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How rarities like *gold* came to exist: on co-evolutionary interactions between morphology and lexical phonotactics[1]

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We address the question of when, how and why highly marked rhymes of the structure VVCC (as in *gold*, *false* or *bind*) came to be established in the lexical phonotactics of English. Specifically, we discuss two hypotheses. The first is that lexical VVCC clusters owe their existence to the fact that similar rhyme structures are produced routinely in verbal past tenses and third-person singular present tense forms (*fails*, *fined*), and in nominal plurals (*goals*, *signs*), The other is based on the insight emerging in morphonotactic research (Dressler & Dziubalska-Kołaczyk 2006) that languages tend to avoid homophonies between lexical and morphotactically produced structures. We hold both hypotheses against a body of *OED* and corpus data, reconstruct the phases in which the lexical VVCC rhymes that are still attested in Present-day English emerged, and relate them to the phases in which productive inflectional rules came to produce rhymes of the same type. We show that the emergence of morphotactic models is indeed likely to have played a role in establishing VVCC rhymes in the English lexicon, since VVCC rhymes of the types VV[sonorant]/d|z/ began to establish themselves in lexical phonotactics at the same period in which they also started to be produced in inflection, and clearly before similar types that had no inflectionally produced analogues (i.e. VV[sonorant]/t|s/ as in *fault*, *dance*). At the same time, we show that this does not necessarily contradict the hypothesis that homophonies between lexical and morphotactic rhymes are dispreferred. We argue that under the specific historical circumstances that obtained in English, natural ways of eliminating the resulting ambiguities failed to be available. Finally, we show that, once the phonotactically and semiotically dispreferred VV[sonorant]/d|z/ rhymes had been established, the emergence of morphotactically unambiguous rhymes of the types VV[sonorant]/t|s/ was to be expected, since they filled what was an accidental rather than natural gap in the phonotactic system of English (see Hayes & White 2013).

1 Introduction

Accounting for the emergence and the historical stability of words such as *gold*, *bind*, *mount*, *fault*, *ounce* or *false*, this article addresses the general problem of how and why individual languages adopt and retain phonological structures that (a) appear to be generally rare and (b) appear to be so for intuitively plausible reasons involving, for

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example, phonetic difficulty. The words mentioned above represent the problem in that their rhymes consist of long vowels or diphthongs followed by sonorant–obstruent clusters, which represent a subset of VVCC rhymes. VVCC rhymes occur only in a minority of the world's languages, and it is widely assumed that their rarity is due to perceptual difficulties. Nevertheless, English has them, and this calls for a special explanation.

This study focuses on words with VV–sonorant–obstruent rhymes[2] attested in present-day English Received Pronunciation (RP),[3] and approaches the question of why they exist from a diachronic perspective. Our approach reflects an understanding of languages as inherently historical – or evolutionary – systems of mentally instantiated constituents (in our case specific rhyme patterns), which 'exist in a language' when they are shared by a minimal number of speakers. Since being shared implies having been transmitted, the existence of linguistic constituents depends on their being expressed faithfully and frequently enough in linguistic discourse to be successfully recognised and acquired. In that sense, we regard constraints on articulation and perception, as well as constraints on learnability and cognitive processing as amounting, in their combination, to constraints on the transmission of linguistic constituents.

Distinguishing between rhyme patterns as mental constituents of phonological knowledge on the one hand, and their phonetic expressions in discourse on the other, naturally implies a multilayered architecture of phonology, and within such a multilayered system we take the words we deal with, i.e. words such as *gold*, *bind*, *mount*, *fault*, *ounce* or *false*, to be represented with VVCC rhymes at the deepest lexical level, i.e. at a level that would be taken to host underlying representations in Lexical Phonology (Kiparsky 1982a, 1982b) or lexical inputs in Optimality Theory (see Prince & Smolensky 2002). Thus, the questions that our article addresses are

[2] Other VVCC rhymes attested in Present-day English end in /st/ and occur in words such as *oust*, *most*, *heist*, etc. We have decided against including them in what we hope to be a coherent historical account, as the specific processes involved in their emergence differ in too many respects from those responsible in the cases of *gold*, *bind*, *mount*, etc. We shall nevertheless refer to VV/st/ cases at various points in this article, since they may be at least indirectly involved in some episodes in the development of the rhymes we focus on.

[3] Selecting the Present-day English standard and RP as a starting point for a backward-looking enquiry might be taken to reflect the kind of 'standard bias' that has often informed simplified and distorted views of the history of English. We are, however, well aware that the present-day standard in its Southern English variant does not represent the only variety of English and does not have a mono-linear history either. Nevertheless, it does represent one variety of English, and in the accent associated with this particular variety words ending in VVCC rhymes happen to be attested. Since we address the question of how and why 'unexpected' rhyme patterns can emerge in the lexical phonotactics of a language, focusing on one variety or accent strikes us as legitimate.

Also, for each VVCC item attested in the phonology of a variety such as the English standard, it is possible to identify an earliest counterpart attested in one of the historical varieties of which we have written evidence. Of course, that variety may not be the one from which the present-day forms 'actually derive'. We regard it as legitimate, however, to take first-attestation dates as roughly indicative of the period in which they entered the 'pool' of varieties of English, including the ones to which the PDE words go back and regardless of how multi-stranded and interwoven the pathways of transmission may in fact have been.

Therefore we refer to alternative developments only in passing, if at all, and only to make clear that the developments reflected in the standard variety were not inevitable.

the questions of when, how and why VVCC rhymes emerged in the mental lexica of speakers of English, and how and why they have been successfully transmitted since.

Our own theoretical roots are in Natural Phonology (see e.g. Stampe 1979; Dressler 1985, 1996; Dziubalska-Kołaczyk 2009) on the one hand, and in Evolutionary Phonology (see e.g. Blevins 2004; Ritt 2004) on the other. That is to say, we think of phonological knowledge, or competence, as reflecting 'grammar-external' constraints on speaker physiology and psychology, just as Natural Phonologists do, but at the same time we regard the historicity of language as its most fundamental property and therefore think of external constraints on phonological constituents ultimately as constraints on their transmission, or replication. Nevertheless, we shall make repeated reference in this article to concepts and arguments developed in other schools of phonological thought, such as Optimality Theory or CV Phonology, to the extent they are relevant to the questions we address.

In the following sections of this article, we first identify and discuss the reasons why VVCC rhymes are typologically rare. Next we turn our attention to words attested in Present-day English Received Pronunciation with VV–sonorant–obstruent rhymes, and sketch the historical sequence in which they emerged. We do this (a) on the basis of their first attestations in the *Oxford English Dictionary* and (b) by taking the historical development of their segmental constituents into account.

We then discuss the hypothesis that VVCC rhymes have come to be established in lexical phonotactics because morphological processes created word forms of the same structure. This started to be the case when, after Middle English schwa loss, past tense and participle forms like [mɔ:nd] *moan+ed* or [faɪld] *fail+ed*, and present tense forms and noun plurals like [saɪlz] *sail+s* or [bɔ:nz] *bone+s* emerged.

Although we show that lexical VV/(n|l)d/ rhymes (as in [tʃi:ld] *child* or [hu:nd] *hound*) may indeed have been stabilised by the frequent occurrence of morphologically produced counterparts, we argue against the more general hypothesis that segment sequences will get licensed in lexical phonotactics when they are frequently produced morphologically. Instead, we follow a proposal by Dressler & Dziubalska-Kołaczyk (2006), elaborated in Dressler, Dziubalska-Kołaczyk & Pestal (2010), who point out that languages normally tend to avoid homophonies between phonological structures that occur within simple morphemes and phonological structures that are produced through morphological operations such as concatenation (We henceforth refer to the former as 'lexical' and to the latter as 'morphotactic'.)

Therefore, we suggest that the rising frequency of morphotactically motivated VVC+/(z|d)/ words first merely increased the expectability of the relevant rhyme structures, and made them both easier to recognise and indicative of morphological complexity. Unavoidably, however, this also facilitated the perception of homophonous sequences that were not morphological in origin but reflected different processes. In English, this applied to the outputs of vowel lengthening before homorganic clusters like [nd] or [ld] (as in *bind* or *child*). Being successfully perceived and phonologically parsed as VV/(n|l)d/ rhymes while being unamenable to morphological analysis, these were then interpreted as lexically underlying. Although the resulting homophony

between lexical and morphotactic VV/(n|l)d/ rhymes was semiotically suboptimal, competing variants that would have done better in that respect were not (and, as we argue below, could not be) produced by morphological or phonological changes. Thus, the establishment of VV/(n|l)d/ rhymes in English phonotactics became the frozen result of very specific historical circumstances.

We also suggest that a distinction needs to be made between VV/(n|l)d/ rhymes on the one hand, and all other extant VV[sonorant][coronal] rhymes on the other. It was only after the former were established in lexical phonotactics, that an 'accidental gap' in the phonotactic system was created, which subsequently came to be filled by words with rhymes like VV/nt/ (as in *mount*), VV/lt/ (as in *halt*), or even VV/ns/ (as in *ounce*) and VV/ls/ (as in *false*). VV/(n|l)d/ rhymes being already established, the new structures could be accommodated in lexical phonotactics because they were (a) perceptually less problematic and (b) morphotactically unambiguous.

2 Outlining our hypotheses

2.1 What it is that makes VVCC rhymes unlikely

Why exactly are lexical VVCC rhymes unexpected? First, the number of languages whose lexical phonotactics allow them is indeed small: according to the *World Atlas of Language Structures* (*WALS*; Maddieson 2013), 61 of 484 (i.e. 13%) documented languages do not admit consonantal codas at all, while in 274 (57%) languages codas with at most a single consonant may occur. Only 151 (31%) languages allow complex syllables, whose codas may contain more than one consonant. However, *WALS* counts also those syllable structures that are brought about through morphological operations, as in English '*strengths*, when pronounced /stɹɛŋkθs/' (Maddieson 2013). Since morpheme-internal phonotactics are more restrictive than the phonotactics of wider phonological domains, this means that the proportion of languages that admit complex codas in lexical morphemes must be considerably lower than the 30 per cent mentioned in WALS. Thus, their rarity can count as safely established (see also Jakobson 1962: 526; Clements & Keyser 1983: 29, 133). However, it is not only the case that complex codas are rare as such, they are even rarer after long vowels or diphthongs, which are in turn rarer than short vowels.[4] This implies that languages like English, which allow lexical entries like *gold* or *false*, are few and far between. Why is this so?

In theories such as CV phonology (Clements & Keyser 1983), Government Phonology (Kaye, Lowenstamm & Vergnaud 1990), or Strict CV Phonology (e.g. Scheer 2004), the unexpectedness of any sequence other than CV follows from assumptions about the organisation of phonological competence. While this is not the place for reviewing the proposals in any detail, it seems that their models, in many of which any patterns attested in the surface structures of word forms are invariably derived

[4] While all 451 languages documented in UPSID, i.e. the UCLA Phonetic Segment Inventory Database, contain short vowels, only 11.3 per cent contain long vowels, and 10.64 per cent diphthongs.

from underlying CV sequences, express adequate and powerful generalisations about sound patterns attested in natural languages, and this might suggest that a preference for such structures is entrenched in the human language faculty. Similarly, Optimality Theory (Prince & Smolensky 2002) quite explicitly assumes innate constraints that in their combination select against any other sequence than CV. Examples are *NOCODA (selecting against CVC sequences), *NOLONGVOWELS (selecting against VV sequences), *NOCOMPLEXCODA (selecting against CC codas), or *SUPERHEAVY (selecting against rhymes containing more than two elements).

However, while it can certainly not be ruled out that the human mind has evolved a bias against complex rhyme sequences, and that models of phonological competence should therefore incorporate it, it is also possible to explain their rarity without making such a strong and specific assumption. It is sufficient, in our view, to take into account that, like any phonological constituent, also rhyme structures need to be transmitted in order to become firmly established in a language.

In order to be transmitted, phonotactic structures need to be articulated, produce acoustic signals and then be inferred from the auditory cues that those signals contain. As is widely known, the acoustic expressions of consonants are perceived most easily against a vocalic background (see e.g. Wright 2004: 43–6). Furthermore, the specific acoustic cues from which the specific types of articulatory constriction involved in the expression of consonantal segments can be inferred are perceived most strongly in the signals that are created when consonantal constriction is released (ibid.), so that prevocalic consonants are recognised more easily while 'word final and preconsonantal consonants are ... poorer vis-à-vis the cues for auditory perception' (49). Taken together, this means (a) that sequences in which vowels and consonants alternate strictly will be transmitted more reliably than other sequences, and (b) that sequences in which consonants precede vowels will be transmitted more reliably than sequences in which they follow them. In their combination these constraints represent a strong selection bias against sequences that end in consonantal clusters (see also Vennemann 1988).

As far as the rarity of long vowels is concerned, it seems to be established that not all languages make a phonological distinction on the basis of length contrasts, and where there is no such distinction there cannot be a class of phonologically long vowels either – although this does not necessarily imply anything about the duration of their phonetic expressions, of course. So, what actually needs to be explained is the rarity of phonological long–short distinctions, and this is fairly easy to understand: the transmission of distinctive length contrasts requires their expression in terms of durational differences. Since duration is a scalar property and usually also influenced by factors such as speech tempo, rhythm and context, categorical distinctions based on phonological length are difficult to recover from durational cues in the speech signal, and this explains why length-based distinctions between vowels cannot be found in all languages.

More important for our purposes, however, is the fact that even in languages which do distinguish between short and long (or diphthongal) vowels, long vowels and diphthongs rarely occur before complex codas. Plausible reasons for this are again based on both articulation and perception. Thus, the effort involved in the production of two consonants

may reduce the energy available for the articulation of the preceding vowel gesture, and vice versa: it is well documented that the duration of syllabic sequences does not rise in proportion to the number of segments it contains, but that the more segments there are, the smaller will the amount of time allocated to the pronunciation of each single one of them be (see e.g. Fowler 1996: 542; Lyberg *et al.* 1981). At the same time, the duration of a vocalic signal may also be perceived as relatively short in the immediate context of a relatively long consonantal stretch, and vice versa. Context-induced contrast effects on perceived size and/or intensity have been known since the days of John Locke (1690). Together, these factors may explain why consonant clusters are transmitted less well after long vowels or diphthongs than after short vowels, and, conversely, why long vowels are transmitted better when they are followed by just a single, short consonant.

In short, there are good articulatory and perceptual reasons why monomorphemic words whose lexical representations end in VVCC are comparably difficult to transmit among speakers and are therefore rare in the world's languages. Whether, like Blevins (2004), one is satisfied with historical (or cultural-evolutionary) explanations like the ones just given, or whether one prefers to assume that human genomes have internalised, in the evolution of the species, corresponding cognitive biases (as held in generative theories, such as Optimality Theory, strict CV Phonology, etc.), is very much a matter of speculation, given how little we actually know about the human brain and its genetic basis. What matters, however, is that for ultimately physiological and physical reasons, words ending in VVCC are difficult to transmit and have, therefore, established themselves in very few actual languages. Thus, the existence of words such as *gold*, *halt*, *blind*, *mount* or *false* is indeed remarkable, and implies that the constraints otherwise selecting against them must be outweighed by other factors.

2.2 Morphology as a source of phonologically unexpected patterns: a good idea and a caveat

Apart from the remarkable fact that they exist at all, another striking fact about the lexical VVCC rhymes in Present-day English is that they all end in coronal obstruents. As has been long and widely known (for a good survey see Paradis & Prunet 1991, and the references therein), coronals seem to be special among consonants in a number of respects. For instance, they appear to be more frequent than other consonants, in any series their existence in a language is implied by the existence of non-coronal counterparts (e.g. /k/ or /p/ imply /t/, /m/ or /ŋ/ imply /n/, /f/ or /x/ imply /s/, etc.), and their phonotactic distribution within languages is typically less constrained than that of other consonants. In theories that employ such terms, coronals are regarded as 'unmarked', or comparably little 'dispreferred'.[5] Against this background, it may therefore not be surprising that the only consonants attested in English lexical VVCC rhymes are indeed coronal ones.

[5] But see Haspelmath (2006) on 'markedness' and Blevins (2004: 125–9) for arguments against assigning a special phonological status to coronals.

However, although VVCC rhymes ending in coronal clusters may be less surprising than VVCC rhymes ending in other clusters, the fact that the rhymes attested in English do happen to end in coronals does not in itself explain their existence. VVCC rhymes are still difficult to transmit, and the fact that the selection bias against coronal clusters seems to be comparably weak does not turn it into a positive bias, merely into a less negative one.

Trying to account for their existence, we therefore turn to another conspicuous quality of the rhymes in question, namely to the fact that they are not merely coronal but share that property with rhymes that get produced through regular morphological operations, namely in (a) verbal past tense forms such as *fail+ed*, *reel+ed*, *cool+ed*, *moan+ed*, *sign+ed* or *feign+ed*, (b) verbal third-person present forms such as *fail+s*, *reel+s*, *cool+s*, *moan+s*, *sign+s* or *feign+s* and (c) noun plurals such as *sail+s*, *fool+s*, *wheel+s*, *loan+s*, *mine+s* or *crown+s*.

This correlation has often been noticed (e.g. Hall 2000) and has inspired hypotheses about a causal connection. Thus, Hogg & McCully (1987: 47) speculate:

> One interesting question ... is why only [+coronal] obstruents are permitted to appear in the R_4 [6] position. In earlier stages of English the final obstruents in words such as *climb* were indeed pronounced and their loss is to be dated round about the time of Chaucer. Examples such as Scottish *chiel* 'lad' perhaps suggest that dentals could be lost as well as labials and velars.[7] Consider in this respect, therefore, inflected forms in Modern English such as *weaned*. One of the oddities of English since around the time of Chaucer is that inflectional endings, if they do not contain a single syllable, as in the case of *-ing*, always contain (underlyingly) a single [+coronal] obstruent. It may be, therefore, that the type of syllable structure found in a word such as *wind* /waind/ has been protected through analogy with inflected forms such as *weaned*.

While Hogg & McCully's suggestion fits the example they give, they wisely refrain from proposing the generalised rule their discussion implies. And indeed, a proposition such as 'Lexical VVCC rhymes will (or even only: can) be historically stable if there exist morphologically produced analogues' does not seem to hold. First of all, the set of VVCC rhymes produced morphologically is not fully identical to the set of lexical ones. Thus, VV/nz/ (as in *moan+s*) and VV/lz/ (as in *sail+s*) are produced morphologically but never occur morpheme finally, while VV/nt/ (as in *mount*), VV/ns/ (as in *ounce*), VV/lt/ (as in *fault*) and VV/ls/ (as in *false*) are possible at the end of lexical morphemes, but are never produced by regular morphological operations.[8]

[6] The last position in a complex coda.

[7] They could indeed. *The Corpus of Narrative Etymologies* (Lass *et al.* (2013–) reports Middle English spellings such as *feon* 'fiend', *freon* 'friend', *hon* 'hand', *lon* 'land' or *shel* 'shield', which suggests that final coronal deletion must have been quite productive already in Early Middle English. Given that the type of variation it gives rise to is still widely attested in present-day varieties of English (Chambers & Trudgill 1998), the failure of the process to make it into a Neogrammarian sound change is remarkable (but see the arguments in section 4.2).

[8] Of course, there are morphologically complex forms such as *burnt* [bɜːnt], but they are not produced by regular past tense formation in Present-day English. Therefore, we think of them as lexically stored just like morphologically simple items (see e.g. Pinker 1999) and subject to stem-level constraints on their phonotactic structure. The same holds for past tense forms such as *felt*, *spelt*, *knelt*, *sent* etc.

Furthermore, there are many VVCC rhymes that are produced morphologically but nevertheless fail to occur within simple word forms. In the domain of {/z/}[9] and {/d/} suffixation they represent a clear majority. In fact, the rules produce only seven types of VVCC rhymes with lexical counterparts, namely

(1) VVf(+)t *craft – laugh+ed*
VVk(+)s *coax – peak+s*
VVl(+)d *bold – bail+ed*
VVn(+)d *wind – sign+ed*
VVp(+)s *corpse – rope+s*
VVr(+)d *beard – fear+ed*
VVs(+)t *moist – race+d*

and nineteen without (practically) any, namely

(2) VVb+d *robe+d*
VVb+z *robe+s*
VVd+z *seed+s*[10]
VVð+d *mouthe+d*
VVð+z *loathe+s*
VVf+s *laugh+s*
VVg+d *intrigue+d*
VVg+z *league+s*
VVk+t *peek+ed*[11]
VVl+z *goal+s*
VVm+d *seem+ed*
VVm+z *stream+s*
VVn+z *bone+s*
VVp+t *seep+ed*
VVt+s *goat+s*[12]
VVθ+s *bath+s*
VVv+d *bereave+ed*
VVv+z *leave+s*

Therefore, the prediction that phonotactic sequences produced through morphological operations will come to be licensed in lexical phonotactics is not borne out.

In fact, the existence of phonotactic sequences arising in speech through morphological processes can even be expected to disfavour, rather than support, the establishment of corresponding lexical structures. This hypothesis represents the core of the 'morphonotactic' research programme proposed by Dressler & Dziubalska-Kołaczyk (2006) and elaborated in Dressler *et al.* (2010) or (Zydorowicz 2007). They assume that the relationship between the phoneme sequences that a language allows

[9] For phonotactic purposes it makes no difference whether {/z/} represents the nominal plural or genitive, or the verbal third singular.
[10] Leaving aside the acronym *AIDS*.
[11] Leaving aside the extremely rare medical term *infarct* (whose final /t/ reflects a Latin participle ending).
[12] Leaving aside historical and possibly still partially transparent plurals such as *oats*.

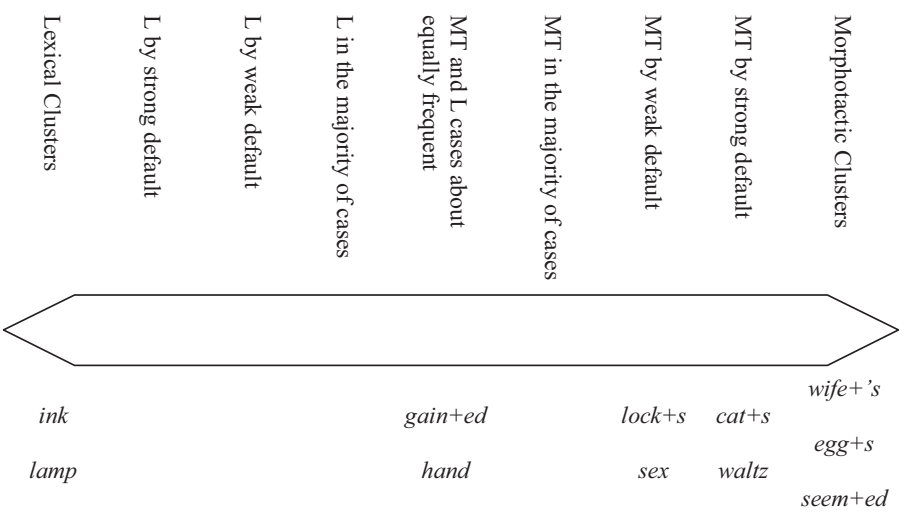


Figure 1. The morph(on)otactic cluster scale

lexically, and the ones that it produces through morphological operations is systematic and functional, and governed by domain-specific dynamics.

Focusing on consonant clusters, Dressler & Dziubalska-Kołaczyk (2006) observe that some of them occur exclusively in lexical roots, others occur exclusively across morpheme boundaries, and still others occur in both contexts. Clusters of the third type, which occur both within roots and across morpheme boundaries can be ordered on a scale according to the relative frequency of their lexical and morphotactic occurrences. Some clusters are lexical by strong default, others morphotactic by weak default, still others frequent both morpheme finally and across boundaries, and so on. Figure 1 illustrates the idea with final two-consonant clusters from Present-day English.[13]

As Dressler & Dziubalska-Kołaczyk argue, some predictions can be derived *a priori* about the distribution of clusters on the scale in figure 1. Thus, physiologically grounded biases against the transmission of specific phonotactic sequences should affect monomorphemic configurations more strongly than morphotactic ones. Compare, for example, the lexical cluster /nd/ in *land* to its morphotactic homophone in *gain+ed*: whenever *land* gets produced, its final [d] is invariably preceded by the homorganic nasal [n]. Since the contrast between [n] and [d] is small each of the two segments makes the other relatively difficult to perceive.[14] Therefore, morpheme-final clusters can be predicted to be relatively unstable, and the historical fate of /mb/ in *climb*, or /ng/ in *sing* appears to reflect this. In the past tense form *gain+ed*, on the other hand, the situation is different: here, the /n/ and the /d/ that make up the final /nd/ cluster do

[13] The examples are taken from Dressler & Dziubalska-Kołaczyk 2006. Their assumption seems to be that not all positions on the scale are filled in the case of English.

[14] For effects of acoustic signal modulation on the perceptibility of consonants in clusters see, for example, Kawasaki (1982), Côté (2000: 143).

not occur exclusively in each other's company. Instead, uses of *gain* will see the final /n/ in a variety of different contexts, and many of them will be more favourable to its clear perception. Also the /d/ in the past tense morph will often occur after segments with which it contrasts much better than with the /n/ of *gain*. Thus, the /n/ will remain stably represented in lexical *gain* and the /d/ will remain stably associated with the past tense morpheme. Being transmitted independently of each other, and being each associated with their own content, the constituents of morphotactic clusters should be less strongly affected by articulatory and perceptual constraints than their lexical counterparts. Therefore, the inventory of morphotactically produced clusters can be expected to include some that do not occur lexically.

At least for languages where the inventory of inflectional and derivational affixes is highly restricted, another prediction can be made (see Jakobson 1962). In such languages, lexical cluster types can be expected to be more numerous and more diverse than morphotactic ones. In English, for example, the inventory of purely consonantal inflectional and derivational suffixes includes only {[s], [z]}, {[d], [t]} and {θ}.[15] Thus, no morphological operations produce clusters ending in [p] [b], [m], [k], [g], [ŋ], [tʃ], [dʒ], etc., while such clusters occur quite frequently at the end of simple morphemes, as in *limp*, *bulb*, *elm*, *sink*, *ring*, *finch* or *singe*, for example. This means that such languages, if they admit clusters at all, are likely to include some that are exclusively phonotactic.

Together the two predictions imply a tendency for lexical and morphotactic consonant clusters to distribute complementarily, and Dressler & Dziubalska-Kołaczyk point out that this tendency lends itself to being utilised for semiotic purposes. According to them, 'prototypical morphonotactic clusters ... have the function of co-signalling the existence of a morphological rule' (2006: 83). They conclude that the ability of morphotactic clusters to invite morphological decomposition may be an additional motivation for their stability, and hypothesise that the natural likelihood of phonotactic and morphotactic clusters to distribute complementarily is likely to be further enhanced.

Morphotactic clusters *with* frequent phonotactic homophones, however, 'are hardly apt to co-signal the application of morphological rules (MRs) and ... may be liable to lose their internal morpheme boundaries in diachronic development' (2006: 72. Furthermore, clusters which are produced morphologically cause listeners to analyse them as compositional even when they are in fact lexical. This has been demonstrated in experiments by Post *et al.* (2008), which confirmed that

> any incoming string that shows the critical diagnostic properties of an inflected form – a final coronal consonant (/t/, /d/, /s/, /z/) that agrees in voicing with the preceding segment as in *filled*, *mild*, or *nilled* [16] – will automatically trigger an attempt at segmentation, [and showed that] any stimulus that can be interpreted as ending in a regular inflection ... is responded to more slowly than an unambiguously monomorphemic stimulus. (Post *et al.* 2008: 1)

[15] In ordinals and deadjectival nouns like *strength*, or *width*.
[16] A nonsense word created for the experiment.

In other words, there are good functional reasons for keeping morphotactic and lexical clusters apart, and they are in clear conflict with Hogg & McCully's hypothesis that the frequency of morphotactic VV/(n|l)[+coronal]/ clusters supported the emergence of lexical homophones in English. Rather than mutually stabilising each other, Dressler & Dziubalska-Kołaczyk would seem to argue, the lexical rhymes and their morphotactic counterparts would have made it difficult for each other to be inferred from speech data, and should not stably coexist in grammars.

2.3 A slightly more complex proposal

As we shall show, there is a way in which both Hogg & McCully's intuition and Dressler & Dziubalska-Kołaczyk's observations are helpful for understanding the way by which VVC[+coronal] rhymes in the lexical phonotactics of English came about. However, the mechanics by which morphologically produced VVC[+coronal] rhymes came to facilitate the establishment of corresponding forms in the lexicon were less than straightforward and can certainly not be simply understood as the 'lexicalisation' of structures that were frequent on the surface.

Instead, the frequency of morphotactic VVC[+coronal] rhymes first merely made such sequences more 'expectable' in the surface realisations of phonological words, and this helped their constituent segments to be perceived and recognised more readily. Crucially, however, the establishment of morphologically created VVC[+coronal] rhymes in phonological words would have increased the perceptibility of *all* word final VVC[+coronal] sequences – even when they did not, actually, involve inflectional suffixes. In English, such non-inflectional [VVC][+coronal] sequences happened to be produced (a) in the nouns ME *freend* 'friend' (< OE *freond*) and ME *feend* 'fiend' (< OE *feond*), which in Old English were still relatable[17] to the verbs *freogan*, 'to love' and *feogan* 'to hate' and (b) through the lengthening of short vowels before homorganic clusters such as /nd/ or /ld/ (as in [huːnd] from lexical /hund/ 'hound', [tʃiːld] from lexical /tʃild/ 'child').[18] Being easily perceived and phonologically parsed as ending in VVC[coronal] rhymes while *not* being analysable as inflected word forms, such word forms were then interpreted as faithful reflections of lexically underlying structures.

While the morphotactic ambiguity that was thereby created among surface word forms would unavoidably have posed processing difficulties of the type detected by Post *et al*., none of the potential variants of the new VV/(n|l)d/ words that phonological or morphological changes could plausibly have produced would have done much better in

[17] The origin and the status of the relation between the nouns *freond* and *feond* and the verbs *freogan* and *feogan* are difficult to reconstruct with certainty. Both participles and nominal *-nd-* stems seem to be related to originally adjectival possessives. Additionally, in various Indo-European languages participles are known to have been nominalised, while nominal stems have yielded verbal back formations (including participial forms in their paradigm). All that matters for the present discussion is that in Early English, both nouns and verbs existed and that the semantic relation between them was still transparent.

[18] Possibly also before /mb/ (as in [kliːmb] from lexical /klimb/ 'climb') and others; see e.g. Minkova & Stockwell (1992), but see Minkova (2014: 166–7) for arguments why /mb/ may never have been a lengthening cluster.

this regard (see section 4.2 for a more detailed discussion). Therefore, the transmission of VV/nd/ words could not easily be avoided.

Thus, we show that Hogg & McCully's proposal is ultimately plausible, and that the stability of lexical VV/(n|l)d/ rhymes was indeed due to the existence of morphotactic patterns of the same shape, even though the resulting ambiguity may indeed have been communicatively suboptimal, as Dressler & Dziubalska-Kołaczyk argue with equal justification. However, it was only in combination with other factors and in specific historical circumstances that the establishment of {/d/} and {/z/} as regular inflectional suffixes came to support and stabilise the existence of [VVC][coronal] rhymes in the English lexicon.

Apart from explaining the establishment of VVC[coronal] rhymes in the English lexicon, we also show that it proceeded in distinct phases involving different subtypes. The first lexically attested VVCC rhymes were VV/nd/ and VV/ld/,[19] and it was their emergence that came about in the way just sketched. In a second phase, i.e. after VV/nd/ and VV/ld/ rhymes were lexically established, words came to be integrated in the lexical phonotactic system which ended in VV/nt/, VV/ns/, VV/lt/, and VV/ls/. We suggest that this was likely to happen, because the existence of VV/nd/ and VV/ld/ words had prepared the phonotactic system for accommodating them. Compared to VV/ld/ and VV/nd/, they were perceptually easier and morphotactically less ambiguous. Thus, when VVCC rhymes that ended in sonorants followed by voiced coronal obstruents had established themselves in the lexicon, the absence of counterparts with voiceless final obstruents came to represent an 'accidental' gap in the lexical phonotactics of English (see Hayes & White 2013), but no longer reflected a conventionalised, categorical constraint against them. When the occasion arose, the accidental gap was filled, and words such as *constraint*, *default*, *announce*, or *false* became current, and finally also words established themselves in which long vowels or diphthongs were followed by [sononant]/(t)ʃ/ or [sonorant]/(d)ʒ/ clusters, such as *range*, *strange*, *staunch* or *launch*.

Indicatively, and very much in line with Dressler & Dziubalska-Kołaczyk's predictions, these later arrivals were not only phonologically more preferred than the VV/nd/ and VV/ld/ types that had paved their way, but they were also morphotactically unambiguous: no productive morphological rule produced VV/n+t/, VV/n+s/, VV/l+s/, VV/n+ʃ/, or VV/n+ʒ/. At the same time, VV/nz/ and VV/lz/ rhymes – which were of course frequently produced morphologically – failed to establish themselves in the lexicon.

3 Reconstructing the emergence of VVCC rhymes in the English lexicon

3.1 Collection and classification

In terms of data, our article rests on a relatively coarse-grained survey of the periods in which Modern English words ending in bimoraic vocalic nuclei (VV) followed by

[19] And VV/rd/, which we do not discuss, because it has not survived as a VV/rd/ rhyme in RP (see also section 3.1).

sonorant–obstruent clusters were first attested.[20] We excluded clusters containing /r/ as a sonorant, because (a) we took Present-day English Received Pronunciation as our starting point, where /r/ has been fully vocalised or lost before obstruents, and because (b) in the varieties where pre-consonantal /r/ still exists it is realised as a highly vocalic allophone and additionally has a length neutralising effect on preceding nuclei (Labov, Ash & Boberg 2006: 14–15), so that the rhymes involving it do not unambiguously constitute VVCC rhymes anymore. As far as final obstruents are concerned we focussed on /t/-/d/ and /s/-/z/, because clusters built with the voiced members of the pairs (i.e. /n+d/, /n+z/, /l+d/ and /l+z/) are also produced by suffixation, while clusters ending in voiceless /t/ and /s/ (i.e. /nt/, /ns/, /lt/ and /ls/) are not. Of these eight clusters /nz/ and /lz/ are lexically unattested,[21] and as we shall see (section 4.3) this is indicative. We were therefore left with six rhyme types, namely VV/nd/, VV/nt/, VV/ld/, VV/lt/, VV/ns/ and VV/ls/.[22] The sample of actual words was derived from the latest *Longman Pronunciation Dictionary* (Wells 2008), because it comes, conveniently, with a phonetically searchable CD.

We found a total of 621 items, which included both rather common words (such as *ground*, *wound*, *kind*, *command*, *plant*, *aunt*, *faint*, *pint*, *mild*, *hold*, *field*, *bald*, *salt*, *malt* or *false*) and a substantial number of more peripheral items, such as *hind* 'female deer', *purblind*, *wont* 'be likely to do something', *catamount* 'panther', *cuckold*, *mangold*, *cobalt* and *waltz*.[23]

In a next step, we attempted to determine when the words emerged in the English lexicon. For that, we relied on the first-attestation dates given in the online *OED*. We were of course perfectly aware that this would give us only a *terminus post-quem*, and no more than a rough estimate, but there simply is no way of estimating the age of an English word that provides a better balance of accuracy and efficiency.

One issue that we did have to deal with, however, was that the *OED* does not commit itself on the phonological shapes which words had at specific dates, although it is of course explicit about attested spelling variants. In our case, the problem was particularly relevant for words ending in /nd/ and /ld/, because although many of them are of common Germanic origin, they acquired their VVCC rhymes only through a sound change known as Homorganic Lengthening. Examples are *bind*, *ground*, *cold*, *field,* but also *comb* and others. The sound change lengthened short vowels before clusters of sonorants and voiced obstruents with identical or at least very similar places of articulation. Homorganic Lengthening represents one of the least well understood sound changes in the history of English, and its dating is insecure. Although the changes

[20] We thus excluded the very limited set of items rhyming in /ps/ and /ks/, which includes *corpse*, *traipse*, *coax* or *hoax*.

[21] Except in proper names (e.g. *Fowles*, *Heinz*).

[22] Since we considered our sample to be sufficient for studying the role of morphology–phonology interaction in the emergence of lexical VVCC in English, we also excluded words ending VV/n(t)ʃ/ such as *launch*, *staunch*, or VV/n(d)ʒ/ such as *strange*, *range*, or *lounge* from our systematic survey. They are referred to at relevant points in our interpretative account, however.

[23] We also counted lexicalised derivations such as $wound_N$ and $wound_V$, and compounds such as *mankind* as separate items, so that the total number of 621 might be somewhat inflated.

have been known since the early days of historical English phonology (see e.g. Luick 1914–21) and repeatedly investigated (e.g. Minkova & Stockwell 1992; Ritt 1994; Fulk 1998; Wełna 1998, 2000; Minkova 2014), all that can count as safely established is that they were never implemented as categorical Neogrammarian sound changes. Instead, they seem to have led to sporadic, item-based replacements of underlying vowels (thus the verb *wind* came to have a lexically long vowel, while the noun *wind* kept its short one). The earliest unambiguous evidence of Homorganic Lengthening is from the *Ormulum* (twelfth century) (Anderson & Britton 1997 and 1999), but it is hard to say which stage in the change it reflects.[24] Having to make an assumption for the period during which lengthened vowels were established in the lexical representations of the words that eventually kept them, we settled for the thirteenth century.

Another sound change by which words came to assume VVCC structures although they had not had them earlier reflected a breaking process. The change diphthongised back vowels before word-final or pre-consonantal /l/ in words such as *hall* > *haul*, *fals* > *fauls*, *bolt* > *b*[ou]*lt* or *folk* > *f*[ou]*lk*.[25] Although the diphthongs did not always remain stable, the bimoraic nature of the nuclei did (and before coronals, the /l/ remained stable as well). Compared to Homorganic Lengthening, the sound change is dated fairly uncontroversially in the fifteenth century (Jones 1989; Brunner 1960; Luick 1914–21; Flasdieck 1954), and that is when we shall take words such as *salt*, *false* or *bolt* to have assumed VVCC structures.

On the basis of these decisions we adjusted the first-attestation dates given in the *OED*. Table 1 below lists the result of our survey. As each of the columns is read downwards, the number of words with the relevant rhyme types increases, because words first attested in each century are added to the previously existing ones.

Table 1 shows that words with VVCC rhymes did not emerge in significant numbers before the thirteenth century, but have become continually more frequent since. It also suggests that words ending in the voiced obstruent /d/ emerged earlier and have remained more numerous than words ending in /t/ or /s/. This comes across more clearly in figure 2.

Suggestive as these numbers appear at first sight, however, their significance needs to be ascertained for two reasons. First, when one starts with a complete set of words attested in a language at a particular stage and moves into the past in incremental steps

[24] We refer here to Bermúdez-Otero's (2014) suggestion that phonological processes undergo a 'life cycle'. They start out as optional and phonetic, then get phonologised and become categorical first on the phrase level, then on the word level and eventually on the stem level. Finally, they may lead to a reinterpretation of lexical underliers, thereby bleeding themselves, so to speak. When it comes to the interpretation of scarce scribal evidence of Homorganic Lengthening, the fact that a vowel was marked as 'long' says little about the stage which the process responsible for its lengthening had reached.

[25] Of course, there are varieties of English in which the words underwent different developments, and even for many RP speakers the vowels in *false* or *salt* may nowadays be short. For the argument made here, however, it is not problematic to focus on a single variety of English. We do not intend to provide a comprehensive survey of lexical VVCC rhymes in the history of English, but address the much more specific question of how and why they emerged and became historically stable at all. For that purpose, we think, focusing on the development of any single variety is a reasonable strategy.

Table 1. *Emergence of lexical VV/(n|l)d/, VV/(n|l)t/, and VV/(n|l)s/ rhymes: lexical types per century*

	Rhyme types						
Centuries in which attested	*VVnd*	*VVld*	*VVnt*	*VVlt*	*VVns*	*VVls*	Total
before and incl. 10th	1	0	0	0	0	0	1
11th	1	0	0	0	0	0	1
12th	1	0	1	0	0	0	2
13th	47	67	20	3	8	0	145
14th	74	79	65	7	19	0	244
15th	84	88	77	27	25	1	302
16th	108	101	102	38	38	1	388
17th	125	112	125	43	38	1	444
18th	139	112	134	45	46	6	482
19th	176	132	156	54	54	8	580
20th	189	143	168	58	55	8	621

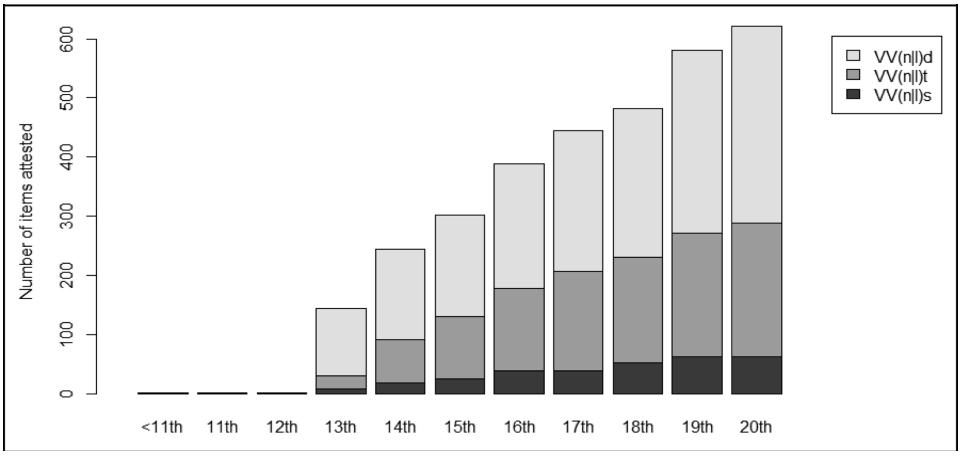
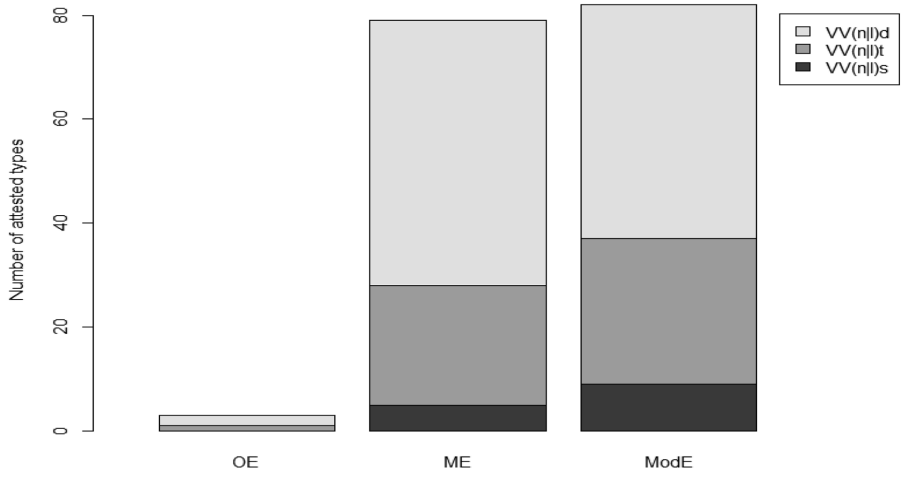


Figure 2. Emergence of lexical VV/(n|l)d/, VV/(n|l)t/, and VV/(n|l)s/ rhymes: bar chart
The respective trajectories of frequencies show a highly significant increase (Pearson's product–moment correlation, $p_d = 9.81 \cdot 10^{-8}$, $p_t = 4.89 \cdot 10^{-8}$ and $p_s = 6.19 \cdot 10^{-8}$). In each of the three cases the effect is large with $R = 0.98$.

to check how many of them were already there at each prior stage, it is to be expected that one will find fewer and fewer of them the further into the past one moves. This follows from the default assumptions that (a) no word has been around forever, and that (b) the range of word ages represented in any sample can be large. Thus, in order to make sure that the picture in figure 2 reflects a set-specific increase in the number of VVCC words rather than the expected base-line pattern, we carried out a search of the corresponding forms in three subsections of the *Helsinki Corpus of English Texts*,



	OE	ME	ModE
VV(n|l)d	2	51	45
VV(n|l)t	1	23	28
VV(n|l)s	0	5	9

Figure 3. Type frequencies of VV/(n|l)d/, VV/(n|l)t/, and VV/(n|l)s/ rhymes in *Helsinki Corpus* periods O4, M4 and E3

The number of attested types in the ME period is significantly larger than the type frequency in OE at a 5% significance level in each of the three cases (chi-squared goodness-of-fit for equal distribution, $\chi^2_s = 5$, $\chi^2_t = 20.17$, $\chi^2_d = 45.3$; $p_s = 0.02$, $p_t = 7.10 \cdot 10^{-6}$, $p_d = 1.69 \cdot 10^{-11}$). The respective effects are large (Cohen's w, $w_s = 1$, $w_t = w_d = 0.92$). Note that in the case of VV/(n|l)s/ rhymes the sample size is small.

namely sections O4 (1050–1150), M4 (1420–1500) and E3 (1640–1710). Figure 3 shows the results for attested types.

The picture derived from the corpus data corresponds very well indeed to the impression gained on the basis of the dictionary data: apart from showing a sudden and significant increase during the Middle English period, the corpus data indicate that VV/nd/ words seem to have established themselves sooner and more firmly than VV/nt/ and VV/ns/ items respectively.

Of course, the corpus data may include items that have not survived into present-day varieties of English, and it deserves to be acknowledged at this point that the perspective we take in this article makes us blind to such items. At the same time, we do not think that this is problematic, since the question we address is when, how and why specific types of rhymes came to be established in the lexical phonotactics of English. For this purpose it is sufficient that the corpus data yield the same general pattern as the backward-looking search for first attestations, because it tells us that the increase in the

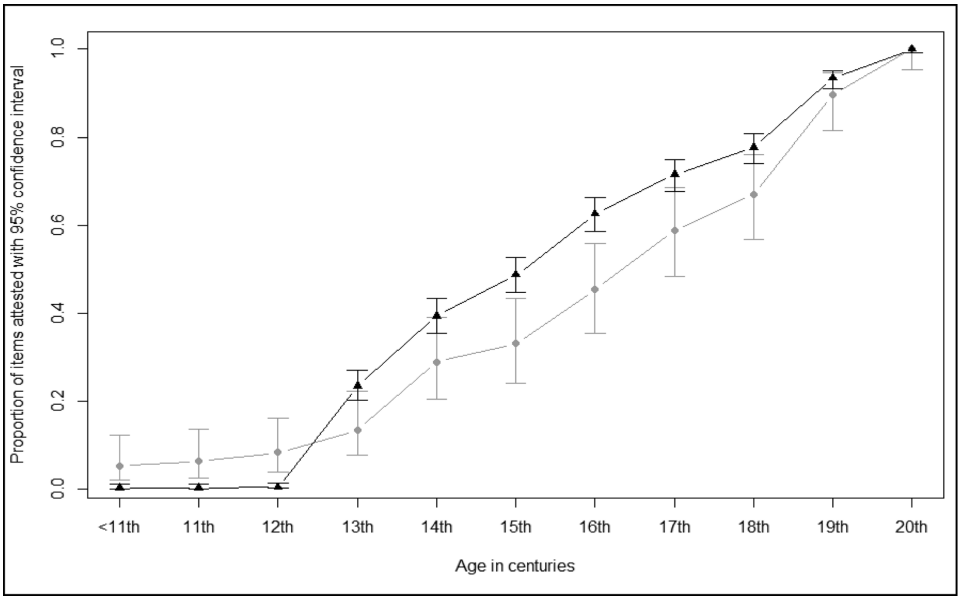


Figure 4. Age profiles of VVCC items (black triangles) and a random set of PDE words (grey circles) together with 95 per cent confidence intervals for the estimated proportions
In pairwise comparisons, non-overlapping confidence intervals imply a significant difference between the two proportions (based on a chi-squared test for independence).

number of VVCC items that we 'see' when 'looking backwards' reflects a real increase rather than the continuous replacement of old VVCC items by new ones.

Even though the corpus data replicated the pattern derived from the backward-looking search, however, we performed another check on it. In particular, we wanted to make sure that the noticeable sharp increase in the frequency of VVCC types in the Middle English period does not simply reflect the well-known fact that the whole vocabulary of English was significantly expanded by the influx of Romance loan words in the wake of the Norman Conquest. Therefore, we performed an age check like the one performed on Present-day English VVCC rhymes on a random control sample of 100 words,[26] and compared the resulting pattern to the age profile of the former. Once again, we took the results, which are reproduced in figure 4, to be reassuring.

As figure 4 shows quite clearly, the increase in the frequency of VVCC items during the thirteenth century was markedly sharper than the increase in the control sample. Also, their practical non-existence in Old English seems to mark VVCC items as special. Thus, both the corpus-derived figures and the control sample suggest that the

[26] We obtained our random sample from the *Oxford Dictionary of English*. We used the random number function in Microsoft Excel to generate 100 random page numbers, and then selected the first major class item on each page.

age profile of VVCC words attested in Present-day English represents a solid basis for further interpretation.

4 Interpretation: phases in the evolution of lexical VVCC rhymes

4.1 Phase 1: Old English

In the Old English lexicon words ending in VVCC were almost non-existent. There were, however, notable exceptions, namely the Old English ancestors of ModE *fiend* and *friend*, i.e. *fēond* 'enemy' and *frēond*, respectively.[27] Although not really representative of our sample, they are highly interesting, since they illustrate one plausible mechanism by which morphological processes may come to expand the range of lexically admissible phonotactic structures, namely lexicalisation. Originally, OE *fēond* and *frēond* were transparently related to the verbs *fēogean* 'to hate' and *frēogean*, 'to love'. Whether they represented nominalised participles as suggested in the *OED* (see s.v. *friend* and *fiend*) or whether the two *-nd-* stem nouns had another source is an open question but does not affect the fact that in Old English the nouns and the verbs would still have been relatable to each other both semantically and phonotactically. Nevertheless, both because of their frequency and their increasing semantic autonomy the nouns would probably have been memorised as lexical chunks, and as they gradually lost the last traces of their compositionality, they would have contributed to establishing the VVCC patterns in the English lexicon.

Of course, only *fiend* has stably maintained the relevant structure over the centuries, while *friend*, which has come to be much more frequent,[28] has been replaced by a variant with a short vowel. Spelling evidence (such as ME *fend*, *fent*, *find* or *fynt*; see *OED*, s.v. *fiend*) might be taken to suggest (albeit with some appropriate reservation) that also *fiend* has been facing similar competition. This shows that in the absence of specific factors supporting their inferability, constraints on their pronounceability and their perceptibility make final VVCC sequences comparably hard to transmit. In the case of *frēond* and *fēond*, however, their relation to the verbs *fēogean* and *frēogean* did represent such a supporting factor and helps to explain why they got a foothold in the English lexicon.[29]

[27] In fact, *fēond* and *fēond* were not the only items in VVCC. As an anonymous reviewer pointed out to us, Campbell's *Old English Grammar* mentions *tēond* 'accuser' and *gōddōnd* 'benefactor'. Since they were very rare, however, they neither showed up in our corpus sample, nor have they survived into Modern English. Otherwise, their cases are fully analogous to the ones of *fēond* and *frēond*, which we discuss.

[28] The *Corpus of Contemporary American English* returns 165,437 occurrences of *friend(s)* and 440 occurrences of *fiend(s)*. In the *British National Corpus* the ratio is 28,938 to 127.

[29] As opposed to lexical VVCC forms, morphotactically complex forms with complex codas after long vowels were well attested in Old English, although they did not end in VV/nd/ or VV/ld/, but rather in (C)/st/, or C/θ/. Such forms were the 2SG or 3SG/PL endings of verb forms such as /riːt+st/ 'you ride', /gaː+st/ 'you go', or /hiːər+θ/. 'he/she/they hear'. Although not directly involved in the processes on which this article focuses, they deserve to be mentioned here for three reasons. First, they may have been involved in the emergence of the only other set of VVCC items still attested in English, namely words such as *oust*, *moist*, *heist*, etc. Second, they

4.2 Phase 2: (Early) Middle English

The Middle English period saw the first substantial increase in the number of lexical VVCC items. Practically all of them resulted from the lengthening of vowels before sequences of homorganic sonorants and voiced obstruents, as in *child*, *find*, *climb* or *long* (with a lengthened vowel preserved only in Northern and Scottish forms such as *laing*). We are of course primarily interested in the words ending in /nd/ and /ld/, because they are the only ones to have preserved their VVCC structure.

Clearly, the period of their emergence supports Hogg & McCully's hypothesis that their stability may have been due to the fact that rhymes of the same structure were produced morphologically, because it was in the same period that English inflection came to produce word forms ending, phonetically, in [VVCC]. This came about, essentially, through the loss of schwa in unstressed final syllables. The change (for which see particularly Minkova 1991 and 2009, but also Lass 1992), was well developed by *c*. 1250 and practically completed (at least for open final syllables, and except in the south of England) by the middle of the fourteenth century. Supressing the phonetic expression of schwas first in absolutely final position and then in checked final syllables, schwa loss caused word forms such as *del+ed* 'dealt', *howl+ed*, *nayl+ed* 'nailed', *stayn+ed* 'stained', *ston+ed*, *sayl+es*, *hol+es*, *bon+es*, *stain+es* to surface with rhymes such as [eːld], [uːld], [aild], [aind], [ɔːnd], [ailz], [ɔːlz], [ɔːnz] and [ainz] respectively. Although it is likely to have taken some time until schwas disappeared from lexically underlying representations, [VVCd] and [VVCz] rhymes are likely to have emerged phonetically in the course of the thirteenth century.[30] This means that schwa loss occurred early enough to qualify as a factor in explaining the emergence of lexical VVCC rhymes.

When schwa loss began to spread, even if only as an optional post-lexical phonetic process, past tense forms and past participles ending in [VVCC] would have been common. A search of M4 of the *Helsinki Corpus* returns about 90 types such as *arreigned*, *assigned*, *complayned*, *constreyned*, *conteyned*, *crowned*, *feyned*, *fyned*, *oppynd*, *ordayned*, *stained*, *woned* 'wont', *appeled*, *begiled*, *begyled*, *deled*, *fayled*, *feled* 'felt', *heled* 'healed', *kneled*, *sailed*, *sealed* and many others.

Now consider what is known – or can at least be assumed with some confidence – about Homorganic Lengthening. Like most sound changes, it is likely to have originated in the phonetics of speech. The factors that motivated it were probably threefold. First, the triggering clusters were high in sonority for consonants. In this respect, then, the boundary between them and the preceding vowel, itself highly sonorous,

(or rather their Middle English descendants) may have indirectly supported the emergence lexical VV/nt/ and VV/lt/ forms such as *mount* or *fault*, which took place soon after lexical VV/nd/ and /VV/ld were established, since speakers would have been familiar with both lexical VV/n|l)d/ items and (morphologically complex) word forms ending in VVC/t/. Third, the case of VV/st/ forms would seem to provide strong support for Dressler & Dziubalska-Kołaczyk's proposal that languages shun homophony between lexical and morphotactic structures, since VV/st/ forms can have been involved in such a homonymy only for comparably brief period. In Old English they were unambiguously morphotactic, and in Present-day English, they are purely lexical.

[30] That is also when spelling variants such as *brennd* 'burnt' (*Ormulum*, *c*. 1200), *turnd* 'turned' (*Lambeth Homilies*, I. 1225), *befeld* 'filled' (*Vices and Virtues*), *c*. 1200 appear.

was perceptually blurred. At the same time, homorganic sonorant-stop sequences are known to allow a fairly rapid pronunciation, so that they surface as hardly longer – in terms of their actual duration – than single segments (Herbert 1986). Finally, there are reasons to assume that – just as in Present-day English – the duration of Middle English syllables would have been frequently adjusted to increase rhythmical isochrony between sequences of stress peaks. Thus, when word forms like *bind* or *child* were pronounced in utterances where they were closely followed by a rhythmic lift, as for instance in *The ˈchild ˈfelt the ˈcoldness of ˈmen*, they would have seen the pronunciation of their vowels phonetically lengthened. When that happened, their rhymes would have been phonetically indistinguishable from the rhymes in forms like *fyn+ed* or *begil+ed*.

As argued above, in the rhymes of such complex word forms the successful recognition of all elements would have been facilitated because (a) they also occurred independently in other word forms where they were easier to pronounce and/or to perceive, and because (b) the final /d/s were morphologically significant, so that their intended presence could be inferred from the semantic context, even when the speech signal itself contained less than optimal cues. Furthermore, the frequency of regular past tense and participle forms would have made final /d/s, statistically speaking, expectable, so that fewer acoustic cues were actually necessary for recognising them. Crucially, however, the expectablility of final /d/s would have also helped them to be recognised in the phonetic expressions of simple lexical items, because, taken together, past tenses and past participles could occur in practically all the syntactic contexts (i.e. both typically verbal and typically nominal ones) in which simple lexical items could also occur. This meant that when listeners heard an expression of lexical *cild* in which the vowel was durationally lengthened, they were likely to identify it as [tʃiːld], because (a) they would recognise the final /d/ easily, and because (b) they would find nothing odd about the fact that it was preceded by a long [iː] and an [l], as such sequences were frequent. Next, they would pursue the hypothesis that the perceived sequence represented, in fact, a morphologically complex word form: as Post *et al.* (2008) have demonstrated, this is what speakers invariably do when they process a word form whose shape suggests that it may be compositional. Now, in the processing of phonetically lengthened forms such as [tʃiːld] from underlying /tʃild/, or [biːnd] from /bind/, this hypothesis would of course have turned out wrong, but at that point the vowels would *already* have been interpreted as phonologically long. When [tʃiːld] and [biːnd] proved not to represent /tʃiːl/+/d/ and /biːn/+/d/, however, the next best inference would have been that they reflected lexical /tʃiːld/ and /biːnd/. Since the lexicon did at that stage already contain forms like the inherited /freːnd/ ‘friend’ and /feːnd/ ‘fiend’, there was no hard and fast phonotactic restriction that would have ruled out /tʃiːld/ and /biːnd/. In that way, then, the emergence of /d/ as a regular past tense marker and the phonetic lengthening of vowels before homorganic clusters ‘conspired’ to establish phonological VV/(n|l)d/ forms in the English lexicon.[31]

[31] Another way in which morphotactically produced sequences can make it into the lexicon is through language acquisition. When children acquire complex items before they know the morphological rules by which they

Clearly, no similar support was available for rhymes in which vowels were reinterpreted as lexically long before clusters such as [ŋg] or [mb], even though such reinterpretations have sporadically occurred. Just as in the cases of [nd] and [ld], the high sonority and the reduced duration of [mb] and [ng] must have led to lengthened articulations of preceding vowels in favourable prosodic contexts, and these have also occasionally been interpreted as reflecting long lexical underliers. In the absence of morphotactic homonyms, however, VV[mb] and VV[ng] forms would have remained rare, and 'unexpected'. Since this made their phonetic expressions difficult to recognise, lexical VV/mb/ or VV/ng/ rhymes soon came to be ousted again by more easily transmittable variants such as VV/m/ or V/ŋ(g)/ (cf. PDE /klaɪm/ 'climb' and /lɒŋ/ 'long').

While the scenario just proposed is clearly compatible with Hogg & McCully's idea that the stability of lexical VV/nd/ and VV/ld/ rhymes is due to the existence of morphotactic counterparts, it is not quite clear what it means for Dressler & Dziubalska-Kołaczyk's theory of morphonactics. At first sight it appears to contradict it, because they seem to suggest that structural similarities between purely lexical and morphotactic sequences should be dispreferred because of the ambiguities they create. However, in evolutionary systems, the mere fact that a specific combination of constituents is 'suboptimal' or 'dispreferred' does not necessarily imply that it should also be unstable. Rather, it may remain stable enough as long as competing variants that are more easily transmitted together fail to emerge, and in the present case this was arguably unlikely.

There were, in principle, two ways in which the structural ambiguity of VV/(l|n)d/ forms might have been removed: either the past and participle forms, or the monomorphemic lexical ones could have been systematically replaced by unambiguous competitors. As far as past forms were concerned, however, this clearly would have come at the cost of creating irregularity unless the whole system of past formation had been changed as well. At the same time, the number of regularly derived past forms ending in VVC+/t|d/ that signalled compositionality correctly and unambiguously (such as VV/b+d/, VV/ð+d/, VV/m+d/, VV/v+d/, VV/f+t/, or VV/k+t/) was clearly higher than the number of forms that did not, which were essentially only VV/l+d/,VV/n+d/ and VVs+t/. Thus, on the whole, the system that was establishing itself produced a sufficiently large number of morphotactically unambiguous rhymes so that the ambiguity of VV/(l|n)d forms represented an unavoidable imperfection, and the costs incurred by its removal would have outweighed the benefits by far. As such imperfections are typical (even diagnostic) of evolutionary systems in general (see e.g. Dawkins 1982: 30–55), it is unsurprising that one should find them in languages as well.

Next consider the option of disambiguating VV/nd/ and VV/ld/ items by changing the phonological structure of lexical instantiations. The following options are theoretically

are derived, they sometimes tend to interpret them as faithful expressions of corresponding lexical underliers, although they are not. Once they acquire the morphology, however, they usually revise such hypotheses. See Jusczyk *et al.* (2002) for a discussion of the phenomenon.

available: (a) vowel shortening, e.g. /biːnd/ → /bind/; (b) nasal/liquid deletion e.g. /biːnd/ → /biːd/; (c) final devoicing, e.g. /biːnd/ → /biːnt/; (d) final coronal deletion, e.g. /biːnd/ → /biːn/. Obviously, however, (a) and (b) would not have removed the morphotactic ambiguity, because VV/d/ and V(l|n)/d/ were also attested in past tense and particle forms such as *sinned* /sin+d/, *filled* /fil+d/, or *died* /diː+d/.

This leaves (c) final devoicing, and (d) final coronal deletion. Clearly, their outputs – i.e. forms ending in VV/(n|l)t/ or VV/(n|l)/ – would not have been created by past tense formation and would therefore have been unambiguously monomorphemic. Particularly final coronal deletion might look like a very plausible 'remedy', since studies in variationist phonology have repeatedly demonstrated (e.g. Labov 1989; Guy 1980; Guy & Boyd 1990; Tagliamonte & Temple 2005) that stops are more likely to be reduced in simple items than in past tense or past participle forms (e.g. more often in *mist* than in *miss+ed*, or and more often in *find* than in *fin+ed*). It might therefore seem a small step from reducing final /d/s more often in simple items such as *find* than in complex items such as *signed*, to categorically deleting them in the former while retaining them in the latter.

However, there are good theoretical reasons why the pattern that is so readily observable in synchronic variation, is unlikely to lead to a sound change of the expected type, and why final stop deletion (nor final devoicing for that matter) could not have selectively and categorically targeted lexical VV/(n|l)d/ rhymes without applying to morphotactic VV/(n|l)d/ rhymes as well. As Bermúdez-Otero (2014) demonstrates, phonological processes that become sound changes go through a diachronic life cycle, in which they usually start as post-lexically phonetic, and reach the stem level only after having been phonologised first on the phrase level and next on the word level. This means that processes such as:

(3) (a) d → Ø /(n|l) __ +
(b) d → t /(n|l) __ +

imply prior

(4) (a) d → Ø /(n|l) __ #
(b) d → t /(n|l) __ #

Therefore, no stages in the life cycle of final devoicing or final coronal deletion are easily conceivable, where they could have exclusively applied to word forms like $[\textit{find}]_{w}$ without having applied to word forms like $[[\textit{sign}]_{s}\ \textit{ed}]_{w}$ as well, and thus, neither of the two processes would have been capable of removing the morphotactic ambiguity of VV/(n|l)d/ forms through being implemented as a sound change.[32]

[32] Note that there are a number of events that our proposal does not rule out and that do therefore not falsify it. First, it does not rule out sporadic occurrences of final devoicing or final coronal deletion, but only their application to a subset of phonological words, specifically distinguished by properties that have no status in word-level phonology.

Secondly, it does of course not mean that final devoicing or final coronal deletion could not have taken place at all. The former obviously has occurred in a number of varieties, such as Scottish English, for example,

In other words, suboptimal as it may have been, the morphotactic ambiguity of word-final VV/nd/ and VV/ld/ failed to inhibit their successful transmission, because variants which would have done better in that respect could not arise immediately. Thus, the interaction between past tense formation and Homorganic Lengthening resulted in a frozen evolutionary accident: it helped to establish phonotactic sequences in the lexicon that would not have emerged otherwise, that produced ambiguities in the speech signal, and that were, communicatively speaking, 'suboptimal', but once they had emerged, there was no way to get rid of them. As already pointed out, such 'imperfections' are perfect examples of the 'bricolage' that characterises evolutionary systems in general (see Lass 1997), and therefore support the idea that languages do indeed represent such systems.

4.3 Phase 3: Late Middle and Early Modern English

As the data in our survey suggest, the inventory of lexical items ending in VVCC came to include words whose rhymes did not have morphotactic counterparts practically as soon as VV/nd/ and VV/ld/, which did have such counterparts, were already established.[33] New arrivals among lexical VVCC items include words in VV/nt/, such as *grant*, *plant*[34], *point*, *quaint*, *faint*, *count* or *constraint*, in VV/lt/, such as *salt*, *malt*, *halt*, *bolt*, *fault* or *assault*, in VV/ns/, such as *dance*, *ounce*, *trance*, *chance*, *circumstance*, or *pronounce*, and very few in VV/ls/, namely *false*, *waltz*, *ringhals* 'spitting cobra' or *valse*.

where voicing in final obstruents is virtually missing. (Note that this has not resulted in a full merger, since (a) historically voiceless /t/ (and to a lesser extent also /p/ and /k/) have been glottalised, (b) historically voiceless fricatives have come to be (optionally) pre-aspirated, and (c) vowels are markedly longer before historically voiced obstruents than before historically voiceless ones.) Our claim is merely that final devoicing could not have been implemented in a way that would have systematically removed the morphotactic ambiguity of [VV(n|l)d] forms.

Finally, it does not rule out the emergence of constellations in which descendants of ME VV/(n|l)d/ forms appear without a final coronal while past tense and participle forms display it. As one anonymous reviewer pointed out, this seems to be the case in 'traditional Ulster varieties'. Crucially, however, such synchronic constellations do not necessarily reflect a phonologisation of final coronal deletion in which the word level was skipped and in which the process jumped from being variably phonetic to being restricted to the stem-final domain. Instead, the process may have gone through its normal life cycle and first affected past tense and participle forms as well as monomorphemic words. Regular past tense formation remaining a highly productive morphological rule, it may have caused stops to re-emerge in past tense forms when potential inputs to the phonologised deletion process had been lost in the lexicon, thereby bleeding it and terminating its life cycle. Thus, even constellations like the ones attested in Ulster English do not necessarily imply that selective final coronal deletion was an option for removing the morphotactic ambiguity of ME VV/(n|l)d/ items.

[33] One apparent exception appears to be *saint*, forms of which are already attested in the twelfth century. Frequent spelling such as *sein*, *san*, *sen*, *sayn*, *sayne*, *sain*, *syn*, *sant*, *sent*, *sont*, *santt*, etc. (*OED* s.v. saint)) suggest that the VV/nt/ form established itself securely only a considerable time after the word was first borrowed.

[34] The modern pronunciation of *plant* does not reflect a long vowel in the Old English counterpart, but rather the quantity taken over from a later French loan. Something similar applies to *grant*: Although the French loan is attested already quite early, i.e. in the *Ancrene Riwle*, it may first have been taken over with a short vowel and adopted a long one – or rather an /au/ diphthong – only in the course of the thirteenth century.

As far as their origin is concerned, many of them reflect loans. In cases such as *grant*, *dance*, their long vowels reflect /au/ diphthongs, which in turn, reflected the way in which the nasalised originals were resolved, while *faint*, or *point* reflect diphthongal pronunciations in the source language (see Bliss 1952/53; Flasdieck 1954; Jones 1989; Lass 1992). Items ending in /lt/ or /ls/, on the other hand, include not only Romance loans, but also a number of Old English words which underwent /l/-breaking in the fifteenth century, yielding first /au/ diphthongs, and eventually long /ɔ:/ monophthongs (see Flasdieck 1954; Jones 1989).

What the rhymes in these words have in common is (a) that the constituents of their final consonant clusters contrast better with one another than the consonants in the clusters /nd/ and /ld/ (Dziubalska-Kołaczyk 2009), (b) that the voiceless obstruents in which they end are easier to pronounce in final position than their voiced counterparts, and (c) that they are not involved in morphotactic ambiguities. This means that they fare better both with regard to physiologically grounded constraints on the transmission of long vowels and coda clusters, and with regard to the processing difficulties arising from homophony with morphotactic counterparts. Since they form a natural class with VV/nd/ and VV/ld/ rhymes, there is no plausible way in which speakers might have learnt that the former should be lexically admissible in their language, while the latter shouldn't. Having learnt to expect coronal consonants even after VV/n/ or VV/l/ sequences, listeners must have recognised them even more easily when they were easier to perceive than the ones they actually expected. Thus, also words like *grant*, *dance*, *fault*,[35] or *false* profited indirectly from the originally morphologically motivated skill in recognising voiced coronals at the end of the same sequences.

At the same time, their recognition would not have required the processing efforts involved in testing the recognised forms for potential morphological compositionality. Thus, when VV/nd/ and VV/ld/ sequences had become phonotactically permissible in the English lexicon, the absence of VV/nt/, VV/lt/, VV/ns/ and VV/ls/ constituted what Hayes & White (2013) refer to as a historically motivated 'accidental' gap in the system, which subsequently came to be filled when the occasion arose. In English that occasion arose in the form of French loans whose surface shapes suggested their interpretation in terms of the relevant lexical structures, and in the form of /l/-breakings in complex codas.[36]

In this connection, what may be even more telling than the occasional emergence of forms like *false*, is the complete absence of lexical VV/lz/ items. That VV/l+z/ has remained exclusively morphotactic, while VV/ls/ is only lexical, demonstrates the

[35] The case of *fault* is particularly illustrative in this connection. As an anonymous reviewer pointed out, *fault* was probably taken over from French in an *l*-less variant, and adopted its present pronunciation only at the end of the sixteenth century. Clearly, a change from /ɔ:t/ to /ɔ:lt/ would have hardly been possible, had VV/lt/ not been licensed in lexical phonotactics at the time. The same argument may be made for *false*.

[36] As indicated above (see note 21) the speed with which lexical VV/nt/ and VV/lt/ items appeared after VV/nd/ and VV/ld/ had been established, may have been due to the prior emergence of word forms that ended in VV/st/, such as ME *taste*, *chaste*, *most*, which may in turn have been motivated by older complex word forms such as *go+est*, *see+st*, etc.

validity of Dressler & Dziubalska-Kołaczyk's proposal that languages generally shun homophony between lexical and morphotactic structures. It also goes to show that the mutually supportive interaction between lexical and morphotactic VV/nd/ and VV/ld/ clusters depended on a very specific historical coincidence.

5 Summary and conclusion

As we hope to have shown, the establishment of cross-linguistically rare VVCC in the lexical phonotactics of English represents the outcome of a number of independent developments, which happened to occur at the right time and in the right sequence. Only in their combination do they explain why words such as *gold*, *bind*, *mount*, *fault*, *ounce* or *false* came to emerge in the English lexicon, and how they managed to be transmitted stably and faithfully afterwards. These factors involved:

(a) The partial lexicalisation of the original participles *fēond* and *frēond*, whose transparent relation to the verbs *frēogean* and *fēogean*, helped them to retain their long vowels in spite of lexical constraints against lexical VVCC.
(b) The coincidence of Homorganic Lengthening in words like *child* or *bind* with the effects of schwa loss on the phonetic outputs of highly productive morphological operations. The co-occurrence of these events made word-final [VVnd] and [VVld] sequences frequent on the phonetic surface. Homorganic Lengthening achieved this through the phonetic lengthening of lexically short vowels (as in *child* or *bind*), while schwa loss caused the past tense and past participle forms of verbs ending, lexically, in VV/n/ and VV/l/ to surface in the very same sequences. The morphological significance of frequently produced [VVnd] and [VVld] sequences facilitated not only their own recognition, but also that of morphologically non-compositional forms, which then came to be interpreted as expressing lexical underliers.
(c) The creation of a systemic gap in lexical phonotactics through the establishment of the comparably difficult rhyme types VV/nd/ and VV/ld/ before that of their more easily expressible, recognisable and transmittable counterparts VV/nt/, VV/ns/, VV/lt/ and VV/ls/. Predictably, the gap came to be filled as soon as an occasion arose.

Generalisable lessons that we think can be drawn from our account include the following. Phonologically dispreferred, or marked, sequences may arise in the lexicon when they are frequently produced in surface word forms through morphological operations, even without straightforward lexicalisation processes being involved. Instead, the frequency of morphologically produced phonotactic sequences first merely facilitates their recognisability. This can have lexical effects when similar sequences come to be produced through independent processes as well, particularly when these processes are variable. In such cases, their outputs – easily recognised without being interpretable in morphological terms – may come to be analysed as faithful reflexes of lexical underliers.

Secondly, we have seen that predictions about the likelihood of linguistic patterns, derived from physiologically grounded constraints on their expressibility or their recognisability, or from semiotic considerations, play an important role in attempts to account for the properties of specific languages. They represent universally present

selection pressures, and in our case they have served to explain why, after the establishment of VV/nd/ and VV/ld/ in the English lexicon, their phonetically more easily transmittable and semiotically less problematic variants VV/nt/, VV/lt/, VV/ns/ and VV/ls/ followed suit practically immediately.

Finally, we have shown that history can create specific circumstances in which the interactions of constituents from different levels of linguistic organisation have surprising effects and come to stabilise sound patterns which strike one as decidedly odd if one considers their phonetic transmittability or their semiotic functionality in general and ahistorical terms. Of course, these interactions always take place against the background of universal, or natural, constraints on the possible design space of linguistic structures. However, whether they are conceived of as grounded in a specific cognitive module or in more general properties of cognition or physiology, all constraints on possible properties of human languages will unfold their full explanatory potential only if one takes into account that the transmission of linguistic patterns is an essentially historical process always occurring under specific circumstances.

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