(Non-)alternating umlaut in English and German: Whither /y/?

ABSTRACT

Umlaut created a new class of front rounded vowels in early English and German, derived from original back vowels (e.g. [y]<[u]), but the modern languages exhibit markedly different structural patterns. Why? We argue that, due to the relative ordering of umlaut and deletion of its trigger, phonological umlaut was more pervasive in Old English than Old High German, resulting in few alternations within paradigms. These alternations proved crucial in sustaining the typologically marked contrast between front rounded and unrounded vowels: without alternations, English reanalysed umlauted stem vowels as underlyingly [CORONAL] (ultimately unrounding them), but the number of alternations in German facilitated the extension of umlaut as a productive *morphological* process. English therefore dramatically increased the number of underlying [CORONAL] vowels but lost alternations, whereas German has far more underlying [DORSAL] vowels and widespread alternations in paradigms. This paper provides comparative synchronic analyses of both modern and mediaeval English and German.

1. Introduction

Germanic (Gmc)[1] umlaut is a type of metaphony which is best known to have occurred synchronically in Old High German (OHG) and Old English (OE).[2] Umlaut (or *i*-mutation) originated in a phonological process whereby the stem vowel loses its back feature in the presence of a high front vowel /i/ or glide /j/ in the following syllable. Ultimately, it resulted in a new series of phonemic front rounded vowels, e.g. /y, ø/, and thus a typologically rare rounding contrast between [CORONAL] (front) vowels (e.g. /y/≠/i/). Historically, the conditioning [HIGH, CORONAL] segments had a range of sources, but the most important of these were 'stem extensions' added (preceding any affixes) to certain classes of nouns and verbs, such as *-i* and *-ja*/*-jō* in nouns (e.g. NHG *Tür* 'door' < OHG *tur-i* < Gmc ***dur-i-***; NE *sin* < OE *syn(n)* < Gmc ***sun-jō-***) and /-j-/ in certain verb classes (e.g. NE *to thirst* < OE *þyrstan* < Gmc ***þurst-j-an***). Umlaut was additionally conditioned by certain suffixes, e.g. the plural suffix /-i/ or the 2/3.SG.PRES.INDIC affixes /-is/ and /-it/.[3] The present paper provides a comparative analysis of umlaut in two West Germanic (WGmc) languages, English and German. The primary focus of this paper is not so much that an erstwhile allophonic alternation led to contrastive phonemes, but rather the nature and consequences of its reanalysis.

Our claim is that, following the reduction of unstressed syllables which affected all WGmc dialects during the mediaeval period, the /i/ or /j/ which caused umlaut ceased to be recoverable. Bereft of unambiguous evidence for the earlier rule, learners were forced to account for the increasingly opaque surface forms within the synchronic system and the underlying grammar was reanalysed. We ask (i) how the divergent structures of two closely related WGmc languages encouraged differing types of reanalysis, despite their shared origin and (ii) why the resulting series of front rounded vowels were able to survive as phonemes in

[1] In this paper, the following abbreviations are used: ART = ARTICULATOR, [CONS] = [CONSONANTAL], [COR] = [CORONAL], [DOR] = [DORSAL], G = Consonant gemination, GD = Glide deletion, Gmc = Germanic, GVS = Great Vowel Shift, [HI] = [HIGH], HVD = High vowel deletion, IE = Indo-European, [LAB] = [LABIAL], [LO] = [LOW], MHG = Middle High German, NE = Modern English, NHG = Modern German, OE = Old English, OHG = Old High German, [SON] = [SONORANT], TH = TONGUE HEIGHT, VL = Vowel lowering, [VOC] = [VOCALIC], WGmc = West Germanic.

[2] It was also active in other Gmc languages, e.g. Old Norse, although details differ (see Lahiri 2003).

[3] For our purposes, the crucial nominal classes in Gmc were those which had stem extensions ending in /j/ or /i/. However, the largest class of nouns, the *a*-stems, had no overt segmental extension in OE and no umlaut in either OE or OHG. As such, this class provides a useful point of comparison.

one language (German) but not the other (English), where they have been unrounded and lost, merging with their front unrounded counterparts (e.g. /yː/ > /iː/).

English and German share a common starting point and, in the early period (when umlaut was active), remained structurally close, having inherited many West Germanic phonological rules, such as WGmc gemination, intact (albeit with differences in their relative ordering, cf. Lahiri 1982). Nevertheless, unlike German, not a single modern dialect of English retained the /ø/ or /y/ which arose from umlaut (Wells 1982; Wright [1905]1968). Although some dialects kept words with ME /yː/ and /iː/ distinct (e.g. Gloucestershire varieties), the *rounding contrast* amongst [CORONAL] vowels was nonetheless lost, with /yː/ unrounded and lowered to /eː/, before being again raised to /iː/ (e.g. /briːd/ *bride* < OE *brȳd*; Wright 1905[1968]: 152ff.). Thus, all corresponding /y(ː)/ vowels in German became /i(ː)/ in English, leading to a substantial increase in front vowels, e.g. *M*[ʏ]*cke–m*[ɪ]*dge*.

The ultimate unrounding of the English vowels is particularly striking. Claims that English lost umlaut completely, whilst German morphologised it (e.g. Nübling 2020) overlook the fact that—when compared to WGmc—fronted stem vowels are actually rife in English. Alternations may be scarce (restricted to lexicalised forms, e.g. *goose~geese*) but many more forms underwent phonological umlaut in OE than OHG, which mainly affected entire paradigms (especially for nouns, cf. E *f*[ɪ]*st–f*[ɪ]*sts* and G *F*[aʊ̯]*st–F*[ɔɪ̯]*ste*). Therefore, later learners of English—lacking evidence for an underlying /u/ from which they could derive [y]—were left no option but to reanalyse the stem vowel as underlyingly front /y/ following the loss of the umlaut-conditioning /i/ and /j/. The result was a dramatic increase in coronal vowels in English stems (and a complementary decrease in back vowels), despite the loss of a productive umlaut rule.

However, this fact has not been recognised in the literature. OE grammars typically mention that the phonemes /ø/ and /y/ lost their rounding in late OE or early Middle English (e.g. Prokosch 1939: 111; Wright & Wright 1928), even providing detailed descriptions of the geography and chronology of this loss (Wright & Wright 1928: 22f.).[4] However, the *cause* is never addressed and detailed comparative studies are rare; nor is it overtly recognised that umlaut in OE resulted in far fewer paradigmatic alternations than OHG, beyond passing observations, e.g. 'beispiele für *y* aus *u* sind sehr zahlreich, aber es lassen sich nur wenige paare mit *u* und *y* nebeneinander anführen, weil ausser vor nasal + consonant urgerm. *u* fast nur vor *i*, *j* zu erscheinen pflegte (§45,3) und daher fast stets umlaut erfahren musste'[5] (Sievers 1921: 43).

In contrast, German has ended up with far fewer underlying umlauted stem vowels but has gained a productive *morphological* process. Morphological umlaut is characteristic of both inflectional and derivational processes, even having been extended to words which never underwent *phonological* umlaut, e.g. OHG *topf~topfe* 'pot.SG~PL' > NHG *Topf~Töpfe*. For instance, umlaut is found in the marking of plurality in many nouns, as well as in 2SG.IMP, 2SG.INDIC.PRES and past subjunctive forms of strong verbs (see Plank & Lahiri 2015: 12ff.). Alternations were instrumental in reinforcing and maintaining the (marked) three-way phonemic contrast in German (/i/, /y/, /u/), despite the surprisingly low number of stems with underlying front rounded vowels. We will argue that, with only a handful of morpho-

[4] /yː/ was unrounded to /iː/ 'in late OE. or early ME. in all the northern counties, in a great part of the east midland counties [...] as well as in parts of the south-western counties' and unrounded and lowered to /eː/ 'in Kent and parts of Middlesex, Sussex, Essex, and Suffolk during the OE. period, [remaining] as such in ME.' It survived as /yː/ in 'all other parts of the country including the West Midlands [...] until about the end of the fourteenth century and then became unrounded to *ī*' (Wright & Wright 1928: 29f.).

[5] 'Examples of *y* from *u* are plentiful but only a few pairs with *u* and *y* can be listed side by side, as, unless before a nasal + consonant, Proto-Germanic *u* almost exclusively occured before *i*, *j* (§45.3) and thus almost always underwent umlaut.'

phonological alternations, English was unable to support the same typologically rare contrast, leading to unrounding and merger (see §4).

Umlaut occurred at a very early point. It was already active and represented orthographically in prehistoric OE, with the conditioning /i(ː), j/ having mostly disappeared (from surface forms!) in even the oldest records (Wright & Wright 1908: 29), e.g. OE *mȳs* < Gmc **mūsiz* 'mice'. The OHG picture is more complicated, as only /a > e/ was represented in writing, e.g. *betti* 'bed' (cf. Gothic *badi*).[6] Multiple periods of umlauting have been proposed (e.g. Wright 1906: 14; see also Kauffmann 1890) but Twaddell (1938) argues that umlaut was only spelt once it had become phonemicised and was no longer allophonic, e.g. OHG *dunni* [dynni] > MHG *dünne* (NHG *dünn* [dʏn] 'thin'). The exception, ‹e› for umlauted /a/, results from its phonetic similarity to an existing phoneme. The consensus is now that umlaut was fully active in OHG, occurring as much as 300–400 years earlier than it appears in writing (see Braune & Heidermanns 2023: 83ff.; Jones & Jones 2019: 44), possibly in the early (Pre-?)OHG period (Braune & Eggers 1987: 54; Moser 1969: 114; see also Twaddell 1938; Penzl 1949). Evidence for the early productivity of umlaut can be seen in certain very early Latin loans, e.g. NE *kiln, inch* < ME *cylne, ynche* < Latin *culīna, uncia* and NHG *Kreuz* ([kʁɔ͡ɪts] 'cross') < MHG *kriuze* < Latin *crux* (GEN. *crucis*).[7]

This paper examines these developments in the context of the theoretical concept of PERTINACITY in language change (Lahiri 2002; Dresher & Lahiri 2005; Plank & Lahiri 2015; see §4.3), understood as the essentially persistent quality of grammars, which are generally resistant to change. When reanalysis does occur, grammars will thus typically follow one of two paths: (i) the same underlying pattern is retained, but new output forms may arise as a result (the default), as in German (Pertinacity A), or else (ii) the same output forms may persist but—as a result of reanalysis—the underlying system may undergo change, as in English (Pertinacity B).

Following a discussion of the phonology of umlaut in §2, §3 presents an overview of the contemporary languages. Diachronic developments during the early period are discussed in §4, providing a synchronic analysis of umlaut in OHG and OE. The typological scarcity of front rounded vowels is discussed in §5 and §6 considers the role of pertinacity in the development of umlaut.

2. The phonology of umlaut

As a result of umlaut, the WGmc [DORSAL] (back) vowels /a,o,u/ became [CORONAL] /e,ø,y/ (note that only /ø,y/ are [LABIAL], i.e. rounded), as Table 1 demonstrates. What should be noted is that in every instance the modern languages feature [CORONAL] vowels, whereas the WGmc vowels were (or became) [DORSAL] (although OHG does not always represent umlaut orthographically, see §4). The Modern English (NE) vowels have additionally lost the feature [LABIAL] (in the case of /øː/>/eː/, this even occurred during OE).

[6] This is often referred to as *Primärumlaut*. Umlaut of /u/ was first represented later, around 1000 CE, but still during the OHG period. The umlaut of /o/ was not really written in OHG and the *Sekundärumlaut* of /a/ in contexts where *Primärumlaut* was initially blocked (i.e. in closed syllables, before combinations such as /xt/) is only found in early MHG, e.g. ‹mahti›~‹mehti› 'strength.NOM/ACC.PL'. Even in MHG, orthographic representation of umlaut was inconsistent.

[7] Note that **monisterium* (< *monastērium*) was borrowed into both languages, where it survives with a coronal vowel to this day: NE *minster* < ME *mynster*, NHG *Münster* (cf. *monastery*, reborrowed into Middle English once umlaut was no longer active).

WGmc	OE	Late ME	NE[8]	OHG	NHG	Gothic	
*u:	fȳr	fīr	[fʌɪə]	fiur	[fɔɪɐ]	fun-, fon	‘fire’
*u	þynne	þinne	[θɪn]	dunni	[dʏn]	*þunnu-s	‘thin’
*o:	fōt > fēt	fēt	[fi:t]	fuoʒi[9]	[fy:sə]	fōtjus	‘foot’
*o[10]	—	—	—	—	—	—	
*ai/e:[11]	hæþ	hæþe, hēþe	[hi:θ]	sāen	[zɛ:ən]	háiþi, saian	‘to heal’; ‘to sow’
*a	ende	ende	[ɛnd]	enti	[ɛndə]	andeis	‘end’

Table 1: The effect of umlaut on relevant WGmc vowels in OE and OHG, contrasted with Gothic.[12]

This paper concerns itself primarily with the umlaut of the high vowel /u/>/y/, as this introduced a new phonological contrast into both German and English which survived into modern German (NHG) but was lost from English during the middle period, unlike /o/>/ø/ (which was already unrounded to /e/ in the early OE period, remaining [CORONAL]). Although it was ultimately lost, /y/ did become a phoneme of English and endured for centuries before disappearing. The goal is to account for the different historical trajectories in English and German and the dissimilar synchronic consequences of umlaut.[13]

The relevant features for the vowels and glides discussed in this section are presented in Table 2. Our analysis follows the Featurally Underspecified Lexicon model (Lahiri and Reetz 2010; Lahiri 2018), which assumes that (i) features are monovalent and (ii) the feature [CORONAL] is universally underspecified, accounting for its absence in the underlying representation of the non-dorsal vowels in Figure 1 (where [—] represents the absence of a feature).[14] It is, however, a contrastive feature which is filled in during articulation and is present in the output, hence its inclusion in Table 2 (cf. Lahiri and Reetz 2010: 47; Plank & Lahiri 2015: 21ff.).

	i/j	u	→	y	o	→	ø
LABIAL		✓		✓	✓		✓
CORONAL	—			—			—
DORSAL		✓			✓		

Table 2: ARTICULATOR feature specification for the relevant segments. The feature [CORONAL] is underspecified (—) but [LABIAL] and [DORSAL] are present in underlying representations (✓).

[8] Since the early period, a number of phonological processes have affected the quality of the OE and OHG long vowels, notably the diphthongisation of /y:/ > /ɔɪ/ and monophthongisation of /yə/ > /y:/ in German and the effects of the Great Vowel Shift in English (of relevance here are /i:/ > /ʌɪ/ and /e:/ > /i:/).

[9] Gmc /o:/ appears in OHG as the diphthong /uo/ (NHG /u:/). However, Gmc /au/ became /o:/ in OHG before certain [COR] consonants, such as /r/. The umlaut of /o:/ > /ø:/ may therefore be seen in OHG *hōren* (‘hear.INF’; cf. NHG [hø:ʁən], Gothic *hausjan*).

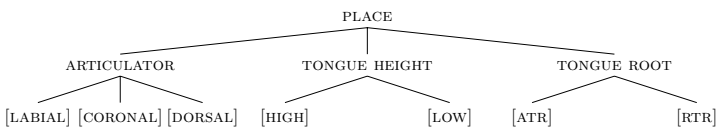
[10] Gmc /u/ did not become /o/ in OE or OHG when there was an /i/ or /j/ in the following syllable, so there was no umlaut of short /o/. All words with umlaut of short /o/, e.g. *Dörfer* ‘villages’ are actually new formations due to levelling or analogy (see Wright & Wright 1908: 54; Wright [1907]/1962: 40).

[11] Gmc only had a very peripheral /a:/ (cf. Ringe 2017: 242). OE /a:/ comes from Gmc /ai/ and OHG /a:/ comes from Gmc /e:/.

[12] The effect of umlaut on the OE diphthongs is omitted. See Wright & Wright (1908) for a full discussion.

[13] The behaviour of *a* and *æ* is more complex than the non-low vowels, sometimes involving raising as well as fronting. We do not address this issue, as this paper focuses on the class of *front rounded* vowels (umlauted *a*-sounds were never rounded). For a full discussion of so-called ‘primary’ and ‘secondary’ umlaut (which may potentially represent different processes), see Braune & Heidermanns (2023: 82ff.).

[14] The PLACE node dominates sub-nodes, ARTICULATOR, TONGUE HEIGHT, TONGUE ROOT. Lahiri (2018) points to the lack of dependency in FUL, which means there are no features such as [±anterior] and [±distributed] under [±coronal] (as this is difficult to reconcile with coronal underspecification, as pointed out by McCarthy 1988). The relevant part of the tree is given below:



Underspecification is justified not only on typological, but also empirical grounds, particularly in relation to the asymmetric processing of certain features in speech perception. That is to say, the perceptual feature-mapping process may result in one of three possibilities: (i) a match (a given feature is present in both acoustic signal and lexical representation), (ii) a mismatch (a feature is present in the signal but clashes with a contrasting feature in the lexical representation) or (iii) no-mismatch (e.g. [LABIAL] is present in the signal and does not clash with the underlying representation of a [CORONAL] phoneme, which is underspecified for place). For experimental and neurophysiological evidence for underspecification and asymmetric perception, see, for example, Lahiri & Reetz (2002), Friedrich and colleagues (2008), and Althaus and colleagues (2024). For instance, Cornell et al. (2013) demonstrate that certain manner features are contrastive in both directions (e.g. [NASAL]–[STRIDENT]), whereas others depend on the direction of featural change (e.g. [NASAL]–[PLOSIVE] or [CORONAL]–[DORSAL]). See also the discussion in §3.1.[15]

The present analysis provides the first formulation of the historical umlaut process within the FUL framework. A description of umlaut in this framework involves the deletion of the feature [DORSAL] in the context of a [HIGH] sonorant with underspecified ARTICULATOR (ART) features, as in Figure 1. Umlaut can thus be conceptualised as a harmonic process whereby a vowel preceding a [HIGH, COR] sonorant lost its specification for ART features which conflict with those of a following [HIGH, COR] sonorant (i.e. [DOR], as [LAB] may co-occur with either [COR] or [DOR]). This is illustrated in Table 2, where it can be seen that the deletion of the feature [DOR] from the back vowels results in the specification of the corresponding umlauted vowel. As [COR] is universally underspecified, this feature is thus filled in by later redundancy rules (for any segments now only underlyingly specified as [LAB], following the deletion of any [DOR] feature).

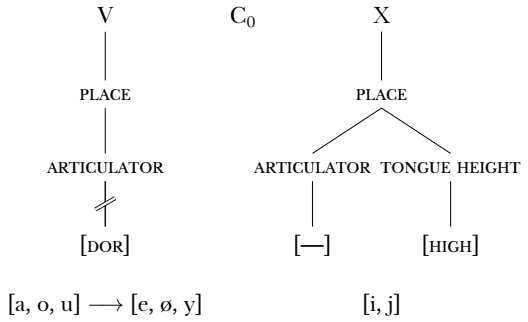


Figure 1: Umlaut as feature deletion

This approach has the benefit of parsimoniously accounting for umlaut as an assimilation process, as vowels and consonants share features and there are no dependencies relating to the PLACE features, [COR] and [DOR]. It also explains why vowels do not revert to [DOR] following the loss of the productive phonological umlaut rule, as the assimilation involves the delinking and loss of this feature. The eventual unrounding of these vowels in English thus involves the secondary deletion of the remaining [LAB] feature from the underlying representation; the resulting vowels, fully underspecified for PLACE, surface simply as [COR]. This contrasts with systems which assume the spreading of a binary [-back] feature. As [±back] is invariably assumed to be a specifically vocalic feature, /j/ presents a problem. It is difficult to account for umlaut as a single assimilatory process in any system which proposes separate vocalic and consonantal features, such as Clements & Hume's (1995) system, which (although using [CORONAL] for both vowels and consonants), assumes

[15] Similar processes, such as palatalisation, involving deletion of [DORSAL] are discussed in depth in Lahiri (2018).

completely separate tiers for V-PLACE or C-PLACE features. Another issue arises in systems which assume any sort of dependency relationships or separate articulator features for front vowels and palatal consonants, such as the system of Halle et al. (2000). Here, the [-back] feature which specifies front vowels is grouped with [dorsal] under the Tongue Body node (itself dominated by the Place node). This can still account for the fronting of /u/ to /y/ in the presence of /i/ (through the spread of a single [-back] feature rather than a node), as illustrated in Figure 2.

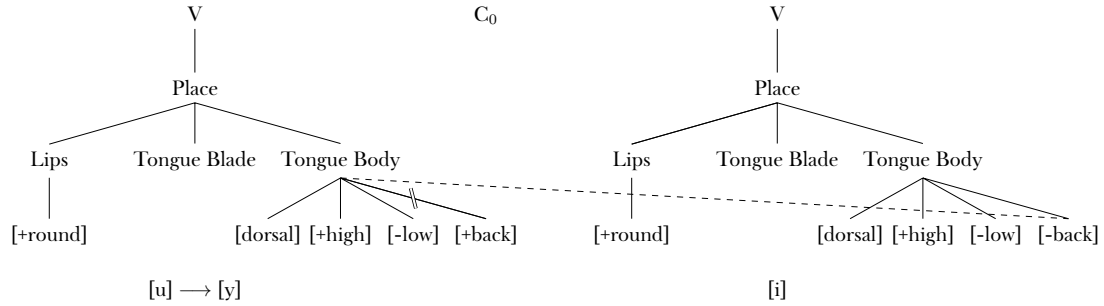


Figure 2: Umlaut as the spread of [-back], following Halle et al.'s (2000) feature system

However, how does this account cope with /j/ as a context for umlaut, along with /i/? Both must condition umlaut, as only /j/ provides the context for gemination (cf. Fikkert et al. 2006).[16] However, /j/ is specified for place by the features [coronal] and [-anterior], which are dominated by a totally separate Tongue Blade node (vocalic place features are dominated by the Tongue Body), as illustrated in Figure 3. The Tongue Blade features are not relevant for vowels and, in order to account for palatalisation processes, the authors are forced to specify additional rules stating that vocalic [dorsal, -back] is 'equivalent' to consonantal [coronal]: 'When the [coronal] specification of a consonant spreads to a vowel, creating a vocalic [coronal] segment, this new configuration is subjected to the equivalency relation, yielding a [dorsal, -back] segment' (Halle et al. 2000: 401). This redundant, additional machinery is required because, even assuming the independent spreading of multiple terminal features, there is otherwise no way to capture umlaut parsimoniously in such a system. This is no obstacle to FUL, which does not assume feature dependencies or the redundant, separate feature specification of consonant and vowel place. Instead, umlaut is simply an assimilatory process deleting [DOR] from a vowel before a [HIGH, CORONAL, SONORANT] segment.

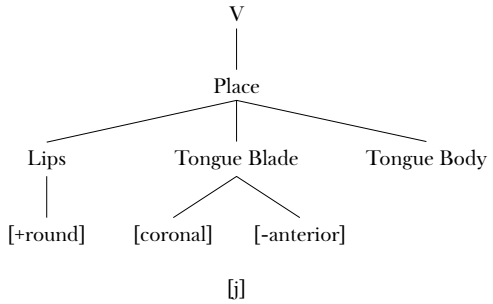


Figure 3: The incompatibility of /j/ with a feature-spreading assimilation account of umlaut, assuming Halle et al.'s (2000) feature system

[16] The distinction between the *i* and *j* stem extensions is crucial, as gemination only occurs before a *-j-* stem extension in light stem nouns (and not *-i-*). Compare the light stems *dyne* ('din': *i*-stem, no gemination) ~ *synn* ('sin': *jō*-stem, with gemination) with the heavy stems *gylt* ('guilt': *i*-stem, no gemination) ~ *wylf* ('she-wolf': *jō*-stem, no gemination). See also §4.1 for full derivations.

3. The modern picture

As mentioned above, the story usually told is that umlaut has been eradicated from contemporary synchronic English but morphologised and preserved in German (e.g. Nübling 2020). In many senses this is true: NE has lost the [LAB] contrast for [COR] vowels and only [DOR] vowels may be [LAB]. Furthermore, umlaut is totally unproductive and morpho-phonemic umlaut alternations are extremely rare. In contrast, German has a three-way phonemic contrast between [COR], [LAB, COR] and [LAB, DOR] vowels (e.g. /eː, øː, oː/) and umlaut has been fully morphologised. Vowel alternations are thus a feature of many NHG processes, particularly inflexion, where such alternations are more likely to survive, e.g. the formation of plurals, comparatives and superlatives, as well as changes in the mood of verbs.

However, this view is misleading. Although both languages have lost the productive *phonological* alternation (see §2), the underlying vowel inventory of English was in some senses *more* dramatically affected than German, as umlauted vowels remained [COR].[17] We argue that, due to historical differences in the phonological grammars of the two languages, umlaut applied in many more contexts in English than German, according to the presence or absence of certain stem extensions or affixes. Table 3 illustrates the most important noun classes. We argue that it is this very success which contributed to the ultimate demise of front rounded vowels, due to the scarcity of alternations to support the phonemic contrast.

	OE		OHG		Gothic		NE
	SG	PL	SG	PL	SG	PL	
a-/o-declension **NO UML**	stān	stānas	stein	steina	stáins	stáinōs	*stone*
	wund	wunde	wunta	wunta	wunds	wundōs	*wound*
	hund	hundas	hunt	hunta	hunds	hundōs	*hound*
i-declension **ALTERNATION**	hȳd	hȳde	hūt	h[yː]ti	**hūþs*	**hūþeis*	*hide*
	hype	hype/as	huf(f)	h[y]ffi	hups	hupeis	*hip*
	stede	stede/as	stat	steti	staþs	staþeis	*stead*
ja/jō- declension **ALL UML**	bed(d)	bed(d)	betti	betti	badi	badja	*bed*
	cyn(n)	cyn(n)	ch[y]nni	ch[y]nni	kuni	kunja	*kin*

Table 3: Patterns of umlaut in OE and OHG declensions: (a) *a-/o*-stem nouns (no umlaut); (b) *i*-declension nouns (SG~PL alternation in OHG but whole paradigm in OE); and (c) declensions with a /j/ stem extension (umlaut throughout the paradigm in OE *and* OHG). Forms from Gothic (which did not have umlaut) are provided for comparison.[18]

It should be noted that umlaut frequently occurred throughout the entire paradigm of a word in OE, where its OHG cognate was only affected before certain inflectional or derivational affixes. Compare OE *fȳst~fȳste* 'fist~fists' and OHG *fūst~fūsti* > MHG *vûst~viuste* > NHG *Faust~Fäuste* (< WGmc **fūsti*). It was thus far easier to reanalyse the umlauted vowel as underlying in OE than OHG, where the stem vowel would more often alternate within a paradigm. With no alternation, there was no reason to reconstruct an underlying [DOR] vowel once the conditioning /i/ or /j/ was lost (and no longer recoverable). As a result, /y/ was reanalysed as part of the underlying representation of stems and phonemicised. This resulted in a dramatic increase in front vowels in the modern English system. The vanishingly small number of alternating pairs which did exist were lexicalised, as in *tooth~teeth, fox~vixen, long~length* (< Gmc **laŋgiþā*), *blood~bleed* (< Gmc **blōdjan*)

[17] With the exception of a few words with obscure phonological development, e.g. *crutch, thrush*, *thrutch*, *worm*, *wort* (explaining the ‹o› spelling).

[18] Umlaut was additionally found in certain case forms of nouns (e.g. *cū~cȳ~cȳna* 'cow.NOM/ACC.SG~DAT.SG ~GEN.PL', cf. *kine*), verb conjugations (particularly the 2/3.sg form, e.g. *cymst* 'come.2SG' < *cuman*), and comparative or superlative forms (e.g. *fyrrest* 'far.SUP'), but these have been largely levelled out.

etc. These lexicalised forms have been particularly vulnerable to analogical levelling, as can be seen from the loss of plurals such as *bēc* ('books') and the archaic *kine* (which survived into literary modern English).[19]

As in English, umlaut has ceased to be a purely phonological process in German. However, unlike English, it has been reanalysed and survives as a morpho-phonological rule which interacts with inflectional and derivational affixes in complex ways. Various synchronic analyses have been offered, assigning varying degrees of importance to the phonology (e.g. Vennemann 1968; Bach & King 1970; Kiparsky 1982; Janda 1987; Yu 1992; Wiese 2000). German has underlyingly umlauted vowels in simplex words but they are far more widespread in complex forms, e.g. *Buch~Bücher* [buːx]~[byːçɐ] 'book~book.PL'; *Rock~Röckchen* [ʁɔk]~[ʁœkçən] 'skirt'~'skirt.DIM' (see below for an analysis of umlaut dependent on the stem rather than the suffix). Féry (1994) argues that the diminutive suffixes *-chen* and *-lein* productively cause umlaut, but only when they form a single foot with the stressed syllable of the stem (compare *Fotochen* [ˈfoːtoçən] 'photo.DIM' **Fötochen* *[ˈføːtoçən] and [haˈløːçən] *Hallöchen* 'hello-DIM'; see also Wiese 2000: 122ff.). For a discussion of the apparent exception to this productive rule in the case of pejorative diminutives, such as *Frauchen* [fʁaʊçən] 'woman.DIM', see Iverson & Salmons (1992).

It is worth noting that the number of words with an underlying umlauted (i.e. [LAB, COR]) stem vowel in German is surprisingly low: only 2 native monosyllabic nouns with [yː] (*Kür, Tür*) and 4 with [ʏ] (*Fürst, Glück, Müll, Stück*).[20] This is far fewer than the number of umlauted vowels which survive in NE as [COR] (e.g. *brine*, *din, fist, guilt, hide* etc.). For a full list of monosyllabic OE nouns with umlauted stem vowels which survived into NE, see the Appendix. Note that most words have retained an (unrounded) underlying coronal vowel, whereas the majority of the German cognates have *not* been inherited with an underlyingly umlauted stem vowel: *Braut, Haut, Luft* etc. (all [DOR]). Those which have survived with a [COR] stem vowel had an underlying /-j-/ stem extension historically, whereas strong *i*-stem nouns exhibit a singular-plural alternation but have [DOR] stem vowels, as illustrated by Tables 4–5 and predicted by our analysis in §4. Note that, due to the English Great Vowel Shift and 'Early Modern German Diphthongisation', long vowels in open syllables underwent subsequent qualitative changes in both languages, accounting for their modern forms.

OE	NE	NE Vowel	NHG	NHG Vowel
hrycg	ridge	ɪ	Rücken	ʏ
mycg	midge	ɪ	Mücke	ʏ
syn(n)	sin	ɪ	Sünde	ʏ

Table 4: OE and OHG light-stem nouns with a /-j-/ stem extension and their NE and NHG reflexes

OE	NE	NE Vowel	NHG	NHG Vowel
brȳd	bride	ʌɪ	Braut	aʊ
fȳst	fist	ɪ	Faust	aʊ
flyht	flight	ʌɪ	Flucht	ʊ

Table 5: OE and OHG *i*-stem nouns and their NE and NHG reflexes

However, unlike English, a highly productive morphological umlaut has developed in German. For instance, umlaut is central to plural inflection, where morpho-phonological stem

[19] Consider the following, from Hardy's *Tess of the d'Urbervilles*: 'The ripe hue of the red and dun kine absorbed the evening sunlight, which the white-coated animals returned to the eye in rays almost dazzling, even at the distant elevation on which she stood' (Hardy [1891]/2008: 102f.).
[20] Words such as *Typ* and *Tüll* are loans and *TÜV* is an acronym.

alternations are far more plentiful in the relevant noun classes: *Bl**a**tt~Bl**ä**tter , B**a**nk~B**ä**nke* [a]~[ɛ]*;* cf. English *blade~blades* [eɪ]~[eɪ], *bench~benches* [ɛ]~[ɛ]. Over time, the plural suffixes have generalised and the stem vowel alternations have become one of the most important markers of plurality (for nouns of all genders). Other than the plural suffix *-s* (restricted to foreign loans and words ending in a short tense vowel, e.g. *Auto~Autos* 'car~cars'), most plural suffixes are capable of triggering umlaut of the stem and the morphological *umlaut+suffix* plural has even been overgeneralised to new forms which never underwent phonological umlaut. The circumstances which led to such a structurally different reanalysis of surface patterns in German than in English are the focus here, and we now turn to the developments involved in this reanalysis.

3.1 A caveat: Reanalysis

The importance of declensional class and gender in supporting the phonemic status of front rounded vowels, is illustrated by OE, where umlaut provided clear evidence of both declension and gender. This would explain the retention of /y(ː)/ during the OE period, before its loss in early ME, as the gender system was being deconstructed. The class of *a*-nouns (masculine and neuter) made up more than half of all commonly used nouns in OE and less than a third of nouns were feminine, the majority of which were old *ō*-stem nouns (cf. Pyles & Algeo 1968[1982]: 113–115; Lass 1994). As umlaut did not occur in these classes, it became a marker of a number of smaller declensional classes, i.e. the masculine and neuter *ja*-stems, masculine and feminine *i*-stems and feminine *jō*-stems (for a list of all morpho-phonemic umlaut patterns, see Hogg 1992: 134ff.; Fikkert et al. 2006).

For example, the surface inflexional patterns *-Ø ~ -u* (NOM.SG~PL) and *-e ~ -u* (NOM.SG~PL) both indicate neuter gender, but the former is only found in *a*-nouns and never occurs with an umlauted vowel (e.g. *broþ~broþu* 'broth.SG~PL'). In contrast, *-e ~ -u* only occurs with front vowel stems (including umlauted vowels), either light *i*-stems or heavy *ja*-stems. The *i*-stems form a very small class and the handful of light stems nouns with /y/ all happen to be masculine, so the presence of /y(ː)/ in a stem inflected NOM.SG *-e* ~ NOM.PL *-u* unambiguously indicates a neuter *ja*-stem (e.g. *rȳne~rȳnu* 'mystery-SG~PL'). For a while, these paradigm structure conditions will also have supported the recoverability of underlying forms with /j/ (depending on declension, stem quantity and the presence or absence of gemination). Ultimately, however, the *a*-stem pattern was extended to all words except a few lexicalised exceptions following the breakdown of the gender system and neutralisation of vowel contrasts in final unstressed syllables. This meant that front rounded vowels no longer indicated any sort of morphological class membership, unlike other Germanic languages, where gender and some remnants of old declensional patterns remain. Front rounded vowels thus lose structural support and might easily be lost, forming few minimal pairs with words containing /i/. In contrast, German never lost grammatical gender and, as a result, the structure of the system instead favoured morphologisation and extension of umlaut.

This process went through two stages. In OHG (as in OE), there was a large class of neuter nouns with no overt marking in the plural (due to a process of high vowel deletion: see §4), e.g. *houbit~houbit* 'head~heads', *wort~wort* 'word~words' (cf. OE *word~word*). At some point—by which time phonological erosion of inflectional suffixes had rendered the underlying high vowel in the plural no longer recoverable—there must have been a strong drive overtly to mark the plural (cf. Kuryłowicz 1947, who argues that a complex, bipartite morpheme is preferable to a simple morpheme with the same function, particularly in relation to major morphological distinctions, such as number). These words were then analogically shifted into another class of *a*-stem nouns which did overtly mark the plural.

Grammatical gender was crucial in the choice of class. In English, following the loss of gender, there was no problem with shifting such words to the large class of masculine *a*-

stems. This led to the generalisation of the *-as* plural suffix and resulted in forms such as NE *heads, words*. For a time, German similarly extended the masculine *a*-stem plural /-ə/. However, gender distinctions were still crucial and many nouns of this type were shifted to a *neuter* class with overt plural marking: the consonantal *os*-stems. This gradual shift began in OHG (affecting roughly 20 words) but has extended to about 100 words in NHG. In OHG, these nouns inserted the umlauting element *-ir* (< Gmc *-*iz*) between the stem and plural affix, e.g. *lamb~lembir* > NHG *Lamm~Lämmer* 'lamb~lambs' (Braune & Heidermanns 2023: 260). This shift produced NHG plurals with stem vowel alternations where none existed in OHG (as phonological umlaut never applied), e.g. *Haupt~Häupter* and *Wort~Wörter*. Consequently, a small class of words with two (semantically or functionally distinct) plurals also exists in German: one with umlaut and one without, e.g. *Worte~Wörter* 'words' and *Lande~Länder* 'lands/countries' (cf. Wright [1888]/1951: 30f.; Jones & Jones 2019: 88). For instance, *Worte* refers to one's 'words' (in the sense of an utterance or saying), while *Wörter* is the plural of individual words, as in *Wörterbuch* 'dictionary'.

It has been stated above that most plural affixes In German may potentially trigger umlaut but need not necessarily do so, which has historically been difficult to account for, particularly given the fact that even words which do not form their plural with umlaut do so in the diminutive (provided the phonological conditions are met), e.g. *Boot~Boote~Bötchen* [boːt~boːtə~bøːtçən] 'boat~boat.PL~boat.DIM'. Wiese (2000) posits a floating umlaut attached to the plural morpheme, but it has also been argued by Lahiri & Reetz (2010), based on experimental evidence, that umlaut in the plural is just as regular as in the diminutive, based on an analysis assuming underspecification of the feature [COR]. Essentially, the usual redundancy rule simply adds the feature [COR] to vowels underlyingly specified as [LAB], but with no other ART features. The assumption here is that those vowels which surface with a dorsal vowel in the singular and an umlauted vowel in the plural are subject to a morpheme-specific rule which applies to such stems in the singular and overrides the usual [COR] redundancy rule, filling in underspecified [LAB] vowels with [DOR] instead. Words which are underlyingly specified as [DOR] then have a separate stem for the diminutive, which is underspecified for ART.

The application of umlaut in the singular and plural is therefore fully predictable and accounted for by coronal underspecification and the regular application of the same redundancy rule found elsewhere in the grammar. The difference between vowels which do and do not undergo umlaut in the plural (e.g. *Stoff~Stoffe* vs. *Kopf~Köpfe*) is therefore due to the underlying specification of the stem vowel ([LAB, DOR] vs. [LAB, —]). In the singular, both surface as [LAB, DOR], due to the stem-specific rule providing the feature [DOR] to underspecified vowels in the singular. In the plural, the fully specified vowel remains dorsal, but the underspecified vowel surfaces as coronal. Stems with underlying [DOR] vowels then have a separate diminutive stem listed in the lexicon, explaining the asymmetry between words such as *Boot~Boote~Bötchen* and *Kopf~Köpfe~Köpfchen* 'head~head.PL~head.DIM'. This is illustrated in Table 6 (for an analysis of umlaut in verb forms, see Plank & Lahiri 2015).

Therefore, although the occurrence of umlaut can be explained on historical grounds, it is not necessarily clear from the point of view of synchronic processing how listeners who hear an inflected form with an umlauted vowel are able to access the non-umlauted base form's lexical representation. The fact that an umlauted form may or may not have an umlauted base (i.e. the status of the base vowel is not predictable based on the inflected form) rules out a simple operation which somehow 'undoes' umlaut. This account, drawing on experimental evidence, instead explains base-form lexical access with reference to phonologically underspecified mental representations. Competing frameworks which assume segmental representations or reject underspecification struggle to account for these facts.

	Singular		Plural		Diminutive	
	UR	SF	UR	SF	UR	SF
Tür	[LAB, —]	*Tür* [t**y**:ɐ] [LAB, **COR**]	[LAB, —]	*Türen* [t**y**:ʁən] [LAB, **COR**]	[LAB, —]	*Türchen* [t**y**:ɐçən] [LAB, **COR**]
Hund	[LAB, DOR]	*Hund* [hʊnt] [LAB, DOR]	[LAB, DOR]	*Hunde* [hʊndə] [LAB, DOR]	[LAB, —]	*Hündchen* [h**ʏ**ndçən] [LAB, **COR**]
Kuss	[LAB, —]	*Kuss* [k**ʊ**s] [LAB, **DOR**]	[LAB, —]	*Küsse* [k**ʏ**sə] [LAB, **COR**]	[LAB, —]	*Küsschen* [k**ʏ**sçən] [LAB, **COR**]

Table 6: Underlying representation (UR) and surface form (SF) of (non-)umlauted singular, plural and diminutive forms of (a) *Tür* ('door': underspecified), (b) *Hund* ('dog': underlyingly [DOR], with separate diminutive stem) and (c) *Kopf* ('head': underspecified, with stem-specific SG [DOR] rule). Features assigned by rules are provided in bold type.

An interesting complement to the contrasting NE and NHG systems is presented by certain Bavarian dialects, which represent a compromise between the developments found in NE and NHG. These dialects, have developed morphological umlaut but *also* undergone unrounding of the [LAB, COR] vowels inherited from Middle High German (MHG). They therefore seem to have dispreferred having vowels specified for both [COR] and [LAB] (just like English), unrounding the front vowels and merging them with the unrounded front vowels (which are often diphthongised). However, the crucial difference to English is that these Bavarian dialects still maintain morphological umlaut, as in standard NHG. Here, the alternation is simply between [COR] and [LAB, DOR], rather than [LAB, COR] and [LAB, DOR], as in (2).

(2) Comparison of Regensburg dialect and NHG variants for 'hat' and 'hat.PL' (Frans Plank, personal communication).

(a) NHG: [hu:t] 'hat' [LAB, DOR] ~ [hy:tə] 'hat.PL' [**LAB**, COR]

(b) Regensburg dialect: [huət] 'hat' [LAB, DOR] ~ [hiət] 'hat.PL' [COR]

This demonstrates that (i) even with an important morphological alternation, the front rounded vowels are vulnerable to loss but—perhaps more importantly—(ii) the morphological process of umlaut is central to the German grammar and robustly preserved, even without a separate phoneme. This is the pivotal distinction between German and English. In the former, alternations within paradigms led to a morphologisation of umlaut, whereas in the latter umlaut was far more pervasive; so much so, in fact, that umlaut was reanalysed as part of the underlying representation of stems. These historical developments will be the subject of the following section.

4. Why was German, but not English, able to preserve an umlaut alternation?

As has been emphasised, unlike German, English shows evidence of umlaut across paradigms, leaving almost no alternations in nouns or verbs.[21] Both languages had several interacting phonological processes, such as such as high vowel deletion and gemination. The answer is to be found in the relative ordering (or ranking) of umlaut and a process of high vowel deletion (HVD) common to the early WGmc languages which interacted with gemination found in light stems. If umlaut applies first, as in OE, then it will apply anywhere where there is an underlying [COR, HI] vowel or glide. But, if HVD precedes umlaut, as in

[21] OHG weak verbs (particularly Class I *jan*-verbs) showed umlaut alternations in heavy stems, e.g. *stellen~stalta* (heavy stem: no umlaut in the preterite), whereas light stems had umlaut throughout, e.g. *zellen~zelita*.

OHG, then the conditioning [COR, HI] segment is deleted in many relevant contexts, resulting in a less extensive application of umlaut (accounting for the alternations observed in the data). The distinction between underlying [COR, HI] vowels and glides is thus highly relevant, as only /j/ triggered WGmc consonant gemination (WGCG). The umlaut rule is defined in §2.1, but Figures 4–5 define the major HVD and WGCG rules relevant for OE and OHG. The processes themselves have a long history of discussion in the literature but the analysis of HVD presented here follows Dresher & Lahiri (1991, 2022; see also Booth 2023; Booth & Lahiri 2023). See Bermúdez-Otero (2005) and Goering (2023) for analyses assuming a strict moraic trochee but for present purposes, the distinction is not crucially important.

For a full discussion of the differences between OE and OHG gemination (with OE—but not OHG—gemination absorbing the /j/), see Lahiri (1982) and Fikkert et al. (2006). In OE, G was accompanied by the loss of the glide (i.e. total assimilation) and remaining glides were syllabified (Lahiri 1982). Due to historical developments affecting OE, the underlying glide never surfaced following gemination, so learners were able to reanalyse WGCG as a single process which involved the deletion of the glide which caused it (Fikkert et al. 2006: 138). This is in contrast to OHG, cf. /kunn-j-Ø/ > [kynni] 'race.NOM/ACC.SG', where the underlying glide is vocalised, surfacing as /i/.

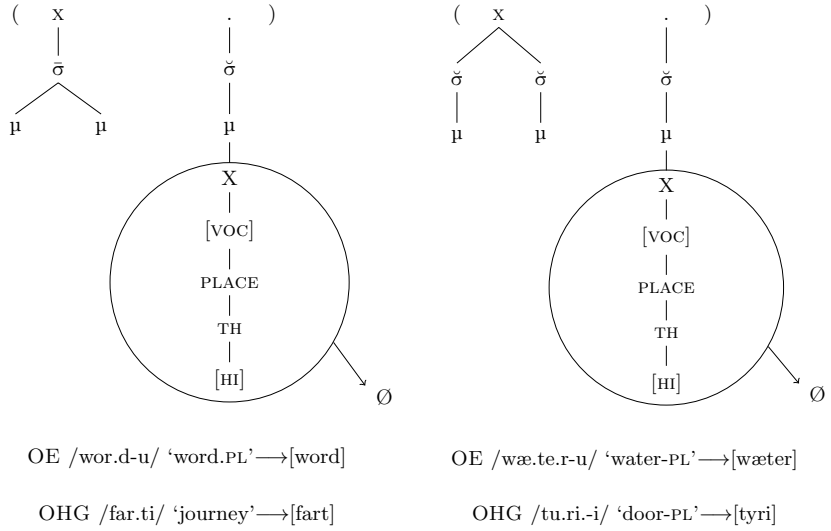


Figure 4: High vowel deletion (HVD) in OE and OHG: Delete an unstressed high vowel following the strong branch of a foot (either two 'light' -V syllables or a single 'heavy' -VV or -VC syllable).

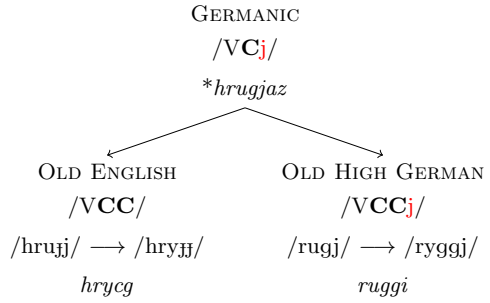


Figure 5: WGmc consonant gemination (WGCG): blocked following /r/ or a heavy syllable: *rr, *-VVCᵢCᵢ, *-VCCᵢCᵢ. (i) OHG: Geminate a consonant immediately followed by the high front glide /j/; (ii) OE: Fully assimilate the high front glide /j/ to a preceding consonant.[22]

[22] There is disagreement over the phonetic realisation of ‹cg› in Old English (see Stenbrenden 2019). Whether it was realised as a palatal stop [ɟ], an affricate [dʒ] (or even a palatalised [gʲ]), the crucial point here is that it was underlyingly geminated.

It is important to make clear that, whilst phenomena such as WGmc consonant gemination and umlaut are, from a diachronic perspective, historical changes which affected the relevant languages, the present analysis approaches OE and OHG as *synchronic* systems. These systems had native speakers, with full phonological grammars (just like the modern languages) and children acquired their grammars from the previous generation. Viewed as a synchronic snapshot, these historical changes were productive phonological processes in the grammars of speakers. Umlaut presents a clear illustration of this point: during the historical period of interest here, it was still a productive phonological rule, but once its triggering environment was no longer recoverable, successive generations reanalysed this formerly allophonic rule and phonemicised the products of umlaut, either (i) reanalysing them as part of the underlying stem (as in English or non-alternating words in German), or else (ii) morphologising umlaut, reanalysing the rule as a morpho-phonological alternation (as occurred in German).

Claims such as Janda (1999, 2003: 409 ff.) that phonologisation had to precede the loss of the conditioning environment, due to the so-called phonologisation problem (namely why the allophonic alternants should remain after the conditioning environment is lost, see Kiparsky 2015) overlook the fact that such changes will pass through several stages of increasing opacity (cf. Purnell & Raimy 2015), until the underlying back vowel is no longer recoverable for learners and reanalysis of underlying forms occurs. For instance, following early non-contrastive variation at the phonetic level (Bermúdez-Otero 2015), surface [y] becomes a transparent allophone of [u]. However, due to sound change, the alternation gradually becomes opaquer. The process thus passes through a transitional stage where underlying forms are still recoverable but learners never produce it themselves, accounting for the survival of the alternant, potentially drawing on other structural evidence (e.g. the presence or absence of geminates or particular affixes; see §3.1). However, a point of rupture will arise when subsequent generations would be unable to reconstruct the same underlying form, leading to reanalysis and phonemic split (i.e. /u/ ≠ /y/ ≠ /i/). The role of opacity and reanalysis is rarely foregrounded in accounts of such processes.

Crucially, at the stage of OE and OHG, HVD and WGCG were productive phonological processes which were still recoverable for learners, even though their interactions led to opacity. Most importantly, the underlying representations of the relevant words (particularly the underlying glide /j/!) were also recoverable, as argued in detail in Lahiri (1982; see Schmierer 1977; Dresher 1978 and Kiparsky 2009 for alternative analyses with underlying /i/). For instance, in the case of neuter *a*-stem nouns, the /j/ would surface word-finally as [i] in NOM/ACC.SG/PL forms, and light stems of verbs ending /jan/ would alternate between ‹C:an› and ‹rian› (due to the constraint against geminating /r/), e.g. OE *dynnan* ‘to make a din’ vs. *styrian* ‘to stir’.[23]

In the process of acquisition, reanalysis may lead to a restructuring or reordering of rules (cf. Kiparsky 1982; 1988; [2003]/2006). The ordering of umlaut relative to HVD is the central concern here: due to the fact that OHG apparently ordered HVD before umlaut, a large number of potential triggers were removed, yielding the alternations observed in the data (see Lahiri 1982).[24] In contrast, as OE ordered umlaut prior to both WGCG and HVD, it did not matter whether the triggering /j/ or /i/ was deleted at a later stage in the derivation; umlaut had already applied. This explains the pervasiveness of umlaut across paradigms, even where no overt affix surfaces. Crucially, at this point, the underlying forms were still

[23] That these geminates were not underlying was clear from 2/3SG.PRES forms, in which there was an alternation in words with underlying /Cj/ sequences, but not in those with underlying /C:/, e.g. *zellen~zelis* ‘tell.1SG~2SG’ vs. *stellen~stellis* ‘stay.1SG~2SG’.

[24] For an illustration of how such a rule ordering might be accounted for within an OT framework, see Kiparsky 2009

recoverable, but this situation would not endure (eliminated by the erosion of case markings). Tables 7–8 compare the derivations of cognate OE and OHG nouns and verbs, illustrating the importance of the respective rule orderings in deriving the correct output forms.

UR	HVD	Umlaut	WGCG	SF	
/hu:ti-Ø /	hu:t			[hu:t]	*hūt*
/hu:ti-i/	hu:ti	hy:ti		[hy:ti]	*hūti*
/huffi-Ø /	huff			[huff]	*huf(f)*
/kun-j-Ø/		kynj	kynnj	[kynni]	*chunni*
/kun-j-u/	kunj	kynj	kynnj	[kynni]	*chunni*
/and-j-u/	andj	endj		[endi]	*endi*
/kus-j-en/		kysjen	kyssjen[25]	[kyssen]	*chussen*
/θurst-j-en/		θyrstjen		[θyrsten]	*thursten*

Table 7: Derivations of OHG *i*-stem nouns and word forms with underlying /j/ stem extensions. Note the SG~PL alternation in *i*-stems, unlike OE (relevant rows highlighted). UR=underlying representation, SF=surface form.

UR	Umlaut	WGCG	HVD	SF	
/hu:di-Ø /	hy:di		hy:d	[hy:d]	*hȳd*
/hu:di-i/	hy:dii		hy:di	[hy:de]	*hȳde*
/hupi-Ø /	hypi			[hype][26]	*hype*
/kun-j-Ø/	kynj	kynn		[kynn]	*cyn(n)*
/kun-j-u/	kynju	kynn		[kynn]	*chun(n)*
/and-j-as/		endias	endas	[endas]	*endas*
/kus-j-an/	kysjan	kyssan		[kyssan]	*cyssan*
/θurst-j-an/		θyrstian	θyrstan	[θyrstan]	*þyrstan*

Table 8: Derivations of OE *i*-stem nouns and word forms with underlying /j/ stem extensions. Note that umlaut applies in every case, in contrast to OHG.

Once the evidence for these underlying forms disappears, the situation becomes ripe for reanalysis. Where there is no alternation, there is no reason for learners to posit an abstract underlying [DOR] stem vowel and OE umlauted vowels were reanalysed as underlyingly [LAB, COR]. The few remaining alternations were lexicalised and many such forms have subsequently fallen away due to analogy (e.g. †*bēc*, *kine*). All that remains is a handful of SG~PL or noun~adjective pairs, e.g. *louse~lice*, *tooth~teeth*, *long~length, full~fill*, as well as a very few old strong feminines, e.g. *fox~vixen*.

In contrast, German featured many more stem vowel alternations due to its higher ranking of HVD, preventing a similar reanalysis. Umlaut was therefore reanalysed as a morphological marker and has since become one of the most important markers of plurality in German. There is even some evidence that it was already morphologised in OHG (cf. Braune & Heidermanns 2023) and that this was related to its phonemicisation (and thus orthographic marking). Ultimately, alternations appear to have supported the contrast, but the erosion of case endings in all of the Germanic languages put paid to umlaut as a productive, purely phonological rule.

[25] As with the OE derivation, an additional, later rule (specific to OHG) has been elided. In this case, it is the deletion of glides in prevocalic position when preceded by another onset consonant, as in /kyssjen/>/kyssen/ and /θyrstjen/>/θyrsten/.

[26] A number of additional rules apply, which are not directly relevant to the present analysis and are thus elided in the derivation. These include a vowel-lowering rule whereby underlying word-final /i/ surfaces as /e/ (e.g. /hypi/ > /hype/). Similarly, underlying /j/ which does not trigger gemination is vocalised to /i/ before being removed by HVD. Here, this has been subsumed under the WGCG rule for simplicity, as it is only relevant for forms such as *endas* and *þyrstan*, where the /j/ does not surface. For a full discussion of the relevant processes, see Lahiri (1982).

5. Typological patterns

The umlauted vowel /y(ː)/ was a well-established phoneme in OE, surviving into ME (even warranting its own orthographic letter), yet—with remarkable consistency—it disappears from *all* pre-modern English varieties (Wright [1905]/1968: 152ff.). This is all the more striking, given English's proclivity for fronting back vowels, e.g. contemporary SSBE 'GOOSE-fronting' (Jansen & Mompean 2023) and comparable developments in other modern dialects, e.g. Lancashire, Cheshire and Greater Manchester (Wells 1982). Even in OE, /w/ tended to cause rounding of /e/ to /ø/ in Northumbrian (Hogg 1992: 203) and northern ME again fronted /oː/ to /øː/, subsequently raised to /yː/ (via the Great Vowel Shift). In English dialects, this new /yː/ again disappeared, often resulting in fully or partially unrounded diphthongs, e.g. [ɪʊ], [ju] or [ɪə]. If systems with [LAB, COR] vowels are 'close to a Germanic "archetype"' (Lass 1989: 164), why have these sounds failed to survive in English?

It is well-documented that front rounded vowels are typologically rare and highly marked outside of geographically restricted clusters in Eurasia (cf. Maddieson 2013; Blevins 2017) and analyses often draw on evidence from the UPSID (Maddieson & Precoda 1990) and WALS (Dryer & Haspelmath 2013; in particular Maddieson 2013) databases. However, explanations typically refer to areal features, overlooking the fact that these clusters mainly comprise genetically-related languages with structural similarities. Reference is often made to perceptual magnet effects (e.g. Maddieson 2003), suggesting that front rounded vowels are supported by language contact, resulting from 'widespread diffusion' (Blevins 2017: 105). We propose instead that geographical clusters result from the fact that related languages will (as a result of their shared history) share a number of systematic structural features which may or may not serve to stabilise and support certain featural contrasts. It is hard to accept the clustering of this areal feature in particular language families, such as Germanic, Uralic and Turkic, as coincidental, when they are so rare in equally geographically close Romance, Balkan or Slavic languages. Nor is it clear why they should be retained in language communities which are geographically isolated from other languages with such vowels (e.g. Icelandic or Iaai, spoken on the island of Ouvéa in New Caledonia).

A large number of minimal pairs, as in French (e.g. *si* [si] 'if', *su* [sy] 'know.PST.PTCP', *sous* [su] 'under'), might be expected to favour a three-way contrast but a series of front rounded vowels need not necessarily be retained in order to prevent merger. Nor does a low functional load in terms of lexical contrasts guarantee that marked phonemes will be lost and 'nonesuch' phonemes like /θ/ or /ʈ/ may survive (Kennard & Lahiri 2020). Although this was true of English front rounded vowels (merger of /y/ and /i/ did not trigger a collapse of contrasts within the lexicon), German, shared the same structural inheritance and retained them. There is furthermore no reason why [LAB, COR] vowels should be any less learnable in English when they appear in a *greater number* of underlying stems. This also discounts the possibility of frequency effects. Although [LAB, COR] vowels appear with high frequency in a language like French (cf. Malécot 1974, due to its presence in the indefinite article [yn], familiar 2SG pronoun [ty] and [dy] 'of'), [y] occurred in more surface forms in OE than OHG.

We suggest that the present analysis of the differences between English and German reflects a typological tendency; contrastive rounding amongst front vowels is marked and vulnerable to loss, should it not be supported by a functional or structural role within the linguistic system, such as participating in morpho-phonological alternations, preserving the distinctiveness of a morphological class or interacting with broader structural patterns (e.g. phonotactic constraints, distributional restrictions or dissimilatory processes). To explore this hypothesis, a search for all languages containing front rounded vowels was conducted in UPSID and WALS (which differ slightly in their language inventories). Of the 569 languages

reported, the vast majority contained no such vowels. Only 33 (5.8%)[27] featured front rounded vowels. The distribution is illustrated in Table 9. Note that the data set is intended to be balanced and 'maximize both genealogical and areal diversity' (Comrie et al. 2013), such that only a subset of Gmc languages is included (i.e. English, German and Norwegian).

	Total	Percentage	Example languages
No [LAB, COR] vowels	536	94%	Dakota, English, Lai, Maori, Swahili
Vowel Harmony languages	18	3%	Finnish, Korean, Kirghiz, Tibetan, Turkish
Non-alternating [LAB, COR] vowels	12	2%	Aikanã, Breton, Cantonese, French, Fuzhou
Umlaut alternation languages	3	0.5%	German, Iaai, Norwegian

Table 9: Distribution of [LAB, COR] vowels (i.e. /y, ʏ, ø, œ/) across the languages reported in UPSID and WALS.

Vowel harmony languages (mostly Finnic or Uralic) are particularly prone to front vowels, especially where all vowels within a certain domain must agree for the features [LAB] or [COR] (see Hulst 2018). The clear majority of front rounded vowel systems involve vowel harmony, which was also a historical feature of Selkup (the only Uralic language without synchronic vowel harmony in the data). There are also three umlauting languages in the sample: German, Norwegian (which has a restricted, largely lexicalised process of umlaut which appears to interact with tone, cf. Kristoffersen [2000]2007) and (non-Gmc) Iaai, where morpho-phonological alternations are a key feature of transitivisation processes (for full details, see Lynch 2002: 785; Dotte 2013: 192f.).

The remaining languages in Table 9 (with underlying (non-alternating) [LAB, COR] vowels) follow the same general tendencies, as summarised in Table 10. The only non-Gmc Indo-European (IE) languages with [LAB, COR] vowels are represented in the selection: French, Breton and Albanian. These languages did not inherit front rounded vowels from PIE (only Turkic and Uralic inherited these vowels, hence their local prevalence). In the case of French, inherited /u/ fronted to /y/ in Old French, with /o/ subsequently raised to /u/, resulting in a three-way contrast. Other IE languages also developed front rounded vowels in their documented history but subsequently lost them, e.g. Greek.

Three other languages, Aikanã (Aikhenvald & Dixon 1999: 362), Highland Chinantec (Robbins 1968) and Hopi (Jeanne 1978) are geographically isolated from other languages with a similar contrast. Unfortunately, little information is available for these underdocumented languages; for instance, the information on Hopi /y/ comes from a published letter). It is worth noting that Maddieson (2013) casts doubt on the reliability of reports of such languages, which lack phonological detail beyond phonemic inventories and a description of a handful of phonological rules.

Breton (the only Celtic language with front rounded vowels) is geographically isolated from other Brythonic varieties but overlaps geographically with French, with all speakers being Breton–French bilinguals. Language contact conceivably plays a role in this case, with the contrast finding support in French /y/ and /ø, œ/ (represented by the graphemes ‹u› and ‹eu› in both languages). As mentioned above, French front rounded vowels have emerged from Latin back vowels and been retained. Here, /y/ plays a morphological role in defining the class of third conjugation verbs, which regularly form the past participle with the addition of the affix /-y/ (< Lat. *-utum*), e.g. NF /vãdy/ 'sell.PST.PTCP' < OF *vendut*. This class is also augmented by a substantial number of irregular past participles with stressed /-y/ (featuring a vowel alternation between INF and PST.PTCP forms), e.g. *avoir* [avwaʀ] ~ *eu* [y], *lire* [liʀ] ~ *lu* [ly], *voir* [vwaʀ] ~ *vu* [vy], *boire* [bwaʀ] ~ *bu* [by] etc. Thus, /y/ has survived with morphological alternations (associated with the perfect tense).

[27] 8 additional languages were excluded, as they were erroneously reported in the databases as featuring front-rounded vowels, often due to reading error (resulting from discrepancies in transcription, e.g. ‹y› indicating /j/) or cases where the vowel is in fact explicitly central, as in Natügu (Boerger 1996).

Language Family	Language	Structural properties involving [LAB, COR] vowels	
Indo-European	Albanian	Potentially underlyingly central vowels, with labialisation a phonetic enhancement resulting in perceptual centring.	Hitch (2017: 9)
	Breton	Intense language contact with French.	Kennard (2022)
	French	Alternations associated with the past participle, particularly the third conjugation verbs.	Schane (1968)
Sino-Tibetan	Cantonese	Labial dissimilation constraint against tautomorphemic sequences of [LABIAL] segments.	Yue-Hashimoto (1972: 139); Bauer & Benedict (1997)
	Fuzhou	Vowel alternations, depending on tone, e.g. /y/~/øy/, /øy/~/œy/.	Donohue (2017)
	Lìjiāng Naxi	The phonemic contrast between /h/ and /ç/ is neutralised before all vowels except /y/.	Michaud (2006); Michaud et al. (2015)
	Mandarin	Rhyme PLACE harmony constraint preventing rhyme sequences not agreeing in rounding or backness.	Duanmu (2007: 60ff.; 2011: 2)
	Changzhou[28]	Distributional restrictions: no nasal counterpart of /y/ and restricted to open or /-ŋ/ final syllables.	Chao (1970)
Uralic	Selkup	Historical vowel harmony; distributional restriction of [LAB, COR] vowels; labiality weakly articulated.	Klumpp & Budzisch (2023)

Table 10: Structural properties of [LAB, COR] vowels in the remaining languages which appear in the UPSID and WALS selection (i.e. those without vowel harmony or umlaut alternations).

For the five additional Sino-Tibetan languages, front rounded vowels again appear to play a role in the morpho-phonological structure of the language (see Table 10). It is worth noting, however, that a number of authors have called the phonemic status of high front rounded vowels into question in both Cantonese and Mandarin (e.g. Benedict 1942 and Chao 1947 for Cantonese; Pulleyblank 1984 and Wang 1993 for Mandarin).

6. Pertinacity

The changes discussed in this paper highlight the diachronic pertinacity of phonological structures, despite the sometimes quite divergent outputs in different historical periods of related languages, such as English and German. We borrow the term 'pertinacious' in its technical sense from Lahiri (2002) and Dresher & Lahiri (2005), but for a thorough discussion of the issue, see also Lahiri & Kennard (2015). Pertinacity is a characteristic of grammars and can take two different forms, as described in (4).

(4) Pertinacity (after Lahiri & Kennard 2015).

(i) The persistence of a particular pattern in a language may apply to new forms and different outputs may emerge.
[A] S*ame pattern, different output realisation*

(ii) Persistence of output forms may occur despite changes in the grammar. Such change always involves a reanalysis of the output form, provoked by changes elsewhere in the system.
[B] *Different pattern, same output realisation*

[28] Unfortunately, phonological descriptions of this variety are restricted to phonemic descriptions.

In these terms, English and German have both been highly pertinacious, *but in contrasting ways*. This is due to the historical developments which have affected umlaut and been the focus of this paper. As many more word forms were affected by umlaut in English, across entire paradigms, alternating pairs were scarce (or ultimately levelled out). As a result of this lack of alternation, surface forms were reanalysed as containing an underlying front stem vowel. Why, when confronted with forms such as *ende~endas*, would learners assume that they were derived from underlying /and/ once there was no longer sufficient evidence to recover the underlying /and-j/? The stem was thus reanalysed as /end/ and a separate rule of umlaut became redundant, disappearing from the grammar. Lacking evidence from phonological alternations, umlaut could not survive as a synchronic rule and was lost, resulting in a dramatic increase in the number of [COR] vowels in underlying stems in English. We thus find the same output realisation ([LAB, COR] vowels), but with a reanalysis of the underlying forms, i.e. Pertinacity B. However, the [LAB, COR] vowels, particularly /ø, y/ had no support from morpho-phonological alternations, which led to a secondary change to their less-marked unrounded [COR] counterparts, /e, i/. Recall that long /eː/ and /iː/ participated in the Great Vowel Shift, becoming /iː/ and /ʌɪ̯/ (*goose~geese, mouse~mice*).

In contrast, German retained alternations in many more contexts, due to the earlier application of HVD in OHG. Once the high vowels which had triggered umlaut were no longer recoverable, learners reanalysed a number of umlauted stem vowels as underlying (as in English), but this was only possible for words where there was no alternation, such as those which had historically had a /j/ stem extension (e.g. *Mücke* /mʏkə/ 'midge'). However, many more words had a surface stem vowel alternation and learners were thus unable simply to reanalyse all stems and lexicalise a few exceptions, as English learners had. Instead, umlaut was morphologised and reanalysed as a productive rule which operates within morphological paradigms. Umlaut was consequently extended to many words which historically never had an alternation, e.g. OHG *hof~hofa* 'court.NOM/ACC.SG~PL'; *stuol~stuola* 'chair/stool.NOM/ACC.SG~PL' (NHG *Hof~Höfe*; *Stuhl~Stühle*). The fact that the umlaut rule was retained, but that output alternations were increased, demonstrates that, unlike in English, the same pattern prevailed in German, but with a different output realisation: Pertinacity A.

5. Conclusion

Umlaut, common to both OE and OHG, involved the loss of the feature [DOR] from back vowels before a following (underspecified) high coronal vowel or glide, resulting in the fronting of the back vowel; both segments thus surfaced as [COR]. Significantly, rounded back vowels retained their [LAB] feature (and therefore rounding), resulting in a new class of front rounded vowels. The analysis presented here treats historical stages of English and German as synchronic systems with full phonological grammars. Umlaut survived for centuries as a productive phonological rule in the synchronic grammars of both languages, during which time front and back rounded vowels alternated. In the earliest stages of the WGmc languages, umlaut was a transparent rule, but over time, this rule interacted with other changes, gradually becoming more opaque, as the triggering segment did not always surface.

In the OE and OHG periods, these segments were, however, crucially still recoverable *and* mutually distinct (compare OE *cynn* /kunj-Ø/ > [kynn] 'race' and *sife* /sifi-Ø/ > [sife] 'sieve'). Umlaut is therefore still a productive rule at this stage. What we do find, though, is a restructuring and reordering of earlier WGmc rules. The two related languages shared many rules, such as WGmc gemination, although many had been generalised or combined and some rules had been lost or added (cf. Lahiri 1982). The most important difference in relation

to umlaut was the presence or absence of the trigger, due to the relative ordering of umlaut, G and HVD (which removed /i/ and /j/ in a number of contexts). In OHG, HVD preceded umlaut, meaning that back stem vowels were preserved in a great many more contexts than in OE, where umlaut preceded HVD and applied much more widely. Therefore, for several classes of words, we find umlaut throughout paradigms in OE, but a paradigmatic alternation in OHG. This is where the distinction between underlying /i/ and /j/ becomes relevant.

This situation remained relatively stable, as the rules and underlying forms—although opaque—were still recoverable. The real divergence came once the reduction of unstressed vowels removed the context for the umlaut alternation and put paid to it as a productive phonological rule. This resulted in a phonemicisation of the umlauted vowels in *both* languages (cf. *bridge–Brücke*). Learners were therefore forced to reanalyse the surface structures they encountered and, as umlaut had been so successful in OE, there were only a handful of alternations available and next to no evidence for underlying back vowels. The umlauted stem vowel was thus reanalysed as underlyingly front, e.g. *dryncˑdryncas* 'drink~drinks'. When the evidence for a regular phonological rule disappeared, German words with no alternation were similarly reanalysed (e.g. *Brücke–Brücken*). However, learners were also faced with large classes of words which exhibited umlaut alternations within their paradigms. Umlaut was therefore reanalysed as a morphological alternation, becoming one of the most important plural markers (e.g. *Buch–Bücher*) and a productive alternation triggered by certain affixes, such as the comparative *-er*. Umlaut has even been generalised and extended as a plural marker, including words which were never historically affected by phonological umlaut, e.g. *Wort–Wörter*.

As English reanalysed /y(ː)/ as underlying (/øː/ having been unrounded and lost in early OE), the question becomes why these phonemes should disappear from every dialect, whilst German retained them. *The answer lies in the presence or absence of alternations*. Front rounded vowels are highly marked typologically and it appears that (morpho-)phonological alternations are important in maintaining a three-way contrast between front unrounded, front rounded and back rounded vowels. The contrast between [COR] and [LAB, COR] was lost in English, but not in German, where umlaut supported the contrast, despite the number of words with underlying front rounded stem vowels actually being much lower (fewer than ten inherited monomorphemic monosyllabic nouns with /y/ or /ʏ/, see §3). The English vowels were therefore unrounded, merging with the unrounded [COR] vowels.

The net effect is a substantial increase in the number of underlyingly front stem vowels in English (and a corresponding decrease in the number of underlying back vowels), but a loss of the productive rule. In contrast, German retained (morphologised) umlaut, but has very few underlying [LAB, COR] vowels, meaning that the underlying representation of stem vowels was actually far less radically affected than English. The concept of pertinacity is important here: following the loss of umlaut as a phonological rule, English maintained the same surface forms, but underwent a dramatic reanalysis of the underlying stems (i.e. different pattern, same output: *Pertinacity B*), whereas German reanalysed and generalised umlaut, extending it to new forms but maintaining the same underlying stem vowel for most words—i.e. same pattern, different output (*Pertinacity A*).

APPENDIX

OE monosyllables with a high front rounded vowel which survived into the middle and modern periods. To this list may be added a large number of words which were disyllabic in OE, but have survived into NE as monosyllables.

OE	NE	NE Vowel	NHG	NHG Vowel
brycg	bridge	ɪ	Brücke	ʏ
brȳd	bride	ʌɪ	Braut	aʊ
byht	bight	ʌɪ	Bucht	ʊ
bȳl	boil	ɔɪ	Beule	ɔɪ
cnyll	knell	ɛ	—	—
crycc	crutch	ʌ	Krücke	ʏ
cȳðð	kith	ɪ	—	—
cȳf	keeve | kive	iː, ʌɪ	—	—
(ge)cynd	kind	ʌɪ	—	—
cyn(n)	kin	ɪ	† Künne	ʏ
cyrf	kerf	ɜː	Kerbe	ɛ
dryncˑ	drink	ɪ	Trunk	ʊ
(ge)dyn(n)	din	ɪ	—	—
dynt	dint	ɪ	—	—
flyht	flight	ʌɪ	Flucht	ʊ
fȳlð	filth	ɪ	—	—
fȳr	fire	ʌɪ	Feuer	ɔɪ
(ge)fyrht	fright	ʌɪ	—	—
fyrs	furze	ɜː	—	—
fyrst	first	ɜː	Fürst	ʏ
fȳst	fist	ɪ	Faust	aʊ
gylt	guilt	ɪ	—	—
(ge)hlyn(n)	linn	ɪ	—	—
hrycg	ridge	ɪ	Rücken	ʏ
hwȳ	why	ʌɪ	—	—
hȳd	hide	ʌɪ	Haut	aʊ
hȳf	hive	ʌɪ	—	—
hyll	hill	ɪ	—	—
hȳr	hire	ʌɪ	—	—
mycg	midge	ɪ	Mücke	ʏ
(ge)mynd	mind	ʌɪ	—	—

myrgð	mirth	ɜː	—	—
pyff	puff	ʌ	—	—
pytt[29]	pit	ɪ	Pfütze	ʏ
scrybb	shrub	ʌ	—	—
scylf	shelf?	ɛ	—	—
scynn	skin	ɪ	Schind(e) (dial.)	ɪ
stybb	stub	ʌ	—	—
syll	sill	ɪ	Schwelle	ɛ
synn	sin	ɪ	Sünde	ʏ
(ge)wyrd	weird	ɪə	—	—
wyrm	worm	ɜː	Wurm	ʊ
wyrt	wort	ɜː	Wurz	ʊ
brygd	† upbrud	—	—	—
byrd	† birde	—	Geburt	uː
byrst	† brust, birse	—	—	—
bytt	† bit	—	—	—
clypp	† clip	—	—	—
cyll	† chelle	—	—	—
cyst	† cust	—	—	—
dryht	† dright	—	—	—
ðrymm	† thrum	—	—	—
ðȳ	† thy	—	—	—
(ge)ðyld	† thild	—	Geduld	ʊ
ðyrs	† thurse	—	† Turse	ʊ
frymð	† frumth	—	—	—
fylst	† filst	—	—	—
fyrmð	† flemensfirth	—	—	—
fyrn	† fern	—	—	—
(ge)hlȳd	† lude	—	—	—
(ge)hlyst	† list	—	—	—
hȳð	† hithe | hythe	—	—	—
hyht	† hight	—	—	—
hyld	† held | helde	—	—	—
lybb	† lib	—	—	—
lyft	† lift	—	Luft	ʊ

[29] Apparently borrowed from Latin into prehistoric Germanic.

lȳt	† lite	—	—	—
nytt	† nut	—	Nütze	ʏ
ryft	† rift	—	—	—
rȳmð	† rimth	—	†Räumte	ɔɪ
scyl	† shill	—	—	—
strȳnd	† strind	—	—	—
swylt	† swelt	—	—	—
tyht	† tight | tyht	—	Zucht	ʊ
wynn	† win	—	Wonne	ɔ
wyrms	† wursom	—	—	—
wyrp	† wurp	—	Wurf	ʊ
ȳð	† ythe	—	—	—
yrð	† earth	—	—	—
hyrst	† hurst	—	Horst (dial.)	ɔ

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