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Incomplete Resyllabification and Ambisyllabic Gestural Coupling in Spanish

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ABSTRACT: In the generative literature, the pattern of coronal fricative lenition found in the traditional Chinato Spanish dialect is commonly cited as a phonological argument that the resyllabification of word-final prevocalic consonants is complete, in the sense that onsets derived by resyllabification are structurally identical to canonical (word-level) onsets. However, recent acoustic studies of Northern-Central Peninsular Spanish have problematized the completeness of resyllabification with experimental evidence that /s̺/ is shorter and more voiced as a derived onset than as a canonical onset. Using a split-gesture, competitive, coupled oscillator model of the syllable in Articulatory Phonology, which divides consonants into a separate constriction and release gesture, we propose a novel representation of ambisyllabicity that predicts the phonetic behavior of derived onset /s̺/ in Northern-Central Peninsular Spanish. We then show that ambisyllabic coupling permits a simpler phonological analysis of coronal fricative lenition in Chinato Spanish as compared to alternative accounts. Our analysis makes typological predictions that are confirmed by patterns from other contemporary Spanish varieties. Lastly, we examine the consequences of ambisyllabicity for the analysis of Spanish rhotic consonants, which have also been argued to support complete resyllabification. We offer an analysis of rhotics that is entirely compatible with an ambisyllabic representation of incomplete resyllabification.

Keywords: Incomplete resyllabification, fricative lenition, Chinato Spanish, rhotic consonants, Northern-Central Peninsular Spanish, Optimality Theory, split-gesture competitive coupled oscillator model of syllable structure, ambisyllabicity, Articulatory Phonology.

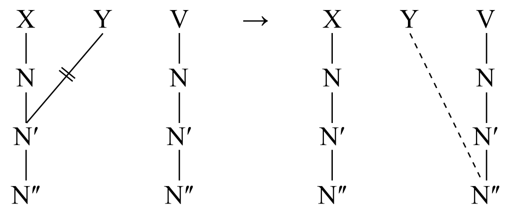
RESUMEN: *Resilabificación incompleta y acoplamiento gestual ambisilábico en español*.- En la literatura generativa, el debilitamiento de fricativas coronales en el dialecto chinato del español peninsular se cita comúnmente como un argumento fonológico a favor de la resilabificación completa de consonantes prevocálicas finales de palabra, o sea que los arranques derivados por resilabificación son idénticos estructuralmente a los arranques canónicos a nivel de palabra. Sin embargo, algunos estudios acústicos recientes han problematizado la resilabificación completa en el español peninsular centro-norteño al presentar evidencia experimental de que la /s̺/ es más corta y sonorizada como arranque derivado que como arranque canónico. Utilizamos un modelo de acoplamiento competitivo desde la Fonología Articulatoria, el cual divide a las consonantes en un gesto de constricción y de soltura, para proponer una nueva representación de la ambisilabicidad que predice el comportamiento fonético de la /s̺/ como arranque derivado en el español peninsular centro-norteño. Luego, demostramos que el acoplamiento ambisilábico permite analizar mejor el debilitamiento de fricativas coronales en el español chinato, en comparación con otras explicaciones alternativas. Confirmamos las predicciones tipológicas de nuestro análisis para otras variedades contemporáneas del español. Por último, examinamos las consecuencias de la ambisilabicidad para el análisis de las consonantes róticas del español, también citadas como otro argumento a favor de la resilabificación completa. Ofrecemos un análisis de las róticas que es totalmente compatible con una representación ambisilábica de la resilabificación incompleta.

Palabras clave: Resilabificación incompleta, debilitamiento de fricativas, español chinato, consonantes róticas, español centro-norteño peninsular, Teoría de Optimidad, modelo de la estructura silábica basado en el acoplamiento competitivo de gestos de constricción y de soltura, ambisilabicidad, Fonología Articulatoria.

1. INTRODUCTION

Resyllabification turns a word-final coda into a derived onset in prevocalic contexts. For Spanish, Harris and Kaisse (1999, p. 137) formalize an autosegmental operation (1) that delinks a segment Y from the rhyme N′ and reassociates it as an onset to the following syllable N″. Resyllabification is complete in that delinking and reassociation render derived and canonical (i.e. word-level) onsets structurally identical.

(1)



An argument often cited by generative phonologists in support of complete resyllabification comes from Hualde's (1991) rule-based account of fricative lenition in the traditional Chinato Spanish (henceforth, CS) variety of western Spain. In the postlexical (i.e. phrase-level) phonology, an aspiration rule targeting coronal obstruents in the syllable rhyme is ordered to apply after resyllabification. Because resyllabification destroys its triggering environment, the aspiration rule applies transparently, affecting only canonical codas. For the analysis to work, derived onsets must be structurally identical to canonical onsets, with no remaining association to the preceding syllable rhyme.[1] Even since the rise of Optimality Theory (henceforth, OT; McCarthy & Prince, 1999; Prince & Smolensky, 2004), which abandons rule ordering and serial derivations in favor of parallel evaluation of output candidates by surface-oriented constraints, most analyses of Spanish phonology still take the structural identity of derived and canonical onsets as a given. To our knowledge, no alternative account of the CS data has been proposed in the OT literature thus far.

More recently, however, the structural identity assumption has been problematized by experimental acoustic studies of Northern-Central Peninsular Spanish (henceforth, NCPS) that uncover subphonemic differences in the realization of intervocalic /s̺/, which is shorter and more voiced in word-final position than in word-medial or word-initial position (Hualde & Prieto, 2014; Strycharczuk & Kohlberger, 2016; Torreira & Ernestus, 2012). How to reconcile the phonological evidence in favor of complete resyllabification with the phonetic evidence against it remains a puzzle.

In this article, we first propose an articulatory representation of ambisyllabicity that predicts the shortening of word-final prevocalic /s̺/ as observed in NCPS. The representation is couched within a split-gesture, competitive, coupled oscillator model of the syllable in Articulatory Phonology (Burroni, 2022; Goldstein et al., 2006; Goldstein & Pouplier, 2014; Hoole & Pouplier, 2015; Marin & Pouplier, 2010; Nam, 2007a, 2007b, 2007c; Nam et al., 2009; Tilsen, 2017; Zsiga, 2011, 2020, pp. 202–210). Then, we show how an ambisyllabic gestural coupling representation streamlines the amount of phonological computation required to account for coronal fricative lenition in CS as compared to alternative theoretical approaches. We offer an OT analysis that also predicts typological patterns of coronal fricative aspiration and voicing that are observed across contemporary Spanish varieties. Lastly, an examination of the consequences of ambisyllabicity for the analysis of rhotic consonants leads us to argue that a markedness constraint on the perceptibility of rhotic contrast is responsible for rhotic neutralization in Spanish phonology, which altogether lacks a rule or constraint targeting individual coda rhotics (Bradley, 2005b, 2006b, 2020).

This article is organized as follows. Section 2 gives the relevant historical background and data from CS and presents Hualde's (1991) analysis motivating complete resyllabification. Section 3 reviews the phonetic evidence from NCPS that resyllabification is incomplete. Section 4 proposes an ambisyllabic, competitively coupled split-gesture representation of derived onsets in NCPS. Section 5 presents our OT account of coronal fricative lenition in CS and explores its typological predictions. Section 6 examines rhotic contrast and neutralization in NCPS. Section 7 concludes.

2. CORONAL FRICATIVE LENITION IN CS

We begin with some background on the historical evolution of Spanish anterior coronal sibilants. In Medieval Spanish (henceforth, MS), the voiced dentoalveolar affricate /dz/ and apicoalveolar fricative /z̺/ were in phonological contrast with their voiceless counterparts /ts/ and /s̺/.[2] Deaffrication of the dentoalveolars resulted in fricatives /z̪/ and /s̪/. According to most accounts, the voiced sibilants /z̪/ and /z̺/ underwent devoicing and merger with their voiceless counterparts, after which point /s̪/ was interdentalized, giving rise to the contrast between interdental /θ/ and apicoalveolar /s̺/ in present-day NCPS (Hualde, 2014, pp. 150–154; Núñez-Méndez, 2021, pp. 29–31, 35–36, 49; Penny, 2014, pp. 120–123; Rost Bagudanch, 2022). MacKenzie (2022) proposes a revised model of the genesis of /θ/, based on a quantitative analysis of corpus data tracking the change from orthographic <*d*> to <*z*> in word-medial preconsonantal contexts, e.g. *juzgar* for *iudgar* 'to judge' (< Latin IUDICARE). He argues that the

[1] Another well-known argument for structural identity comes from the pronunciation of Spanish rhotic consonants in word- and prefix-final prevocalic contexts. See Section 6 for further discussion and analysis.

[2] Although not examined here, MS also had three non-anterior coronal sibilants: a voiceless prepalatal affricate /tʃ/ and fricative /ʃ/ but only a single voiced prepalatal with affricate [dʒ] and fricative [ʒ] as allophones (Bradley & Lozano, 2022; Hualde, 2013, pp. 250–252; Penny, 2000, p. 8). Present-day NCPS maintains MS /tʃ/, while MS /ʃ/ and /dʒ~ʒ/ were neutralized to velar /x/ by the end of the 17th century (Núñez-Méndez, 2021, pp. 31, 35–36, 49).

deaffricated reflexes of MS /dz/ and /ts/ underwent *dissibilation* to non-sibilant /ð/ and /θ/, respectively, before the devoicing process was completed by the 17th century—a view also held by Menéndez Pidal (1987, p. 113).[3]

In CS, which is the traditional variety of Malpartida de Plasencia in the province of Cáceres, in Extremadura, Spain (Catalán, 1954; Espinosa, 1935; Hualde, 1991), the anterior coronal sibilants of MS evolved differently compared to NCPS, giving rise to some unexpected correspondences:

(2)		CS	NCPS	
	a.	[éθo]	[éso̺]	'this'
	b.	[móθo]	[móθo]	'boy'
	c.	[kóða]	[kós̺a]	'thing'
	d.	[beðíno]	[beθíno]	'neighbor'
	e.	[θólo]	[s̺ólo]	'alone'
	f.	[dáŋgano]	[θáŋgano]	'drone'
	g.	[θendíʎo]	[s̺enθíʎo]	'simple'

These and other similar data come from "texts sent by a native speaker of the dialect, doña Gregoria Canelo, to Ramón Menéndez Pidal in 1904, and that were published and studied by Catalán (1954)" (Hualde, 1991, p. 57), as well as from descriptions by Espinosa (1935). We have adapted Canelo's orthographic renditions into modern IPA. In CS, both [θ] (2)a,b and [ð] (2)c,d appear as canonical onsets in word-medial intervocalic position. Surprisingly, NCPS [s̺] corresponds to interdental [θ] (2)a and [ð] (2)c in CS, which altogether lacks apicoalveolar fricatives. According to Hualde's (1991, pp. 59–60) historical account of CS, MS apicoalveolar /z̺/ and /s̺/ merged with the deaffricated reflexes of dentoalveolar /dz/ and /ts/, which then were fronted to /ð/ and /θ/, respectively. However, /ð/ did not devoice. CS therefore maintains the MS voicing contrast but neutralizes the place contrast to interdental. The contrast between /ð/ and /θ/ lends further support to MacKenzie's revised chronology of MS sibilants. In fact, MacKenzie (2022, p. 191, note 15) cites CS as an example of a variety in which dissibilation of /z̺/ and /s̺/ took place without subsequent devoicing, while at the same time highlighting the loss of apicoalveolar /z̺/ and /s̺/. Word-initially, [θ] and [ð] are not in direct contrast in CS. Of the two fricatives, only [θ] appears after a pause (2)e,g. Espinosa (1935, pp. 78, 102) gives two examples of voiced plosive [d], after a pause (2)f and a nasal (2)g. Apparently, the dissibilation of /z̺/ to /ð/ in CS led to a phonemic merger between /ð/ and /d/, whereby /ð/ acquired plosive allophones in the same phonological contexts as /d/ (Hualde, 1991, pp. 60−61).

In the synchronic CS grammar, the contrast between /ð~d/ and /θ/ is neutralized by processes of voicing and aspiration outside of the canonical onset environment. Spaces appear in the phrasal examples below to make the word divisions clearer. First, [ð] appears in word-final position before a following vowel (3)a,b and, according to Espinosa (1935, pp. 61, 73), in stem-final position before a vowel-initial plural (3)c or derivational (3)d suffix (cf. NCPS [rés̺es], [més̺es], and [luθéɾo].) Second, the glottal fricative [h] appears before a consonant, within the same word (3)e or across word boundaries (3)f, and before a pause (3)a,c, where it variably disappears in utterance-final position, e.g. [lað álah ~ lað ála], [réðeh ~ réðe], etc.

(3)			
	a.	[lað álah]	'the wings'
		[θántað i βu̯énah]	'holy and good'
	b.	[poð en éθo]	'well, in that'
		[báð a mi káða]	'you go to my house'
	c.	[réðeh]	'cows'
		[méðeh]	'months'
	d.	[luðéɾo]	'star'
	e.	[ehta]	'this'
		[θupu̯éhto]	'supposed'
	f.	[di̯óh ki̯éɾe]	'God loves'
		[poh nó]	'well, no'

Hualde (1991) formalizes two rules targeting coronal obstruents in the syllable rhyme. Coronal Obstruent Voicing (COV) operates as a cyclic, stem-level lexical "constraint or filter on representations that checks the well-formedness of certain segments in certain positions, rather than as an active feature-changing rule" (p. 65). Applying vacuously to underlying final /d/ but actively to final /θ, t/ in loanwords, COV explains why the three-way coronal contrast in [éθo] 'that' (2)a, [kóða] 'thing' (2)b, and, e.g. [panderéta] 'tambourine', is neutralized to intervocalic [ð] in word- and stem-final environments (3)a–d. The second rule is Coronal Obstruent Aspiration (COA). It applies postlexically to delink supralaryngeal features in the syllable rhyme, leaving behind only the laryngeal features responsible for aspiration, which is transcribed as the glottal fricative [h].

The sample derivations in (4) and (5) illustrate the analysis. Periods denote syllable boundaries, and the + symbol, the morphological boundary between a stem and a derivational affix.

(4)		/lad álad/
	Lexical phonology	
a.	Syllabification	.lad. .á.lad.
b.	COV	√ √
	Postlexical phonology	
c.	Resyllabification	.la.dá.lad.
d.	Spirantization	.la.ðá.lað.
e.	Final Devoicing	.la.ðá.laθ.
f.	COA	.la.ðá.lah.

[3] MacKenzie's revised model also questions the teleological basis of interdentalization (and velarization, see footnote 2) as a strategy for increasing the perceptual distance between /s̺/ and /s̺/ to avoid contrast neutralization (*pace,* e.g. Baker & Holt, 2020, pp. 490–491). MacKenzie (2022, pp. 11−13) argues that dissibilation likely resulted from a listener-driven perceptual reanalysis of /z̺/ and /s̺/ as /ð/ and /θ/, respectively.

(5)		/lud+éɾo/
	Lexical phonology	
a.	Syllabification	.lud.
b.	COV	√
c.	Syllabification (cycle 2)	.lu.dé.ɾo
d.	COV (cycle 2)	—
	Postlexical phonology	
e.	Resyllabification	—
f.	Spirantization	.lu.ðé.ɾo
g.	Final Devoicing	—
h.	COA	—

For [lað álah] (3)a, syllabification first takes place within each word separately (4)a, which puts each /d/ in the syllable rhyme. Checkmarks indicate the vacuous application of COV (4)b. Postlexical resyllabification turns the word-final prevocalic coda into a derived onset (4)c. Ordered after the spirantization of postvocalic voiced plosives (4)d and the devoicing of the word-final coda obstruent (4)e, COA applies (4)f, followed by an optional rule of utterance-final glottal fricative deletion (not shown here). The derived onset fricative escapes COA, which applies only to the canonical coda fricative. For [luðéɾo] (3)d, the first cycle of the lexical phonology induces syllabification within the domain of the stem (5)a, where final /d/ in the syllable rhyme satisfies COV (5)b. Adding the derivational suffix triggers a second cycle: stem-final prevocalic /d/ syllabifies as a word-medial onset (5)c, and then COV fails to apply (5)d. The only postlexical rule that can apply in this derivation is Spirantization (5)f. The stem-final canonical onset fricative escapes COA, as does the word-final derived onset fricative (4)f.

COV and COA interact with resyllabification in opposite ways. First, COV is phonologically opaque because the rule 'overapplies' in onsets. Overapplication opacity arises because COV is ordered to apply *before* stem-final codas become derived onsets postlexically (4)c or canonical onsets on a second lexical cycle (5)c. This type of relationship, known as a counterbleeding rule order, is seen as evidence supporting the existence of derivational steps and abstract intermediate representations. Overapplication opacity is problematic for 'classic' monostratal OT, in which input-output mappings are evaluated in parallel without serial rule application or intermediate derivational steps (Baković, 2011, 2013). Second, because it is ordered *after* postlexical resyllabification, COA operates transparently, targeting only canonical codas (4)f. Applying first, resyllabification (4)c destroys the environment that triggers COA, thereby blocking the aspiration of derived onsets. Because COA could still apply if the word-final fricative were to maintain its lexical affiliation to the preceding rhyme, resyllabification must be assumed to be complete, i.e. derived onsets must be structurally identical to canonical onsets.

3. INCOMPLETE RESYLLABIFICATION

Contemporary laboratory phonology has come to question the generative assumption that resyllabification across word boundaries in connected speech is complete. The critique was initiated by phonetic studies of French *enchaînement* 'linking'. Gaskell et al. (2002) report that French listeners show sensitivity to subphonemic differences between /VC#V/ and /V#CV/ sequences in lexical priming tasks (# denotes a morphological word boundary). According to Fougeron et al. (2003) and Fougeron (2007), French intervocalic consonants in laboratory speech are acoustically shorter as derived onsets than as canonical onsets. Listeners are capable of noticing durational and spectral cues in order to perceive the contrast between such sequences, which is incompletely neutralized (Fougeron, 2007). In American English laboratory speech, /l/ and /w/ are found to have less consonantal constriction and more asynchronous timing of intra-segmental tongue tip and tongue body gestures as derived onsets than as canonical onsets, e.g. *hall otter* vs. *ha lotter, how otter* vs. *ha wadder* (Gick, 2004). In British English, patterns of linguopalatal contact in derived onset /l/ differ from those found in canonical onset or coda /l/ (Scobbie & Pouplier, 2010). In American English spontaneous speech, intervocalic consonants are acoustically shorter word-finally than word-initially, e.g. *beef eater* vs. *bee feeder* (Tao et al., 2018).

Evidence for incomplete resyllabification in NCPS comes from acoustic studies reporting differences in the realization of apicoalveolar /s̺/ between vowels, depending on the presence and location of a word boundary. The following examples, from Strycharczuk and Kohlberger (2016, p. 5), illustrate the three main contexts of interest, namely canonical onset /s̺/ in initial (6)a and medial (6)b positions and derived onset /s̺/ in final position (6)c:

(6)			
	a.	*cruce s̺agrado*	'sacred crossing'
	b.	*gran pes̺adilla*	'big nightmare'
	c.	*redes̺ atadas*	'tied nets'

Torreira and Ernestus (2012) collected 1,257 tokens of intervocalic /s̺/, produced in spontaneous conversational speech by 27 female and 25 male speakers from Madrid as part of the *Nijmegen Corpus of Casual Spanish,* and analyzed voicing based on acoustic measurements of an uninterrupted pitch track during the fricative, as well as intensity differences with surrounding vowels. Of the total tokens of intervocalic /s̺/, 34% were realized with a fully voiced [z̺], more frequently in word-final position, the faster the rate of speech, and the shorter the duration of the fricative. Intervocalic /s̺/ voicing is thus consistent with laryngeal coarticulation, which is known to be sensitive to temporal variation. However, the fact "that voicing is considerably more common in word-final position suggests that this coarticulatory pattern is not an entirely passive phenomenon, and that it may contain the seeds of phonologization" (p. 139).

Hualde and Prieto (2014) analyzed 684 tokens produced by 16 female speakers from Madrid in directed conversational speech collected via map tasks for the *Interactive Atlas of Spanish Intonation.* Of the total tokens of intervocalic /s̪/, only 8.3% were fully voiced. Measurements of uninterrupted voicing replicated the findings of Torreira and Ernestus (2012) by revealing higher rates of fully voiced /s̪/ in final (12.5%) than initial (10.64%) or medial (5.93%) position, as well as significantly more voiced frames in final than medial /s̪/. Duration measurements revealed a significantly shorter intervocalic /s̪/ word-finally than initially or medially but no significant difference between the latter two contexts. Derived and canonical /s̪/ should be expected to pattern the same phonetically if Spanish resyllabification were completely neutralizing. Hualde and Prieto suggest that resyllabification is only partial and that a symbolic transcription of *más amor* 'more love' as [má.s̪a.móɾ] "simply offers an incomplete view of phonetic reality" (p. 124). They propose that in /VCV/ and /V#CV/ contexts, the onset consonant is "timed to start in-phase with the following vowel (Nam et al., 2009), whereas in /VC#V/ lexical syllabic affiliation may result in a different gestural coordination, even if, as it is generally assumed for Spanish and Catalan, there is postlexical resyllabification" (p. 123).

Evidence from a third study with carefully controlled materials uncovers even more systematic variation in laboratory speech. Strycharczuk and Kohlberger (2016) used a reading task with two-word stimuli embedded in carrier phrases, eliciting a total of 792 tokens from 1 male and 10 female speakers from northern and central Spain. As summarized in Table 1, an analysis of fricative duration revealed significant contextual differences, except for canonical coda /s̪/:

Table 1: Mean fricative duration (in milliseconds) by context. /P/ denotes voiceless plosives.

<table>
<tr><td>/Vs̪#s̪V/</td><td>112.52</td><td></td></tr>
<tr><td>/V#s̪V/</td><td>87.91</td><td></td></tr>
<tr><td>/Vs̪V/</td><td>81.9</td><td></td></tr>
<tr><td>/Vs̪#V/</td><td>76.23</td><td></td></tr>
<tr><td>/Vs̪#PV/</td><td>64.39</td><td rowspan="2">} ns</td></tr>
<tr><td>/Vs̪PV/</td><td>58.99</td></tr>
</table>

Between vowels, the fricative was the shortest as a word-final derived onset, but unlike in Hualde and Prieto's results for spontaneous speech, there was also a difference between canonical onsets: initial /s̪/ was significantly longer than medial /s̪/. Canonical codas were shorter than canonical onsets, with no significant difference between preconsonantal contexts, e.g. *meses pasados* 'past months', *seis españoles* 'six Spaniards'. No spectral differences are reported for the surrounding vowels, but a significantly longer preceding vowel in /Vs̪#V/ than in /Vs̪#PV/ (68.26 ms > 60.76 ms) is consistent with the cross-linguistic tendency toward open syllable lengthening, suggesting some type of affiliation between /s̪/ and the following vowel. The duration of derived onset /s̪/, intermediate between canonical onsets and codas, shows that resyllabification was nonetheless incomplete. The implication is that "structural differences between canonical and derived onsets are accessible to learners at a level of linguistic representation that connects directly to phonetic realization" (Strycharczuk & Kohlberger, 2016, p. 17).

Strycharczuk and Kohlberger consider two possible prosodic representations of incomplete resyllabification. If derived onsets are treated as *ambisyllabic,* then they should be distinguishable from canonical onsets and codas such that only ambisyllabic consonants will be targets of weakening. However, as the researchers point out, ambisyllabicity is also commonly used to represent intervocalic geminate consonants in many languages, which highlights the theoretical inconsistency of using the same type of syllabic structure to explain two opposing phenomena, i.e. lengthening and shortening. Jensen (2000) raises a similar theoretical critique of the use of ambisyllabicity in generative analyses of segmental strengthening and weakening in English, German, and Danish, as does Purse (2020, pp. 104–105) based on an acoustic study of /l/-vocalization in Philadelphia English. As an alternative to ambisyllabicity for singling out derived onsets, Strycharczuk and Kohlberger suggest the possibility of *prosodic misalignment,* whereby /s̪/ associates to the following syllable onset while remaining associated to the preceding prosodic word. Prosodic word-initial /s̪/ is correctly predicted to be the longest because consonants are independently known to undergo domain-initial strengthening, which increases fricative duration (Fougeron & Keating, 1997; Keating et al., 2004; White et al., 2020)—an explanation we adopt here. However, as Strycharczuk and Kohlberger highlight, initial strengthening cannot explain why medial /s̪/ should be longer than final /s̪/, as neither fricative is word-initial. Although not statistically significant, in Table 1 the mean duration of coda /s̪/ is longer word-finally in /Vs̪#PV/ than word-medially /Vs̪PV/, which suggests the possibility of lengthening in prosodic word-final position. Unfortunately, final lengthening makes the opposite prediction that intervocalic /s̪/ should be longer word-finally than medially. How to capture the structural difference between canonical and derived onset /s̪/ in NCPS laboratory speech remains elusive.

Ramsammy (2021) used electropalatography to describe word-final /l/ reduction in the speech of four NCPS speakers from Galicia, based on data from a carrier phrase task involving nonce word stimuli.[4] Linguopalatal contact was the longest and most extensive utterance-finally be-

[4] A reviewer asks about potential language transfer effects from Galician. Two participants were NCPS-Galician bilinguals who reported using NCPS regularly in their daily lives (Ramsammy, 2021, pp. 7–8). Galician has a clear lateral phoneme /l/ (Regueria, 1996), as does NCPS, which suggests that bilingual interference effects should have been minimal.

fore a pause but showed varying degrees of reduction before word-initial /a/ and voiceless plosives and fricatives. Because the study did not examine contexts of canonical onset /l/, it remains unclear whether participants showed asymmetrical reduction across /V#lV/, /VlV/ and /Vl#V/ contexts, as Strycharczuk and Kohlberger report for the duration of /s̺/. Still, Ramsammy argues that speaker-specific gestural overlap and reduction strategies provide a better explanation of the contextual variation in word-final /l/ than do differences in syllabification or prosodic structure, *pace* Rubach's (1996) use of ambisyllabicity to explain properties of English word-final prevocalic /l/.

4. A COMPETITIVELY COUPLED SPLIT-GESTURE REPRESENTATION OF AMBISYLLABIC CONSONANTS

This section argues that the shortening of derived onset /s̺/ in NCPS, as documented by Strycharczuk and Kohlberger (2016), is predicted to emerge in speech planning from multiple competitive couplings among the fricative's target and release gestures and the surrounding vowel gestures. In Articulatory Phonology (henceforth, AP; Browman & Goldstein, 1989, 1990), the grammar operates over dynamically defined movement tasks, or *gestures,* that instruct the active articulators to constrict the vocal tract during speech production. Abandoning the traditional phonological segment, AP posits that gestures are the 'atomic' units of speech production, glued together by coupling relations into larger 'molecules' that cohere into word forms during language acquisition (Goldstein et al., 2006, p. 225).

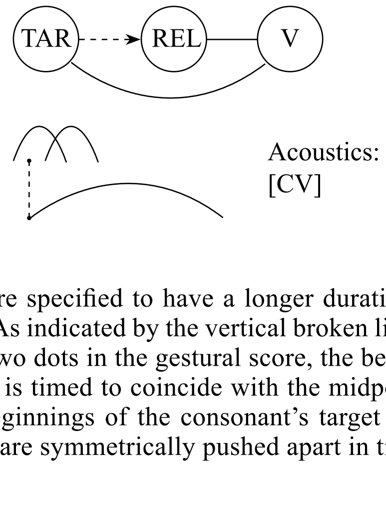
Building on work by Saltzman and Munhall (1989), the development of the coupled oscillator model of syllable structure (Goldstein et al., 2006; Goldstein & Pouplier, 2014; Hoole & Pouplier, 2015; Marin & Pouplier, 2010; Nam et al., 2009; Zsiga, 2011, 2020, pp. 202–210) makes it possible to represent the temporal coordination of gestures using two basic timing relations. When two gestures G_1 and G_2 are coupled *in-phase,* they will begin simultaneously, but when coupled *anti-phase,* G_2 will begin after the midpoint of G_1. The model can be implemented computationally in the Task Dynamics Application (henceforth, TaDA; Browman et al., 2006; Goldstein et al., 2006). Coordination relations are formalized as *intergestural coupling graphs,* in which gestures are nodes that are connected by edges, or association lines, that specify the coupling relation. A solid line denotes in-phase coupling, i.e. G_1—G_2, while a dotted arrow denotes anti-phase coupling of the first gesture to the second one, i.e. G_1⇢G_2. Based on physical principles governing the movement of coupled oscillators, TaDA executes a speech planning process that computes the most stable timing pattern for all the gestures of an utterance at a specified speech rate. The output of the process is a *gestural score,* which displays gestures on separate tiers that correspond to the active articulators, i.e. Lips, Tongue Tip, Tongue Body, Tongue Root, Velum, and Glottis. Informed by mathematical equations of task dynamics, an interarticulator component then uses the gestural score to derive output movement trajectories that can serve as input for speech synthesis and vocal tract modeling (not examined here).

4.1. The split-gesture hypothesis

Based on simulations in TaDA, Nam (2007a, 2007b, 2007c) argues for the *split-gesture hypothesis,* whereby a plosive's primary constriction gesture is decomposed into separate closure and release gestures (Browman, 1994). To model Browman and Goldstein's (1995) experimental finding that in English /pV/ sequences, the vowel gesture begins around the midpoint between the beginnings of the plosive's closure and release gestures, Nam argues that the vowel is coupled in-phase with both the closure and release, i.e. CLO—V and REL—V, but that the closure is coupled anti-phase with the release, i.e. CLO⇢REL. The in-phase and anti-phase couplings are *competitive* in the sense that they place opposite demands on the closure and release gestures. A temporal compromise emerges in speech planning: the closure and release are symmetrically pushed apart in opposite directions in time, with the closure beginning earlier and the release later, while the vowel begins after the closure begins but before the release begins. For experimental data from human subjects confirming the split-gesture model of timing in /pV/ sequences, see Tilsen's (2017) electromagnetic articulographic study of unconditioned variation, in which six speakers repeated [ip^{h}á] 400 times per session.

We adopt the split-gesture hypothesis but substitute the broader label *target* for closure, thereby generalizing the model to all consonantal constriction types, including plosives, fricatives, and approximants. The coupling graph in (7) defines a /CV/ demisyllable. Below the graph appears a hypothetical gestural score, in which consonantal and vowel gestures are displayed as arcs along two separate tiers, with the horizontal axis denoting time. To the right of the gestural score, we transcribe its hypothesized acoustic output.

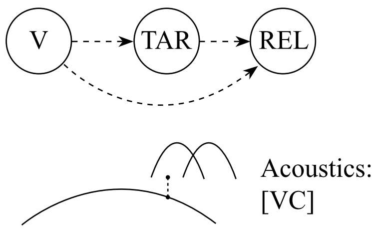
(7)



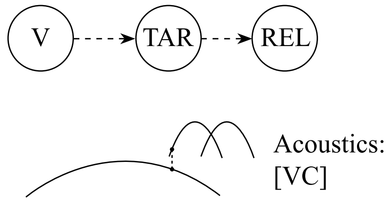
Vowels are specified to have a longer duration than consonants. As indicated by the vertical broken line connecting the two dots in the gestural score, the beginning of the vowel is timed to coincide with the midpoint between the beginnings of the consonant's target and release, which are symmetrically pushed apart in time.

Nam (2007c, pp. 500–503) argues that the split-gesture representation can also explain why, in syllable theory, onset consonants are typically weightless, while coda consonants can either bear their own mora or share one with the preceding vowel. In a /VC/ syllable rhyme, the vowel is coupled anti-phase with both the target and release of a non-moraic, weightless coda (8)a but only with the target of a moraic coda (8)b. Competitive coupling yields a degree of temporal compression of the target and release in speech planning that makes the consonant too short to contribute weight as an onset (7) or as a mora-sharing coda (8)a. Since they are not competitively coupled with the vowel, the target and release of a moraic coda (8)b are not under any pressure to begin at the same point in time, which allows the anti-phase coupling to produce a greater delay in the initiation of the release, effectively lengthening the consonantal constriction, i.e. [Cː].

(8) a.



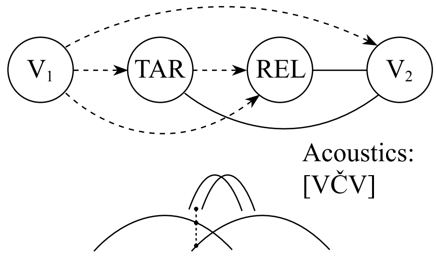
b.



4.2. Ambisyllabic shortening in NCPS

Because stress assignment in contemporary NCPS is arguably insensitive to syllable weight (Baković, 2016; Piñeros, 2016), we assume that coda consonants in the language share a mora with the preceding vowel. This assumption makes it possible to combine the split-gesture representation of onsets (7) and weightless codas (8)a into a new dynamical representation of ambisyllabicity that naturally and correctly predicts the shortening of derived onsets discussed in Section 3. We argue that the target and release of a derived onset are competitively coupled anti-phase with the first vowel and in-phase with the second. Furthermore, the first vowel is coupled anti-phase to the second, across a word boundary. As illustrated in (9), the target and release are under twice as much pressure to begin at the same time. Logically, the oral constriction of the consonant will be subject to twice as much temporal compression as that of a canonical onset (7) or weightless coda (8)a alone. Greater compression in speech planning predicts a shorter constriction in the gestural score and the acoustic output, transcribed here as [Č].

(9)



The gradient duration asymmetries among /V#s̺V/, /Vs̺V/, and /Vs̺#V/ contexts in Table 1 can now be theoretically predicted based on the combined effects of prosodic strengthening and multiple competitive couplings. The competitive coupling in (7) yields a baseline duration mean of 81.9 ms for word-medial canonical onset /s̺/. Prosodic word-initial strengthening increases the magnitude of the fricative's target gesture, which gradiently lengthens the constriction duration up to a mean of 87.91 ms. At the right edge of a morphological word, multiple competitive couplings with the adjacent vowels in (9) increase the temporal compression of the fricative's target and release, which shortens the constriction duration down to a mean of 76.23 ms. Gradient shortening follows neither from the fricative's affiliation to two abstract syllable nodes, nor from its misalignment across prosodic word and syllable domains, but rather from the fact that its target and release gestures are competitively coupled to two vowels instead of just a single vowel.

4.3. Ambisyllabic lengthening in Italo-Romance and Standard Italian

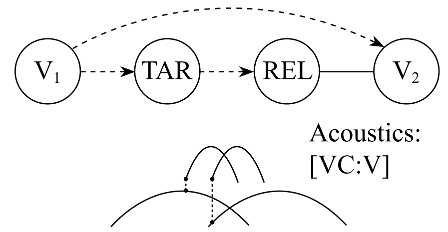
Further support for the split-gesture model comes from Burroni's (2022) account of ambisyllabic consonant lengthening across morpheme boundaries in Central and Southern Italo-Romance varieties and Standard Italian. A process known as *Raddoppiamento Sintattico* derives word-initial geminate consonants in certain prosodic (10)a and morphological (10)b contexts. Furthermore, morpheme-final singleton codas in loanwords become geminates in suffixed forms (10)c and as derived onsets in word-final prevocalic position (10)d.

(10)	a.	/farɔ́ bɛ́ne/ [farɔ́ bːɛ́ne]	'I will do well'
	b.	/kóme mái̯/ [kóme mːái̯]	'how come'
	c.	/buldog+ino/ [buldogːino]	'small bulldog'
	d.	/buldog agːresːivo/ [buldogː agːresːivo]	'aggressive bulldog'

Building upon the computational approach of Nam (2007a, 2007b, 2007c), Burroni carries out TaDA simulations that further support a split-gesture representation of

/CV/ demisyllables (7) and also make possible a unified account of derived geminates, which are hypothesized to emerge across morpheme boundaries as a result of "changes in the dynamical coupling between the oscillator controlling the relative timing of CLO, REL, and V" (2022, p. 18). Specifically, the CLO of a word-initial onset loses its in-phase coupling with V_2 and becomes coupled anti-phase with V_1, and the REL of a word-final coda loses its anti-phase coupling with V_1 and becomes coupled in-phase with V_2. These symmetrical changes give rise to an ambisyllabic but *non-competitively* coupled split-gesture that is the same in word-initial and morpheme-final contexts (see Burroni's Figures 7 and 9 on pp. 16–17). We recreate this structure here, following the same format as in (7)–(9) above:

(11)



In (11), the first vowel is coupled anti-phase with only the target, and only the release is coupled in-phase with the second vowel. Because they are not competitively coupled with V_1 and V_2, the target and release are pushed farther apart by their anti-phase coupling, thereby lengthening the consonantal constriction, as in the case of moraic codas (8)b.

In syllable theory, word-final derived onsets in NCPS (9) and edge geminates in Italo-Romance and Standard Italian (11) can be considered ambisyllabic, since in both cases, an intervocalic consonant belongs to two adjacent syllables simultaneously. However, ambisyllabicity itself makes no inherent predictions about consonantal shortening or lengthening. On the other hand, a split-gesture, coupled oscillator model of the syllable makes possible a principled account of the difference, which depends on the dynamical couplings among the consonant's target and release gestures and the adjacent vowels. Competitive coupling predicts shortening (9), while non-competitive coupling predicts lengthening (11).

5. ACCOUNTING FOR CORONAL FRICATIVE LENITION

In doña Gregoria Canelo's orthographic renditions of traditional CS speech (Catalán, 1954), <*j*> denotes a glottal fricative [h], and <*d*> denotes a voiced interdental continuant [ð] or its dental plosive allophone [d]. Canelo varies in her transcription of word-final intervocalic <*d*>, either attaching it to the following word, e.g. *la dalaj* for [lað álah] (3)a, or combining words without spaces, e.g. *badamicada* for [báð a mi káða] (3)b. An underappreciated observation about Canelo's texts is that word-final fricatives are often transcribed as <*j*> followed by a space and then a word-initial <*d*>:

(12) *cadalmoj dejte año* 'to get married this year'
herej dunconfite 'you are a confection'
zarzaj dilaj 'bushes and the'

These examples correspond to NCPS *casarnos este año, eres un confite* and *zarzas y las.* While they may be transcription errors, Hualde (1991) acknowledges that such forms "could be interpreted as instances of ambisyllabicity: word-final [ð] links to the following syllable without delinking from the coda position that it occupied" (p. 64, footnote 7). Based on the orthographic variation in (12), we assume that CS derived onsets were ambisyllabic, as in (9). This assumption leads to a novel account of coronal fricative lenition, as we next show.

5.1. The phonetics of aspiration and voicing

Although commonly transcribed by linguists as [h], this symbol does not reflect the phonetic reality of the glottal fricative with regards to variation in the voicing of the vocal folds. Garellek et al. (2021) report that a phonological contrast between voiceless /h/ and voiced /ɦ/ is typologically rare and usually involves phonetic dimensions other than glottal vibration alone. They exhort analysts to specify the glottal fricative for aspiration, or spreading of the glottis, but to leave the magnitude of the spreading gesture unspecified in the absence of phonological arguments otherwise. Whether the glottis vibrates in output speech is partly determined by universal aerodynamic factors: vibration is favored utterance-medially, where subglottal pressure is generally high, but difficult to sustain at utterance edges, where subglottal pressure naturally drops. In contexts of prosodic strengthening, the magnitude of the glottal spreading gesture is increased to the point that vibration may cease altogether.

Aerodynamic factors are also implicated in the contextual voicing of coronal fricatives in Spanish dialects that do not aspirate such obstruents to [h]. By traditional accounts, preconsonantal /s/ voicing, e.g. *lo*[z] *gansos* 'the geese' vs. *lo*[s] *pavos* 'the turkeys', is an example of regressive voicing assimilation, whereby the [+voice] feature of the following onset consonant spreads leftward onto the coronal fricative in the preceding syllable rhyme. Recent laboratory work suggests instead that the directionality is progressive and that voicing originates in the vowel that precedes the fricative. An acoustic study of Mexico City Spanish by Schmidt and Willis (2011) reveals a previously unnoticed pattern of coarticulatory voicing between the vowel and the left edge of the fricative in both intervocalic and preconsonantal contexts, which can be represented in narrow transcription as [V^zsV] and [V^zsCV], respectively. Expanding the study to include two varieties of NCPS, Sedó et al. (2020) report high frequencies of left-edge voicing in coda /s/ before voiced *and before voiceless* consonants, especially in lenition contexts such as unstressed syllables. They argue that phonological lenition of the fricative's devoicing gesture before a voiced consonant allows for the potential continuation of glottal vibration from the left to the right edge of the fricative, yielding a fully voiced [z] in [VzV] and [VzCV]. However, progressive voicing is also gradiently counteracted by context-specific articulatory and aerodynamic factors. A high oral pressure before certain voiced consonants, such as nasals and /l/, can cause transglottal airflow to drop below the minimum threshold required to sustain glottal vibration, resulting in partial devoicing. In the second half of a sentence "voicing may not be the traditional reduced or lenited outcome due to additional constraints of potential sentence-final devoicing, and/or a reduction in airflow at the end of an utterance" (Sedó et al., 2020, p. 206). Campos-Astorkiza's (2019) acoustic study of /s̺/ voicing in NCPS also supports a model of overlap and blending of laryngeal gestures, in which voicing is gradiently counteracted by aerodynamic factors, as well as by the presence of an intervening intonation phrase boundary. However, Campos-Astorkiza assumes that voicing assimilation is regressive.

5.2. A formal account of aspiration and voicing in CS

A standard assumption in the coupled oscillator model of the syllable is that intergestural coupling graphs are stored in the lexicon. Smith (2018) and Walker and Proctor (2019) propose instead that gestural coupling is phonologically regulated by a constraint-based OT grammar. A single hierarchy of ranked constraints chooses the optimal coupling graph of an input utterance, which can then be phonetically implemented in TaDA as a gestural score. Some approaches to the phonetics-phonology interface postulate distinctive features in the lexicon and the phonology, which are then transduced into articulatory gestures in the phonetic component. The framework employed here gets closer to the original intent of AP by positing articulatory gestures as phonological primitives throughout the entire grammar, thereby obviating the need to map features onto gestures in the first place. From a representational point of view, there is, technically speaking, no phonetics-phonology interface, even if the grammar still distinguishes between optimization and implementation.

In our analysis, the optimal distribution of fricative gestures emerges from constraint interaction, and then gradient (de)voicing may arise in implementation under the influence of articulatory and aerodynamic factors, as discussed by Sedó et al. (2020) and Garellek et al. (2021). Table 2 gives the relevant gestural specifications for voiceless and voiced anterior coronal fricatives and for [H], which we use as a cover symbol for the glottal spreading gesture that is responsible for aspiration but that is not coupled to any oral gesture. Glottal [H] is distinct from the phonemic posterior fricative of many Andalusian and Latin American Spanish varieties, e.g. as in *gente* 'people', *ajo* 'garlic', which we assume to be a pharyngeal (Marrero, 1990, p. 377) and, therefore, oral gesture activating the Tongue Root articulator.

Table 2: Constriction Degree (CD) specifications of the Tongue Tip and Glottis articulators for seven fricative gestures.

	θ, s̪, s̺	H	ð, z̪, z̺
Tongue Tip CD	[critical]	—	[critical]
Glottis CD	[wide]	[mid]	[narrow]

Constriction Degree (CD) is a phonetic continuum divided into discrete ranges, from most to least open: [wide], [mid], [narrow], [critical], and [closed] (Browman & Goldstein, 1989, p. 225). In coronal fricatives, a Tongue Tip CD [critical] gesture is responsible for generating turbulent noise in the oral cavity. In order to provide enough air flow to generate such noise (Solé, 2010), voiced fricatives require a larger glottal opening than the Glottis CD [critical] specification that Browman and Goldstein (1989, pp. 237–239) posit as the default value for modally voiced plosives and sonorants. Table 2 situates three gestural classes along a Glottis CD continuum. The [mid] value of [H] is intermediate between the [wide] value of voiceless fricatives and the [narrow] value of voiced ones.

We take constriction duration to be the primary cue to an obstruent's phonological voicing category: voiced obstruents are phonetically shorter than their voiceless counterparts (Katz, 2016, pp. 64–66). A contrast based on consonant duration is most perceptually distinctive between two vowels, which make it easier for the listener to identify the consonant's beginning and ending points (for experimental evidence from a perception study, see Dmitrieva, 2018). Our analysis uses two faithfulness constraints. (13)a formalizes the intervocalic preference by enforcing faithfulness to the Glottis CD specification of an input gesture appearing in the following position: between two vowels that belong to the same morphological stem, without an intervening stem boundary. (13)b penalizes, in any context, an unfaithful mapping of any gesture (or set of gestures comprising the traditional phonological 'segment'—see the discussion around (18) below). For example, /θ/→ð and /θ/→H each violate (13)b once, as do /ð/→θ, /ð/→H, /H/→θ, and /H/→ð.

(13) a. Ident-GCD/[V_V $_{\text{Stem}}$]
Assign a violation for every Glottis CD gesture whose output value is not identical to the input in the context *between two vowels belonging to the same morphological stem.*

b. Ident-(gesture)
Assign a violation for every gesture or set of gestures whose output values are not identical to the input.

Interacting with faithfulness are markedness constraints (14)a,b that penalize in-phase fricative-vowel couplings and (14)c–e that penalize anti-phase couplings with a fricative:

(14) a. *H—V c. *⇢S
b. *{H,Z}—V d. *⇢Z
e. *⇢H

The symbols S and Z denote voiceless and voiced Tongue Tip fricatives in Table 2, abstracting away from differences in the location of the constriction. These constraints assume the competitively coupled split-gesture model of consonants, as in NCPS (7) and (8)a. For visual simplicity, the constraint names collapse the target and release into one cover symbol, and a single line indicates the relevant competitive coupling relation. The two in-phase constraints exist in a stringency, or specific-to-general, relationship (de Lacy, 2004), whereby candidates violating (14)a necessarily violate (14)b as well, but not vice versa. Stringency captures the relative harmony, or well-formedness, of onset fricatives, but without the need to posit a universally fixed constraint ranking. The fewer total violations of the two constraints, the more harmonic the onset fricative. For example, the demisyllable H—V violates both (14)a,b, ð—V only (14)b, and θ—V, neither. This predicts a universal scale of relative well-formedness for onset fricatives: θ—V > ð—V > H—V, where more harmonic gestural couplings appear to the left. By contrast, the anti-phase coupling constraints (14)c–e are not stringently related. A candidate that violates one of the three anti-phase coupling constraints does not automatically violate either of the other two constraints.

Tableau (15) gives the analysis of stem-medial intervocalic and word-initial postpausal positions (2)a–e, in which all three fricative gestures are considered as possible inputs. The forms under evaluation are idealized word shapes that represent only the phonological context that is relevant to the analysis. Output candidates for intervocalic position (15)a–i omit the anti-phase coupling between vowels. *H—V eliminates (15)c,f,i,l,o,r, in which the glottal fricative appears as a canonical onset. Ranked above *{H,Z}—V, positional faithfulness maintains the voicing contrast between intervocalic /θ/ and /ð/ (15)a,e. However, positional faithfulness is irrelevant in word-initial contexts. The ranking of *{H,Z}—V above context-free faithfulness neutralizes the input /θ/–/ð/–/H/ contrast to [θ] (15)j,m,p. Postpausal and postnasal /d/ (2)f,g plausibly arose by a previous sound change, whereby listeners misperceived historical [dz] (or [ð]) as a non-sibilant plosive in fortition environments and subsequently restructured those lexemes with underlying /d/.

(15)		*H—V	Ident-GCD/[V_V $_{St}$]	*{H,Z}—V	Ident-(gesture)
☞ a. /VθV/	V θ—V				
b.	V ð—V		*!	*	*
c.	V H—V	*!	*	*	*
d. /VðV/	V θ—V		*!		*
☞ e.	V ð—V			*	
f.	V H—V	*!	*	*	*
☞ g. /VHV/	V θ—V		*		*
h.	V ð—V		*	*!	*
i.	V H—V	*!		*	
☞ j. /θV/	θ—V				
k.	ð—V			*!	*
l.	H—V	*!		*	*
☞ m. /ðV/	θ—V				*
n.	ð—V			*!	
o.	H—V	*!		*	*
☞ p. /HV/	θ—V				*
q.	ð—V			*!	*
r.	H—V	*!		*	

Anti-phase coupling constraints become relevant before a consonant (3)e,f and a pause (3)a,c. Tableau (16) includes only /θ/ in the input, shown in the upper-left cell, but the analysis still works assuming input /ð/ or /H/ instead. Positional faithfulness is irrelevant outside of the stem-medial intervocalic context. The ranking of *⇢H below *⇢S and *⇢Z chooses [H] as the optimal canonical coda fricative (16)c. Gradient devoicing of [H] in phonetic implementation follows from the subglottal pressure drop that naturally occurs at the end of an utterance (Garellek et al., 2021; Sedó et al., 2020, p. 206). The complete loss of subglottal pressure can variably prevent turbulent noise from being generated across the glottis at all, e.g. [lað álah ~ lað ála].

(16) /Vθ#V/	*H—V	Ident-GCD/[V_V $_{St}$]	*⇢S	*{H,Z}—V	*⇢Z	*⇢H	Ident-(gesture)
a. V⇢θ			*!				
b. V⇢ð					*!		*
☞ c. V⇢H						*	*

In word-final prevocalic position (3)a,b, ambisyllabic coupling (9) activates both in-phase and anti-phase constraints. Output candidates in tableau (17) omit the anti-phase coupling between the two vowels. Even though the context is intervocalic, positional faithfulness is irrelevant because both vowels do not belong to the same morphological stem. The ranking of *⇢Z below *H—V and *⇢S chooses [ð] as the optimal derived onset (17)b.

(17) /Vθ#V/	*H—V	IDENT-GCD/[V_V$_{St}$]	*⇢S	*{H,Z}—V	*⇢Z	*⇢H	IDENT-(gesture)
a. V⇢θ—V			*!				
☞ b. V⇢ð—V				*	*		*
c. V⇢H—V	*!			*		*	*

In stem-final intervocalic contexts (3)c,d, the fricative contrast is neutralized to voiced [ð]. Our analysis makes use of a morphologically sensitive markedness constraint on the coupling of gestures within the consonant. In AP, a distinction can be made between primary and secondary constriction gestures, which together comprise the traditional phonological 'segment' (Gafos, 2002, p. 284; Proctor, 2011; Smith, 2018, pp. 22–24). The primary constriction of a consonant includes its anti-phased target and release gestures (Nam 2007a, 2007b, 2007c). The secondary constriction depends on the consonant's manner of articulation, i.e. a Tongue Body, Velum or Glottis gesture for liquids, nasals, and voiceless obstruents, respectively. We assume secondary constrictions are not split into separate target and release and that they are coupled to the target gesture of the primary constriction.

Given these assumptions, we propose a markedness constraint that penalizes the intra-segmental, in-phase coupling of a secondary Glottis CD [wide] gesture to a primary Tongue Tip gesture at the right edge of a morphological stem, irrespective of the primary gesture's Constriction Degree or Location:

(18) $*GCD_{wide}—TT_{Stem}]$
Assign a violation for every Glottis CD [wide] gesture that is coupled in-phase with a stem-final Tongue Tip gesture.

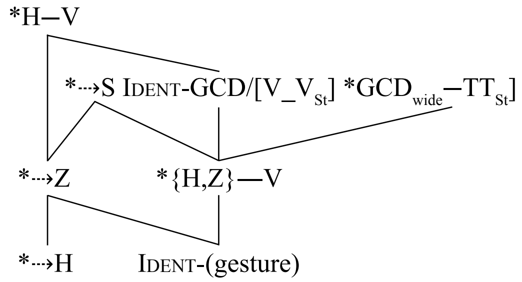
Rather than a universal constraint, (18) can be understood as a phonotactic restriction that is particular to the morphology of CS. As such, the constraint is not automatically projected by learners of other language varieties. In the CS grammar, (18) outranks *{H,Z}—V, thereby optimizing syllable-initial [ð] in stem-final prevocalic contexts. Although few if any words in the native CS lexicon end in /t/, (18) would predict voicing in stem-final prevocalic contexts, e.g. in loanwords or neologisms with final /t/. In phonetic implementation, the resulting output [d] gesture would be realized as a continuant [ð] as the result of gestural undershoot in phrase-medial postvocalic contexts (Parrell, 2011). For plural forms whose corresponding singulars end in a consonant, it must be assumed, *pace* Bermúdez-Otero (2006, 2013), that the /e/ of the final syllable is not a suffixal allomorph of the null stem formative Ø but instead appears outside the stem, either as the result of phonological epenthesis (Colina, 2006; Moyna & Wiltshire, 2001; Wiltshire, 2020, p. 322) or as part of a lexically listed allomorph of the plural suffix (Saporta, 1965, p. 220):

(19) a. $[[\text{með}_{\text{Stem}}]\ \text{eH}_{\text{MWd}}]$
b. $[[[\text{luð}_{\text{Stem}}]\ \text{eɾo}_{\text{Stem}}]_{\text{MWd}}]$

The stem boundary deactivates positional faithfulness and activates (18), which together ensure stem-final intervocalic [ð].

The Hasse diagram in (20) summarizes the complete constraint ranking for CS. Vertical lines connect higher-ranking constraints to the lower-ranking constraints they dominate. Unconnected constraints do not directly conflict.

(20) Constraint ranking for traditional CS



5.3. Typological predictions

An advantage of the OT framework is its ability to generate explicit typological predictions based on the systematic and exhaustive reranking of a given set of constraints. Unlike MS and CS, which both had a phonological contrast between voiced and voiceless anterior coronal fricatives in stem-medial intervocalic position, contemporary Spanish neutralizes this contrast to voiceless. Therefore, we assume that IDENT-GCD/[V_V$_{Stem}$] now ranks below *{H,Z}—V in the phonological grammars of present-day Spanish varieties. To help identify predicted cross-dialectal patterns of allophonic voicing and aspiration in contemporary Spanish, we used OTSoft (Hayes et al., 2013) to compute a factorial typology of coupling constraints (14) but excluding the CS-specific morphologically sensitive constraint (18). From 120 logically possible rankings, only six distinct output patterns emerged, as shown in Table 3.

Different degrees of shading within cells indicate implicational relationships among contexts. Canonical onset S is predicted by all rankings, R1 through R6. If [S] occupies a given cell, then it occupies all cells to the left within the same row. If [Z] appears in derived onsets, then either [Z] (R4) or [H] (R5) appears in canonical codas but not vice versa (cf. R2, R3, R6). If [H] appears in derived onsets, then it also appears in canonical codas (R6) but not vice versa (cf. R3, R5).

Table 3: Factorial typology of coronal fricative voicing and aspiration in present-day Spanish varieties across the contexts of canonical onset, derived onset, and canonical coda (top), as predicted by six different rankings of the coupling constraints (bottom).

	_–V	**V⇢_–V**	**V⇢_**
R1	S	S	S
R2	S	S	**Z**
R3	S	S	**H**
R4	S	**Z**	**Z**
R5	S	**Z**	**H**
R6	S	**H**	**H**

R1	*H–V, *{H,Z}–V, *⇢H, *⇢Z » *⇢S
R2	*H–V, *{H,Z}–V, *⇢H » *⇢S » *⇢Z
R3	*H–V, *{H,Z}–V, *⇢Z » *⇢S » *⇢H
R4	*H–V, *⇢H, *⇢S » *{H,Z}–V, *⇢Z
R5	*H–V, *⇢S » *{H,Z}–V, *⇢Z » *⇢H
R6	*⇢Z, *⇢S » *H–V, *{H,Z}–V, *⇢H

Patterns of voicing and aspiration in contemporary Spanish dialects lend strong empirical support to the factorial typology, in conjunction with gradient articulatory and aerodynamic effects. R1 represents careful speech in normative varieties like NCPS that typically maintain coda [S], with coarticulatory left-edge voicing after a vowel (Sedó et al., 2020) taking place in phonetic implementation. In the same varieties but in casual speech style, the demotion of *⇢Z in R2 can be understood as the phonologization of left-edge coarticulatory voicing in coda position: voicing is sustained from the vowel into [Z] but can be gradiently inhibited before a nasal or lateral and in utterance-final position during phonetic implementation. Coda [Z] is also gradiently devoiced before a voiceless consonant, which accounts for the appearance of left-edge voicing, even in this context.

According to Harris and Kaisse (1999, p. 158), in Buenos Aires Spanish the voiceless coronal fricative aspirates before a consonant but not before a pause, however slight. Aspiration also fails to apply in word-final prevocalic position, where [S] appears instead. For this variety, we argue that R1 generates phonological [S] in all canonical codas and that preconsonantal aspiration arises in the phonetic implementation of coupling graphs that contain S⇢C. Increased overlap between the primary constriction gestures of the adjacent consonants prevents the oral pressure build-up that is necessary for generating oral turbulence (Solé, 2010). The result is a percept of glottal frication [H] in output speech. R3 predicts the existence of a related pattern in which [H] appears before a pause or a consonant, as in CS (3)a,c,e,f, but only [S] appears in canonical and derived onsets, which differs from CS (cf. the [θ]–[ð] contrast (2)a–d and the neutralization to [ð] (3)a–d).

Chappell and García (2017) distinguish between two disparate voicing processes targeting intervocalic coronal fricatives in contemporary Spanish. As they document in Costa Rican Spanish, one type of voicing is phonetically gradient, variable, and favored in—but not limited to—word-final position, as in spontaneous NCPS (see Section 3 above), for which they endorse an overlap account in AP. We interpret the higher frequency of gradient intervocalic voicing in word-final position as further empirical evidence of an ambisyllabic, competitively coupled split-gesture representation (9), in combination with the voiceless [S] that R1 and R2 predict for derived onsets. The shorter the duration of [S], the greater the likelihood of gradient coarticulatory voicing from the surrounding vowels.

The other type of intervocalic voicing identified by Chappell and García (2017) is phonological, applying categorically in word-final position. The phonological voicing process is geographically limited to highland Ecuador (Lipski, 1989, 2021, pp. 267–271; Robinson, 2012). Strycharczuk et al. (2014) show that in Quito Spanish, some speakers fully voice the coronal fricative in word-final prevocalic position, even in slow speech, but not in stem-final position, e.g. *ga*[Z] *acre* 'acrid gas' vs. *ga*[S]*ita* 'gauze (diminutive)'. We argue that R4 predicts categorically voiced [Z] in *quiteño* codas and derived onsets. In phonetic implementation, gradient devoicing occurs before voiceless consonants and utterance-finally, while word-final [Z] remains fully voiced between vowels and even before hesitation pauses (Lipski, 1989, p. 54; Robinson, 2012, p. 129), where subglottal pressure is abruptly truncated instead of dropping gradually like it naturally does in true utterance-final position. As revealed by experimental manipulations of speech rate, some of the participants in Strycharczuk et al.'s (2014) study instead show the gradient voicing pattern, which in our view suggests interspeaker variation between R2 and R4 in Quito Spanish.

In a classic quantitative phonetic study of coronal fricative weakening throughout the Argentinian province of Misiones, some 500 miles northeast of Buenos Aires, Sanicky (1984) documents variation in voicing and aspiration. Even when the fricative does not aspirate, it still undergoes voicing before a following voiced consonant or word-initial vowel, e.g. *lamentamo*[Z] *de* 'we are sorry for', *sobrino*[Z] *en* 'nephews on'. According to Sanicky's description, when aspiration does apply, only voiced [ɦ] appears before a voiced consonant or vowel, e.g. *e*[ɦ] *de* '(s)he/it is from', *pasamo*[ɦ] *acá* 'let's go here'. Before a voiceless consonant, [ɦ] varies with [h], although the voiced allophone is more frequent, e.g. *pesca* [péɦka ~ péhka] 'fishing'. Unlike in Buenos Aires, the coronal fricative is most frequently deleted in prepausal position. The variation attested in Misiones Spanish plausibly stems from variability among

R4, R5, and R6, combined with coarticulatory and aerodynamic effects in phonetic implementation giving rise to the variable, contextual voicing of the glottal aspiration and its apparent deletion in utterance-final position.

Lastly, R6 represents a number of Andalusian and Caribbean varieties (Colina, 2021, p. 364), as well as Río Negro Argentinian Spanish (Kaisse, 1999, pp. 204), spoken approximately 620 miles southwest of Buenos Aires. In these dialects, aspiration applies in canonical codas and between vowels in word-final, but not stem-final, position, e.g. *me*[H] *austero* 'austere month' vs. *me*[S]*es* 'months'.

5.4. Theoretical comparisons

Our OT account avoids several drawbacks of a derivational rule-based analysis of CS. First, we assume an entirely monostratal phonological component, requiring only a single mapping from an input utterance. The grammar evaluates output candidates to select from a set of plausible competitors what is the optimal intergestural coupling graph, which is then phonetically implemented, potentially giving rise to further gradient changes. A rule-based approach with lexical cycles, lexical vs. post-lexical levels, and extrinsic rule ordering, as in (4) and (5), necessarily generates abstract intermediate forms that never surface as such. Second, Hualde (1991) treats stem-final voicing as a case of overapplication opacity, requiring COV to target voiceless coronal codas *before* they become onsets later in the derivation. Our approach renders the alternation fully transparent. Since it does not specify any coupling relation between the voiceless coronal and an adjacent vowel, the morphologically sensitive markedness constraint (18) is able to rule out voiceless coronals in stem-final prevocalic contexts. Finally, parallel evaluation in OT avoids the circuitous derivation in (4), in which coronal obstruents in the syllable rhyme are first voiced by COV in the lexical phonology, only to be devoiced later in the postlexical phonology by Final Devoicing, followed by an optional rule of utterance-final glottal fricative deletion. In our analysis, devoicing and variable deletion of utterance-final [H] fall out naturally as gradient effects in phonetic implementation.

The gestural coupling constraints we propose in (14) find parallels in previous OT markedness constraints that penalize the association of segments to syllable positions. For example, *⇢S (14)c can be understood as similar to a markedness constraint like *Coda/s (Colina, 2009, p. 78) but translated into AP's coupled oscillator model, in which a coda consonant gesture is coupled anti-phase with a preceding vowel or, in the second position of a complex coda, with the postvocalic consonant. The syllable theory analogue that comes closest to our analysis of CS is Lipski's (1999) use of ambisyllabicity to account for phonologically opaque word-final aspiration in Andalusian, Caribbean, and Río Negro Argentinian Spanish (pattern R6 in Table 3). In his analysis, word-final prevocalic consonants are treated as ambisyllabic, and the ranking of the syllable-based markedness constraints $*_\sigma[$h and $*$s$]_\sigma$ determines whether "a particular dialect finds (partially) syllable-final [s] or (partially) syllable-initial [h] least tolerable" (p. 209). Since ambisyllabic derived onsets do not completely separate from the rhyme, aspiration in word-final prevocalic position is rendered fully transparent by Lipski's account. Building on his approach, our analysis recasts $*_\sigma[$h and $*$s$]_\sigma$ as intergestural coupling constraints and further embeds them within a more complete constraint set in (14) that includes the alternation with voiced coronal fricatives.

Re-envisioning incomplete resyllabification in terms of ambisyllabic, competitive gestural coupling makes it possible not only to predict the phonetic shortening of derived onset /s̺/ in NCPS but also to minimize the amount of abstract phonological computation needed to model interactions among voicing, aspiration and resyllabification in CS and other varieties of contemporary Spanish. Extensions to the monostratal, parallel architecture of classic OT, such as output-output faithfulness (Baković, 1998; Colina, 1997, 2002, 2006, 2009), Stratal OT (Bradley, 2005a, 2007; Bradley & Delforge, 2006; Broś, 2018, 2020; Kaisse & McMahon, 2011), or Harmonic Serialism (Torres-Tamarit, 2014), turn out to be unnecessary to account for opaque voicing and/or aspiration of word-final prevocalic coronal fricatives across Spanish varieties.

6. RHOTIC NEUTRALIZATION IN DERIVED ONSETS

The patterning of word- and prefix-final prevocalic rhotic consonants in Spanish seems to provide further evidence that resyllabification must be complete. To indicate syllable boundaries, we add periods to the following examples, which are drawn from Hualde's (2014, pp. 181–185) description of NCPS:

(21)	a.	[ká.ɾo]	'expensive, dear'
		[ká.ro]	'car'
	b.	[dáɾ~dár]	'to give'
	c.	[dá.ró.kas̺]	's/he gives rocks'
	d.	[eks̺.tɾa.rá.pi.ðo]	'extra-fast'
	e.	[dá.ɾó.kas̺]	'to give geese'
	f.	[s̺u.pe.ɾá.βi.ðo]	'super-eager'

There is a phonological contrast between an apicoalveolar tap /ɾ/ and trill /r/ in stem-medial intervocalic position, where both rhotics syllabify as single onsets, e.g. *caro* vs. *carro* (21)a. In the syllable rhyme, neutralization results in non-contrastive variation between the tap and trill, e.g. *dar* (21)b. Outside of the stem-medial context, the pronunciation of an intervocalic rhotic signals its morphological affiliation. For example, the trill is necessarily word-initial in the two-word phrase *da rocas* (21)c and stem-initial in the prefixed form *extra-rápido* (21)d, while the tap is necessarily word-final in *dar ocas* (21)e and prefix-final in *super-ávido* (21)f.

In a foundational rule-based account of Spanish rhotics, Harris (1983, 2001, 2002) argues that the stem-medial intervocalic contrast in (21)a is represented phonologically as a difference between a singleton /ɾ/ and its geminate counterpart /ɾɾ/. A lexical rule strengthens onset /ɾ/ to a trill [r] after a consonant in the preceding syllable rhyme (e.g. *honra* 'honor', *alrededor* 'around', *Israel* 'Israel') and is followed by a postlexical rule of coda /ɾ/-deletion before [r]. Together, these two rules derive an intervocalic singleton onset trill from the underlying stem-medial geminate /ɾɾ/, e.g. /kaɾɾo/ → káɾ.ɾo → káɾ.ro → [ká.ro]. On the other hand, strengthening in the syllable rhyme (21)b is an optional rule of emphatic speech, which Harris assigns to the postlexical phonology, ordered to apply after resyllabification. In addition to the rule of postconsonantal strengthening mentioned above, the analysis requires a separate rule of stem-initial /ɾ/ strengthening to account for the contexts in (21)c,d. For Hualde (1989, p. 824), stem-initial strengthening is an obligatory, early cyclic rule of the lexical phonology.

The crucial argument for complete resyllabification comes from the contexts in (21)e,f. Harris's ordering of optional rhyme strengthening after postlexical resyllabification explains the prohibition against prevocalic [r] at the right edge of a word or prefix. At the point in the derivation when emphatic strengthening could apply, the taps in question are no longer in the syllable rhyme, having already resyllabified into the following onset. Because emphatic strengthening could still apply if such taps were to maintain their lexical affiliation to the preceding rhyme, resyllabification must be assumed to be complete.

Bradley's (2020) monostratal OT account of the NCPS rhotic distribution turns out to be entirely compatible with an ambisyllabic representation of incomplete resyllabification. The analysis uses a perceptually-based markedness constraint on consonant duration contrast and two markedness constraints on the in-phase coupling of tap and trill gestures with a following vowel. Grounded in previous work on rhotics in Spanish (Bradley, 2005b, 2006b) and Catalan (Padgett, 2009) within the constraint-based Dispersion Theory of Contrast (Flemming, 2004), (22) rules out a surface contrast between the relatively shorter tap [ɾ] and the relatively longer trill [r] in any position that is not stem-medial intervocalic:

(22) Space-Dur/[V_V $_{\text{Stem}}$]
For every potential minimal pair based on duration, assign a violation if the consonants occupy less perceptual space than they do in the context *between two vowels belonging to the same morphological stem.*

Bradley (2020, p. 247) initially relativized this constraint to the prosodic word domain. In keeping with the positional faithfulness constraint (13)a, the updated constraint (22) is relativized to the morphological stem domain. The definition is functionally motivated by Dmitrieva's (2018) experimentally supported claim that differences in consonant duration are easiest to hear in the context of two surrounding vowels.

The analysis requires only two markedness constraints on in-phase coupling:

(23) a. *[ɾ—V $_{\text{Stem}}$]
b. *r—V

(23)a is violated whenever [ɾ] and a following vowel are coupled exclusively in-phase while belonging to the same morphological stem domain.[5] (23)b is more general, penalizing the in-phase coupling of [r] with a following vowel in any morphological context.

Tableau (24) gives an analysis of rhotic contrast and neutralization across six contexts:

(24)			Space-Dur/[V_V $_{\text{St}}$]	Ident-(gesture)	*[ɾ—V $_{\text{St}}$]	*r—V
	/VɾV$_1$	VrV$_2$/				
☞ a.	V ɾ—V$_1$	V r—V$_2$			*	*
b.	V ɾ—V$_{1,2}$			*!	*	
c.		V r—V$_{1,2}$		*!		*
	/Vɾ$_1$	Vr$_2$/				
d.	V⇢ɾ$_1$	V⇢r$_2$	*!			
☞ e.	V⇢ɾ$_{1,2}$			*		
☞ f.		V⇢r$_{1,2}$		*		
	/V#ɾV$_1$	V#rV$_2$/				
g.	V ɾ—V$_1$	V r—V$_2$	*!		*	*
h.	V ɾ—V$_{1,2}$			*	*!	
☞ i.		V r—V$_{1,2}$		*		*
	/V+ɾV$_1$	V+rV$_2$/				
j.	V ɾ—V$_1$	V r—V$_2$	*!		*	*
k.	V ɾ—V$_{1,2}$			*	*!	
☞ l.		V r—V$_{1,2}$		*		*
	/Vɾ#V$_1$	Vr#V$_2$/				
m.	V⇢ɾ—V$_1$	V⇢r—V$_2$	*!			*
☞ n.	V⇢ɾ—V$_{1,2}$			*		
o.		V⇢r—V$_{1,2}$		*		*!
	/Vɾ+V$_1$	Vr+V$_2$/				
p.	V ɾ—V$_1$	V r—V$_2$	*!			*
☞ q.	V ɾ—V$_{1,2}$			*		
r.		V r—V$_{1,2}$		*		*!

Within each context, the input contains two highly idealized words or phrases, each tagged with its own

[5] (23)a is inactive on /CɾV/ demisyllables because the in-phase ɾ—V coupling is not *exclusive* but, instead, *competitive* with the in-phase C—V coupling. For further discussion of complex onsets and syllable-initial postpausal and postconsonantal contexts, which are not treated here, see Bradley (2020, pp. 243–249).

subscript. These shapes stand in for actual words or phrases from the language's lexicon but also represent phonological contexts in loanwords or neologisms. The analysis systematically considers three output candidates: (i) contrast between the tap and trill, (ii) neutralization to the tap, and (iii) neutralization to the trill. Combined subscripts indicate neutralization, or the merger of two words or phrases in the output. The ranking of IDENT-(gesture) above the constraints on intergestural coupling predicts a tap/trill contrast in stem-medial intervocalic position (24)a, which corresponds to the existing minimal pair in (21)a, among others. Attempting a tap/trill contrast in any other context fatally violates perceptual spacing, as seen in (24)d,g,j,m,p. In each case, the two remaining neutralization candidates are tied on their faithfulness violations, which passes the decision down to the lower-ranking gestural coupling constraints. Since they refer specifically to in-phase coupling, *[ɾ—V $_{\text{Stem}}$] and *r—V are inactive on rhotics that are coupled only anti-phase with a preceding vowel. The analysis predicts free variation between co-optimal (24)e,f, which corresponds to the non-contrastive variation observed in (21)b. Further gradient weakening can occur in the phonetic implementation of [ɾ] and [r] in this and other contexts (see Bradley, 2020, pp. 251–253).

To understand the evaluation of candidates (24)g–r, it helps to consider the morphological representations of examples (21)c–f:

(25)	a.	[da $_{\text{MWd}}$] [[roka] $_{\text{Stem}}$] s̺ $_{\text{MWd}}$]	= (21)c
	b.	[eks̺tɾa [rapiðo $_{\text{Stem}}$] $_{\text{MWd}}$]	= (21)d
	c.	[daɾ $_{\text{MWd}}$] [[oka] $_{\text{Stem}}$] s̺ $_{\text{MWd}}$]	= (21)e
	d.	[s̺upeɾ [aβiðo $_{\text{Stem}}$] $_{\text{MWd}}$]	= (21)f

The ranking of *[ɾ—V $_{\text{Stem}}$] above *r—V eliminates candidates (24)h,k, in which [ɾ] and the following vowel are coupled in-phase while belonging to the same morphological stem. Because their violations of lower-ranking *r—V are tolerated, candidates (24)i,l emerge as optimal, predicting neutralization to stem-initial [r] in (25)a,b. Although intervocalic word-/prefix-final [ɾ] is coupled in-phase with a following vowel, this vowel does not belong to the same morphological stem as the rhotic. Therefore, *[ɾ—V $_{\text{Stem}}$] is inactive on syllable-initial [ɾ] in both word-final (24)m,n and prefix-final (24)p,q contexts. Because they satisfy the only remaining constraint in the hierarchy *r—V, candidates (24)n,q emerge as optimal, predicting neutralization to [ɾ] in (25)c,d.

Bradley (2020, pp. 246–251) originally relativized *[ɾ—V $_{\text{Stem}}$] to the morphological word domain. However, the constraint *[ɾ—V $_{\text{MWd}}$] incorrectly excludes syllable-initial [ɾ] from the context in (25)d because the rhotic and the following vowel still belong to the same MWd domain, thereby overgenerating **supe*[r]-*ávido*. Relativized instead to the morphological stem, *[ɾ—V $_{\text{Stem}}$] becomes inactive in prefix-final prevocalic contexts, which correctly allows *r—V to favor syllable-initial [ɾ], as shown in (24)q.

Another piece of evidence that the morphological stem is the correct domain of *[ɾ—V $_{\text{Stem}}$] comes from plural forms of rhotic-final singular nominals. An apparent restriction in the morphology of NCPS is that the nominal class of Ø-stems does not include roots that end in a trill /r/. Harris (1969, p. 51, 1983, p. 69, 2002, p. 96) interprets the lack of singular-plural alternations, e.g. *flo*[ɾ] ~ **flo*[r]*es* 'flower ~ flowers' as evidence that a root-final trill is an underlying geminate tap /ɾɾ/. A final /e/ allows the geminate in /toɾɾe/ *torre* 'tower', as well as the root-final cluster in /kaɾne/ *carne* 'meat', to be properly syllabified. However, Baković (2009, p. 9) counters that positing a geminate interpretation is no better motivated than defining the relevant stems in terms of permissible final consonants. Other singleton consonants like /t/ must be excluded from this set, e.g. /bote/ *bote* 'boat' vs. */bot/, and a singleton trill /r/ would need to be excluded as well. An explanation for this morphological gap falls out naturally from our analysis, without the need to assume a geminate tap /ɾɾ/ in a language that otherwise lacks true geminate consonants. In line with (19)a, we postulate [[floɾ $_{\text{Stem}}$] es̺ $_{\text{MWd}}$] as the morphological representation of the plural form *flores,* which allows us to invoke the same analysis that accounts for prefix-final prevocalic rhotics. Because the surrounding vowels do not belong to the same stem, the perceptual spacing constraint prevents a tap/trill contrast and forces neutralization. Because the /e/ of the plural suffix does not belong to the same stem as the rhotic, *[ɾ—V $_{\text{Stem}}$] becomes irrelevant, thereby allowing *r—V to eliminate the trill in favor of the tap in the syllable onset, as in prefix-final prevocalic position (24)q.

Crucially, our analysis is able to ensure neutralization to morpheme-final prevocalic [ɾ] independently of how the rhotic is actually syllabified. Whether the rhotic is coupled ambisyllabically with both surrounding vowels (24)n or coupled only in-phase with the following vowel (24)q, it is the presence of a morphological stem boundary that crucially triggers a violation of SPACE-DUR/[V_V $_{\text{Stem}}$] and also renders *[ɾ—V $_{\text{Stem}}$] inactive. Alternative accounts of optional emphatic strengthening posit a rule (Harris, 1983, 2001, 2002) or markedness constraint (Colina, 2009, 2010; Roca, 2005) targeting individual rhotics in the syllable rhyme. Because it uses only in-phase coupling constraints *[ɾ—V $_{\text{Stem}}$] and *r—V, our analysis does not have to worry about overgenerating a trill [r] when coupled anti-phase with a preceding vowel in ambisyllabic environments. Derived onset rhotics can be ambisyllabic (24)n, as long as gestural coupling constraints target only the in-phase coupling of a rhotic with a following vowel.

7. CONCLUSION

The main goal of this article has been to reconcile two opposing claims about the status of resyllabification in the Spanish phonology literature. On the one hand, a classic generative analysis of coronal fricative lenition in CS has long provided a compelling theoretical argument in favor of complete resyllabification (Section 2). On the other hand, recent experimental studies of NCPS have uncovered gradient phonetic differences in voicing and duration between derived and canonical onset /s̬/ (Section 3), which suggests that, at least for some speakers in laboratory speech, the structural difference between the two categories is incompletely neutralized. An explanatory phonological representation of the difference has remained elusive, until now.

Our approach to resolving these contradictory findings has been to start with insights from studies based on computational articulatory simulations (Section 4.1), which led us to propose a novel, competitively coupled split-gesture representation of ambisyllabic consonant shortening in AP (Section 4.2). We then showed how such a phonetically-based representation predicts the behavior of derived onset /s̬/ in NCPS and, with minimal changes in dynamical couplings, is further supported by Burroni's (2022) TaDA simulations of the opposite phenomenon of ambisyllabic lengthening in Italo-Romance and Standard Italian (Section 4.3). Ambisyllabic gestural coupling then provided a simpler approach to coronal fricative weakening in CS and other varieties of contemporary Spanish, couched within monostratal, parallel OT, without ordered levels or strata, intermediate forms, or output-output faithfulness (Section 5).

As we demonstrated in Section 6, it is no longer necessary to assume complete resyllabification of prefix- and word-final prevocalic consonants in order to account for obligatory neutralization to [ɾ] in these contexts, *pace* Harris (1983, 2001, 2002). Henceforth, this pattern can be better understood as supporting our claim that in Spanish phonology, a perceptually-based markedness constraint restricts the rhotic duration contrast to stem-medial intervocalic position and that *there is no rule or markedness constraint targeting individual taps or trills in the syllable rhyme.* Both the aspiration of coda obstruents in CS and the emphatic strengthening of coda /ɾ/ in NCPS are compatible with incomplete resyllabification, represented as ambisyllabic gestural coupling, which in turn supports our definition of markedness constraints (14) and (23) on intergestural coupling.

The present study invites further laboratory and theoretical research. The mathematical implications of ambisyllabic competitive coupling for the shorter duration of the oral constriction of derived onsets in NCPS still need to be verified by explicit computational modeling in TaDA, following Burroni's (2022) account of Italo-Romance. There is also a need for phonetic studies of resyllabification in varieties other than NCPS, using different consonants and experimental methodologies.[6] Finally, more work within the grammatical architecture employed here is necessary to explore the implications of ambisyllabic coupling for modeling other well-known segmental coda alternations of Spanish phonology, e.g. nasal velarization and liquid vocalization, and in a wider range of morphophonological contexts, i.e. prefixation and compounding.

Our analysis further supports a grammatical approach to the phonetics-phonology interface that does not require any transduction of distinctive features into articulatory gestures (Bradley, 2020; Smith, 2018; Walker & Proctor, 2019). Rather, the intergestural coupling graph of an utterance is phonologically optimized by OT constraint interaction and then phonetically implemented, where gestural overlap and reduction and universal aerodynamic principles further shape the speech output. In terms of the architecture of the grammar, phonology and phonetics are derivationally ordered components, but they nonetheless operate on the same representational primitives, namely intergestural coupling graphs.

[6] Initial work along these lines, with speakers of Latin American Spanish, has been presented by Beristain (2021), based on nasal airflow data, and Repiso-Puigdelliura (2021), based on acoustic duration measurements with a range of word-final coronal consonants. Using a lexical decision experiment, Lahoz-Bengoechea and Jiménez-Bravo (2021) found that NCPS listeners can perceptually distinguish between canonical and derived onset /s̬/ and /n/ (but not /l/) based on gradient, synthetically manipulated differences in consonant duration. Lahoz-Bengoechea and Jiménez-Bravo also describe derived onsets as ambisyllabic, but they do not discuss Nam's split-gesture hypothesis nor the link between competitive coupling and temporal compression, as predicted by our representation in (9).

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