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A Stratal Phonological Analysis of Stem-Level and Word-Level Effects in Old French Compensatory Vowel Lengthening upon Coda /s/ Deletion

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Abstract: The well-known deletion of coda sibilants in Old French (11th–14th centuries) induced a compensatory lengthening effect on the preceding vowel, generally described as applying uniformly where coda /s/ was lost. This study highlights and analyzes phonological contexts where lengthening likely did not occur, examining their interaction with stress assignment, vowel quality, schwa adjustment, prothesis, and morphological structure. The Stratal OT analysis formalizes the proposed pattern differentiating the long and short vowel reflexes identified especially for mid vowels: while categorical in tonic syllables and low vowels /a, ɑ/ irrespective of stress, lengthening only prevails in atonic mid vowels when coda /s/ deletion impacts a syllable assigned stress within the specific stratal phonological cycle when /s/ is deleted from input. The resulting length is transmitted and preserved in subsequent stratal cycles regardless of eventual word-level stress reassignment, especially (but not exclusively) because of word-level schwa adjustment, allowing a shift to word-final stress and producing an opacity effect of a long atonic mid vowel inherited from an earlier cycle. The stratal account formalizes observed analogical effects between lexical items and derived forms with respect to vowel quality and length and proposes them to result instead from the interplay of morphology and phonology.

Keywords: Old French; historical phonology; coda deletion; compensatory lengthening; stratal phonology; morphology–phonology interface; vowel length

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1. Introduction

In this paper, I propose a stratal phonological account of stem- and word-level stratal effects accounting for the non-uniform realization of compensatory vowel lengthening posited to have accompanied Old French (OF, approximately 11th–14th centuries) coda /s/ deletion, yielding superficial analogical effects within morphologically-related words as well as opacity in others where there is an unexpected mismatch between vowel lengthening and stress assignment. Coda /s/ deletion in OF has generally been described as a straightforward deletion with compensatory lengthening process affecting a relatively low-sonority segment, /s/ ([s] or [z]) in coda position (e.g., *feste* > *f*[ɛ:]*te* 'party') (e.g., Pope 1952; Gess 1998, 1999, 2001; Marchello-Nizia et al. 2020 [*Grande grammaire historique du français*, henceforth *GGHF* 2020]; Montaño, forthcoming). However, a more extensive examination of the lexical items impacted by coda /s/ deletion, the word positions representing the locus of the process, as well as the diachronic trajectory of the vowels preceding deleted coda /s/ in affected words cast doubt that lengthening occurred uniformly in all contexts. Furthermore, the morphological and phonological factors governing the patterning of short and long vowel reflexes are in reality quite complex. As will be detailed in the proposed account below, whether coda /s/ deletion induced lengthening on the preceding vowel results from the interplay of phonology and morphology, with stem-level and word-level stratal effects central to correctly predicting whether lengthening accompanied coda /s/ deletion in the word-level output form. The Stratal Optimality-Theoretic analysis (Kiparsky

2015; Bermúdez-Otero 2018) presented here has two principal aims. First, it seeks to more precisely define the locus and factors governing OF compensatory vowel lengthening upon coda /s/ deletion. Second, it aims to elucidate the complex interaction of processes and constraints as well as the opacity produced in certain loci of application, teasing apart the overlapping applications of coda /s/ deletion, prothesis, and compensatory lengthening as they interact with affixation, stress assignment, schwa alternations, and vowel quality within stem- and word-level strata. By doing so, it proposes a clearer account of where lengthening does and does not occur upon the loss of coda /s/. In this paper, I focus especially on the Francien dialect of OF, the historical progenitor of Parisian French localized in the Île-de-France region, though much of the analysis can be readily applied to related northern *langue d'oïl* varieties of Gallo-Romance.

A well-established process in OF diachronic phonology, coda /s/ deletion represents a subprocess of the more extensive loss of most word-internal coda consonants characteristic of OF more generally, potentially in a sonority-graded progression first affecting coda /s/ and advancing to coda nasals, /l/ and, in some varieties, /r/ (Gess 1999). Coda sibilants ([s] or [z]) survived the Proto-French (PF) period bridging Latin and OF (2nd–10th centuries), despite the previous loss of coda obstruents over the course of PF (Jacobs 1995; *GGHF* 2020, sct. 21.2, pp. 390–95; Montaño 2023). The unique status attributed to sibilants in early French phonology is evidenced by their licensing in coda position until the time of coda /s/ deletion beginning around the 11th century. Their persistence as codas beyond PF is representative of sibilants constituting a slightly higher sonority class than other obstruents, likely because of the high perceptual salience of such turbulent fricatives (Wright 2004; Yin et al. 2023) amongst obstruents. Diachrony supports this reasoning, given the existence of some orthographic evidence for aspiration and backing to [h] as an intermediate transitional stage before the full deletion of [s] or [z] (*GGHF* 2020, sct. 363, p. 457). Earlier lenition to [h], arguably an allophone of /s/ in coda position, gives way to full segmental deletion, with compensatory lengthening of the preceding vowel claimed to accompany /s/-loss (Nyrop 1914; Pope 1952; Gess 1999, 2001; *GGHF* 2020, sct. 24.2.1.2d, pp. 454, 24.2.2.2f, 458) in at least two attested stages as follows: an 11th-12th century Stage 1 affecting [z], which occurred before /l/, nasals, or a voiced obstruent, and a 13th century Stage 2 affecting coda [s] preceding voiceless obstruents (Nyrop 1914; Pope 1952; Bourciez 1955; Gess 1999). Lexical items exemplifying these two attested stages appear in Table 1.

Table 1. OF coda /s/ deletion in two stages (11th–13th centuries) (Pope 1952, p. 151, cited in Gess 1999; Montaño, forthcoming).

(a) Stage 1: Loss of word-internal coda [z] before /l/, nasals, and voiced obstruents (11th and 12th centuries)				
	Latin (>PF)	**> earlier OF**	**> later OF**	**Gloss**
i.	insula(m) (>*isola)	> *isle* [iz.lə]	> ['iː.lə]	'island'
ii.	hispidu(m)	> *hisde* [iz.də]	> ['iː.də]	'horror'
iii.	*blastemare	> *blasmer* [blaz.mer]	> [blɑː.'mer]	'accuse-INF'
iv.	misculare	> *mesler* [mez.ler]	> [mɛː.'ler]	'mix-INF'
(b) Stage 2: Loss of word-internal coda [s] before voiceless obstruents (mid-13th century)				
	Latin (> PF)	**> earlier OF**	**> later OF**	**Gloss**
i.	festa(m)	> *feste* [fɛs.tə]	> ['fɛː.tə]	'party'
ii.	noster	> *nostre* [nɔs.trə]	> ['noː.trə]	'our.POSS.1PL'
iii.	*sponsare	> *esposer* [es.po.zer]	> [e.pu.'zer]	'wed-INF'
iv.	*frisca(m)	> *fresche* [fres.tʃə]	> ['frɛː.ʃə]	'fresh-FEM.SG'
v.	*(e)skutarju(m)	> *escu(d)ier* [es.ky.(ð)i.er]	> [e.ky.'jer]	'squire'

Most accounts of OF coda /s/ deletion (Nyrop 1914; Pope 1952; Bourciez 1955; Gess 1999) cite the distinction between surface [z] and [s] as determining the chronology of the two stages in Table 1, with [z] deleting before [s]. Anglo-Norman borrowings into English corroborate this diachronic division reflecting the loss of [z] in the earlier stage alongside the continued realization of coda [s] at that time (cf. *ile*, *hideous*, *blame* vs. *feast*, *beast*, *espouse*, etc.). While the ordering of the two stages is largely uncontroversial, a moraic account of OF coda deletion such as in Gess (1998, 1999) referencing a sonority-graded progression of mora-licensing constraints against low-sonority moraic segments may not fully align with the chronology of coda /s/ deletion. This is because, by most phonological accounts (e.g., Gouskova 2004; Pons-Moll 2011, amongst many), voiced obstruents are generally considered more sonorous than their voiceless counterparts, making [z], in principle, a more suitable moraic consonant than [s]. But the opposite ordering is documented for OF. A plausible counterpoint to this might be that the high perceptual salience of [s], yielding greater frication noise and amplitude, could instead translate to its greater sonority than [z] on a phonological level if acoustic intensity (Wright 2004; Yin et al. 2023) is equated with degree of phonological sonority. The lack of consensus on the relative sonority of [z] versus [s] thus constitutes a potential drawback to the moraic approach to the diachrony of OF coda /s/ deletion, given it specifically relies on the fine-grained distinction between these two near-identical segments in coda position.

While a dispreference for moraic sibilants likely indeed plays a central role in the loss of syllable-final /s/ in OF more generally, as part of the broader progression posited by Gess as following the loss of coda obstruents and progressing to coda sonorants (Gess 1998, 1999), Montaño (forthcoming, 2024) proposes a distinct account not immediately reliant on the sonority relation between [z] and [s] (in which they are in fact classed within the same sonority tier of "sibilants"). Based on the observation that [s] and [z] were non-distinctive in OF in coda position and arguably positional allophones of /s/ that were entirely predictable according to the nature of the following onset consonant, Montaño instead argues that the diachronic trajectory of phonological repairs on word-internal /sC/ sequences is best described as a syllable contact effect. Syllable-contact clusters composed of a coda segment plus the following onset universally prefer maximally falling sonority, as the least marked coda segments are of high sonority while the least marked onsets are of low sonority (cf. Clements 1990; Bat-El 1996; Baertsch and Davis 2003). Repairs like deletion targeting /sC/ clusters in early French may instead be triggered by the relative acceptability of the sonority contour between /s/ and the following onset across the syllable boundary. This account is further corroborated by the absence of a sibilant preceding a rhotic by the time of OF, totally absent in the examples in Table 1. This sequence had already undergone repair to [s.tr] or [z.dr] during the earlier PF period via stop epenthesis, a phonological repair previously attributed to resolving a poor syllable contact cluster (cf. Martínez-Gil 2003; Montaño 2024). If the quality of the consonant following /s/ is taken into account, OF coda /s/ deletion can instead be seen, alongside the OF preference for deletion over epenthesis as the preferred repair mechanism, as the progression and culmination of ever-stricter syllable-contact constraints on /s/ + consonant sequences. Beginning with /sr/, advancing to /sl/, /sN/, and /s/ + voiced obstruent, and culminating with /s/ + voiceless obstruent, this diachronic shift forms a natural progression from least harmonic syllable contact sonority contour (rising to near-flat) to least marked (slightly falling) (Montaño 2024). In this perspective, the diachrony of [z] deleting before [s] falls out naturally from universal hierarchies of optimal syllable contact sonority contours.

The compensatory lengthening effect posited to have accompanied OF coda /s/ deletion is largely treated in the literature as a uniform effect (Nyrop 1914; Pope 1952; Bourciez 1955, pp. 216–17; Gess 1998, 1999; *GGHF* 2020, sct. 24.2.1.2d, p. 454; §24.2.2.2f, p. 458). It has typically been described as "ordinarily lengthening" the preceding vowel ("*l'amuïssement de [s] amenait ordinairement l'allongement de la voyelle précédente*" ["the muting of [s] ordinarily brought lengthening of the preceding vowel"] [Nyrop 1914, p. 417]; "*une longueur phonétique compensatoire associée à la consonne disparue*" ["a phonetic compensatory

length associated with the lost consonant"] [*GGHF* 2020, sct. 24.2.1.2d, p. 454]), with some reference to lengthening affecting "especially the tonic vowel" (Pope 1952, §564, p. 206). Direct and indirect evidence of vowel lengthening upon the loss of coda /s/ includes rates of poetic rhyme segregation of vowel + s + consonant sequences from other vowel + consonant sequences, an extensive example of which, spanning the 12th–16th centuries and including the scansion of over 100,000 lines of verse, is presented by Gess (2001). Gess' valuable study shows that, while segregation rates are relatively high and stable before coda /s/ deletion and during a century and a half afterward, there is a significant drop-off around the 15th century in the rhyme segregation rates of syllables containing orthographic *s*. A spelling convention that continued beyond when /s/ had lost its consonantal value in OF, orthographic preconsonantal *s* has generally been understood as a graphic representation of vowel length, eventually supplanted by the modern use of the circumflex accent (Bourciez 1955, p. 217). That distinctive vowel length for the purposes of poetic rhyme in syllables where coda /s/ was lost had become unstable by this time is corroborated by the prescriptive pressure exerted in the remarks of several 16th-century grammarians. Though indubitably conservative in nature as typical of grammarians' prescriptive recommendations, the statements below (from Gess 2001; citing Pope 1952, p. 206) constitute indirect evidence of the reality of phonological vowel length in close chronological proximity to when Gess notes the instability in vowel length segregation rates in poetry:

- "...when *s* is elided before a consonant, as in *est*, they sound a double or triple sound *eee*" (Gess 2001, citing Erasmus' *De recta latini graecique sermonis pronunciatione* from 1528).
- "*Afin qu'il gemist* ... the interpolation of this letter *s* shows that this letter *i* is to be pronounced differently from the way it is pronounced in the present tense *il gemit*" (Gess 2001, citing H. Estienne's *Traicté de la conformité du langage françois auec le grec* from 1582).
- "Every *s* mute before a consonant ... lengthens the preceding vowel" (Gess 2001, citing Théodore de Bèze's *De Francicae linguae recta pronunciatione* from 1584).
- "Nothing can offend the ear more than the lengthening of the short vowel and the shortening of the long" (Gess 2001, citing Théodore de Bèze's *De Francicae linguae recta pronunciatione* from 1584).

Finally, vowel quality shifts in non-high vowels accompanying the deletion of /s/, arguably reinforced by vowel lengthening, leave diachronic evidence of syllables once closed by /s/ and erstwhile vowel length. Regular changes from /e/ → [ɛ], /ɔ/ → [o], and /a/ → [ɑ], attributed to a syllable-final articulatory backing and lowering effect also characteristic of the transitional positional variant [h] for lenited coda /s/ before it fully deleted (*GGHF* 2020, sct. 24.2.2.2e, p. 457), attest to the earlier presence of /s/ and likely also the compensatory vowel length resulting from /s/ deletion. This effect is further suggested by the persistence in some North American French varieties of a contrast between monophthongal short vowels and a diphthongized realization of historically long vowels produced by coda /s/ deletion sharing the same place of articulation (e.g., *fête* [fɛit] 'party' vs. *faite* [fɛt] 'done'). Even though diphthongization is variable and especially representative of /ɛ/ vs. /ɛ:/ (Walker 1984; Côté 2012, pp. 244–45), the survival of a distinction between once-lengthened versus short phonemic contrasts like these finds additional support in morphophonology. For example, in addition to long tonic vowels, pretonic length is possible in affixed words built on a word containing an "intrinsically long" vowel, e.g., *arr*[ɛ:]*ter* 'stop-INF' (cf. *arr*[ɛ:]*t* 'stop-NOUN) or *pr*[ɛ:]*tresse* 'priestess' (cf. *pr*[ɛ:]*tre* 'priest') (Walker 1984, pp. 47–48). In such examples, the long vowel in the base is preserved in derived forms and can optionally undergo diphthongization in the output of certain speakers. These quality and length correlates of the historical output of coda /s/ deletion offer supporting evidence of the reality of compensatory lengthening of the vowel preceding early OF coda /s/. Similarly, the data in Table 1 corroborate that vowel lengthening in some cases affected more than "especially the tonic vowel" (Pope 1952, §564, p. 206). In (1a,iii–iv), affixed examples with word-final stress like *blasm+er* >

bl[ɑː]*mer* 'blame-INF' and *mesl+er* > *m*[ɛː]*ler* 'mix-INF' exist alongside other lexical items like *ostel* > [oː]*tel* 'lodging,' *gastel* > *g*[ɑː]*tel* 'cake,' and *chastel* > *ch*[ɑː]*tel* 'castle' that are likely polymorphemic yet exhibit a quality-shifted and presumably once-long vowel in the pretonic syllable.

On the other hand, distinct from these pretonic lengthened vowels is the short vowel reflex of coda /s/ deletion in words undergoing prothesis of /sC.../ → [es.C...], like those in (1b,iii) and (1b,v). In such words, there is no evidence that the vowel quality of the prothetic vowel preceding a word-initial /sC/ cluster ever shifted from [e] or ever lengthened, despite the deletion of /s/ in this position. Montaño's analysis (forthcoming) of the intersection of OF coda /s/ deletion with word-initial prothesis accounts for the short vowel as resulting from such words not possessing the vowel preceding /s/ underlyingly, making them still /sC/-initial in input. This claim is justifiable given the near-contemporary alternation between prothetic ([es.C...]) and non-prothetic ([s.C...]) forms according to the preceding phrase-level segmental context (preceded by a vowel-final word or not) (Pope 1952; Sampson 2010). Further suggestive evidence can be found in contemporary OF prefixed forms not exhibiting the prothetic vowel (e.g., *despoir* 'make-hopeless-3RD.SG.PRES.IND' ← /de(s) + sper/ vs. later, *des̲espoir*) (Montaño, forthcoming). In Montaño's (forthcoming) account, the short vowel reflex of /s/ deletion in examples like *espouser* /spu.zer/ > *épouser* [e.pu.zer] in (1b,iii) diverge from when the process occurs after an underlying vowel that can be lengthened (e.g., *estre* 'be-INF' > [ɛː.trə]) in compensation for the lost /s/. When prothesis accompanies /s/ deletion, the short vowel reflects the preservation of a single word-initial root node corresponding to deleted /s/. The vowel represents the only segment that can syllabify pre-consonantally in this position and is thus inserted to fill the abandoned root node and surfaces as short by virtue of holding a single root position.

Once stress is taken into account, however, examples like *estre* ['ɛː.trə] may instead be said to diverge from those like *épouser* [e.pu.'zer] because of coda /s/ deletion affecting a tonic or atonic syllable. Additional examples, such as the eventual homophony of *esté* /este/ > [e.'te] 'summer' (< Latin *æstate(m)* (Meyer-Lübke 1890, p. 424)), whose initial vocalic segment is inherited etymologically, with *esté* /(e)ste/ > [e.'te] 'be-PAST.PARTICIPLE' (< Latin *statu(m)*), exhibiting prothesis of the input-initial /sC/ cluster, illustrate that the consistent atonic status of the initial vowel, whether etymological or prothetic, indeed represents an additional factor interacting with lengthening. Such examples stand in opposition with *estre* ['ɛː.trə] (< °*essere* < Latin *esse* 'be-INF'), where the etymological initial vowel bears stress and thus diachronically exhibits the long vowel reflex. That the prothetic vowel is always atonic furthermore stands in opposition to examples like *blasmer* [blɑː.'mer] and *ostel* [oː.'tɛl], where the word-internal atonic vowel preceding deleted /s/ lengthens.

Whereas compensatory lengthening in the tonic syllable appears essentially categorical, both short and long vowel reflexes in atonic syllables, as evident in (1b-iii,v) versus (1a-iii,iv), do not support claims that compensatory lengthening applied uniformly when coda /s/ was deleted in OF. A broader examination of the OF lexicon and the diachronic trajectory of words undergoing coda /s/ deletion uncover numerous additional examples exhibiting a similar aversion to compensatory lengthening upon /s/ deletion when occurring in the atonic syllable of impacted words. Examples like *tesmoing* [tes.'mɔ̃ĩɲ] > [te.'mɔ̃ĩɲ] 'witness', *postel* [pɔ.'tɛl] 'post, pole' (> Modern French [ModFr] *poteau*, cf. OF *post* 'post, pole' < Latin *postis* 'door jamb' [*TLFi* 1994]) and prefixed forms like *desfaire* > *d*[e]*faire* 'undo-INF' corroborate that a long vowel is not always the reflex of the process, especially outside of the tonic syllable. It is difficult to know with absolute certainty if such vowels simply never lengthened or if they lengthened and then shortened soon thereafter, given the continued convention of including orthographic *-s-* for either length or to reflect etymology in words where it no longer represented a consonantal pronunciation, as well as what is indubitably a measure of variation with respect to the concomitant shifts in vowel quality in atonic syllables. Even so, the lack of the generally regular vowel quality shifts in many examples of atonic coda /s/ deletion strongly points to many of these vowels,

especially the mid vowels /e, ɛ, o, ɔ/, never lengthening, with some early examples attested where spelling quite clearly aims to represent a short vowel (e.g., *potteau* [< *postel*] cited from 1412 [*TLFi* 1994]). Bourciez (1955, p. 217) notes this with respect to /e/ in atonic syllables: "*Le* s *en 'seffaçant a allongé la voyelle précédente, et cet allongement est 'dordinaire marqué dans 'lorthographe par un accent circonflexe. Toutefois, 'laccent aigu se trouve souvent sur* é *en syllabe atone* (fétu, répondre, témoin, etc.)" ("*S*, when deleting, lengthened the preceding vowel, and this lengthening is ordinarily marked in spelling by a circumflex accent. However, the acute accent is often found on *é* in an atonic syllable [*fétu, répondre, témoin,* etc.]" [*translation my own*]). Low vowel /a/, on the other hand, with few exceptions (e.g., *vaslet* > *v*[a]*let* 'servant' [*TLFi* 1994]; cf. **v*[ɑ]*let*), regularly yielded quality-shifted [ɑ] regardless of whether the following coda /s/ was deleted in a stressed or unstressed syllable (e.g., atonic *mastin* 'guard dog', *chastain* ~ *chastaigne* 'chestnut(-colored)', *'bastir* (/bast+ir/) 'build-INF', *blasmer* (/blasm+e+r/) 'blame-INF', *chastier* /ʧasti+e+r/ 'castigate-INF', *chastel* 'castle', *rastel* 'rake' vs. tonic *asne* 'donkey', *masle* 'male', *haste* 'haste', *mast* 'mast', *bast* 'packsaddle', etc. [*TLFi* 1994]). Low vowels' uniform lengthening reflexes irrespective of tonicity are reflective of their greater intrinsic articulatory backness and duration with respect to non-low vowels (Keating 1985; Flemming 2005; Toivonen et al. 2015) and thus their expected higher propensity towards backing and lengthening than non-low vowels. This consistent backing and lengthening of /a, ɑ/ regardless of stress aligns with these phonetic properties of /a, ɑ/ and likely underlies the examples cited above, echoed by Pope's (1952, pp. 244, 246) claims that these vowels transmitted as long subsequent to coda /s/ deletion both in examples where they are tonic and atonic. The overall divergence between vowel quality shifts in mid vowels versus consistent reflexes for low vowels in atonic syllables impacted by coda /s/ deletion strongly suggests that mid vowels may not have always lengthened in this position while low vowels did. In the present discussions, left aside are high vowels, given no vowel quality shifts to evidence historical length in atonic syllables. My study's prediction, however, is that they likely patterned with the mid vowels, exhibiting categorical lengthening reflexes in tonic syllables, as is generally well-evidenced in French historical phonology (e.g., *isle* > ['iːlə] 'island' [Gess 1999]), and favoring a short vowel reflex in atonic syllables.

While it remains possible that all vowels preceding deleted coda /s/ lengthened and some or all lost length in atonic syllables shortly thereafter, or that all atonic vowels preceding deleted coda /s/ remained short and the low vowels only underwent backing to short [ɑ], given the evidence available in atonic positions with respect to vowel quality and subsequent vowel length or pretonic diphthongization in some modern varieties of French (cf. some North varieties as cited by Walker 1984 and Côté 2012), I argue that the evidence weighs in favor of both stress and vowel quality interacting with the realization or not of compensatory vowel lengthening preceding deleted coda /s/ in OF. As will be discussed alongside the analysis further below, if future evidence demonstrates that vowel quality did not actually affect the original lengthening behavior in atonic syllables, or if shortening was chronologically subsequent to coda /s/ deletion with a more uniform lengthening effect, it is not fatal to the analysis presented here but rather compatible with minor adjustments in the definition of the relevant phonological constraints (see Section 2.3). A few exceptions notwithstanding, and leaving aside high vowels for the reasons mentioned above, vowel quality shifts as corroborated by the diachronic trajectory of words affected by coda /s/ deletion within atonic syllables strongly suggest the influence of vowel quality in the ability of compensatory lengthening to affect or endure diachronically on vowels in atonic syllables undergoing OF coda /s/ deletion. A summary of examples illustrating this differential effect of vowel quality in atonic syllables is presented in Table 2.

Table 2. Interaction of vowel quality on long vs. short vowel reflex of OF coda /s/ deletion in atonic syllables.

(a) Lack of lengthening in atonic /e, ɛ, o, ɔ/ upon coda /s/ deletion (examples from *TLFi* 1994; Bourciez 1955)

	Latin	**> earlier OF**	**> later OF**	**cf. ModFr.**	**Gloss**
i.	*festucu(m)*	> *festu* [fes.'ty]	> [fe.'ty]	*fétu* [fe.'ty]	'wisp of straw'
ii.	*testimoniu(m)*	> *tesmoing* [tes.'mɔ̃ĩɲ]	> [te.'mɔ̃ĩɲ]	*témoin* [te.'mwɛ̃]	'witness'
iii.	*dis + facere*	> *desfaire* [des.'faj.rə]	> [de.'faj.rə]	*défaire* [de.'fɛʁ]	'undo-INF'
iv.	*re+spondere*	> *respondre* [res.'pɔ̃n.drə]	> [re.'pɔ̃n.drə]	*répondre* [re.'pɔ̃.dr(ə)]	'respond-INF'
v.	*sponsa(m)*	*(e)spose* [(e)s.'po.zə]	> [e.'pu.zə]	*épouse* [e.'puz]	'spouse-FEM'
v.	*postis (+ellum)*	> *postel* [pɔs.'tɛl]	> [pɔ.'tɛl]	*poteau* [pɔ.'to]	'post, pole'
vi.	*posterula(m)*	> *posterne* [pɔs.'tɛr.nə]	> [pɔ.'tɛr.nə]	*poterne* [pɔ.'tɛʁn]	'postern'
vii.	*costa (+ellum)*	> *costel* [kɔs.'tɛl]	> [kɔ.'tɛl]	*coteau* [kɔ.'to]	'hill'

(b) Lengthening in atonic /a, ɑ/ upon coda /s/ deletion (examples from *TLFi* 1994; Pope 1952; Bourciez 1955)

	Latin	**> earlier OF**	**> later OF**	**cf. ModFr.**	**Gloss**
i.	*castaneu(m)*	> *chastaigne* [tʃɑs.'taj.ɲə]	> [tʃɑ:.'taj.ɲə]	*châtaigne* [ʃɑ.'tɛɲ]	'chestnut'
ii.	*rastellu(m)*	> *rastel* [rɑs.'tɛl]	> [rɑ:.'tɛl]	*râteau* [rɑ.'to]	'rake'
iii.	*mansuetinu(m)*	> *mastin* [mɑs.'tĩn]	> [mɑ:.'tĩn]	*mâtin* [mɑ.'tɛ̃]	'guard dog'
iv.	*castigare*	> *chastier* [tʃɑs.'tjer]	> [tʃɑ:.'tjer]	*châtier* [ʃɑ.'tje]	'castigate-INF'
v.	Germ. *bastjan* or Latin *bastum + ire*	> *bastir* [bɑs.'tir]	> [bɑ:.'tir]	*bâtir* [bɑ.'tir]	'build/support-INF'
vi.	*castellu(m)*	> *chastel* [tʃɑs.'tɛl]	> [tʃɑ:.'tɛl]	*château* [ʃɑ.'to]	'castle'

Alongside the examples of the likely non-lengthening of mid vowels in Table 2(a) exist lexical families of morphologically-related words in which the lengthened vowel characteristic of the base word variably persists in derived words. For example, alongside *coteau* in Table 2(a-vii), we find not only *côte* ['ko:.tə] 'coast, rib' exhibiting compensatory lengthening in the tonic syllable, but also what were likely variably realized quality-shifted and long atonic vowels in derived forms like *c*[o:]*té* 'side', *c*[o:]*toyer* 'be-next-to-INF', *c*[o:]*telette* 'cutlet', *c*[o:]*tier* 'coastal', with variation in the vowel quality between atonic [o] and [ɔ] noted historically (*TLFi* 1994) for these derived forms (though not for *coteau*). As will be argued below, the morphological structure and derivation as it interacts with phonology offers an explanation for the potential variable persistence of the long vowel in morphologically-related forms of words of this type despite surfacing in an unstressed position, in contrast to words where the short vowel reflex prevails.

The locus of compensatory lengthening is therefore far from uniform. More specifically, it does not lend itself readily to a stressed–unstressed dichotomy but rather exhibits

a complex pattern influenced not only by stress assignment but also by vowel quality and internal morphological structure. As in the examples of intrinsically long vowels in Canadian French presented by Walker (1984) and more recently by Côté (2012), it is in the morphophonology of OF lexical items undergoing coda /s/ deletion that we are able to more precisely define the locus of application of compensatory lengthening. The analysis below, couched in stratal phonology (Kiparsky 2015; Bermúdez-Otero 2018), will demonstrate that the application or non-application of compensatory lengthening hinges on when in the morphological build-up of stem-level and word-level stratal phonological cycles /s/ finds itself in coda position and deletes, with stress and vowel quality as interacting variables. Specifically, in the stratal phonological cycle when pre-consonantal /s/ is introduced into the input, if coda /s/ deletion takes place in a syllable that is assigned stress within that very cycle of the phonology, lengthening is correctly predicted, even if that syllable ultimately becomes atonic when final word-level stress is assigned after all affixes and inflections are concatenated. But if the syllable containing coda /s/ is unstressed in the cycle when /s/ deletion occurs, the preceding vowel will be short and remain short in subsequent stratal phonological cycles and into the word-level output, with the exception of [ɑ] that is intrinsically prone to lengthening and thus favors lengthening regardless of stress. In this way, the short or long vowel reflex of coda /s/ deletion depends on where within the morphophonological structure the process occurs, as well as whether the relevant syllable bears stress within the intermediate cycle when /s/ deletes, regardless of where stress is ultimately assigned in the output of the word-level phonological stratum and with vowel quality influencing this pattern. We thus now turn to an account drawing on such an interplay of morphological structure and well-formedness constraints in different phonological strata in order to tease apart the complex non-uniform realization of vowel lengthening upon coda /s/ deletion.

2. Materials and Methods

The present analysis relies on defining word classes according to their morphological structure as well as the phonological reflex they exhibit with respect to vowel lengthening upon coda /s/ deletion, a crucial first methodological step for properly identifying why the compensatory vowel lengthening reflex differs in otherwise comparable phonological strings. As observed above, compensatory lengthening is not a uniform by-product of coda /s/ deletion, and deletion in a tonic versus atonic syllable does not fully explain the pattern. Yet stress is clearly relevant given categorical lengthening when /s/ deletion affects a stressed syllable, making stress an independent variable favoring lengthening but not the complete picture. Second, the analytic benefits of a stratal phonological approach will be highlighted, along with a brief overview of how this framework advantageously integrates stem-, word-, and phrase-level morphosyntactic structure as it interfaces with phonology. Finally, in order to formalize the distribution of compensatory vowel lengthening upon coda /s/ deletion in OF, the pertinent phonological constraints and their relative priority with respect to one another will be defined in order to construct an account for the non-uniform and at times opaque application of the process within Stratal Optimality Theory (OT).

2.1. Defining Word Classes: The Interplay of Stress and Morphological Structure

As the discussion in Section 1 highlights, lexical items like *tesmoing*, *espose*, and *feste* that are essentially monomorphemic—beyond nominal inflection like gender, case, and number that are obligatory for nouns and adjectives in OF—show vowel lengthening upon coda /s/ deletion as conditioned by occurring within a stressed or unstressed syllable. The main exception to this is low vowel [ɑ], for which evidence is highly suggestive that it lengthens regardless of stress. Polymorphemes with derivational morphology, such as infinitives *blasm+er* and *des+fai+re* or derived forms like *ost(e)+el* [ɔ:.'tɛl], are where the interaction of morphology and phonology induces opacity with respect to the application of compensatory lengthening in atonic syllables, as lengthening may or may not occur in an atonic syllable, unlike in the near-monomorphemes above. Separating out low vowel [ɑ],

which appears to lengthen regardless of stress, we can break up the other atonic contexts involving mid vowels. When occurring within monomorphemes (including /s/ deletion in words undergoing word-initial prothesis), the short vowel reflex prevails. On the other hand, polymorphemic examples show an opaque divide between the short and long reflex when /s/ deletion affects unstressed syllables, to be analyzed in greater detail below. These preliminary word categories, illustrating the intersection of stress and morphological structure, are presented in Table 3, with lexical examples for each.

Table 3. Short vs. long vowel reflexes of OF coda /s/ deletion according to syllable stress, morphological structure, and vowel quality.

	***Monomorphemic* (Exclusive of Gender, Number, Case Nominal Inflection)**	***Polymorphemic***
/s/ deletion in atonic syllable	/e, ɛ/ → [e] *tesmoing* > [te.'mɔ̃ĩɲ] 'witness' /VsC/ → [VC]	/e, ɛ/ → [e] *tesmoign+er* > [te.mɔ̃ĩ.'ɲer] 'testify-INF' /VsC/ → [VC]
		/e, ɛ/ → [ɛ:] *fest+er* > [fɛ:.'ter] 'celebrate-INF' /VsC/ → [V:C]
	/o, ɔ/ → [ɔ] *posterne* > [pɔ.'tɛr.nə] 'postern' /VsC/ → [VC]	/o, ɔ/ → [ɔ] *post+el* > [pɔ.'tɛl] 'post, pole' /VsC/ → [VC]
		/o, ɔ/ → [o:] *oste+el* > [o:.'tɛl] 'lodging' /VsC/ → [V:C]
	/a, ɑ/ → [ɑ:] *mastin* > [mɑ:.'tĩn] 'guard dog' /VsC/ → [V:C]	/a, ɑ/ → [ɑ:] *blasm+er* > [blɑ:.'mer] 'blame-INF' /VsC/ → [V:C]
	prothesis: *(e)spose* > [e.'pu.zə] 'wife' /(V)sC/ → [VC]	*prefixed:* *des+fai+re* > [de.'faj.rə] 'undo-INF' /Vs+C/ → [VC]
/s/ deletion in tonic syllable	/e, ɛ / → [ɛ:] *feste* > ['fɛ:.tə] 'party' /VsC/ → [V:C]	/e, ɛ / → [ɛ:] *(°essere >) est+re* > ['ɛ:.trə] 'be-INF' *re+queste* > [rə.'kɛ:.tə] 'request' /VsC/ → [V:C]
	/o, ɔ/ → [o:] *oste* > ['o:.tə] 'host' /VsC/ → [V:C]	/o, ɔ/ → [o:] *de(s)+post* > [de.'po:t] 'deposit' /VsC/ → [V:C]
	/a, ɑ/ → [ɑ:] *asne* > ['ɑ:.nə] 'donkey' /VsC/ → [V:C]	/a, ɑ/ → [ɑ:] *mar+astre* > [ma.'rɑ:.trə] 'stepmother' /VsC/ → [V:C]
	= vowel lengthening	= no vowel lengthening

Separating out the special case of [ɑ], which likely lengthens irrespective of stress, the data verge on the generalization that the compensatory lengthening by-product of coda /s/ deletion is obstructed by the opposing dispreference for vowel length outside a stressed syllable, resulting in a potential long vowel instead surfacing as short when in an atonic position. This dichotomy nearly holds for the mid vowels, although there

are varying reflexes in polymorphemic items exhibiting coda /s/ deletion in an atonic syllable. In a language like OF where word-level stress is essentially fixed, always landing on the word-final syllable unless that syllable is headed by the vowel schwa, in which case stress lands at most one syllable back on the penult, the aversion to lengthening an atonic vowel can be indirectly imposed by a constraint enforcing the WEIGHT-TO-STRESS principle (WSP) (Prince 1990; cf. McCarthy et al. 2016; Jacobs 2019 for applications to Latin and early Romance). Such a constraint militates for heavy syllables (for our purposes, especially those containing a long vowel, which is bimoraic) to bear stress—essentially, if a syllable is heavy, then it is stressed (Kiparsky 2008; Lleó and Arias 2009; Ryan 2017). If not violating this constraint is prioritized highly enough with respect to opposing phonological priorities, it may pull stress to a heavy syllable, as occurs in languages like Latin. Alternatively, in order to avoid infractions of the constraint, the language may violate faithfulness by making input sequences that would otherwise produce a heavy syllable in the output surface as light (e.g., a long vowel surfaces as short) if they are unable to be assigned stress, provided that WSP is prioritized above relevant faithfulness constraints. Since word-level stress is immutable in OF, it is this latter phonological reflex that appears to characterize the fate of at least most potential long mid vowels that would be produced in an unstressed syllable by coda /s/ deletion. Instead, these mid vowels remain short in words like *tesmoing* [te.'mɔ̃ĩŋ] 'witness' and *espose* [e.'pu.zə] 'spouse-FEM,' where vowel lengthening is dispreferred, despite there remaining no output correspondent of the deleted /s/, because it is an atonic syllable.

Contrasting with examples like *tesmoing* [te.'mɔ̃ĩŋ] 'witness-NOUN' are those like *fester* [fɛː.'ter] 'celebrate-INF' (cf. noun *feste* ['fɛː.tə] 'party') and *arrester* [ar.rɛː.'ter] 'stop-INF' (cf. noun *arrest* [ar.'rɛːt] 'stop-NOUN'), with word-final stress and an atonic long vowel. Morphological structure differentiates these latter examples, however, from a word like *tesmoing*, which represents an indivisible root to which is adjoined any additional morphology in the stem- and word-level phonology, whether overt (e.g., verbal affixes to form *tesmoign+er* 'witness-INF') or null (e.g., masculine gender marking, certain case-number combinations in OF). Crucially, any affixation to a word like *tesmoing* is external to the locus of coda /s/ deletion within the lowest morphological levels of the stem. On the other hand, the overt morphology of *fester* or *arrester* exhibits the root *fest-* or *arrest-*, the verb class theme vowel *-e-* (schwa), as well as the infinitive mood marker *-r*, in addition to any null inflectional morphology (person, number, etc.) required for its syntactic category of verb. Roots like *fest-* or *arrest-* possess a distinct potential for divergent reflexes depending on the morphology affixed to them in a way that *tesmoing* does not, specifically because the content of the syllable following the coda /s/ + onset cluster in *tesmoing* is already pre-determined by the lexicon within the word root. On the other hand, for *fest-* or *arrest-*, syllabification and stress possibilities are not constrained until affixation occurs, which I will show below results in a consequential difference in the phonological reflex towards vowel lengthening in the word-level output.

2.2. Advantages of Stratal Phonology for Opacity and Analogical Effects

Given the central nature of the interplay of morphology and phonology in defining whether or not compensatory lengthening accompanies coda /s/ deletion, I adopt the framework of stratal phonology (Kiparsky 2015; Bermúdez-Otero 2018), and more specifically, Stratal OT, to formalize the cyclic application of phonology as morphological structure is adjoined incrementally to form the word. Stratal phonological approaches like Stratal OT incorporate the tiered and cyclic application of phonological processes, at minimum, to the morphosyntactic strata of the stem, the word, and the phrase. In this way, Stratal OT integrates a structured and constrained degree of seriality and cyclicity as has proven fruitful throughout modern phonology for explaining cases of phonological opacity (when a process does not apply where it is expected) and paradigmatic transfer effects, also known as analogy, in which derived forms inherit properties from their morphological bases (Kiparsky 2015). In Stratal OT, a classic Optimality-Theoretic parallel input–output mapping as determined by a hierarchy of violable, ranked well-formedness constraints,

evaluating faithfulness to the input form while shaped by markedness constraints imposing restrictions on the surfacing of dispreferred formal complexity in the output, characterizes each phonological stratum of the stem, the word, and the phrase. Between strata, the ranking of a particular constraint may potentially differ via its promotion to undominated status in the constraint hierarchy of a superordinate stratum (Kiparsky 2008, 2015, 2023). Such mappings of input to output occur cyclically within the stem-level stratum, with a lexical root adjoining stem-level affixes in cyclical and serial applications of the stem-level phonology, ultimately yielding a syntactically independent word in the output that then serves as the input for the word-level phonological stratum. The phonology of the word-level stratum applies to this input, adjoining any word-level affixes and ensuring that the full set of inflectional features required by the word's syntactic category have been incorporated before generating an output to the phrase-level phonology. In this way, the output of a subordinate stratal domain such as the stem is inherited—and potentially obscured—in superordinate domains such as the word or phrase. This layering of strata may yield analogical effects, such as paradigmatic transfer, that align morphologically-related words. Alternatively, it may induce opacity in the seeming underapplication of a process occurring at a lower phonological stratum but that is ultimately masked upon the application of the higher-tier stratum's distinctly-ranked phonological constraint hierarchy.

A useful example of a stratal phonological derivation is presented in Bermúdez-Otero's (2018) exposition of stratal phonology as it applies to English stress assignment in polymorphemic words like *accomodationlessness*. The stratal phonological derivation accounting for the opaque stress pattern of *accòmmodátionlessness*, with pre-antepenultimate primary stress, is shown in Figure 1.

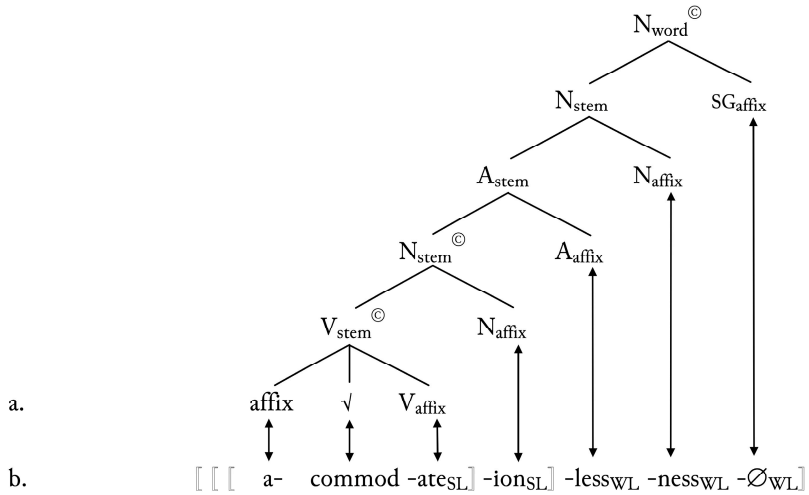

Figure 1. Stratal phonological account of stress assignment in English *accòmmodátionlessness* (Bermúdez-Otero 2018). ($\mathcal{P}$ = phonological function [input–output mapping]; SL = stem-level; WL = word-level, © = cyclic node [marks boundaries of cyclic domains within a stratum]). (**a**) Morphosyntactic structure of *accommodationlessness* in stratal phonology. (**b**) Morphological structure of *accommodationlessness* in stratal phonology. (**c**) Stratal phonological functions on *accommodationlessness* according to morphosyntactic structure. (**d**) Stratal phonological derivation of *accommodationlessness*.

In (a) and (b) in Figure 1, the morphological structure of *accòmmodátionlessness* is shown. It consists of a root, *commod*, joined with categorial affixes producing first the verb *accómmodàte* in a first stem-level cycle and subsequently, in the second stem-level cycle, the noun *accòmmodátion* (whose input is the output of the first stem-level cycle). Stem-level stress assignment follows the same phonological constraints within that cyclic domain. Once the stem-level stratum has fully applied, its output serves as the input to the word-level phonology, which adjoins additional derivational affixes *-less* and *-ness*, as well as the null singular number inflection required of nouns, to the already independent word *accòmmodátion*, which was the output of the stem stratum, to form *accòmmodátionlessness*. The opacity of the resulting word-level stress pattern lies both in the placement of the primary stress, four syllables from the rightmost word edge, and that of the secondary stress, which would be expected on the first syllable (Bermúdez-Otero 2018). The stress pattern is instead inherited from and can only be understood by considering the stem-level stratum's output of *accòmmodátion* in (d), a necessary intermediate form whose stress pattern remains unchanged by the distinct word-level phonology, and which would be unavailable in a purely parallel phonological account of the word *accòmmodátionlessness*.

Applying this approach to the OF word classes defined in Table 3, parsing stem-level and word-level morphological structure yields a clearer picture of the pattern, as presented in Table 4.

Table 4. Short vs. long vowel reflexes of OF coda /s/ deletion through the lens of stem- and word-level morphological structure.

(a) /s/ deletion in atonic syllable within the stratal cycle		
Monomorphemic (exclusive of gender, number, case nominal inflection)	*Polymorphemic*	
Type 1a: /e, ɛ/ → [e] *tesmoing* > [te.'mɔ̃ĩɲ] 'witness-NOUN' [[tes**mɔ̃ĩɲ**+Ø$_{MASC}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$ → [te.'**mɔ̃ĩɲ**] /VsC/ → [VC]	**Type 1b** /e, ɛ/ → [e] *tesmoing+e+r* > [te.mɔ̃ĩ.'ɲer] 'witness-INF' [[[tes**mɔ̃ĩɲ**+ə$_{V}$]+r$_{INF}$]$_{STEM}$]$_{WORD}$ → [te.mɔ̃ĩ.'**ɲer**] /VsC/ → [VC]	
Type 1a: /o, ɔ/ → [ɔ] *posterne* > [pɔ.'tɛr.nə] 'postern' [[pɔs**tɛr**n+ə$_{FEM}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$ → [pɔ.'**tɛr**.nə] /VsC/ → [VC]	**Type 1b** /o, ɔ/ → [ɔ] *post+el* > [pɔ.'tɛl] 'post, pole' [[pɔst+**ɛl**$_{MASC}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$ → [pɔ.'**tɛl**] /VsC/ → [VC]	
Type 1a *prothesis:* *(e)spose* > [e.'pu.zə] 'wife' [[(e)s**po**s+ə$_{FEM}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$ → [e.'**pu**.zə] /(V)sC/ → [VC]		**Type 1c** *prefixed:* *des+fai+re* > [de.'faj.rə] 'undo-INF' [des+[[[**faj**+Ø$_{V}$]+rə$_{INF}$]$_{STEM}$]$_{WORD}$] → [de.'**faj**.rə] /Vs+C/ → [VC]
Type 1a: /a, ɑ/→ [ɑ:] *mastin* > [mɑ:.'tĩn] 'guard dog' [[mas**tĩn**+Ø$_{MASC}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$ → [mɑ:.'**tĩn**] /VsC/ → [V:C]	**Type 1b** /a, ɑ/ → [ɑ:] *rast+el* > [rɑ:.'tɛl] 'rake-NOUN' [[rast+**ɛl**$_{MASC}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$ → [rɑ:.'**tɛl**] /VsC/ → [V:C]	

Table 4. *Cont.*

(b) /s/ deletion in tonic syllable within the stratal cycle

Monomorphemic (exclusive of gender, number, case nominal inflection)	*Polymorphemic*	
Type 2a	**Type 2b**	**Type 2c**
/e, ɛ/ → [ɛ:]	/e, ɛ/ → [ɛ:]	/e, ɛ/ → [ɛ:]
feste > ['fɛ:.tə] 'party'	(°*essere* >) *est+re* > ['ɛ:.trə] 'be-INF'	*fest+e+r* > [fɛ:.'ter] 'celebrate-INF'
[[**fɛst**+ə$_{FEM}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$	[[[**ɛst**+Ø$_{V}$]+rə$_{INF}$]$_{STEM}$]$_{WORD}$	[[[**fɛst**+ə$_{V}$]+r$_{INF}$]$_{STEM}$]$_{WORD}$
→ ['**fɛ:**.tə]	→ ['**ɛ:**.trə]	→ [fɛ:.'**ter**]
arrest > [ar.'rɛ:t] 'stop-NOUN'	*re+queste* > [rə.'kɛ:.tə] 'request-NOUN'	
[[ar**rɛst**+Ø$_{MASC}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$	[[rə+[**kɛst**+ə$_{FEM}$]]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$	
→ [ar.'**rɛ:t**]	→ [rə.'**kɛ:**.tə]	
/VsC/ → [V:C]	/VsC/ → [V:C]	/VsC/ → [V:C]
/o, ɔ/ → [o:]	/o, ɔ/ → [o:]	/o, ɔ/ → [o:]
oste > ['o:.tə] 'host'	*de(s)+post* > [de.'po:t] 'deposit-NOUN'	*oste+el* > [o:.'tɛl]/[o:.'tæl] 'lodging'
[[**ɔst**ə+Ø$_{MASC}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$	[[des+[**pɔst**+Ø$_{MASC}$]]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$	[[[**ɔst**ə+Ø$_{MASC}$]+æl]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$
→ ['**o:**.tə]	→ [de.'**po:.t**]	→ [o:.'**tɛl**]/[o:.'**tæl**]
tost > [to:t] 'early'		
[[**tɔst**]$_{STEM}$]$_{WORD}$		
→ ['**to:t**]		
/VsC/ → [V:C]	/VsC/ → [V:C]	/VsC/ → [V:C]
/a, ɑ/ → [ɑ:]	/a, ɑ/ → [ɑ:]	/a, ɑ/ → [ɑ:]
asne > [ɑ:.nə] 'donkey'	*mar+astre* > [ma.'rɑ:.trə] 'stepmother'	*blasm+e+r* > [blɑ:.'mer] 'blame-INF'
[[**as**nə+Ø$_{MASC}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$	[[mar+**as**trə]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$	[[[**blas**m+ə$_{V}$]+r$_{INF}$]$_{STEM}$]$_{WORD}$
→ ['**ɑ:**.nə]	→ [ma.'**rɑ:**.trə]	→ [blɑ:.'**mer**]
mast > [mɑ:t] 'mast'		
[[**mast**+Ø$_{MASC}$]$_{STEM}$+Ø$_{SG}$+Ø$_{OBL}$]$_{WORD}$		
→ ['**mɑ:t**]		
/VsC/ → [V:C]	/VsC/ → [V:C]	/VsC/ → [V:C]

= vowel lengthening = no vowel lengthening

Boldface highlights stress assignment within the stem-level stratal cycle and word-level output.

The re-aligned word class divisions in Table 4 highlight stem- and word-level morphological structure as per the tenets of stratal phonology. Here, if we focus on the phonological cycle in which coda /s/ is present in that cycle's input and is thus targeted for deletion, we can see that whether or not /s/ deletion affects a stressed or unstressed position *within that specific cycle* is what correctly predicts the co-occurrence or lack of compensatory vowel lengthening, respectively, for mid vowels. This outcome is then preserved regardless of whether that syllable ultimately ends up stressed in the output of the word-level stratum (cf. Type 2c). The low vowel [ɑ] is predicted instead to lengthen regardless of stress within the stratal cycle of /s/ deletion, as per the overwhelming consistency of vowel quality shifts in these words. Table 4 highlights these generalizations by displaying in boldface the stressed syllable in the stratal phonological cycle (indicated by each pair of brackets) where coda /s/ deletion occurs, as well as the syllable that is ultimately stressed in the word-level output.

Given that stress falls on the word-final syllable unless it is headed by a schwa, in which case stress becomes penultimate, we can see that when coda /s/ deletes in an atonic syllable within the stem-level cycle where the process transpires, a mid vowel surfaces as short, as in *tesmoing* [te.'mɔ̃ĩŋ], *espose* [(e).'pu.zə] (Type 1a), and *desfaire* [de.'faj.rə] (Type 1c). If the output of this stratal cycle yields a short vowel reflex upon /s/ deletion, that result is then carried through subsequent cycles, as seen in the polymorphemic derived forms that constitute Type 1b. When the vowel is low (/a, ɑ/), the evidence weighs heavily on

quality-shifted long [ɑː] in both atonic (Type 1a) and tonic (Type 2a) syllables of the stratal cycle in which coda /s/ deletion takes place, with this long reflex transmitted into the next stratal cycle (as in Type 1b). If it were shown to be the case that low vowels only underwent backing but not lengthening in atonic syllables, which I do not argue to be the case, but the plausibility of which cannot be entirely ruled out, the analysis is elastic enough to allow for the same patterning as mid vowels according to morphological structure within the stratal phonological system. On the other hand, when coda /s/ deletion impacts a syllable that would be assigned stress within the stem-level cycle of its application, the vowel preceding deleted coda /s/ undergoes lengthening, as in essentially monomorphemic *oste* ['oː.tə], *feste* ['fɛː.tə], *arrest* [ar.'rɛːt], *asne*, ['ɑː.nə], etc. (Type 2a), or polymorphemic *requeste* [rə.'kɛː.tə], *estre* ['ɛː.trə], *marastre* [ma.'rɑː.trə], *dépost* [de.'poːt], etc. (Type 2b). This same effect, though ultimately masked by stress reassignment, explains the opaque surfacing of the long vowel in words like *blasmer* [blɑː.'mer], *ostel* [oː.'tɛl], and *fester* [fɛː.'ter] (Type 2c), even though the syllable from which /s/ is deleted winds up unstressed in the word-level output. According to the present analysis, this results from coda /s/ deleting in what would be a stressed syllable (/blasm+ə/ → ['blɑː.mə]) in the earlier stem-level cycle when the process applies, given stress cannot be assigned to the stem-final syllable if it is headed by schwa. The long vowel outcome from this cycle is subsequently inherited and preserved by faithfulness constraints in the following stem-level or word-level input–output mappings, irrespective of the ultimate word-level stress assignment. In this way, as predicted by stratal phonology, the paradigmatic transfer effects of basic forms like *feste* ['fɛː.tə] 'celebrate-1ST/3RD.SG.PRES.IND' (surfacing as such without further overt inflection in 1st and 3rd person singular present indicative, for example, or 2nd person singular imperative) are inherited by morphologically-related forms like the infinitive (*fester* [fɛː.'ter] 'celebrate-INF'), despite the opacity produced by the potential reassignment of stress to the word-final syllable when additional morphology, such as the infinitive marker *-r*, is affixed.

2.3. Constraint Hierarchy for of Compensatory Lengthening upon Coda /s/ Deletion

To account for the non-uniform realization of compensatory lengthening upon coda /s/ deletion in OF within a Stratal OT analysis, numerous phonological constraints and their relative prioritization with respect to one another must be identified and brought to bear to account for the patterns observed in the preceding sections (a list of constraint definitions and how violation marks are assigned is provided in Appendix A). Several interacting processes and properties of OF require formalization as the result of the interaction of a hierarchy of constraints, with the potential for differential rankings of specific constraints within the hierarchies of the stem-level and word-level strata. Here, I propose a constraint hierarchy for OF accounting for stress assignment, coda /s/ deletion, compensatory lengthening, and atonic shortening, as well as schwa adjustment.

As described above, OF stress falls on the word-final syllable, unless this syllable is headed by a schwa, in which case it retracts to the penultimate syllable (Gess 2001). OF stress is also easily recast in terms of prosodic foot structure, with maximally binary iambic feet constructed exhaustively from the right edge of the word moving leftward, and a word-final syllable headed by [ə] being extrametrical and thus unable to bear stress, making stress fall on the strong syllable of the rightmost iambic foot preceding it (Morin 1991). While the latter characterization better conforms to most recent prosodic accounts of primary and secondary stress assignment (cf. Kiparsky 2008; McCarthy et al. 2016; Jacobs 2019), appealing to a number of prosodic constraints of alignment, (non-)finality, and foot construction in order to yield stress patterns within an Optimality-Theoretic parallel phonology, for the present purposes, I will employ a simplified pair of constraints for expositional purposes and as not to obscure the interaction of stress assignment with compensatory vowel lengthening or its lack of realization upon coda /s/ deletion. To this end, I will employ a single conglomerate constraint, ALIGN(FT, R, 𝔇, R, σ) (henceforth, ALIGN-R), akin to ALIGN(FT, R, ω, R, σ), requiring that "the right edge of every foot coincides with the right edge of some prosodic word...[with] a violation mark for each syllable intervening

between misaligned edges" (Hyde 2012). This conglomerate constraint encapsulates the combined effect of several stress-related constraints, including the enforcement of feet being both iambic and binary and that primary stress is assigned to the rightmost foot, while applying to the phonological string referencing the appropriate domain ($\mathfrak{D}$) of the current stratal phonological cycle. That is, it applies to the phonological string of each stem-level cycle within the stem stratum ($\mathfrak{s}$) before applying again to the entire prosodic word (ω) in the word-level stratum, operating cyclically as morphology builds up from the root to the stem and finally to the word, as per a stratal phonological framework as described above in Section 2.2. (Alternatively, Rainsford (2020), building on a proposal ultimately abandoned in Jacobs (1994), instead proposes primary stress landing on the rightmost syllabic trochee in OF. But this account requires positing a word-final catalectic and often empty-headed, or segmentally-null, syllable for OF, an abstraction that runs into some difficulties in accounting for vowel-final words. The more transparent iambic stress pattern espoused by Morin (1991) is therefore adopted here, though both characterizations of OF primary stress would be compatible with the present analysis since they identify the same tonic and atonic syllables in words.)

In order to incorporate that schwa cannot head the prominent syllable of the rightmost iambic foot (Morin 1991) and thereby cannot bear stress (cf. Ulfsbjorninn 2022 regarding contemporary French), ALIGN-R is dominated by a constraint we can call *ə́, essentially banning a schwa bearing primary stress (and likely also dispreferring secondary stress, though Morin (1991) shows a more complex picture for schwa outside the rightmost foot, cf. Morin (1991) and further discussion below). This constraint integrates the generalizations regarding the extrametricality of schwa-headed word-final syllables and that schwa in word-final syllables cannot be stressed in OF. This ranking, *ə́ » ALIGN-R, yields the attested and categorical primary stress pattern of OF, whereby primary stress falls on the final syllable unless it is headed by schwa, in which case the penultimate syllable is stressed. Given that only the presence of schwa in the word-final syllable allows for a violation of ALIGN-R, I propose that ALIGN-R is undominated in the constraint hierarchy with the exception of *ə́, which outranks it.

Central to the present analysis are constraints producing coda /s/ deletion and the accompanying compensatory vowel lengthening effect. As discussed in Section 1, the gradated diachronic realization of coda /s/ deletion according to the nature of the following onset consonant motivates the syllable contact account espoused here for coda /s/ deletion in OF diachrony. In keeping with this, I follow Montaño's (2024) analysis in referencing a constraint against a sibilant surfacing in coda position before an onset consonant, *$X_1S_2]_\omega$, a generalized constraint in the formal notation of the Split Margin Approach to the Syllable (Baertsch 2002; Baertsch and Davis 2003; and later work). Focusing on details pertinent to the present analysis, the Split Margin Approach identifies parallel inner (M_2) and outer (M_1) margins of the syllable flanking the syllable peak (P). In Split Margin notation, a maximal C(C)VC(C) syllable yields the form $[M_1(M_2)PM_2(M_1)]_\sigma$ and formalizes the analogous segmental markedness relations, according to sonority class, found in both M_1 or both M_2 positions on each side of the Peak, barring intervening constraints (Baertsch and Davis 2003). In this approach, the syllable contact environment referenced for coda /s/ deletion is defined as a syllable-final M_2 segment evaluated in tandem with the initial M_1 segment of the following syllable, within the domain of the phonological word containing both syllables, notated as $M_2.M_1]_\omega$ (Baertsch and Davis 2008). Split-margin constraints targeting clusters in any domain (e.g., onset clusters within the syllable domain, or $M_1M_2]_\sigma$) notationally reference the M_1 before the M_2, and so for a particular syllable-contact cluster in the domain of the word, *$M_1M_2]_\omega$ targets $[M_2.M_1]$, yielding the *$X_1S_2]_\omega$) constraint employed here targeting [s.C]. In particular, this constraint bans a sibilant (S) in the M_2 position, corresponding for our purposes to a single coda segment, before another consonant (here, "X", representing whichever sonority class of consonants appears as the first onset segment) in the following syllable, within the domain of the phonological word. I employ X_1 as a shorthand for any of the possible sonority

classes of the onset following the coda sibilant. This is for expositional simplicity, instead of separating out the more specific split-margin constraints *$R_1S_2]_\omega$ » *$L_1S_2]_\omega$ » *$N_1S_2]_\omega$ » *$O_1S_2]_\omega$, which more specifically prohibit sibilants before /r/, /l/, a nasal consonant, or an obstruent, respectively, as per the syllable contact effect argued to underlie the two stages of OF coda /s/ deletion. In this way, *$X_1S_2]_\omega$ allows us to generalize the effect regardless of whether the target word lost coda /s/ during chronological Stage 1 or Stage 2, as presented in Table 1, and to focus instead on the interaction between any coda /s/ deletion and the effect on the preceding vowel. For the compensatory lengthening effect specifically, which stage of coda /s/ deletion and thus which class of onset segments follows coda /s/ does not interact with the short or long vowel reflex, and, therefore, the generalized constraint *$X_1S_2]_\omega$ allows for greater expository clarity when referencing the phonology's aversion to coda sibilants.

Opposing *$X_1S_2]_\omega$ are two constraints of the MAX family of Correspondence Theory within OT (McCarthy and Prince 1995), which requires that a phonological entity in the input be realized in the output. Of this family of constraints, the basic MAX constraint, ensuring that a segment in the input is present in the output, is violated when coda /s/ deletes. This yields the ranking *$X_1S_2]_\omega$ » MAX, representing the fact that the phonology prioritizes the avoidance of a sibilant in the coda position over ensuring that all input segments surface in the output. In keeping with the non-moraic approach to OF coda /s/ deletion as motivated in Section 1, I employ Montaño's (forthcoming) MAX(ROOT) approach to compensatory lengthening upon deletion, rather than a purely moraic approach (Hayes 1989, for example). This constraint requires that the root node of a deleted segment be preserved in the output, by re-associating with an adjacent segment or, if unavailable, by filling the position with an epenthetic segment. An example of the effect of MAX(ROOT) is provided in Figure 2.

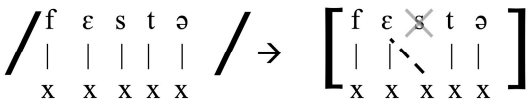

Figure 2. Effect of MAX(ROOT) yielding vowel lengthening upon coda /s/ deletion (Montaño, forthcoming).

An important advantage of the MAX(ROOT) analysis over the moraic approach to compensatory lengthening (Hayes 1989) for the behavior observed across OF /sC/ clusters is that it can account for the continued appearance of the short prothetic vowel in /sC/-initial words once coda /s/ deletion targets them (Montaño, forthcoming), thus achieving a generalization across the two contexts. OF's reflexes towards word-initial and word-medial /sC/ clusters are unlike the Latin examples cited by Hayes (1989), in which /s/ deletion is accompanied by a compensatory effect only when a moraic /s/ is deleted (e.g., earlier *kasnus* > *ka:nus* 'gray') but not when word-initial non-moraic /s/ is lost (e.g., earlier *snurus* > *nurus* 'daughter-in-law' [Hayes 1989, pp. 261–63]). In OF, once coda /s/ deletion is active, prothesis should not represent a viable repair for word-initial /sC/ clusters, given the prothetic vowel is superfluous if /s/ could instead simply delete as in Hayes' Latin examples (e.g., /spos+ə/ → [e.'pu.zə], *['pu.zə] 'wife'). Its continued surfacing in place of underlying /s/, at a time when the prothetic vowel was plausibly not yet part of the input (supported by its surfacing as short, as discussed in Section 1), is suggestive of the prothetic vowel actually preserving the root node position of deleted word-initial /s/ once the sibilant is no longer permitted in the coda position where it would land upon prothesis (e.g., *[es.C]). The MAX(ROOT) analysis can thus more readily capture the compensatory effect that the inserted prothetic vowel represents once coda /s/ deletion is active and succeeds in linking this behavior to the compensatory lengthening effect accompanying coda /s/ deletion in word-medial contexts.

While the phonological system tolerates the loss of /s/ from the input in order to satisfy the ban on coda /s/, it further prioritizes the preservation of the deleted segment's root

node by associating it with the preceding vowel, when there is one available. While gemination of the following onset consonant hypothetically constitutes an alternate manifestation of the need to satisfy MAX(ROOT), as proposed for some processes of the earlier PF period predating OF (Montaño 2023), the fact that erstwhile geminate consonants had degeminated before OF (Jacobs 1996; *GGHF* 2020, sct. 21.1.2.3, p. 388) points to a high-ranking opposing constraint precluding this path to satisfy MAX(ROOT) by the time of OF. That a long vowel is preferable to the surfacing of coda /s/ in the output furthermore entails both that MAX(ROOT) outranks *$X_1S_2]_\omega$ and that *$X_1S_2]_\omega$ dominates a markedness constraint against long vowels in the output (*V:), yielding the preliminary ranking in Figure 3.

*ə́ » ALIGN-R » MAX(ROOT) » *$X_1S_2]_\omega$ » *V:, MAX

Figure 3. Preliminary constraint ranking for OF in light of stress assignment and long vowel reflex upon coda /s/ deletion.

As underscored above, however, a long vowel is not always the result of coda /s/ deletion, meaning that MAX(ROOT) is sometimes violated when coda /s/ deletes. As highlighted in Table 4 above, when coda /s/ deletion follows a mid vowel in a syllable that is not assigned stress within that stratal phonological cycle, compensatory lengthening does not occur and the vowel surfaces as short. This effect, akin to atonic shortening but achieved indirectly in the constraint interaction, results from a constraint enacting the WEIGHT-TO-STRESS principle (WSP) (Prince 1990; Kiparsky 2008; Lleó and Arias 2009; McCarthy et al. 2016; Ryan 2017; Jacobs 2019), cited in Section 2.1. WSP clashes with ALIGN-R when coda /s/ deletion would impact an unstressed position within that phonological cycle. This is because producing a long vowel to preserve the root node of deleted /s/ would yield a bimoraic syllable, but ALIGN-R still demands that stress falls on the final syllable (unless headed by schwa), resulting in an unstressed bimoraic syllable and thus incurring a violation of the WSP. Since ALIGN-R is essentially undominated (with the exception of *ə́), the only way to avoid a WSP violation is to instead violate MAX(ROOT), deleting the /s/ but not preserving its root node via vowel lengthening. In this way, compensatory lengthening is blocked within the stratal phonological cycle in which coda /s/ deletion is realized when this occurs in an unstressed position. On the other hand, the preservation in subsequent cycles of a long vowel produced when /s/ deletion impacts a stressed position within its phonological cycle of application, even if stress is later reassigned as in *blasmer* or *ostel*, highlights the role of MAX(LENGTH), which seeks to preserve vowel length if it is present in the input. Given that both MAX(ROOT) and WSP are dominated by ALIGN-R, they appear equally ranked below ALIGN-R in this analysis. With this equal ranking, WSP can indirectly block lengthening in atonic syllables, via its opposition to ALIGN-R, when a long vowel is not yet in the input. On the other hand, the combined effect of MAX(ROOT) and lower-ranking MAX(LENGTH) instead act in tandem to preserve vowel length if it was lengthened in a previous stratal cycle and thus is now part of a later cycle's input, a result that falls out from the constraint ranking (ALIGN-R ») MAX(ROOT), WSP » MAX(LENGTH).

Furthermore, this analysis' argument that low vowels likely shifted in quality and lengthened before deleted coda /s/ in both atonic or tonic syllables, while mid vowels illustrate the short versus long reflex according to whether the syllable in which coda /s/ deletes is stressed or not in that stratal phonological cycle, requires an elaboration of the *V: constraint against the surfacing of long vowels more generally. As well-established in articulatory and acoustic phonetic studies (Keating 1985; Flemming 2005; Toivonen et al. 2015), vowel height correlates inversely with duration. Low vowels exhibit the most intrinsic length, and therefore lengthening is expected to occur more naturally on low vowels than on non-low vowels. This intrinsic relationship between vowel height and duration can be translated into a constraint hierarchy more specific than *V:, namely, *HIGH: » *MID: » *LOW: (a long high vowel is marked with respect to a long mid vowel, which is marked with respect to a long low vowel). For the present purposes, I will label the *MID: » *LOW: constraints as *e:/o: (including [ɛ] and [ɔ] as well) » *ɑ: since these are

the vowels in focus in this analysis. The converse of this scale is also true, with shortness preferred as vowel height increases, or, formalized as constraints opposing the long vowel scale, *ă » *ĕ/ŏ. Given the systemic preference for the mid vowels to surface as short and low vowel [ɑ] to surface as long, the latter part of the hierarchy in Figure 3 can be recast as follows, replacing the generic *V: with the scalar constraints graded according to the inverse relationship between vowel height and length: ... $*X_1S_2]_\omega$ » *e:/o:, *ă, MAX » *ĕ/ŏ, *ɑ: (these final two must rank quite low, as they surface very commonly in OF). The effect of this elaboration of *V:, given the additional influence of equally-ranked MAX(ROOT) and WSP, is that vowel quality interacts with the long versus short reflex of coda /s/ deletion when impacting an atonic syllable within that stratal cycle. As a result of [ɑ]'s intrinsic propensity towards length over shortness, it can overcome a WSP violation in a way that a mid vowel cannot. Given that these latter vowels prefer surfacing as short, in the case of the mid vowels, it is preferable to incur a MAX(ROOT) violation upon /s/ deletion rather than surface as long. As MAX ranks equally with *e:/o: and *ă, output candidates including them in atonic syllables and not otherwise eliminated by a higher-ranking violation will incur a double violation in that tier of the constraint hierarchy and thus lose out to alternative candidates violating instead only MAX and lower-ranked *ĕ/ŏ, *ɑ:. In this way, we succeed in formalizing the ability of low vowels to overcome the atonic shortening reflex. (If evidence surfaces showing instead that [ɑ] also remained short from the stratal cycle when /s/ deleted from an atonic syllable, which I have argued to be less likely given the highly consistent diachronic trajectory of [ɑ] with respect to the mid vowels, this adjustment could easily be incorporated in the analysis by reverting to the quality-insensitive *V: constraint equally ranked with MAX, as in Figure 3.) Finally, omitted here is a likely DEP constraint against inserting a non-underlying root node for an input vowel to link with in order to lengthen, ensuring that other input low vowels, for example, do not lengthen simply because of the effect of *ă » *ɑ:, and barring similar unattested overgeneralizations of these constraints.

A final piece of the analysis is required to explain the shift in stress assignment in Type 2c words like *fester, blasmer*, and *ostel*, which preserve a long vowel in an atonic syllable where coda /s/ is deleted. As proposed above, polymorphemic words of this type differ from those like *tesmoing* or *espose*, where coda /s/ deletion occurs within a monomorphemic stem, because, in the former word class, coda /s/ deletion occurs in a syllable that bears stress in the stratal cycle when /s/ deletes (despite stress shift in the word-level stratum). This is the case whether coda /s/ deletion occurs in the string-final syllable, as in *arrest, tost*, or *mast*, or in the penultimate syllable that is stressed by virtue of the string-final syllable being headed by a schwa, as in *fest+e+r* [[**fɛs**t+ə]+r], *oste+el* [[**ɔs**tə]+æl], and *blasm+e+r* [[**blas**m+ə]+r]. That the underlying vowel in these examples is schwa can be seen in numerous conjugated forms such as *fest*[ə] 'celebrate-1ST/3RD.SG.PRES.IND.', *fest*[ə]*rons* 'celebrate-1ST.PL.FUT.IND.', etc., where schwa cannot be considered epenthetic because of the general acceptability of *-st* and *-t* final words (Rainsford 2020) that do not necessitate word-final schwa insertion (as occurs when Late Latin syncope produces a word-final rising-sonority cluster, e.g., *semper*, which, upon syncope to °*semp'r*, yields *sempre* 'always' [*GGHF* 2020, sct. 18.9.2.2b, p. 338]). When the infinitive marker /r/ is added to the stem plus schwa theme vowel, schwa exhibits an alternation with [e], as in *fest*[e]*r* 'celebrate-INF' and, with this full-vowel surface quality, stress can shift to the word-final syllable no longer headed by schwa.

With respect to *ostel* 'lodging', which to masculine base *oste* /ɔstə+$Ø_{MASC}$/ 'host' adds nominal suffix *-el*, the base already contains an underlying schwa inherited historically. The underlying nature of this word-final schwa is evidenced by the fact that *-st* is otherwise a possible word-final consonant sequence, e.g., *tost* 'early', without the need for a word-final epenthetic supporting schwa, as seen in non-falling word-final clusters (*GGHF* 2020, sct. 18.9.2.2b). This means that in *oste+el* [[**ɔs**tə+$Ø_{MASC}$]+æl], /s/ deletion in the initial stem-level cycle affects what would be a tonic syllable preceding the schwa-headed final syllable. When the *-el* suffix is added, stress shifts to the word-final syllable, while preserving in

the output the lengthened vowel of the previous stem-level cycle. While the most certain source of atonic lengthened mid vowel [oː] in *ostel* is the stem-final schwa, the suffix *-el* (< Latin *-alis/-alem*) exhibits some possibility for a distinct underlying form from the OF suffix /ɛl/ (< Latin *-ellum*, with OF plural *-ea(u)ls*, e.g., *chastel* 'castle'), given its often different plural reflex to *-els* and distinct etymology. The suffix *-el* from Latin *-alis/-alem* is not nearly as commonly affixed to nouns as to adjectives (alongside *ostel,* e.g., *chanel* 'channel, canal' < Latin *canalis/canalem*, from *chane* 'water container' + *el* [Constans 1918; *TLFi* 1994]), and the once-distinct ending mostly merged with the *-el/-eau /-ea(ul)x* pattern historically. Here, I conservatively posit /æl/ as the form of this suffix (though its alternation with schwa in related forms like 12th-century *ost*[ə]*lier* 'welcoming' vs. *ost*[æ]*l* 'lodging' [Morin 1991] may not totally preclude /əl/ that surfaces as [ɛl] ~ [æl] in word-final closed-syllable positions). In cases where underlying schwa ends up in a closed syllable, most clearly seen in *blasmer* or *fester,* the well-known alternation of /ə/ → [ə] ~ [e, ɛ] possibly fronted to [æ], (Dell 1973; Morin 1991; Ulfsbjorninn 2022) depends, in the relevant stage of a derivation, both on whether schwa is stressed (Morin 1991 for OF; Ulfsbjorninn 2022 for Modern French) as well as whether it surfaces in a closed syllable (Dell 1973 for Modern French; Morin 1991 for OF), where schwa is disallowed. This latter adjustment of schwa to a full vowel in a closed syllable is known as *closed syllable adjustment*, or CSA, in the traditional French phonological literature.

Condensing the findings of Morin's (1991) excellent study on OF stress assignment and schwa alternations, schwa can only surface in a post-tonic extrametrical final syllable or in the weak position of an iambic foot when it is an open syllable. The constraint *ə above handles most of these cases at the right edge of the stem- or word-level phonological string, minus the requirement that schwa cannot surface in a closed syllable but rather a full vowel allophone must. Additional complexities such as the status of schwa in non-final positions as underlying or not, the interaction of vowel reduction yielding schwa in weak metrical positions, and possible stem allomorphy as cited by Morin (1991) represent tangential issues surrounding schwa in OF that will be left aside here, without any intended incongruity with Morin's well-argued characterization of many pre-tonic schwas representing underlying full vowels that have been reduced in weak foot positions. For the present purposes, the fact that schwa cannot be stressed and that it cannot surface in a closed syllable constitute the relevant factors influencing the locus of stress in the stratal phonological analysis presented here. Instead of obscuring the analysis with the mechanics of schwa's inability to surface in a closed syllable by means of numerous additional constraints, I will employ for expository purposes a conglomerate constraint yielding this effect in the present analysis, which I will call CSA only insofar as this name for the process is well known in the French phonological tradition. The ban on schwa appearing in a closed syllable is categorical in OF (Morin 1991), unlike in Modern French where schwa deletion interacts with CSA on the word and phrasal levels and may yield some schwas in closed syllables in the output (cf. Ulfsbjorninn 2022 for many examples).

In a stratal phonological analysis, CSA appears to operate at the word level in OF as it does in Modern French (Ulfsbjorninn 2022), given that a schwa-headed syllable in the stem-level stratum does not adjust to its full vowel allophone if it finds itself in a closed syllable in any of the stem-level cycles' output. For example, forms like *blasm*[ə]*rons* 'blame-1ST.PL.FUT.IND', with a morphological structure of [[[blasm+ə]+r]+ɔns], should yield a word-level output of *[blɑː.me̲.rɔ̃ns] if CSA were active at the stem level, given the intermediate cycle [[blɑː.mə]+r] where schwa would appear in a closed syllable. If CSA were active in this stem-level cycle, it would require the adjustment of the underlying schwa, now in a closed syllable in this cycle's output, to a full vowel, forms that are unattested for words of this type. An alternate approach could be that resyllabification does not apply until the word-level stratum, but this may have undesirable consequences elsewhere in the phonology. For example, in a stem ending in /z/ (*faire* 'do-INF', /faj ~ fajz +$Ø_V$ + r(ə)/), the selection of the allomorph with the stem-final sibilant is entirely contingent upon its ability to resyllabify into the onset of a vowel-initial suffix within a

cycle of the stem-level stratum (e.g., /faj ~ fajz/ yields *faire* before a consonant-initial affix but forms like *fesons ~ faisons* 'do-1ST.PL.PRES.ind' with preserved /z/ when the affix is vowel-initial). Given this, the more targeted effect of CSA, rather than a general claim on non-resyllabification in the stem-level stratum, is adopted here. Given word-level outputs without schwa adjustment where the syllable was closed in an intermediate stem-level cycle like in [[[blasm+ə]+r]+ɔns], the joint effect of constraints enforcing CSA must be characteristic of the phonology of the word-level stratum and not the stem-level stratum, within a stratal phonological analysis such as the present one.

Diachronically speaking, it makes sense that CSA operates especially at the level of words rather than stems. This is because the metrical basis for vowel reduction to schwa in weak metrical positions (including word-final unstressed Latin *-a* > -[ə]) and the closely related syncope process active from Late Latin through PF (e.g., *insula(m)* > °*isola* > *isle* 'island', *hispidu(m)* > *hisde* 'horror', etc., in (1a) above) apply to the output form of fully formed words according to their final stress pattern after the addition of morphology. In some cases, this eventually gave rise to previously non-existent stem allomorphy within certain lexical paradigms (e.g., *parol-/parl-* 'speak' [*GGHF* 2020, sct. 31.3.1.4b-ii, pp. 755–56] according to the word-level stress pattern of earlier unsyncopated forms). Vowels ending up in closed syllables were generally protected from syncope or vowel reduction by virtue of heavy syllables being favored to occupy stronger metrical positions. In this vein, vowels in closed syllables, like those that were stressed but in open syllables, prove much more resistant to the diachronic pressures of lenition and reduction, generally preserving their etymological vowel quality into OF (e.g., *bl**a**stemare* > *bl**a**smer* 'blame-INF' in [1a-iii]). Similarly, vowels that were in stressed, open syllables also remain full vowels, often diphthongized (e.g., *bove(m)* > *buef* 'beef' [*GGHF* 2020, sct. 17.5.1, p. 315]) or with a vowel quality shift representing the monophthongization of an earlier diphthong posited in Late Latin (e.g., *spatha(m)* > °*sp*[æɛ]*the* > 9th-century *sp**e**de* 'sword' [*GGHF* 2020, sct. 17.2.1, pp. 306–7]). Especially for schwa that became underlying, such as the 1st conjugation theme vowel, word-level CSA reflects the non-reduction of the historical full vowel when these ended up in closed syllables.

Opposing the effects of CSA would be a faithfulness constraint DEP-V(PLACE) that penalizes the surfacing of an underlying schwa, representing a placeless vowel as per Eychenne (2014), with defined place features absent in the input when underlying schwa surfaces as allophonic variants such as [e, ɛ, æ]. In the spirit of minimal violation, the centrality of the placeless schwa vowel aligns most readily with mid vowel height (neither [+high] nor [+low]) and the less marked [-round] value of the [±round] feature. This provides a likely explanation for the unmarked preference for /ə/ to surface as [e], [ɛ] (or fronted to [æ]) when its position requires a full-vowel allophone (additional constraints achieving these non-controversial and well-established allophonic vowel qualities are omitted in this analysis, however, as not to obscure what is already a complex constraint interaction). In the stem-level stratum, given CSA is not active, DEP-V(PLACE) must outrank CSA, disallowing the surfacing of non-underlying place features when the underlying vowel is schwa. In the word-level stratum, however, CSA promotes to undominated status, as per the tenets of Stratal OT (cf. Kiparsky 2015), and thus the opposite ranking holds true, whereby an underlying schwa surfaces with minimally-defined place features (i.e., as [e, ɛ, æ]) if syllabified in a closed syllable in the output of the word-level stratum, satisfying CSA at the expense of DEP-V(PLACE). While most typically it is faithfulness constraints that become undominated in superordinate strata, in his exposition of the architecture of Stratal OT, Kiparsky notes that "on OT assumptions, sound change must be the reranking of a markedness constraint to a position where it dominates all faithfulness constraints", and "levels can differ in other ways as well, [such as] in what syllable structures are allowed and in what measures are taken to repair impermissible ones" (Kiparsky 2015, pp. 33–34). The promotion of CSA to ensure that a reduced and intrinsically unstressable vowel such as schwa does not head an otherwise complex stress-attracting closed (and by virtue of

its coda, bimoraic) syllable aligns with these characterizations of which constraints and properties may be prioritized in superordinate strata outside of faithfulness constraints.

There is additional evidence of the position of these final two constraints within the constraint hierarchies with respect to other constraints established above for the present analysis. First, DEP-V(PLACE) must outrank ALIGN-R, since a word-final schwa does not surface with defined place features (e.g., as [e], [ɛ], etc.) in order to satisfy stress alignment on the word-final syllable. This positions it with at least equal ranking to *ə̊ in the stem-level and word-level constraint hierarchies. If it were not so, a word like *feste* 'party-FEM.SG.NOM' /fest+ə/ might surface as [fɛ(:).'te] in order to allow for rightmost stress assignment, but this is unattested in this meaning and form of the word. Second, when CSA ranks below DEP-V(PLACE) in the stem-level stratum, it likely ranks relatively low, at least below MAX(ROOT) and WSP, given the intermediate output ['fɛ:.tər] of the stem-level cycle when the infinitive marker /r/ is adjoined ensures the long vowel is preserved by remaining in a tonic position at the expense of satisfying CSA. It is only if CSA does not apply and schwa remains intact that stress can remain on the penultimate syllable (the rightmost not headed by schwa) to favor the preservation of the long vowel. (If CSA is instead ranked a bit higher, however, such as immediately below DEP-V[PLACE], it does not change the outcome, as its effect is still blocked in the stem-level stratum by higher-ranking DEP-V[PLACE] and *ə̊.)

It is no simple task to tease apart whether schwa is underlying or represents a reduced vowel allophone in the word-level output beyond the word-final syllable. In word-final syllables, its exceptionality from stress assignment and from right-to-left iambic footing makes it quite clearly, in agreement with Morin (1991), have to be posited as underlying in order to distinguish it from a word-final full vowel (e.g., *feste* ['fɛ:.tə] 'celebrate-1ST/3RD.SG.PRES.IND.' vs. *festé* [fɛ:.'te] 'celebrated-PAST.PARTICIPLE'). Whether underlying schwas in strong foot positions bearing stress require them to surface as full vowels or underlying full vowels surface as schwa in weak open-syllable positions both constitute possible analyses of surface alternations of OF schwa. In the case of the data at hand exhibiting compensatory vowel lengthening and its interaction with stress assignment at various stem-level cycles and in the word-level stratum, positing underlying schwa offers an explanation for the distribution of vowel length upon coda /s/ deletion and thus may constitute indirect evidence in favor of underlying schwa in many, but not all, cases.

Word-final schwas affected by CSA are abundantly represented in the lexicon in the 1st conjugation verb class, whose theme vowel is likely schwa, alongside /i/ for 2nd conjugation and /Ø/ for 3rd conjugation. These verb classes form the infinitive by adding /r/ for 1st or 2nd conjugations and its potential allomorph /r(ə)/ for 3rd conjugation verbs. (In most cases, the final schwa for 3rd conjugation infinitives is derivable as epenthetic after a word-final rising cluster, e.g., *pren**dr**e* 'take-INF', *es**tr**e* 'be-INF.' This occurs because the vast majority of 3rd conjugation verb stems are consonant-final, or were historically, alongside the 3rd conjugation's absence of a theme vowel, necessitating the schwa to license the rising-sonority cluster formed at the stem-affix juncture ([Cr]) word-finally. As this lies outside the focus of this study, the infinitive marker for 3rd conjugation verbs analyzed here will be cited as /rə/, with no substantive effect on the claims of the analysis, as the schwa remains present even if a historical stem-final consonant is already lost by OF, e.g., *lire* 'read-INF,' *faire* 'do-INF,' etc.) That schwa must be the underlying form for the 1st conjugation theme vowel finds its strongest evidence in the word-final surfacing of [ə] in many related finite forms, for example in some 1st but especially 3rd person singular forms of the present indicative (e.g., *aime* 'loves,' *loue* 'praises,' etc. [*GGHF* 2020, sct. 31.3.1.3c, p. 752]). Here, there is general consensus that word-final schwa must be underlying [Morin 1991], at least when not motivated by the need to license a preceding rising-sonority cluster (e.g., *asn**e*** 'donkey,' *sempr**e*** 'always' [Jacobs 1995; Rainsford 2020]). In addition, theme vowel schwa bears a paradigmatic relation to the theme vowels /i/ and /Ø/ of the other conjugation classes before person markers such as /s/ (2nd person singular) or arguably /t/ (3rd singular) in earlier OF. These are the only inflectional segments permitted after schwa in a word-final syllable without

triggering schwa adjustment (equally true of inflectional /s/ for nominal number and case marking) (Rainsford 2020, p. 71), highlighting the unique phonological status (perhaps extrasyllabicity) of these well-recognized morphophonological exceptions to CSA (e.g., neither verb nor noun *fest+e+s* ['fɛ(s).təs], 'celebrate-2ND.SG.PRES.IND' or 'party-FEM.PL', respectively, triggers schwa adjustment to [e] or stress reassignment). Finally, the alternation between [e] in infinitives and [ə] in future and conditional forms, which use the infinitive as a stem but in which the theme vowel surfaces in an open syllable (e.g., *blasm*[e]*r* 'blame-INF' vs. *blasm*[ə]*rons* 'blame-1ST.PL.FUT.IND'), serves as supporting evidence for the viability of the theme vowel's underlying form being /ə/.

An additional likelihood is that vowel reduction and schwa fortition at times overlap in word-internal contexts where schwa and a full vowel alternate, and that output well-formedness for both processes coincides in dictating that schwa only appears in weak, open-syllable foot positions and a full vowel surface in strong foot positions or in a closed syllable. This may or may not be reinforced by allomorphy in some alternating stems and affixes (e.g., the stem *cel+e+r* 'hide-INF' /tˢɛl/ ~ /tˢəl/), also proposed by Morin (1991) for later OF, with allomorph selection depending on the output well-formedness of schwa versus full vowel allophone in non-final syllables. As the present analysis is especially focused on the interaction of post-tonic schwa insofar as it determines stress assignment for the purposes of compensatory lengthening or non-lengthening upon coda /s/ deletion in tonic and atonic syllables, respectively, and given that not all vowels undergo reduction in atonic syllables, it lies beyond the scope of this study to pursue and offer a fully elaborated answer to such intriguing questions. Where an alternation between schwa and a full vowel exists in an affix that is string-final within some cycle of the stem-level stratum and word-level stratum, or where there is a stable schwa in the surface form, an underlying schwa will be posited, barring specific contrasts to the contrary (for example, in the case of the two distinct *-el* suffixes from Latin *-alis/-alem* versus from *-ellum*, if *-alis/-alem* > /æl/ is actually /əl/ versus *-ellum* > /ɛl/, their generally distinct plural forms *-els* and *-ea(u)ls*, respectively, could be cited as evidence). The justification for positing underlying schwa in these cases stems from the fact that the structural context for an underlying full vowel reducing to schwa is very often not met within the stratal cycle when the potential schwa segment is appended, leaving the schwa surface value unexplained if it is not underlying. Finally, one contribution to this complex question from the present analysis is that the presence of an underlying schwa, even when it is not surface-apparent in the output of the word-level stratum, can be detected as it indirectly conditions the lengthening of the previous syllable's vowel upon coda /s/ deletion.

Putting this all together with the dominance relations established already, we arrive at the final constraint ranking in Figure 4 for OF, accounting for the distribution of compensatory vowel lengthening upon coda /s/ deletion, for all lexical types presented in Table 4.

As proposed for constraint hierarchies between distinct phonological strata, a given constraint may be promoted in a superordinate stratum to undominated status with respect to a subordinate stratum (Kiparsky 2008, 2015, 2023). In this case, it is the conglomerate constraint CSA, representing the joint effect of constraints enforcing the full vowel realization of an alternating schwa in a closed syllable, that is promoted in the word stratum to impose this requirement in the word-level, though not in the stem-level, stratum. The consequence of this re-ranking allows for stress to shift at the word level to word-final closed syllables that, despite being headed by a schwa at the stem level, surface at the word level with a full vowel allophone. Meanwhile, any compensatory vowel lengthening produced in a previous stem-level cycle is preserved in a potentially opaque atonic position in the output of the word-level stratum (cf. Type 2c in Table 4). The interplay of these constraints and their dominance relations in the hierarchy will be demonstrated in the Stratal OT analyses to which we now turn.

(a) Constraint ranking for stem-level stratum for OF compensatory lengthening upon coda /s/ deletion

DEP-V(PLACE), *ə́ » ALIGN (FT, R, ʂ, R, σ) »
MAX(ROOT), WEIGHT-TO-STRESS »
MAX(LENGTH), *$X_1S_2]_\omega$, CSA » *e:/o:, *ă, MAX » *ĕ/ŏ, *ɑ:

(b) Constraint ranking for word-level stratum for OF compensatory lengthening upon coda /s/ deletion: promotion of CSA to undominated status

CSA » DEP-V(PLACE), *ə́ » ALIGN (FT, R, ω, R, σ) »
MAX(ROOT), WEIGHT-TO-STRESS »
MAX(LENGTH), *$X_1S_2]_\omega$ » *e:/o:, *ă, MAX » *ĕ/ŏ, *ɑ:

Figure 4. Constraint ranking for OF in light of stress assignment, schwa adjustment, and short vs. long vowel reflex upon coda /s/ deletion.

3. Results

In this section, I present Stratal OT tableaux for the main word types presented in Table 4. Some types or vowel qualities within the word type will be explicitly collapsed when they pattern together. When there are distinct reflexes within a word type, for example, because of the quality of the affected vowel, vowel-specific examples will be illustrated in separate tableaux.

3.1. Monomorphemic Word Types (1a, 2a)

Type 1a includes words that are essentially monomorphemic —that is, exclusive of basic obligatory inflection marking for their syntactic category, such as nominal gender or verbal theme vowel. It comprises words with both root-internal atonic mid vowels followed by coda /s/ (e.g., *tesmoing* [te.'mɔ̃ĩŋ], *posterne* [pɔ.'tɛr.nə]) as well as arguably root-external prothetic [e] (e.g., *espose* [e.'pu.zə]), which pattern together given compensatory lengthening does not apply to the atonic mid vowels. Also within Type 1a are words of the same morphological structure that contain root-internal atonic /a, ɑ/ (e.g., *mastin* [mɑ:.'tĩn]), which, by virtue of being low vowels, lengthen regardless of being in a stressed or unstressed position in the stem-level cycle when coda /s/ deletes. Type 2a differs from Type 1a in that coda /s/ deletion affects a stressed syllable, whether word-final or penultimate if followed by a word-final schwa, within that stem-level cycle, thus yielding a long vowel regardless of vowel height.

Type 1a words with an atonic mid vowel like *tesmoing* [te.'mɔ̃ĩŋ] and *posterne* [pɔ.'tɛr.nə] represent the most straightforward example of the short vowel reflex of coda /s/ deletion when it occurs in an unstressed syllable within its cycle of application, as illustrated in Tableau 1a-i.

Tableau 1a-i. ***tesmoing*** /[tesmɔ̃ĩŋ]+$Ø_{MASC}$]+ $Ø_{OBL}$+$Ø_{SG}$]/

(a) *Stem-level:* /[tesmɔ̃ĩŋ]+$Ø_{MASC}$/ → [te.'mɔ̃ĩŋ]

/[tesmɔ̃ĩŋ]+$Ø_{MASC}$/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*$X_1S_2]_ω$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'tes.mɔ̃ĩŋ			*!		*			*				*	
b. 'te:.mɔ̃ĩŋ			*!		*				*		*		
c. 'te.mɔ̃ĩŋ			*!	*	*						*	*	
d. tes.'mɔ̃ĩŋ					*			*!				*	
e. te:.'mɔ̃ĩŋ					*				*		*!		
☞ f. te.'mɔ̃ĩŋ				*							*	*	

(b) *Word-level:* /[te.'mɔ̃ĩŋ+$Ø_{MASC}$]+$Ø_{OBL}$+$Ø_{SG}$]/ → [te.'mɔ̃ĩŋ]

/[[[te.'mɔ̃ĩŋ]]+$Ø_{OBL}$+$Ø_{SG}$]/	CSA	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	*$X_1S_2]_ω$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'te:.mɔ̃ĩŋ				*!		*			*				
b. te:.'mɔ̃ĩŋ						*!			*				
☞ c. te.'mɔ̃ĩŋ												*	
d. 'te.mɔ̃ĩŋ				*!	*	*						*	

In this tableau and all subsequent tableaux, as per standard Optimality Theory notation, each * indicates a violation of that column's constraint incurred by that row's candidate, and ! indicates that the violation represented by the preceding asterisk was fatal and is the violation that eliminates that row's candidate from optimality.

The stem-level cycle in (a) illustrates the short vowel reflex as the result of the interaction of lower-order constraints, given equal higher-ranking violations of MAX(ROOT) and WEIGHT-TO-STRESS. In order to respect rightmost primary stress as enforced by ALIGN-R, the stem-level phonology must tolerate a violation of either MAX(ROOT) or WSP within this cycle. It is thus lowest-ranking MAX, penalizing the deletion of a segment in the input, paired with the unmarked short mid vowel, that represents the minimal violation with respect to *$X_1S_2]_ω$, banning the surfacing of the sibilant in coda position, or *e:/o:, dispreferring long mid vowels in the output. We thus see the output of the stem-level cycle evading an infraction of WSP by selecting a short vowel, unmarked for mid vowels, despite running awry of MAX(ROOT) and low-ranking MAX when /s/ deletes without a trace. In (b), candidate *c*, which is entirely faithful to the input of the word-level stratum (transmitted from the output of the preceding stem-level stratum), proves optimal, given there is no motivation to adjust stress assignment or alter the input sequence. Nor is there any overt morphology to integrate into the phonological string, which is already optimized with respect to the constraint hierarchy. The output of the word-level stratum is thus [te.'mɔ̃ĩŋ], preserving the short mid vowel reflex of coda /s/ deletion in unstressed position determined earlier in the derivation during the stem-level cycle.

Within Type 1a are words exhibiting an initial prothetic [e] in surface forms. Whether the prothetic vowel preceding coda /s/ is derived or underlying does not alter the outcome for the purposes of compensatory lengthening, which does not apply and thus exhibits the same short mid vowel reflex of coda /s/ deletion as other words in Type 1a. As

discussed in Section 1, until after the early 12th century (Pope 1952; Sampson 2010), words undergoing prothesis like *espose* 'wife/spouse-FEM.SG' alternated between forms exhibiting the prothetic vowel or not according to whether the sequence is preceded by a vowel-final word at the phrase level (e.g., *out* ***esp****osede* 'had-3RD.SG.PRET. wed-PAST.PARTICIPLE.FEM.SG' vs. *ta* ***sp****use* 'your spouse-FEM.SG' [Montaño, forthcoming, citing early 12th century *La Vie de Saint Alexis*, ms. L]). In the latter part of the 12th century, the prothetic vowel became fixed regardless of its phrasal context, in close chronological proximity and likely overlapping partially with coda /s/ deletion. The underlying nature of the prothetic vowel thus becomes unclear once it becomes a stable fixture at the beginning of the word, even triggering elision of determiners as other vowel-initial words do (e.g., /sa#(e)spee/ → *s'espee* 'his/her sword' [Montaño, forthcoming, citing Pope's (1952) example from later 12th-century *Chanson de Roland*, ms. Digby, ll. 346, 3267]).

Montaño's (forthcoming) analysis advocates for an underlying form for these words that does not include the prothetic vowel given the short vowel reflex upon /s/ deletion, as MAX(ROOT) only needs to preserve a single root node upon the deletion of /s/. The abandoned root node of deleted /s/ is filled with an epenthetic vocalic element that surfaces as short since it is not furthermore linked to a preceding underlying vowel to yield a long vowel, as occurs in word-internal contexts. The present account is compatible with this position but also poses no conflict with the alternative analysis that the prothetic vowel had become underlying once it became fixed in surface forms. This is because if the prothetic vowel is underlying, it will always be unstressed in the cycle in which the following coda /s/ deletes, and thus the short mid vowel reflex will prevail in that phonological cycle. This is an advantage of the present Stratal OT account of the lack of compensatory lengthening in Type 1a words affected by prothesis since the attested output prevails regardless of the underlying status posited for the prothetic vowel. Tableaux 1a-ii and 1a-iii illustrate the transmission of the short vowel reflex from the stem-level stratum into the output of the word-level stratum for both possible input forms including the prothetic vowel (Tableau 1a-ii) or not (Tableau 1a-iii).

Tableau 1a-ii. ***espose*** **/**[espos]+$_{\text{ə FEM}}$]+ Ø$_{\text{OBL}}$+Ø$_{\text{SG}}$]/

(a) *Stem-level:* **/**[espos]+$_{\text{ə FEM}}$/ → [e.'pu.zə]

/[espos]+$_{\text{ə FEM}}$/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'es.pu.zə			**!					*				*	
b. 'e:.pu.zə			**!						*		*		
c. 'e.pu.zə			**!	*							*	*	
d. es.'pu.zə			*		*			*!				*	
e. e:.'pu.zə			*		*				*		*!		
☞ f. e.'pu.zə			*	*							*	*	
g. es.pu.'zə		*!			*			*				*	
h. e:.pu.'zə		*!			*				*		*		
i. e.pu.'zə		*!		*							*	*	

(b) *Word-level:* /[e.'pu.z+ə$_{FEM}$]+Ø$_{OBL}$+Ø$_{SG}$]/ → [e.'pu.zə]

/[[[e.'pu.z+ə$_{FEM}$]]+Ø$_{OBL}$+Ø$_{SG}$]/	CSA	Dep-V(Place)	*ə́	ALIGN-R	Max(root)	Weight-to-Stress	Max(Length)	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	Max	*ɛ̀/ɔ̀	*ɑ:
a. 'e:.pu.zə				**!					*			*	
b. e:.'pu.zə				*		*!			*				
c. e:.pu.'zə			*!			*			*				
☞ d. e.'pu.zə				*								*	
e. 'e.pu.zə				**!								*	
f. e.pu.'zə			*!									*	

Tableau 1a-iii. ***espose*** /[spos]+ə$_{FEM}$]+ Ø$_{OBL}$+Ø$_{SG}$]/
(a) *Stem-level:* /[spos]+ə$_{FEM}$/ → [e.'pu.zə]

/[spos]+ə$_{FEM}$/	Dep-V(place)	*ə́	Align-R	Max(root)	Weight-to-Stress	Max(Length)	CSA	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	Max	*ɛ̀/ɔ̀	*ɑ:
a. 'es.pu.zə			**!					*				*	
b. 'e:.pu.zə			**!						*		*		
c. 'e.pu.zə			**!								*	*	
d. es.'pu.zə			*		*!			*				*	
e. e:.'pu.zə			*		*!				*		*		
☞ f. e.'pu.zə			*								*	*	
g. es.pu.'zə		*!			*			*				*	
h. e:.pu.'zə		*!			*				*		*		
i. e.pu.'zə		*!		*							*	*	

(b) *Word-level:* /[e.'pu.z+ə$_{FEM}$]+Ø$_{OBL}$+Ø$_{SG}$]/ → [e.'pu.zə]

/[[[e.'pu.z+ə$_{FEM}$]]+Ø$_{OBL}$+Ø$_{SG}$]/	CSA	Dep-V(Place)	*ə́	ALIGN-R	Max(root)	Weight-to-Stress	Max(Length)	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	Max	*ɛ̀/ɔ̀	*ɑ:
a. 'e:.pu.zə				**!					*				
b. e:.'pu.zə				*		*!			*				
c. e:.pu.'zə			*!			*			*				
☞ d. e.'pu.zə				*								*	
e. 'e.pu.zə				**!								*	
f. e.pu.'zə			*!									*	

Tableau 1a-ii shows that if the prothetic vowel is posited as having become part of the input form drawn from the lexicon (e.g., *espose* = /espos+ə/), then prothesis words of Type 1a pattern identically to other Type 1a words with an atonic mid vowel. What was once a non-underlying initial vowel preceding the input-initial sibilant–consonant cluster would now have simply become an underlying /VsC/ sequence in the stem-initial syllable, akin to that in the initial syllable of *tesmoing*, despite the lack of an inconsequential consonantal onset at the initial margin of the syllable. Tableau 1a-iii, on the other hand, shows that if the prothetic vowel is not considered underlying immediately upon becoming fixed in the word-level output, the short vowel reflex still prevails when coda /s/ deletion overlaps in application with prothesis. For expositional purposes and given the scope of the present analysis on the compensatory lengthening effect of coda /s/ deletion and not on the detailed mechanics of prothesis, Tableau 1a-iii only presents output candidates including the prothetic vowel so as not to necessitate additional constraints required to illustrate why prothesis is optimal for /sC/-initial strings when [.sC] is not a possible onset cluster. For these details, I refer the reader to Montaño (forthcoming) for one fully-elaborated Optimality-Theoretic proposal compatible with the present analysis.

Prothesis was likely a word-level phenomenon, however, during later OF, as opposed to a stem-level one as depicted in Tableau 1a-iii. As argued in Montaño (forthcoming) and following the life cycle of phonological processes proposed by Bermúdez-Otero (2013) from the phrase stratum to the word stratum and subsequently to the stem stratum, prothesis is in all likelihood a process affecting the word-level phonology once its domain narrows from the phrasal phonology. Suggestive internal evidence can be found in the existence of doublets for some prefixed forms not including the prothetic vowel on a stem that would otherwise undergo prothesis if word-initial. For example, lexical variants exist demonstrating realization of prothesis at the word or stem levels in examples of words containing the privative prefix *de(s)*, as in *despoir* versus later *des̲espoir* ← /de(s) + sper/ 'make-hopeless-3RD.SG.PRES.IND' (Montaño, forthcoming, citing Constans' (1918) example from late 12th-century *Yvain et le Chevalier du Lion*). In this example, the first variant shows no prothesis in the stem before the prefix is adjoined and the second exhibits prothesis in the stem (cf. non-prefixed *esperer* 'hope-INF') before adjoining the prefix. Additional doublets that co-exist for a time until prothesis is eventually definitively active at the stem level include *dé<s>chouer* ~ *dése<s>chouer* 'refloat-INF' and *dé<s>pingler* ~ *dése<s>pingler* 'unpin-INF' (<s> where coda /s/ deletion had applied during OF marked for illustrative purposes to citation forms from the *TLFi* 1994). Examples such as these corroborate the anticipated path of the phonological process of prothesis from the phrase to the word, and only later to the stem. Given this, in Tableau 1a-iv, I demonstrate that even if the stem-level stratum's output does not yet include the prothetic vowel, prothesis applied at the word-level stratum yields the same result of a short vowel reflex to /s/ deletion.

Tableau 1a-iv. ***espose*** **/**[spos]+ə$_{FEM}$]+ Ø$_{OBL}$+Ø$_{SG}$]/
Word-level: /['spu.z+ə$_{FEM}$]+Ø$_{OBL}$+Ø$_{SG}$]/ → [e.'pu.zə]

/[[['spu.z+ə$_{FEM}$]]+Ø$_{OBL}$+Ø$_{SG}$]/	CSA	DEP-V(PLACE)	*ə̆	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'e:.pu.zə				**!					*		*		
b. e:.'pu.zə				*		*!			*		*		
c. e:.pu.'zə			*!			*			*		*		
d. 'es.pu.zə				**!				*				*	
e. es.'pu.zə				*		*!		*				*	
f. es.pu.'zə			*!			*		*				*	
g. 'e.pu.zə				**!							*	*	
☞ h. e.'pu.zə				*							*	*	
i. e.pu.'zə			*!								*	*	

The crucial difference illustrated in Tableau 1a-iv is that a MAX(ROOT) violation does not accompany the deletion of /s/ when a short vowel surfaces, unlike in the stem-level stratum of Tableau 1a-i when /s/ deletes from the input /tesmɔ̃ĩŋ/. This is because the inserted vowel preserves the root node of deleted /s/, as per Montaño's (forthcoming) analysis, and given that it is a single root node position, the vowel surfaces as short. In this way, the WSP violation excludes other candidates *b* and *e* bearing optimal penultimate stress for a schwa-final word (incurring an unavoidable single violation of ALIGN-R). It is worth noting that even without the effect of the WSP, winning candidate *h* would still prevail given it only violates MAX and unmarked *ĕ/ŏ as far as constraints ranked below WSP are concerned. The analysis thus continues to make the correct prediction with prothesis reserved for the word-level phonological stratum, as per the highly suggestive diachronic morphophonological evidence of prefix reflexes before potentially prothetic stems and in keeping with the theoretical arguments put forth by Bermúdez-Otero (2013) with respect to the diachronic trajectory of phonological processes through morphosyntactic domains.

When a Type 1a word contains a root-internal low vowel /a, ɑ/ in atonic position within the cycle when a following coda /s/ deletes, however, the inverted markedness scale for length with respect to low vowels allows long [ɑ:] to surface in compensation for deleted /s/ despite being unstressed. Tableau 1a-v illustrates this distinct reflex from atonic mid vowels of Type 1a for monomorphemic *mastin* 'guard dog'.

Tableau 1a-v. *mastin* /[mastin]+$Ø_{MASC}$]+ $Ø_{OBL}$+$Ø_{SG}$]/

(a) *Stem-level:* /[mastin]+$Ø_{MASC}$/ → [mɑ:.'tĩn]

/[mastin]+$Ø_{MASC}$/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*$X_1S_2]_ω$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'mɑs. tĩn			*!		*			*		*			
b. 'mɑ:.tĩn			*!		*						*		*
c. 'mɑ. tĩn			*!	*	*					*	*		
d. mɑs.'tĩn					*			*!		*			
☞ e. mɑ:.'tĩn					*						*		*
f. mɑ.'tĩn				*						*	*!		

(b) *Word-level:* /[mɑ:.'tĩn+$Ø_{MASC}$]+$Ø_{OBL}$+$Ø_{SG}$]/ → [mɑ:.'tĩn]

/[[[mɑ:.'tĩn]]+$Ø_{OBL}$+$Ø_{SG}$]/	CSA	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	*$X_1S_2]_ω$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'mɑ:.tĩn				.*!		*							*
☞ b. mɑ:.'tĩn						*							*
c. mɑ.'tĩn					*		*!			*			
d. 'mɑ.tĩn				*!	*	*	*			*			

Within the stem-level stratum, because MAX(ROOT) and WSP are equally ranked, a tie at this higher tier of the hierarchy allows candidates with either the root node of deleted /s/ eliminated or with a tonic long vowel to remain in the running for optimality. For this reason, lower-ranked constraints determine the winner. At the stem level, candidate *f* with marked short [ɑ] fails, as it incurs a double violation of *ă and MAX in avoidance of the coda /s/, when the vowel surfacing as long [ɑ:] can instead violate only MAX in this lower tier of the constraint hierarchy. The long vowel reflex is thus transmitted to the input of the word-level stratum, where MAX(LENGTH) ensures it is preserved in the output despite infringing on the WSP, yielding an atonic long [ɑ:] words of this type.

When coda /s/ deletion impacts a syllable that would indeed bear stress within the phonological cycle of its application, however, as in Type 2a (e.g., *feste* /[[fɛst+$ə_{FEM}$]+$Ø_{OBL}$ +$Ø_{SG}$]/ → ['fɛ:.tə], *oste* /[[ɔstə+$Ø_{MASC}$]+$Ø_{OBL}$+$Ø_{SG}$]/ → ['o:.tə], *mast* [[mast+$Ø_{MASC}$]+ $Ø_{OBL}$+$Ø_{SG}$]/, etc.), compensatory vowel lengthening proves optimal in order to preserve the root node of the deleted input /s/. This occurs when the syllable impacted by coda /s/ deletion is either root-final with null morphology appended, or potentially followed by a root-internal (e.g., *oste*) or morphologically concatenated schwa (as in nominal feminine or verbal theme vowel -[ə]), ensuring stress lands on the syllable in which coda /s/ deletion is realized within that cycle. Tableau 2a illustrates this effect for schwa-final *feste* → ['fɛ:.tə], though the outcome is identical whether the tonic syllable is followed by a schwa or not within the cycle of /s/ deletion.

Given that the relevant syllable is assigned stress within the stem-level cycle of coda /s/ deletion, vowel quality does not affect the outcome, as WSP is satisfied when a long vowel surfaces in a tonic syllable. This makes a violation of equally-ranked MAX(ROOT) superfluous and therefore fatal for a stem-level candidate exhibiting the short vowel reflex of coda /s/ deletion (candidate *c*). A long mid vowel is preferable to allowing coda /s/ to surface, a violation of $*X_1S_2]_\omega$, and so compensatory lengthening alongside the violation of MAX from the deleted /s/ prevails in the output of the stem-level stratum. In the word-level stratum, reminiscent of the preservation of long atonic [ɑ:] in Type 1a words, MAX(ROOT) and MAX(LENGTH) guarantee that the vowel length produced in the stem-level stratum persists into the output of the word stratum, resulting in word-level output ['fɛ:.tə].

Tableau 2a. ***feste*** **/**[fɛst]+$ə_{FEM}$]+$Ø_{OBL}$+$Ø_{SG}$]/

(a) *Stem-level:* **/**[fɛst]+$ə_{FEM}$/ → ['fɛ:.tə]

/[fɛst+$ə_{FEM}$]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	$*X_1S_2]_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'fɛs.tə			*					*!				*	
☞ b. 'fɛ:.tə			*						*		*		
c. 'fɛ.tə			*	*!							*	*	
d. fɛs.'tə		*!			*			*				*	
e. fɛ:.'tə		*!			*				*		*		
f. fɛ.'tə		*!		*							*	*	

(b) *Word-level:* /[['fɛ:tə] +$Ø_{OBL}$+$Ø_{SG}$]/ → ['fɛ:.tə]

/[['fɛ:.tə]+$Ø_{OBL}$+$Ø_{SG}$]/	CSA	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	$*X_1S_2]_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
☞ a. 'fɛ:.tə				*					*				
b. 'fɛ.tə				*	*!		*					*	
c. fɛ:.'tə			*!			*			*				
d. fɛ.'tə			*!		*		*					*	

3.2. Polymorphemic Word Types 1b, 1c, and 2b

Polymorphemic words of Types 1b, 1c, and 2b, despite possessing a more complex morphological structure, mirror the word-level output of Types 1a and 2a in terms of compensatory lengthening or lack thereof upon OF coda /s/ deletion. This is because the syllable losing coda /s/ within the stratal cycle of deletion receives the same atonic or tonic stress assignment as in monomorphemic Types 1a and 2a, even though words of these types bear additional derivational morphology. Words of Types 1b, 1c, and 2b, though differing in their internal morphological structure, overall follow the same phonological pattern

as seen for Types 1a and 2a, as will be illustrated below for the following four representative polymorphemic examples: *postel* /[[pɔst+ɛl$_{\text{MASC}}$]$_{\text{STEM}}$+Ø$_{\text{SG}}$+Ø$_{\text{OBL}}$]$_{\text{WORD}}$ → [pɔ.'tɛl] 'post, pole' (Tableau 1b-i) and *rastel* /[[rast+ɛl$_{\text{MASC}}$]$_{\text{STEM}}$+Ø$_{\text{SG}}$+Ø$_{\text{OBL}}$]$_{\text{WORD}}$/ → [rɑ:.'tɛl] 'rake' (Tableau 1b-ii) representing the short vowel reflex for atonic mid and lengthening for atonic low vowels, respectively; and Type 1c word *desfaire* [des+[[[faj+Ø$_{\text{V}}$]+rə$_{\text{INF}}$]$_{\text{STEM}}$]$_{\text{WORD}}$] → [de.'faj.rə] 'undo-INF' (Tableau 1c) and Type 2b word *requeste* [[rə+[kɛst+ə$_{\text{FEM}}$]]$_{\text{STEM}}$+Ø$_{\text{SG}}$+Ø$_{\text{OBL}}$]$_{\text{WORD}}$ → [rə.'kɛ:.tə] 'request-FEM.SG' (Tableau 2b) illustrating that stress is the determining factor for the long versus short vowel reflex in prefixed words upon coda /s/ deletion.

As Tableaux 1b-i and 1b-ii illustrate, the morpheme boundary in the first stem-level cycle does not alter the output for that phonological stratum with respect to Type 1a words, where coda /s/ deletion is realized within the monomorphemic root plus a null stem-level suffix. This is because the first stem-level string is such that coda /s/ deletion affects an atonic syllable. In these tableaux, the roots *post-* (cf. OF *post* 'post-MASC' [*TLFi* 1994]) and *rast-* plus diminutive noun suffix /ɛl/ (< Latin *-ellum*; OF plural *-eau(l)s*) yield stress on the string-final syllable, resulting in the short vowel reflex for an atonic mid vowel and compensatory lengthening for an atonic low vowel upon the loss of /s/. The phonology of the word-level stratum preserves this outcome, given no motivation to lengthen an atonic short vowel in the case of *postel* and the preservational effect of MAX(LENGTH) in the case of *rastel*. We thus see that polymorphemic Type 1b mirrors the reflexes of Type 1a, despite greater internal morphological complexity, since the stress profile of the stem-level string is the same.

Tableau 1b-i. ***postel*** /[[pɔst+ɛl$_{\text{MASC}}$]+Ø$_{\text{OBL}}$+Ø$_{\text{SG}}$]/

(a) *Stem-level:* /[pɔst+ɛl$_{\text{MASC}}$/ → [pɔ.'tɛl]

/[pɔst+ɛl$_{\text{MASC}}$/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'pɔs.tɛl			*!		*			*				*	
b. 'pɔ:.tɛl			*!		*				*		*		
c. 'pɔ.tɛl			*!	*	*						*	*	
d. pɔs.'tɛl					*			*!				*	
e. pɔ:.'tɛl					*				*		*!		
☞ f. pɔ.'tɛl				*							*	*	

(b) *Word-level:* /[[pɔ.'t+ɛl$_{MASC}$]+Ø$_{OBL}$+Ø$_{SG}$]/ → [pɔ.'tɛl]

/[[pɔ.'t+ɛl$_{MASC}$]+Ø$_{OBL}$+Ø$_{SG}$]/	CSA	Dep-V(Place)	*ə́	Align-R	Max(Root)	Weight-to-Stress	Max(Length)	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	Max	*ɛ̆/ɔ̆	*ɑ:
a. 'pɔ:.tɛl				*!		*			*				
b. pɔ:.'tɛl						*!			*				
☞ c. pɔ.'tɛl												*	
d. 'pɔ.tɛl				*!		*						*	

Tableau 1b-ii. ***rastel*** **/**[[rast+ɛl$_{MASC}$]+ Ø$_{OBL}$+Ø$_{SG}$]/

(a) *Stem-level:* **/**[rast+ɛl$_{MASC}$]/ → [rɑ:.'tɛl]

/[rast+ɛl$_{MASC}$]/	Dep-V(place)	*ə́	Align-R	Max(Root)	Weight-to-Stress	Max(Length)	CSA	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	Max	*ɛ̆/ɔ̆	*ɑ:
a. 'rɑs.tɛl			*!		*			*		*			
b. 'rɑ:.tɛl			*!		*						*		*
c. 'rɑ.tɛl			*!	*	*					*	*		
d. rɑs.'tɛl					*			*!		*			
☞ e. rɑ:.'tɛl					*						*		*
f. rɑ.'tɛl				*						*	*!		

(b) *Word-level:* /[rɑ:.'t+ɛl$_{MASC}$]+Ø$_{OBL}$+Ø$_{SG}$]/ → [rɑ:.'tɛl]

/[[[rɑ:.'t+ɛl]]+Ø$_{OBL}$+Ø$_{SG}$]/	CSA	Dep-V(Place)	*ə́	Align-R	Max(Root)	Weight-to-Stress	Max(Length)	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	Max	*ɛ̆/ɔ̆	*ɑ:
a. 'rɑ:.tɛl				*!		*							*
☞ b. rɑ:.'tɛl						*							*
c. rɑ.'tɛl					*		*!			*			
d. 'rɑ.tɛl				*!	*	*	*			*			

This is also true of Type 1c words, exemplified by *desfaire* (Tableau 1c). Here, the mid vowel preceding deleted coda /s/ in the prefix adjoined to the verb stem is atonic within that stratal cycle (in this example, the word-level stratum, as prefix *des-* attaches freely to any verb whose semantics are compatible with it and with predictable privative meaning), and thus must surface as short. Prefixed polymorphemes like *desfaire*, but also

other words prefixed by *des-*, *mes-*, *tres-*, and the like, will exhibit identical patterning with no compensatory lengthening upon coda /s/ deletion. In this way, Type 1c words look very much like words that underwent prothesis, with the distinction that the initial prothetic vocalic element of prothesis words is a *phonetic* product of the word-level stratal phonology, while the prefixes cited above are of course morphemes affixed to the phonological string within a stratal phonological cycle.

Tableau 1c. ***desfaire*** /[des+[[[faj ~ fajz+$Ø_V$]+rə$_{INF}$]$_{STEM}$]$_{WORD}$]/

(a) *Stem-level:* /[faj ~ fajz+$Ø_V$]/ → ['faj ~ fajz+$Ø_V$]

/[faj ~ fajz+$Ø_V$]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*$X_1S_2]_ω$	*eː/oː	*ă	MAX	*ĕ/ŏ	*ɑː
☞ a. 'faj ~ 'fajz													

(b) *Stem-level (cycle 2):* /[['faj ~ fajz+$Ø_V$]+rə$_{INF}$]/ → ['faj.rə]

/[['faj ~ 'fajz]+rə$_{INF}$]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*$X_1S_2]_ω$	*eː/oː	*ă	MAX	*ĕ/ŏ	*ɑː
a. faj.'rə		*!			*								
☞ b. 'faj.rə			*										
d. fajz.'rə		*!			*			*					
e. 'fajz.rə			*					*!					

(c) *Word-level:* /[des+['faj.+rə$_{INF}$]] / → [de.'faj.rə]

/[des+['faj.+rə$_{INF}$]]/	CSA	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. de.faj.'rə			*!		*	*					*	*	
☞ b. de.'faj.rə				*	*						*	*	
c. 'de.faj.rə				**!	*	*					*	*	
d. de:.faj.'rə			*!			**			*		*		
e. de:.'faj.rə				*		*			*		*!		
f. 'de:.faj.rə				**!		*			*		*		
g. des.faj.'rə			*!			**		*				*	
h. des.'faj.rə				*		*		*!				*	
i. 'des.faj.rə				**!		*		*				*	

In the example *desfaire* in Tableau 1c, I include root allomorphy for the base verb *faire*, which includes a potential root-final /z/ that surfaces pre-vocalically (e.g., *fais+ons* 'do-1ST.PL.PRES.IND.', *fais+oie* 'do-1ST.SG.IMPERF.IND.', *fes+imes* 'do-1ST.PL.PRET.IND.', etc.) but is deleted pre-consonantally. Once an overt phonological element is concatenated to the right of the input string, allomorph selection occurs according to the phonological constraint hierarchy. Given the *X$_1$S$_2$]$_\omega$ constraint militating against coda sibilants, the allomorph without final /z/ proves optimal once a post-/z/ consonantal phonological segment is introduced into the input (in this case, infinitive marker /rə/). While the focus of Tableau 1c is on the deletion of /s/ in the word-level prefix, this additional formalization showing how the present analysis can further account for cases of sibilant-final verb stem allomorphy is a welcome advantage.

In the word-level stratum when prefix *des-* is introduced, candidates with penultimate stress vie for optimality, given the final syllable cannot bear the otherwise preferable word-final stress by virtue of infinitive marker /rə/ being headed by schwa in an open syllable. Amongst these candidates (*b, e, h*), the short vowel reflex of coda /s/ deletion wins out, given it contains neither coda /s/ (candidate *h*), banned by *X$_1$S$_2$]$_\omega$, nor an undesirable atonic long mid vowel (candidate *e*) alongside the violation of MAX incurred by the deletion of /s/. Instead, the prefix surfaces as atonic short [de], as predicted for atonic mid vowels in the syllable from which coda /s/ deletes. A second welcome outcome of this analysis is the generation by phonology of what eventually become the two allomorphs of this prefix in diachrony, pre-consonantal *dé-* [de] and pre-vocalic *dés-* [dez], whose forms can arguably still be the product of phonology at this diachronic stage, but which eventually represent a clear case of allomorphy once coda /s/ deletion is no longer active at later stages of French.

Type 2b words are similar to those of Type 1b and 1c, except that stress lands on the vowel preceding coda /s/ in the cycle in which it undergoes deletion. As seen in Tableau 2b, presenting the stratal input–output mapping of *requeste*, the result is the predicted compensatory lengthening effect on the tonic vowel, regardless of vowel quality. This is because vowel length is determined in the stratal phonological cycle when coda /s/ deletes, and it is then carried through the remainder of the cycles by MAX(ROOT) and MAX(LENGTH), as we saw above in *feste* in Tableau 2a. The prefix *re-* is posited to be joined within the stem-level stratum, unlike word-level prefix *des-* in Tableau 1c (with no consequence on coda /s/ deletion or compensatory lengthening resulting from this

stance), given this prefix often interacts unpredictably with the semantics of its base, as is more characteristic of stem-level than word-level affixes (Bermúdez-Otero 2018). Tableau 2b illustrates, as expected, that adding the prefix to the base *queste* has no effect on compensatory lengthening since coda /s/ deletion occurs in a prior stratal phonological cycle and thus is a *fait accompli* by stem-level cycle 2 when it attaches to the stem.

Tableaux 1b-i,ii, 1c, and 2b confirm that being polymorphemic does not necessarily alter the realization or not of compensatory lengthening upon OF coda /s/ deletion, given that whether the preceding vowel is stressed or unstressed within the stratal phonological cycle of coda /s/ deletion is still the determining factor. But while Type 2c polymorphemes covertly follow this same pattern, we will see below that such words opaquely exhibit compensatory lengthening in an atonic syllable, even for mid vowels, when there is a shift in stress assignment in the word-level stratum.

Tableau 2b. ***requeste*** /[rə+[kɛst+ə$_{\text{FEM}}$]]+Ø$_{\text{OBL}}$+Ø$_{\text{SG}}$]/

(a) *Stem-level cycle 1:* **/**[kɛst+ə$_{\text{FEM}}$]/ → ['kɛ:.tə]

/[kɛst+ə$_{\text{FEM}}$]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'kɛs.tə			*					*!				*	
☞ b. 'kɛ:.tə			*						*		*		
c. 'kɛ.tə			*	*!							*	*	
d. kɛs.'tə		*!			*			*				*	
e. kɛ:.'tə		*!			*				*		*		
f. kɛ.'tə		*!		*							*	*	

(b) *Stem-level cycle 2:* **/**[rə+['kɛ:.t+ə$_{\text{FEM}}$]]/ → [rə.'kɛ:.tə]

/[rə+['kɛ:.t+ə$_{\text{FEM}}$]]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
☞ a. rə.'kɛ:.tə			*						*				
b. rə.'kɛ.tə			*	*!		*						*	
c. rə.kɛ:.'tə		*!			*				*				
d. rə.kɛ.'tə		*!		*		*						*	
e. 'rə.kɛ:.tə		*!	**		*				*				
f. 'rə.kɛ.tə		*!	**	*		*						*	

(c) *Word-level:* /[[rə+'kɛ:.t+$ə_{FEM}$]+$Ø_{OBL}$+$Ø_{SG}$]/ → [rə.'kɛ:.tə]

/[rə+'kɛ:.t+$ə_{FEM}$]+$Ø_{OBL}$+$Ø_{SG}$]/	CSA	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*$\chi_1 S_2]_\omega$	*ɛ:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
☞ a. rə.'kɛ:.tə				*						*				
b. rə.'kɛ.tə				*	*!		*						*	
c. rə.kɛ:.'tə			*!			*				*				
d. rə.kɛ.'tə			*!		*		*						*	
e. 'rə.kɛ:.tə			*!	**		*				*				
f. 'rə.kɛ.tə			*!	**	*		*						*	

3.3. Polymorphemic Word Type 2c

Polymorphemic words of Type 2c are unique in that stress is not assigned to the same syllable in the stem-level and word-level strata, producing opaque compensatory lengthening, regardless of vowel quality, upon OF coda /s/ deletion in an atonic syllable in the output of the word-level stratum. The distinction between Type 2c words like *fester* (/[[[**fɛs**t+ə]+r]$_{STEM}$]$_{WORD}$/ → [fɛ:.'**ter**] 'celebrate-INF'), *ostel* (/[[[**ɔs**tə+$Ø_{MASC}$]+æl]$_{STEM}$]$_{WORD}$/ → [o:.'**tæl**] 'lodging') and *blasmer* (/[[[**blas**m+ə]+r]$_{STEM}$]$_{WORD}$/ → [blɑ:.'**mer**] 'blame-INF') exhibiting opaque atonic compensatory lengthening and those in Type 1b (e.g., *tesmoigner* /[[[tes.**mɔ̃ĩ**.ɲ]+ə]+r]$_{STEM}$]$_{WORD}$/ → [te.mɔ̃ĩ.'**ɲer**] 'witness-INF', *postel* /[pɔs**t+ɛl**]$_{STEM}$]$_{WORD}$/ → [pɔ.'**tɛl**] 'post, pole') showing the short vowel reflex for atonic mid vowels lies in where stress is assigned within the intermediate stratal cycle when coda /s/ deletes, prior to the input–output mapping of the word-level stratum, when stress is potentially reassigned according to the constraints of that stratum. In Type 1b words, stress does not land on the syllable from which coda /s/ deletes within the stratal cycle of deletion, and thus mid vowels surface as short because of the pressure of the WSP and the markedness constraints on non-low vowels surfacing as long. On the other hand, in Type 2c words like those exemplified above, stress is assigned within the stem-level cycle of coda /s/ deletion to the syllable from which the sibilant deletes, yielding compensatory lengthening of the preceding vowel within that cycle's mapping from input to output. The vowel length produced within that cycle is then preserved and transmitted to subsequent stratal cycles, surfacing in the word-level output because of the effect of faithfulness constraints MAX(ROOT) and MAX(LENGTH), despite the reassignment of stress to the word-final syllable. The presence of schwa within the morphological structure of many Type 2c words like those in Tableaux 2c-i,ii favors this pattern, as the affixation of schwa yields penultimate stress on the preceding syllable, often on the root containing the coda /s/ to be deleted. Recall from the discussion and arguments in Section 2.3 that stress shifts in the word stratum result from the promotion of schwa-adjustment constraint CSA, allowing stress to fall on an underlying schwa that surfaces as a full vowel allophone. This general pattern is illustrated in Tableaux 2c-i and 2c-ii for *fester* and *blasmer*, with the first representing a lengthened atonic mid vowel and the second showing the same effect for low vowels, as expected given they lengthen regardless of stress.

While the presence of a schwa at some tier of the morphological structure is a frequent property of Type 2c words, it is not a requirement, and there are variations on the pattern of Type 2c. In examples like probable denominal verb *arrester* (/[[[[arrest+$Ø_{MASC}$]+$ə_V$]+r_{INF}]$_{STEM}$]$_{WORD}$/ → [ar.rɛ:.'ter] 'stop-INF', cf. *arrest* [ar.'rɛ:t] 'stop-NOUN', with tonic long vowel transmitted in subsequent stem-level cycles), stress lands on the syllable containing the

input /s/ targeted for deletion in the initial stem-level cycle, during which the long vowel reflex is determined and before schwa is concatenated in the subsequent cycle. Similarly, *-ir* verbs that are likely denominal such as *bastir* (/[[[[bast+$Ø_{MASC}$]+i_V]+r_{INF}]$_{STEM}$]$_{WORD}$/ → [bɑ:.'tir] 'build, support-INF', cf. bast 'packsaddle' < Latin *bastum 'support-NOUN, thing that carries' < *bastare* 'carry-INF' [*TLFi* 1994]) and *rostir* (/[[[[rost+$Ø_{MASC}$]+i_V]+r_{INF}]$_{STEM}$]$_{WORD}$/ → [ro:.'tir] 'roast-INF', cf. rost 'roast-NOUN' [*TLFi* 1994]), of a similar morphological relationship to *choix* 'choice' / *choisir* 'choose-INF', *fin* 'end' / *finir* 'finish-INF', also exhibit /s/ deletion in a stressed syllable of the initial stem-level cycle, without the presence of schwa anywhere in the internal structure. Since /s/ deletion impacts a stressed syllable in the initial cycle, however, a long vowel accompanies deletion and preserves the sibilant's root node, as per MAX(ROOT), length that is preserved and transmitted to ulterior stratal cycles.

Tableau 2c-i. ***fester*** **/**[fɛst]+$ə_V$]+r_{INF}]$_{STEM}$]$_{WORD}$/

(a) *Stem-level:* **/**[fɛst+$ə_V$]/ → ['fɛ:.tə]

/[fɛst+$ə_V$]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*$X_1S_2]_ω$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'fɛs.tə			*					*!				*	
☞ b. 'fɛ:.tə			*						*		*		
c. 'fɛ.tə			*	*!							*	*	
d. fɛs.'tə		*!			*			*				*	
e. fɛ:.'tə		*!			*				*		*		
f. fɛ.'tə		*!		*							*	*	

(b) *Stem-level cycle 2:* **/**['fɛ:.t+$ə_V$]+r_{INF}] / → ['fɛ:.tər]

/[fɛ:t+$ə_V$]+r_{INF}]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*$X_1S_2]_ω$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
☞ a. 'fɛ:.tər			*		*		*		*				
b. 'fɛ.tər			*	*	*!	*	*					*	
c. fɛ:.'tər		*!			*		*		*				
d. fɛ.'tər		*!		*		*	*					*	
e. fɛ:.'ter	*!				*				*				
f. fɛ.'ter	*!			*		*						*	

(c) *Word-level:* /[['fɛ:.t+əV+rINF]STEM]WORD] / → [fɛ:.'ter]

/[['fɛ:.t+əV]+rINF]/	CSA	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	*X1S2]ω	*e:/o:	*ă	MAX	*ɐ̆/ŏ	*ɑ:
a. 'fɛ:.tər	*!			*		*			*				
b. 'fɛ.tər	*!			*	*	*	*					*	
c. fɛ:.'tər	*!		*			*			*				
d. fɛ.'tər	*!		*		*		*					*	
☞ e. fɛ:.'ter		*				*			*				
f. fɛ.'ter		*			*		*!					*	
g. 'fɛ:.ter		*		*!		*			*				
h. 'fɛ.ter		*		*!	*	*	*					*	

Tableau 2c-ii. ***blasmer*** /[[[[blasm+əV]+rINF]STEM]WORD] / → [blɑ:.'mer]

(a) *Stem-level:* /blasm+əV/ → ['blɑ:.mə]

/[blasm+əV]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*X1S2]ω	*e:/o:	*ă	MAX	*ɐ̆/ŏ	*ɑ:
a. 'blɑz.mə			*					*!		*			
☞ b. 'blɑ:.mə			*								*		*
c. 'blɑ.mə			*	*!						*	*		
d. blɑ.'mə		*!		*						*	*		
e. blɑ:.'mə		*!			*						*		*
f. blɑz.'mə		*!			*			*		*			

(b) *Stem-level (cycle 2):* /[['blɑ:.m+ə$_V$]+r$_{INF}$]/ → ['blɑ:.mər]

/[['blɑ:.m+ə$_V$]+r$_{INF}$]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
☞ a. 'blɑ:.mər			*		*		*						*
b. 'blɑ.mər			*	*	*!	*	*			*			
c. blɑ.'mər		*!		*		*	*			*			
d. blɑ:.'mər		*!			*		*						*
e. blɑ:.'mer	*!				*								*
f. 'blɑ:.mer	*!		*		*								*
g. blɑ.'mer	*!			*		*				*			
h. 'blɑ.mer	*!		*	*	*	*				*			

(c) *Word-level:* /[[['blɑ:.m+ə$_V$+r$_{INF}$]$_{STEM}$]$_{WORD}$]/ → [blɑ:.'mer]

/[['blɑ:.m+ə$_V$+r$_{INF}$]]/	CSA	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'blɑ:.mer		*		*!		*							*
b. 'blɑ.mer		*		*!	*	*	*			*			
c. blɑ.'mer		*			*		*!			*			
☞ d. blɑ:.'mer		*				*							*
e. blɑ:.'mər	*!			*		*							*
f. 'blɑ:.mər	*!			*		*							*
g. blɑ.'mər	*!			*	*		*			*			
h. 'blɑ.mər	*!				*	*	*			*			

For a Type 2c word like *ostel* [o:.'tɛl], the presence of schwa is not-surface-apparent but present in the output in related forms. The schwa within the morphological structure of *ostel* comes from its base, the existing noun *oste* ['o:.tə]. This schwa is not morphological, as it is a masculine singular noun with null inflection (-Ø$_{MASC}$, -Ø$_{SG}$). It is thus presumed to be part of the input form for this noun drawn from the lexicon. (As stated above, *-st* is an acceptable word-final consonant sequence in OF, and so the word-final schwa in *oste* cannot be said to be derived to support the cluster, as seen when a rising-sonority word-final consonant sequence is inherited diachronically, e.g., *asinu(m)* > *asn**e*** 'donkey'.) Given this, the initial stem-level cycle applies the constraint hierarchy to input /ɔstə+Ø$_{MASC}$/, with coda /s/ deleting from the tonic penultimate syllable and thus producing compensatory lengthening on the preceding mid vowel. When suffix *-el* (/æl/) is added, the prevocalic schwa deletes, as typical of schwa before many vowel-initial suffixes (this is indicated by a parenthetical violation of MAX(ROOT) in Tableau 2c-iii below), and stress shifts to the word-final syllable, as it is not headed by a schwa (though even if *-el* suffix were

underlyingly /əl/, CSA to [ɛl] ~ [æl] would ensure stress can still land on the final syllable, with a preserved lengthened [o:] in the atonic syllable). The preservation of the lengthened mid vowel in an atonic position of the word-level output for *ostel*, given the schwa-final stem /ɔstə/ to which suffix *-el* is added, is illustrated here in Tableau 2c-iii:

Tableau 2c-iii. *ostel* /[ɔstə+Ø$_{\text{MASC}}$]+æl]$_{\text{STEM}}$+Ø$_{\text{SG}}$+Ø$_{\text{OBL}}$]$_{\text{WORD}}$/

(a) *Stem-level:* /[ɔstə+Ø$_{\text{MASC}}$]/ → ['o:.tə]

/[ostə+Ø$_{\text{MASC}}$]/	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'ɔs.tə			*					*!				*	
☞ b. 'o:.tə			*						*		*		
c. 'o.tə			*	*!							*	*	
d. ɔs.'tə		*!			*			*				*	
e. o:.'tə		*!			*				*		*		
f. o.'tə		*!		*							*	*	

(b) *Stem-level cycle 2:* /['o:tə+æl] / → ['o:.tæl]

/['o:tə+æl] /	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	CSA	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
a. 'o:.tæl			*!	(*)	*				*				
b. 'o.tæl			*!	*(*)	*	*						*	
☞ c. o:.'tæl				(*)	*				*				
d. o.'tæl				*(*)		*!						*	

(c) *Word-level:* /[['o:t+æl]$_{\text{STEM}}$]$_{\text{WORD}}$] / → [o:.'tæl]

/[[o:.'tæl]+Ø$_{\text{OBL}}$+Ø$_{\text{SG}}$]/	CSA	DEP-V(PLACE)	*ə́	ALIGN-R	MAX(ROOT)	WEIGHT-TO-STRESS	MAX(LENGTH)	*X$_1$S$_2$]$_\omega$	*e:/o:	*ă	MAX	*ĕ/ŏ	*ɑ:
☞ a. o:.'tæl						*			*				
b. o.'tæl					*		*!					*	
c. 'o:.tæl				*!		*			*				
d. 'o.tæl				*!	*	*	*					*	

Type 2c words are thus defined by the opacity produced by the masking of schwa in their morphological structure. This underlying schwa, which is not visible in the surface form of the word-level stratum's output, is what produces the unexpected atonic long vowel where coda /s/ was deleted. As can be seen in Tableaux 2c-i,ii, the promotion of CSA at the word level produces the opaque atonic lengthening in many polymorphemic words containing an underlying schwa. This is only possible because the underlying schwa ultimately adjusts to a full vowel in a closed final syllable, allowing stress to shift back to its preferred position on the word-final syllable given there is no longer a schwa at the surface. In the case of words like *ostel*, exemplified in Tableau 2c-iii, it is instead the non-surface-apparent stem-final schwa that allows vowel lengthening upon /s/ deletion, while the addition of vowel-initial suffix *-el* /æl/ masks the presence of schwa in the stem-level stratum that made stress fall on the syllable of /s/ deletion in that initial cycle. In both cases, stress reassignment occurs too late in the stratal phonological cycles to have any impact on compensatory lengthening, which occurred in a prior cycle (and potentially several cycles prior) when input /s/ was deleted, lest it surface in the syllable coda. In the word-level stratal cycle, once schwa-adjustment inducing stress reassignment to the word-final syllable must be inevitably tolerated for any winning candidate, it is once again MAX(ROOT) and MAX(LENGTH) that ensure that the lengthened vowel from earlier stratal cycles prevails in the output, despite now being unstressed and regardless of vowel quality, given the constraints governing length markedness for vowels of different heights rank too low in the hierarchy to have an effect as they did in Types 1a, 1b, and 1c.

4. Conclusions

A significant advantage of the stratal phonological analysis presented here is how generally stipulative analogical effects amongst morphologically-related forms such as *feste* and *fester*, *oste* and *ostel*, and innumerous others instead fall out from the formal interplay of morphology and phonology as per stratal phonology. Couched in a rich framework like stratal phonology that formalizes the complex cyclic phonological effects as morphology builds stems and words via morpheme concatenation, such paradigmatic effects prove predictable based on structural properties and the morphological and phonological behavior of component morphemes in the stem- and word-level strata. Furthermore, the otherwise opaque realization of compensatory lengthening on atonic mid vowels in derived forms finds explanation in the preservation of induced vowel length upon coda /s/ deletion in an earlier stratal cycle when the vowel bore stress, formally distinguished from the short vowel reflex that reflects that syllable's atonic status within the specific stratal phonological cycle when coda /s/ is deleted from the input. The opacity is deepened by the differential ranking of CSA in the stem-level and word-level strata, evidenced and justified by this process' non-cyclic application within the same stratum (e.g., several stem-level cycles, as per the tenets of Stratal OT) in the morphological build-up of related derived forms of words containing underlying schwa (e.g., *fest*[ə]/*fest*[ə]*rons*, *fest*[e]*r*/*fest*[e]*(th)* 'celebrate-3RD.SG.PRES.IND/1ST.PL.FUT.IND/INF/MASC.PAST.PARTICIPLE'). This crucial distinction between stem-level and word-level stratal constraint hierarchies allows for primary stress to shift between strata and thus mask the tonicity permitting compensatory lengthening in the syllable from which /s/ is deleted. An elaborate approach drawing on both morphological and phonological factors such as Stratal OT proves capable of more precisely defining the non-uniform realization of compensatory lengthening upon coda /s/ deletion and elucidating when and how opaque atonic vowel length arises. Such an approach furthermore illustrates the effect of stratal phonological cycles as morphology builds from root to stem and finally to the word-level output in a way that a fully parallel single-tier analysis (e.g., Montaño, forthcoming) cannot do for all short and long reflexes of the process.

While exceptions of various types exist (e.g., *vaslet*, with output [a] that seemingly never backed or lengthened) and there was undoubtedly a certain degree of variation in the realization of the patterns proposed above (e.g., [o] ~ [ɔ] variation noted for words related to coste, with the exception of *coteau* 'hill' with consistent [ɔ] [*TLFi* 1994, citing Grammont]),

the overall generalization holds for the majority of short versus long vowel reflexes accompanying or shortly following OF coda /s/ deletion. The more precise definition of the locus of compensatory lengthening upon coda /s/ deletion offers welcome suggestive evidence in favor of understanding such exceptions based on the factors governing the more widespread pattern described here. For *vaslet* → [va.'lɛt], for example, variants such as *vallet*, dialectal *varlet* and *vadlet* [*TLFi* 1994], and *vaillet* 'young warrior' ("jeune guerrier" (Godefroy 1881, p. 142)), reflecting a possible fusing with similar root *val-* ~ *vaill-* 'worth' (cf. *vaillant* 'valiant', *valoir* 'be-worth-INF'), suggest that the surviving variant may not actually be based on deleted medial /s/ after all. Vowel quality variation between atonic [o] and [ɔ], as noted in derived forms of the *coste* family (with the exception of *coteau* < OF *costel*), while destabilizing the stratal effect reminiscent of analogy in words of Type 2c, at the same time corroborate the expansion of the pattern identified for words of Type 1b, exhibiting the short mid vowel reflex in polymorphemic words, with the two patterns in likely competition with one another later on in French diachrony. The same could be said of a small handful of derived forms exhibiting a short vowel but the base word contains a long vowel, which would be predicted to transmit to suffixed forms, such as *beste* ['bɛ:.tə] 'beast, animal' vs. *bestail* [be.'tajʎ] 'cattle' and *mesler* [mɛ:.'ler] 'mix-INF' vs. *meslange* [me.'lɑ̃:.ʒə] 'mixture'. Deviant examples like *bestail* and *meslange* likely attach the stem-level suffix directly to roots *best-* and *mesl-*, as seen in Tableau 1b-i (*post+el*), instead of building on top of related forms ending in schwa such as *mesl-* + /ə$_{V}$/ (first conjugation theme vowel) or *best-* +/ə$_{FEM}$/ (noun marker for feminine class) as seen in *mesler* and *beste*, respectively. An infinitive like *vestir*, presumably representing a long atonic [ɛ:], can be understood by noting many of its conjugated forms (e.g., *vests, vest* 'dress-1ST/3RD.SG.PRES.IND') show its theme vowel to be -Ø characteristic of third conjugation verbs like *desfaire*, with what is likely an irregular infinitive form. While many of these may indeed be exceptions and others only seemingly so, the patterns, word types, and interplay of morphology and phonological constraints well-motivated for OF as posited here offer avenues for better understanding the exceptional or variable nature of examples like these that diverge from the overall generalizations proposed above.

The account thus sheds light on the phonological complexity that characterizes the locus of compensatory lengthening upon OF coda /s/ deletion, despite its usual description as a simple segmental deletion process accompanied by uniform vowel lengthening. As the examination of monomorphemic and polymorphemic lexical examples above illustrates, whether compensatory lengthening applies depends on numerous phonological and morphological factors, including whether the syllable from which a coda sibilant is deleted is tonic or atonic within the stratal phonological cycle when coda /s/ deletion takes place, mid versus low vowel height, if the vowel is prothetic or underlying, the presence and behavior of schwa in morphemes, and the morphological structure of the word. Ultimately, defining the short or long vowel reflex of coda /s/ deletion and elucidating opaque lengthening in atonic mid vowels proves that the compensatory effect is in reality quite complex, necessitating both the interplay of these competing factors and processes cited above, as well as a multi-tier cyclic stratal phonology drawing upon intricate constraint interaction and internal morphological structure to illustrate the non-uniform application of compensatory vowel lengthening upon OF coda /s/ deletion.

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Appendix A

In this appendix, brief definitions of phonological constraints proposed for the analysis and what constitutes a violation of them are defined, for reference purposes.

- ALIGN(FT, R, 𝔇, R, σ) ["ALIGN-R"]: the right edge of a foot coincides with the right edge of the specified stratal domain within the stratal cycle. Assign a violation mark for each syllable that intervenes between misaligned edges. * (adapted from Hyde 2012).

  Violation: Given iambic feet posited for OF, assign a violation mark for each syllable not bearing primary stress from the right edge of the segmental string and moving leftward until a syllable bearing primary stress is reached.

  * *As stated in* Section 2.3*, this is a conglomerate constraint used to encapsulate the preference for primary stress on the rightmost syllable of the string within the domain (𝔇) of each stratal cycle (𝔰 =* stem *or ω =* word*). It is not intended to exhaustively formalize all prosodic properties of footing and metrical structure.*
- *ə́: no schwa bearing primary stress.

  Violation: Assign a violation mark for each schwa bearing primary stress in the output.
- *$X_1S_2]_\omega$: No M_1M_2 or M_2M_1 sequences within the word, where M_2 = a sibilant and M_1 = any consonant.*

  Violation: Assign a violation mark for any sequence of M_1M_2 or M_2M_1 within the string where M_2 = a sibilant and M_1 = a consonant.

  * *Essentially, for present purposes, "no sibilants in coda position before the consonant onset of the following syllable." As cited in* Section 2.3*, this shorthand constraint encapsulates the universal split-margin ranking of word-level cluster constraints* $*R_1S_2]_\omega$ » $*L_1S_2]_\omega$ » $*N_1S_2]_\omega$ » $*O_1S_2]_\omega$*, in which "X" is defined for rhotics (R), laterals (L), nasal consonants (N), or obstruents (O).*
- MAX: Every segment in the input has a correspondent in the output (no phonological deletion) (McCarthy and Prince 1995).

  Violation: Assign a violation mark for each segment in the input that is absent in the output.
- MAX(ROOT): Every root node in the input has a segment associated with it in the output (no deletion of root nodes).

  Violation: Assign a violation mark for each root node in the input not associated with a segment in the output.
- *V: : No long vowels in the output.

  Violation: Assign a violation mark for each long vowel in the output.
- WEIGHT-TO-STRESS PRINCIPLE (WSP): If a syllable is heavy, it is stressed in the output.

  Violation: Assign a violation mark for each heavy syllable that is not stressed in the output. *

  * *As stated in* Section 2.3*, this is applied in the present analysis to syllables that are bimoraic, especially by virtue of surfacing with a lengthened vowel. In practice, other heavy syllables, like those closed by a coda consonant, would be targeted by the same constraint, though opposing constraints like* MAX(ROOT) *and* MAX *would ensure that tolerable coda consonants (e.g., sonorants, other than obstruents and sibilants) are not deleted in order to satisfy WSP when these syllables are too far from the right edge of the string to be stressed.*
- MAX(LENGTH): A long vowel in the input is long in the output.

  Violation: Assign a violation mark for each long vowel from the input that is short in the output.
- *e:/o: : No long mid vowels (*[e:, ɛ:, o:, ɔ:]) in the output.

  Violation: Assign a violation mark for each long mid vowel (*[e:, ɛ:, o:, ɔ:]) in the output.
- *ɑ: : No long low vowels (*[a:, ɑ:]) in the output.

  Violation: Assign a violation mark for each long low vowel (*[a:, ɑ:]) in the output.
- *ă: No short low vowels (*[ă, ɑ̆]) in the output.*

Violation: Assign a violation mark for each short low vowel (*[ă, ɑ̆]) in the output.

* *As stated in* Section 2.3, *omitted here is a* DEP *constraint against lengthening a short low vowel outside of compensatory motivations in order to satisfy this constraint. Additional well-formedness constraints as well as* MAX *of course also ensure that regular underlying short low vowels outside of the compensatory lengthening context can surface despite the* *ɑ̆ *constraint.*

- *ĕ/ŏ: No short mid vowels [*ĕ, ɛ̆, ŏ, ɔ̆] in the output.*

  Violation: Assign a violation mark for each short mid vowel (*[ĕ, ɛ̆, ŏ, ɔ̆]) in the output.
- CSA [=*closed syllable adjustment*]: No schwa in closed syllables.*

  Violation: Assign a violation mark for any closed syllable headed by a schwa in the output.

  * *As discussed in* Section 2.3, *this conglomerate constraint encapsulates the joint effect of several component constraints ensuring a complex stress-attracting syllable such as one closed by a coda consonant is not headed by a weak reduced vowel like schwa.*
- DEP-V(PLACE): Vocalic place features in the output must be present in the input.

  Violation: Assign a violation mark for an output vowel bearing place features not present in the input.

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