAKRHOTIC}</th>
<th>LEX(segment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $V\text{r}\text{r}V$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. $V\text{r}V$</td>
<td>$V\text{r}\text{r}V \succ V\text{r}V !$</td>
<td></td>
</tr>
<tr>
<td>c. $V\text{r}V$</td>
<td>$V\text{r}\text{r}V \succ V\text{r}V !$</td>
<td></td>
</tr>
<tr>
<td>Cumulative ordering:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$V\text{r}\text{r}V \succ V\text{r}V$

$V\text{r}\text{r}V \succ V\text{r}V$
Since candidate (a) does not violate the targeted constraint, no harmonic orderings can be established thus far. \textsc{lex(segment)} is violated by the deleting candidates (b) and (c) and thereby asserts the harmonic ordering of both below the non-deleting candidate (a), i.e., $Vr\texttt{j}RV \succ V\texttt{j}RV$ and $Vr\texttt{j}RV \succ Vr\texttt{j}V$. Since the most harmonic candidate is (a), the alveolar tap is predicted to cluster with a following uvular trill—exactly the attested behavior in those varieties of European Portuguese in which trills are realized as uvular.

In conclusion, I have proposed a targeted constraints approach to the neutralization of postlexical rhotic sequences which correctly predicts the deletion of word-final taps before word-initial alveolar trills in Iberian Romance. As we will see in Section 5.3.2 of Chapter 5, the targeted constraint \textsc{noweakrhotic} also plays a role in the neutralization of morphologically derived tap + tap sequences.

3.4 Comparison with Syllable-based Accounts

In this chapter, I have argued that the constraint rankings in (3.79) are responsible for the rhotic patterns of Iberian Romance varieties with alveolar trills:
(3.79) Constraint rankings for Iberian Romance varieties with alveolar trills

a. Spanish and Catalan

\[
\begin{align*}
\text{LEX(dur)} & \\
\text{CONTRAST(dur/V)} & \\
*\text{FAST/INITIAL} & \\
\text{CONTRAST(dur#V)} & \\
*\text{FAST/SAME} & \\
*\text{HOLD,} & \\
*\text{FAST} & \\
\text{CONTRAST(dur)} & \\
\end{align*}
\]

b. European Portuguese

\[
\begin{align*}
\text{LEX(dur)} & \\
\text{CONTRAST(dur/V)} & \\
*\text{FAST/INITIAL} & \\
\text{CONTRAST(dur#V)} & \\
*\text{FAST/SAME} & \\
*\text{HOLD} & \\
*\text{FAST,} & \\
\text{CONTRAST(dur)} & \\
\end{align*}
\]

In the remainder of this chapter, explicit comparisons are made with existing prosodic accounts. I show how the analysis developed here successfully accounts for several facts that remain problematic under previous proposals.

3.4.1 Neutralization of Postlexical Rhotic Sequences

As discussed in Chapter 2, Harris (1983) posits the rule in (3.80) to account for the deletion of word-final taps before trills in Spanish:

(3.80) Deletion ensures that [rr] is not distinct from [r] (Harris 1983:63)

\[ r \rightarrow \emptyset / \_ r \]

Deletion of word-final taps is accounted for by the postlexical application of this rule. Subsequent analyses, such as Lipski (1990), Morales-Front (1994) and Bakovic (1994), do not consider the realization of postlexical rhotic sequences and, therefore, make no provision for a rule or constraint that would ensure neutralization to trill. Although the
analysis of Núñez Cedeño (1988, 1994) might account for postlexical clusters by assuming Harris' (1983) tap deletion rule, a separate and somewhat redundant rule would still be necessary in order to convert the dually-linked geminate structure to a phonetic trill in word-medial position, which only complicates the grammar. Bonet and Mascaró (1997) essentially agree with Harris and assume the rule shown in (3.80). Since they assume the trill to be a single underlying unit, no separate rule is required which converts a dually-linked geminate to a trill in word-medial intervocalic position.

There are two main problems with the rule in (3.80). First, why should it target the first rhotic of a cluster for deletion as opposed to the second? While the rule captures the descriptive fact, it fails to explain why the trill is never deleted instead of the tap. Second, it is unclear why those European Portuguese dialects with uvular trills do not have a deletion process paralleling that in (3.80). That is, why should Place make a difference in the neutralization of rhotic clusters? Again, the rule in (3.80) is an adequate description of the facts, but it offers little insight as to why we do not find a rule such as that in (3.81) in European Portuguese:

(3.81) Hypothetically possible but unattested deletion rule for European Portuguese

\[ r \rightarrow \emptyset / \_ \_ r \]

In Section 3.3.5, it was argued that driving force behind the neutralization of postlexical rhotic sequences is a broadly attested restriction on the clustering of coronal rhotics. This restriction was formulated as a targeted markedness constraint, \textsc{NoWeakRhotic}, which ultimately guarantees deletion of the perceptually weak word-final tap before a word-initial alveolar trill. The failure of deletion to occur before uvular
trills stems from the fact this is not a perceptually weak position for the alveolar tap, as ensured by discernible differences in the place cues of the two rhotics. The targeted constraints analysis surpasses the rule-based deletion account by exposing the perceptual basis underlying rhotic cluster neutralization. In short, taps delete because they are perceptually indistinguishable before homorganic trills.

3.4.2 Rule Ordering and Word-final Prevocalic Tap

In Spanish and Catalan, neutralization to tap is obligatory word-finally before vowels, while the tap and trill are in non-contrastive, stylistically-controlled variation before both consonants and pause. Previous accounts have attempted to explain the lack of trills in word-final prevocalic contexts by ordering a resyllabification rule before an optional coda strengthening rule at the postlexical level. When a word-final tap is resyllabified to the onset of the following word, coda strengthening can no longer apply to it. The rule-bleeding account originates with Harris (1983), and subsequent analyses either assume this account or remain silent on the issue of obligatory neutralization to tap in this environment.60 Sample derivations from Spanish are given in (3.82) below:

60 In Chapter 2, I considered possible modifications of the OT analyses of Bakovic (1994) and Morales-Front (1994) in order to account for cases of optional emphatic strengthening in clusters and in word-final position. However, the accounts remain problematic since they lack a mechanism to ensure taps in word-final prevocalic position (see Sections 2.2.4 and 2.2.5).
According to Harris (1983), the ordering of resyllabification before coda strengthening at the postlexical level "is predictable on the not implausible assumption that prosodic rules precede segmental rules of the same (lexical or postlexical) type, at least in the unmarked case" (77). However, there is no apparent reason to rule out the possibility of the coda strengthening rule applying after syllabification at the lexical level, which would not contravene Harris' assumption about the ordering of prosodic rules with respect to segmental ones at the same level. The lexical application of this rule would potentially—and undesirably—generate word-final prevocalic trills, as shown in (3.83):
Coda strengthening before resyllabification

<table>
<thead>
<tr>
<th></th>
<th>UR:</th>
<th>SR:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/mar berde/</td>
<td>[mar]</td>
</tr>
<tr>
<td></td>
<td>/mar/</td>
<td>[mar]</td>
</tr>
<tr>
<td></td>
<td>/mar asul/</td>
<td>*[mar]</td>
</tr>
</tbody>
</table>

Lexical Syllabification: mar|ber.de mar|mar|a.sul
Coda strengthening: mar|ber.de mar|mar|a.sul

Postlexical Resyllabification: — — ma.r|a.sul

Under this scenario, coda strengthening is no longer bled by postlexical resyllabification, and underlying /mar asul/ surfaces incorrectly as *[mar]|a.sul] 'blue sea', with the trill in word-final prevocalic position. One must wonder why this type of derivation is universally unattested among varieties of Iberian Romance. Harris' rule-bleeding account adequately describes the facts, but only at the price of stipulating the application of coda strengthening at the postlexical level.

In contrast, the analysis developed here captures neutralization to tap in word-final prevocalic contexts as an effect of LEX(dur), whose ranking over CONTRAST(dur/V_V) is independently motivated by the behavior of rhotics at the other end of the word. In Section 3.3.2.1, the ranking of LEX(dur) » CONTRAST(dur/V_V) was

61 See Pensado (1984) for apparent counterexamples, which, however, involve spelling pronunciations of foreign words ending in orthographic –rr. Another partial exception is the assibilated pronunciation [z] of highland Ecuadorian Spanish, which occurs phrase-finally and can carry over to word-final prevocalic position, e.g., 'to go now' (Lipski 1990:156, Fn. 4). See Bradley (1999) for a derivational account of the Ecuadorian Spanish pattern that builds upon the analysis of Lipski (1989).
established on the basis of obligatory word-initial trill. \textit{*Fast/Initial} ensures initial strengthening in the lexically listed isolation form, and \textit{Lex(dur)} makes this an invariant word-initial property, even when the phrasal syntactic context might have otherwise licensed a rhotic duration contrast. In Section 3.3.3.1, \textit{Lex(dur)} was also shown to nullify the effects of \textit{Contrast(dur/V-V)} in word-final prevocalic position, thereby allowing lower-ranked markedness constraints to determine the outcome. I repeat tableau (3.45) for convenience below:

(3.84) Neutralization to tap in word-final prevocalic contexts as TETU (=3.45)

\begin{itemize}
\item L(W): Vr ~ Vr (=3.43b,c))
\end{itemize}

\begin{tabular}{|c|c|c|c|c|}
\hline
 & \textit{Lex(dur)} & \textit{Contrast (dur/V-V)} & \textit{Hold} & \textit{Fast} & \textit{Contrast(dur)} \\
\hline
a. \(Vr\backslash V \neq Vr\backslash V\) & *! & ** & * & \\
\hline
\textasciitilde b. \(Vr\backslash V\) & * & * & * & \\
\hline
\textasciitilde c. \(Vr\backslash V\) & * & **! & * & \\
\hline
\end{tabular}

\textit{Lex(dur)} rules out the contrastive candidate (a), and *\textit{Hold} can now decide in favor of candidate (b). On this analysis, the tap simply emerges as the unmarked rhotic in word-final prevocalic position when lower-ranked markedness constraints are given the chance to exert their effects.

In sum, the TETU analysis successfully explains the intricacies of word-final neutralization without syllable structure and ordered rules—a welcome result, given our assumptions regarding Segmental Autonomy and the non-derivational nature of constraint-based OT (see the discussion of theoretical assumptions in Section 1.2 of Chapter 1). Furthermore, the absence of word-final prevocalic trills is intimately linked to
the obligatory presence of word-initial trills under this analysis, since each necessitates
the ranking of \( \text{LEX}(\text{dur}) \gg \text{CONTRAST}(\text{dur}/\overline{V}_V) \). The behavior of rhotics in two distinct
environments falls out from one and the same constraint ranking. This constitutes a very
interesting and novel result, insofar as no previous analysis of Spanish rhotics has ever
attempted to draw a connection between these two phenomena.

3.4.3 Structure Preservation and Hypercorrection

To account for the fact that hypercorrection in Dominican Spanish involves insertion of
/s/ at the end of a syllable, Núñez Cedeño (1988) posits the rule in (3.85):

\[
\text{(3.85) } \quad \text{/s/-epenthesis rule (Núñez Cedeño 1988:324)}
\]

\[
\begin{align*}
\emptyset & \rightarrow s/ \_ \_ \_ \sigma \\
\end{align*}
\]

Since this rule is structure-preserving, it fails to apply if general syllabic or prosodic
constraints would be violated. Specifically, application of the rule in (3.85) is blocked if
the result would either create structures not otherwise generated by phonological rules or
alter the phonological features of immediately adjacent segments.

Specifically, /s/-epenthesis before an intervocalic trill would violate the universal
constraint on crossing association lines. The application of (3.85) in the first syllable of a
word like \textit{carreta} 'cart' would yield the structure in (3.86), in which coda [s] illegally
splits the heterosyllabic geminate tap:
Epenthesis before trill generates an ill-formed prosodic structure in which association lines are crossed (Núñez Cedeño 1994:31)

Structure preservation also explains epenthesis blocking before intervocalic taps, since the result would alter the phonological features of the adjacent rhotic. The application of (3.85) in the first syllable of caro 'expensive; dear' would trigger fortition of /r/ to trill, by the independent rule shown in (3.87):

On the assumption that epenthesis is a structure-preserving rule, the ill-formed prosodic structure in (3.86) and the gratuitous modification of the underlying tap induced by the application of (3.87) both serve to block /s/-epenthesis before rhotics in intervocalic position. The lack of epenthesis in this environment suggests that the heterosyllabic geminate cluster proposed by Harris (1983) should be represented as a one-to-many association of a single underlying /r/ to two timing slots, as shown in (3.86).

In fact, Núñez Cedeño (1994) argues that /s/-epenthesis should be possible before an intervocalic trill in an analysis positing a unitary underlying trill /r/. While other recent accounts of Spanish rhotics have posited that the trill is a single unit, they have failed to
show how the Dominican facts might be explained without the assumption that the surface trill is an underlying geminate.

The analysis developed in this chapter is among those positing that the trill is a single unit, as shown by the monosegmental aperture-theoretic representation in (3.6b). However, this assumption does not preclude an account of epenthesis blocking—contrary to Núñez Cedeño's prediction. In Section 3.3.4.1, the lack of epenthetic \[s\] was shown to emerge as a consequence of independently motivated lexical conservatism conditions. Not only does the ranking of \( \text{LEX}(\text{dur}) \gg \text{CONTRAST}(\text{dur/}\_\_\text{V}) \) explain the behavior of rhotics in word-initial and word-final intervocalic contexts at the phrasal level, it also explains why \(/s/\) is never inserted before a word-medial intervocalic tap or trill: to do so would neutralize contrast, which is a property of lexically listed forms that contain rhotics in that position. The lexical conservatism analysis surpasses the structure-preservation account in that the latter requires two constraints, namely that (1) association lines must not be crossed and (2) adjacent segments must not be altered, while the former appeals to a single constraint, namely \( \text{LEX}(\text{duration}) \). In Section 3.3.4.2, further evidence was presented from Dominican Spanish in support of lexical conservatism: devoicing and preaspiration must accompany the temporal reduction of the intervocalic trill in order to avoid neutralization.

No previous proposal in the literature has attempted to explain the behavior of intervocalic taps and trills in word-initial, word-medial, and word-final contexts using a single formal mechanism. In the present analysis, lexical conservatism achieves this by ensuring the preservation of a lexically listed property in all three contexts: neutralization
of rhotic duration contrast at the edges of words, but preservation of the contrast word-
medially. Furthermore, lexical conservatism accounts for the blocking of /s/-epenthesis
without the need for a geminate representation of the trill. This is a welcome result given
the fact that in some languages, the trill cannot be analyzed as a geminate.\(^{62}\) By positing
that the trill is a single phonological unit, the present analysis can be readily extended to
cover all languages of the rhotic duration typology, which is the goal of the following
chapter.

\(^{62}\) See Section 2.3.1 of Chapter 2 on the behavior of trill as a single phonological unit.