

Syllable contact effects as a diachronic precursor to mora licensing in early French /sC/ clusters

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Abstract

This paper proposes that Old French coda /s/ deletion (11th-13th centuries) forms part of a broader diachronic progression of ever-stricter requirements on the sonority contour of /sC/ clusters in syllable contact, reframing part of a well-known moraic analysis (Gess 1998a, 1999, and later work) of Old French coda loss phenomena. Given the multistage rollout of coda /s/ deletion as a function of the sonority of the following onset, an approach hinging on syllable contact constraints not only offers a more detailed and precise formalization of the diachrony of word-medial /sC/ in Old French, but also draws systemic connections with cognate processes affecting /sC/ clusters in early French such as prothesis and earlier Proto-French stop epenthesis. The Optimality-Theoretic analysis presented here formalizes these phenomenological links and the constraints on syllable-contact sonority using the Split Margin Approach to the Syllable (Baertsch 2002, Baertsch & Davis 2003). Rather than sonority-graded

mora-licensing constraints causing Old French coda /s/ deletion, the present account argues that their ranking above FAITH is instead the acquisitional outcome of the near-total absence of coda /s/ across the lexicon, as a culminative result of the progressive tightening of syllable contact requirements.

Keywords: Old French, /sC/ clusters, syllable contact, historical phonology, coda deletion.

1. Introduction

This paper aims to provide a more extensive diachronic and phenomenological context to the well-known process of coda /s/ deletion in the Old French (OF) period (10th-13th centuries), a process whose end result is the near-total loss of /s/ in word-internal syllable-final position with accompanying compensatory lengthening of the preceding vowel (Pope 1952; Gess 1998a, 1999, 2012). While some diversity of accounts exists, including pre-generative documentation of observed sound changes within the philological traditions (Nyrop 1914; Pope 1952; Bourciez 1955, and others), generative and optimality-theoretic analyses first cite alignment constraints (Jacobs 1995; Gess 1996) and graduate to a sonority-graded moraic account (Gess 1998a; 1999; 2012), highlighting the insufficient sonority of /s/ to occupy the syllable coda, despite these distinctively turbulent obstruents surviving in this prosodic position where other coda obstruents had already been banned (Jacobs 1995) over the course of the earlier Proto-French (PF) period (2nd-9th centuries). While these studies rightly identify the eventual loss of /s/ from coda position by the end of OF as sonority-based, in this paper I argue that the diachronic evolution of these clusters in broader early French diachrony is best understood as the culmination of syllable contact effects, with the eventual ban on coda /s/ instead resulting from incrementally stricter constraints on what constitutes a harmonic sonority slope across the syllable juncture between coda /s/ and the onset of the following syllable. The analysis presented here focuses on Francien dialect, the progenitor of contemporary hexagonal French.

As will be presented below, the phonological repair of /s/-initial syllable-contact clusters (henceforth SCCs) extends further back than OF in early French diachrony, with several interrelated processes, including multi-stage OF coda /s/ deletion, representing distinct surface manifestations of a single progressive tightening of the phonological system's constraints on syllable contact sonority contours. Rather than argue for the abandonment of the sonority-based mora-licensing account of coda /s/ deletion proposed by Gess (1998a, 1999), this paper instead reframes the moraic restriction as the compound effect of several earlier syllable-contact phenomena whose end result comes to be reanalyzed during acquisition as a total ban on coda or moraic sibilants. The analysis presented here thus further contextualizes coda /s/ deletion diachronically while bearing implications for related synchronic phenomena such as the prothesis of word-initial /sC/ clusters.

2. Uncovering the syllable contact precursors to OF mora-licensing

Bringing to bear compelling historical evidence including loanword data, orthographic practices, and rhyme segregation in poetry, while highlighting shortcomings in other proposed chronologies, Gess (1999) argues for a sonority-graded dating of OF coda loss phenomena, with coda /s/ deleting first chronologically, followed by a staggered diachronic progression to coda nasal deletion, coda /l/ vocalization and, in some dialects, coda /r/ deletion, as in (1):

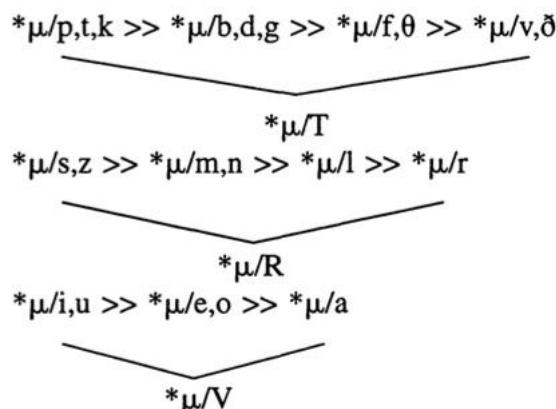
(1) OF coda loss phenomena (Gess 1999)

Syllable-final consonant loss in OF			
	Before	After	Gloss
a. <i>blasmer</i>	blazmer	bla:mer	“to blame”
b. <i>angle</i>	ãglə	ã:głə	“angle”
c. <i>albe</i>	a:bə	awbə	“dawn”
d. <i>large</i>	lɑ:dʒə	la:dʒə	“wide”

In keeping with his (1998a) analysis, ever-stricter mora-licensing constraints outrank FAITH (PARSEFEATURES), with the principle of minimal violation giving rise to the preservation of some underlying features of deleted codas such as [+nasal] or [+back] for velar /l/ vocalization to [w]. Gess accounts for compensatory lengthening by appealing to a BIMORAICITY constraint giving preference to a syllable being bimoraic in OF. A brief summary of the analysis is presented below in (2):

(2) Mora-licensing analysis of OF coda loss:

a. Relative hierarchy of mora-licensing constraints¹



Source: Gess 1998a

¹ Gess (1998a) encapsulates the more granular sonority-graded mora-licensing constraints shown in (2a) into *μ/T, *μ/R, and *μ/V for expositional purposes, where T = obstruents and fricatives minus s,z; R = sonorants plus s,z; and V = vowels.

b. Constraint ranking for OF coda loss (adapted from Gess 1998a)

- i. *Early OF*: BIMORAICITY ($\sigma=\mu\mu$) » PARSEFEATURES » * μ/R
- ii. *Later OF*: BIMORAICITY ($\sigma=\mu\mu$), * μ/R » PARSEFEATURES » ...



c. Sample tableau for coda /N/ deletion with compensatory lengthening

/anta/	$\sigma=[\mu\mu]$	* μ/R	PARSEFeatures
(a)		*!	
(b)		*!	
(c)		*!	
(d)			*

Source: Gess 1998a

As concerns OF coda /s/ deletion, to which this paper limits itself for the most part, there are diachronic and phonological details that are left unexplained by a purely moraic analysis such as this one. First, the impermissibility of a mora dominating a sibilant, as in the * $\mu/s,z$ constraint, does not align with the well-established chronology of coda /s/ deletion, long documented in the philological tradition (e.g. Pope 1952 and others) and cited by Gess (1999), by which the process occurred in (at least) two stages: the first began around the 11th century and completed by the 13th century, with [z] deleting before [l], a nasal consonant (/N/) or a voiced obstruent (henceforth, /O⁺/), and the second stage completed during the 13th century with the loss of [s] before voiceless obstruents (henceforth /O⁻/). Illustrative examples are presented in (3):

(3) Two stages of OF coda /s/ deletion (11th-13th centuries) (Pope 1952: 151, cited in Gess 1999; Montaño, *in press*) (^o = reconstructed form)

a. Stage 1: Loss of word-internal coda /s/ ([z]) before /l/, /N/, and voiced obstruents (11th and 12th centuries)

<u>Latin</u> (>PF)	<u>earlier OF</u>	<u>OF</u>	<u>Gloss</u>
i. insula(m) > ^o isola >	isle [iz.lə]	> [i:.lə]	'island'
ii. hispidu(m) >	hisde [iz.də]	> [i:.də]	'horror'

iii. *blastem-are	> <i>blasm-er</i> [blaz.mer]	> [bla:.mer]	'accuse-INF'
iv. miscul-are	> <i>mesl-er</i> [mez.ler]	> [me:.ler]	'mix-INF'

b. Stage 2: Loss of word-internal coda [s] before voiceless obstruents (mid-13th century)

<u>Latin</u>	<u>earlier OF</u>	<u>Later OF</u>	<u>Gloss</u>
i. festa(m)	> <i>feste</i> [fes.tə]	> [fe:.tə]	'feast'
ii. noster	> <i>nostre</i> [nɔs.trə]	> [nɔ:.trə]	'our.POSS.1PL'
iii. *spons-are	> <i>espos-er</i> [es.po.zer]	> [e.pu.zer]	'wed-INF'
iv. *frisca(m)	> <i>fresch-e</i> [fres.tʃə]	> [fre:.ʃə]	'fresh-F.SG'
v. *(e)skutarju(m)	> <i>escu(d)ier</i> [es.ky.(ð)i.er]	> [e.ky.jer]	'squire'

Several issues arise for the moraic analysis of OF coda /s/ deletion upon more detailed inspection of the data. The first concerns the compensatory lengthening effect on the preceding vowel. Why, for example, did lengthening not occur in words such as in (3b,iii) and (3b,v), in which the /s/-obstruent cluster is preceded by a vowel resulting from prothesis, which allowed the syllabification of a potential word-initial /sC/ cluster? As observed by Montaño (*in press*), if the moraic analysis claims that /s/ deletes because it would otherwise syllabify into a moraic position, the lack of vowel lengthening is left unexplained as this constitutes a context no different from other coda /s/ deletion examples that exhibit lengthening. The gap does not find obvious explanation by restricting BIMORACITY to stressed position (e.g. STRESS-TO-WEIGHT), as numerous examples of atonic lengthening upon /s/ deletion exist in the lexicon, not only in obvious polymorphemes such as *blasm-er* and *mesl-er* in (3a,iii-iv) but also in what are likely monomorphemes, such as *ostel* [ɔ:.'tel] 'lodging', *gastel* [ga:.'tel] 'cake', *chastel* [tʃa:.'tel] 'castle', the stem of *chasti-er* [tʃa:.ti.er] 'punish-INF', and others (*TLFi*).

The diachrony of prothesis raises further questions for the moraic analysis. From Late Latin through OF, /s/ is unique in its ability to precede stops (e.g. Latin *sponsa* > OF (*e*)*spuse* 'wife' [Pope 1952: 151]), nasals (*Smyrna* > 1st century Late Latin inscription *Ismurna* 'town of Smyrna' [Sampson 2010: 56]) and other obstruent-liquid onset clusters (Latin *scripta* > Late Latin *iscripta* 'writings' [Pope 1952: 145]) word-initially. Widely attested cross-linguistically beyond Latin and early French, this privileged positional capacity of /s/ likely derives from the acoustic advantages of fricatives', and especially sibilants', "intensity of frication noise...making sibilants particularly easy to recover as a group" and the "offset frequency of the fricative spectrum in fricative + stop clusters [which] serves as a cue to place of articulation of a following stop" (Wright 2004: 38), with word-initial /s/ preceding an onset consonant typically formalized phonologically as an adjunct to the syllable or word (Sampson 2010: 45-46). In Late Latin, a prosthetic vowel appears before these sequences as early as the first century, inserted postlexically when word-initial /sC/ was not preceded by a vowel-final word (Pope 1952; Sampson 2010) as in (4a), a pattern continuing into earlier OF. Over the course of the 12th century, overlapping chronologically with coda /s/ deletion, the prosthetic vowel became a fixed element of these words (Pope 1952), as in (4b), suggesting the process was now occurring at the lexical level, with the vowel presumably stabilizing into the underlying form shortly thereafter. In (4), the interaction with pre-vocalic elision of determiners is indicative of the status of

prothesis as a postlexical (4a) or lexical (4b) process, depending on whether the final vowel of the preceding determiner is visible to the process within its domain of application:

(4) Behavior of OF word-initial /sC/ in sandhi contexts (examples from Pope 1952: 217)

a. 11th century: No prothesis after a vowel-final word, and no determiner elision (postlexical prothesis)

La Vie de Saint-Alexis (11th century):

ta spuse (53) ‘your wife’

la spuse (102, 147) ‘the wife’

b. 12th century: Prothesis regardless of preceding vowel-final determiner, resulting in determiner elision (lexical prothesis)

Chanson de Roland (12th century):

s’espee (← *sa + (e)spee*) (346) ‘his sword’

l’espee (← *la + (e)spee*) (443) ‘the sword’

l’estandard (← *le + (e)standart*) (3267) ‘the banner’

One conclusion might be that the prothetic vowel had become underlying shortly after it became a fixed element in surface forms. But once coda /s/ must delete, lengthening would be expected under the moraic analysis if the prothetic vowel were underlying and not a mere insertion, as the deletion of /s/ in these words would be no different from other word-internal /s/ deletions; in a related moraic perspective, if mora preservation underlies compensatory lengthening, /s/ deletion in such words would indeed be occurring in a moraic position, and thus a long vowel is to be expected, then, too. On the other hand, if the vowel was not yet underlying, abstract as such a claim may be, given the stability of the prothetic vowel in surface forms, then /s/ would not underlyingly be in position to be moraic, and thus would not readily be a target for deletion due to a violation of the mora-licensing constraint; word-initial /s/ could simply delete without prothesis, presumably, incurring fewer FAITH violations, and still evade a violation of constraints targeting /s/ in this position.²

An additional question that arises under the moraic analysis, given the two-stage diachrony of coda /s/ deletion, is whether a constraint such as ${}^*\mu/s,z$ can

² A third alternative (I thank an anonymous reviewer for encouraging the consideration of this possibility) is that the prothetic vowel was not yet underlying, but still visible to coda /s/ deletion, giving it a distinct intermediate status from true underlying vowels. For example, in a multi-tier phonology, prothesis could affect the input-initial /sC/ cluster in a lower phonological tier, followed by coda /s/ deletion either in a later serial phase, or in cyclical application at each tier of the input-output mapping. While plausible, such an account still must explain why no compensatory lengthening is exhibited on the preceding vowel, despite lengthening attested in atonic syllables elsewhere in OF, as shown in (3) and discussed above, an issue not faced by the analysis presented here. Finally, as far as the intersection of prothesis and coda /s/ deletion is concerned, this hypothetical multi-tier analysis may be less desirable also for considerations of analytical economy, as the analysis in the present study can accomplish this in a single-tier, parallel phonology. I therefore leave the further exploration of this alternative as a path for future inquiry.

differentiate between the acceptability of surface [z] and [s] as targets for licensing a syllable-final mora. While the constraint could be conceived of as two separate constraints (${}^*\mu/z$ and ${}^*\mu/s$), the historical ordering of sibilant deletion runs contrary to the expected sonority relation between voiced and voiceless counterparts within a sonority class (cf. Gouskova 2004; Pons-Moll 2011), with the former being more sonorous than the latter. If so, and if coda loss occurred in a progression from least sonorous (coda obstruents in PF) to most sonorous (coda /r/ in some dialects), one would expect coda /z/ to have deleted after coda /s/, but the opposite diachronic ordering is instead attested.

A final issue lies in the fact that [z] and [s] were most likely allophones of one another in coda position, as their surface voicing is totally predictable and conditioned by the [±voice] feature of the following segment. If [z] and [s] in (3a) and (3b) are instead all /s/ (or underspecified /S/) underlyingly, more than a single lexical phonological tier is presumably needed so that the allophonic voicing is visible to moraic constraints. While plausible in a theoretical sense, it is unnecessary in the case of coda /s/ deletion, since the phonology need only look forward at the [±voice] feature of the following consonant to determine if the underlying would-be coda /s/ will be voiced or voiceless. The historical two-stage rollout of the process, if conceived of as purely moraic, seemingly necessitates more than one phonological tier to be processed serially, but parallel mapping of input to output for coda /s/ deletion is indeed possible and more economical if, as I claim, the phonology instead jointly evaluates the coda segment in tandem with the following onset according to the acceptability of the sonority contour across the cluster. Below, I will therefore argue that the two-stage chronology of coda /s/ deletion is instead the effect of syllable contact constraints, which can select the right target for deletion in a single-tier lexical phonology.

3. Diachrony of early French repair of unharmonic /s/-initial SCCs

Syllable contact requirements consider the degree of sonority contour rise or fall across syllables, in this case, specifically the sonority of a coda in relation to the sonority of the following onset. Phonological and typological findings (Murray 1982; Murray & Vennemann 1983; Vennemann 1988; Martínez-Gil 2003; Baertsch & Davis 2009; Pons-Moll 2011; and many others) establish that the ideal syllable contact is maximally falling in sonority, from a high sonority segment like a liquid to a low sonority segment like a voiceless stop. While there are many versions and refinements upon what is known as the Syllable Contact Law, requiring sonority to fall across the syllable boundary, at minimum the directionality of sonority at the syllable juncture is referenced in these and many phonological accounts of heterosyllabic consonant cluster phenomena.

Adopting Montaño's (2023) sonority scale for PF and OF (obstruents < sibilants < nasals < laterals < rhotics, from lowest to highest sonority), we only have a sonority fall when coda /s/ precedes an obstruent. By considering syllable contact instead of just the moraic viability of the coda, the two-stage diachrony of OF coda /s/ deletion finds a natural explanation. In Stage 1, the [z] allophone of /s/ deletes earlier because [z.l] and [z.N] carry sonority contours that are rising instead of falling; [z.O⁺] also undergoes the deletion repair as a near-flat sonority. Before a voiceless stop, [s] is tolerated until stage 2 because this represents minimal but sufficient falling sonority

in syllable contact. Just as admissible coda consonants for moraic association are universally ranked in order of increasing sonority, acceptable syllable contact clusters beginning with a sibilant would be ranked in order of decreasing sonority of the onset segment, as a less sonorous onset produces a greater sonority fall. The onsets before which coda /s/ deletes in Stage 1 thus form a natural class, with a cut-off between voiceless obstruents on the one hand and voiced obstruents and sonorants on the other. By Stage 2, the fall in sonority between the sibilant and the voiceless obstruents is no longer sufficient to be harmonic, and so /s/ deletion applies here, as well.

Recasting OF coda /s/ deletion as a repair on suboptimal syllable contact contours positions the process in a more extensive context within early French diachrony. In Late Latin and early PF, unharmonic underlying SCCs resulted especially from affixation (e.g. gemination of /dm/ in examples like *ad+mir-ari* → *ammir-er* 'admire-INF' [Gess 1998b]) or, much more extensively, from the output of the Late Latin and early PF syncope process (Pope 1952; Dumas 1993; Jacobs 1995; Gess 1998b; Hartkemeyer 2000; Scheer & Ségeral 2020; and others), which, by eliminating most post-tonic or pre-tonic short vowels, brought together new combinations of underlying consonants at the syllable juncture where the atonic vowel was lost. When stranded consonants did not meet prosodic requirements, an array of phonological repairs applied, as briefly presented in (5), with many diverse phenomena potentially understood through the lens of improving syllable contact:

(5) PF phonological repair of unharmonic word-internal clusters produced by syncope

a. PF gemination of flat or near-flat sonority biconsonantal SCCs (Pope 1952; Bloch & Wartburg 1964; Gess 1998b)

<u>Latin</u>		<u>PF</u>	<u>OF</u>	<u>Gloss</u>
i. <i>debita(m)</i>	[<i>'de.bi.ta(m)</i>]	° <i>de[tt]e</i>	<i>de[t]e</i>	'debt'
ii. <i>capsa(m)</i>	[<i>'kap.sa(m)</i>]	° <i>cha[ss]e</i>	<i>cha[s]e</i>	'box (> <i>châsse</i> 'reliquary')
iii. <i>femina(m)</i>	[<i>'fe.mi.na(m)</i>]	° <i>fe[mm]e</i>	<i>fe[m]e</i>	'woman'

b. Stop epenthesis of insufficiently rising sibilant-rhotic and sonorant-liquid SCCs (Pope 1952; Bourciez 1955; Bloch & Wartburg 1964; Dumas 1993; Gess 1998b; Hartkemeyer 2000; Martínez-Gil 2003; Montaño, *forthcoming*)

i. Sibilant-rhotic SCCs: /... sr .../ > [... s.tr ...]
 /... zr .../ > [... z.dr ...]

<u>Latin</u>		<u>OF attestation</u>	<u>Gloss</u>
° <i>ess-ere</i>	>	<i>est-re</i> [es.trə]	'be-INF'
<i>mis-erunt</i>	>	<i>mist-rent</i> [mis.trent]	'put-3PL.PST'
<i>sicera(m)</i> > ° <i>cisera(m)</i>	>	<i>cisdre</i> [t'siz.d्रə]	'cider'
° <i>cos-ere</i>	>	<i>cosd-re</i> [kɔz.dৰə]	'sew-INF'

ii. Nasal-lateral SCCs: /... ml .../ > [... m.bl ...]

<i>cumulu(m)</i>	>	<i>comble</i> [kɔm.blə]	'peak/top'
<i>simil-are</i>	>	<i>sembl-er</i> [sɛm.blər]	'seem-INF'

iii. Nasal-rhotic SCCs:		/... mr .../ > [... m.br ...] /... nr ... / > [... n.dr ...]		
<i>camera(m)</i>	>	<i>chambre</i>	[tʃam.brə]	'room'
<i>teneru(m)</i>	>	<i>tendre</i>	[tɛn.dʁə]	'tender'

iv. Lateral-rhotic SCCs:		/... lr .../ > [... l.dr ...]		
<i>mol-ere</i>	>	<i>mold-re</i>	[mɔl.dʁə]	'grind-INF'
<i>pulvere(m) > °pulvera</i>	>	<i>poldre</i>	[pɔl.dʁə]	'powder'

c. Late PF assibilation of underlying /dN/ SCCs (Pope 1952; Montaño 2023)

<u>Latin</u>	<u>Early PF</u>	<u>Late PF</u>	<u>Gloss</u>	
i. (<i>Rhodanu(m)</i> >) ° <i>Rodno</i>	[rɔð.no]	<i>Rosne</i>	[rɔz.nə]	'Rhone river'
ii. (<i>platantu(m)</i> >) ° <i>pladno</i>	[plað.no]	<i>plasne</i>	[plaz.nə]	'plane tree'
iii. (<i>bodina(m)</i> >) <i>bodne</i>	[bɔð.nə]	<i>bosne</i>	[bɔz.nə]	'limit-marking stone'
iv. (° <i>retina(m)</i> >) <i>redne</i>	[rɛð.nə]	<i>resne</i>	[rez.nə]	'rein'

d. PF deletion of medial consonants in unsyllabifiable medial triconsonantal clusters produced by syncope (Pope 1952; Jacobs 1995; Gess 1998b)

<u>Late Latin</u>		<u>OF attestation</u>	<u>Gloss</u>	
i. <i>dormitoriu(m)</i>	[dor.mi.'to.ri.u(m)]	<i>dortoir</i>	[dɔr.tojr]	'bedroom'
ii. <i>comput-are</i>	[kom.pu.'ta.re]	<i>cont-er</i>	[kun.ter]	'count-INF'
iii. <i>hospitale(m)</i>	[(h)os.pi.'ta.le(m)]	<i>ostel</i>	[ɔs.tel]	'residence'
iv. <i>galbinu(m)</i>	['gal.bi.nu(m)]	<i>jalne</i>	[dʒal.nə]	'yellow'
v. <i>fortimente</i>	[for.ti.'men.te]	<i>forment</i>	[fɔr.mənt]	'strongly'

The data in (5a-c) provides internal evidence for syllable contact effects in early French, with deletion of an offending segment as a last resort (5d) when alternate repairs such as gemination (5a), stop epenthesis (5b), or subsegmental modification such as assibilation (5c) could not meet syllabification or sonority requirements. Medial consonant deletion in triconsonantal clusters, as exemplified in (5d), evidences that deletion was not fully off the table when clusters violated high-order syllabification constraints, such as a ban on complex codas (Jacobs 1995; Gess 1998b) and requirements on what constitutes a sufficiently steep sonority rise within an onset cluster (no falling, flat, or insufficiently rising sonority, as in obstruent-nasal [5d,iv-v]). Moreover, it can be confirmed that not all rising sonority was banned across the syllable boundary, either, including [z.n] in (5c), which avoids an illicit coda obstruent while also making the syllable contact contour's rising slope less steep (Montaño 2023).

Importantly, the data in (5) offers diverse evidence for the higher sonority of sibilants with respect to other obstruents, which are essentially eliminated in coda position (Jacobs 1995, Gess 1998b) by repair mechanisms during PF. For example, assibilation as in (5c) substantiates the distinction in sonority between obstruents and sibilants in PF, given the sufficiently improved sonority contour across [z.n] as opposed to the input /dn/ sequence (Montaño 2023). Furthermore, sibilants' overall acceptability in coda position during PF is corroborated by their preservation upon the simplification of /s/-initial unsyllabifiable triconsonantal clusters like in (5d,iii) as well as their survival in outputs of /sr/ and /zr/ stop epenthesis clusters in (5b,i), which are

especially relevant to the present study given they constitute a word-medial /sC/ cluster targeted for repair even as early as PF.

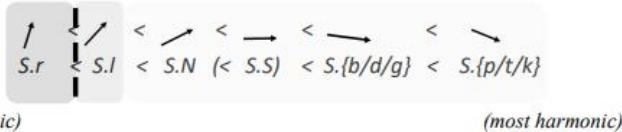
PF stop epenthesis, as in (5b), was triggered when syncope brought together a sibilant and a rhotic (5b,i) or a sonorant followed by liquid (5b,ii-iv). The generalization for PF stop epenthesis, whose earlier effect is already attested in the earliest 9th and 10th century texts (Rainsford 2020; Montaño, *forthcoming*), is that the input consonants stranded by syncope were not well-formed onset clusters, requiring them to surface heterosyllabically, yet given their rising sonority, they also yield a poor syllable contact, as also noted by Morin (1987), Martínez-Gil (2003) and analyzed more comprehensively by Montaño (*forthcoming*). By creating a sonority valley in the form of a minimally invasive stop drawing most features from the preceding input segment, the repair achieves falling sonority across the syllable boundary and the preservation of both input segments. Given the focus of this paper, I especially highlight sibilant-rhotic clusters among these, even though all of these cluster types represent the same phonological repair of epenthesis to remedy a poor syllable contact.

When viewed through the lens of syllable contact effects as the common motivator amongst diverse repairs of /sC/ SCCs across PF, earlier OF, and later OF, a more general diachronic trend involving ever-stricter syllable contact constraints comes into view, with different outward manifestations of phonological repair resolving the unharmonic cross-syllabic sonority contour. A summary is in (6):

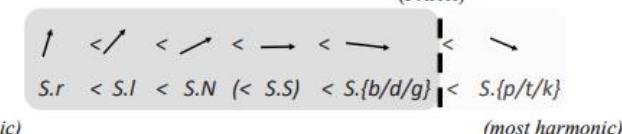
(6) Relative harmony of early French /sC/ syllable-contact clusters (SCCs) and respective sonority contours in diachrony³

= disallowed = marginally permitted = permitted

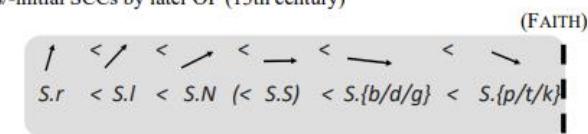
a. Licensed /s/-initial SCCs in PF (by 9th century)
(FAITH)



b. Licensed /s/-initial SCCs in earlier OF (11th-12th centuries) (F)



c. Licensed /s/-initial SCCs by later OF (13th century)



³ In the scales in (6), sibilant-sibilant (S.S) SCCs appear in parentheses, as they were likely simplified by degemination of geminates (outside of /rr/) posited in later PF around the 7th century (Jacobs 1994a), rather than via coda /s/ deletion in OF. They are included here for the scales' completeness, with the prediction that such clusters would have simplified during early OE (11th-12th centuries) if degemination had not already eliminated them.

With the unified directionality identified for licit /s/-initial syllable contact contours, I will now present a diachronic constraint-based analysis formalizing this progression in syllable-contact requirements as the progenitor of a more total ban on coda sibilants that would be enforced by a mora-licensing constraint such as ${}^*\mu/S$ by late OF.

4. Analysis

In the preceding section, I argue that the motivation for the repair of /sC/ SCCs lies in a phonological impetus to avoid an unharmonic syllable contact sonority contour across these clusters, with distinct repair effects manifesting at different points of the syllable contact scale in (6), first earlier in the PF period with stop epenthesis of /sr/ clusters and graduating to deletion of coda /s/ in at least two stages during the OF period. PF stop epenthesis, beyond the mention of the insertion of a transitional consonant ("*consonne transitoire*," Bourciez 1955: 218, 268) or the "development of a glide" (Pope 1952: 148) in such sequences, has been described before as specifically rooted in the improvement of syllable contact sonority, notably by Morin (1987) and more recently by Martínez-Gil (2003) within an Optimality-Theoretic framework. Martínez-Gil's (2003) analysis, primarily focused on Old Spanish stop epenthesis, employs a generic SYLLABLE CONTACT constraint militating against rising sonority across the syllable boundary. While it may be sufficient for that analysis, in the broader context of the progressive loss of /sC/ SCCs in French diachrony including OF coda /s/ deletion, as well as alongside distinct phonological repairs, as in (5), and gaps in application (e.g. [z.l] clusters) for qualitatively different but equally rising SCCs (Montaño, *forthcoming*), a more nuanced approach is needed here to uncover the dynamic nature of ever-stricter constraints on what constitutes a licit sonority slope across syllables, in addition to the interconnected nature of seemingly disparate repairs all aimed at a common target within the phonological system.

4.1. Constraint-based approaches to syllable contact: in favor of the Split Margin Approach to the Syllable

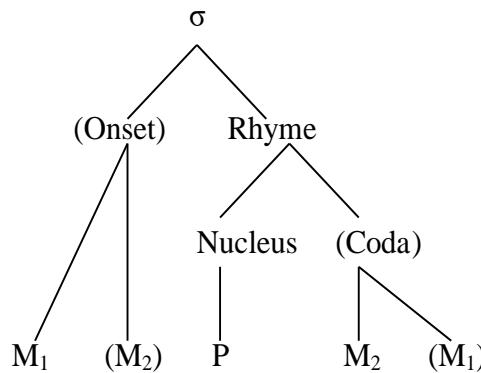
Among more granular constraint-based approaches is the SONORITY DISTANCE approach (Gouskova 2004, Pons-Moll 2011), which defines tiers of sonority distance between segments of an SCC (+1, +2, +3, etc., with + and – representing rising and falling sonority respectively), with the premise that clusters bearing the same sonority distance between member segments are targeted by the same phonological constraint. For example, depending on the sonority scale used, with language-specific subdivisions within sonority classes permitted, [s.r] and [t.l] would occupy the same sonority distance tier of +5, and [d.n] and [z.l] would do so as well at a +2 sonority distance, with additional independently motivated constraints accounting for differential reflexes if a particular sonority distance is not tolerated in the language (Pons-Moll 2011).

While this approach proves well-suited to phenomena where clusters of the same sonority slope are equally targeted within the phonology, it is less adept for early French where the distinct segmental make-up of clusters very much plays a role in the repair or faithful surfacing of SCCs within the same sonority distance tier. For

example, while flat-sonority clusters (sonority distance 0) as in (5a) repair via gemination, much worse syllable contact sonority distances surface unchanged, such as [z.n] (+1) in late PF assibilation repairing the underlying medial /dn/ cluster (a would-be +2 sonority distance) as in (5c). Meanwhile, stop epenthesis clusters as in (5b) span sonority distance tiers +5 through +1, but it is the specific featural make-up of these clusters that clearly differentiates them from clusters within the same distance tiers such as [s.l] (+4), [z.l] (+2), [s.n] (+3), and [z.n] (+1) that surface unproblematically until OF (ignoring here that voicing harmony within the cluster [Martínez-Gil 2003] gives preference to the clusters with [z] over [s]). The commonality amongst clusters affected by PF stop epenthesis considered alongside their connection to those undergoing coda /s/ deletion in OF (and potentially other coda loss phenomena, not explored here) is lost in such an approach, as the specific featural make-up of these SCCs' member segments is central to how they incrementally progress towards the eventual ban on coda or moraic segments of a particular sonority.

An especially well-suited alternative for drawing the necessary connections amongst phenomena affecting early French /sC/ clusters in diachrony is Baertsch & Davis' Split Margin Approach (SMA) to the Syllable (Baertsch 2002; Baertsch & Davis 2003, 2008, 2009; Green et al. 2014; and other work), which brings to bear, within an Optimality-Theoretic framework, both the featural make-up of clusters and the sonority slope across member segments without the inherent implication that clusters of the same sonority distance tier are targeted together (Pons-Moll [2011] offers an insightful consideration of distinct formal approaches to syllable contact, to which I refer the reader for further comparison). The SMA builds formal links between potential outer margin segments (M_1) and inner margin segments (M_2) on both sides of the syllable peak, as represented in (7), drawing on the well-established generalization that outermost margin segments (the first or only member of an onset and the final member of a coda cluster) favor low sonority while inner margin segments (the second member of an onset cluster and the first or only member of a coda), prefer high sonority, expressed in the universal hierarchies presented in (8):

(7) Syllable structure in the SMA



Source: Baertsch & Davis 2008

(8) a. M_1 hierarchy - universal ranking (adapted from Baertsch & Davis 2003):

$(*M_1/[+low] \gg *M_1/[+high]^4 \gg) *M_1/[r] \gg *M_1/[l] \gg *M_1/\text{Nas} \gg *M_1/\text{S} \gg *M_1/\text{Obs}$

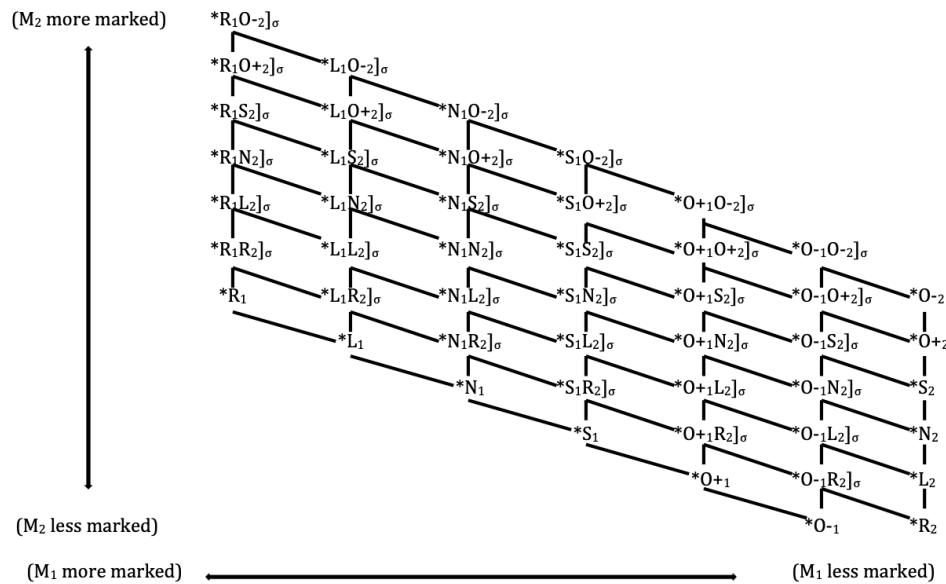
b. M_2 hierarchy - universal ranking (adapted from Baertsch & Davis 2003):

$*M_2/\text{Obs} \gg *M_2/\text{S} \gg *M_2/\text{Nas} \gg *M_2/[l] \gg *M_2/[r] (\gg *M_2/[+high] \gg *M_2/[+low])$

A significant contribution of this approach lies in the formal link between the syllabic positions paired as inner and outer margins of the syllable, which are predicted to pattern together barring intervening independently motivated constraints (such as a coda condition limiting rhymal M_2 features, or a constraint against superheavy syllables barring any segment from the syllable-final M_1 position). Building on this structural connection between M_1 or M_2 segments on opposite sides of the syllable peak, the SMA proves capable, in a single unified framework, of evaluating the relative markedness of both syllable-internal clusters — in the case of non-final early French syllables, onset clusters ($[.M_1M_2...]$) — and heterosyllabic SCCs ($[...M_2.M_1...]$) via the local conjunction of the two margin hierarchies in (8a) and (8b) within distinct prosodic domains. For onset clusters, this domain is the syllable, with composite locally-conjoined split-margin constraints drawing on the underlying rankings of the component M_1 and M_2 constraints and thus formalizing, in a vast relative hierarchy as shown in (9), the generalization that onset clusters rising maximally in sonority are the least marked, while flat and falling sonority onset clusters are the most:

⁴ In Baertsch & Davis' work, [+low] and [+high] vowels represent the highest sonority segments in the split-margin hierarchies, corresponding at times with glides when occupying an M_1 and M_2 position, but drawn in most cases into the syllable peak as vowels or diphthongal glides by a separate hierarchy of Peak constraints (cf. Baertsch 2002; Baertsch & Davis 2003: 5 for further discussion). This detail is inconsequential to the present analysis, and the margin constraints for [+low] and [+high] shall thus be henceforth omitted.

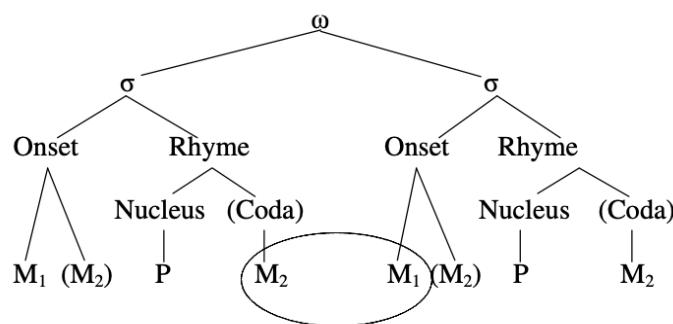
(9) Hierarchy of conjoined split-margin constraints within the syllable domain
(adapted from Baertsch & Davis 2008)⁵



As the SMA, like the sonority distance approach, allows for further subdivisions within each sonority tier on a language-specific basis when phonetically and empirically justified, I separate out sibilants from other obstruents and voiced from voiceless obstruents in my modeling of early French based on the distinct reflexes towards the sonority of these segments in the phenomena examined above, as discussed and argued in section 3. These subdivisions are incorporated into the constraint hierarchies in (8) and (9). A similar approach is used in Green, Davis, Diakite & Baertsch's (2014) application of the SMA to Bamana, where voiceless and voiced obstruents represent separate sonority tiers.

In the SMA, SCCs are formalized as a syllable-final M₂ segment followed by a syllable-initial M₁ segment (M₂.M₁), spanning across adjacent syllables within the broader prosodic domain of the phonological word, as shown below in (10):

(10) The syllable contact environment within the SMA:



Source: Baertsch & Davis 2009

⁵ Adapted nomenclature: O⁻ = voiceless Obs; O⁺ = voiced Obs; S = sibilant; N = nasals; L = laterals; R = rhotics;]_σ = syllable domain;]_ω = word domain; *S₁ = *M₁/S; *S₁O₂ = conjoined constraint *M₁/S&M₂/Obs.

Local conjunction of the M_1 and M_2 constraints within the word domain yields a hierarchy otherwise identical to that in (9) but indexed for the word domain (ω), and the margin segments referenced in the constraints appear in reverse order in phonetic form, as SCCs are sequences of first an M_2 and then an M_1 , as highlighted in (10). For example, *plasne* [plaz.nə] 'plane tree,' in (5c-ii), contains SCC [z.n], with [z] in M_2 position in the first syllable and [n] in M_1 position of the following syllable, both of which are contained within the domain of the word; thus, SCC [z.n] is targeted by word-level constraint $*N_1S_2]_\omega$.

Given that the stricter domain of the syllable is necessarily contained within the word, and in keeping with the locality ranking of prosodic domains *phrase* > *word* > *syllable* (Baertsch & Davis 2008, citing Itô & Mester 1998), a violation within the syllable domain necessarily entails a concomitant violation in the word domain, while the reverse is not true. This implies that a conjoined constraint in the subordinate domain (syllable) is expected to dominate the same constraint in the superordinate domain (word); in the case of onset clusters and SCCs, the syllable-level conjoined split-margin constraint targeting the former outranks the same word-level constraint governing the mirror-image SCC (since these segments appear in the order $M_2.M_1$ in a SCC), or more specifically, $*X_1Y_2]_\sigma \gg *X_1Y_2]_\omega$. For example, the acceptability of a given syllable-internal cluster, such as $[.M_1M_2...]_\sigma$ onset cluster [.pl] in *plasne*, entails that of the reverse-order [... $M_2.M_1...$] SCC in the word domain ([l.p] in *talpe* [tał.pə] > *taupe* 'mole' [Pope 1952]), barring intervening constraints. This is because [.pl]'s tolerated violation of higher-ranking $*O_1L_2]_\omega$ further violates lower-ranking $*O_1L_2]_\omega$ (the sequence is contained in both the syllable and the word), while [l.p] only violates the latter constraint (it is contained within the word but not within one syllable). On the other hand, the acceptability of a particular SCC, such as [n.d] in *tendre* [tən.drə] 'tender' in (5b,iii), violating lower-ranking $*O_1N_2]_\omega$, does not necessarily imply the mirror-image onset cluster is tolerable (e.g. *[.dn], as seen in the avoidance of this sequence in [5c] and, for comparable *[.tn], in [5d,v]), governed by higher-ranking $*O_1N_2]_\sigma$ that may or may not constitute a fatal violation of the phonological constraint hierarchy.

For the purposes of this study, the capacity of split-margin constraints to evaluate the relative harmony of both onset clusters and SCCs, with a rich network of implicational relationships between them, represents one of the formal strengths of this approach for the diachronic phenomena in consideration here. What makes /sl/, for example, a poor syllable contact for the purposes of Stage 1 coda /s/ deletion, needs to be considered alongside why it is also an unacceptable onset cluster, despite possessing a rising sonority. This joint evaluation is equally relevant word-internally during OF as for PF stop epenthesis, and at the same time word-initially in words undergoing prothesis as in (4). Given the high versatility of this approach, as well as its sensitivity to the featural make-up of consonant clusters targeted by its constraints, I adopt the SMA within Optimality Theory for the formalization of the progressively stricter syllable-contact requirements underlying the eventual near-total elimination of word-medial /sC/ SCCs over the course of early French diachrony.

Before turning to the formal analysis, the focus on onset clusters and not coda clusters when examining M_1M_2 sequences within the syllable domain merits brief discussion. In PF and OF, syllable-final consonant sequences were largely banned outside of word-final syllables (Jacobs 1995; Gess 1998b), an example of "the familiar

tendency in languages for syllable onsets (and codas) to admit greater complexity at word edges than word-medially" (Sampson 2010: 46). While word-final two-consonant sequences (e.g. *cerf-Ø* 'deer-OBL.SG,' *colp-Ø* 'blow-OBL.SG,' *corp-Ø* 'body-OBL.SG,' *dorm-Ø* 'sleep-1ST.SG.PRES') — or even inflected three-consonant sequences in early OF that reduced to two by the 12th century (*corp-s* > *cor-s* 'body-NOM.SG,' cf. *dorm-Ø* vs. *dor-s/dor-t* [$\leftarrow /dorm +Ø, +s, +t/\right]$ 'sleep-1ST/2ND/3RD.SG.PRES') (Jacobs 1995) — are attested, these do not appear word-internally (outside of compound words, e.g. *forsfait* 'criminal.act', *arcbaleste* 'crossbow' [Rainsford 2020], where such sequences are arguably still word-final), having reduced over the course of Late Latin into PF, as evidenced in inscriptions (*scul-tus* < *sculp-tus* 'sculpt-PAST.PART', *cunti* < *cuncti* 'together') and in medial consonant loss shown in (5a) above (*comput-are* > *co[nt]-er*, **co[mp.t]-er* 'count-INF,' *hospitalem* > (*h)o[st]el*, *(*h)o[sp.t]el* 'lodging,' etc.) (Gess 1998b). Word-final consonants and consonant sequences exhibit a wide range of additional segmental possibilities beyond those found in word-internal codas, which primarily permit singleton /s/ or sonorants: word-finally, singleton obstruents (*trop* 'too') and falling-sonority sequences (*halt* 'high,' *jurn* 'day'), disallowed in word-internal codas, suggest they are structurally distinct from proper codas. This has led some (Jacobs 1994b; Rainsford 2020) to posit that many such word-final consonants, outside of (most) singleton /s/ or sonorants, are in fact the onsets of empty-headed syllables, aligning with their characterization of OF rightward primary stress assignment in trochaic feet parsed right-to-left and as a counterpart to post-tonic schwa-headed syllables (e.g. *port* ['pɔr.tØ] 'pass' vs. *porte* ['pɔr.tə] 'door' [Rainsford 2020]).

While the present study focuses on repairs affecting /sC/ clusters within or across word-internal (i.e. non-final) syllables, leaving clusters unclearly contained fully in word-final syllables beyond its scope, the analysis is readily extendable to this position, where cluster-initial /s/ also deletes in word-finally (e.g. *gost* > *g[u:]t* 'taste' [Pope 1952]). If we allow that such word-final sequences instead consist of a coda (M₂) plus the onset (M₁) of an empty-headed syllable, then coda /s/ deletion in these cases is not surprising, as they are actually sequences of [M₂.M₁] contained within the word, like those found word-medially, explaining their patterning with SCCs. Similarly, if the same word-final consonants argued to be onsets (Jacobs 1994b; Rainsford 2020) are instead word-final adjuncts, their behavior akin to word-internal coda-onset sequences, the mirror-image of Goad's (2012) analysis for word-initial adjunct + onset /sC/ sequences, provides an alternative and largely parallel explanation for their patterning with word-medial coda-onset sequences. These potential formalizations furthermore account for why word-final [rs] or [ls] sequences are attested (e.g. *cor-s* 'body-NOM.SG', *cheval-s* 'horse-NOM.SG') even though syllable-initial *[.sr] or *[.sl] are disallowed, for example, in PF stop epenthesis ($\rightarrow [s.tr], [z.l]$), given the latter type has no option but to be properly contained within the word-medial syllable or span across syllables (i.e. it is not at a word edge), while word-final [rs] or [ls] instead include a word-final [s] outside the final full (non-empty-headed) syllable. Finally, characterizations of word-final consonant sequences like these corroborate my claim that coda /s/ deletion in OF is best defined as a syllable-contact effect, given that word-final singleton coda /s/ does not generally delete during OF (cf. puns between Latin and French like "*inimicos* : *il n'y mit qu'os*" [i.ni.mi.kɔs] cited by Pope [1952: 222] that date later than OF). This is a natural outcome of my analysis given it is not in a syllable-contact relation to a following consonant, therefore making its deletion

not immediately required. Such word-level generalities, however, are further complicated by the nascent phrase-level interaction of neighboring words in syntax on the deletion of word-final /s/ (and other obstruents) in later OF before a following consonant-initial word (Pope 1952), the seeds of the well-known modern phenomenon of liaison. Given the present study's focus on word-medial sequences and syllable contact effects, the further definition of these avenues to extend the present analysis to word-final clusters and the exploration of these interesting additional dimensions lie beyond its scope, and thus the interaction of these processes with the exceptional status of OF word-final consonants shall be left for future inquiry.

4.2. Diachronic constraint-based analysis of early French repair of /s/-initial SCCs

The SMA is extremely well-suited to the array of phonological processes examined here and can aptly formalize the interconnected nature of the phenomena in focus with interrelated constraints on sonority relations across consonant clusters and within a unified, cohesive approach. In the SMA, the ever-stricter progression on syllable contact sonority contours proposed in (6) above is neatly redefined as the promotion of word-level split-margin constraints on sibilant + consonant SCCs (${}^*R_1S_2]_w \gg {}^*L_1S_2]_w \gg {}^*N_1S_2]_w \gg {}^*O^+1S_2]_w \gg {}^*O^-1S_2]_w$) above distinct FAITH constraints, thus producing differential repair effects (stop epenthesis, coda deletion) at different points in diachrony. Furthermore, split-margin constraints also prove fitting to characterize the prothesis of word-initial /sC/ clusters, continuous throughout early French, by underscoring /sC/’s inability to syllabify as an onset cluster; prothesis as a phonological process implies that syllable-domain split-margin constraints (${}^*S_1O^-2]_σ \gg {}^*S_1O^+2]_σ \gg {}^*S_1N_2]_σ \gg {}^*S_1L_2]_σ \gg {}^*S_1R_2]_σ$), as well as a constraint banning the adjunction of /s/ to the syllable node (*ADJUNCT),⁶ constitute high-priority constraints within the phonological system as early as the PF period and through OF.

As Montaño (*in press*) highlights, prothesis of word-initial /sC/ is also illuminating with regard to the relative severity of violating the FAITH constraints inherent to particular phonological repairs. In Correspondence Theory (McCarthy & Prince 1995) terms, despite deletion (a violation of MAX) being preferred over word-internal vowel insertion (a violation of O[UTPUT]-CONTIGUITY-V) in unsyllabifiable medial clusters such as geminating biconsonantal clusters, illustrated in (5a), or reduced triconsonantal clusters, as in (5d), prothesis shows that vowel insertion can indeed constitute the minimal repair when it occurs at the edge of the input string. At the word edge, the prothetic vowel violates the more general DEP-V constraint ("no vowel insertion"), mostly overlapping with O-CONTIGUITY-V, which militates against vowel intrusion within the input string (/xyz/ → *[xVyz]) but crucially not at its edges (i.e., /xyz/ → [Vxyz] violates DEP-V but not O-CONTIGUITY-V, as all input segments

⁶ Given prothesis during PF and early OF depended on whether the /sC/ sequence was preceded by a vowel-final word or not, as in (4), its high rank in PF is especially motivated at the phrase level, and the precise position of *ADJUNCT may be somewhat lower in the PF word-level phonology represented by the constraint hierarchies in (11) and (12) below, where it therefore appears in parentheses. This detail is inconsequential to the discussion of PF stop epenthesis presented here as representative of the initial step of the more extensive progression against medial /sC/, and shall thus be glossed over until this constraint is of more central importance for our characterization of word-level prothesis at the time of OF coda /s/ deletion.

remain contiguous). In this way, prothesis clarifies the relative ranking of the FAITH violations incurred by these phonological repairs as O-CONTIGUITY-V » MAX » DEP-V. Even though prothesis is a phrase-level process during PF, the preferability of vowel insertion at word edges rather than within the input string in the word-level phonology is further evidenced by word-final schwa insertion after rising-sonority input clusters (Jacobs 1994, Rainsford 2020) produced by syncope (e.g. *galbinum* > *jalne* 'yellow' in [5d-iv], *sen(io)r* > *sendra* 'lord', *semp(e)r* > *sempre* 'always' [Pope 1952]), suggesting that the locus of the inserted vowel as seen in prothesis is also reflective of the preferred string-external site of vowel epenthesis at the word level. In light of these conclusions, and in keeping with the implicational relations among split-margin constraints — both amongst conjoined constraints within the same prosodic domain, as well as between equivalent conjoined constraints within superordinate and subordinate domains (syllable > word) — I propose the preliminary constraint ranking for PF in (11) to frame the upcoming account of stop epenthesis of /sr/ SCCs, the first stage of the broader diachronic progression on /sC/ clusters in syllable contact:

(11) Preliminary hierarchy for PF in light of prothesis, word-final schwa insertion, and attested word-medial /sC/ clusters

(*ADJUNCT,) *S₁O⁻²]_σ » *S₁O⁺²]_σ » *S₁N₂]_σ » *S₁L₂]_σ » *S₁R₂]_σ »

O-CONTIGUITY-V » MAX » DEP-V »

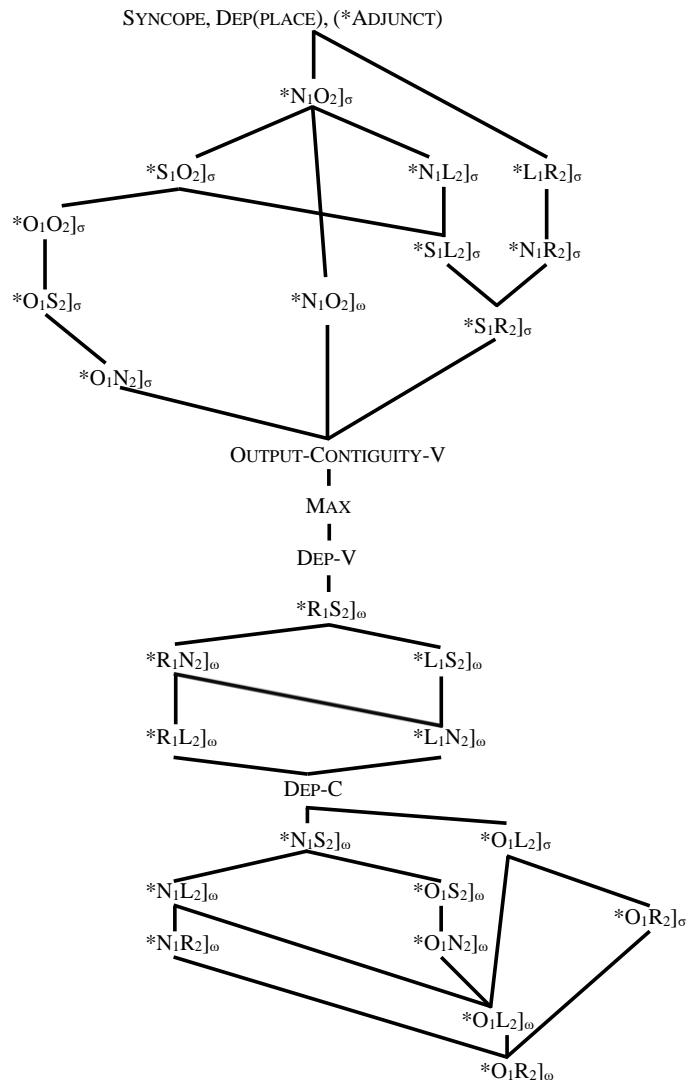
*R₁S₂]_ω » *L₁S₂]_ω » *N₁S₂]_ω » *O⁺¹S₂]_ω » *O⁻¹S₂]_ω

In the first stage of the progression of syllable-contact constraints on medial /sC/ clusters, the hierarchy in (11) in light of prothesis of word-initial /sC/ informs why PF stop epenthesis, as in (5b), represents the optimal repair for these SCCs, whose sonority is rising but insufficiently so to constitute an onset cluster. Unlike word-initial /sC/ with access to the prothesis repair by virtue of occurring at the edge of the input string, we observe that word-medial /sr/, which is string-internal rather than at the edge, cannot be broken up by vowel insertion, nor does deletion apply to the underlying segments under pressure to form a suboptimal cluster by syncope. The non-application of these potential repairs implies that O-CONTIGUITY-V » MAX » DEP-V rank higher than the split-margin constraint (*R₁S₂]_ω) militating against surface [s.r] SCCs due to their poor syllable contact sonority contour. We know from the PF data in (5b) that sibilant-rhotic SCCs are not alone to undergo stop epenthesis and pattern with sonorant-liquid (nasal-lateral, nasal-rhotic, lateral-rhotic) SCCs, a group of clusters that class together naturally within the SMA as adjacent constraints within the conjoined hierarchies (*R₁S₂]_ω » *R₁N₂]_ω, (*L₁S₂]_ω)⁷ » *R₁L₂]_ω, *L₁N₂]_ω). As stated above, while Martínez-Gil's (2003) generic SYLLABLE CONTACT constraint may be sufficient for the purposes of his analysis, I follow Montaño's (*forthcoming*) account

⁷ *L₁S₂]_ω is included here, in parentheses, for completeness, as per the universal conjoined split-margin hierarchy in (9), despite this cluster not undergoing PF stop epenthesis, a fact discussed briefly after the presentation of Tableau 1 (see Montaño [*forthcoming*] for a fuller exploration and proposal for this cluster's escape of repair in PF). This constraint and its position in the hierarchy are of course of central importance to the present analysis' account of coda /s/ deletion in OF, as per (15), and its effect on OF /sl/ clusters, shown in Tableau 2.

of PF stop epenthesis that hinges on a more nuanced division of constraints according to the segmental make-up of the clusters, an analysis whose granularity is supported by the SMA's implicational rankings of the syllable-level and word-level conjoined constraints. Appealing to the SMA not only defines in a natural way which clusters of a particular sonority contour trigger the stop epenthesis repair but also uncovers some asymmetries in application, such as in /sl/ clusters, which surface faithfully despite possessing the same sonority slope and a comparable segmental profile as clusters repaired by epenthesis. Given the PF phonology prevents the faithful surfacing of sibilant-rhotic or sonorant-liquid SCCs via the insertion of a stop, one must conclude that the split-margin constraints banning these rising-sonority SCCs rank higher than DEP-C (no consonant insertion), with constraints referencing SCCs that trigger no repair and surface faithfully ranking below it. Based on these relations between split-margin and FAITH constraints, a more complete ranking of constraints pertinent to PF stop epenthesis can be defined as in (12):

(12) Constraint hierarchy for PF stop epenthesis



Source: adapted from Montaño (*forthcoming*)

Included in this hierarchy are relevant supplemental constraints evidenced in the data in (5): a conglomerate SYNCPE constraint, capturing the myriad complex details of pre-tonic or post-tonic short vowel deletion in syncopated words, and DEP(PLACE), ensuring that the epenthetic stop is homorganic with the preceding coda consonant. For expositional purposes, these constraints are presented as undominated (without any intended claim that they are fully undominated in the phonology), given they are always obeyed in the PF stop epenthesis data in (5b) under consideration here. Below these appear high-ranking syllable-level split-margin constraints banning onset clusters avoided both in stop epenthesis (*[.sr], *[.ml], *[.nr], *[.lr]) as well as in medial consonant deletion in (5d) (*[.mt], *[.pt], *[.bn], etc.). Given repairs on such sequences, these high-order syllable-level constraints rank above the relevant FAITH constraints as shown in the preliminary hierarchy in (11) above. Word-level split-margin constraints prohibiting faithful heterosyllabic outputs *[z.r], *[m.l], *[n.r], and *[l.r] dominate DEP-C, ensuring these are repaired via stop epenthesis. Below DEP-C appear additional low-ranking split-margin constraints unable to prohibit sequences surfacing faithfully during PF, including obstruent-liquid onset clusters (* $O_1 L_2$ _σ, * $O_1 R_2$ _σ) and acceptable SCCs, as exemplified in (5), such as [z.n], [l.n], [r.m], [s.t], [l.t], and [r.t]. Finally, as voicing does not interact with whether or not stop epenthesis applies in a given context, voiced and voiceless obstruents are grouped together in the generalized split-margin constraints included in the PF hierarchy in (12).

While the proposed hierarchy indeed yields the attested output for all stop epenthesis cluster types exemplified in (5b), including nasal-lateral, nasal-rhotic, and lateral-rhotic, given the scope of the present study, Tableau 1 homes in on the epenthesis of would-be sibilant-rhotic clusters produced by syncope in PF:

Tableau 1. PF stop epenthesis of sibilant-rhotic clusters produced by syncope.
/esere/ → [ɛs.trə] 'be-INF'

/esere/	SYNCOPE	DEP(PLACE)	* $S_1 R_2$ _σ	O-CONTIG-V	MAX	DEP-V	* $R_1 S_2$ _ω	DEP-C	* $O_1 S_2$ _ω
a. e.se.rə	*!								
b. e.srə			*!		*				
c. ɛs.prə		*!			*			*	*
d. ɛs.trə					*			*	*
e. ɛs.rə					*		*!		
f. e.rə					**!				
g. e.sə.rə	(*!)			*!	(*)	*			

Source: adapted from Montaño (*forthcoming*)

Tableau 1 illustrates the constraint interaction yielding the creation of a sonority valley via the insertion of a stop, avoiding the marked cross-syllabic rising sonority contour the potential *[s.r] SCC (candidate *e*) would bear in favor of the falling sonority sibilant-obstruent syllable contact resulting from epenthesis (candidate *d*). While the prosodic profile of the input requires syncope to apply (arguably also further precluding vowel insertion as a repair, as indicated in the parenthetical

violation in candidate *g*) and thus promises at least one violation of MAX, the lower ranking of DEP-C offers a workaround for deletion as a repair on the unharmonic SCC, thereby avoiding a fatal second violation of MAX (candidate *f*). With the higher-ranking syllable-domain split-margin constraint and lower-ranking but impactful word-level split-margin constraint ensuring that the potential sibilant-rhotic cluster not surface as an onset cluster (candidate *b*) or as a SCC (candidate *e*) respectively, the violation of DEP-C proves the least egregious violation by remedying the suboptimal syllable contact sonority contour and by avoiding higher-order violations of FAITH. Via the stop epenthesis repair, potential sibilant-rhotic clusters that would result from the application of syncope are thus avoided in favor of a falling sonority sibilant-obstruent syllable contact, instead violating low-ranking $*O_1S_2]_o$.

One must ask why potential sibilant-lateral clusters do not also insert a stop in avoidance of an illicit sonority contour, when the word-level split-margin constraint militating against such SCCs, $*L_1S_2]_o$, constitutes a more serious transgression of well-formedness than, say, nasal-lateral (/ml/) or lateral-rhotic (/lr/) clusters, to which stop epenthesis indeed applies. The ranking of $*L_1S_2]_o$ above $*R_1L_2]_o$ and $*L_1N_2]_o$ in the universal split-margin hierarchy is highly suggestive that [s.l] (and [z.l]) clusters were marginal at best during the PF period, as indicated in the schema in (6a) above. As Montaño (*forthcoming*) argues,⁸ stop epenthesis in potential /sl/ clusters, if the homorganicity of the inserted stop is obligatorily enforced by the phonology as a minimal violation of FAITH, would have to result in a word-medial [s.tl] cluster, running awry of a phonotactic ban on [tl] (or [dl]) in complex onsets throughout PF (Scheer 2014) and eventually in later PF as a heterosyllabic cluster as well (Pope 1952), as seen in the reflexes of word-medial /tl, dl/ in examples like *spatula(m) > 'espafð/le > espalle* 'shoulder' (Nyrop 1914; Pope 1952; Montaño 2023). Apparent exceptions to the acceptability of heterosyllabic [tl, dl] are generally restricted to learned loanwords like *idolu(m) > idle ~ idre* 'idol,' *titulu(m) → title ~ titre* 'title,' and *apostolu(m) → apostle ~ apostre* 'apostle' (Pope 1952), with the rhotacized [.tr] or [.dr] variant unsurprisingly prevailing historically to the exclusion of [.tl] or [.dl] — if graphical *-tl-* and *-dr-* are not instead simply prestige spellings reminiscent of the Latin provenance of such loanwords and thus not representative of typical pronunciations at the time.

The appeal to a phonotactic constraint on [tl, dl] outputs reflects a widespread cross-linguistic aversion to such sequences (e.g. Late Latin [tl] → [kl] in *Appendix Probi* examples *vetulus non veclus* 'old', *vitulus non viclus* 'veal' [Pope 1952: 145]), distinct from the overlapping but more general syllable-level split-margin constraint, $*O_1L_2]_o$, targeting this same cluster in addition to any obstruent-lateral onset cluster (e.g. also [pl], [bl], [kl], [gl], etc.). This latter constraint, $*O_1L_2]_o$, could not have been sufficiently high-ranking to impose an effect on /sl/ clusters' escape of stop epenthesis, given its clearly low rank allowing obstruent-lateral onset clusters of different places of articulation to surface without issue, not only in the output of other stop epenthesis clusters (e.g. /ml/ → [m.bl] in *cumulu(m) > comble* 'peak' in [5b-ii]) but also more generally in Latin and onward in the history of French (e.g. *circulu(m) > cercle* 'circle,'

⁸ This brief account only offers one crucial portion of a more complex picture of why word-medial /sl/ avoids repair in PF, according to Montaño (*forthcoming*). Additional factors claimed to interfere with /sl/’s repair during PF are irrelevant to the remainder of the present analysis, however, and the reader is therefore referred to Montaño (*forthcoming*) for a fuller exploration of interacting variables.

arbore(m) > arbre 'tree,' *cengle* 'girdle,' etc. [Pope 1952]).⁹ Instead, it is specifically this particular ordered sequence of a coronal obstruent plus coronal lateral that is avoided, for which many phonetic and phonological justifications have been put forth in the literature (see Bradley 2006 for a comprehensive summary), such as obligatory contour effects (Baertsch & Davis 2008: 36) and low distinctness producing perceptual difficulties (Segui et al. 2001, Bradley 2006). In the case of /sl/ clusters that would otherwise trigger stop epenthesis, the phonotactic constraint bars both onset clustering (*[s.tl]) and breaking up [tl] or [dl] across the syllable boundary (*[st.l]), prohibited given the continuing PF ban on complex cudas that similarly required the last resort repair of deletion in syncopated triconsonantal clusters (cf. examples in [5d], where the nature of the second and third cluster segments precluded syllabification as a coda plus onset cluster). The overriding phonotactic constraint thus results in the (temporary) survival of sibilant-lateral SCCs in unmodified surface forms until the early OF period, when such clusters are lost during the first stage of coda /s/ deletion, to which we now turn.

By the time of OF, reverse-slope rising sonority contours in syllable contact from coda /s/ to onset laterals and nasals, in addition to the near-flat sonority from coda /s/ to voiced obstruents, all of which had survived repair in the PF period, were no longer tolerated, resulting in the deletion of the coda /s/ in these non-falling or insufficiently falling-sonority SCCs. Until the 13th century Stage 2 of coda /s/ deletion, when the sibilant additionally deleted before voiceless obstruents, only sufficiently falling sonority across the syllable boundary was licensed across these clusters, indicating that the slight sonority dip between coda /s/ and a voiced obstruent was too shallow to satisfy requirements on the steepness of the sonority slope, a distinction seen elsewhere in early French in the inclusion of near-flat sonority (for example, obstruent-sibilant geminating in *capsa(m) > cha[ss]e* 'box' as in [5a,ii]) patterning with flat-sonority clusters in PF gemination as in (5a). The loss of coda /s/ before laterals, nasals, and voiced obstruents over the course of the 11th and 12th centuries is thus a tightening of requirements on syllable-contact sonority slope and is indicative of the relevant split-margin constraints having promoted above MAX by this time (*L₁S₂]_ω » *N₁S₂]_ω » *O⁺₁S₂]_ω » MAX » *O⁻₁S₂]_ω).

On a systemic level, stage 1 coda /s/ deletion generalizes the impermissibility of rising and (near-)flat sonority in the OF syllable contact environment. After the application of PF stop epenthesis and gemination (including that of rising-sonority but phonotactically offensive /tl/ and /dl/ to [ll]), which ensured that coda /N/, /l/, and /r/ only combined with onsets of lower sonority, or alternatively fused together to form a single geminate, such sonority slopes only persisted in /sC/ SCCs ([z.l], [z.n]). Once the effects of stop epenthesis had come to be acquired as part of underlying forms during acquisition, as evident from the chronologically later Stage 2 deletion of coda /s/ in words that had once undergone PF stop epenthesis, such as *est-re* 'be-INF,' *ancestre* (< *antecessore(m)*) 'ancestor,' and others (Pope 1952), only sibilant-lateral and sibilant-nasal remained in surface forms as SCCs whose sonority rose instead of

⁹ Meanwhile, word-final [lt] sequences, as in *sal-t* 'jump-3RD.SG.PRES' or *halt* 'high' (Rainsford 2020), may not represent true tautosyllabic coda clusters, as discussed at the close of section 4.1. Even so, the low ranking of *O₁L₂]_ω predicts their acceptability, while the phonotactic constraint only references [tl, dl] in that particular order, unlike the conjoined split-margin constraints that refer to paired M₁ and M₂ segments on either side of the syllable peak and thus in either order.

fell. In this way, the promotion of $*X_1S_2]_o$ split-margin constraints during acquisition occurs in the context of systemic pressure to extend an already generalized property of early French syllable contact sonority contours to the last surviving rising-sonority SCCs. Sibilant + voiceless obstruent is unsurprisingly the last /sC/ cluster to be lost, given its minor but not negligible sonority fall across the syllable juncture.

A further implication of this re-ranking is that hypothetical newly-formed /sr/ clusters during this period, given $*R_1S_2]_o$'s status as the highest-ranking or most marked of $*X_1S_2]_o$ split-margin constraints, should also undergo /s/ deletion once it outranks MAX. This is because words containing /sr/ to which stop epenthesis would theoretically apply, as indeed occurred in the earlier PF period when $*R_1S_2]_o$ ranked below MAX, now as of OF would furthermore need to delete coda /s/, incurring an unavoidable violation of MAX (coda /s/ deletion) regardless of whether it also violated lower-ranking DEP-C to insert a stop. For this reason, a hypothetical input-output mapping in which the epenthetic stop were purely phonetic and not underlying would fail to yield the attested forms, as the DEP-C violation is superfluous given the option to only violate MAX (/ɛsər/ → hypothetical *[ɛ:.rə]). Given such forms as *[ɛ:.rə] are not attested reflexes of words that had undergone stop epenthesis in PF, it must be presumed that the epenthetic stop had been incorporated into underlying forms in acquisition no later than Stage 2 OF coda /s/ deletion (since *[ɛs.tə] still fatally violates $*O^-_1S_2]_o$) though likely even earlier. This is a welcome implication not left to probability but rather built into the syllable-contact account, additionally aligning with the expectation that several centuries would be more than sufficient for the epenthetic stop to stabilize into underlying forms and thus persist beyond when stop epenthesis was a truly active process in early French, making these words targets, diachronically speaking, for Stage 2 coda /s/ deletion (as in Late Latin *⁰ess-ere* > PF *est-re* > OF [ɛ:.tə] 'be-INF').

Potential internal evidence of deletion affecting clusters that once underwent stop epenthesis can be found in conjugated forms of OF verb stems ending in /s/ or a nasal before tense endings beginning in *-r-*, such as future tense forms (Pope 1952; Kibler 1984; Schwarze 2009). For some verbs, especially those defensibly termed as irregular by virtue of being outside the more productive 1st conjugation (*-er*), stop epenthesis is preserved in a stem alternation at the stem-inflection juncture in certain verbs, as in *ist-rai* 'leave-1ST.SG.FUT.' (*is* + *rai*, cf. *iss-ir* 'leave-INF') and infinitive forms such as *est-re* 'be-INF' (*es* + *re*), *conoist-re* 'know-INF' (*conois* + *re*), *paraist-re* (*parais* + *re*); some verbs lose the stem-final /s/, however, as in *ler-rai* or *lai-rai* 'leave.behind-1ST.SG.FUT' (cf. *laiss-ier* 'leave.behind-INF', with potential compensatory gemination of /l/ in the stem exhibiting short [ɛ]), a verb in the much more productive 1st conjugation *-er* class. For other stop epenthesis clusters, doublets exist for certain verbs, such as *don-rai/dor-rai* 'give-1ST.SG.FUT' (*don* + *rai*) and *men-rai/mer-rai* 'lead-1ST.SG.FUT' (*men* + *rai*) for nasal-rhotic stem-inflection junctures, while /l/-final verb stems reliably insert [d] at the /l+r/ juncture in future forms, as in *vold-rai* 'want-1ST.SG.FUT' (*vol+rai*) *bold-rai* 'boil-1ST.SG.FUT' (*bol-rai*), and many other examples in both the future tense and in some other verb forms with /r/-initial inflection (e.g. earlier *mist-rent* vs. later *mi-rent* 'put-3RD.PL.PAST' as distinct outputs for *mis* + *rent*). The stability or variability of the epenthetic stop within alternate verb stems is suggestive of $*R_1S_2]_o$ more definitively ranking above MAX, with lower-ranking $*R_1N_2]_o$ ranking equal or variably with MAX, and $*R_1L_2]_o$ ranking definitively below it for a time until

such stem alternations lexicalized into irregular morphological paradigms, potential rankings that are compatible with the split-margin constraint hierarchy as posited here.

Further support within morphophonology is found in the deletion of prefix-final /s/ in *des-*, *mes-*, and such, before /r/-initial bases (*desrang-er* 'fall.out.of.rank-INF', *desraison* 'irrationality'), as similarly occurs before other consonants. While stop epenthesis between the /s/-final prefix and base-initial /r/ is not attested at any stage (nor between prefix-final nasals and base-initial /r/, e.g. *en + rage + er* → *enrag-er* 'enrage-INF'), doubtlessly due to the morpheme boundary between prefix and base, the deletion of /s/ before /r/ as occurs before other consonants lends support to this analysis' implication that $*R_1S_2]_o$ would rank above MAX by the time of Stage 1 coda /s/ deletion, in keeping with the promotion of $*L_1S_2]_o$, $*N_1S_2]_o$, and $*O^+1S_2]_o$. Furthermore, the exceptionality of the juncture of prefix-final /s/ and base-initial /r/ to the earlier stop epenthesis repair during PF underscores these processes' sensitivity to grammatical properties of target words within the phonology, suggesting that stop epenthesis is not a purely phonetic by-product of the suboptimal transition between segments like /s/ and /r/ (or other sonorant-sonorant combinations triggering stop epenthesis) in syllable contact. While gestural mistiming in the articulation of such sequences may lie at the phonetic roots of stop epenthesis (see Recasens 2011 for a comprehensive treatment), potentially inducing the perceptual effect of an inserted stop as an entry point into the underlying form of these syncopated lexical forms, the sensitivity the process exhibits to the morphological structure of affected words, distinguishing between different affixes like the *des-* or *mes-* prefixes or verbal inflection as in the /r/-initial future tense endings discussed above, is highly suggestive of such processes passing through phonology and not representing a purely phonetic effect of certain suboptimal segmental transitions. If this were the case, some variation might at the very least be expected in examples well-established in the lexicon, where the morpheme boundary might be hypothetically erased, but this is not attested. A more thorough investigation of the interaction of morphology with coda /s/ deletion as well as with stop epenthesis represents a promising path for deeper inquiry that lies outside the primary focus of this paper and will thus be left for future research.

A similar line of reasoning drawing phenomenological connections amongst diachronic processes of early French, when applied to /sl/ SCCs, elucidates the role of the phonotactic constraint against [tl] and [dl] clusters, which for the purposes of this study can be simplified as a markedness constraint $*[TL]/[DL]$. Building on Montaño's (*forthcoming*) claim that such a constraint blocks stop epenthesis in /sl/ clusters when this process was active in PF, this undoubtedly leaves underlying /sl/ clusters as the input sequence in words such as *masle* 'male,' *mesl-er* 'mix-INF,' *isle* 'island,' and others that evaded stop epenthesis in order to sidestep the undesirable phonotactic consequence the insertion of the coronal stop would entail. By OF, however, the persistence of underlying /sl/ in these words, once $*L_1S_2]_o$ is promoted above MAX as part of Stage 1 coda /s/ deletion, reveals the relatively high priority by this diachronic period of the phonotactic constraint. Given attested forms in which coda /s/ deletes before the lateral onset ([ma:.lə], [me:.ler], [i:.lə], etc., to reprise the examples above), it becomes clear that the phonotactic constraint, too, outranked at the very least MAX in the OF constraint hierarchy. Were the opposite ranking to hold, one might expect stop epenthesis to occur during Stage 1 coda /s/ deletion, as the insertion of a coronal stop (e.g. /sl/ → $*[s.tl]$) would only violate split-margin constraints militating against sibilant-obstruent SCCs; since the stop would potentially be voiceless, provided it is

true that [z] and [s] were allophones of one another in coda position (/S/), such clusters would thus not trigger coda /s/ deletion until Stage 2 (yielding, hypothetically, unattested outputs such as /islə/ → Stage 1 *[is.tlə] ~ *[iz.dlə] > Stage 2 *[it.lə] ~ *[id.lə]), since MAX still outranked *O₁S₂ until that time. In this way, my account of coda /s/ deletion elucidates and provides an answer to why /sl/ SCCs evade stop epenthesis not only during PF but furthermore during OF, in what would otherwise be a theoretically plausible workaround for resolving the suboptimal syllable contact sonority contour.

Returning to the question of vowel lengthening upon coda /s/ deletion, my analysis' focus on constraints on syllable-contact sonority contour does not require a moraic account of the accompanying compensatory lengthening effects as proposed in Gess' (1998, 1999, etc.) work on OF coda loss phenomena. Given lengthening of the preceding vowel accompanies /s/ deletion word-internally, the non-reliance on moras is an important feature of my account, especially given that underlying /s/ indeed still surfaces in coda position before voiceless obstruents before Stage 2 of coda /s/ deletion. Under a moraic account, as discussed in section 2, it is unclear how this arises using mora-licensing constraints on sibilants, as such constraints would presumably target the /S/ underlying both [s] and [z] allophones in coda position, or alternatively, if /s/ and /z/ were phonemic, more granular constraints on *μ/z and *μ/s would have to be ranked contrary to the established sonority relation between voiced and voiceless counterparts of the same segment. In other words, one would expect lower-sonority /s/ to delete earlier in diachrony than higher-sonority /z/, but the reverse is attested historically. Finally, while Gess' analysis attributes the compensatory lengthening effect to a BIMORACITY constraint, I find such a claim suspect for OF, given how commonplace light syllables are in the language. Despite the violability of any phonological constraint within Optimality Theory and most other constraint-based frameworks, a more satisfying explanation of compensatory lengthening rests on its intrinsic structural link to deletion phenomena, as is also observed in related lengthening processes such as gemination in (5a) and in the verbal morphology examples above (*donrai/dorrai*, etc.), where lengthening takes place upon the loss of an underlying segment.

For this reason, I opt for a root node preservation account of compensatory lengthening in OF coda /s/ deletion via a MAX(ROOT) constraint (Montaño 2023; *in press*), as modeled in (13a) below. Furthermore, appealing to such a constraint allows for a potential generalization across lengthening phenomena both in the early French consonant space (gemination), of which an example is presented in (13b), as well as in the vocalic space, as characteristic of OF coda loss phenomena:

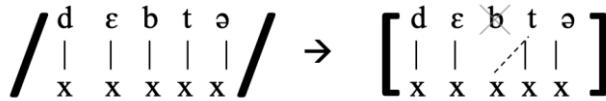
(13) MAX(ROOT): a root node in the input is associated with a root node in the output

a. MAX(ROOT) in OF coda /s/ deletion with compensatory lengthening of the preceding vowel: /festə/ → [fε:.tə] 'party'



Source: Montaño (*in press*)

b. Potential effect of MAX(ROOT) in PF gemination of flat and near-flat sonority medial biconsonantal clusters produced by syncope: /debita/ → [det.tə] 'debt'



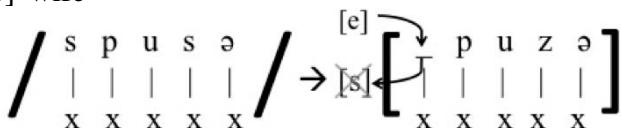
Source: adapted from Montaño (2023)

Gess (1998b) rejects a constraint of this type especially for OF coda nasal deletion and /l/ vocalization, based on the fact that features such as [+nasal] or [+back] were retained in post-deletion output forms. While this may be true for those processes — for which I am unaware of any clear diachronic evidence of the influence of syllable contact, and thus more likely remain motivated by mora-licensing concerns — there is on the contrary strong reason to claim that spreading to an abandoned root node was a by-product of the earlier syllable-contact-induced coda /s/ deletion. My claim is not inconsistent with the chronology of the incipient stages of coda nasal deletion and /l/ vocalization, which potentially occur after the onset of coda /s/ deletion (Gess 1999). As shown in (5a) as well as in the verbal morphology examples above of geminate [rr] in future forms, the preservation of a deleted segment's root node very likely constitutes a more general property of early French with phenomenologically diverse manifestations. PF gemination, as exemplified in (13b), may very well represent the interplay of MAX(ROOT) with constraints against flat and near-flat sonority clusters by re-associating the root node abandoned by the deleted consonant with the surviving consonant. Given geminates' frequent characterization as moraic consonants, whether the subsequent degemination of non-rhotic geminates over the course of PF (Jacobs 1994a) is connected to the eventual promotion of a moraic constraint such as ${}^*\mu/\text{Obs}$, of Gess' ${}^*\mu/p,t,k$ or ${}^*\mu/b,d,g$ type (Gess 1998a), above MAX(ROOT) once coda obstruents became absent for the most part across the lexicon (Jacobs 1995; Gess 1998b) offers potential historical and phonological context for the trajectory of PF geminates congruent with an analysis, such as that presented here, hinging on the interaction of coda, moraic, and syllable-contact constraints alongside root node preservation. Finally, whether PF stop epenthesis entails the salvaging of the vocalic root node abandoned in syncope via the insertion of a medial stop is an additional and intriguing possibility that, to my knowledge, has not heretofore been observed. Nevertheless, as far as medial /sC/ clusters are concerned, the effect of MAX(ROOT) on adjacent vowels is only visible later when sibilants delete in OF.

As detailed in Montaño (*in press*), appealing to a MAX(ROOT) constraint for compensatory lengthening upon coda /s/ deletion also holds distinct implications for /s/ deletion in later OF words exhibiting prothesis of what either once was or still was underlying word-initial /sC/. This is a crucial difference with the moraic account, which seemingly leaves unexplained the lack of compensatory lengthening upon coda /s/ deletion in words to which prothesis applied, as in (3b-iii,v). Once prothesis as a process shifted from the postlexical to the lexical phonology, as shown above in (4a-b), the fixed surface presence of the prothetic [e] is unsurprising but need not necessarily be indicative of this vowel having already become underlying, at least as long as coda /s/ was permitted to surface faithfully in the [s.C] cluster that predictably followed the prothetic vowel. Although more abstract to posit that the prothetic vowel was not yet underlying, appealing to MAX(ROOT) transforms prothesis at the time of

coda /s/ deletion into an opaque work-around to the illicit word-initial /sC/ cluster. Since there is (underlyingly) no preceding vowel to which to link the root node of /s/, which must delete to resolve the illicit onset cluster, its abandoned root node is salvaged by simple vowel insertion, and thus surfaces as short since it occupies one root position, while the /s/ is deleted despite, crucially, not being in a moraic position in this account, in a case of non-surface-apparent opacity (McCarthy 1999). Active during the same diachronic stage as its word-internal application in (13a), the word-initial effect of MAX(ROOT) in words undergoing prothesis is illustrated in (14):

(14) OF prothesis with /s/ deletion in underlying word-initial /sC/ clusters:
/spusə/ → [e.pu.zə] 'wife'



Source: Montaño (*in press*)

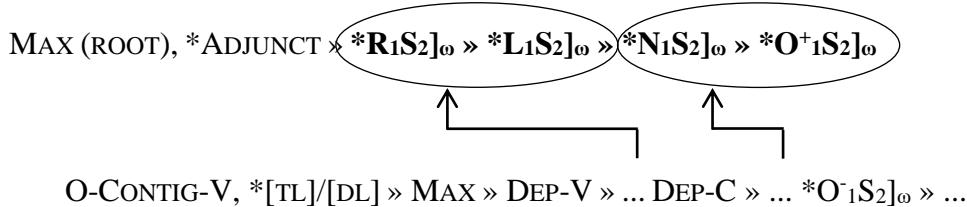
In this way, MAX(ROOT) accomplishes compensatory lengthening word-medially when /s/ deletes after an underlying vowel via the re-association of the abandoned root node to the preceding input vowel, now doubly-linked; meanwhile, prothesis words exhibit a short vowel in output instead, because the insertion of the prothetic vowel in word-initial /sC/ contexts salvages the single root node of deleted word-initial /s/. Some lexical variants in the 12th century like *despoir*-Ø vs. *desespoir*-Ø 'despair-1ST.SG.PRES' (/des ~ de + spoir ~ espoir + Ø/)¹⁰ (Constans 1918, citing *Yvain et le Chevalier du Lion*, late 12th century: "*Mès d'une chose me despoir*" 'but of one thing I despair') or, after OF, *désépingl-er* vs. *dépingl-er* 'unpin-INF' or *déchou-er* vs. *déséchou-er* 'refloat-INF' (Montaño, *in press*, citing *TLFi*), in which both preconsonantal ([de]) and prevocalic ([des]) allomorphs of the prefix are attested, point to potentially distinct reflexes towards the underlying presence or absence, synchronically or diachronically, of the prothetic vowel in morphophonology. Critically, they furthermore suggest that it is at the very least defensible not to assume that the fixed nature of the prothetic vowel during OF indicated it had so definitively and immediately become underlying.

Based on the arguments above, and with the inclusion of MAX(ROOT), undominated for the purposes of the phenomena in focus here and achieving the unequal application of compensatory lengthening upon coda /s/ deletion, I formalize the two-stage continuation of the syllable-contact effect resulting in OF coda /s/ deletion in the two constraint hierarchies in (15), expanding on previous work restricted to sibilant-obstruent clusters (Montaño, *in press*):

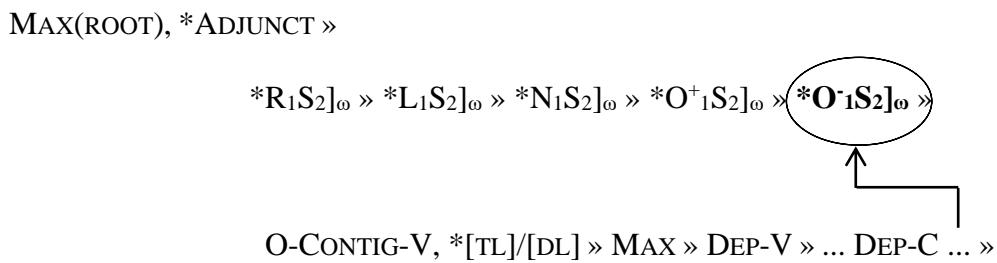
¹⁰ This particular stem, /sper ~ spoir/ meaning 'hope' (cf. *espér-er* 'hope-INF'), is well-known as an exception to coda /s/ deletion, likely due to its semi-learned use in religious contexts from ecclesiastic spheres (Pope 1952), with the preservation of coda /s/ in pronunciation persisting into contemporary French. Even so, as a word-initial /sC/ cluster, the variable reflex of prefix *des-* before /sper ~ spoir/ is suggestive of the potentially unstable underlying status of the prothetic vowel at this stage. Alternatively, a true lexical doublet *desper-er* 'despair-INF' based on Latin *desperare* existing alongside a polymorphemic *des+esper-er* 'despair-INF' offers another viable hypothesis (Bloch & Wartburg 1964) (my thanks to an anonymous reviewer for pointing out this alternative claim).

(15) Constraint hierarchies for OF coda /s/ deletion, Stages 1 and 2, in light of prothesis and syllable contact effects

a. Stage 1: OF constraint hierarchy (11th & 12th centuries)



b. Stage 2: Later OF constraint hierarchy (13th century)



With respect to the PF constraint hierarchy in (12), no additional assumptions are made regarding changes in constraint rankings not reflected in the data. As discussed above, *ADJUNCT must rank high in the OF word-level phonology once prothesis affects /sC/-initial words regardless of phrasal context. In addition, while DEP-C may or may not in reality rank as low during OF as it did during PF, even if one takes the conservative stance that its ranking remained unchanged, deletion would still represent the minimal violation, since more stringent restrictions on /sC/ combinations in syllable contact ensured that stop epenthesis would not yield an optimal output by Stage 2 without the additional elimination of the coda /s/. Given this, and no clear evidence for either stance outside of verb stem alternations that likely represented lexicalized stem allomorphs, DEP-C remains *in situ* in the constraint hierarchy in (15) in order to demonstrate that even if it ranked below MAX during OF, this would not change the outcome for words affected by coda /s/ deletion.

I now present tableaux illustrating the constraint interaction yielding attested outputs for Stage 1 coda /s/ deletion, exemplifying the OF phonological system's reflexes towards underlying word-medial /sI/, /sN/, /sO⁺/ and /sO⁻/ SCCs, presented in Tableaux 2-5 respectively:

Tableau 2. OF Stage 1 coda /s/ deletion in /sl/ SCCs.*/maslə/ → [mə:lə] 'male'*

maslə/	MAX(ROOT)	* ADJUNCT	DEP(PL)	* S ₁ L ₂] _σ	* L ₁ S ₂] _ω	* O ⁺ 1S ₂] _ω	O-CONT-V	* [TL]/[DL]	MAX	DEP-C	* O ₁ S ₂] _ω
a. maz.lə				*!							
b. ma.zə.lə				!							
c. ma.zlə				*!							
d. ma.z+lə		*!									
e. mas.tlə								*!		*	*
f. maz.blə						*				*	
g. ma.lə	*!										
h. ma :lə									*		

Tableau 3. OF Stage 1 coda /s/ deletion in /sm/ SCCs.*/blasmer/ → [bla:.mer] 'accuse-INF'*

/blasmer/	MAX(ROOT)	* ADJUNCT	* S ₁ N ₂] _σ	* N ₁ S ₂] _ω	O-CONT-V	MAX	* O ₁ S ₂] _ω
a. blaz.mer				*!			
b. bla.zə.mer					*!		
c. bla.zmer				*!			
d. bla.z+mer		*!					
e. bla.mer	*!						*
f. bla :mer							*

Tableau 4. OF Stage 1 coda /s/ deletion in /sd/ SCCs.*/isdə/ → [i:.də] 'horror'*

/isdə/	MAX(ROOT)	* ADJUNCT	* S ₁ O ⁺ 2] _σ	* O ⁺ 1S ₂] _ω	O-CONT-V	MAX	* O ₁ S ₂] _ω
a. iz.də				*!			
b. i.zə.də					*!		
c. i.zdə				*!			
d. i.z+də							
e. i.də	*!						*
f. i :də							*

Tableau 5. OF Stage 1 preservation of coda /s/ in /st/ SCCs.*/fəstə/ → [fəs.tə] 'party'*

/fəstə/	MAX(ROOT)	*ADJUNCT	*S ₁ O ₂] _σ	O-CONTIG-V	MAX	*O ⁻¹ S ₂] _ω
a. f fəs.tə						*
b. fə.sə.tə				*!		
c. fə.stə			*!			
d. fə.s+tə		*!				
e. fə.tə	*!				*	
f. fə:.tə				*!		

Tableau 2 illustrates that despite having escaped stop epenthesis in PF, the promoted $*L_1S_2]_ω$ split-margin constraint, higher-ranking than during PF, alongside the continued failure due to phonotactics of a hypothetical epenthesis repair, now favors the deletion of the offending coda sibilant in violation of MAX, with MAX(ROOT) ensuring compensatory lengthening of the preceding vowel. Tableaux 3 and 4 show how $*N_1S_2]_ω$'s and $*O^{+1}S_2]_ω$'s promotion above MAX ensures /s/ deletion, with fewer confounding factors than seen for /sl/, given no cluster-final liquid to syllabify as a complex onset with a hypothetical epenthetic coronal stop (cf. PF medial stop deletion in [5d], showing the impermissibility of *[.tm], for example, in *fortimente* > *forment* 'strongly'). Finally, Tableau 5 confirms that the Stage 1 constraint hierarchy yields the attested preservation of coda /s/ before voiceless stops during the 11th and 12th centuries.

In the 13th century, the slight sonority fall from sibilant to voiceless stop ceases to be sufficient, and thus coda /s/ is lost in this final syllable-contact environment via the promotion of $*O^{-1}S_2]_ω$ above MAX, as shown in Tableau 6:

Tableau 6. OF Stage 2 coda /s/ deletion in /st/ syllable-contact clusters.*/fəstə/ → [fə:.tə] 'party'*

/fəstə/	MAX(ROOT)	*ADJUNCT	*S ₁ O ₂] _σ	*O ⁻¹ S ₂] _ω	O-CONTIG-V	MAX
a. fəs.tə				*!		
b. fə.sə.tə					*!	
c. fə.stə			*!			
d. fə.s+tə		*!				
e. fə.tə	*!					*
f. f fə:.tə						*

With the deletion of coda /s/ in this final SCC type, the ever-stricter requirements on /s/-initial SCCs have culminated in a more comprehensive phonological ban against /s/ in word-internal coda position.

In keeping with Montaño's (*in press*) MAX(ROOT) analysis, words exhibiting prothesis look a bit different, given the unique way in which they meet the requirements of the constraint hierarchy during Stages 1 and 2, as presented in Tableaux 7 and 8:

**Tableau 7. Prothesis of word-initial /sC/ in OF Stage 1, with preservation of [s.C] SCC.
/spuser/ → [es.pu.zer] 'wed-INF'**

/spuser/	MAX(ROOT)	* ADJUNCT	* $S_1O_2]_o$	O-CONTIG-V	MAX	DEP-V	* $O_1S_2]_o$
a. sə.pu.zer				*!		*	
b. spu.zer			*!				
c. s+pu.zer		*!					
d. e.spu.zer			*!			*	
e. es.pu.zer						*	*
f. e.pu.zer					*!	*	
g. pu.zer	*!				*		

**Tableau 8. Prothesis of word-initial /sC/ in OF Stage 2, with deletion of coda /s/ and without compensatory lengthening.¹¹
/spuser/ → [e.pu.zer] 'wed-INF'**

/spuser/	MAX(ROOT)	* ADJUNCT	* $S_1O_2]_o$	* $O_1S_2]_o$	O-CONTIG-V	MAX	DEP-V
a. sə.pu.zer					*!		*
b. spu.zer			*!				
c. s+pu.zer		*!					
d. e.spu.zer			*!				*
e. es.pu.zer				*!			*
f. e.pu.zer						*	*
g. pu.zer	*!					*	

In OF Stage 1, when [s.O⁻] remains licit word-medially, the interplay of O-CONTIGUITY-V » MAX » DEP-V continues to yield a word-initial prosthetic vowel,

¹¹ A hypothetical candidate *[e:pu.zer] constitutes another unattested output form. One possibility is that it violates an additional constraint such as *VV against long vowels. This constraint must rank below MAX(ROOT) to allow for the surfacing of long vowels in compensation for word-medial coda /s/ deletion via root node re-association. But in the case of prothesis, the long vowel is superfluous, since a single short prosthetic vowel already preserves the root node of deleted word-initial /s/ and thus satisfies MAX(ROOT), making the violation of *VV fatal. The alternative hypothetical input form /espuser/, including the prosthetic vowel as underlying (not argued here), introduces the additional undesired effect, as highlighted above, of predicting unattested compensatory vowel lengthening when /s/ deletes in words undergoing prothesis, leaving the attested short vowel unexplained. The further elaboration of this point is left aside here for future elaboration.

with underlying word-initial /sO⁻/ surfacing as a SCC ([es.O⁻...]). When such SCCs are no longer tolerated by Stage 2, the promoted split-margin constraint rules out simple vowel prothesis due to the creation of the illicit SCC, and so the last resort to satisfy MAX(ROOT) upon /s/ deletion is to insert a vowel, which surfaces as short, to hold the root node. In this way, MAX(ROOT) ensures the continued surfacing of the non-underlying initial vowel despite the opaque motivation for its insertion, the /sC/ SCC, no longer apparent in the surface form.

With the rise of all word-level $*[X_1S_2]_o$ constraints above MAX banning the surfacing of sibilant-initial SCCs in OF, /s/ is essentially eliminated from coda position throughout the lexicon. Upon and beyond Stage 2 OF, only a handful of exceptions, like *espér-er* 'hope-INF,' undoubtedly under the influence of learned ecclesiastic spheres, remain with coda [s] in a word-internal SCC, reflective of a conservative treatment (akin to Stage 1 OF) of the word-initial /sC/ cluster surfacing with the prothetic vowel (still avoiding an /sC/ onset cluster) and exceptionally retaining coda [s] in the least marked [s]-initial SCC, [es.O⁻]. Importantly, this analysis does not necessitate appealing to moraic constraints, which, as argued above, leave unexplained many of the historical details of the multi-stage rollout of coda /s/ deletion, defined here as a function of constraints on the sonority differential of sibilants with the following onset, a syllable contact effect reflected in the attested evolution of early French /sC/ clusters. Instead, the culmination of coda /s/ deletion in syllable contact upon Stage 2 paves the way for the likely promotion of a moraic constraint on sibilants above MAX no earlier than after all instances of surface coda /s/, minus learned exceptions, have been lost. Finally, the interconnected nature of OF coda /s/ deletion within the diachronic phonology to cognate phenomena affecting /sC/ clusters, such as PF stop epenthesis and prothesis, is not only underscored but formalized in this account. Instead of mora licensing causing coda /s/ deletion at the time of its application, I instead argue that the ever-stricter syllable contact progression gives rise to it as the natural acquisitional consequence of the more total ban on sibilants in coda position in OF.

5. Conclusions

In this paper, I propose that the details of OF coda /s/ deletion and its phenomenological connections with prothesis and PF stop epenthesis are best formalized as a progressive tightening of constraints on syllable contact sonority contour whose end result is the loss of sibilants in coda position. The seeds of this progression are present in the PF period and culminate in the 13th century with OF coda /s/ deletion, resulting in the near-total absence of /s/ in word-internal coda position throughout the lexicon. On the model of $*\mu/Obs$ once coda obstruents were lost over the course of the PF period, the distributional gap of /s/ in coda position motivates upcoming generations to acquire $*\mu/S$ over MAX, with the long vowel output re-interpreted as a moraic phenomenon. The progression begun by $*\mu/Obs$, and then $*\mu/S$, continues as progressively-stricter sonority-graded mora-licensing constraints advance against other coda consonants in OF (nasals, laterals, rhotics in some dialects), as posited by Gess (1999 and later work). In this way, the rise of mora-licensing constraints is not the cause of OF coda /s/ deletion, but rather the effect.

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