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Liquid polarity, positional contrast, and diachronic change: Clear and dark /r/ in Latin

Ranjan Sen, University of Sheffield & Nicholas Zair, Cambridge University

Abstract

Apparently disparate sound changes in Latin involving both vowels and consonants, but sensitive to /r/, can be explained by reconstructing a positional clear/dark contrast in /r/, motivated by the seldom-mentioned ‘liquid polarity’ effect. Examining these diachronic processes together allows us to see a larger picture, providing evidence for the reconstruction of successive past synchronic states. Latin /r/ mirrored the behaviour of Latin /l/ up to the first century BC: /l/ was dark and /r/ was clear in codas, and /r/ was dark and /l/ was underspecified for tongue body position in onsets. Darkness in /r/ was partly implemented through the selection of r-type: dark onset approximant and clear coda tap. Later, coda /r/ became an approximant, like onset /r/, and subsequently both rhotics became trills, as reported by the grammarians, resulting in the erosion of the positional contrast and the liquid polarity effect.

Keywords: *Latin; Historical Phonology; phonetic reconstruction; clear and dark resonance; liquid polarity; positional contrast; rhotics*

1. Introduction

Apparently disparate sound changes in Latin involving both vowels and consonants, but

seemingly sensitive to /r/,¹ can be explained by reconstructing a single synchronic cause, once we appreciate the possibility afforded by the seldom-mentioned ‘liquid polarity’ effect combined with the positional pattern already reconstructed for Latin clear and dark /l/. Examining diachronic processes together, rather than in isolation, therefore allows us to see a bigger picture, providing evidence for the reconstruction of successive past synchronic states as we chart sound changes through history.²

Liquid polarity refers to the phenomenon whereby liquids in a language or dialect are differentiated using opposite dark/clear resonance implementations, where darkness is correlated with acoustic features such as high F1 and low F2 (see §4.2), and a range of articulatory features, mainly related to tongue body position. Thus /l/ may be clear while /r/ is dark, or vice versa (e.g. in British English dialects; Kelly & Local 1989: 213-4; Tunley 1999; West 1999; Heid & Hawkins 2000). Alongside this effect, the conditioning of liquid resonances through syllable position is well known, with Southern Standard British English commonly reported to show clear /l/ in syllable onsets and dark /l/ in syllable rimes (e.g. Sproat & Fujimura 1993). Rhotics in English have also been found to display a syllable-position contrast, with dark /r/ syllable-initially and clear /r/ syllable-finally in American (Olive et al. 1993: 204, 216) and British (Carter 2003) varieties. Furthermore, the two types of conditioning effect (liquid polarity and positional contrast) have been found to interact in dialects of British English: in syllable positions where /l/ is clear, /r/ is dark, and vice versa (Carter 2003; Carter & Local 2007). Whereas the clear/dark contrast in /l/, and notably its diachronic effects, is well-researched, it is relatively understudied in /r/, and the interaction between polarity and positional contrast within a language has been rarely addressed since Carter & Local’s work. This paper demonstrates that liquid polarity and positional contrast can be reconstructed for early

¹ /r/ is used here as a generic symbol for any rhotic phoneme. We will discuss the details of the allophones of /r/ in Latin in the rest of the article.

² Our approach is similar to that of Denton (2003), who discusses the allophones of /r/ in the Germanic languages.

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Latin, gradually becoming eroded in imperial times: coda /l/ and onset /r/ were dark, whereas coda /r/ was clear and onset /l/ was underspecified for tongue body position.³ We further argue that the primary strategy for the implementation of r-darkness was selection of r-type: dark approximant in onsets versus clear tap in codas in early Latin.⁴ This formulation explains a wide range of Latin phenomena, from rhotacism and vowel reduction in very early times, to later lengthening and lowering. Although the claim regarding the existence of a clear/dark contrast in /r/ can be made independently of our reconstruction of the other most likely phonetic characteristics of the allophones of /r/, the two are compatible and mutually supportive, being based on common characteristics of r-types.⁵ As noted in footnote 4, clearness and darkness can be instantiated in types of /r/ of a number of different places and manners of articulation.

Attempts to describe Latin /r/ go back to ancient grammarians, and have been the subject of modern works such as Kent (1932: 59), Juret (1938: 14), Maniet (1957: 19),

³ We thank an anonymous reviewer for highlighting that ‘onset’ can refer to initial, intervocalic, or C2 (in an onset cluster) position, and it is possible that Latin rhotic reflexes were different in these. In our early Latin data, none of the available sound changes can provide evidence for /r/-resonance or type in word-initial position. Intervocalic position is represented by rhotacism, vowel reduction, initial-syllable vowel lowering (§§4.1-4.3), and C2 position by secondary syllable *r̄ and metathesis (§§4.4-4.5). All aside from rhotacism indicate dark resonance, while rhotacism suggests an approximant articulation which is straightforwardly compatible with darkness. We therefore proceed on the basis that all onset variants of /r/ were dark at the very least, and probably approximants in the absence of evidence for any systematic positional difference among onset types.

⁴ It should be noted that we do not claim that approximants are necessarily always dark, or taps always clear. It is well known that approximants in particular allow for a wide range of tongue positions (e.g. Delattre & Freeman 1968; Westbury et al. 1998), which may affect their clearness or darkness in particular contexts or languages. Another language with a clear/dark distinction which also differs in rhotic type is Malayalam (Scobbie et al. 2013: 100-101), although here there is a phonemic difference between clear tap and a dark trill.

⁵ Hall & Hamman (2010) discuss the cross-linguistic avoidance of rhotic and high vowel/glide sequences, and conclude that it reflects the “antagonistic” positions of apical rhotics, which involve a lowered tongue blade and retracted dorsum, giving a concave shape, and high front vocoids, with fronted and raised blade and dorsum. This might be taken to imply that all apical rhotics should be ‘dark’, but the evidence cited above for ‘clear’ /r/ in British and American English indicates otherwise. In fact, the restrictions on co-occurrence of rhotics and high front vocoids are particularly strong for trills, and Hall & Hamann (2010: 1838, 1840) mention exceptions such as the American ‘bunched’ (approximant) /r/, with a different tongue position, and the Norwegian apical alveolar flap, which does not avoid front vocoids.

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Sturtevant (1968), Monteil (1970: 72), Allen (1989: 32-3), Painter (2011), and Pultrová (2013). Surprisingly, despite the advances in our understanding of /r/ in Latin that these studies make, no thorough investigation of all the pertinent evidence has yet been carried out, and there remains scope for a more comprehensive analysis.⁶ Most do not adequately take into account the diachronic nature of the evidence, such that sound changes that took place in the fourth century BC and first century AD, or comments by authors of the second century BC and third century AD, are taken to be evidence for the ‘same’ /r/. This is despite that fact that change in phonetic production over even a fairly short space of time is a well known feature of rhotics (Wiese 2011: 717-20).

In addition, none aside from Painter (2011) seriously consider the possibility that there may have been allophones of /r/ which may have had different effects on nearby segments, and have undergone different sound changes. Again, rhotics are often characterised by variety in phonetic implementation, and many languages show a number of positionally sensitive allophones of /r/ (Lindau 1985: 161; Wiese 2011: 716). We argue that, for at least part of its history, Latin had allophones of /r/ depending on its position in the syllable, with onset /r/ being specified as ‘dark’ and coda /r/ being ‘clear’. ‘Dark’ /r/ is predominantly characterised by lowering of nearby vowels, while ‘clear’ /r/ causes fronting and raising.⁷

In this article, we provide an overview of the evidence for clear and dark /r/ in Latin (§2), then discuss the linguistic evidence pertaining to /r/ in prehistoric times (§3). The

⁶ Latin /r/ was an alveolar trill according to Juret, Maniet, presumably Monteil, who is, however, rather vague, and Sturtevant (1968: 151), who states that “Lat[in]. *r* was, throughout the history of the language, a trilled tongue-tip *r* [r]”. Kent (1932: 59) describes /r/ as a trill, adding that /r/ “before consonants and final was weak, perhaps as in English, and was occasionally omitted in writing”. Allen describes Classical Latin /r/ as a trill, with earlier stages as a fricative and a tap. Pultrová argues for a tap.

⁷ This argument builds considerably on the foundations of this position outlined in Sen (2009: 288-92, more briefly 2015: 92 fn. 17), and Stuart-Smith (2004: 213-8), the only previous author to our knowledge to discuss Latin /r/ with regard to dark resonance, on the prehistoric developments. Stuart-Smith (2004: 216) notes with regard to her account of the prehistoric change discussed in §3 that “there does not seem to be any other evidence for positing a clear/dark variation for Latin /r/”. This paper aims to provide the required evidence.

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following sections present the evidence for dark /r/ in onsets (§4) and clear /r/ in codas (§5) in archaic and early Latin, each organised chronologically from earliest to latest phenomena, discussing the relevant sound changes and consequently the likely phonetic correlates of each variant. Finally, we argue that the clear/dark distinction in /r/ was gradually eroded from early imperial times, with both onset and coda /r/ becoming first approximants and then trills (§6). This includes brief discussion of the metalinguistic evidence; this section is short, since the evidence has already been collected by Pultrová (2013), and we only mention points which we think are relevant. While we do not entirely agree with her statement that “[t]he given testimonies of ancient authors attempting a direct characteristic of the sound R are totally inconclusive” (2013: 26), we do think that the statements of grammarians largely operating in the 2nd–5th centuries AD cannot be used for evidence for the characteristics of /r/ at earlier stages. Finally, we discuss the place of liquid polarity and positional contrast in the phonology of Latin in §7 and offer conclusions in §8.

We adapt the practice of Weiss (2009: 23) in referring to the following periods of Latin: ‘prehistoric Latin’ (before the first attestations in the 7th century BC), ‘archaic Latin’ (7th–3rd century BC) and ‘early Latin’ (3rd–2nd century BC).⁸ In general, we use ‘imperial Latin’ (1st century BC–4th century AD) in place of ‘classical Latin’, since much of our evidence from this period for the status of /r/ comes from sub-elite writers rather than from the elite authors generally invoked when referring to ‘classical Latin’ (although we use classical when referring to standard classical forms).⁹

It is unfortunately the case with even as well-attested a corpus language as Latin that there is often a relatively small evidence base of forms by means of which to try to establish the environment for a given sound change. Although this can be frustrating, we follow the general methodological approach adopted by linguists working on Latin (and

⁸ For the dating of archaic Latin inscriptions see Hartmann (2005).

⁹ This use of ‘imperial’ is slightly anachronistic, since the first Roman emperor is widely felt to be Augustus (63 BC – 14 AD).

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other ancient languages) in trying to reconstruct a plausible picture of the synchronic and diachronic phonological system by making the best of the evidence available to us and combining this with insights from linguistic theory and typology. Naturally, some aspects of this reconstruction will rest on a stronger basis than others. Most of the individual sound changes on which our analysis is based are generally accepted, and to be found in the numerous handbooks of Latin historical phonology which we refer to at the relevant points; where the evidence is more than usually limited or there is less consensus about a given development, we have made this clear in the text.

2. Clear and dark /l/

The evidence for the well-known feature of l-darkness in archaic/early Latin is extensively discussed by Sen (2015, chapter 2), whose analysis is summarised here (for a brief summary, see Weiss 2009: 117, 139). Coda /l/ was categorically specified as ‘dark’, and geminate /ll/ as ‘clear’, while onset /l/ was underspecified for tongue body position, becoming contextually darkened in line with the backness of a following vowel: clear before /i/, darker before /e: e/, and darker still (but not as dark as coda /l/) before /a o u/. This reconstructed ternary surface contrast – clear, dark, and underspecified – is supported by the evidence in two ways. In addition to grammarians’ statements reporting three varieties of /l/ correlating with these three positions, the main evidence for l-darkness comes from the conditioning of a preceding vowel. Coda dark /l/ usually coloured a preceding /o/ (also from *e in this position) as /u/ even in initial syllables, which were stressed in archaic Latin: *welti > volt > vult “wants”. Onset /l/ before /a o u/ also yielded internal /u/ (*konseluērunt > cōnsuluērunt “they took counsel”), but only initial-syllable /o/ (*welō > volō “I want”). Onset /l/ before /e(:)/ was still dark, but less so, yielding internal /o/ (*ad-alēskō > adolēscō “I grow up”).¹⁰ Finally, onset /l/

¹⁰ The related form *adolēscēns* “young man” probably has /u/ rather than /o/ due to analogical influence from *adultus* “adult”. A reviewer makes the valid point that darkening before front /e(:)/ suggests that the onset variant was not altogether unspecified for tongue body position, but rather tended to be dark where

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before /i/ was clear/palatalised, and behaved the same as geminate /ll/ in that neither coloured a preceding vowel: compare *vult* above with *velle* “to want” and *velim* “I want (subjunctive)” from the same root.

The primary acoustic correlate of dark resonance in liquids has been shown to be the second formant (F2): dark liquids have lower F2, whereas clear variants have higher F2 (e.g. Carter & Local 2007: 184 with numerous references). This would tally well with the behaviour of /l/ in Latin, with darker variants causing increasingly greater backing of vowels, since F2 is inversely correlated with backness in vowels. From an articulatory perspective, we can assume that clear /l/ had a high, fronted tongue body position, corroborated by the identical behaviour of clear geminate and pre-/i/ onset laterals (both palatal); conversely, dark /l/ had a velarised or retracted tongue body producing the low F2, which ultimately vocalised in several Romance languages (e.g. Latin *alba* “white” > French *aube*).

3. Prehistoric Latin: *s and *ð > /b/ when next to /r/

It is widely recognised that /r/ variants (tap, trill, fricative, approximant at several different places of articulation) show more of a network resemblance than a single common acoustic or articulatory feature (Lindau 1985). However, the most widely applicable characteristic of the rhotic family is a lowered third formant (F3), both within the /r/ and/or in surrounding vowels (Delattre & Freeman 1968; Ladefoged & Maddieson 1996: 244-5). F3 has been found to be notably low in approximant /r/ variants, whether postalveolar, bunched, or retroflex (e.g. Tunley 1999: 25-35, 70-72 for Standard British English), and also in apical trills (see Lawson et al. 2011: 78) and retroflex trills compared to non-retroflex trills in Toda, a Dravidian language of southern India (Spajić et al. 1996).

possible. We maintain the analysis of Sen (2015) given that the point remains that the onset variant is contextually sensitive unlike the coda and geminate variants, hence there is a categorical difference in their behaviour. Onset /l/ could therefore have been underspecified for darkness in the phonology, but darkened by a gradient phonetic implementation rule of the language.

No significant difference in F3 between the tap and trill in Catalan was found by Recasens and Pallarès (1999: 156), but Cathcart (2012) observes a tendency in a small group of speakers to produce taps with a concave tongue shape, with lower F3. Additionally, lip protrusion in onset /r/ in many varieties of English further decreases F3 (and F2) (Zawadzki & Kuehn 1980).

It is this common feature of several (but not all) types of /r/ that underlies the main sound change in Latin which is conditioned by both onset and coda /r/ identically: the prehistoric labialisation (and fortition) of voiced coronal fricatives to /b/ which had already occurred by the time of the first attestations of the language. Word-internally, both before (onset) and after (coda) /r/, the fricative *ð originating from the Proto-Indo-European voiced aspirated plosive */d^h/ became /b/, presumably via a voiced bilabial fricative *β (Stuart-Smith 2004: 204, 213). The development *ð > /b/ also took place before onset /l/, as well as after /u/ and before /w/ (Weiss 2009: 75-6).¹¹

(1) *ð > /b/ in prehistoric Latin

Onset /r/: *krið^hrom > *kriðrom > *kriβrom > *cribrum* “sieve”

Coda /r/: *werð^hom > *werðom > *werβom > *verbum* “word”

Onset /l/: *stad^hlom > *staðlom > *staβlom > *stabulum* “quarters”

After /u/: *k^wud^hei > *k^wuðei > *uβei > *ubi* “where”

Before /w/: *lonð^hwos > *lonðwos > *lomβwos > *lumbus* “loin”

¹¹ Stuart-Smith (2004: 213) notes that there is no evidence for the treatment of *ð after dark coda /l/, so any account need not be to the exclusion of that environment. She offers three possible motivations for labialisation adjacent to liquids (2004: 216-7): (i) dark /r/ in the same distribution as dark /l/ (i.e. in codas and before non-front vowels in onsets), which she notes is problematic due to *srīgos > *frīgus* “cold” (see (3)), and which in our account would contradict liquid polarity so would not be expected; (ii) lip-rounding in /r/ (see above), or (iii) a common lowered F2 in rhotics of any type. We conclude from our reconstruction of an apical trill for coda /r/ below that low F3 is more likely than low F2, and note that (e.g.) Delattre & Freeman (1968) conclude that F3 lowering is a more common property across rhotics than F2 lowering, but acknowledge the possibility of the latter (see also fn 13), particularly if lip-rounding (lowering both F2 and F3) was involved. Stuart-Smith’s (2004: 41-2) inclusion of ‘after *r’ as an environment for this change seems to be an error, since she gives as an example *ob-b^hend^h- > *offendicēs* “knots of the straps fastening a priest’s cap”.

The key element of this change that is conditioned by /r/ and the other segments is the labialisation; we leave aside motivations for fortition (see Stuart-Smith 2004: 204-6).¹² The identical behaviour of *ð before both onset and coda /r/ is best explained by the rhotic's low F3 in any position, a property shared by /u w/ due largely to their lip-rounding, and thereby known to cause labial percepts, whence *ð > /b/. Based on this patterning, it is possible that prehistoric Latin /r/ also showed a degree of rounding, much like British English /r/, as suggested by Stuart-Smith (2004: 217). Onset /l/ poses more challenges as a trigger environment. As onset /l/ was underspecified aside from its tongue tip constriction, it is plausible that a following rounded vowel resulted in anticipatory low F3 in the lateral and preceding consonant. It is noteworthy that instances of *ðl > /bl/ can almost always be attributed, as in the example above, to the suffix *-ðlom > *-blom > *-bulum* with a following /o/, or its analogical effect (e.g. in adjectival derivatives in *-ðlis > *-blis > *-bilis*, e.g. *stabilis* “firm, stationary”; Stuart-Smith 2004: 215).¹³ On its own, /o/ adjacent to *ð did not trigger labialisation (e.g. *nog^wod^hos > *nowoðos > *nūdus* “naked”, *wid^howā > *wiðowā > *vidua* “widow”; de Vaan 2008: 418, 676-7), so it seems that the colouring of adjacent onset /l/ was required to generate the low F3 trigger, in a similar fashion to the low F2-triggered colouring of /e/ to /o/ to /u/ before /lo/ (§2, e.g. *wetelos > *wetolos > *vitulus* “calf”). Consequently, labialisation adjacent to /r/ (e.g. *werd^hom > *verbum* “word”) cannot be caused by the following /o/, but necessarily by the preceding /r/ alone, which has no adjacent back vowel.

¹² PIE */d^h/ resulted in Latin /d/ word-internally in the vicinity of other sounds, e.g. *h₂ejd^h- “be on fire” > *aedēs* “temple”, *med^hjos > *medius* “middle” (Sihler 1995: 149; Weiss 2009: 75).

¹³ The trigger could also have been low F2 caused by co-articulation with the following back vowel; this is a property also shared by /u w/ (and coda /l/), but not obviously by /r/ in any position, unless accompanied by lip-rounding. Under our analysis, where coda /l/ (for which there is no evidence as a labialisation trigger) was specified as dark with a high ‘degree of articulatory constraint’ (DAC) (Recasens et al. 1997; see also Bladon & Al-Bamerni 1976; Barry 1997: 40 on a “coarticulatorily opaque trill”; Sen 2012: 491 for Latin /l/), it might thereby have been resistant to the coarticulatory rounding which caused labialising low F3. However, there seem to be no good examples of the sequence *-ld^h- in Latin to test this hypothesis, so we accept, with Stuart-Smith (2004:217), the possibility that low F2 may have been the labialisation trigger.

Similarly, word-internal *sr developed to /br/, presumably via *zr > *ðr (merging with *ðr above) > *βr (see Sen 2015: 186-9 on voice assimilation triggered by simple onset /r/ only).¹⁴

(2) *-sr- > /br/ by archaic Latin

*founesris > *founezris > *founeðris > *founeβris > *fūnebris* “funereal”

Finally, at the beginning of a word, *sr- became /fr/.

(3) *sr- > /fr/ by archaic Latin

*srīgos > *frīgus* “cold”

In these cases, /r/ again caused labialisation of the preceding coronal fricative, for the same reasons as above (low F3). However, only onset /r/ caused this development, as inherited internal *rs with coda /r/ became geminate /rr/, both word-internally (e.g. *fersi > *ferre* “to bear”) and word-finally, where the geminate was scanned long in the early Latin verse of Plautus, but was later simplified to /r/ (e.g. *ters (see §4.5 for earlier stages) > *terr* (Plautus) > *ter* “thrice”). Pre-empting the sections below, we already see diverging behaviour in onset and coda /r/, and hypothesise that the root of the asymmetry lies in different allophonic r-types in the two positions. Simple onset /r/ triggered regressive voice assimilation *sr > *zr, causing its merger with *ðr, followed by the labialisation of *ð to *β caused by /r/ in both coda and onset (with subsequent regular fortition of word-medial *β to /b/). The most likely r-type to trigger such voice assimilation would be an approximant, with salient internal acoustic cues to voicing (e.g. clear formant structure). Ohala & Solé (2010: 58) note that trill /r/ has triggered regressive voice assimilation in Spanish, Catalan, and Portuguese, but they also highlight that aerodynamic constraints on the production of voiced fricatives, especially before a trill, may result in loss of the fricative, or weakening to an approximant or vowel (2010: 56-

¹⁴ Before other voiced sonorants /l m n/, word-internal *s was lost in Latin with compensatory lengthening of preceding vowels, a change which had not yet occurred in the earliest period of Latin, as shown by sixth century *cosmis* (CIL 1².4) = Classical *cōmis* “kindly”. Voice assimilation before onset /l/ and subsequent loss of [z] with compensatory lengthening probably occurred in the fourth century BC (Sen 2015: 187-8).

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7). This would render fortition to a plosive /b/ in Latin difficult to explain if onset /r/ were a trill. We therefore conclude prehistoric Latin onset /r/ was most likely an approximant.

Conversely, *rs underwent total progressive assimilation to /rr/ instead of merging with *rð in a mirror image of *sr > *zr > *ðr.¹⁵ As /r/ in both positions must have had low F3, and we have seen above that approximant, tap, and trill /r/ can display this characteristic, we might hypothesise that prehistoric coda /r/ was a coronal trill, whose salient articulatory properties and high-frequency ‘percussive’ acoustics masked the production and perception of cues of a following coronal /s/ at the same place of articulation, resulting in a geminate trill /rr/ (see Steriade 2001 and Wright 2004 on cue masking).¹⁶ In support, Solé (2002: 675-7, 682-4) notes that trilling may become extinguished into a fricative when oropharyngeal and subglottal pressure fall below a threshold. Presumably, frication for an intended /s/ might therefore be interpreted by a listener through hypercorrection as phonetic frication at the offset of a trill, resulting in total assimilation.¹⁷ Progressive consonantal assimilation is rare in Latin compared to the standard regressive assimilations in voice, place, and continuance from prehistoric times

¹⁵ Sen (2015: 186-9) analyses onset /r/’s ability to trigger voice assimilation as a surface specification for active voicing in simple onset /r/. Coda /r/ did not trigger voice assimilation in following /s/.

¹⁶ Solé (2002: 680-2, 686) characterises voiced trills as having “auditory distinctiveness” with “a clearly modulated signal, distinct from other speech segments”. Such distinctiveness combined with a specified resistance to coarticulation in a given language at a given time (Bladon & Al-Bamerni 1976; Recasens et al. 1997; Barry 1997: 40 on a “coarticulatorily opaque trill”) may result in the unusual progressive assimilation pattern seen in prehistoric Latin.

¹⁷ Ohala & Solé (2010: 56-9) note that lingual fricatives and apical trills require antagonistic positional requirements of the tongue tip and dorsum, and consequently a fricative preceding a trill may be lost or weakened through inability to generate audible turbulence, due to the anticipatory tongue gestures for a following trill. Diachronic loss or total regressive assimilation to /rr/ has resulted in Spanish and Catalan. In our Latin assimilation example, the positions of the hypothesised trill and fricative are reversed, with the trill in coda position. Ohala & Solé (2010: 86 fn. 12) report that in such a sequence, /r/ is commonly detrilled and may itself regressively assimilate to the fricative, e.g. Latin *bursa* > Catalan *bossa* “bag”. This would be due to anticipatory preparation of the configuration of the fricative. If, however, the trill was specified in a language as being resistant to coarticulation (fn. 13), and its perseverative effects robust in the ways outlined above, we might expect masking of the following fricative.

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(Sen 2015, chapter 6), signalling the strength of the coda rhotic articulation and acoustics: cue masking is likely to have been severe for progressive assimilation to occur, with the trill variant presenting the most likely masking.¹⁸

A good indication that the prehistoric coda rhotic changed in nature by historical times is that historical Latin /rs/ – resulting from the simplification of inherited *rss, *rtt, or from *rVs with syncope – remained intact, e.g. *wert-tos > *versus* “turned”, *sort-s > *sorss > *sors* “lot”. We argue below (§5) that coda /r/ changed from a trill to a tap after prehistoric times.¹⁹

4. Dark, approximant onset /r/

The clearest evidence for dark resonance and an approximant realisation in onset /r/ comes from a series of sound changes involving the rhotic from archaic to early Latin.

4.1. Rhotacism

Intervocalic *-s- became /r/ in Latin in the course of the fifth and fourth centuries BC. This had not yet occurred in our earliest Latin sources where we find forms like *Vetusia* (7th century BC) = classical *Vetūria*, *Numasioi* (7th century BC) = classical *Numeriō*, *Valesiosio* (6th century to 480 BC) = classical *Valerīi*, *iovesat* (first half of the 6th century BC) = classical *iūrat*. The *terminus ante quem* is the mid fourth century, when,

¹⁸ Prehistoric *ls – with the other liquid in C1 position – also underwent total progressive assimilation to /ll/, e.g. *welsi > *velle* “to want”, as an anonymous reviewer points out. It is unclear what triggered this development given that in historical times coda /l/ was specified as dark and geminate /ll/ specified as clear (§2). However, it is notable that, unlike with /r/, /l/ preceding coronals /d/ and /n/ also triggered total progressive assimilation, suggesting that the motivations of /r/ and /l/ assimilation were different e.g. *saldō > *sallō* “I salt”, *kolnis > *collis* “hill” (Weiss 2009: 169, 171-2).

¹⁹ See §5.5 for a development of historical Latin /rs/. We acknowledge, as pointed out by an anonymous reviewer, that reconstructing a much stronger coda variant (trill) than an onset one (approximant) on a strength/lenition scale (e.g. Gordon 2016: 153) might be typologically unusual. However, we note that there is still a considerable time depth in the changes involved above. It may be that at the time of progressive assimilation, both onset and coda variants were trills, but only the latter underwent total assimilation due to the perseverative effect above. Thereafter, both may have weakened to a tap, with the onset further becoming an approximant triggering regressive voice assimilation and labialisation/fortition.

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according to Cicero, L. Papirius Crassus, the consul of 339 BC, was the first to change the spelling of his name from Papisius (Weiss 2009: 151).

The changing consonant in these cases was in onset position (*Vetūria* = /we.tu.si.a/ > /we.tu.ri.a/), and we hypothesised above that onset /r/ was an approximant going into archaic times. Positing approximant /r/ is commonly acknowledged in the literature to be the best account of intervocalic rhotacism phenomena (e.g. Catford 2001: 179; Vijūnas 2018; see Painter 2011, especially 59-64, for detailed articulatory and perceptual discussion, analysis of Latin, and references); here intervocalic /s/ underwent lenition according to the well-attested clines (Gurevich 2011; Honeybone 2012) ‘voiceless > voiced’ (* /we.tu.zi.a/) then ‘fricative > approximant’ (/we.tu..i.a/).

An alternative possibility is that the result of rhotacism was a flap or tap.²⁰ There is evidence in Castilian Spanish and Mallorcan Catalan for /s/ becoming a flap (although in syllable coda before certain consonants), and experiments in which the duration of /s/ between vowels was reduced found that speakers of Spanish, Catalan and American English perceived it as a flap (Romero & Martín 2003).²¹

Conversely, intervocalic fricative > trill is highly unlikely based on articulatory and acoustic grounds, especially in the Latin case (Painter 2011: 15-44, 50-64, 98-9).

²⁰ An additional, but slight, piece of evidence for an approximant or tap is the claim of the 1st century BC grammarian Varro to have seen *medidies* on an old sundial, whence *meridiēs* “midday” by distant dissimilation /d...d/ > /r...d/ (Weiss 2009: 156). In support, the etymology for the original form of the word reported by both de Vaan (2008: 170, 369) and OLD (1103) is **medī-diē*, the locative forms of *medius* “middle” and *dies* “day”, meaning “in the middle of the day”. The rationale for the rhotic outcome of the dissimilation could be interpreted on the hypothesis that onset /r/ was an approximant as a result from a voiced tongue-tip closure dissimilation, changing from a ‘closure-closure’ voiced sequence (plosive + plosive) to ‘no_closure-closure’ (approximant + plosive). This would not be the case for a tap or trill /r/ which both still involve tongue tip contact with an upper articulator. However, a dissimilation to a tap could not be ruled out if we interpret the dissimilation of ‘closure-closure’ to be less extreme than to ‘no_closure-closure’, but only to ‘reduced_closure-closure’, that is tap + plosive.

²¹ Solé (2010) emphasises the syllable coda as the site for ‘weakening’ of fricatives, including the /s/ > [r] change discussed here. Vijūnas (2018) demonstrates that *allegro* speech – i.e. presumably with reduced duration of /s/ – is unnecessary for the development of an approximant variant, and provides an example of approximant realisation in the present day Austronesian language Tsou.

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Rhotacism therefore provides evidence for approximant or tap onset /r/ in archaic Latin; the approximant interpretation is preferable based on the conditioning of vowels before /r/, discussed in the following sub-sections.²²

4.2. Vowel reduction

In Latin, short vowels in non-initial open syllables underwent a process of reduction between about the sixth and third centuries BC, the normal result of which was a development to /i/ (examples taken from Sen 2012: 470).

(4) Vowel reduction in open syllables

/i/	*ad <u>i</u> tus	>	ad <u>i</u> tus	“way”
/e/	*ē <u>l</u> egō	>	ē <u>l</u> igō	“I choose”
/a/	*ke <u>k</u> adai	>	ce <u>c</u> i <u>d</u> i	“I fell”
/o/	*kupi <u>d</u> otāts	>	cupi <u>d</u> itās	“desire”
/u/	*kap <u>u</u> tes	>	cap <u>i</u> tis	“head (gen.)”

Before onset /r/ (including from intervocalic *s by rhotacism), the result was instead /e/ (examples from Sen 2012: 471; for discussion and further examples see Parker 1988: 223-4).

(5) Vowel reduction > /e/ before /r/ in open syllables

/i/	*kin <u>i</u> ses	>	*kin <u>i</u> res	>	cin <u>e</u> ris	“ashes (gen.)”
/e/	*kom <u>s</u> erō			>	con <u>s</u> erō	“I sow”
/a/	*pe <u>p</u> arai			>	pe <u>p</u> erī	“I brought forth”
/o/	*-fo <u>r</u> os			>	-f <u>e</u> r ²³	e.g. frūgifer “fruit-bearing”
/u/	*sw <u>e</u> ku <u>r</u> os			>	so <u>c</u> er	“father-in-law” ²⁴

²² An anonymous reviewer notes that rhotacism appears to be incompatible with a dark rhotic, presumably due to the high tongue tip configuration of earlier [z]. However, the approximant sound resulting from weakened, defricated [z] may have been assimilated into the existing category of ‘onset rhotic’, triggering a categorical realisation of the result of rhotacism in this way. We argue in the following sub-sections why this pre-existing onset rhotic appears to have been dark.

²³ Via *-feros > *-fers > *-ferr > *-fer.

²⁴ Another example is *peiero* “swear falsely” < *per-jurō.

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Latin vowel reduction is generally attributed to lack of stress, which at this period fell on the initial syllable. We assume that the result was a fairly neutral vocalic transition with few cues to backness, roundedness, or height. When the stress system changed around the late 4th century BC (Meiser 1998: 66; Sen 2015: 62) to the classical system, in which stress fell on the penultimate syllable if it was heavy, and otherwise on the antepenultimate syllable, these vowels were re-classified as full vowels. The default classification was as /i/, but the realisation was often affected by adjacent sounds (for more details see Sen 2012: 470-74). In the case of an originally unstressed vowel preceding onset /r/, it was realised as a lower /e/.²⁵

In closed syllables, a less drastic reduction took place, whereby *a became /e/, while *o was raised to /u/ in the late third or early second century BC (Meiser 1998: 70; Weiss 2009: 121, 140), but *e, *i, and *u were not affected (examples taken from Weiss 2009: 117).

(6) Vowel reduction in closed syllables

/i/	*mag <u>i</u> steros	>	mag <u>i</u> ster	“master”
/e/	*skele <u>s</u> tos	>	scele <u>s</u> tus	“criminal”
/a/	*refa <u>k</u> tos	>	refe <u>k</u> tus	“remade”
/o/	*al <u>o</u> mnos	>	alu <u>m</u> nus	“nursling”
/u/	*add <u>u</u> ktos	>	add <u>u</u> ctus	“led to”

Notably, it appears that vowels before /r/ in the syllable coda show exactly the same pattern as other vowels in closed syllables, although the evidence is not complete for all vowels (Sen 2015: 82).

²⁵ A long-distance conditioning effect of /r/ in a complex onset has also been posited by Sen (2015: 117-19) to explain unexpected open-syllable /e/ in forms such as *genetrix* “mother”, *meretrix* “courtesan”, and *moletrina* “mill”. The effect is only seen when perseveratively supported by a mid vowel in the preceding syllable, and not obliterated by a dorsal consonant preceding /r/ in the complex onset (e.g. *molucrum* “millstone brush”). Conversely, Nussbaum (2016) argues that sequences of a plosive followed by /r/ were heterosyllabic, hence forms like these just reflect the closed syllable treatment of *a as laid out directly below. He claims that sequences of a plosive followed by /l/, on the other hand, were tautosyllabic.

(7) Vowel reduction before /r/ in closed syllables

/i/	*kom <u>f</u> irmō	>	conf <u>f</u> irmō	“I confirm”
/a/	*in <u>a</u> rmis	>	in <u>e</u> rmis	“harmless”
/o/	Greek kót ^h <u>o</u> rnos	>	co <u>th</u> urnus	“high boot”

Therefore, ‘r-lowering’ (i.e. conditioning of the reduced vowel before /r/ as /e/) only occurred before onset /r/, not coda /r/, indicating a difference in the realisation of the sound in the two positions.²⁶

Although most studies on /r/ and dark resonance in liquids have focused on their effects on F2 and F3, there is evidence that liquid resonances can also be seen in the first formant (F1), inversely correlated with vowel height. Vowels before (or after) /r/ have often been reported to lower (Bhat 1974: 76-7; Lindau 1985: 158; Recasens 2012 reports raised F1 in vowels adjacent to the trill in Catalan), and a secondary correlate of /r l/-darkness, after F2, has been found to be F1 (Sproat and Fujimura 1993: 292; Carter & Local 2007: 184; see also Recasens et al.’s 1995: 41 darkness measure ‘F2 minus F1’): dark liquids can have a relatively high F1 compared to clear ones. Furthermore, West (1999: 412-13) found that some Southern British English speakers showed significantly higher F1 in onset rhotic contexts than in onset lateral ones. F1 was the main indicator of the liquid darkness contrast in onsets in the study, as F2 in vowels before onset /r/ was usually higher than before onset /l/, an unexpected result given that (as in Latin) onset /r/ might expected to have dark resonance and thus lower F2. However, just as in Latin contextual darkening of onset /l/ (§2), the F2 of English onset /l/ was found to be relatively low in some back-vowel contexts through anticipatory coarticulation. This seems to indicate that onset /l/ in both languages is/was relatively unconstrained in its tongue body articulation (in §2 we analysed it as underspecified in Latin), and free to

²⁶ Sporadic cases of apparent raising of *o > /u/ in before coda /r/ in initial syllables, such as *furnus* “oven” beside *fornāx* “furnace”, have been explained by Zair (2017) as due to borrowing from Umbrian.

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undergo coarticulatory influences in F2;²⁷ therefore, given the possible variability in F2, the /r ~ l/ contrast in onsets is/was characterised in a more stable fashion by F1 than by F2.

Latin r-lowering indicates that onset /r/ was ‘dark’, with a relatively high F1 (compared to coda /r/), incompatible with a preceding high vowel /i/. However, as in English, its F2 was perhaps not particularly low compared to the F1 difference with coda /r/, leading primarily to lowering rather than backing of preceding vowels (although a slightly lower F2 may have enhanced the lowering effect, with moderate backing conditioning the neutral vowel as /e/). The similarity in behaviour with English, and the high F1, low F2 profile would fit well with the analysis that archaic Latin onset /r/ was an approximant and not a tap (with relatively low F1 and high F2; e.g. Recasens & Pallarès 1999 for Catalan).²⁸

4.3. Vowel lowering in initial syllables

According to Parker (1988), lowering of *i and *u in word-initial syllables to /e/ and /o/ respectively was regular before onset /r/. However, the evidence is limited: not all examples of high vowel + /r/ show lowering, and the only certain cases are forms of the verb “to be”.²⁹

(8) Initial-syllable vowel lowering before onset /r/

*fusi > *furi > *fore* “be (fut. inf.)”

²⁷ In contrast with ‘dark’ coda /l/ in English, which Bladon & Al-Bamerni (1976) argue shows greater ‘coarticulatory resistance’ than ‘clear’ onset /l/.

²⁸ Note that Recasens & Pallarès also found that a tap had less effect on a preceding /i/ than a trill (and than /n/), which also argues against onset /r/ being a tap. The lowering effect of the trill in Catalan shows that a dark trill would also be a possible hypothesis for onset /r/ in Latin, but the evidence of rhotacism discussed in §4.1 favours an approximant.

²⁹ Parker also includes *snusā > *nora “daughter-in-law”. Although this is not made clear by Parker, *nora is a reconstructed Proto-Romance form which leads to Italian *nuora*, Spanish *nuera* etc.; it is not attested in Latin (which has *nurus* for this lexeme). While the form with lowering seems to be found in most Romance varieties, there are some which preserve /u/ (Meyer-Lübke 2009: 492). Consequently, we do not think this apparent lowering in some branches of the Romance languages is relevant for the status of Latin /r/.

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*fusēm > *furēm > *fōrem* “be (imp. subj.)”

Possibly *si-sō > *sirō > *serō* “I sow”

Possibly *d^hurom > *furom (cf. Umbrian *furo*) > *fōrum* “forum”

It has been suggested (e.g. by Meiser 1998: 80) that the /o/ in the first two cases is due to lowering in enclitic forms of the verb “to be”. While it is true that “to be” could be enclitic in Latin, we find that lack of stress in enclitic words results in raising of vowels, not lowering, as seen in *te^bh^ei > *tibi* “you (dat.)”, *se^bh^ei > *sibi* “to him/her”, *sowos > *suus* “his/her” (Meiser 1998: 157; Weiss 2009: 334), i.e. the vowel undergoes reduction (see §4.2) as though in a non-initial syllable. If this were the case also for *fusi and *fusēm we would expect them to become †fere and †ferem. Thus, the best explanation for lowering in initial stressed syllables in these words is that it was caused by following onset /r/, much like its lowering effect in internal syllables. Regarding the final two cases, *serō* may go back to a reduplicated formation *si-sō, but is instead reconstructed as *se-sō by Rix (1995: 406) and Meiser (1998: 191-2). However, there are no other certain examples in Latin of reduplicated verbs with *e rather than *i in the reduplicated syllable (Weiss 2009: 405-6), which makes this interpretation less likely. Even so, it is still conceivable that the vocalism of *serō* could be analogical on its compounds such as *conserō* “I sow, plant”, where the *i was not in an initial syllable, as suggested by LIV (518). *Forum* could come from *d^hurom if it is directly cognate with Umbrian *furo*, although *d^hworom > *forum* directly is also possible (Zair 2017: 278-9).

As in §4.2, this initial lowering effect may provide evidence for dark onset /r/ with high F1, most plausibly an approximant. The fact that this effect appears to be found even in an initial syllable, which would have borne stress in archaic times, might indicate the large degree to which onset /r/ was dark, affecting even the longer, louder stressed vowel; a striking parallel can be seen in dark coda /l/ which also conditioned stressed initial-syllable vowels as /u/ in archaic times (*welti > *vult* “wants”; §2). Onset /r/ must

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have had a significantly back articulation, perhaps similar to US English bunched or retroflex /r/, to produce the high F1, low F2 required for its dark resonance.

We are aware of the following three plausible counter-examples (for a full discussion of all possible counter-examples see Parker 1988).

(9) Counter-examples to lowering in initial syllables

*pisos	>	*piros	>	<i>pirus</i>	“pear-tree”
*snusus			>	<i>nurus</i>	“daughter-in-law”
*wisejō			>	<i>vireō</i>	“be green”

Given the small amount of evidence available, it is difficult to know exactly what context lowering occurred in, or why it appears to be restricted to *fore* and *forem*; however, no better explanation imposes itself for the /o/ < *u in these words. The counterexamples can be dealt with in three possible fashions: (i) accepting the sporadic nature of the change, or treating it as a lexically diffused change (Chen & Wang 1975), which affected only the most frequent forms (Phillips 2006) – those of “to be” – before ceasing to operate, and therefore leaving the remainder of the lexicon unaffected (e.g. “pear-tree”, “daughter-in-law”); (ii) reasonable, but ultimately ad hoc explanations; (iii) lowering in initial syllables may have affected only *u. We present the various possibilities here, without deciding between them.

As for (ii), a common etymology for *vireō* connects it to Lithuanian *veisiù* “breed, rear”, Old English *wīse* “sprout”, Old High German *wīsa* “meadow” (LIV 671), but this is doubted by Parker due to a lack of close semantic connection (likewise de Vaan 2008: 681-2); without an etymology that confirms *ī, this is not a strong counter-example. Alternatively, Weiss (forthcoming), who accepts the connection between *vireō* and *veisiù* etc., suggests that lowering was inhibited by a preceding /w/.

Other Indo-European languages show as preform of the “daughter-in-law” word either *snus-ā (e.g. Sanskrit *snuṣā́*) or *snus-o-s (e.g. Greek *nuós*); the transfer to the u-stems in Latin *nurus* is often explained as the result of analogy with *socrus* “mother-in-

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law”. Parker (1988) argues that, thereupon, lowering of /u/ in the first syllable of *nurus* was blocked due to anticipatory vowel-height assimilation with /u/ in the following syllable (or lowered **norus* was assimilated back to *nurus*). This seems a plausible suggestion given other vowel assimilations especially across sonorant consonants in Latin (although these are perseverative and affect unstressed syllables), e.g. *alacer* “quick”, *anatis* “duck (gen.)”, *genetivus* “genitive” (Sen 2015: 85).

Parker considers *pirus* to be a loan-word from some other Mediterranean language, and hence not subject to the lowering rule. However, while this is possible, it does not obviate the problem.³⁰ The comparison of Latin *pirus* with Greek *ápion* “pear” suggests an Italic reconstruction **pisos* (< **h₂pisos*), because intervocalic **s* becomes /r/ in Latin, and disappears in Greek. Since this **s* became /r/ in Latin, it must have been borrowed into the language prior to rhotacism, which must have taken place prior to initial and internal lowering (cf. **fusi* > *fore* and §4.2). Consequently, *pirus* ought to have undergone lowering just like any inherited word.

However, a more clearly defined borrowing interpretation is possible for *pirus*: it may have been borrowed from Umbrian, a Sabellic language in the Italic family related to Latin and spoken at the relevant time in some of the same areas (rather than a purported ‘Mediterranean’ language). Crucially, Umbrian also underwent rhotacism, hence inherited **pisos* would have become **piros* in this language, and it is this post-rhotacism form which could have been borrowed into Latin, AFTER lowering had already taken place and ceased to operate. In support of this interpretation, there are a number of other words borrowed from Sabellic languages into Latin (*būfō* “toad”, *lupus* “wolf”, etc.; arguably also *ursus* “wolf”, *turdus* “thrush”, *turpis* “disgusting” etc. from Umbrian in particular; Zair 2017). In contrast with *pirus* would be *forum* in (8) which as a native Latin word has undergone lowering (unless it comes from **d^hworom*).

³⁰ But see Huld (2011), for a plausible argument that **h₂pisos*- is inherited.

As for (iii): lowering in initial syllables may have affected only *u, if *sisō > serō is ruled out as being due either to a different etymology or derived forms; the remaining forms (i.e. *fore*, *forem*, perhaps *forum*) show lowering of the back vowel *u to /o/, and never *i > /e/. An explanation based on the phonetics of /r/ is forthcoming: in both initial sequences CirV and CurV, the dark rhotic raised the F1 of the preceding high vowel, rendering them slightly lowered towards /e o/. In the former sequence, this was normalised by the listener, having no effect on the perception of phonological vowel height. However, in the latter, phonetic lowering was accompanied by an ambiguous attribution of the low F3 of intended /u/: was it intrinsic to the vowel or coarticulatory due to the following /r/, also with very low F3 (§3)? Where listeners misinterpreted it as the latter, the vowel was misanalysed as lower /o/, with lower F3 conditioned by following /r/. This would be a case of hypercorrection (Ohala 2003). In the even more ‘dark’ sequence /uru/ in *nurus*, the hypercorrection did not occur, presumably as all perceptual cues in the sequence indicated a very dark environment, overriding the lowering effect of /r/.

Finally, contrast vowel lowering before onset /r/ discussed here with vowel RAISING before coda /r/ explored in §5.3, indicating the contrary influences of the two rhotic allophones.

4.4. Secondary syllabic *r̥

‘Secondary’ syllabic *r̥ arising by syncope of the vowel after onset *r in *CrVC became /er/ by vocalic epenthesis preceding the rhotic.³¹ By comparison, secondary syllabic *l̥ > /il/ and *ŋ̥ > /in/, with /i/ as the epenthetic vowel (Meiser 1998: 74).

(10) Syncope and epenthesis before syllabic sonorants

a. *ro ri > *r̥ > /er/

*agros > *agr̥s > *agers > *ager* “field”

³¹ ‘Primary’ syllabic sonorants were those inherited from Proto-Indo-European, with a different reflex in Latin.

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*matroterā > *matrterā > *matertera* “mother’s sister”

*ākris > *ākrs > *ākers > *ācer* “sharp”

b. *lo > *l̥ > /il/

*wekslolom > *weksllom > *vexillum* “flag”

c. *no > *n̥ > /in/

*tignolom > *tignlom > *tiginlom > *tigillum* “a small beam”

The lower vowel before secondary syllabic /r/ as opposed to before /l̥ n̥/ is a strong indication that conditioning was caused by properties which were not straightforwardly coronal, but due to a dark secondary articulation. In /n/ and onset /l/, there was no specified secondary articulation, whereas in /r/ it was specified as dark, with high F1 (and low F2). Consequently, when syncope occurred presumably due to casual-speech variants of the words (e.g. English [ptɛɪtə] for *potato*), the sonorant consonant in each case was still phonologically in onset position. It would certainly be more implausible to suggest that the careful- and casual-speech variants were /CrVC/ with dark onset /r/ versus /Cr̥C/ with non-dark /r/ (whatever nucleus /r/ would have been), as the phonetic nature of /r/ would simply remain the same after the phonetic deletion rule at the start of the life cycle of the process (e.g. Bermúdez-Otero 2015). Epenthetic vowels in Latin were usually high /i u/, presumably due to the phonologisation of a very short vocalic interval between consonants (Sen 2015: chapter 5), which showed similar characteristics to the unstressed internal vowels showing vowel reduction to /i/ (§4.2). Consequently (similar to §4.5 below), when a prop vowel began to emerge BEFORE the sonorant, it was high /i/, unless there were acoustic properties which were unexplained by the coda variants of those consonants: before /n/, there were simply coronal percepts, resulting in a high, front vowel; before newly coda /l/, which was usually extremely dark, the absence of the expected strong back-vowel percepts preceding the lateral was interpreted as evidence for a high, front vowel /i/; however, before newly coda /r/, the unexpected high F1 (due to the original onset /r/) was interpreted as a lower vowel /e/. The development of the

secondary syllabic sonorants therefore again corroborates our hypothesis that onset /r/ was dark.³²

4.5. Metathesis

In a similar vein, original *Cri appears as /Cer/ in Latin in an open initial syllable or a monosyllable before a coronal.³³

(11) *Cri > /Cer/

*krinō > *cernō* “I separate”

*kritos > *certus* “certain”

*tritostis > *terstis > *testis* “witness”

*tris > *ters > *ter* “three times”

This change could be subsumed under the development of secondary syllabic *r̥ discussed in §4.4, rather than metathesis, e.g. *krinō > *kr̥nō > *cernō*; *tris > *tr̥s > *ters > *ter*. This is the position taken by Leumann (1977: 142) and Sihler (1995: 69), and is supported by the initial-syllable development *CroC > CerC seen in *trosejō > *terreō* “terrify” (LIV 650-51), presumably via *tr̥sejō > *tersejō, then with progressive assimilation (see §3) to *terreō*. In contrast, metathesis would have yielded †torsejō > †torreō, as under our analysis there is no reason to believe that initial-syllable /o/ would have been conditioned as /e/ (like original /i/ in *Cri which was simply perceived as a lower vowel). However, the counter-evidence to this analysis, and the evidence in favour

³² A reviewer suggests that the epenthetic /i/ in *vexillum* and *tegillum* might reflect the fact that it is (synchronically) before a geminate /ll/, which is ‘clear’ in Latin. The key evidence here is forms such as *agrelōs > *agrlos > *agerlos > *agellus* “small plot of land” where we find /e/ as the epenthetic vowel arising from *r̥, although synchronically it is before geminate /ll/. Likewise in *asanelō- > *asenlo- > *asellus* “donkey” and *kolamenelā > *kolamenlā > *columella* “little column” we find original *e preserved before geminate /ll/.

³³ The handbooks tend to be vague on the exact formulation of this rule (compare Meiser 1998: 80 and Weiss 2009: 123, 142). An alternative formulation would be that *ri became /er/ before any coronal when also preceded by /t/, but only in open syllables when preceded by /k/ (thus Nussbaum 1999: 413). That the rule did not apply in closed syllables which began with /k/ is shown by *crista* “crest”, *crispus* “curled”. Whether metathesis occurred when the initial consonant was labial is unclear, given *fritillus* “dice-box” but *cōnfestim* “immediately” < *ferstim < *-b^hristim (de Vaan 2008: 216).

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of metathesis, is probably stronger. Syncope, the necessary first step in the development of secondary syllabic *r̥, did not otherwise occur in initial syllables in Latin (in these periods), as they were stressed in archaic times.

Moreover, there was a genuine liquid-vowel metathesis phenomenon in initial syllables after another consonant, providing a parallel: *Clu with onset /l/ was metathesised to /Cul/ in *dlukwis > *dulcis* “sweet”, *plumō > *pulmō* “lung”.³⁴ In these words, metathesis is the only possible explanation, since *Clu > *Cɫ would have given /Cil/ (see §4.4). Here, the underspecified onset lateral was contextually darkened by following /u/, but was misanalysed by the listener as a specified dark /l/, i.e. a coda. The metathesis analysis for *Cri, almost exactly a mirror-image, is therefore preferable to syncope plus epenthesis.

Under this analysis the apparent syncope in the first vowel of *trosejō > *terreō* remains unexplained, but the same is also true of *sorbeō* “drink, suck” < *srob^hejō- (LIV 587), which appears to be an isolated instance of metathesis in the environment *Cro. These two, apparently sporadic, cases effectively cancel each other out in terms of evidence against and for metathesis in *Cri sequences.

Weiss (2009: 123, 142) interprets this development as metathesis *Cri > *Cir followed by lowering of /i/ to Cer. If this is correct, it would seem to provide evidence for lowering caused by CODA /r/, contrary to our expectations of lowering being a feature (only) of onset /r/, as seen in §§4.2 and 4.3. However, another explanation is possible, retaining onset-triggered lowering. According to Blevins & Garrett (1998: 510-11), CV to VC metatheses of this type “originate when features extending across a CV or VC domain, or perceived as extending across such a domain, are reinterpreted as originating in nonhistorical positions”. This will take place when the consonant is a segment with

³⁴ De Vaan (2008: 182) gives a rather confused account of the origin of *dulcis*, seeming to prefer an original *dɫk-. But Greek *gleūkōs* “sweet new wine”, *agleukēs* “sour” shows that the *u is original. And a pre-metathesis *dlukwis > *dluk^wis would provide an explanation for loss of the *w in *dulcis*, by dissimilation from the /u/ in the preceding syllable (Weiss 2009: 34).

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long drawn-out perceptual features such as rhotics. If Latin onset dark /r/ had a higher F1 and lower F2 than clear coda /r/, anticipatory coarticulation of the following high, front /i/ (with low F1 and high F2) with dark /r/ in the complex onset (and consequently masked to a degree by the preceding consonant) might have led to ‘lightening’ of /r/ (i.e. reduction in F1 and increase in F2). The listener therefore interpreted the long-domain rhotic cues as for a clear /r/, expected to be in the coda, resulting in reanalysis of the sequence *Cri as /CVr/. However, the source of the still relatively high F1 and low F2 distributed across the syllable and originally due to onset /r/ was unclear to the listener, since coda /r/, like /i/, also had relatively low F1 and high F2. This led to a new analysis of the – now preceding – vowel as /e/, with higher F1 and lower F2 than /i/. Therefore, the development of the mid vowel in /Cer/ is properly to be seen as part and parcel of the perceptual misanalysis involved in metathesis, not a secondary development apparently providing evidence for lowering due to coda /r/.³⁵

5. Clear, tap coda /r/

Whereas onset /r/ is characterised by lowering, coda /r/ tends to cause fronting and raising. In §3 we suggested that coda /r/ was originally a trill in prehistoric Latin. For archaic and early Latin, we reconstruct a tap allophone in coda position, with low F1 and high F2, on the basis of numerous indications.

5.1. Failure of onset /r/ phenomena

The clearest evidence for onset and coda /r/ having significantly different realisations lies in the failure of coda /r/ to be involved in any of the processes discussed in §4: rhotacism, r-lowering in vowel reduction (where failure in codas is explicitly discussed; §4.2), vowel lowering in initial syllables, syllabic /r/ epenthesis and metathesis (where the expected

³⁵ The metathesis *pretty* → *purty* found in some historical Irish and present-day US dialects might present a good parallel of r-metathesis with vowel lowering caused by the phonetics of the rhotic (but see Ritchie 1999 for an account based on lengthening of an epenthetic schwa).

clear resonance of coda /r/ had an influence). In a symmetrical fashion, the failure of onset /r/ to partake in the developments discussed in this section provides evidence for a different allophone in that position.

5.2. Pre-coronal fronting

In the course of the second century BC, /o/ became /e/ after /w/ and before a coronal (Weiss 2009: 140), including /r/ in a syllable coda, and geminate /rr/ resulting from *rs through progressive assimilation (§3).³⁶ However, this change did not take place when /o/ was followed by /r/ in a syllable onset, as shown by *vorō* ‘I devour’ and its derivative *vorāgō* ‘pit, chasm’.

(12) Pre-coronal fronting *woC[COR] > weC

a. Before /s t/

voster > *vester* “your”

votō > *vetō* “I forbid”

b. Before coda /r/

*advorssom > *advorsom* > *adversum* “against”

advortit > *advertit* “(s)he turned towards”

*worsō > *vorrō* > *verrō* “I sweep”

*worsēs > *verrēs* “boar”

The development can be explained through a combination of ‘hypercorrection’, the treatment by the listener of a phonological effect as phonetic, and ‘hypocorrection’, its opposite. Here, the anticipatory high, front tongue tip of the following coronal coloured

³⁶ As *rs > /rr/ assimilation was prehistoric (§3), fronting in this environment occurred before geminate /rr/, which therefore also had ‘clear’ characteristics. The geminate’s fronting influence also seems to have prevented the regular third/second-century raising *o > /u/ in closed syllables (§4.2) in *extorris* ‘exiled’ (although this is the only relevant form). We have hypothesised that geminate /rr/ was trilled at an early stage, to explain the progressive assimilation in *rs > /rr/. However, trills are particularly likely to be produced with a retracted tongue dorsum (Hall & Hamann 2010: 1837-8, 1840), and we would therefore expect them to be ‘dark’ (we thank an anonymous reviewer for pointing this out). Consequently, /rr/ may have changed to another type of rhotic by the second century; we know of no evidence which would allow us to identify it with more precision.

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the back vowel /o/; this coarticulatory effect was filtered out by the listener through normalisation in all other environments aside from after /w/, where normalisation failed due to the misanalysis of the back-vowel acoustic features of the intended vowel /o/ as being due to perseverative coarticulation with /w/ (hypercorrection); the vowel was therefore interpreted phonologically as /e/ (hypocorrection), with phonetic back-colouring at its onset.

The fact that the environmental context ‘pre-coronal’ includes coda /r/, but not onset /r/, again indicates an articulatory difference in their realisations, suggesting that the coda variant shared more characteristics with coronal consonants /s t/ than the onset, and was therefore ‘clear’ (low F1, high F2). If coda /r/ had a high, front tongue position, the most forthcoming interpretation is that it was a tap, different to coronal plosives only in closure duration. High F2 in dental and alveolar coronals is the result of the necessity of the tongue tip and blade being close to the front teeth, which is easiest if the tongue body is also relatively far forward (Flemming 2003: 338). In contrast, onset /r/ must have had a much more back articulation.

5.3. Raising of /e/

Coda /r/ also provides the environment for a sporadic change in Latin, whereby /e/ is RAISED to /i/; contrast r-conditioning to LOWER /e/ instead of /i/ before onset /r/ (§4.2). In some cases, the standard Classical Latin word shows /i/ from reconstructed *e; in others, standard Latin has /e/, but there are inscriptional forms from the third and second centuries BC with <i> (Adams 2007: 89-91; Zair 2017: 267-9).

(13) Raising /er/ > /ir/

*d ^h ermos	>	<i>firmus</i>	“strong”
*g ^h ertos	>	<i>hirtus</i>	“hairy”
*skerpos	>	<i>scirpus</i>	“bulrush”
<i>stercus</i>	=	<i>stircus</i> (CIL 1 ² .401)	“dung”
<i>Mercurius</i>	=	<i>Mircurios</i> (CIL 1 ² .564 etc.)	“Mercury”

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Note that the consonants preceding the vowel and following coda /r/ could be coronal, labial, or dorsal, indicating that raising was caused specifically by the rhotic, and not by the perseverative or anticipatory influences of a coronal.³⁷

As with the cases of *vor-* > *ver-* (§5.2), this can be seen as part of a general tendency to fronting caused by following coronals in Latin; this is also seen in *e > /i/ in the environment *m_n* in *meneswā > *Minerva* “Minerva”, *menōr > *minor* “I threaten”, which may be a regular sound change (Weiss 2009: 137), and the sporadic or originally dialectal *wetelos > *vitulus* “calf”. As above, the patterning of coda /r/ with coronals /n t/ again supports its interpretation as a (tapped) clear allophone, this time causing raising (lower F1, in contrast with dark onset /r/) as well as mild fronting (higher F2). Note also that this development never affected the forms containing /er/ with coda /r/ developing from secondary syllabic *r̥ (§4.4) or metathesis (§4.5); this may either be lexically conditioned as there are only a handful of words showing raising, or it may suggest that complete reanalysis with coda /r/ had not yet been completed in those forms.

5.4. Raising of *ō

Coda /r/ may also be responsible for the raising of *ō to /u:/ in two words; the change did not occur when there was no following /r/, e.g. *sōl* “sun”.

(14) Raising of *ō before coda /r/

quōr > *cūr* “why”

*b^hōr > *fūr* “thief”

This sound change is normally characterised as taking place before /r/ in monosyllables (e.g. Meiser 1998: 86; Weiss 2009: 143), which is descriptively accurate. However, the latter aspect is not a necessary component of the environment: monosyllables would in

³⁷ The change can perhaps also be seen in Faliscan, the closest relative of Latin (and arguably a dialect of it): compare Latin *libertās* with Faliscan **loifirtato** “freedom” (bold is used to show that the inscription is in the Faliscan alphabet). As an anonymous reviewer points out, the preform of *libertās* and **loifirtato** is *lew^herotāt-, so the /r/ was originally in the onset rather than the coda. This suggests that clearness of coda /r/ developed after syncope of the medial vowel.

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fact be the only place where a tautosyllabic sequence /o:r/ would be possible, since long vowels were shortened before word-final /r/ except in monosyllables at about the same time as the raising (Weiss 2009: 128), while long vowels had also been shortened before non-word-final coda sonorants ('Osthoff's law').³⁸ Consequently, it is only in monosyllables that long vowels were preserved before coda /r/. Again, the clear variant in this position may have raised the preceding vowel.

However, the further backing of *-ōr to /u:r/ in this development (rather than mild fronting in *er > /ir/ in §5.3) is difficult to explain if caused by a clear allophone. We could appeal to low F1 being the primary characterisation of /r/ in coda position, as we saw high F1 was for onset /r/. But while we can find a motivation for high F1 in onset /r/ (because it helps to distinguish it from onset /l/), there is no similar motivation for low F1 in coda /r/: in onsets, liquid polarity was implemented through F1 because F2 was inadequate as a result of the possibility of contextually darkened /l/ (also with low F2) in that position; in contrast, coda /l/ was always (very) dark with low F2, so high F2 on its own was sufficient to mark out coda /r/ from coda /l/. An alternative explanation might therefore be preferable, which is that *ō became /u:/ in a monosyllable by rounding after a labial or labialised consonant, as in /k^wo:r/ and *fōr, but not as in *sōl* "sun", which seems to be the only other monosyllable containing /o:/. Therefore, although coda /r/ has traditionally been interpreted to cause this raising – which if true could be explained by our account – /r/ is not necessarily the reason for the development to /u:/.

5.5. Evidence for a tap

There are several indications which suggest that clear coda /r/ may have been realised as a tap. Before a labial fricative or approximant, /d/ is written <r> in some inscriptions. The earliest instance may be from the late fourth century *apur finem* "by the boundary" (but a new reading of the inscription has *apud finem*; Clackson & Horrocks 2011: 112). There are then clear-cut examples such as *arfuisse* = *adfuisse* "to have been present" and

³⁸ Note that short /o/ was probably lower than long /o:/ (Allen 1989: 47-9).

arvorum = *advorum* “opposite” in the second century BC.³⁹ The spelling with <d> was clearly standard by the first century BC onwards, and the spelling with <r> is not found again.

This coda development is generally considered to indicate the presence of a tap /r/ (Allen 1989: 33; Painter 2011: 78), where articulatory anticipation of the labiodental fricative or labiovelar approximant (both requiring the tongue tip to be away from the teeth or alveolar ridge) impeded coronal closure in /d/, reducing its magnitude to a tap. As a parallel, Recasens & Pallarès (1999) note that Catalan has a pre-consonantal tap allophone of /r/, although it is a trill elsewhere.

The prehistoric change of *s to /r/ in the sequences *sg (*mesgō > *mergō* “I sink”, *wisgā > *virga* “twig, sprout”; Weiss 2009: 173, de Vaan 2008: 682) is compatible with a tap realisation.⁴⁰ As already mentioned (§4.1), in syllable coda /s/ before another consonant can be realised as [r] in Castilian Spanish and Mallorcan Catalan (Romero & Martín 2003); this is attributed to articulatory reduction in the duration of the /s/. Position before a (voiced) consonant is a likely cause for such reduction due to “a decrease in intraoral pressure triggered by the voiced consonant following /s/” (Recasens 2006: 11).⁴¹

Similarly, the prehistoric change *n > /r/ before /m/, e.g. **kan-men* > *carmen* “song” and **gen-men* > *germen* “seed” (Weiss 2009: 168) is compatible with a tap realisation. Ohala & Solé (2010: 77) note that a coronal nasal is perceptually similar to a nasalised tap so could plausibly be interpreted as one, with hypercorrect attribution of the nasality to the following /m/ in the Latin case. They provide examples of sound changes involving /n/ to a tap in Romanian and from Sanskrit to Middle Indo-Aryan.

³⁹ For a list of other possible examples given by the grammarians see Pultrová (2013: 27 fn. 10).

⁴⁰ There is also a development of *sw > /rw/ (*kateswā > *caterva* “crowd”, *meneswā > *Minerva*; Weiss 2009: 162, de Vaan 2008: 98), but this appears to have taken place in Proto-Italic times, so is outside the scope of this article.

⁴¹ An approximant is, perhaps, not entirely ruled out, however. In addition to rhotacism, of /s/ before voiced consonants, some Mallorcan Catalan speakers produced “an approximant-like realization with some low intensity noise overlaid on it” which “may have an /r/-like quality” (Recasens 2006: 14).

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Words containing /rs/ sequences have variants with /ss/ in them from the second century BC onwards (Leumann 1977: 211). Thus, beside *dorsum* “back” is a variant *dossum*, read in a manuscript of Varro and some later manuscripts, and mentioned as being used by “some people” by the second century AD grammarian Velius Longus, (Keil 1855-1880: 7.79), which is the origin of all Romance forms (e.g. Italian *dosso*). A derived name *Dosuo* for *Dorsuo* is found in an inscription of the first or second centuries BC (CIL 1².270), and *dorsuarius* “which carries a load on its back” is found as *doss(u)ario* in an inscription from Britain of imperial date (Hassall & Tomlin 1977: 434 no. 35). An inscription from 117 BC (CIL 1².584) contains both *controvosias* = classical Latin *controversias* (see §5.2 for the vowel before /r/), and *susum*, *suso* = *sursum*, beside *controvorsieis*, *vorsum*, *deorsum* and a variant spelling *dorsum*, *sursum* with preserved <rs>.⁴² This assimilation is also demonstrated by *prōsus* beside *prōrsus* “straightforward”, because /ss/ degeminated after a long vowel about 100 BC (Meiser 1998: 125). *Prōsus* comes from *prōworsus > *prō-orsus > *prōrsus* > *prōssus* due to a rule which deleted /w/ before /o/, followed by contraction of the adjacent vowels, then assimilation, and finally degemination. Degemination also occurred when another consonant followed original *rs, if these forms are interpreted to have first undergone total assimilation to /ss/, thus *torstos > *tosstos > *tostus* “parched” and *farstīgium > *fasstīgium > *fastīgium* “tip”.

In showing total regressive assimilation before /s/, coda /r/ again patterns with coronal plosives /t d/, e.g. *quatsai > *quassī* “I shook”, corroborating our hypothesis that it was a coronal tap. Although original assimilation of */ts ds/ had taken place at a much earlier stage than /rs/ > /rr/, this sequence had been preserved across a prefix + stem boundary, where the prefix can have been restored by analogy. However, also in these cases assimilation subsequently re-occurred, giving forms like *assum* beside *adsum* “I am

⁴² This inscription does not consistently write geminate consonants with double letters, so <s> can stand for /ss/ in *controvosias*. In *susum*, *suso*, the preceding vowel is long, giving single /s/ after assimilation and degemination, if the latter had already taken place.

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present” (Allen 1989: 22). If prehistoric coda /r/ was a trill, as argued in §3, its salient articulation might have been crucial in resisting assimilation before /s/ at the earlier time. Its transition to a tap by early Latin provides a good account of why consonantal assimilation only occurred at that stage.⁴³

This ‘rightward’ assimilatory development in a VrC sequence can be contrasted with the later ‘leftward’ vowel-lengthening development in the same sequence, discussed in §6; the disparity is explained by a further development of coda /r/ from a tap to an approximant.

6. Imperial Latin erosion of clear/dark /r/ distinction

We have reconstructed approximant onset /r/ with high F1, low F2 throughout prehistoric, archaic, and early Latin, and possibly a trill coda /r/ in prehistoric Latin weakening to a tap in archaic and early times. In this section, we continue to see the weakening of the coda allophone, with further lenition from a tap to an approximant (like onset /r/) near the end of the early Latin period, a development which eroded the clear/dark distinction in /r/, and consequently liquid polarity. There are two main sources of evidence for this: vowel lengthening before coda /r/ and vowel lowering before any /r/, whether coda or onset. However, centuries later in imperial Latin we apparently see approximant /r/ in all positions developing further to a trill; the main source of evidence for this is the grammarians’ statements, which have often erroneously been taken to indicate trilled Latin /r/ throughout its history. Such change in phonetic production over even a fairly short space of time is a well-known feature of rhotics (Wiese 2011: 717-20).

⁴³ We thank an anonymous reviewer for pointing out that a change */rs/ > /ss/ is not incompatible with a trill /r/, as a result of /s/-frication impairing the trill’s tongue tip vibration, as noted in fn. 17 (Ohala & Solé 2010: 86 fn. 12). However, a tap is supported by the other evidence in this section, as well as its ability to characterise the differing behaviour of prehistoric *rs > /rr/ with a trill (§3), but later /rs/ > /ss/.

6.1. Vowel lengthening

It seems likely that, phonetically at least, vowels in Latin were lengthened before sequences of coda /r/ followed by another consonant from around the 1st century BC, towards the end of the early Latin period. This is demonstrated by the use of the *apex*, *I-longa*, or the double writing of vowels in inscriptions (Leumann 1977: 114; see Sen 2015: 11-12 on these devices).

(15) Vowel lengthening before coda /r/

aarmeis “weapons (abl.)” (AE no. 473, 1st century BC)

arcae “boxes” (CIL 13.1708, no date)

firmi name = “firm (gen.)” (CIL 6.1248, 38-49 AD)

Romance and other languages also provide evidence for long vowels in this position in some words, e.g. Latin *ordō* “order” > Logudorese *órdene* (Meyer-Lübke 2009: 500), Welsh *urdd* (Weiss 2009: 179 fn. 21).⁴⁴ However, not all words show lengthening in Romance (e.g. Italian *fèrmo* from *fīrmus*, not *fīrmus*), so the phonologisation of vowel length in this position seems to have been lexically determined.

This phonetic lengthening of vowels is found before coda /r/, not before onset /r/. This kind of lengthening effect by rhotics is characteristic of approximant variants, which have long transitions from the preceding vowels, whereas vocalic transitions into taps or trills are reported to be “considerably shorter than into an approximant and comparable

⁴⁴ In most of the Romance languages Latin /o:/ and /u/ fell together, as did /e:/ and /i/. But some languages such as the Logudorese dialect of Sardinian kept them apart (Herman 2000: 32-3); similarly, /o:/ in Latin loanwords is kept separate from /o/ in Welsh (Jackson 1953: 307). The confusion between /o:/ and /u/, which is already visible in written sources in the late Roman empire, is probably the reason for cases like *fūrmica* for *formica* “ant” in Appendix Probi 25, with lengthening before coda /r/. Powell (2007) provides a recent edition of the Appendix Probi, a list of corrections preserved in a manuscript from the seventh or eighth century AD, but which could have begun to be compiled at any time from the first or second century onwards. An unexpectedly early example of the confusion of /o:/ and /u/ may be found in *turtas* for *tortas* “loaves” in a wooden tablet from Vindolanda (Tab. Vindol. II.180, Bowman & Thomas 1994), around the late 1st century AD.

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to that of a stop” (Kavitskaya 2002: 51-2, 55-6).⁴⁵ The fact that this development occurred later than those discussed above indicate that a change in pronunciation of coda /r/ took place from the 1st century BC, from a tap to an approximant, following the expected lenition cline (closure > no_closure).

6.2. Imperial vowel lowering before /r/

Up until the 1st century BC, as shown above, onset and coda /r/ differed in their effects on preceding vowels: onset /r/ caused lowering of high vowels (§4.2-4.3), while coda /r/ supported fronting and raising (§5.2-5.3). In two sub-elite sources from the first century AD, we see a small amount of evidence for the lowering of /e/ to [a] by a following onset /r/, a sound change which occurs also in the Romance languages; perhaps around the same time, and at least from the third century AD this lowering seems to take place regardless of whether /r/ was in the syllable onset or coda, as shown by inscriptional evidence, and by developments in the Romance languages (Adams 1977: 13-14).⁴⁶

(16) Vowel lowering before /r/ in any position

a. Pre-onset

petierit “seek (perf. subj.)” > *petiarit* (Camodeca 1999 no. 67,
38 AD)

iterum “again” > *itarum* (P. Mich. VIII.468.23, Pighi 1964 no.5,
c. 100 AD)

valeriana “type of fig” > Abbruzese *vaiaranę* (Meyer-Lübke
2009: 762)

⁴⁵ Kavitskaya sees this phonetic lengthening as the first stage in compensatory lengthening, where the /r/ is lost and the length is analysed as inherent to the preceding vowel. Loss of /r/ does not take place in Latin, except in a few cases before /s/, where the length of the vowel is unrecoverable (Leumann 1977: 211; and see §5.5). Instructively, Kavitskaya (2002: 55-6) compares the (highly morphologised) coda r-deletion WITHOUT compensatory lengthening in Standard Turkish, where /r/ is a tap, with coda r-deletion WITH lengthening in Western Anatolian, where “r is more approximant-like”.

⁴⁶ As Adams observes, a number of other examples, such as *passar* (Appendix Probi 163) for *passer* “sparrow” may have been the result of assimilation of unstressed vowels to stressed /a/ in the preceding or following syllable rather than (or as well as) lowering caused by /r/.

b. Pre-coda

Serdica “place name in Thrace” > *sardi(ca)* (RIB no. 201, after 43 AD)

Mercuri “Mercurius (gen.)” > *marcuri* (Wilson & Wright 1968 no. 73, no date)

libertabus “freedwomen (dat.)” > *libar(tabus)* (CIL 6.10104b, 3rd century AD)

contubernio “squad (dat.)” > *contubarnio* (AE 1975 no. 638b, no date)

noverca “step-mother” > *novarca* (Appendix Probi 168, see fn. 44)

lacertus “upper arm” > Spanish, Portuguese *lagarto* (Meyer-Lübke 2009: 393)

pergaminum “parchment” > Lugodoresse *bargaminu*, Provençal *pargamí* (Meyer-Lübke 2009: 528)

This suggests that, at least in the speech of some Latin speakers, from at least the third century AD onwards, coda /r/ no longer had raising effects on preceding vowels, but instead shared lowering effects with onset /r/.⁴⁷ Given that we have analysed onset /r/ as an approximant, this development provides evidence that the coda too had become an approximant by this time, consistent with the lengthening phenomenon seen in the last section. The collapse of the positional distinction resulted in the erosion of the clear/dark rhotic contrast.

⁴⁷ András Cser (p.c.) has pointed out to us that one also finds inscriptional evidence for original /a/ being spelt <e> in both contexts. The occasional case of nom. *Caeser*, gen. *Caeseris* etc. “Caesar” may perhaps be attributed to the same assimilation envisaged in footnote 46, since this would have been pronounced [kɛ:sar] in many sociolects of Latin by the 1st century AD. However, in addition, we have found a handful of examples like *meritus* (Solin & Caruso 2014, no. 1, 4th century AD), probably for *maritus* “husband”, *trierchus* (CIL 8, 7030, 180-188 AD) for *triarchus* “triarch”, *biercus*, *bierco* (Petolescu 1985, undated) for *biarchus*, *biarcho* “commisary (dat.)”. Since the Romance evidence shows that the eventual result was a change of /e/ > /a/, we attribute these apparent instances of the opposite to hypercorrection.

6.3. Grammarians

Contrary to our formulations above, the evidence from Roman grammarians on the pronunciation of <r> has been traditionally interpreted as indicating a trill (e.g. Sturtevant 1968: 150-1; Kent 1932: 59). Pultrová (2013) extensively reports the direct evidence of the Roman grammarians on the pronunciation of <r>, highlighting the difficulty in its interpretation and apparent contradictions, and Painter (2011: 59-64) provides an insightful evaluation of the sources, concluding that the trill may either be a later development (as we do), or a hyperarticulated pronunciation by the grammarians.

The only characterisations of /r/ from as early as the 2nd century BC (Lucilius) and 1st century AD (Persius) are utterly opaque, comparing its sound to that of a dog. Attempts to interpret these as evidence for a trilled articulation (e.g. Sturtevant 1968: 150) cannot be taken too seriously.⁴⁸ Recall that we reconstructed approximant and tap (> approximant) variants for these periods.

As Painter (2011: 61) notes, it is only from the 2nd century AD that we find clearer grammarians' evidence for trilled /r/. The two most cited examples are from Terentianus Maurus (2nd century AD) and Marius Victorinus (4th century AD), although as Pultrová (2013) notes, the latter contains a corruption (indicated by the dots below) which renders its interpretation more difficult than is usually reported. However, it unequivocally describes vibration and, like Terentianus, “trembling blows”, which is best interpreted as evidence for a trill.

(17) Imperial Latin grammarians' evidence for trill

a. Terentianus

vibrat tremulis ictibus aridum sonorem

“[R] vibrates with a dry sound from trembling blows”

⁴⁸ We observe that in British English, which does not have a trilled /r/, the sound of a dog growling is made with the approximant [ɹ].

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b. Victorinus

r, quae vibrato... linguae fastigio fragorem tremulis ictibus reddit

“R, which produces noise from the tip of the tongue vibrating with trembling blows.”

As Allen (1989: 33) suspects, this pronunciation was a later innovation based on the evidence in the preceding sections. We then must posit that the approximant in both onset and coda positions from the 1st century BC gave way to a trill (in both positions, in the absence of evidence to the contrary) in later imperial Latin. In support of the plausibility of such a diachronic development, Painter (2011: 63) argues that the articulatory configuration of some forms of approximant /r/, the ‘molar/back/bunched’ /r/ (Catford 2001: 172) may “provide the correct stability of the tongue dorsum which allows the tip to slacken and initiate trilling”, concluding that “trills can originate from approximant forms of *r*”. Given the imperial lowering effect of /r/ discussed in §6.2, it is very plausible that Latin /r/ of that time was a ‘molar’ approximant with a low tongue body. Alternatively, the first trilled stage was uvular before then becoming coronal; the mechanism by which ‘molar’ /r/ became a uvular trill might be found in Catford’s (2001: 173) advice to people trying to replicate the “trough-like concavity in the tongue dorsum in the velar-uvular area” found in US English molar /r/: “approach it from a uvular trill (or from gargling). The trick is to suppress the trill but carefully maintain the trough or furrow in the back of the tongue as one moves the tongue slightly forward”. The advice appears to suggest that the molar approximant and uvular trilled varieties are not too distant. At any rate, Catford (2001: 179) appears to be satisfied that Latin /r/ could have progressed from a fricative or approximant pronunciation at the time of rhotacism to a later trill.

7. Liquid polarity and positional contrast

We noted in the Introduction that opposite resonances may be used by a language or dialect to enhance surface contrasts between onset and coda liquids (positional contrast) between laterals and rhotics (liquid polarity), or both. We have argued that Latin employed both strategies, but in a loose fashion rather than a strict requirement in phonetic implementation. Table 1 summarises the phonological and phonetic surface contrasts in early Latin.

Table 1. Surface liquid contrasts in early Latin.

	/l/ (§2)	/r/
Onset	Underspecified: phonetically dark or clear	Dark (§4)
Coda	Dark	Clear (§5)
Geminate	Clear	Clear (fn. 36)

We see that phonological positional contrasts are employed by both liquids individually: clear, dark, and underspecified for /l/, and clear and dark for /r/, with the geminate patterning with the clear coda variant. Similarly, liquid polarity is implemented most notably in coda position (dark /l/ but clear /r/), but also in onset position in terms of differing (rather than opposite) phonological specifications (underspecified /l/ but dark /r/). However, phonetically both the positional contrast and liquid polarity are compromised by the underspecified onset /l/ which was realised as relatively dark in all pre-vocalic environments aside from before /i/ (§2), thus both the positional contrast with between onset /l/ and (specified dark) coda /l/ and the polarity contrast between onset /l/ and (specified dark) onset /r/ can be lost. The two effects therefore appear to be loosely implemented in the categorical surface phonology of the language (clear, dark, or underspecified) rather than in phonetic realisation. A hypothetical language with stricter phonological positional and polarity requirements might require specified darkness in onset /r/ and coda /l/ and clearness in coda /r/ and onset /l/ (or vice versa), maximising

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the surface liquid contrasts. Presumably such a phonology might be prone to diachronic change (as any phonology) due to the phonologisation of coarticulatory effects with adjacent segments (vowels in particular), resulting in one or more liquid variants becoming phonologically underspecified, as Latin onset /l/.

Clear resonance in both geminates is the only instance where both liquids have the same resonance specifications on the surface. This is presumably the result of the increased duration available for the listener to perceive the perceptual divergences, which appear to have been sufficient for liquid polarity to be relaxed at a surface phonological level.

8. Conclusions

We argue that a chronologically sensitive investigation of all the processes in which /r/ was involved from prehistoric to imperial Latin constructs a fascinating picture, both from synchronic and diachronic perspectives. Latin /r/ was realised in categorically different ways in onset and coda positions up to the first century BC, mirroring the behaviour of Latin /l/ in a ‘liquid polarity’ effect to maximise the perceptual contrasts between (i) onset and coda liquids, and (ii) lateral and rhotic liquids: /l/ was dark and /r/ was clear in codas, and /r/ was dark and /l/ was underspecified for tongue body position in onsets. Liquid resonance in /r/ was aided through the selection of rhotic type. This reconstructed picture showing an interaction between liquid polarity and positional contrast is corroborated by similar findings in present-day English varieties (Carter & Local 2007), but with the added confound of rhotic type. However, the possibility of such behaviour in liquids is rarely investigated elsewhere, and it is hoped that the pattern revealed here through rhotic-and lateral-sensitive processes may inform future studies in historical liquid behaviour in any language.

The low F3 characteristic of many rhotics conditioned the earliest changes found in prehistoric Latin (labialised fortition of coronal fricatives), although even then, an

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asymmetry in the behaviour of onset and coda /r/ indicates a difference in their articulations: only coda /r/ triggered total progressive assimilation, a phenomenon found in only a small number of other instances in Latin in the face of the standard regressive assimilation in voice, place, and continuance. We therefore reconstruct for this time an approximant /r/ in onsets and a trill /r/ in codas, where the latter's perceptual robustness caused the unusual assimilation pattern. At the next stage, archaic Latin, onset /r/ remained an approximant, as shown by intervocalic rhotacism, whose 'dark' resonance was implemented through a low F1 (since F2 would have provided a poorer contrast with onset /l/, whose F2 could be contextually lowered) which resulted in the conditioning of a preceding vowel as lower than otherwise expected in the environment. That this effect was even seen with further restrictions (possibly back vowels only) in initial syllables, which were stressed at this time, demonstrates the extent to which onset /r/ was dark with distributed acoustic and articulatory features, in a fashion similar to coda /l/ (which also affected stressed initial syllables). Its dark resonance also conditioned the epenthetic or metathesised vowel as lower than otherwise expected as a result of hypocorrection, the treatment of the phonetic lowering as phonological. Finally, onset /r/ failed to partake in any of the strikingly opposite effects caused by coda /r/.

Coda /r/ in archaic Latin was clear, with low F1 and high F2 relative to onset /r/. Just as onset /r/ did not cause any of the same effects as coda /r/, the latter also did not cause any of the archaic effects discussed above. Instead, coda /r/ triggered fronting and raising of a preceding vowel, whereas onset /r/ caused lowering. The fronting effect (signalling high F2) was supported by a preceding /w/ (low F2), and was thereby brought about by both hypo- and hypercorrection; in both fronting and raising, coda /r/ patterned unambiguously with other coronal consonants. Furthermore, coda /r/ behaved like a coronal plosive (*ts ds > ss) in total regressive consonantal assimilation rs > ss, and was perceptually similar enough to coda /d/ for it to be misanalysed as /r/ before labiodentals/-velars. All of these indications suggest a coronal tap allophone of /r/ in coda

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position in archaic to early Latin, in contrast with the dark onset approximant, and the dark coda lateral. The change of coda *s and *n > /r/ in some contexts is compatible with a tap realisation.

From the first century BC, coda /r/ again changed in its articulation, also becoming an approximant, like onset /r/, and resulting in pre-coda-/r/ vowel lengthening, and lowering /e/ > /a/ before either onset or coda /r/ in imperial times. This suggests a very dark rhotic in all positions, with high F1, which is best interpreted as a back, ‘molar’ approximant. This change resulted in the erosion of the positional liquid resonance contrast, and the liquid polarity effect (with the only non-dark variants of any liquid coming in onset /l/ before /i/, and geminate /ll/). The coda variant therefore underwent the expected lenition cline trill > tap > approximant over several centuries. Finally, a few centuries later in the second century AD, approximant /r/ in both positions became the coronal trill known from the grammarians’ statements through a type of fortition; this may have come about first through a uvular trill given the similarity in tongue body position between this and the molar /r/.

Examining all the processes in which /r/ was involved has for the first time permitted us to build a picture of the surface contrasts in which /r/ partook at several periods, and reconstruct the story of its development, which has never yet been fully articulated. The synchronic and diachronic analyses are supported by known sub-phonemic types of phonological contrast (syllable position and liquid polarity), as well as well-researched acoustic effects based on well-known articulatory variants of rhotics, and finally by plausible historical changes based on those phonetic facts. It is conceivable that such a methodology may reveal liquid behaviours in the histories of other languages that are worthy of further investigation.

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Corresponding addresses

Dr Ranjan Sen
School of English, University of Sheffield
Jessop West, 1 Upper Hanover Street
Sheffield
S3 7RA
ranjan.sen@sheffield.ac.uk

Dr Nicholas Zair
Peterhouse
Cambridge
CB2 1RD
naz21@cam.ac.uk

French summary

Les différentes modifications phonétiques en latin qui impliquent à la fois voyelles et consonnes, mais qui sont sensibles à /r/, peuvent s'expliquer si on reconstitue un contraste positionnel entre 'clair' et 'sombre' de /r/, motivé par l'effet de polarité liquide, qui est rarement évoqué. L'examen de l'ensemble de ces processus diachroniques nous permet de prendre du recul ; il nous fournit aussi les éléments pour reconstruire des anciens états synchroniques successifs. Le comportement du /r/ en latin reproduit celui de /l/, mais dans l'autre sens, jusqu'au 1^e siècle avant JC : dans les codas, le /l/ était sombre alors que le /r/ était clair, mais dans les attaques, le /r/ était sombre tandis que le /l/ était sous-spécifié dans la position de la masse de la langue. La qualité sombre du /r/ était en partie mise en œuvre par la sélection du type de /r/ : l'attaque sombre était spirante et la coda claire était battue. Plus tard, le /r/ coda devint une approximante, comme le /r/ attaque, et par la suite les deux rhotiques sont devenues vibrantes, comme les grammairiens le rapportent, avec pour résultat l'érosion du contraste positionnel et de l'effet de polarité liquide.

German summary

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Scheinbar unterschiedliche Lautwandel im Lateinischen, die sowohl Vokale als auch Konsonanten in der Präsenz von /r/ betreffen, sonst aber keine offensichtlichen Gemeinsamkeiten aufweisen, können durch die Rekonstruktion eines positionsbedingten hell/dunkel Kontrasts von /r/ erklärt werden und haben ihre Ursache in dem selten erwähnten ‘*liquid polarity effect*’. Eine gemeinsame Untersuchung dieser unterschiedlichen diachronischen Prozesse ermöglicht es, größere Zusammenhänge zu erkennen, da sie Belege für die Rekonstruktion von aufeinanderfolgenden früheren synchronen Stadien erkennen lässt. Lateinisch /r/ verhält sich bis zum ersten Jahrhundert v. Chr. spiegelbildlich zu Lateinisch /l/: am Silbenende war /l/ dunkel und /r/ hell, während /r/ im Anlaut dunkel war, /l/ dagegen unbestimmt für die Position des Zungenrückens. Dunkles /r/ wurde teilweise durch die Wahl der Artikulationsart gekennzeichnet: als dunkler Approximant im Anlaut und als heller *tap in* der Silbenkoda. Später wurde /r/ im Auslaut wie auch /r/ im Anlaut zu einem Approximanten und anschließend, wie von den Grammatikern berichtet, wurden beide /r/-Typen zu Vibranten, was sowohl die Beseitigung des Positionskontrasts als auch den *liquid polarity effect* zur Folge hatte.