

## **The Phonologization of Predictable Allophones in Old English**

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### **Abstract**

This article shows how, by adopting the framework of Modified Contrastive Specification, we can provide a principled theoretical basis for earlier contrastivist analyses of the evolution of the Proto-Germanic vowel system through West Germanic and into Old English. These include Antonsen's (1972) analysis of Proto-Germanic and Hogg's (1992) account of the evolution of the low vowels. This framework proposes that phonology operates on contrastive features assigned by hierarchies that can vary across dialects and over time. It gives us the means for understanding how non-contrastive features can become contrastive, via contrast shift. It also provides a mechanism for allowing predictable allophones to enter the lexical phonology, if they are created by contrastive features. We can thereby give a new account of the phonologization of *i*-umlaut in early Old English. Finally, this approach gives us a way to more fully implement the contrastive aspects of the Jakobsonian structuralist program for diachronic linguistics within a generative framework.

### **Keywords**

phonologization; contrast; Old English, West Germanic; allophones

## 1. Introduction

In an article originally published in 1931, Roman Jakobson (1972 [1931]) argued for a perspective on historical phonology that assigns a central position to contrast. In such an approach, phonological change is understood not just as affecting the phonetic realization of individual sounds, but may also involve a reorganization of the system of contrasts in a language:

Once a phonological change has taken place, the following questions must be asked: What exactly has been modified within the phonological system?...has the structure of individual oppositions [contrasts/ BED] been transformed? Or in other words, has the place of a specific opposition been changed...?

Since Jakobson wrote the above, aspects of the broader structuralist approach have been successfully applied to phonological change (see Salmons & Honeybone to appear). However, the role of contrast in phonological change was not systematically pursued; for reasons discussed in detail by Drescher (2009), it has not been clear how ‘the structure of individual oppositions’ should be represented in a grammar.

Nevertheless, isolated applications of this way of thinking about phonological change can be found throughout the literature. In this article I will build on two such accounts. In a 1972 article, Elmer Antonsen proposed an analysis of the vowel system of Proto-Germanic that prefigures the theory I advocate here. His approach is taken up and extended to Old English in Richard

Hogg's (1992) *Grammar of Old English*. Hogg shows that his Neogrammarian predecessors were unable to give a satisfactory account of developments in early Old English precisely because they lacked a contrastive phonemic perspective. He demonstrates that an appreciation of the contrastive status of a sound within its phonological inventory can be crucial to a proper understanding of the changes it underwent.

The above works, however, did not articulate a formal theory of phonology in which these contrastive phonemic insights could be expressed. While the theory of generative phonology developed in the tradition of Chomsky & Halle (1968) and Kiparsky (1965) has been successful in accounting for many aspects of synchronic and diachronic phonology,<sup>1</sup> it requires some modification in order to realize Jakobson's contrastive program. I have argued (Dresher 2009) that the effects of language-particular contrasts can be best captured in a generative phonology in which underlying phonemes are specified for hierarchically organized contrastive features. A natural application of this framework to phonological change allows us to more fully implement Jakobson's program in terms of the notion of *contrast shift*, a change in the contrastive structure of a phonological system (Ko 2010, 2011, 2012; Dresher, Harvey, and Oxford 2014).

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<sup>1</sup> See Dresher (to appear) for a review of this approach.

Such a theory does not just recapture lost structuralist insights about phonological change; it also suggests new solutions to long-standing problems that have not been adequately addressed by earlier approaches. In this article I will show how the contrastive hierarchical feature representations required to instantiate Antonsen's and Hogg's analyses of the Proto-Germanic and early Old English vowel systems also suggest a new solution to a phonologization paradox posed by Janda (1999) and Kiparsky (to appear). In keeping with the theme of this volume, the analysis shows how a marginal non-phonemic contrast may come to be revalued as contrastive. A key to the solution is the realization that contrast and predictability are not co-extensive concepts: in a hierarchical approach, some contrastive features may be predictable (that is, derivable from the other contrastive features in the inventory). Therefore, a non-contrastive, hence predictable, feature specification may become contrastive while still remaining predictable.

The plan of this article is as follows. In §2, I review the traditional accounts of the developments leading up to Old English *æ*: (§2.1), and then recount Hogg's (1992) phonemic analysis (§2.2).

In §3, I show how Hogg's analysis can be captured in terms of a theory that provides for contrastive underspecification. In §3.1, I briefly present the main principles of the theory of Modified Contrastive Specification, aka Contrast and Enhancement theory. In §3.2 I show that the analysis of Antonsen (1972) of the vowel system of Proto-Germanic is consistent with this approach, and in §3.3 I

present a slightly different analysis of the vowel systems leading to early Old English, based in part on Purnell & Raimy (to appear).

Section 4 takes up the challenges posed by *i*-umlaut to phonological theory. In §4.1, I consider the general problem posed by non-contrastive allophones to a theory of phonology based on contrastive representations. I propose that some allophones can be created using only contrastive features, but others require the participation of non-contrastive features or properties that are supplied post-phonologically by the enhancement component.

In §4.2, I consider some criteria for deciding which features of allophones are contrastive and which are redundant. I argue that a common criterion, which I call the *Allophonic Uniformity Principle*, is not universally valid, but holds only when not contradicted by other evidence from phonological activity.

Section 4.3 reviews two apparent paradoxes posed by the development of umlauted allophones: an orthographic paradox, and a phonologization paradox. The orthographic paradox will not overly concern us here. The phonologization of *i*-umlaut in West Germanic languages presents a paradox, because it appears that the predictable front rounded allophones produced by *i*-umlaut must become phonemic at a stage when they are still predictable.

A new solution to this paradox is presented in §4.4. I argue that the crucial development is that the non-contrastive rounding feature of these allophones becomes contrastive while their conditioning contexts are still present. The reorganization of the system of contrasts implicated by this change in turn paves

the way for the subsequent phonologization of the allophones into independent phonemes. Thus, a contrastive hierarchical approach provides a new perspective on the phonologization of *i*-umlaut in Old English in terms of the notion of contrast shift.

Section 4.5 considers some consequences of the proposed early Old English contrast shift, and §5 is a brief conclusion.

## 2. The Prehistory of Old English *æ*: An Unnecessary Detour?

The prehistory of early Old English long *æ*: has been controversial. Hogg's (1992) analysis, which crucially distinguishes between the phonetic and phonemic (contrastive) status of the relevant sounds at each stage, shows the need for a contrastive approach to phonological representation.

### 2.1 *Traditional approaches to the prehistory of Old English æ:*

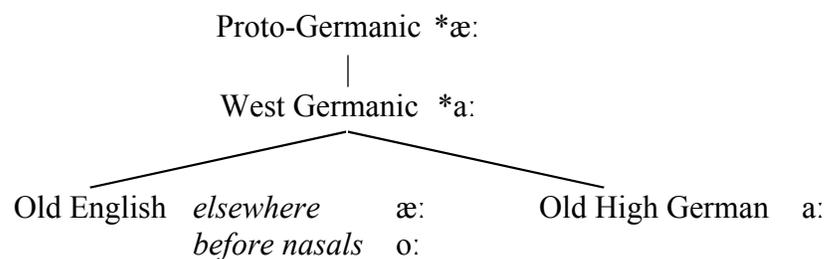
The Proto-Germanic vowel corresponding to southern Old English *æ*: is assumed to have also been \**æ*:, from Indo-European \**e*: (Prokosch 1939: 99).<sup>2</sup> Therefore, Wright & Wright (1925) proposed that *æ*: simply persisted into the Old English period. For example, Proto-Germanic \**æ*: appears in Old English (West Saxon) as *dǣd* 'deed'; before nasals it retracts to *ō* as in *mōna* 'moon'.

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<sup>2</sup> The vowel *æ*: appears in the southern West Saxon and Kentish dialects of Old English. In the Northern Anglian dialects it is raised to *e*:

Against this view is historical and comparative evidence which appears to show that it was a back vowel, \*a:, in West Germanic (Prokosch 1939: 99). For example, the long low vowel in Latin loanwords such as *strāta* ‘street’ was borrowed as Germanic \*a:. In other West Germanic languages, this vowel develops as *a:*, as in Old High German *tāt* ‘deed’ and *māno* ‘moon’. The version of events accepted by most other writers (Bülbring 1902; Luick 1914–40; Girvan 1931; Campbell 1947, 1959; see further Hogg 1992: 62) therefore posits, as in (1), that Proto-Germanic \*æ: retracted to \*a: in West Germanic; this vowel remained in Old High German, but fronted again to \*æ: in Old English when not before a nasal.

(1) Development of Proto-Germanic \*æ: (conventional view)



## 2.2 *The Phonemic Approach of Hogg (1992)*

Following in the tradition of structuralist approaches, Hogg (1992: 61–3) considers not just the phonetic value of this vowel, but also its phonemic status at each stage of the language. This approach results in a richer picture of its development. He assumes, as in the traditional account, that \*/æ:/ was a contrastively front vowel in early Germanic. As his starting point, Hogg (1992:

53) adopts a stage, shown in (2a), that represents ‘the period when Germanic had become clearly distinct from the other IE languages but before the time of the Germanic accent shift’. This stage thus appears to correspond to what Voyles (1992: 11) refers to as the vowel system of ‘the western Indo-European of about 500 B. C. from which Germanic developed.’<sup>3</sup>

(2) Early Germanic long vowel systems<sup>4</sup>

a. Early Primitive Germanic (Hogg 1992: 53)

Monophthongs		Diphthongs	
*/i:/	*/u:/		
*/e:/	*/o:/	*/ei/	*/eu/
*/æ:/	*/ɑ:/	*/ai/	*/au/

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<sup>3</sup> Voyles (1992: 12) shows this system as having five long vowels, /ī, ē, ā, ō, ū/; however, he comments (1992: 26) that whereas most of the cognates of Gothic /ē/ are /ā/ in Northwest Germanic, there are also some /ē/ ~ /ē/ correspondences that have led many scholars to posit two \*/e:/ vowels: Germanic ‘ē<sub>1</sub>’, often written æ:, as in (2a), and ‘ē<sub>2</sub>’ = /e:/. Ringe (2006: 7) also posits the five long Proto-Indo-European vowels listed by Voyles. Those who posit five vowels still assume that \*/e:/ lowered at some point to a contrastively low front vowel equivalent to the \*/æ:/ assumed by Hogg in (2a).

<sup>4</sup> Hogg’s term ‘Primitive Germanic’ is roughly equivalent to what other writer’s designate as ‘Proto-Germanic’.

b. Later Primitive Germanic (Hogg 1992: 54)

*/i:/	*/u:/
*/e:/	*/o:/
*/a:/	

At a later stage shown in (2b), \*/a:/ merged with \*/o:/, leaving \*/æ:/ as the only low vowel phoneme. Hogg proposes that this vowel was contrastively neutral with respect to the front/back dimension; therefore, it can be represented as \*/a:/, whatever its precise phonetic character. Since it could act neutrally with respect to backness, it appeared to earlier writers as though it were a back vowel in early West Germanic. Hogg suggests that this phoneme may have nevertheless been phonetically front throughout in the dialects that developed into Old English.

At a later period, a contrasting low back vowel /ɑ:/ developed in Old English from the monophthongization of older \*/ai/ which merged with retracted \*/a:/ before nasals. This new phoneme created a backness contrast which led to a reanalysis of the original low vowel to a contrastively front vowel /æ:/ (3).

(3) Early (non-Anglian) Old English long vowel system (Hogg 1992)

/i:/	/u:/
/e:/	/o:/
/æ:/	/ɑ:/

Hence, the alleged shift of Proto-Germanic \*æ: to West Germanic \*a: and then back to \*æ: in Old English and Old Frisian emerges as ‘an artefact of phonemic theory’ (Hogg 1992: 62). A phonemic perspective allows for a simpler

sequence of development: the phonetic value of \*/æ:/ may have remained relatively unchanged from Proto-Germanic to Old English, though its contrastive status changed (4).

(4) Phonemic and phonetic development of Proto-Germanic \*æ:

(Hogg 1992)

	a. Phonemic	b. Phonetic
Proto-Germanic	*/æ:/	*[æ:]
West Germanic	*/a:/	*[æ:]
Old English	*/æ:/	*[æ:]

Hogg (1992: 77f.) suggests that short \*/a/ developed in parallel with the long low vowel. Primitive Germanic had only four short vowels, as in (5a).<sup>5</sup> Like the long low vowel, this \*/a/ was neutral with respect to the front/back dimension, though it appears to have had a more back pronunciation than \*/a:/ in West Germanic. At some point in its evolution, \*/u/ developed an [o] allophone as a result of lowering before non-high vowels; when some of these vowels deleted, a

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<sup>5</sup> Voyles (1992:12) and Ringe (2006: 7) list five short vowels \*/i, e, a, o, u/ in the period corresponding to the long vowel inventory in (2a). The four-vowel system in (5a) is the result of the later merger of \*/o/ to \*/a/ (Voyles 1992: 48). Ringe (2006: 145) places the change ‘late in the prehistory’ of the Germanic subgroup.



## (6) Early Old English short vowel system (Hogg 1992)

/i/	/u/
/e/	/o/
/æ/	/ɑ/

**3. Incorporating Contrast into a Generative Analysis**

Having set out the main aspects of Hogg's phonemic analysis of the development of the low vowels, let's now turn to see how it can be incorporated into a generative grammar. In terms of distinctive features, Hogg's discussion suggests that the West Germanic low vowels \*/a:/ and \*/a/ should not be specified as being either [+back] or [-back]. This kind of contrastive underspecification cannot be expressed in a theory that requires full specification of features.

*3.1 Modified Contrastive Underspecification*

Hogg's insight can be translated into an explicit theory in the framework of Modified Contrastive Underspecification (Avery and Rice 1989; Dresher, Piggott & Rice 1994; Dresher & Rice 2007; Dresher 2009), what Hall (2011) calls a Contrast and Enhancement approach to phonology. Building on ideas of Jakobson and his collaborators (Jakobson, Fant & Halle 1952, Cherry, Halle & Jakobson

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phoneme \*/a/, simply by extending the scope of the [±back] contrast to include the low vowel.

1953, Jakobson & Halle 1956), Dresher (2009) proposes that contrastive features are assigned by language-particular feature hierarchies, what were called ‘branching trees’ in the literature of the 1950s and 1960s (7a). Phonological inventories are divided by the Successive Division Algorithm (7b).<sup>8</sup>

- (7) Contrastive feature hierarchies (Dresher 2009)
- a. Contrast in features is assigned hierarchically  
Contrastive features are assigned by language-particular feature hierarchies.
  - b. The Successive Division Algorithm (Dresher 2009:16)
    - i. Begin with *no* feature specifications: assume all sounds are allophones of a single undifferentiated phoneme.
    - ii. If the set is found to consist of more than one contrasting member, select a feature and divide the set into as many subsets as the feature allows for.
    - iii. Repeat step (ii) in each subset: keep dividing up the inventory into sets, applying successive features in turn, until every set has only one member.

This theory further assumes what Hall (2007) has dubbed the Contrastivist Hypothesis (8a), according to which *only* contrastive features are computed by the phonology; in other words, only contrastive features can be *phonologically active*.

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<sup>8</sup> See Dresher (2009:16–17) for a more detailed algorithm.

It follows from this assumption that phonological activity can serve as a heuristic to identifying contrastive features; it is a corollary of the Contrastivist Hypothesis that if a feature is phonologically active, it must be contrastive (8b). Therefore, to find the contrastive hierarchy of a particular phonological system, assume that the active features are contrastive, and find, if possible, a feature ordering that fits the observed patterns of activity.

(8) Contrast and phonological activity

a. The Contrastivist Hypothesis (Hall 2007)

The phonological component of a language L operates only on those features which are necessary to distinguish the phonemes of L from one another.

b. Corollary to the Contrastivist Hypothesis

If a feature is phonologically active, then it must be contrastive.

Some further assumptions about features that I adopt here are listed in (9).

For purposes of this article I will not be concerned with markedness.

(9) Assumptions about features

a. Binariness:

Features are *binary*.

- b. Markedness:
  - i. Every feature has a *marked* and *unmarked* value.
  - ii. Markedness is language particular (Rice 2003; 2007) and accounts for asymmetries between the two values of a feature, where these exist.

### 3.2 *Antonsen's (1972) analysis of the Proto-Germanic vowel system*

An analysis consistent with the above principles was proposed by Antonsen (1972) for the vowels of Proto-Germanic.<sup>9</sup> He proposes the feature specifications in (10a) for the short four-vowel system in (5a). These specifications imply that the features are ordered as listed, [low] > [round] > [high].<sup>10</sup> The vowel features can be displayed in a tree as in (10b).

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<sup>9</sup> Antonsen (1972) does not discuss the theoretical principles that underlie his analysis. For a recent contrastivist account of the evolution of the Proto-Indo-European vowel system through Western Germanic and into Old English, see Purnell & Raimy (to appear). Their account builds on the stages proposed by Lass (1994).

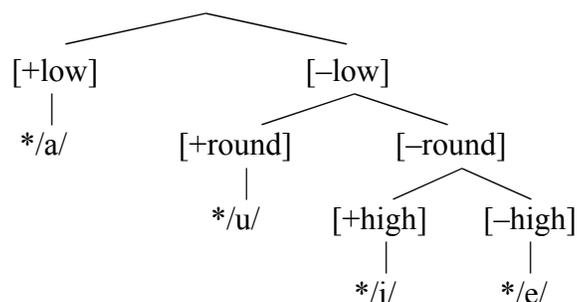
<sup>10</sup> In my own usage I will designate Antonsen's '[rounded]' feature as '[round]'.

- (10) a. Feature specifications for the Proto-Germanic short vowels

(Antonsen 1972)

	*/a/	*/u/	*/i/	*/e/
[low]	+	-	-	-
[rounded]		+	-	-
[high]			+	-

- b. Contrastive feature hierarchy: [low] > [round] > [high]



The first division in the tree in (17b) divides the vowels on the basis of [low]. There is only one [+low] vowel, therefore \*/a/ receives no further contrastive specifications. The [-low] vowels are then divided by [round]; again, there is only one [+round] vowel which is not specified further. The two [-round] vowels are then divided by [high].

Notice that this type of contrastive specification does not necessarily omit all redundant feature specifications. The vowel \*/u/, for example, is specified [-low, +round]; since \*/u/ is the only [+round] vowel in this inventory, the specification [-low] is predictable, hence redundant. Similarly, the [+high] specification of /i/ makes its [-low] feature predictable. In some approaches to

contrastive specification, these predictable features would be omitted. In a hierarchical approach, however, features ordered higher in the inventory are not removed on the basis of features ordered lower down. Thus, this approach to contrastive specification does not identify the notions ‘contrastive’ and ‘non-predictable’.<sup>11</sup> This distinction will become important in our discussion of the phonologization of predictable features in §4.

Antonsen (1972: 132–133) supports these feature specifications by citing patterns of phonological activity (neutralizations, harmony, and distribution of allophones) and loan word adaptation from Latin. Thus, based on the evidence from the descendant dialects, he assumes that \*/a/ had allophones \*[a, æ, ə, ɒ], which all have in common that they are [+low]. Moreover, stressed \*/u, i/ were optionally lowered to \*[o, e] when followed by a non-high vowel (see also Voyles 1992:51). There is no evidence that /a/ had any other active features.

Antonsen (1972: 133) observes that the contrast between \*/i/ and \*/e/ was neutralized in environments that affected tongue height: before high front vowels, low vowels, and before nasal clusters. He argues that this fact supports distinguishing \*/i/ and \*/e/ by a single feature, [high]. Further, he notes that the entirely negative (unmarked, in terms of (9)) specifications of \*/e/ are consistent with the fact that ‘this is the only vowel which does not cause umlaut assimilations in a preceding root syllable’.

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<sup>11</sup> See Dresher (2009:11–30) for discussion of the logic of contrast.

It is clear, given a hierarchical contrastive approach, that if [low] is the highest feature in the ordering, and if [high] is the lowest feature (so as to group \*/i/ with \*/e/ rather than with \*/u/), then only one contrastive feature can be selected to distinguish between \*/u/ on one side against \*/i, e/ on the other. Of the two most usual options, [back] and [round], Antonsen chooses [round]. His reason has to do with the distribution of umlauted allophones which he assumes already existed at this stage of Germanic. I will return to this issue in §4.2, where I will argue in favour of [back] as the contrastive feature at this stage.

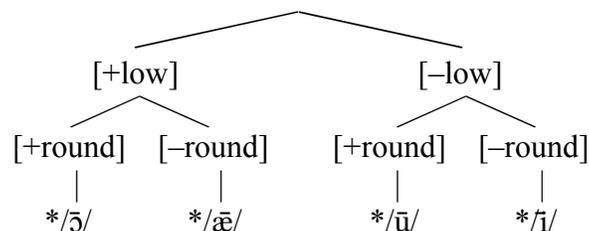
Antonsen also proposes distinctive features for the long vowels of Proto-Germanic. He posits the four-vowel system in (11). This stage precedes the five-vowel system in (2b) and follows the six- (in this case five – see note 3) vowel system in (2a). As Antonsen points out, the short and long vowel sub-systems are not isomorphic, despite each having four vowels, and using the same features [low] and [rounded] in the same ordering (the Successive Division Algorithm ends before [high] can be assigned to any vowel). The tree diagram for the long vowels is shown in (11b).

(11) a. Feature specifications for the Proto-Germanic long vowels

(Antonsen 1972)

	*/ī/	*/ū/	*/ǣ/	*/ō/
[low]	–	–	+	+
[rounded]	–	+	–	+

b. Contrastive feature hierarchy: [low] > [round] > [high]



Antonsen (1972: 134) supports the assignment of [+low] to \*/æ/ (equivalent to \*/æ:/ in (2a)) on the basis of the low outcomes in the daughter languages. In the case of \*/ɔ/ he argues that loan word evidence shows it was [+low]: Latin /o:/ was borrowed as Germanic [-low] /u:/, just as Latin /e:/ was borrowed as Germanic /i:/.

Antonsen's discussion suggests that the length (or tenseness) feature goes at the top of the feature hierarchy, creating two relatively independent vowel subsystems: short/lax and long /tense.<sup>12</sup>

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<sup>12</sup> Antonsen (1972) designates the relevant feature [long/tense], on the grounds that the precise phonetic nature of the contrast cannot be determined. Oxford (2012c) proposes that whether we call the feature [long] or [tense] may, in many common cases, depend on its ordering in the feature hierarchy: the lower the feature in the ordering, the more it can be interpreted as pure length, as no other features distinguish between long and short vowels; the higher the feature in the ordering, the more distant from each other are the vowels distinguished by it, and thus the tendency is to refer to it as [tense].

### 3.3 *Alternative contrastivist accounts of Proto-Germanic and West Germanic vowel systems*

Antonsen's selection of [rounded] as the contrastive feature rather than [back] is contrary to a number of other commentators, including Lass (1994) and Purnell & Raimy (to appear). Similarly, Ringe (2006: 148) proposes a 'square' long vowel system like that in (11b); according to him, however, 'the qualitative differences between the vowels can be minimally described by the oppositions high: nonhigh and front: nonfront.' Therefore, I would amend Antonsen's feature specifications for the Proto-Germanic vowels by replacing [rounded] by [back], as in (12) and (13).

- (12) a. Revised feature specifications for the Proto-Germanic short vowels

	*/a/	*/u/	*/i/	*/e/
[low]	+	–	–	–
[back]		+	–	–
[high]			+	–







#### 4. A Contrastive Perspective on the Phonologization of *i*-umlaut

The above picture of the vowel features of West Germanic and Old English is complicated by the introduction of *i*-umlaut, whereby a back vowel followed by *i* or *j* is fronted. In Old English, for example, \**u*(:) becomes *y*(:), as in ‘evil’ (16a), and \**o*(:) becomes *ø*(:), as in ‘feet’ (16b).

(16)	<i>i</i> -umlaut of * <i>u</i> (:) and * <i>o</i> (:)	
	Gloss	a. ‘evil NOM. SG.’      b. ‘foot NOM. PL.’
	Pre-Old English	* <i>ubil</i> * <i>fɔ:t+i</i>
	<i>i</i> -umlaut	* <i>ybil</i> * <i>fø:t+i</i>
	<i>i</i> -lowering/deletion	<i>yfel</i> <i>fø:t</i>

Notice that *i*-umlaut results in front rounded vowels: in (16), the front feature comes from the /*i*/, and the round feature must come from /*u*/ and /*o*/: We have assumed, however, that [round] is not a contrastive feature of the earliest stage of Old English. Recall the representations given by the feature hierarchy in (15): changing non-low [+back] vowels to [–back] in this structure would result in \*[*i*(:)] and \*[*e*(:)], not [*y*(:)] and [*ø*(:)]. To obtain front rounded vowels, the non-low [+back] vowels must also be [+round].

Alternatively, on Antonsen’s (1972) account, [round] is contrastive and [back] is not; in that case, fronting cannot be formulated at all without introducing redundant [back] specifications. The key point is that in all accounts of the early Germanic vowel system, only *one* of [back] and [round] is considered to be

contrastive;<sup>14</sup> but the front umlaut of \*u(:) and \*o(:) requires that *both* [back] and [round] be active. At some point in the development of English and German, these fronted allophones became independent phonemes, by which point it must have been the case that both [back] and [round] were contrastive features.

The changes in the contrastive structure of the West Germanic vowels is only one of a number of problems for phonological theory posed by *i*-umlaut. I will argue that a hierarchical contrastive approach sheds new light on these problems.

#### *4.1 Non-contrastive Allophones*

In a phonology where underlying phonemes are contrastively specified, it is inevitable that they must be further specified in order to be pronounced. These further specifications can be added at various points in the phonology, or after the phonology. Consider again, for example, the Proto-Germanic four-vowel system shown in (12). The phoneme designated /u/ is specified by the features [–low, +back]; therefore, it could equally be symbolized as /ʊ/, /u̯/, /i̯/, /o/, /ɤ/, or any

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<sup>14</sup> Thus, Fertig (1996: 176) remarks with respect specifically to German: ‘Until the advent of non-primary umlaut, frontness and rounding of vowels were not independent in German...Clearly, one of them, either frontness or rounding, was non-distinctive in German until the appearance of non-primary umlaut’.

other non-low, back vowel. Clearly, IPA symbols fail us when depicting contrastively specified sounds (see further Hall 2011:22–24).

We observed that it is assumed that the [–low, +back] vowel appeared as [o] when followed by a non-high vowel, that is \*/e/ and \*/a/. In the case of \*/e/, we can assume that the [–high] feature is spread (or copied) to \*/u/, resulting in the specification [–low, +back, –high], which straightforwardly translates into a mid back vowel (its rounding has not yet been specified). The other non-high vowel, \*/a/, has only the feature [+low] to contribute to \*/u/; unlike the case of \*/e/, however, this feature conflicts with the original [–low, +back] specification of \*/u/. Evidently, the derived vowel does not lose its [–low] specification, but the [+low] of /a/ prevents it from becoming a high vowel, resulting again in \*[o].<sup>15</sup>

In both cases, the modifications of \*/u/ result from the effects of contrastive features spreading from other vowels onto the \*/u/. Therefore, the [–high] allophone of \*/u/ could be created in the phonology proper; that is, the

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<sup>15</sup> Alternatively, we can take the lowering facts as indicating that \*/a/ has a [–high] feature that spreads to \*/u/. While there are hierarchies that would assign \*/a/ [–high], they have other drawbacks. What the best hierarchy is remains an empirical question, requiring an evaluation of all the evidence.

derived allophone [–low, +back, –high] is made up entirely of contrastive features that are available to the phonological component.<sup>16</sup>

The same is not the case with the roundness specification of the allophones of \*/u/: what makes them come out as \*[u] and \*[o] rather than as \*[ɯ] and \*[ʏ]? We observe that there is no contrastive feature [round] in the underlying specifications of the vowels in (10); nor does the rounding of \*/u/ result from the effects of neighbouring segments. Rather, I assume that roundness is assigned post-phonologically<sup>17</sup> by a process of *enhancement* (Stevens, Keyser

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<sup>16</sup> While the derived allophone created by *i*-umlaut consists of contrastive features, the rule is not *structure preserving* in the sense of Kiparsky (1982, 1985), in that there is no underlying phoneme with the specifications [–low, +back, –high]. Some lexical phonological processes do appear to observe structure preservation (the constraint that they may only create feature combinations that correspond to underlying phonemes), but such a constraint does not follow from the Contrastivist Hypothesis.

<sup>17</sup> Following the usage common in the theory of Lexical Phonology and Morphology (LPM, Pesetsky 1979; Kiparsky 1982, 1985; Kaisse and Shaw 1985; Mohanan 1986), I will from here on refer to the phonological component as the *lexical phonology* and the post-phonological component as the *postlexical phonology*. Note, however, that the latter term is ambiguous, in that it can refer to phrasal phonology that occurs in domains larger than the word. As I have argued

& Kawasaki 1986; Stevens & Keyser 1989; Keyser & Stevens 2001, 2006), whereby the contrastive features of a segment are made more salient by the addition of phonetic properties that enhance their acoustic effects. As discussed in some detail by Hall (2011), a vowel that is contrastively [+back] can be enhanced by being {[+round]}, and vice-versa, because both rounding and backness contribute to lowering the second formant; a vowel that is contrastively [–low] can enhance its non-lowness by being {[+high]}<sup>18</sup>. Hence, the [–low, +back] vowel defaults to [u] when not affected by neighbouring segments. Similarly, the non-back vowels \*/i/ and \*/e/ surface as front vowels by enhancement.

The story is essentially the same on Antonsen’s (1972) analysis, where [rounded] is contrastive and [back] is non-contrastive. On this account, [round] is enhanced by {[back]}.

A contrastive approach, therefore, arrives at the same conclusions as many

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with respect to Tiberian Hebrew (Dresher 1983), phrasal phonology can have many of the properties normally taken as characteristic of lexical phonology. In the sense used here, postlexical phonology refers to what has sometimes been called ‘low-level phonetics’, a post-phonological component that is exempt from the contrastive constraints of the phonology proper.

<sup>18</sup> I follow Purnell & Raimy (to appear) in indicating non-contrastive properties contributed by enhancement in curly brackets.

commentators, beginning with V. Kiparsky (1932) and Twaddell (1938), who propose that *i*-umlaut began as a phonetic, that is, postlexical, rule (see also Antonsen 1972; Penzl 1972). In other words, it applies after the [–low, +back] features of /u/ have been enhanced by lip rounding.

To sum up, we have seen that allophones can be created both phonologically and post-phonologically. They can be created in the lexical phonology by the addition or substitution of contrastive features (perhaps from neighbouring segments). Allophones that require non-contrastive features must of necessity be postlexical, since non-contrastive features are not available in the lexical phonology. In fact, there is no reason to suppose that properties added by enhancement are even *features*, in the sense of the discrete objects computed by the phonology; they could just as well be gradient properties, perhaps similar to the scalar entities posited by Chomsky and Halle (1968:164–170; 295–298) as the phonetic counterparts to phonological features. For simplicity, however, I will continue to refer to them as if they were features.

#### 4.2 *Which features are contrastive?*

I have mentioned that all commentators assume that only one of [back] and [round] was contrastive in the vowel systems of early Germanic, though they do not agree on which one of these it was. In this section I will look at Antonsen's (1972) rationale for choosing [round] as contrastive, and then present my reasons for nevertheless going with [back].

Antonsen (1972: 132) assumes, based on reflexes in the later dialects, that there was already considerable front-back vowel allophony in the short/lax vowel system of Proto-Germanic, given in (10), and he reasons as follows:

front variants of \*/u, a/ (\*[y, æ]) developed in the environment high-front, back variants of \*/i, e, a/ (\*[ɯ, ʏ, ɒ]) arose in the environment high-back, a low variant of \*/u/ (\*[o]) was produced before low vowels, and \*/a/ in combined high-back and high-front environments produced still a third variant (\*[ə]) which may be characterized as higher-central. From these variations, it is possible to conclude that the distinction spread : rounded (but not front : back) was the feature which set off \*/u/ from both \*/i/ and \*/e/, since the front variant of \*/u/ = \*[y] did not coalesce with \*/i/, nor the back variant of \*/i/ = \*[ɯ] with \*/u/, and the lower variant of \*/u/ = \*[o] did not coalesce with the back variant of \*/e/ = \*[ʏ]. While \*/u/ = \*[u, y] could be adequately characterized by the single feature [+rounded], \*/i/ = \*[i, ɯ] and \*/e/ = \*[e, ʏ] shared the feature [−rounded].

Antonsen is here appealing to a common principle for diagnosing contrastive features that Dresher (2009: 72) states as in (17).

(17) Diagnostics used in identifying contrastive features (Dresher 2009:

72 ex. (38))

A phoneme  $\phi$  has contrastive feature F if:

...

d. the set of allophones which make up  $\phi$  all have F in common.

We can call this the *Allophonic Uniformity Principle*. Dresher (2009) cites appeals to this principle in the work of Trubetzkoy (1939) and Hockett (1955): if all the allophones of a phoneme share a certain feature, it makes sense to suppose that that feature is contrastive; conversely, if the allophones of a phoneme do not have a certain feature in common, we might conclude that the feature is not contrastive.

Hall (2011: 18) provides a rationale for the Allophonic Uniformity Principle, grounding it in a basic difference between contrast and enhancement:

If the relative scope of [back] and [round] can vary from one vowel system to another, how can we tell, in any particular case, which is the distinctive feature and which the enhancement? One possible answer is phonetic. Keyser & Stevens (2006: 40) claim that the implementation of distinctive features is categorical, whereas enhancement is gradient. Positing [+round] as the distinctive feature in English is thus consistent with the observation that /u/ ...is subject to various degrees of fronting – but generally not to unrounding – in many contemporary varieties of English...If the

backness of English /u/ is merely an enhancement of its distinctive roundness, then this variability is expected.

In other words, we do not expect enhancement to contradict the contrastive values of a phoneme. Thus, a contrastively [–low] vowel might be expected to sometimes be realized as high, when its non-lowness is enhanced, or as mid, when enhancement does not apply or applies to a lesser extent.<sup>19</sup> However, we have seen above that allophones can be influenced not just by enhancement, but by neighbouring segments; and these segments *can* contribute features that contradict the underlying contrastive features of a phoneme.

An example of the limitations of the Allophonic Uniformity Principle is provided by Dresher (2009:162–163), dealing with the case of the Russian phoneme /i/, which has allophones that vary in backness but share the property of being [– round].<sup>20</sup> In the absence of conflicting evidence, we would suppose, by Allophonic Uniformity, that [– round] is contrastive for /i/ and [back] is

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<sup>19</sup> See Dyck (1995) for a detailed study of the enhancement of desinential vowels in Iberian Romance dialects. She finds that even closely related dialects can vary considerably in the realization of contrastively non-low vowels unspecified for [high]: in some dialects they range widely from high to mid vowels, in others they are realized in a much narrower region of the vowel space.

<sup>20</sup> I follow the Moscow School in assuming that [i̯] is an allophone of /i/ and not an independent phoneme, as proposed by the Leningrad School

redundant. However, phonological activity provides more compelling evidence that /i/ is contrastively [-back]; moreover, the [+ back] allophone [ɨ] is demonstrably the result of the spreading of [+ back] from a preceding consonant (see Dresher 2009:220–223).

A similar situation prevails in the Proto-Germanic vowel system portrayed by Antonsen (1972). Antonsen does not give an explicit analysis of how the front allophones of \*/u, a/ and the back allophones of \*/i, e, a/ arise, though he makes it clear that they develop in high-front (i.e., before \*/i/) and high-back (before \*/u/) contexts, respectively. Consider the case of an underlying sequence \*/u...i/, as in, for example, Proto-Germanic \*ubil, the ancestor of *evil* in (16). According to Antonsen (1972), \*/u/ has the features [-low, +rounded], and \*/i/ is specified [-low, -rounded, +high]. For \*/u/ to develop a front rounded allophone \*[y], it must receive a [-back] specification from \*/i/; but \*/i/ has no such contrastive specification. Therefore, we must assume, on Antonsen's analysis, that \*/i/ receives {[-back]} by enhancement, and that this redundant feature triggers the fronting of \*/u/. A sample derivation is shown in (18); only the features [back] and [rounded] are shown where they are specified, as the features [low] and [high] are not relevant here.

## (18) Postlexical fronting of \*/u/ based on Antonsen (1972)

Underlying	/ u b i l/
	[+rnd] [-rnd]
<i>Lexical Phonology</i>	————
<i>Postlexical Phonology</i>	
Enhancement of [rnd]	{[+bk]} {[-bk]}
<i>i</i> -umlaut	{[-bk]}
Surface	[ybil]

The problem with this analysis is that it requires a redundant feature to act as a trigger. Even though we are supposing that redundant features are available post-enhancement, it is still unexpected to see them triggering changes in neighbouring segments.<sup>21</sup>

The alternative analysis preferred here reverses the roles of [back] and [round]: [back] is the contrastive feature of \*/u, i, e/ and {[round]} is the enhancement, as shown in (19). On this analysis, *i*-umlaut is triggered by a contrastive feature, just like the raising and lowering processes attributed to the lexical component; the only difference is that fronting (and backing) occur after

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<sup>21</sup> The derivation in (18) can be made more elegant if we suppose that the enhancement of [+rounded] by {[+back]} is prevented by the following {[-back]} on the \*/i/. But this would attribute to the enhancement component the sort of ordering and organization more usually associated with the lexical phonology.

enhancement by {[round]}, preventing the newly created allophones from merging with underlying front (and back) vowels.

- (19) Postlexical fronting of \*/u/ with [back] contrastive

Underlying	/ u    ʊ    i    l/
	[+bk]    [-bk]

<i>Lexical Phonology</i>	————
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*Postlexical Phonology*

Enhancement of [bk]	{[+rnd]}    {[-rnd]}
<i>i</i> -umlaut	[-bk]
Surface	[yʊil]

#### 4.3 *Umlaut Paradoxes*

The history of *i*-umlaut in West Germanic dialects presents a number of puzzling, indeed paradoxical looking, problems that have given rise to a large literature.

There are two central problems. The first is what I will call, following Fertig (1996), the Orthographic Problem. This was the problem tackled by V. Kiparsky (1932) and Twaddell (1938) with respect specifically to German. The problem is that the umlaut of the non-low back vowels is not indicated orthographically until after the conditioning factors that presumably caused the fronting (a following *i* or

*j*) had disappeared.<sup>22</sup> Thus, a literal interpretation of the orthography would appear to lead to the paradoxical conclusion that umlaut only appeared *after* its conditioning context was gone.

The solution proposed by V. Kiparsky (1932) and Twaddell (1938) is that the key lies in phonemic theory and its connection to orthography. Twaddell proposes that umlaut existed in Old High German, but being purely allophonic, was not indicated in the orthography, on the assumption that purely allophonic differences are not recorded in orthographies except under special conditions. When the conditioning factors of umlaut were lost, however, the front rounded allophones became phonemic, at which point they came to the attention of scribes, who began indicating them in writing. Twaddell's solution can be summed up as in (20).

(20) Twaddell's (1938) solution to the Orthographic Problem of *i*-umlaut

a. Prior to the loss of the conditioning context

Phonemic	Phonetic	Orthographic
/uxi/	[yxi]	<uxi>
/uxa/	[uxa]	<uxa>

---

<sup>22</sup> This discussion thus does not include the umlaut of *a* (sometimes called 'primary umlaut'), to which other considerations apply. Our focus here is on 'secondary umlaut'.

## b. Following the loss of the conditioning context

Phonemic	Phonetic	Orthographic
/yxə/	[yxə]	<yxe>
/uxə/	[uxə]	<uxe>

As Fertig (1996) observes, though Twaddell's solution (Kiparsky's earlier article in Finnish was not as well known) was praised by some as a triumph of phonemic theory applied to historical linguistics, other writers pointed out problems with it. The most serious is that the conditioning contexts of *i*-umlaut disappeared long before its orthographic marking became consistent: not only is Old High German problematic in this sense, but so, too, is Middle High German and even Early New High German. Fertig (1996: 179) concludes: 'The true solution may lie partially or entirely in the conservatism of writing systems and the inadequacy of the Latin alphabet'.

There is a second problem associated with the Kiparsky-Twaddell account, and this can be called the Phonologization Problem. In the scenario sketched above in (20), the loss of the conditioning context of *i*-umlaut causes the front rounded allophones of (20a) to become phonemic in (20b). We must assume a similar development in Old English. Already in early Old English, the \*/i/ trigger of *i*-umlaut was either lowered after a light syllable or deleted after a heavy syllable, making *i*-umlaut opaque on the surface, as shown in the last row of (16). In many cases, the *i*-umlaut trigger became unrecoverable to learners. According to standard accounts in line with the Kiparsky-Twaddell analysis of

German, this led to the phonologization of [y(:)] and [ø(:)] as new phonemes; an example is again ‘evil’, whose underlying form is restructured from /ufil/ to /yfel/ (21a). I assume that *i*-umlaut persisted as a synchronic rule in forms with alternations, like *fō:t* ~ *fø:t* ‘foot ~ feet’ (21b).<sup>23</sup>

(21) Phonologization of *i*-umlaut

Gloss	a. ‘evil nom. sg.’	b. ‘foot nom. pl.’
Underlying	/yfel/	/fō:t+i/
<i>i</i> -umlaut	—	fø:t+i
<i>i</i> -lowering/deletion	—	fø:t

There is a logical problem with this scenario that has been pointed out many times in the literature, notably by Janda (1999) and, most recently, by Kiparsky (to appear):<sup>24</sup> as long as *i*-umlaut remains postlexical, it should not be able to survive the loss of its triggering contexts. Thus, in the example in (22), once /ufil/ is restructured to /yfel/, there is no reason for *i*-umlaut to continue to apply: the expectation is that [yfel] would revert to [ufel].

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<sup>23</sup> See Dresher (1981, 1985) for arguments that some deleted or lowered unstressed /i/ could still be recovered in the Mercian Old English dialect of the *Vespasian Psalter*.

<sup>24</sup> See Janda (1999) for discussion and review of scholars who have pointed out this problem and for various attempts to resolve this problem. I am grateful to Kathleen Currie Hall for calling my attention to Janda’s article.

(22) Expected non-phonologization of *i*-umlauta. Before loss of *i*-umlaut trigger

Underlying	/ufil/
<i>Lexical Phonology</i>	—
<i>Postlexical Phonology</i>	
<i>i</i> -umlaut	yfil
<i>i</i> -lowering	yfel
Surface	[yfel]

## b. After loss of trigger

Underlying	/ufel/
<i>Lexical Phonology</i>	—
<i>Postlexical Phonology</i>	
<i>i</i> -umlaut	—
Surface	*[ufel]

The only way for *i*-umlaut to persist is if it enters the lexical phonology *before* the [y(:)] and [ø(:)] allophones become contrastive, that is, while they are still predictable allophones of [u(:)] and [o(:)], respectively (23a). Then, the subsequent loss of the triggering *i* or *j* will not affect the results of *i*-umlaut, which can then be lexicalized (23b).

(23) Phonologization of *i*-umlauta. Before loss of *i*-umlaut triggerUnderlying /u<sup>h</sup>fil/*Lexical Phonology**i*-umlaut yfil*Postlexical Phonology**i*-lowering yfel

Surface [yfel]

## b. After loss of trigger

Underlying /yfel/

*Lexical Phonology**i*-umlaut —*Postlexical Phonology* —

Surface [yfel]

Why does *i*-umlaut enter the lexical phonology while its products are not contrastive? Building on Jakobson, Fant & Halle's (1952) discussion of Russian [i̯], Kiparsky (to appear) suggests that it is because the front rounded allophones, which occur in stressed syllables, are more perceptually *salient* than their unstressed triggers, which become weaker over time to the point that they are eventually reduced or deleted. These salient allophones thus come to be perceived as belonging to a category distinct from the back rounded allophones. These two

conditions allow the allophones to become ‘quasi-phonemes’ (Korhonen 1969) even before their conditioning contexts are lost.

According to Kiparsky, we cannot account for the phonologization of quasi-phonemes while holding onto the view that ‘phonemic representations specify exactly the invariant distinctive features of the language.’ This is because, on such a view, ‘Quasi-phonemes are not allowed at the phonemic level since redundant, predictable feature values are excluded from lexical representations.’ He argues that Stratal OT provides the necessary theoretical foundation for the quasi-phoneme.

We have seen, however, that in a hierarchical approach to contrast, some predictable feature values *are* specified in lexical representations. In the following section, I will show how the essence of Kiparsky’s account can be incorporated very naturally into the framework advanced here.

#### 4.4 *Contrast Shift and the Phonologization of Predictable Allophones*

As Jakobson (1972 [1931]) proposed, phonological change can affect the contrastive organization of a language. Recently, the notion of *contrast shift* within a hierarchical contrastive approach (Dresher 2009) has been revived in a number of publications.<sup>25</sup> The contrastive analysis presented earlier, together with

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<sup>25</sup> See Ko (2010, 2011, 2012), and Dresher, Harvey, and Oxford (2014) for discussion of contrast shift as a theoretical notion. Looking at phonological

the notion that contrast shift is a type of grammar change, allows us to keep the more appealing aspects of Kiparsky's analysis, while still maintaining the Contrastivist Hypothesis and the phoneme as a contrastive unit.

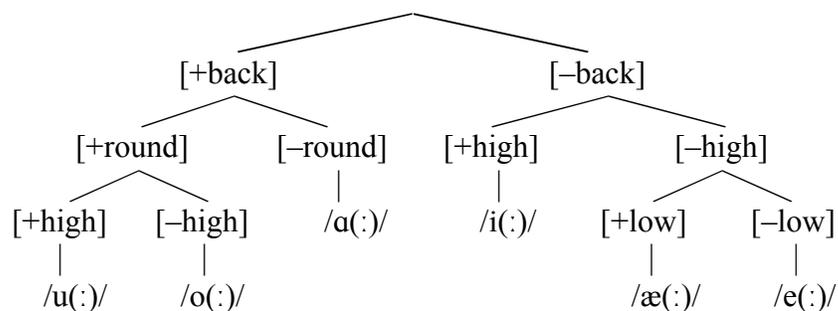
Let us revisit the early stage of *i*-umlaut as a postlexical and post-enhancement rule. Some writers assume that this stage may have extended over a very long period. Presumably, though, the umlauted allophones did not become salient until toward the end of the prehistoric period, when the weakening of the unstressed syllables became significant. While it is not clear exactly when this occurred, I will assume that early Old English inherited the West Germanic feature hierarchy shown in (15). At this point the feature [round] is not yet contrastive, but occurs only as a postlexical enhancement of [back]; therefore, *i*-umlaut must still be a postlexical rule.

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change in terms of shifts in the contrastive feature hierarchy has proved to be fruitful in the study of a variety of languages. Examples include: Zhang (1996) and Drescher and Zhang (2005) on Manchu; Barrie (2003) on Cantonese; Rohany Rahbar (2008) on Persian; Drescher (2009: 215–225) on East Slavic; Compton & Drescher (2011) on Inuit; Gardner (2012), Roeder & Gardner (2013), and Purnell & Raimy (2013) on North American English vowel shifts; and large-scale studies by Harvey (2012) on Ob-Ugric (Khanty and Mansi), Ko (2010, 2011, 2012) on Korean, Mongolic, and Tungusic, and Oxford (2012a, b) on Algonquian.

Adapting Kiparsky's formulation, I propose that the perceptual salience of the front rounded umlaut allophones, perhaps increasing in conjunction with the progressive weakening of unstressed syllables, could have reached the point where it caused learners to hypothesize that [round] is a contrastive feature. This would lead them to construct a new feature hierarchy, which requires demoting [low] to allow [round] to be contrastive over the back vowels. This new hierarchy is illustrated in (24).<sup>26</sup>

- (24) Early Old English feature hierarchy 2: [back] > [round] > [high] > [low] > [long]



Notice that the contrast shift from (15) to (24) does not immediately result in any overt change to the inventory, and *i*-umlaut can continue as a postlexical rule. However, it is now possible for it to be promoted to the lexical phonology; for changing the [+back, +round] vowels to [-back] results in front rounded allophones, as shown in (25).

<sup>26</sup> See Purnell & Raimy (to appear) for a similar solution to the phonologization of *i*-umlaut, in somewhat different terms.



have [+round] making [+back] predictable, because there are no underlying vowels that are [+round] and [–back]. At a later stage, when the umlauted allophones become independent phonemes, [+back] is no longer predictable from [+round]. But the tree in (25) still has redundant features. Having a value for [low], for example, implies that a vowel is [–back, –round, –high]; so all these features are predictable. Yet they are still contrastive, for they are generated by the Successive Division Algorithm.

It follows, then, that the transition of the feature [round] to a contrastive feature, which makes possible the promotion of *i*-umlaut to the lexical phonology, is not a singular event that requires any special mechanisms in the current approach. That is, the contrastive hierarchy in (24) is no more unusual than the one in (15). Which one speakers choose depends on the patterns of phonological activity in the language.

To sum up this account, the phonologization of *i*-umlaut followed the path shown in (26).

- (26) The phonologization path of *i*-umlaut
- a. *i*-umlaut begins as a postlexical rule, dependent on the enhancement of [back] by {[round]}.<sup>27</sup>

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<sup>27</sup> Purnell & Raimy (to appear) suggest that *i*-umlaut originated in phonetic co-articulation before it became a postlexical rule.

- b. As the conditioning contexts of *i*-umlaut weaken, the umlaut allophones become more salient, leading to a contrast shift whereby [round] becomes a contrastive feature on the [+back] vowels.
- c. *i*-umlaut becomes a lexical rule, making use only of contrastive features, producing ‘deep allophones’ that have the same type of categorical representations as underlying phonemes.
- d. As the conditioning contexts become unlearnable, umlaut allophones are reanalyzed as underlying phonemes, creating a phonemic split of the original non-low back vowels.

#### 4.5 *An Unexpected Consequence of the Old English Contrast Shift*

It should be clear that the promotion of one feature in the hierarchy, without increasing the phonemic inventory, must necessarily involve the demotion of another feature. If we compare the feature hierarchies in (15) and (23), we find that the promotion of [round] to be contrastive in the [+back] vowels had consequences for some of the other features. The feature [back] remains contrastive over all the vowels, as does [long] at the bottom of the hierarchy. The feature [high] remains almost as it was, with the exception that it now includes \*/æ(:)/ in its scope.

The big loser in this contrast shift is [low], which falls from the top of the vowel feature hierarchy, with scope over every vowel, to taking contrastive scope

over only two (actually four, including length) vowels, /æ(:)/ and /e(:)/. The most striking result of this contrastive reorganization is that an asymmetry is introduced between the former front and back [+low] vowels: the front vowels /æ:/ and /æ/ remain [+low] (as well as gaining [–high]), but the back vowels /ɑ:/ and /ɑ/ are left with no height feature at all.

The major consequence of this change is that /ɑ:/ and /ɑ/ no longer have a height feature that can trigger lowering. It is interesting, then, that these vowels do not trigger lowering in Old English, in striking contrast to earlier stages of Germanic, in which high vowels lowered before \*/ɑ/. Old English unstressed /ɑ/ participates with the other back vowels in triggering the rules of *a*-restoration and back mutation. *a*-restoration causes a stressed /æ/ to become /ɑ/ when a back vowel, including /ɑ/, occurs in a following syllable (Hogg 1992: 96–101). Back mutation, also known as back umlaut, operates in a similar context and changes stressed short front vowels, orthographic <æ>, <e>, and <i>, to <ea>, <eo>, and <io>, respectively (Hogg 1992: 152–166). I interpret these short digraphs as representing [æə], [eə], and [iə], respectively, and the rule of back mutation as adding a [+back] component, represented by [ə], to front vowels.<sup>28</sup> Both retraction and back mutation require /ɑ/ to have a [+back] feature, which it does.

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<sup>28</sup> The Old English short digraphs have occasioned much controversy; see Dresher (1985: 9–10) and Minkova (to appear) for a review and references. On diphthongization as adding a [+back] element see Dresher (1993).

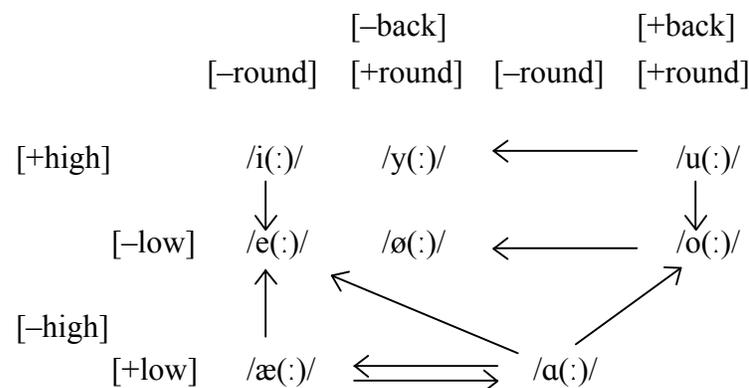
Another process in which both long and short /ɑ(:)/ participate, this time as targets, not triggers, is *i*-umlaut. The umlaut of the low vowels is rather complex, and I cannot pursue the details here (see Hogg 1992: 126–131 and Anderson 2005). One fact that is fairly clear is that /ɑ:/ from Germanic \*ai regularly umlauts to [æ:] in all dialects of Old English. Notice that this umlaut would have already been available in the lexical phonology at the stage of the older hierarchy in (15), which we can call Old English 1: changing the [+back] feature of long or short \*/ɑ(:)/ to [–back] would straightforwardly result in \*/æ(:)/.

/æ(:)/.

At the later stage of (24), what we can call Old English 2, the result of umlauting /ɑ(:)/ is not straightforward. Besides length, these vowels have the underlying contrastive features [+back, –round]; the immediate result of *i*-umlaut is a vowel specified [–back, –round]. As there is no phoneme with this specification, it would have to be interpreted further, perhaps in terms of markedness. Assuming that the minus values of [high] and [low] are unmarked, the least marked path under [–back] leads us to /e(:)/. In fact, there are cases where the umlaut of a back low vowel is /e(:)/, but it remains to be clarified whether these are due to the effects of the hierarchy in (24) or to other independent causes of raising.

To sum up, the arrows in (27) schematically show the major types of vowel activity in Old English, abstracting away from vowel length: fronting (*i*-umlaut), backing (various rules, including *a*-Restoration and back mutation), lowering of high vowels, and raising and rounding of low vowels. In the proposed feature hierarchy (24), all the active features are contrastive.

(27) Old English vowel activity



## 5. Conclusion

I have proposed that phonology operates on contrastive features assigned by hierarchies that can vary across dialects and over time. Evidence for this approach comes from the fact that contrastive specifications can capture observed patterns of phonological activity. Equally significant, like the dog that didn't bark, is the activity that we do *not* find, as predicted from the absence of features that are non-contrastive in the proposed analyses.

Specifically, I have shown how we can provide a principled theoretical basis for earlier contrastivist analyses of the evolution of the Proto-Germanic

vowel system through West Germanic and into Old English. These include Antonsen's (1972) analysis of Proto-Germanic and Hogg's (1992) account of the evolution of the low vowels.

The proposed framework also gives us means for understanding how non-contrastive features can become contrastive, via contrast shift. It also provides a mechanism for allowing predictable allophones to enter the lexical phonology, if they are created by contrastive features. We can thereby retain and elaborate on the core of Kiparsky's (to appear) account of the phonologization of *i*-umlaut, while still adhering to the view that the phoneme is a contrastive unit. Finally, this approach gives us a way to more fully implement the contrastive aspects of the Jakobsonian structuralist program for diachronic linguistics within a generative framework.

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Association, Victoria, June 2013; and the themed session: The Representational Consequences of Marginal Contrasts at the Annual Meeting of the Linguistics Association of Great Britain (LAGB), SOAS, August 2013. I am grateful to members of the project on Markedness and the Contrastive Hierarchy in Phonology at the University of Toronto (Dresher and Rice 2007). This research was supported in part by grant 410-08-2645 from the Social Sciences and Humanities Research Council of Canada.

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