

THE SYLLABLE IN PERFORMANCE:
DIACHRONY

CHAPTER SEVENTEEN

DIACHRONIC PHONOTACTIC DEVELOPMENT IN LATIN: THE WORK OF SYLLABLE STRUCTURE OR LINEAR SEQUENCE?

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1 *Introduction*

There has been considerable debate in the phonological literature of the last few decades concerning the role played by the syllable in consonantal phonotactics. One party attributes the range of contrasts in each environment to positions within the syllable (the syllable-based approach; section 1.1); an opposing camp argues that linear segmental sequence, not syllable-internal position, determines phonotactics (the linear approach; section 1.2). Whereas the majority of previous studies have adopted a position in one or other camp with a solely synchronic focus,¹ this chapter evaluates the two approaches from a mainly diachronic perspective with reference to the development of Latin consonantal phonotactics, focusing upon assimilations. Our understanding of Proto-Indo-European (PIE) word-formation has long been sufficiently refined to furnish us with a rich array of securely reconstructed consonantal sequences in prehistoric Latin, whose outcome in the familiar classical language is much altered. As the two accounts make different predictions regarding the possible development of word-internal consonantal sequences, Latin presents a promising testing ground.

1.1 *The Syllable-Based Approach*

A syllable-based account of phonotactics can be found in early investigations into syllable-internal structure, which focused on the distribution of segments in different syllable constituents (Fudge 1969,

¹ Notable recent exceptions being the work of Blevins (2003, 2004).

Hockett 1947, Pike and Pike 1947).² The now much-refined syllable-based approach to phonotactics claims to explain assimilations and neutralisations at syllable boundaries. Three different strategies have emerged: positional licensing—the coda position has fewer licensing possibilities than the onset (Goldsmith 1990, 125); negative coda constraints—codas cannot contrast in certain features (Itô 1988, 1989); and positional faithfulness—onsets are more faithful to their underlying lexical forms than codas (Beckman 1999). All three have in common that codas exhibit fewer contrasts than onsets and therefore, all things being equal, regressive assimilation is preferred to progressive, as codas can assume the features of their ensuing onsets.

1.1.1 *Positional Licensing*

Developing the early idea that only a specific set of segments can appear in a given syllable position, the theory of positional licensing expands the notion of syllable position to any prosodic unit, and refers to features (or autosegments), not segments. This account is expounded by Goldsmith (1990, 123–127) and, with specific reference to voice neutralisation, by Lombardi (1995). Prosodic units license features; the syllable is a primary licenser, and the coda a secondary one, allowing only a subset of the possibilities available in the onset, which is directly licensed by the syllable. For example, it is common for the coda to be incapable of licensing place of articulation, resulting in the homorganicity of coda nasals and obstruents with the following onset, where place is licensed by the syllable (e.g. Lat. **eum.dem* > *eun.dem* ‘same (acc.)’),³ or the realisation of the coda at a default place of articulation (e.g. Ancient Greek word-final nasals were realised as [n]).

² The earliest (Brosches 1765, Jespersen 1904, Saussure 1916, Sievers 1881, Whitney 1873) and most celebrated syllable-based governing principle for phonotactic organisation is undoubtedly the sonority sequencing generalisation/principle/constraint, which states that segments rise in sonority (perhaps maximally) from the start of the syllable to a peak, then fall (perhaps minimally) to the end of the syllable. Sonority is viewed as an inherent property of a segment. Given the ongoing debate surrounding its validity, it is perhaps advantageous that the present study requires no recourse to the principle as an explanatory tool. For further discussion and references, see Steriade (1982), Clements (1990), Zec (1995), and Ohala and Kawasaki-Fukumori (1997), among others.

³ In this chapter, ‘*’ indicates a reconstructed form, ‘>’ a historical development (or ‘is higher than’ in the two hierarchies below), ‘.’ a syllable boundary, ‘-’ a morphological boundary, ⟨x⟩ orthographic x, and small capitals an inscriptional form. Attested forms are written in their received orthography, with the addition of the length mark ‘ː’ as appropriate.

1.1.2 *Coda Constraints*

Coda constraints are in effect a negative version of licensing: rather than positing prosodic units with licensing capabilities in accordance with their position in the prosodic hierarchy, codas are deemed specifically incapable of licensing certain features. One such formulation is Itó's Coda Condition (1988, 1989), prohibiting a place specification in coda consonants, but allowing doubly linked structures where the place feature is linked to a following onset as well as the coda (i.e. geminates and place-assimilated sequences).⁴

Under the coda constraint analysis, the labial place feature of the nasal in the coda of the first syllable of **eum.dem* could not surface from the time when the condition prohibiting specified place in codas was introduced into the grammar. Instead, the coronal place feature of the following onset spread to the immediately preceding nasal, yielding *eundem*, with a doubly linked coronal place feature.

1.1.3 *Positional Faithfulness*

Under the positional faithfulness approach to phonotactics, the interaction of faithfulness and markedness constraints, which form an integral part of the Optimality Theoretic machinery (Prince and Smolensky 2004), can bequeath assimilated output forms to a language. Assimilation is the result of the existence of specific and general forms of the same constraint, where the former demands greater faithfulness in certain privileged positions, such as syllable onsets. Where a markedness constraint is ranked between specific and general versions of a faithfulness constraint, neutralisation of the relevant feature in unprivileged positions such as codas results.

It is argued (Beckman 1999, Lombardi 2001) that these constraints are well equipped to generate the correct typology of assimilation and neutralisation without recourse to the additional mechanisms of the licensing approach: word-internal regressive assimilation without word-final neutralisation can be derived simply through constraint ranking, whereas special word-final licensing possibilities would be required in a licensing approach (Lombardi 1999). However, note that the negative coda constraint is still invoked in some such analyses (Lombardi 2001).

⁴ For further discussion regarding the form of coda constraints, see Blevins (1995, 227–229) and Lombardi (2001).

1.2 *The Linear Approach*

The linear approach claims that the features that can contrast in an environment are determined by linear segmental sequence alone, by means of the robustness of the perceptual cues for each feature in that environment. Its proponents (Blevins 1993, 2003, 2004, Rubach 1996, Steriade 1999a, b, 2001) claim that this approach is more descriptively adequate than syllable-based efforts, both language-internally and cross-linguistically, e.g. where languages with differing syllabifications of a sequence have identical phonotactic constraints. Furthermore, the dependence of the linear approach on the phonetic origins of consonantal sequences purportedly endows this account with greater explanatory force. This view has enjoyed considerable support in recent years.

Whereas the syllable-based approach, with contrasts determined by syllable position, is built upon purely phonological grounds, a key dimension to the linear approach is its reference to the phonetic basis of phonotactic constraints. As stated above, positions of contrast are those where perceptual cues for that contrast are most robust, whereas positions of neutralisation are those where the cues are least robust. Wright (2001, 2004, 36) defines a cue as “information in the acoustic signal that allows the listener to apprehend the existence of a phonological contrast.” The portion of the signal in which this information is encoded can either correspond with the segment in which the feature resides (internal cues), or be found in neighbouring segments, created by coarticulation (external cues). Furthermore, Wright (2004, 52) defines robustness as “the redundancy of the cues minus the vulnerability of those cues”, meaning that “the more cues point to a contrast and the less susceptible to masking or loss those cues are the more likely the contrast is to survive.” Finally, it should be noted that the relevant cues are different for each contrast, and different features are more reliably perceived in different environments.

1.3 *Selecting the Correct Analysis*

From the perspective of phonotactic development, the approaches make differing predictions with regard to the contrasts which survived in coda position in a given context, with more consistency demanded by the syllable-based approach. Where a sequence could have been syllabified in two different ways in Latin, e.g. intervocalic stop + liquid (VT.RV versus V.TRV), the syllable-based approach predicts that the

sequence would have developed differently along the lines of those two syllabifications, whereas the linear approach predicts identical outcomes for the two linearly identical sequences. In theory, this sets out clear tracks for a course of investigation. In practice, the tracks themselves are barely visible where the Latin of the archaic period in question is concerned. How, for example, can one ascertain which consonant in a sequence was most robustly cued, or how stop + liquid sequences were syllabified at a time long before the existence of the helpful metrical evidence, or indeed whether there was any variation at all in the syllabification of a given sequence? This investigation therefore aims to decipher the phonetic and phonological circumstances the data betray, as well as to evaluate which approach accounts best for that data. Unless otherwise specified, the data regarding all the phenomena investigated in this chapter are drawn from the evidence reported in various handbooks dealing with Latin phonology (Allen 1973, 1978, Leumann 1977, Meiser 1998, Niedermann 1997, Sommer and Pfister 1977, Sihler 1995).

2 Voice Assimilation

We reconstruct Proto-Indo-European etymologies containing sequences of obstruents with different voice specifications, based upon our knowledge of PIE morphemes. In Latin, these sequences all showed a single voice specification, with regular regressive assimilation. Comparative evidence indicates that voice assimilation occurred in PIE, but must also have been operational at a much later date in several branches, and was certainly still occurring in formations within Latin (see *obtineo*: below), as a synchronic rule or constraint plausibly present in the grammar since PIE times.

- (1) Stop + stop: *skrib^h-tos > *scriptus* ‘written’
- (2) Stop + fricative: *nurb-sai > *nupsi*: ‘I married’
- (3) Fricative + stop: *is-dem > *izdem > *idem* ‘same’; contrast *kas-tos > *castus* ‘chaste’

The apparent failure of regressive voice assimilation in orthographically regular forms such as *obtineo*: ‘I possess’, *subtus* ‘beneath’ and

subtilis ‘delicate’ is in fact misleading, as the spelling ⟨pt⟩ was common in all periods and the evidence of the grammarians Quintilian (*Inst.* 1.7.7)⁵ and Velius Longus (*G.L.* 7.62) both indicate the pronunciation [pt]. Orthographic ⟨bt⟩ reflects preservation or replacement by analogy of the prefixes, cf. *obduro*: ‘I persist’, *subdolos* ‘deceitful’ (Niedermann 1997, 129), in spelling alone. Examples of inscriptional phonetic spellings are: *CIL* 1².7 OPSIDES = *obsiders* ‘hostages’ (3rd cent. B.C.), *CIL* 1².1570 OPTINVI = *obtinuei*: ‘I possessed’, *CIL* 12.1783 OPTVLIT = *obtulit* ‘he brought before’, *CIL* 6.9797 SVPTILISSIMA = *subtilissima* ‘most delicate (fem.).’

Both the syllable-based and linear approaches are capable of accounting for the above data. The consonant which underwent assimilation in each case was in coda position, e.g. */skri:b^h.tus/, */nu:b.sai/, but, from a linear perspective, it was also in preobstruent position, a context in which cues for the perception of voice contrasts in stops are often weak: failure to release stops (into a vowel or sonorant) removes cues to voicing in the release burst, aspiration noise (if present in the language) and VOT. The remaining cues to voicing (duration of the preceding vowel, closure duration and periodicity in the signal) are often weaker and no longer salient in the absence of the release cues (Wright 2004, 40–41). The linear explanation is weaker where the coda was a fricative, as the presence or absence of periodicity during frication noise is a strong cue to voicing (Cole and Cooper 1975). The absence of phonemic /z/ in Latin could explain the voicing of /s/ in robustly cued voiced contexts, as in (3) where the voiced stop C₂ was released. As there was no sibilant voice contrast, /s/ could become contextually voiced to provide further cues to the voicing of an adjacent consonant.

Regressive voice assimilation also took place in obstruent sequences forming complex codas or at any rate sequences which were not coda + onset. Thus, beside orthographically regular *plebs* ‘people’, we find inscriptional PLEPS (*CIL* 12.4333.12; 11 AD), and we also reconstruct the development **snig^{wh}-s* > *nix* ‘snow’, with an original labiovelar stop. Furthermore, we have grammarians’ statements to support the voicelessness of the stop, at least in imperial times (e.g. Scaur. gram. *G.L.* 7.27.11ff.). The correct formulation for voice assimilation in Latin

⁵ References and abbreviations regarding Latin authors and their works are as per Glare (1996).

Table 1 Assimilation in obstruent place and continuance

C ₁ \ C ₂	Dorsal	Labial	Coronal
Dorsal	* <i>ekke</i> > <i>ecce</i> 'look!'	(no secure native Latin examples)	<i>lactis</i> 'milk (gen.)'
+ fricative	(no dorsal fricative)	<i>ecfero</i> : (Plautus) 'I carry out'	* <i>deiksai</i> > <i>dixi</i> [di:ksi:] 'I said'
Labial	* <i>obkaido</i> : > <i>occido</i> : 'I knock down'	* <i>obpeto</i> : > <i>oppeto</i> : 'I encounter (prematurely)'	<i>optimus</i> 'best'
+ fricative	(no dorsal fricative)	<i>opificina</i> > * <i>opficina</i> > <i>officina</i> 'workshop'	* <i>nubsai</i> > <i>nupsi</i> : 'I married'
Coronal	* <i>hodke</i> > * <i>hocce</i> > <i>hoc</i> 'this (neut.)'	* <i>quidpe</i> > <i>quippe</i> 'for'	* <i>pattos</i> > * <i>patstos</i> > <i>passus</i> 'suffered'
+ fricative	(no dorsal fricative)	<i>adfero</i> : > <i>affero</i> : 'I deliver'	* <i>quatsai</i> > <i>quassi</i> : 'I shook'

□ = apparent regressive assimilation in place and continuance⁶

must therefore be 'every part of an obstruent sequence came to agree in voice, regardless of syllabification', lending some weight to the linear approach over the syllable-based approach.

3 Place and continuance

The Latin data relating to assimilations in obstruent place and continuance can be most insightfully represented in tabular form in Table 1.

Regressive place assimilation occurred regularly in C₁ regardless of its place when C₂ was a dorsal stop, and in coronal C₁ when C₂ was a labial obstruent. The contrast between all three major places survived before coronal stop C₂, although coronal stop + coronal stop yielded assimilated /ss/, probably via /tst/ (Niedermann 1997, 148). Sequences of a later origin with two coronal stops showed only regressive voice

⁶ 'Apparent' due to the fact that the shading is somewhat speculative, intended purely to aid the extraction of a pattern from the data. There is no reason to shade any part of the dorsal + dorsal cell, and the homorganic stop + stop cells are shaded simply because of assimilation in the corresponding stop + fricative examples.

assimilation and no assibilation, thus **kedate* > **kedte* > *cette* ‘give here! (pl.)’.

Unlike voice assimilation, place assimilation cannot be dated as far back as PIE, but was probably operational as far back as prehistoric Latin given the absence of unassimilated forms in the earliest attestations. Place assimilation was still operational after syncope in the 6th–5th cents. B.C. (Meiser 1998, 66–67), thus **sitikos* (cf. *sitis* ‘thirst’) > **sitkos* > *siccus* ‘dry’.

How then do we correctly formulate the context for place assimilation? Observe that dorsal C₂ admitted no place contrast in C₁: place features were neutralised and the obstruent was assimilated in place to C₂. Slightly more permissive were labials, allowing dorsal C₁ to survive, but not recognising coronal C₁, which was assimilated to the labial place of C₂. Finally, the most permissive place in C₂ was coronal, allowing the survival of the contrast between labial and dorsal, as well as assibilated coronals. Alternatively, the formulation can be inverted by referring to C₁ rather than C₂: dorsals were the most resistant C₁, followed by labials, followed by coronals, the least identifiable before another consonant.⁷

Stop C₁ before fricative C₂ shows the same environment for regressive assimilation in continuance as for place:⁸ there was no phonemic dorsal fricative, but before the labial fricative /f/, only a contrast between dorsal (Plautine *ecfero*; but later *effero*; see section 8 below)⁹ and other places of articulation survived, with assimilation in continuance in labial C₁ (*officina*), and in both place and continuance in coronal C₁ (*affero*). And the similarity with place assimilation continues when we look at coronal fricatives in C₂, which allowed both the manner and place of dorsal and labial C₁ to persist (*dixi*, *nupsi*), but which triggered neutralisation of manner in coronal C₁, realised as a fricative (**quat-sai* > *quassi* ‘I shook’).

The resulting pattern of shading in table 1 is neatly captured by reference to a hierarchy relating to place:

⁷ Inherited labiovelar /k^w/ and /g^w/ behaved in precisely the same way as the dorsal stops preconsonantly (Niedermann 1997, 151), thus **eksting^wsi* > *extinxi* ‘I extinguished’, **ung^wtio* > *unctio* ‘anointing’, **k^wok^wtos* > *coctus* ‘cooked’.

⁸ Or alternatively, more thoroughgoing assimilation, as sequences homorganic in place assimilated in continuance, whereas we cannot tell whether place in C₁ of homorganic stop + stop sequences was neutralised or retained.

⁹ Leumann (1977, 210) argues that the prefix *ec-* that appeared regularly only before roots beginning in /f/ developed from secondary **eks-*, the inherited prefix analogically restored after the development **eks-fero* > *effero* had occurred.

(4) The Place Hierarchy: dorsal > labial > coronal

C_1 lower than or level with C_2 on the Place Hierarchy assimilated to C_2 in place, and in continuance if a stop.¹⁰

This formulation is clearly in accord with the linear approach. Only by taking into account both the nature of a consonant and its environment (i.e. the interaction of C_1 and C_2) can the developments be correctly predicted. A syllable-based formulation would resemble 'coda stops came to be unspecified for coronal place regardless of the environment, and for labial place if followed by a labial or dorsal onset; coda obstruents were unspecified for continuance if unspecified for place' (see below regarding fricative C_1). The syllable-based approach is clearly unsatisfactory: there is no motivation for reference to syllable position; linear sequence is necessary and sufficient to capture the generalisation, as (4) demonstrates.

Furthermore, the syllable-based approach not only includes unnecessary information, it also under generates in the same way as we saw for voice assimilation: in word-final consonantal sequences, regressive assimilation in continuance still occurred despite the absence of a syllable boundary. The only fricative occurring word-finally was /s/, which being a coronal only triggered assimilation in another preceding coronal, thus */ts, ds/ > /ss/, an outcome sequence required for the correct scansion of early Latin verse (Plautus), but which simplified to /s/ in classical times, thus *mīlets > mīless > mīles 'soldier', *obseds > *obsess > obses 'hostage'. Contrast *daps* 'feast' and *mox* 'soon' for a preceding labial and dorsal respectively, surviving as stops.

Jun (2004, 63–64) formulates a hierarchy for resistance to assimilation according to the place of articulation of (unreleased) consonants which matches that in (4) above: dorsal > labial > coronal. He concludes, along the lines of Browman and Goldstein (1990), that the difference in coronal place and the others lies in the greater speed of tongue tip gestures, resulting in their being overlapped when in C_1 by tongue dorsum and lip gestures in C_2 , whose beginnings are found in the VC transition. To explain the greater perceptibility of dorsals over labials, Jun cites the noticeable convergence of F2 and F3 in vowels adjacent to dorsals, based on the findings of Jakobson, Fant, and Halle (1952) and Stevens (1989). Typological evidence bears out the predictions (Jun 2004, 67–68): if dorsals are targets of place assimilation,

¹⁰ See section 4 regarding fricative and nasal C_1 .

so are labials (e.g. Thai), but the reverse is not true, as labials can be targeted where dorsals are not (e.g. Korean, Inuktitut); if labials are targets, so are coronals (e.g. Hindi, Korean, Thai), but again the reverse is not true (e.g. Catalan, English, Lithuanian).

However, as the Latin data clearly illustrate, consideration of only the target consonant is insufficient, as we need to look at both target and trigger to achieve the formulation in (4) above. Jun (2004, 65) offers the same gestural explanation for the role of the trigger consonant (usually C_2) as for the target, noting the asymmetry between coronals and noncoronals as triggers in Latin stop assimilation. No further asymmetry between dorsals and labials as triggers in Latin is motivated, as we cannot tell whether dorsal C_1 retained its place or was assimilated before dorsal C_2 .

4 Manner

A look at the manner of articulation of C_1 and C_2 further demonstrates that the interaction of the two consonants is paramount in place assimilation, and a consideration of any one of them in terms of syllable position is incapable of producing the right results. In table 1, we saw that fricative C_2 triggered place assimilation in stop C_1 wherever stop C_2 did as well, obeying the Place Hierarchy in both cases. However, the reverse is not true: fricative C_1 retained its place regularly before stops, and only assimilated before other fricatives, obeying the Place Hierarchy, thus **dis-facilis* > *difficilis* ‘difficult’, with place assimilation in a coronal + labial fricative sequence, but *dispomo*: ‘I distribute’, *hospes* ‘guest’, where /s/ survived before a labial, *priscus* ‘ancient’ where it survived before a dorsal, and *castus* ‘pure’ before another coronal. Therefore, fricatives were more resistant to place assimilation than stops.

Like stops, nasal C_1 assimilated in place to C_2 of any manner:

(5) Nasal + stop: **enprobos* > *improbos* ‘dishonest’; **tengo*: > *tingo*: = [tiŋgo:] ‘I dye’¹¹

(6) Nasal + fricative: **komsol* > *consul* ‘consul’

¹¹ See fn. 12 regarding the raising **e/* > */i/* before a dorsal nasal.

- (7) Nasal + nasal: **enmaneo*: > *immineo*: ‘I overhang; threaten’

However, nasals were even less resistant to place assimilation than stops, as can be seen in the fact that place assimilation in a nasal + obstruent sequence was exceptionless, failing to obey the Place Hierarchy, thus **kemtom* > *centum* ‘hundred’, showing assimilation of a labial to a following coronal. However, the Place Hierarchy was obeyed in nasal + nasal sequences, again showing that the interaction of the consonants was of the utmost importance, thus **enmaneo*: > *immineo*: ‘I overhang; threaten’ with place assimilation in a coronal + labial sequence, but *autumnus* ‘autumn’, with no assimilation in a labial + coronal configuration.

This information can be captured by a hierarchy indicating the most to least resistant manners of articulation regarding place, as shown in (8).

- (8) The Manner Hierarchy: fricative > stop > nasal.

Fricative C_1 assimilated in place only before fricative C_2 , in accordance with the Place Hierarchy. Stop C_1 assimilated in place before C_2 of any manner, in accordance with the Place Hierarchy. Nasal C_1 assimilated in place before C_2 of any manner, but only in accordance with the Place Hierarchy before nasal C_2 , and without exception before obstruent C_2 .

As with the Place Hierarchy, phonetic explanations for the Manner Hierarchy have appeared in prior phonological literature. Reporting the findings of studies by Kohler (1990), Hura, Lindblom and Diehl (1958) and Jun (1995), Steriade (2001, 223–224) concludes that perceptibility differences control the incidence of place assimilation (i.e. the linear approach), with nasals being the most confusable class, fricatives the least, and stops in the middle. Jun (2004, 61–63) discusses the proposed reason for this: in preconsonantal position, place in all consonants is cued by VC formant transitions, a relatively poor source compared to CV transitions. Whereas fricatives and approximants are enhanced by reliable internal cues to place, nasals are further handicapped by the characteristic nasalisation of the preceding vowel. The predicted hierarchy is borne out by language typology (Jun 2004, 66–67): continuants virtually never undergo place assimilation (although we have seen that this did occur in a constrained fashion in Latin), and if stops can be targeted for assimilation, so can nasals, but no language targets stops but not nasals.

Table 2 Assimilation in nasality and place

	Nasal C ₂	Labial	Coronal
C ₁			
Dorsal		* <i>sekmentom</i> > <i>segmentum</i> = [gm] 'piece'	* <i>deknos</i> > <i>dignus</i> = [ɲn] 'worthy' ¹²
Labial		* <i>supmos</i> > <i>summus</i> 'highest'	* <i>swepnos</i> > <i>somnus</i> 'sleep'
Coronal		* <i>kaidmentom</i> > * <i>kaimmentum</i> > <i>caementum</i> 'rubble'	* <i>atnos</i> > <i>annus</i> 'year'

 = regressive nasal assimilation

 = regressive nasal and place assimilation

These considerations provide a basis for the patterns we find in Latin and other languages. The Place and Manner Hierarchies have foundations in perceptibility and the pattern in Latin arises from their interaction.

5 Nasality

In this section, we look at assimilation in nasality in the sequence stop + nasal. Again, the evidence is most easily surveyed in tabular form (Table 2), recalling that there was no phonemic dorsal nasal.

The generalisation appears to be this: stop C₁ assimilated in nasality to nasal C₂, and also in place, in accordance with the Place Hierarchy. Regressive assimilation in nasality can be straightforwardly accounted for by considering the relevant articulatory gestures once again. The gesture of lowering the velum to articulate a nasal is relatively slow

¹² There are clear indications that ⟨g⟩ in ⟨gn⟩ sequences was a dorsal nasal: (1) the omission of ⟨n⟩ before ⟨g⟩ (⟨ng⟩ being the usual way of denoting a dorsal nasal) in *ignotus* 'unknown' < **en-gno:-tos*, *cognatus* 'related by birth' < **kom-gna-tos*, suggest that ⟨g⟩ on its own represented [ŋ]; (2) inscriptional spellings such as SNNV for *signum* and SINGNIFER for *signifer* suggest a dorsal nasal; (3) the raising */e/ > /i/ occurred before ⟨gn⟩ just as before ⟨ng⟩ (= [ŋg]), thus **dek-nos* > *dignus* 'worthy', **leg-nom* > *lignum* 'wood', **teg-nom* > *tignum* 'timber' (note that this did not occur before ⟨gm⟩), providing evidence for the retention of the stop in that sequence).

compared to the articulation of major place features, which can result in a timing mismatch between the opening of the velic aperture and the intended start of the nasal consonant (Ladefoged and Maddieson 1996, 104–106). Such an effect is seen in the common nasalisation of vowels before nasals. Where a stop precedes, it can be realised partially or fully as a nasal if the velum lowers early; the paucity of cues for the stop manner could then result over time in the phonologisation of the nasalisation of the stop as a nasal.

There is an exception to nasal assimilation in Latin: the sequence dorsal + /m/ remained intact, with C_1 keeping its articulation as a stop (heterorganic in place with the nasal as would be expected per the Place Hierarchy), thus **seksmentom* > *segmentum* = [gm] ‘piece’ (see fn. 12). There are consequences arising from this gap: the syllable-based approach could postulate that Latin coda stops came to be unspecified for nasality and therefore underwent nasal assimilation when followed by a specified nasal in an onset. However, a coda dorsal stop must be stipulated to have maintained its nonnasal specification before a labial nasal onset. This is quite clearly an unsatisfactory formulation.

A more parsimonious approach would do away with reference to syllable position, referring only to linear sequence. In investigating the occurrence of the gap in nasal assimilation, consideration of the robustness of the cues to the manner of articulation in different sequences provides a better starting-point. If regressive nasal assimilation results from the early lowering of the velum, while the preceding stop is being articulated, it follows that a slower stop articulation will have less of its articulation time overlapped by the opening of the velic aperture. As noncoronals, and arguably dorsals, have the slowest gestures, with long transitions (see section 3), it is unsurprising that dorsal stops escaped assimilation to the nasal. However, they did assimilate before /n/, the coronal nasal, and this can again be explained with reference to relative timing: the lowering of the velum could have occurred early before the slowly articulated labial nasal, but due to the time taken to articulate the labial place, the early opening of the velic aperture fell mainly within the time taken to articulate the nasal itself and not the preceding stop. Nasal assimilation in labial stop + labial nasal can be accounted for by the homorganicity in place: the articulators were already in position for labial place and therefore the early lowering of the velum could only encroach upon the labial stop gesture and not the time taken to form the place of articulation of the nasal, as it had already been formed.

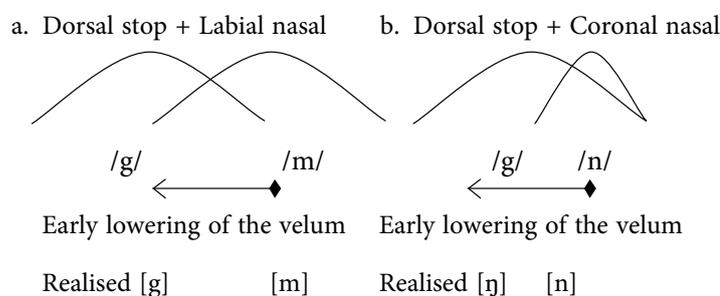


Figure 1 Regressive nasal assimilation

This rather complicated set of affairs can be neatly illustrated by diagrams (Figure 1), where the curved lines represent the articulatory gestures associated with formation of place of articulation, as in Jun (2004, 63, 65).

The articulators start moving towards the place of articulation of the nasal while the stop is still being articulated (the beginning of the second curve in each diagram). Coronals are rapidly articulated and therefore reach their target (the peak of the second curve) before labials. However, the velum also starts to lower to ensure the achievement of nasal manner by that target time (the curve peak), illustrated by the arrow pointing leftwards. In Latin, where the nasal was a slowly articulated labial (Figure 1a), the velic lowering encroached upon the dorsal only partially, allowing the accurate perception of a preceding dorsal stop. However, where the nasal was a rapidly articulated coronal (Figure 1b), the velic lowering encroached upon the dorsal stop sufficiently for a listener to perceive a dorsal nasal, resulting over time in its phonologisation as a nasal (which formulation maintains a perceptually driven analysis).

Traces of the effects of the long, slow transition between a dorsal stop and /m/ can perhaps be detected in the early Latin phenomenon of vocalic epenthesis in these sequences, thus Greek *drachmá:* ‘coin’ was borrowed into Latin with an alternative form *drac(h)uma*, containing an epenthetic vowel separating the sequence. Similarly, we find the native Latin word *tegmen* ‘covering’ with the alternative spellings *tegimen/tegumen*, resulting finally in regular *tegimen*. Contrast the mythological name *Procne*, found in Latin in both this form, borrowed accurately from Greek with internal [kn], but also as *Progne*, no doubt pronounced with [ŋn].

6 *A Linear Hypothesis*

The linear approach is more successful in accounting for the assimilations of voice, place, continuance and nasality than the syllable-based approach. (9) is an attempt to formulate this approach succinctly in phonological terms.

- (9) Feature x , if poorly cued to a sufficient degree relative to an adjacent more robustly cued value of that feature, was assimilated to that value, where x is taken to range over [voice], [PLACE], [continuant] and [nasal].

Note the relativity of this formulation. It is not the case that a less robustly cued feature always assimilated to a more robustly cued value of that feature, which would have resulted in unconstrained assimilation of all features in all consonantal sequences. Therefore, the difference in the robustness of the two values of the feature is relevant. Only where a feature was poorly cued by a sufficient degree relative to that feature in an adjacent segment did assimilation occur.

Recall from section 1.2 that perceptual cues can be divided into internal and external cues. The most salient family of external cues we have witnessed resides in the release into a vowel; this affords a listener place, manner and voice cues in the stop release burst, place and manner cues in the CV formant transitions, and voice cues in aspiration noise and VOT (Wright 2004, 37–41). It is the absence of these often relatively robust cues in C_1 that resulted in the more robust cuing of C_2 over C_1 to trigger regressive, and not progressive, assimilation.

The Place Hierarchy is based mainly upon external VC transition cues in sequences of $V_1C_1C_2V_2$, with dorsal and labial C_2 being capable of affecting the transitions from V_1 to C_1 due to their long, slow gestures. Conversely, the Manner Hierarchy results mainly from internal cues (e.g. frication noise), although the position of stops above nasals on the hierarchy resides in the weak external cues to place in the nasalised vowels preceding nasal consonants.

7 *Sonorant Voice Specification*7.1 *A Puzzle*

Recall from section 2 above that every member of an obstruent sequence came to agree in voice in Latin regardless of syllabification. Latin also inherited a series of sonorant consonants /r, l, m, n/, whose voice we could expect to be cued robustly by the periodicity in the signal during their articulation (an internal cue) and therefore be immune to voice assimilation when in C_1 . Alternatively, the other robust manner cues for a sonorant (nasals: nasal murmur, nasal pole and zero, nasalisation of the previous vowel; liquids: relative gradualness of transitions, presence of formant structure throughout their peak of stricture), could render the vibration of the vocal folds by the speaker redundant in providing cues for the nature of the consonant, resulting in partial devoicing of the sonorant in voiceless environments, itself an external cue for the voice specification of an adjacent voiceless segment (Steriade 1999b).

Such considerations have led phonologists often to treat sonorants as redundantly voiced on the surface, or unspecified for voice in their underlying representation (Kiparsky 1995, 644–647), in languages where sonorants do not contrast for voice. If we can treat sonorants as lexically unspecified for voice in Latin, then perhaps it is possible to extend the range of the voice assimilation formulation to ‘every part of a consonantal sequence, not just obstruents, came to agree in voice’. Such a formulation is in accord with the occurrence of a voice contrast in obstruent C_2 where C_1 was a sonorant:

(10) /r/ + stop: *verpa* ‘penis’ : *verba* ‘words’

(11) /l/ + stop: *mulceo*: ‘I soothe’ : *mulgeo*: ‘I milk’

(12) /m/ + stop: *computo*: ‘I calculate’ : *combuoro*: ‘I burn up’

(13) /n/ + stop: *pontus* ‘sea’ : *pondus* ‘weight’

We could argue on this basis that sonorants were unspecified for voice preconsonantly: the cues to their manner were sufficiently robust for their identification, leaving contextual devoicing as a possibility in voiceless environments. This contextual devoicing could just as easily provide a robust cue for an obstruent C_1 when the sonorant was C_2 ,

thus allowing a voice contrast to surface in the obstruent C_1 , unlike in the obstruent sequences discussed in section 2, where C_1 could never contrast for voice. Note that C_1 was often a coda, lending further weight to the linear approach. And this is indeed the situation we find where C_2 was a liquid:

(14) Stop + /r/: *acri:* ‘sharp (dat.)’ : *agri:* ‘field (gen.)’

(15) Stop + /l/: *planta* ‘shoot’ : *blanda* ‘flattering (fem.)’

Liquids appear to have been unspecified for voice prevocally as well as preconsonantly. However, the situation among nasals was different. The only sequence in which we can expect to detect voice assimilation, due to the failure of nasal assimilation, is dorsal + /m/ (see section 5). And here, nasal C_2 appears to have triggered voice assimilation in a formation which arose within Latin:

(16) (Dorsal) stop + /m/: **sekmentom* > *segmentum* ‘piece’

This evidence suggests that /m/ came to be actively voiced prevocally within the history of Latin, i.e. voice unspecified > [+voice]. Phonetically, this divergence among the sonorants can be attributed to the easier detection of cues to voicing of obstruents released into liquids than into nasals (Steriade 1999b).

The situation is confused further by the voicing of /s/ to [z] in archaic Latin postvocally before any voiced consonant (with subsequent loss of [z] and compensatory lengthening of the preceding vowel), whether that consonant was a voiced obstruent (**nisdos* > **[nizdos]* > *nīdus* ‘nest’), a nasal, as expected given the evidence of (16) above, (*cosmis* > [kozmis] (cf. *CIL* 1².4 COSMIS) > *comis* ‘friendly’, **kasnos* > **[kaznos]* > *canus* ‘white(-haired)’), or even, unexpectedly, a liquid (**preslom* > **[prezlom]* > *prelum* ‘wine-/oil-press’). Does this then indicate that /l/ was actively voiced prevocally, contrary to (15) above?

And what of /r/? The sequence /sr/ did not survive into archaic Latin, having merged with Proto-Italic **[ðr]* or similar¹³ and developed to /br/ at a prehistoric stage (Stuart-Smith 2004): **funesris* > *funebri*

¹³ **[ð]* was the regular Proto-Italic reflex of PIE **d^h/*, merging with **[β]* from PIE **b^h/* in some contexts, e.g. before liquids.

‘funereal’. The merger of /sr/ and a sequence of voiced fricative + /r/ is a strong indicator that the sibilant was voiced [z] at that prehistoric stage. In contrast, /sl/ seems to have survived into archaic Latin, whereas the Latin reflex of *[ǰl] (or similar) was /bl/ (PIE ‘tool’ suffix **-d^hlom* > Lat. *-blum*), in the same way as *[ǰr] > [br]. The divergence of /s/ and *[ǰ] before /l/ suggests further that /s/ was not voiced in this context in prehistoric times. The conclusion that falls out of these patterns is that /r/ came to be actively voiced at this prehistoric stage, whereas /l/ only became actively voiced in archaic Latin.

Further evidence for the later phonological voicing of /l/, and furthermore /n/, comes from prehistoric consonantal epenthesis in /m/ + sonorant sequences. In /mr/, the epenthetic stop was voiced /b/: PIE **g^heimrinos* > **heimbrinos* > *hibernus* ‘wintry’. In contrast, the epenthetic stop in /ml/ and possibly /mn/ was voiceless /p/: **exemlom* > *exemplum* ‘example’, *autumnus* > *autumpnus* ‘autumn’ (a variant form). Given the consistent appearance of /m/ in C₁ in these sequences, the different voicing of the epenthetic stop can only have been the result of the voicing of the sonorant C₂.

So far so good, but here we reach an impasse. If all the sonorants came to be actively voiced prevocally by an early stage of the language, why do we find a voice contrast persisting into the classical language in obstruents before liquid C₂, as seen in (14) and (15) above? Surely the voiced sonorants would have triggered regressive voice assimilation in these sequences?

7.2 *The Return of the Syllable: TR Onsets*

This puzzle finds a solution in the very phonological entity that has enjoyed little success in this investigation thus far: the syllable. The difference between forms such as *acri*, *agri*, *planta* and *blanda* on the one hand, and **prezlom* and **funesris* on the other is plausibly that the stop + liquid sequence (TR) was tautosyllabic in the former group, but heterosyllabic in the latter at the time when voice assimilation began to occur in these sequences (prehistoric for /r/; archaic for /l/). The regular tautosyllabic treatment of stop + liquid in the early dramatic verse of Plautus (3rd–2nd cents. B.C.) lends credence to the analysis of such words as *acri* and *capra* ‘she-goat’ as having tautosyllabic TR in the immediately preceding archaic period. Evidence of their syllabification in archaic Latin from vowel reduction (6th–5th cents. B.C.) is unclear, but it appears that to some extent, syllable edges

were aligned with transparent morpheme edges (see section 8), allowing us to interpret TR in these words as tautosyllabic.

We hypothesise then that a syllable-initial, simple onset sonorant came to be phonologically voiced in prehistoric/archaic Latin, whereas a sonorant which was not syllable-initial, but either a liquid in a complex TR onset, or any sonorant in a syllable coda, remained unspecified for voice. The divergent voice specifications of liquids in simple versus complex onsets can find a phonetic basis in the cross-linguistically common allophonic distribution of voiceless liquids, notably /l/, in complex TR. Ladefoged and Maddieson (1996, 237) note that “voiceless allophones of rhotics are quite common, especially in utterance-final position, and after voiceless stops,” the second of which could be either a simple onset or in complex TR. The behaviour they report for laterals is more suggestive: /l/ has been well documented in many languages to be subject not only to considerable coarticulatory effect from adjacent voiceless consonants, especially preceding stops, and adjacent vowels, but also to variation attributable to syllable and morpheme position (Ladefoged and Maddieson 1996, 192 with references). Selkirk (1982, 359–360) and Gimson (2001, 201, 205) are more explicit in reporting that in English, voiceless stop + /l/ is realised as aspirated voiceless stop + voiceless [l̥] when a complex syllable onset, but as unaspirated voiceless stop + voiced [l] when heterosyllabic, thus *incline* [m.k^hlaj̥n] versus *ink-line* [ɪŋk.laj̥n].¹⁴ In Latin, the prominence of the syllable-initial position possibly resulted in the speaker ensuring that sonorants were articulated robustly in that position, maximising the number and salience of cues to their character, whereas other positions did not demand such prominence and were therefore left with unspecified voice.¹⁵

Support for this state of affairs at least in early Latin comes from the rare instances where phonologically identical sequences were syllabified divergently. This is best witnessed in the noun **poplos* ‘people’ and its adjectival derivative **poplikos* ‘public’ (Wachter 1987, 384–386): the TR sequence in the former would be expected to have been tautosyllabic in archaic Latin, given the lack of a transparent morpheme

¹⁴ The variable pronunciations probably depend on other contextual factors to a large degree, and are not simply due to syllabification.

¹⁵ Note that all sonorants could have remained unspecified for voice in their underlying representation and only acquired positive voice specifications when they were syllabified.

boundary, thus /po.plos/; and indeed we find that the classical Latin outcome was *populus*, with vocalic epenthesis breaking up an earlier tautosyllabic onset sequence of /pl/ as expected. In the adjective **poplikos*, on the other hand, the TR sequence arguably came to be treated as heterosyllabic, presumably on the basis of the association of the ‘clear’ allophone of /l/, found before /i/, with the syllable-initial position,¹⁶ thus /pop.li.kos/. This change in syllabification occurred at a period after that in which syllable-initial sonorants became actively voiced, leaving the new voiceless coda /p/ in a precarious position. Therefore, despite its synchronic association with **poplos*, the adjective developed into **poblikos*, with regular regressive assimilation in voice of sonorants to stops across a syllable boundary (cf. *CIL* 1².397 *PUBLICAI*).¹⁷ After breaking of the vowel in syllables closed by a labial (**poublikos*) and subsequent monophthongisation, we reach the classical Latin form *publicus* ‘public’. For a similar divergence according to syllabification, see the developments of *vehiculum* and *neglego*: in section 8 below.

We therefore must admit that syllable structure played a role in archaic Latin phonotactics, and therefore an indirect role in assimilations: syllable structure determined which allophones of sonorants surfaced, the syllable-initial actively voiced allophone triggering regressive voice assimilation, which phenomenon can retain the linear formulation hypothesised in section 7.1 above: ‘every member of a consonantal sequence came to agree in voice.’

8 *Morphological Pressures*

To complete the picture regarding assimilations in the early history of Latin, we must take into consideration the morphological pressures giving greater prominence to roots than to affixes and requiring alignment of grammatical and prosodic constituents. In Latin, this is manifested in three ways.

¹⁶ Consider in this context the metathesis witnessed in Lat. **plumo* > *pulmo*: ‘lungs’, triggered by the association of the ‘dark’ allophone of /l/, found before /u/, with coda/preconsonantal position (Blevins and Garrett 1998, 516–518).

¹⁷ Note that this is not an unusual instance of neutralisation of an obstruent coda to a voiced value, but rather regressive assimilation in voice, which could only occur when C₁ was a coda before syllable-initial sonorant C₂ in Latin.

First, we find more thoroughgoing regressive assimilation at prefix + verbal root contacts. For example, although we expect to find the sequence /br/ to survive intact in Latin (e.g. *ebrius* ‘drunk’) both across a syllable boundary and as a complex onset, at a prefix + root boundary, it underwent total regressive assimilation to /rr/, thus **sub-rego* > *surrigo*: ‘I rise’.

Second, there is generally more faithful retention of root shape in the verbal morphology of Latin than elsewhere, particularly at morpheme boundaries within the paradigm. Thus, beside expected **kemtum* > *centum* ‘hundred’, with place assimilation in nasal C₁, we find **sumtos* > *sumptus* ‘assumed’, the past participle in **-to-* in the paradigm of *sumo*: ‘I assume’. Consonantal epenthesis (see section 7.1) seems to have been the victorious repair strategy over place assimilation where the latter would break the uniformity of the paradigm.

Third, and possibly of greatest relevance in this study given the conclusions of section 7.2, morpheme boundaries which were transparent in archaic Latin were aligned with syllable boundaries (see Sen 2006 for discussion), which in turn resulted in the syllabification of some TR sequences as heterosyllabic. The consequent voiced sonorant in syllable-initial position could then trigger regressive voice assimilation across the morpheme boundary. Such an effect is seen in **nek-lego*: (cf. *nec* ‘and not’ and *lego*: ‘I choose’) > *neglego*: (/neg.le.go:/) ‘I neglect’, versus *vehiculum* (/ve.hi.klum/) ‘vehicle’ (> class. Lat. *vehiculum* with regular vocalic epenthesis in originally tautosyllabic /kl/; see section 7.2).

9 Conclusions

This investigation evaluated two approaches claiming to account for assimilations, the syllable-based approach and the linear approach, from a diachronic perspective in relation to the early history of Latin. We found that assimilations were driven by linear segmental sequence alone, whereas syllable structure was relevant only in the assignment of allophones, a process which could in turn feed assimilations. A feature in a segment, if poorly cued to a sufficient degree relative to the value of that feature in an adjacent segment, was assimilated to that other value. Likely cues that we may identify for the language in this long-gone era, from a close reexamination of the data and typological evidence, included internal cues, such as frication noise or nasal

murmur, as well as external cues, such as formant transitions in neighbouring vowels. The data allowed us independently to construct two hierarchies for the resistance to assimilation in place in Latin, based upon a combination of internal and external cues phonologized in the language: the Place Hierarchy (dorsal > labial > coronal) and the Manner Hierarchy (fricative > stop > nasal).

However, we found that although the syllable was irrelevant in correctly formulating the contexts for assimilations, syllable structure was still of phonotactic relevance through governing the distribution of the actively voiced allophones of sonorant consonants to syllable-initial position. These, but not the allophones unspecified for voice, could trigger voice assimilation, due to their resistance to contextual devoicing in a prominent position.

Finally, morphology could magnify the straightforward phonetic pressures involved in assimilations, resulting in either more thoroughgoing assimilation, such as the total assimilation found at prefix + verbal root boundaries, or greater resistance, demanding an alternative repair strategy, as at verbal root + paradigmatic suffix boundaries. Furthermore, morphology could influence phonotactics in a role two steps removed from assimilations via the alignment of morpheme boundaries with syllable boundaries and the resulting active voicing of sonorants.

In sum, between linear segmental sequence and morpheme structure constraints, the syllable only had a minor role to play in the development of Latin phonotactics.

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