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Saturday 6 June 2015
Jesus College, Cambridge

Contrastive Feature Hierarchies in Diachronic Phonology

B. Elan Dresher
University of Toronto

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Introduction

Introduction
1. Hogg
2. Antonsen
3. Benediktsson
4. Jakobson et al.
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6. Trubetzkoy
7. Halle
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9. i-umlaut
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Conclusions

Introduction

In this talk I would like to pursue two related goals:

- First, I will argue that contrastive feature hierarchies are an organizing principle of synchronic phonology, and hence, provide a fruitful way to understand phonological change.

- At the same time, I will look at the origins and uses of contrastive hierarchies in the history of phonological theory.

I will focus on the development of West Germanic vowel systems, looking at several stages that lead to Old English.

Introduction

I will show that there are precedents for analyses that make use of contrastive feature hierarchies in the work of some prominent scholars.

However, in many cases these analyses appear in their work without context or supporting framework.

I will attempt to provide the missing framework and historical context for these analyses, while showing their value for understanding the development of phonological systems.

I will show that behind these apparently isolated analyses there is a substantial theoretical edifice that once held a central role in phonological theory.

Introduction

The structure (and progress) of this talk is indicated in the panel:

I will start with an analysis of the West Germanic vowel system by Hogg and trace its sources all the way back to the work of Sweet.

Then I will go forward in time to develop a theory based on these ideas.

In the last part of the talk, I will apply this theory to a problem connected with the phonologization of *i*-umlaut in languages that descend from West Germanic.

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Part 1
Hogg 1992
The Phonemic Status of West Germanic */æː/

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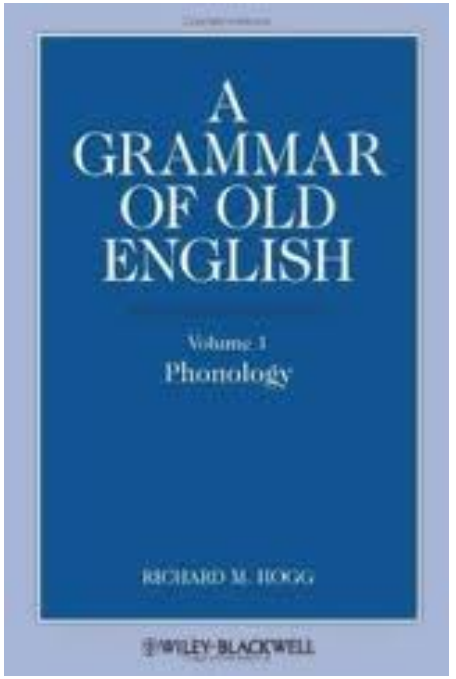
The Phonemic Status of WGmc */æː/



In the first volume of *A Grammar of Old English* (1992), Richard Hogg posits some stages in the development of the vowel system from Primitive Germanic to Old English.

The Phonemic Status of WGmc */æː/

One of the stages is shown below (Hogg 1992: 54): it has five long vowels, three diphthongs, and four short vowels.

We will revisit the short vowel system later; our immediate focus is on the long vowels.

Concerning them, Hogg (1992: 61) writes the following:

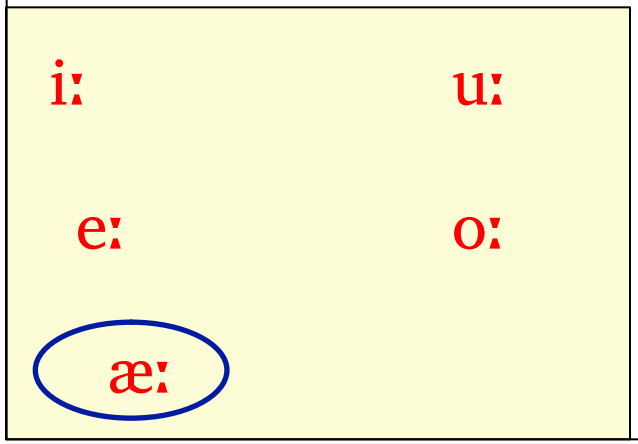
Primitive Germanic Vowel System

Long vowels		Diphthongs		Short vowels	
iː	uː			i	u
eː	oː		eu	e	
æː		ai	au	a	

The Phonemic Status of WGmc */æː/

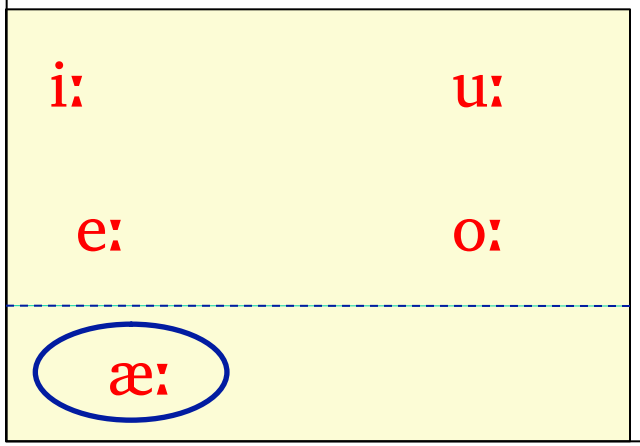
‘The long vowel system which developed in PrGmc… was generally well preserved in the Gmc dialects leading to OE.

One major exception to this, however, concerns the development of the low long vowel indicated [below] as */æː/.’



The Phonemic Status of WGmc */æː/

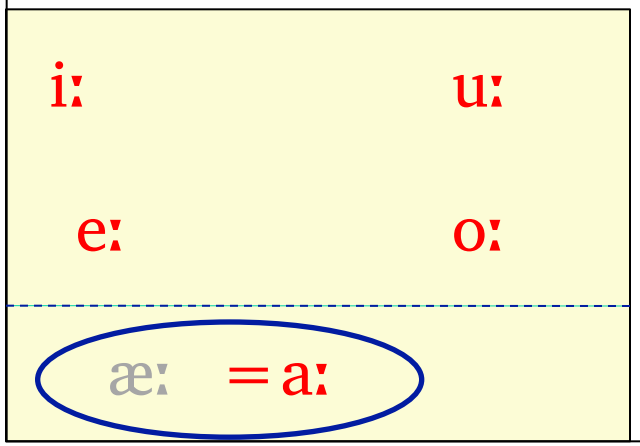
‘As will be observed, */æː/ is the only low long vowel and there is no front/back contrast in operation.



The Phonemic Status of WGmc */æː/

‘As will be observed, */æː/ is the only low long vowel and there is no front/back contrast in operation.

From the structural point of view, therefore, the vowel as it develops in WGmc may be considered to be neutral in this last respect, that is, */aː/.’

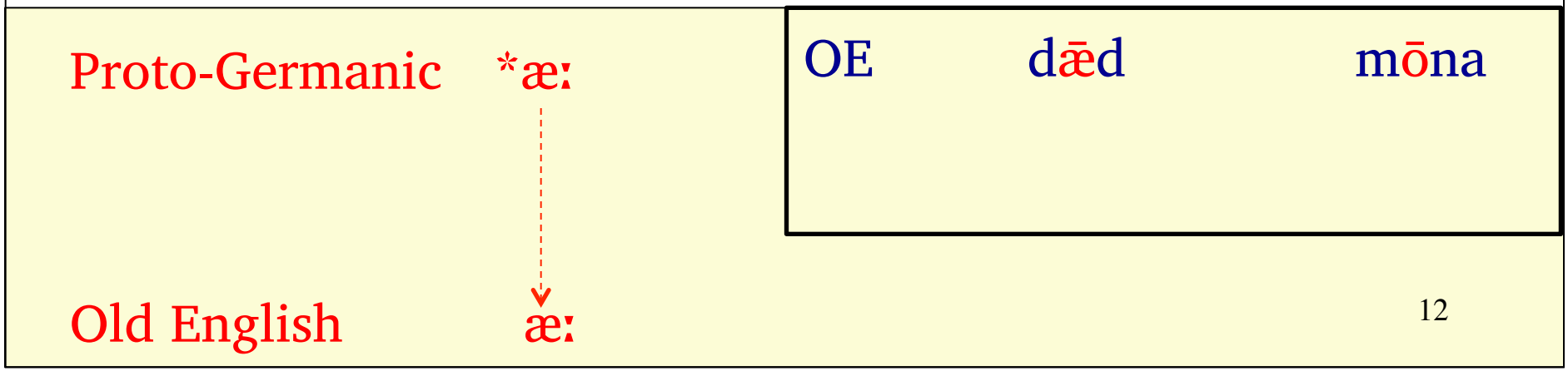


The Prehistory of Old English æː

Hogg proposes this analysis as a way of resolving a controversy about the development of the low long vowel into Old English long *æː* (or *eː* in Anglian dialects).

Since the corresponding vowel in Proto-Germanic was also *æː, Wright & Wright (1925) had proposed that *æː* simply persisted into the Old English period.

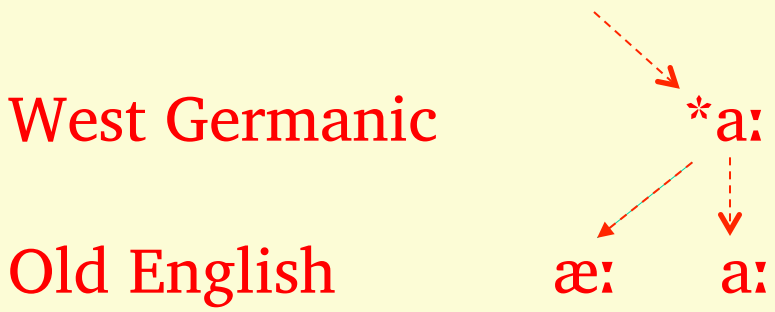
For example, P-G *æː appears in Old English (West Saxon) as *dǣd* 'deed'; before nasals it retracts to *ō* as in *mōna* 'moon'.



The Prehistory of Old English æː

Against this view is historical and comparative evidence which appears to show that it was a back vowel, *aː, in the West Germanic period that intervened between P-G *æː and OE *æː*.

In other West Germanic languages, this vowel develops as aː, as in Old High German *tāt* 'deed' and *māno* 'moon'.



OE	dǣd	mōna
OHG	tāt	māno

The Prehistory of Old English æː

The version of events accepted by most other writers therefore posits, as below, that Proto-Germanic *æː retracted to *aː in West Germanic.

This vowel remained in Old High German, but fronted again to *æː in Old English when not before a nasal.

OE	dǣd	mōna
OHG	tāt	māno

Hogg's Phonemic Approach

Hogg proposes to distinguish between the phonemic and phonetic status of the low vowel.

Phonemically, this vowel was contrastively neutral with respect to the front/back dimension; therefore, it can be represented as /a:/, whatever its precise phonetic character.

Phonemic long vowel system

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

Hogg's Phonemic Approach

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, while being phonetically further back in pre-Old High German.

Phonemic long vowel system		Phonetics of /aː/
/iː/	/uː/	West Germanic /aː/
/eː/	/oː/	OE: /aː/ = [æː]
/aː/		OHG: /aː/ = [aː]

Hogg's Phonemic Approach

Hence, the alleged shift of P-G *æː to WGmc *aː and then back to æː in Old English and Old Frisian emerges as 'an artefact of phonemic theory' (Hogg 1992: 62).

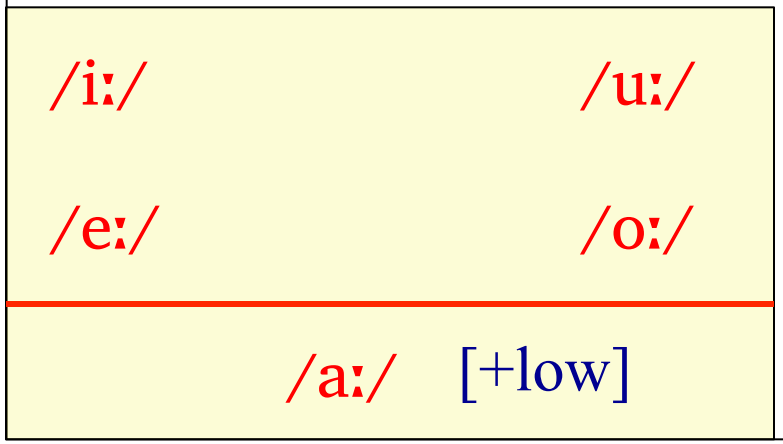
A phonemic perspective allows for a simpler sequence of development: the phonetic value of */æː/ may have remained relatively stable from Proto-Germanic to Old English, though its contrastive status may have changed.

	Phonemic	Phonetic
Proto-Germanic	*/æː/	*[æː]
West Germanic	*/aː/	*[æː]
Old English	/æː/	[æː]

A Featural Analysis: Some Questions

In terms of distinctive features, Hogg's proposal suggests that WGmc */aː/ should not be specified either [+back] or [–back] because there is no front/back contrast in the low vowels.

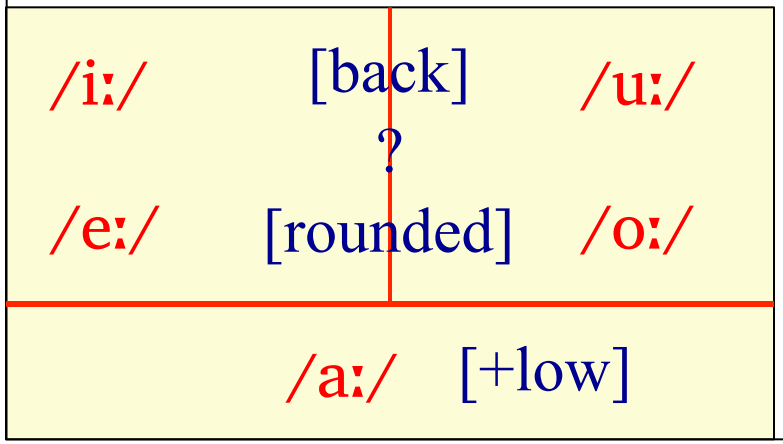
While this analysis appears to give an insightful solution to the development of the low vowel, it raises some questions:

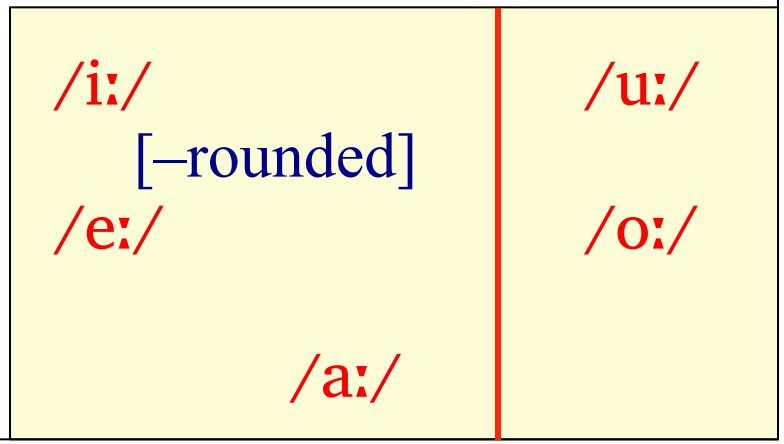


A Featural Analysis: Some Questions

- How are contrasts computed in the rest of the vowels? For example, are /iː, eː/ distinguished from /uː, oː/ by [back], or by [rounded], or by both? How can we tell?

- How do we know to evaluate the backness of /aː/ only in the low domain, and not with respect to all the vowels, or the non-round vowels, as in the diagram on the right?





A Featural Analysis: Some Questions

- More generally, in what theory does this type of analysis find a home?

This kind of contrastive underspecification cannot be expressed in a theory that requires full specification of features, such as , for example, the theory of Chomsky & Halle 1968, the 'classical' generative phonology of *Sound Pattern of English*.

A Featural Analysis: Some Questions

- Finally, what is the source of Hogg's analysis?

He does not connect his account of the long low vowel to any specific reference, but writes at the outset:

> 'Fuller discussions of the Germanic material may be found in works such as Prokosch (1939), Krahe and Meid (1969), and the contributions in van Coetsem and Kufner, especially Antonsen (1972) and Bennett (1972).'

It is to Antonsen 1972 that we will turn next.

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Part 2
Antonsen 1972
Contrastive Feature Analysis of the Proto-Germanic Vowel System

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Proto-Germanic Contrastive Features

Elmer Antonsen was an American linguist and runologist who made a number of contributions to the study of Germanic phonology.

His 1972 article cited by Hogg provides a more complete contrastive feature analysis of the vowels of Proto-Germanic.

Proto-Germanic Contrastive Features

His analysis of the long vowels assumes four vowels with symmetrical contrasts, and so is not very informative with respect to our questions.

Proto-Germanic Contrastive Features

His analysis of the long vowels assumes four vowels with symmetrical contrasts, and so is not very informative with respect to our questions.

However, his analysis of the short vowels is very illuminating!

Antonsen proposes these feature specifications for the short vowel system (1972: 133):

Short vowels

i		u
	e	
	a	

	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

Proto-Germanic Contrastive Features

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].

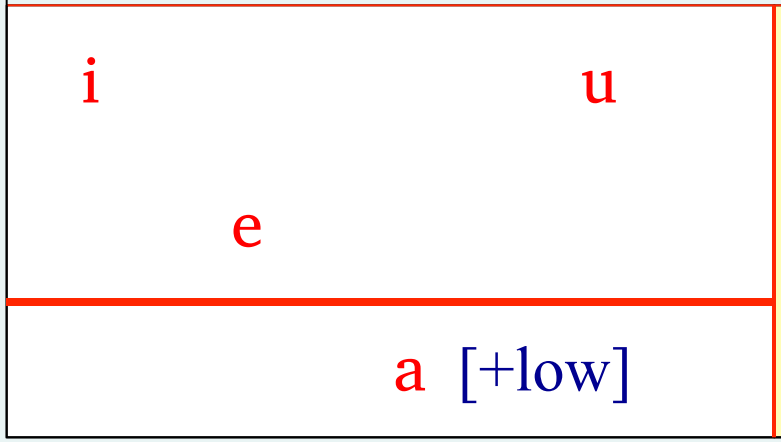
i		u
	e	
	a [+low]	

	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

Proto-Germanic Contrastive Features

Further, there is evidence that */i/ and */u/ had lowered allophones before */a/, again suggesting that */a/ had a feature that could affect vowel height, in this case [+low].

There is no evidence that */a/ had any other active features; that is, features that played a role in the phonology by affecting neighbouring segments, or that grouped */a/ with other segments as a natural class.



	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

Proto-Germanic Contrastive Features

As the feature that distinguishes */u/ from */i/ and */e/ Antonsen chooses [rounded].

His reason is that all the allophones of */u/ were rounded.

We will return later to this this specific aspect of the analysis.

i e	u [+rounded]
a [+low]	

	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

Proto-Germanic Contrastive Features

Antonsen 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].

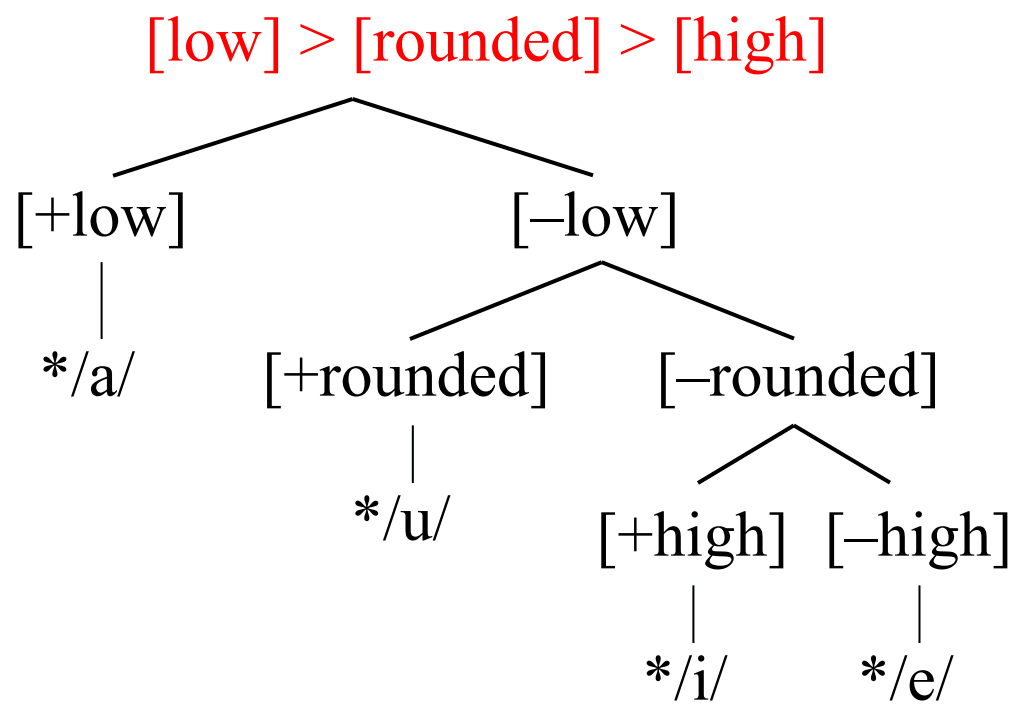
He notes that the entirely negative specifications of */e/ are consistent with the fact that 'this is the only vowel which does not cause umlaut assimilations in a preceding root syllable'.

i [+high]	u [+rounded]
e	
a [+low]	

	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

A Contrastive Feature Hierarchy

Antonsen does not comment on the theory that underlies these specifications, but their pattern indicates that they can be modeled as a branching tree, with the features in the order as shown.



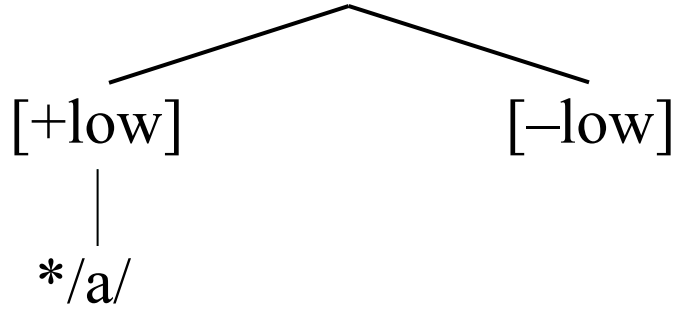
	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

A Contrastive Feature Hierarchy

Thus, the vowel inventory is first split by the feature [low]:

There is only one [+low] vowel, so this vowel receives no further features.

[low] > [rounded] > [high]

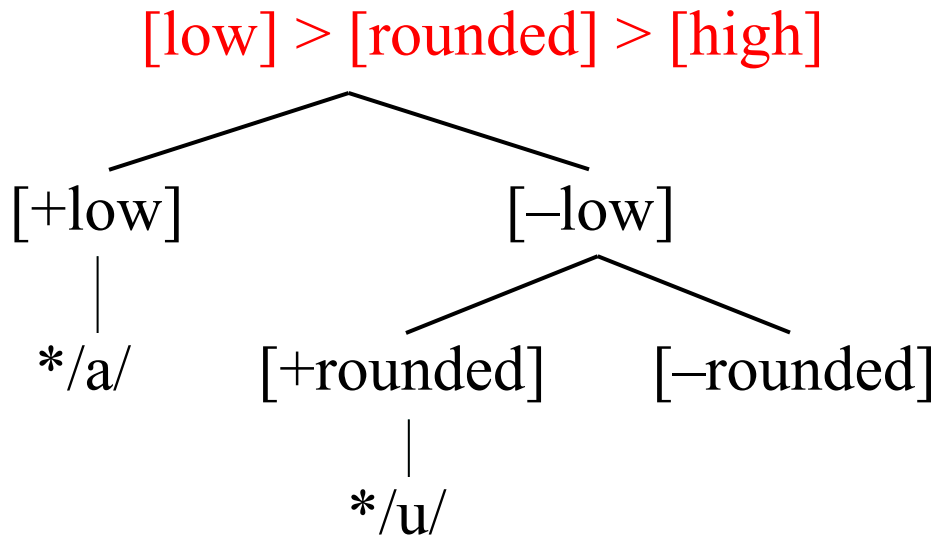


	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

A Contrastive Feature Hierarchy

The [–low] vowels are then split by the feature [rounded]:

Again, there is only one vowel, */u/, in the [+rounded] set, and it receives no further features.

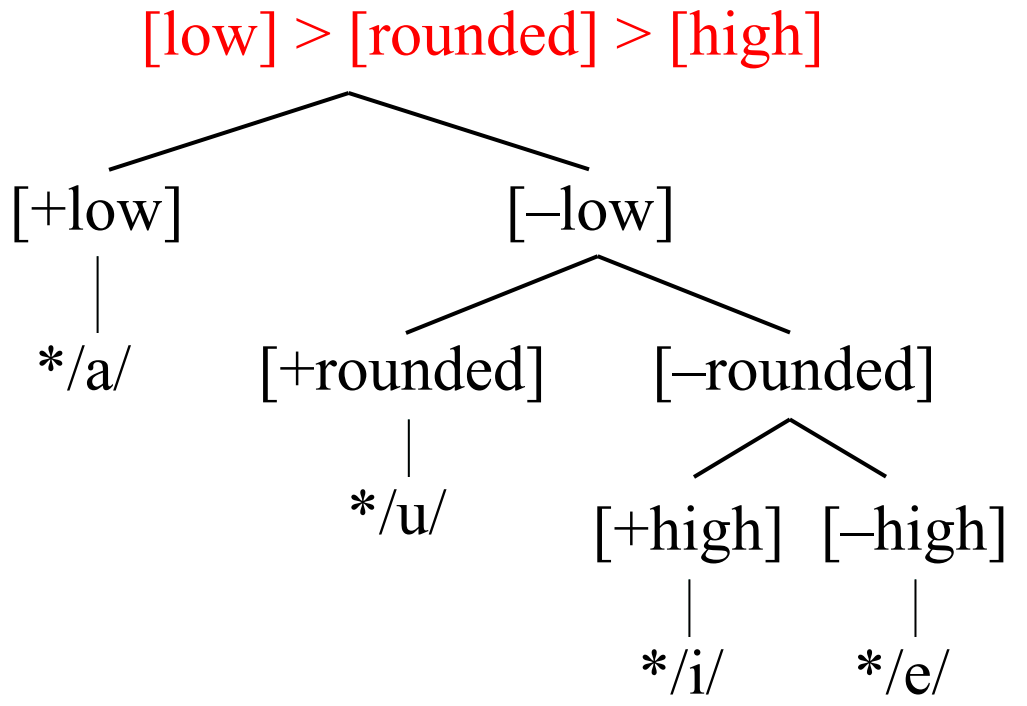


	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

A Contrastive Feature Hierarchy

Finally, the remaining two undifferentiated vowels are split by the feature [high]:

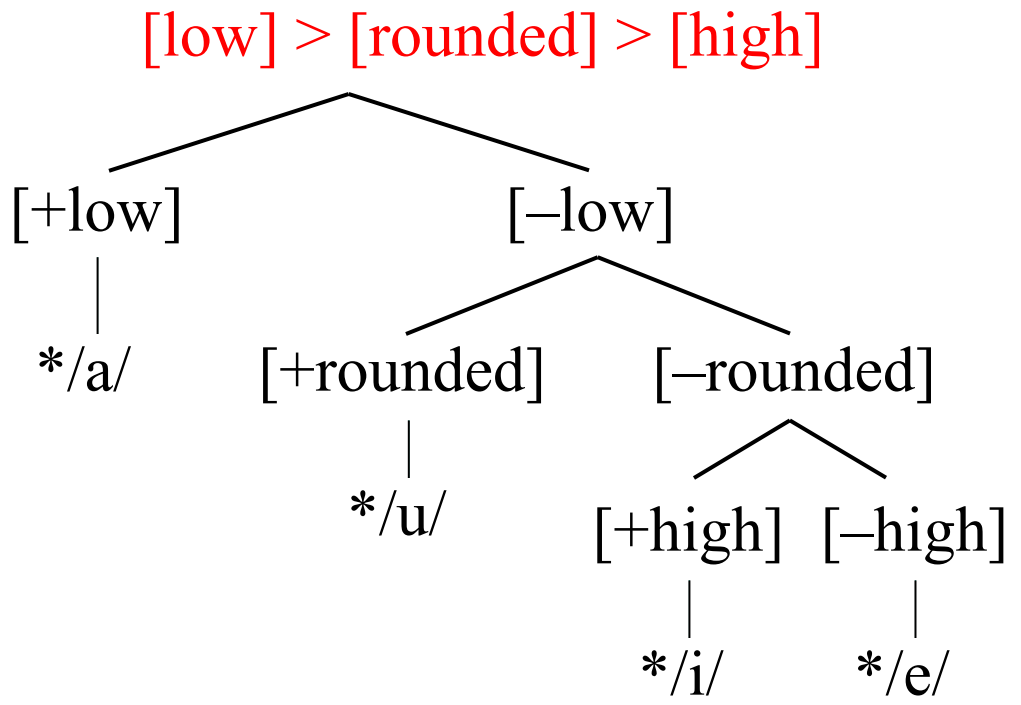
All the vowel phonemes are uniquely specified, and there are no more contrastive features.



	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

A Contrastive Feature Hierarchy

Notice that the ordering of the features is crucial.

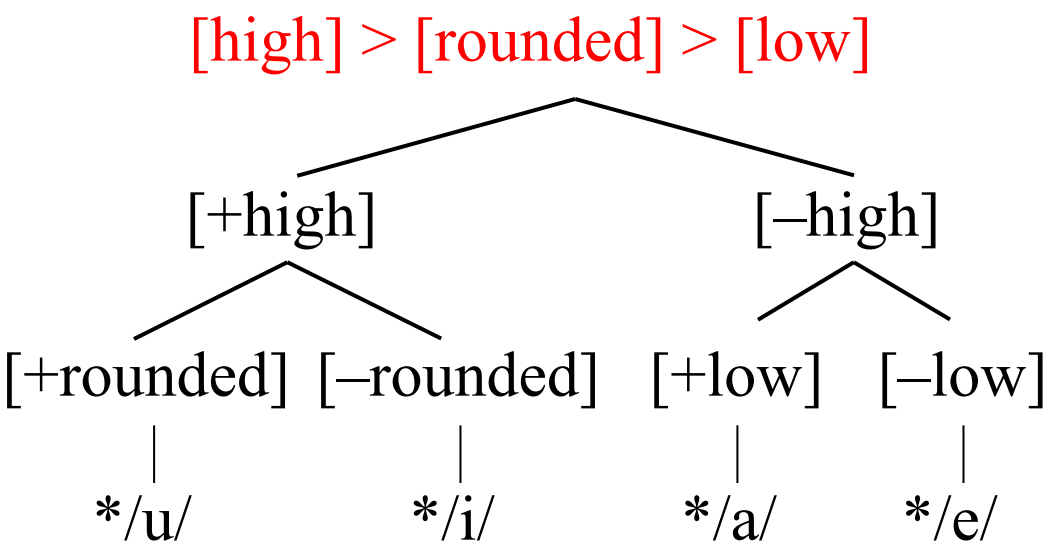


	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

A Contrastive Feature Hierarchy

Notice that the ordering of the features is crucial.

A different order, say [high] > [rounded] > [low], results in very different specifications (differences indicated by ◯).



	*/a/	*/u/	*/i/	*/e/
Low	+	◯	◯	–
Rounded		+	–	◯
High	◯	◯	+	–

Where do the Trees Come From?

Antonsen 1972 gives us some additional context for Hogg's 1992 analysis of the West Germanic low long vowel; but what is the source of Antonsen's theoretical framework?

Antonsen 1972 cites some of his own previous articles, as well as one by Benediktsson (1967).

Let's take a look at Benediktsson 1967, which will provide a bridge to the origins of branching trees in phonology.

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Part 3
Benediktsson 1967
A Jakobsonian Analysis of the Proto-Germanic Vowel System

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Proto-Germanic Contrastive Features

Hreinn Benediktsson was an Icelandic linguist with many publications on Nordic and Germanic historical phonology.

His 1967 article on 'The Proto-Germanic vowel system' appears in the first volume of *To Honor Roman Jakobson*.

This fact is significant, because the device of contrastive features organized into branching trees can be traced back to Jakobson and his colleagues.

Benediktsson (1967)

Benediktsson's analysis is along similar lines as that of Antonsen 1972, and I will not dwell on it here.

One difference is that Benediktsson uses Jakobsonian acoustic features: [compact] in place of [low], [diffuse] in place of [high], [grave/acute] in place of [back/front], and [flat/natural] in place of [rounded/unrounded].

I mention his article here because it points us directly to the source of the feature theory he employs, the *Preliminaries to Speech Analysis* (1952) by Roman Jakobson, C. Gunnar M. Fant and Morris Halle.

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Part 4
Jakobson et al.
Origins of Branching Contrastive Feature Trees

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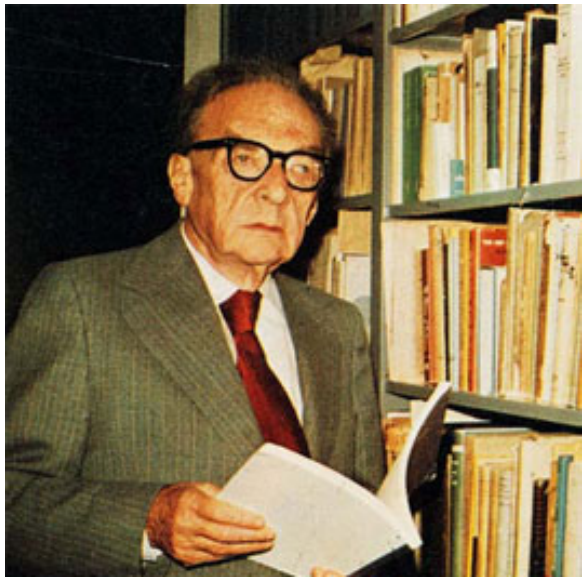
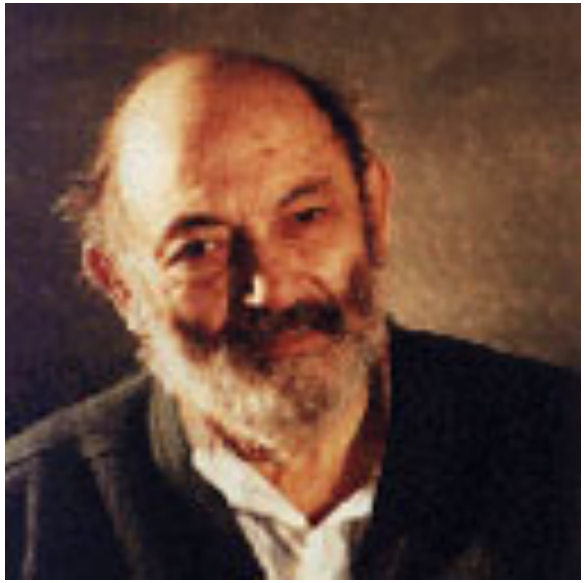
Origins of the Branching Tree





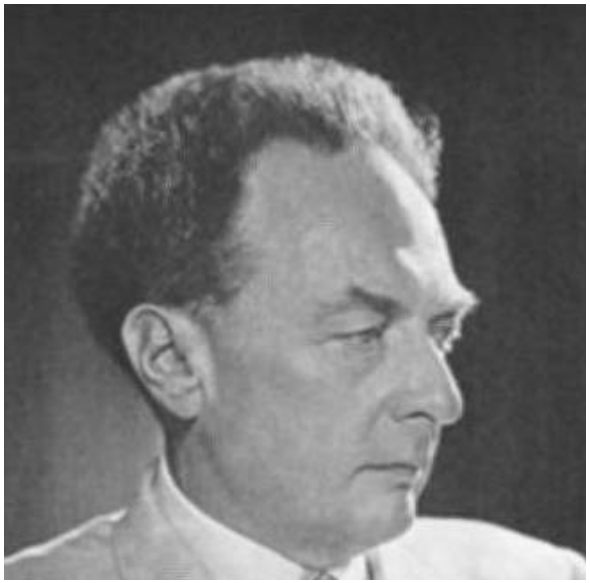
The branching tree appears overtly in Jakobson, Fant & Halle 1952. They propose that listeners identify phonemes by distinguishing them from every other phoneme in the system.

Origins of the Branching Tree

These distinctions are effected by making a series of binary choices that correspond to the oppositions active in the language.

By ‘oppositions active in the language’ they mean that not all phonetic properties of a phoneme are equally important to the phonology, but only the contrastive ones.

Origins of the Branching Tree



A tree of this kind is anticipated a few years before in an article on Standard French by Jakobson and John Lotz (1949).

The tree itself does not appear. However, their representations are consistent with such a tree, and are difficult to explain otherwise.

Decision Tree for Standard French

[vocality] > [nasality] > [saturation] > [gravity] > [tensity] > [continuousness]

Jakobson and Lotz assume the feature ordering shown above. Each feature applies in turn to each branch of the inventory in which it is contrastive.

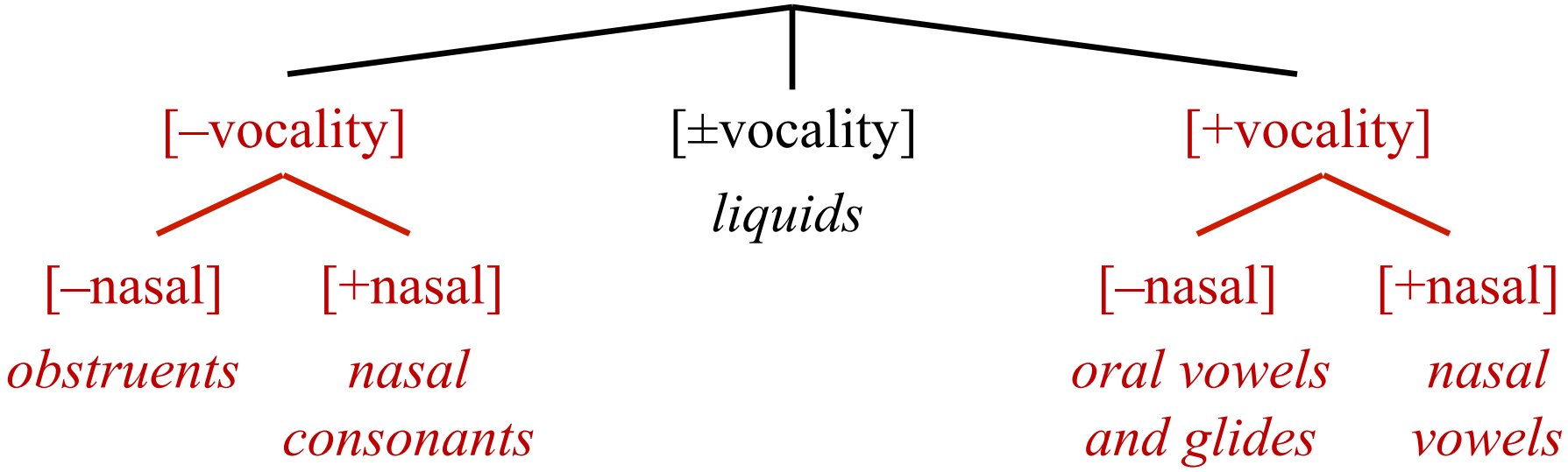
Decision Tree for Standard French

[–vocality]	[±vocality]	[+vocality]
consonants	*liquids*	*vowels and glides*

[vocality] > [nasality] > [saturation] > [gravity] > [tensity] > [continuousness]

The first division of the inventory in their analysis pertains to [vocality]: consonants are –, vowels and glides are +, and liquids have a third, intermediate, value, ±.

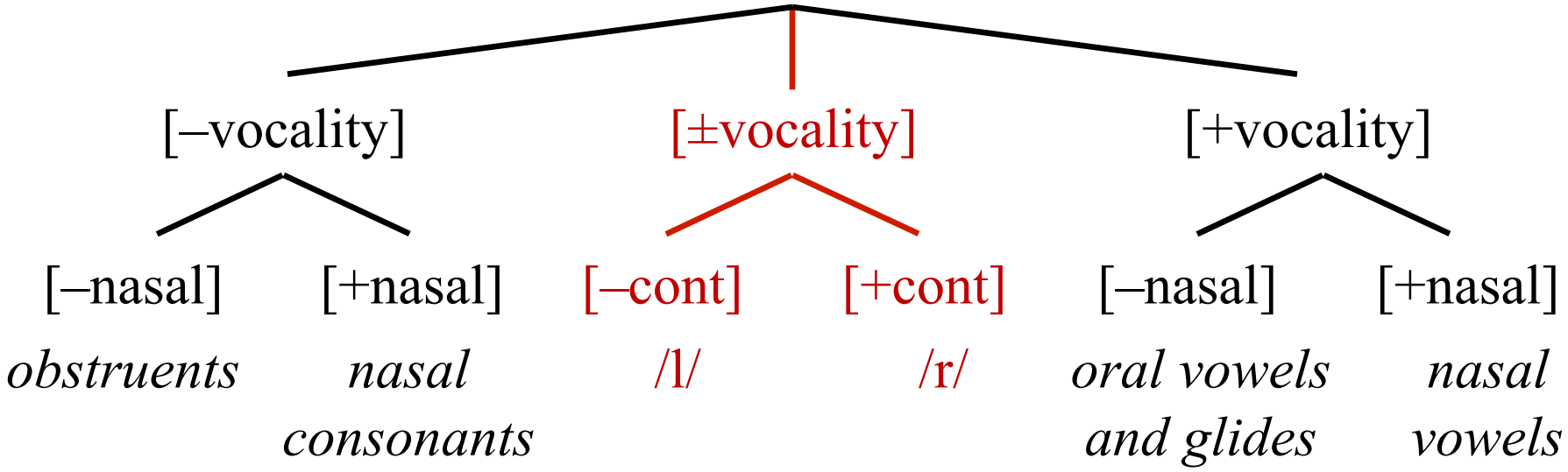
Decision Tree for Standard French



[vocality] > [nasality] > [saturation] > [gravity] > [tensity] > [continuousness]

The second feature to apply is [nasality]. It is contrastive in the consonants and vowels, but not among the liquids.

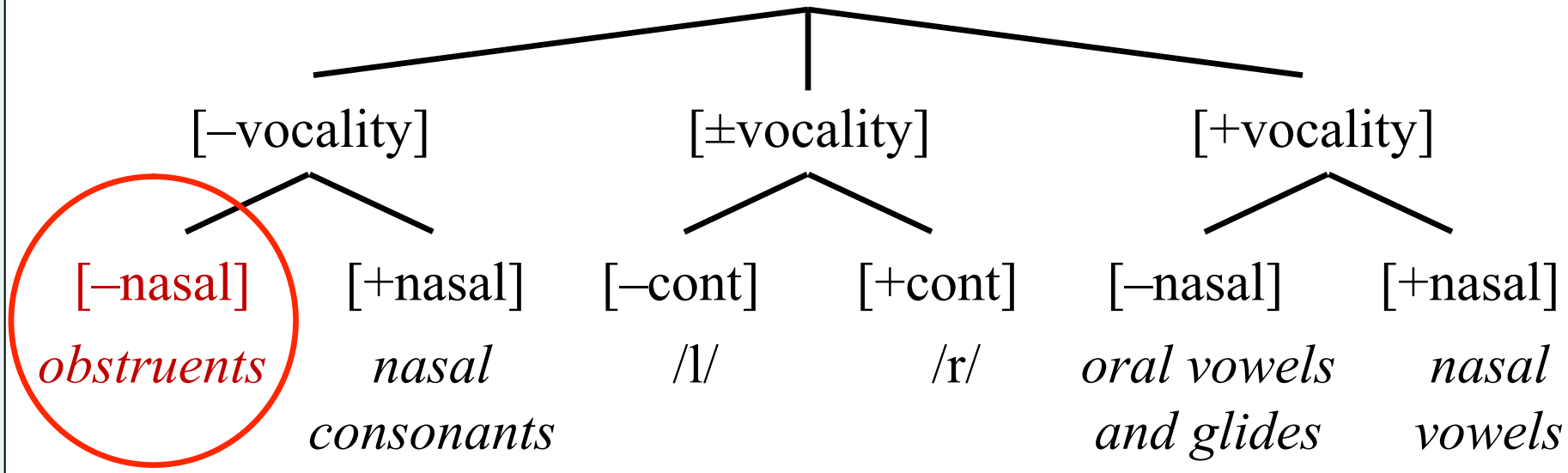
Decision Tree for Standard French



[vocality] > [nasality] > [saturation] > [gravity] > [tensity] > [continuousness]

If a feature is not contrastive in a branch, it is not assigned there. In this example, there are only two liquids, /l, r/, and only the last feature, [continuousness], distinguishes between them.

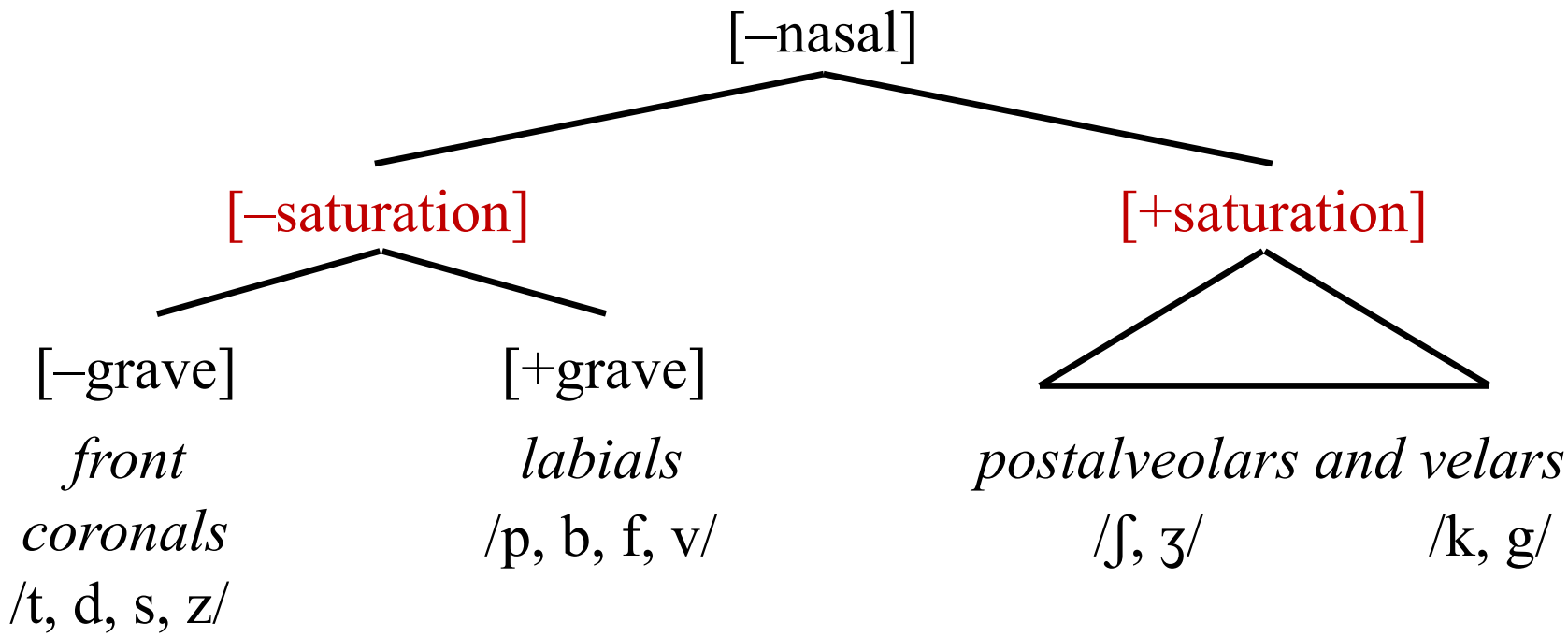
Decision Tree for Standard French



[vocality] > [nasality] > [saturation] > [gravity] > [tensity] > [continuousness]

We need not go through the whole tree here, but let us briefly look at the expansion of the non-nasal obstruents.

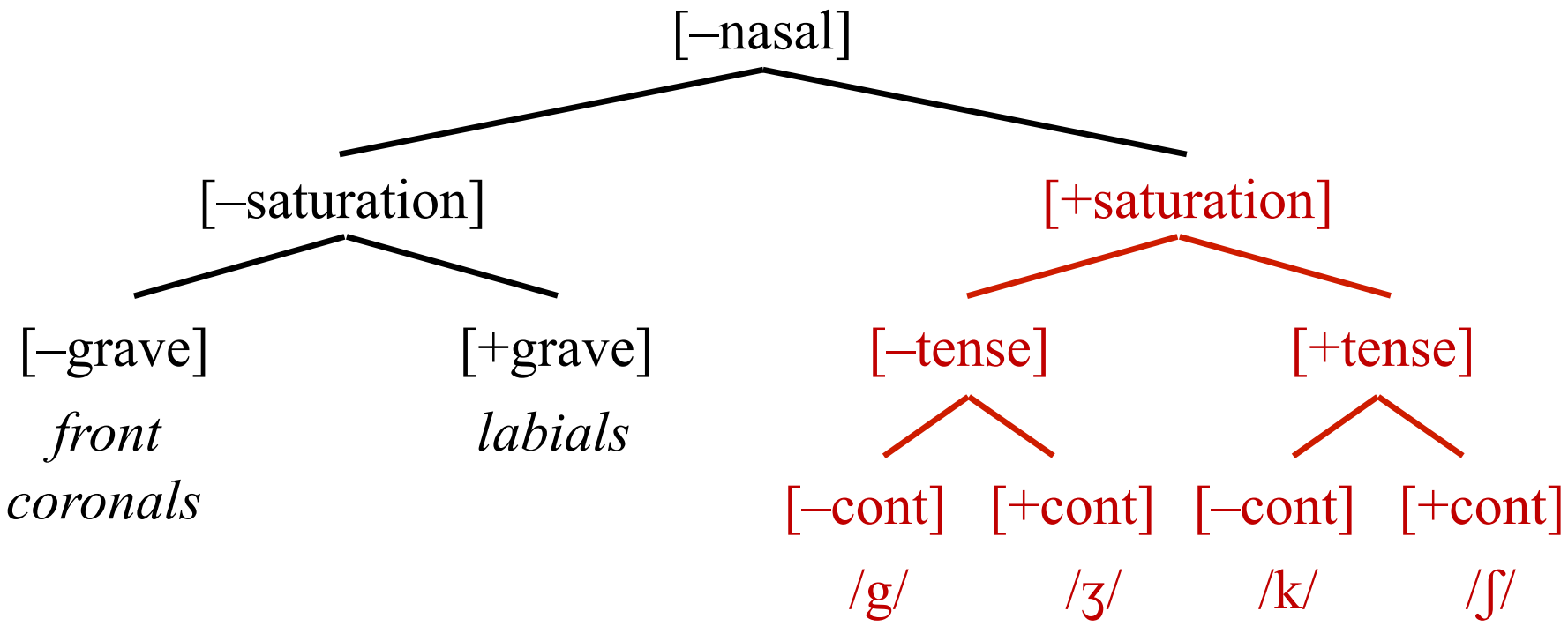
Decision Tree for Standard French



[vocality] > [nasality] > [saturation] > [gravity] > [tensity] > [continuousness]

The next choice is [saturation]: front coronals and labials are –, and postalveolars /ʃ, ʒ/ and velars /k, g/ are +.

Decision Tree for Standard French



[vocality] > [nasality] > [saturation] > [gravity] > [tensity] > [continuousness]

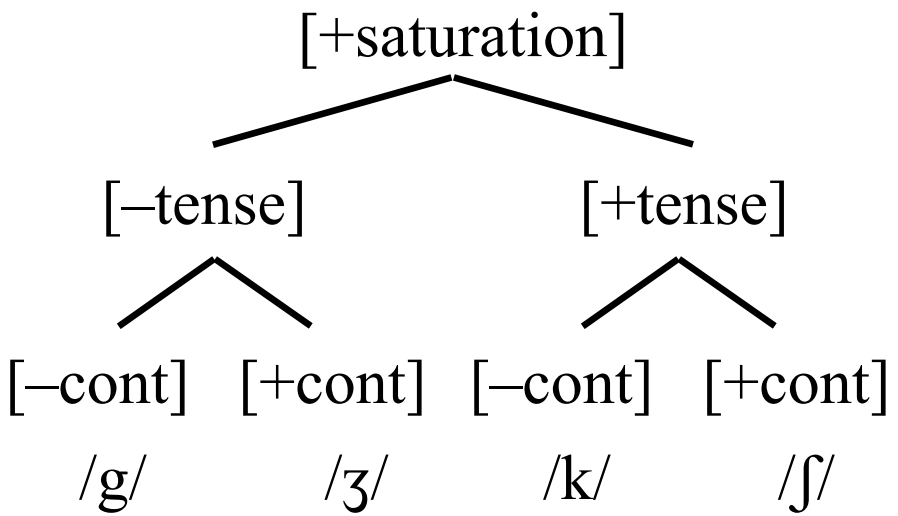
The [+saturated] consonants are divided by [tensity] and [continuousness]; this analysis does not distinguish post-alveolars from velars, but mixes the [+saturated] segments together.

Decision Tree for Standard French

To support their use of the feature [saturated], Jakobson & Lotz observe (1949: 153):

'the difference between velar and palatal is irrelevant in French phonemics…'

'These contextual variations do not hinder French speakers from rendering the English velar *ŋ* through the French palatal *ɲ*... or the German 'ich-Laut' through *ʃ*.'



'The advanced articulation of *k g* before *j* or *i*, as well as the existence of *ŋ* instead of *ɲ* before *w*…illustrates the unity of the saturated consonants in French.'

Phonemes and Contrastive Properties

That is, the idea of representing phonemes only by their contrastive features is not motivated here by a desire to economize on lexical representations.

Rather, as in the articles by Benediktsson (1967) and Antonsen (1972), the contrastive features are closely tied to activity, that is, to the phonological patterning of the phonemes.

The germ of this idea can be traced back to the dawn of modern phonology, in the work of Henry Sweet.

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Part 5
Sweet 1877
Contrastive Properties and 'Broad Romic' Transcription

Introduction
1. Hogg
2. Antonsen
3. Benediktsson
4. Jakobson et al.
5. Sweet
6. Trubetzkoy
7. Halle
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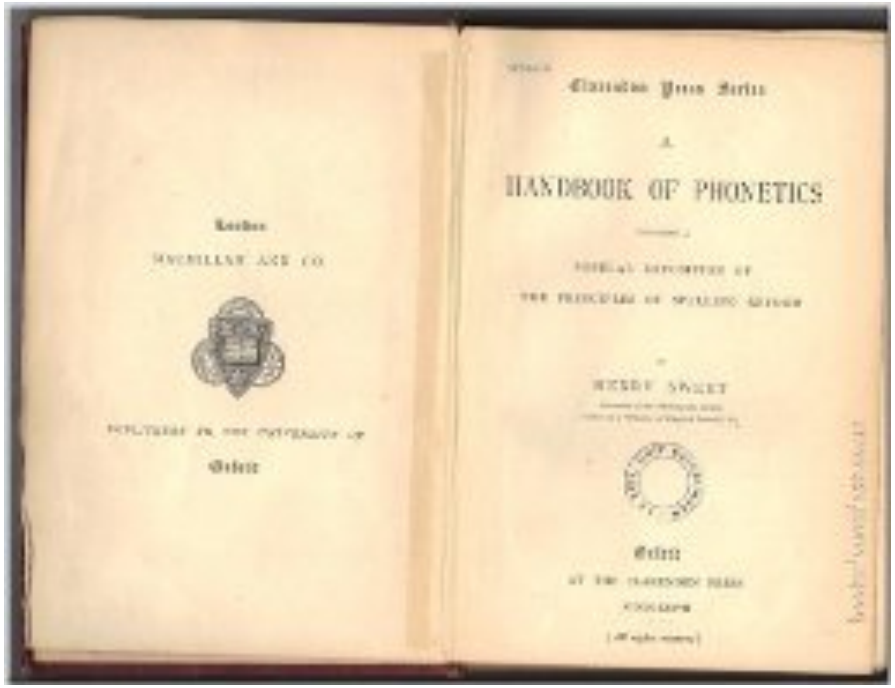
Conclusions

Contrast and Broad Transcription



According to Daniel Jones (1967: 256), Henry Sweet was the first to distinguish two types of transcription: 'Narrow Romic' (a detailed phonetic transcription), and 'Broad Romic' (a phonemic transcription suitable to an individual language).

Contrast and Broad Transcription

For example, the vowels in the English words *bait* and *bet* differ in three ways: the vowel in *bait* is longer and tenser than in *bet*, and is a diphthong, whereas the vowel in *bet* is a monophthong.

An accurate phonetic transcription would indicate all these distinctions; in the current notation of the International Phonetic Alphabet (IPA), they are transcribed as shown.

	Differences	IPA
bait	long, tense, +*j*	[eːj]
bet	short, lax, +Ø	[ɛ]

Contrast and Broad Transcription

These three differences, however, are not independent: recombining the various properties to create new vowels as shown would not result in a new word distinct from both *bait* and *bet*, but would be heard as some (perhaps odd-sounding) variant of one of these words.

Sweet (1877: 104) writes: 'we may lay down as a general rule that only those distinctions of sounds require to be symbolized in any one language which are *independently significant*'.

	Differences	IPA	Non-contrasting vowels
bait	long, tense, +*j*	[eːj]	[eː], [ej], [e], [ɛː], [ɛj], [ɛːj]
bet	short, lax, +Ø	[ɛ]	

Contrast and Broad Transcription

Further, 'if two criteria of significance are inseparably associated, such as quantity and narrowness or wideness [i.e., tenseness or laxness/BED], we only need indicate one of them.'

Sweet proposes (1877: 109–110) that in broad transcription [eːj] should be transcribed 'ei' (or, equivalently, 'ej') and [ɛ] as 'e'.

Thus, of the three differences in the vowels, he chooses the presence of an off-glide *j* as significant, ignoring both quantity (length) and narrowness or wideness (tenseness or laxness).

	Differences	IPA	Broad
bait	long, tense, +*j*	[eːj]	ei *or* ej
bet	short, lax, +Ø	[ɛ]	e

Contrast and Broad Transcription

In this case he gives the rationale for his choice. He observes (p. 110): 'The narrowness of all [English] vowels is uncertain', especially /ij/ and /ej/.

That is, vowels can vary in the degree to which they are tense or lax without essentially changing the identity of the vowel, as long as other properties do not change.

	Differences	IPA	Broad	Narrowness not contrastive
bait	long, tense, +*j*	[eːj]	ei *or* ej	[eːj] *or* [ɛːj]
bet	short, lax, +Ø	[ɛ]	e	[ɛ] *or* [e]

Contrast and Broad Transcription

Similarly, he finds (p. 18) that 'originally short vowels can be lengthened and yet kept quite distinct from the original longs'.

That is, [bɛt] (*bet*) can be lengthened to [bɛːt] without passing into *bait*, and [beːjt] (*bait*) can be shortened to [bejt] without being perceived as *bet*.

	Differences	IPA	Broad	Length not contrastive
bait	long, tense, +*j*	[eːj]	ei *or* ej	[eːj] *or* [ej]
bet	short, lax, +Ø	[ɛ]	e	[ɛ] *or* [ɛː]

Contrast and Broad Transcription

While tenseness and length can be altered without changing one vowel phoneme into another one, presumably the same is not the case for the third distinguishing property.

Adding a glide to the vowel in *bet*, or removing it from *bait*, could cause the resulting vowel to be perceived as having changed category.

	Differences	IPA	Broad	Glide is contrastive
bait	long, tense, +*j*	[eːj]	ei *or* ej	[eːj] *not* [eː]
bet	short, lax, +Ø	[ɛ]	e	[ɛ] *not* [ɛj]

Contrast and Broad Transcription

We can conclude from his discussion that Sweet's analysis posits that the contrastive features of both the vowels in *bet* and *bait* are mid and front, with no contrastive specification for tenseness or quantity.

The difference in the two words resides in the addition of a second segment to the vowel in *bait*.

	Differences	IPA	Broad
bait	long, tense, +*j*	[eːj]	ei *or* ej
bet	short, lax, +Ø	[ɛ]	e

Contrast and Broad Transcription

Sweet did not propose a method for computing contrastive properties, nor did he consistently attempt to identify what the contrastive properties are for every segment.

However, we can see in his work the ideas that only contrastive properties need be transcribed, and that these properties can be identified by observing how sounds function in a particular language.

The further development of these ideas, and their connection with feature hierarchies, came some years later in the work of the Prague School linguists, notably Jakobson and Trubetzkoy.

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Part 6
Trubetzkoy 1939
The Connection between Contrast and Hierarchy

Introduction
1. Hogg
2. Antonsen
3. Benediktsson
4. Jakobson et al.
5. Sweet
6. Trubetzkoy
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Contrast and Hierarchy

Up to now, I have been tracing the origins of a number of ideas related to feature contrasts, and it would be good to review them before moving on:

- One idea is that only some properties of a segment are active, or relevant, to the phonology, and these are the distinctive, or contrastive, properties.
- Another is that contrastive features are computed hierarchically by ordered features that can be expressed as a branching tree.

While these two notions appear together in some of the work we have reviewed, this is not the case, or does not appear to be the case, for all the analyses we have looked at.

Contrast and Hierarchy

Thus, there is no evidence of a feature hierarchy in Sweet 1877, nor does Hogg (1992) mention a hierarchy in his discussion of Germanic vowel systems.

Nevertheless, I believe that the notions of contrast and hierarchy are closely linked.

This connection was made explicit in the 1950s, but its roots can be found in the work of Jakobson and Trubetzkoy in the 1920s and 1930s.

Trubetzkoy (1939)

The phonologist who did the most to establish sub-phonemic contrastive features as an organizing principle of phonology was Prince N. S. Trubetzkoy.

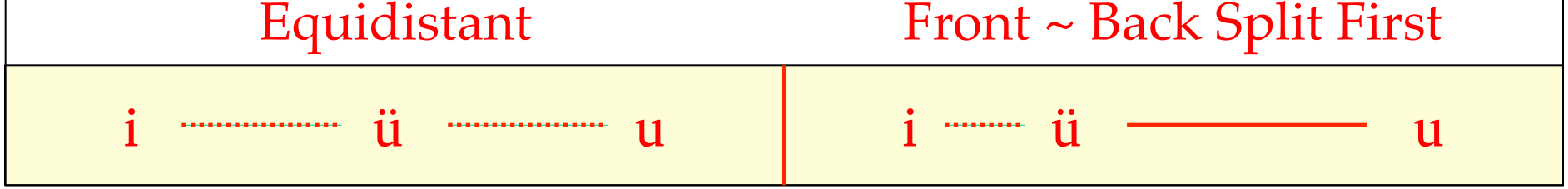
His posthumous *Grundzüge der Phonologie* (1939) contains many valuable insights, but no consistent method for computing which features are contrastive.

Trubetzkoy (1939)

There are places in the *Grundzüge* where Trubetzkoy explicitly alludes to an ordering of features.

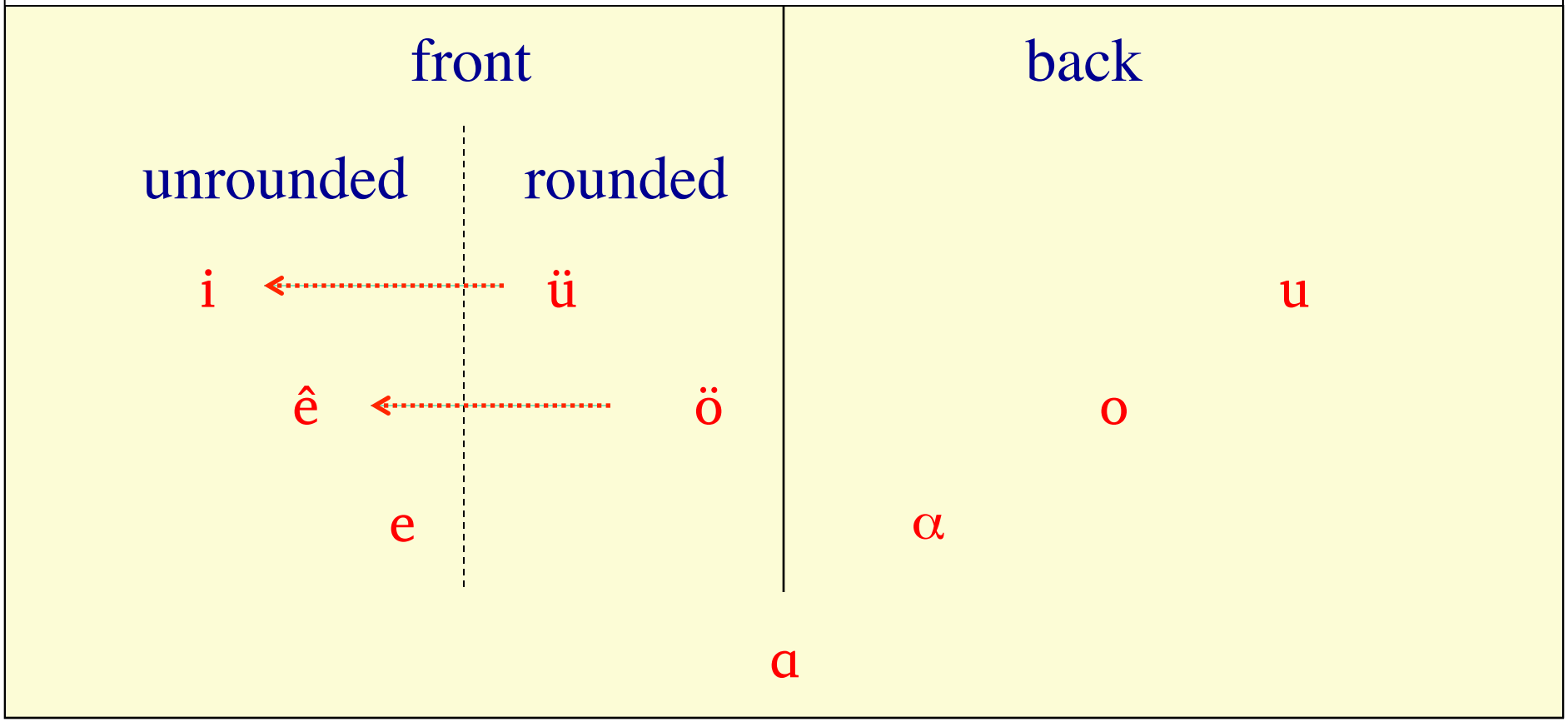
For example, given an inventory containing the phonemes /i, ü, u/, one might suppose that the front rounded /ü/ would function as intermediate between /i/ and /u/.

However, Trubetzkoy observes (1969: 102–3) that a 'certain hierarchy existed' in the Polabian vowel system, whereby the back ~ front contrast is higher than the rounded ~ unrounded one, the latter being a sub-classification of the front vowels.



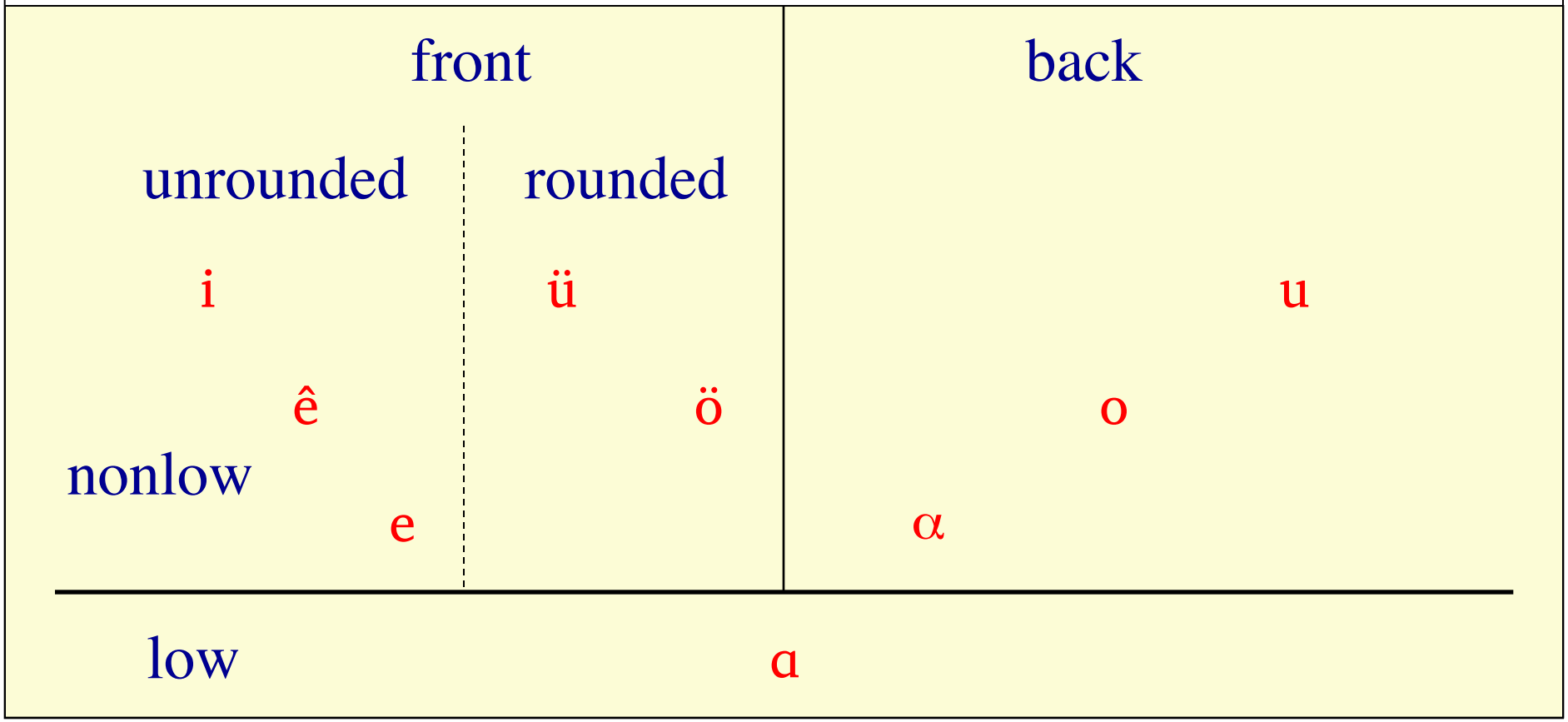
The Polabian Vowel System

Evidence is that the oppositions between back and front vowels are constant, but those between rounded and unrounded vowels of the same height can neutralize to the unrounded vowels.



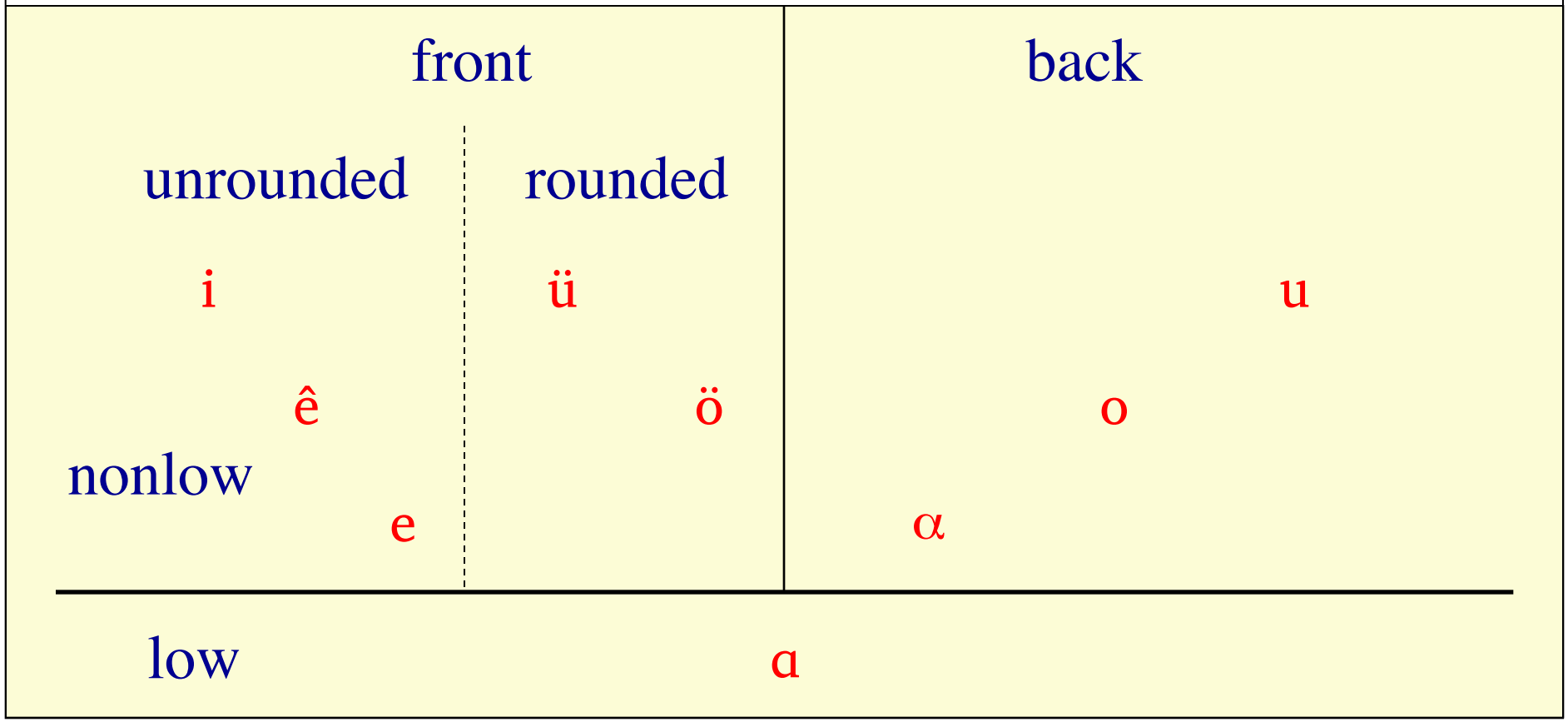
The Polabian Vowel System

Further, palatalization in consonants is neutralized before all front vowels and before 'the maximally open vowel *a* which stood outside the classes of timbre' (1969: 102).



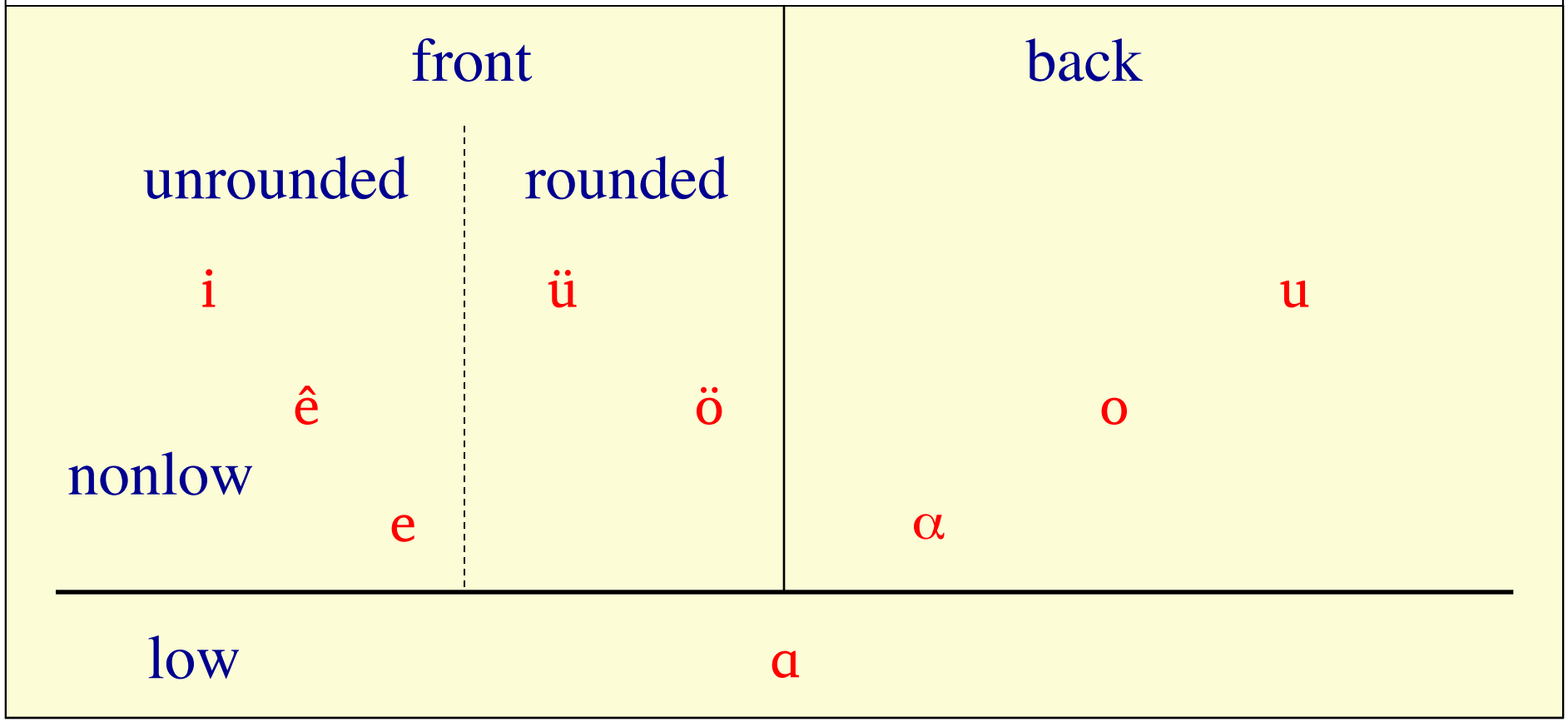
The Polabian Vowel System

As with West Germanic */a/, the notion that Polabian /ɑ/ 'stood outside the classes of timbre' can be expressed by dividing this vowel from the others by ordering [low] first.



The Polabian Vowel System

Trubetzkoy's analysis suggests that the features are ordered into the (partial) hierarchy: [low] > [back] > [rounded]



Five-Vowel Systems

Elsewhere, Trubetzkoy (1939) presents analyses that imply a contrastive feature hierarchy, though it is not stated explicitly.

This can be demonstrated in his review of five-vowel systems. He observes that in many such systems the low vowel does not participate in tonality contrasts, as we saw in the case of Polabian.

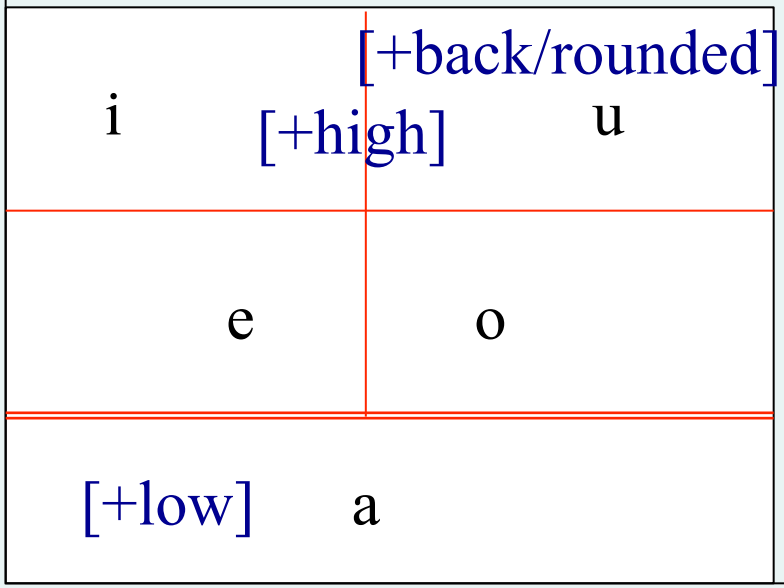
He cites Latin as an example of this kind of system.

Five-Vowel Systems: Latin

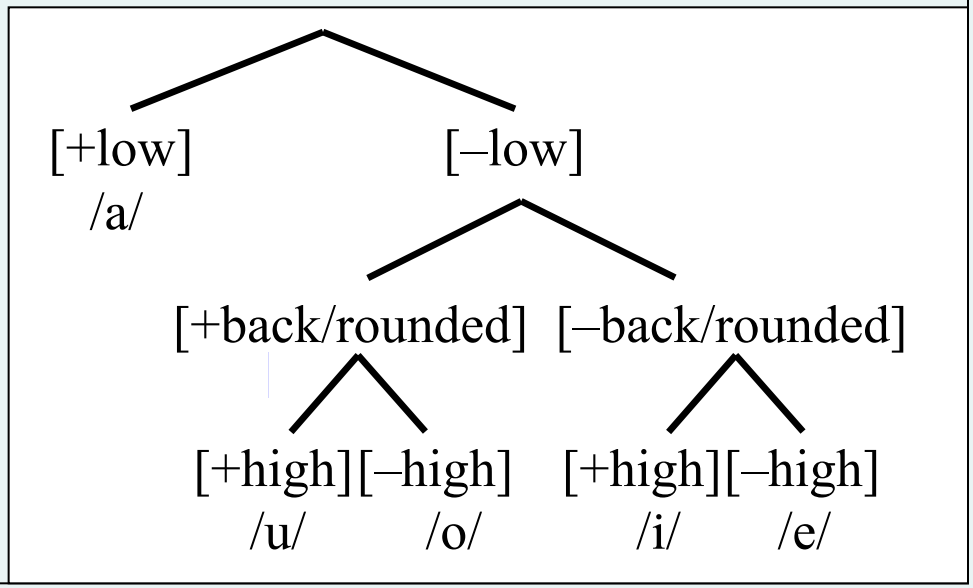
In order to exclude /a/ from receiving tonality features, it is necessary to order [low] highest in the hierarchy, which has the effect of separating /a/ from the other vowels.

The diagram on the left thus corresponds to the feature tree on the right.

Latin



[low] > [back/rounded], [high]

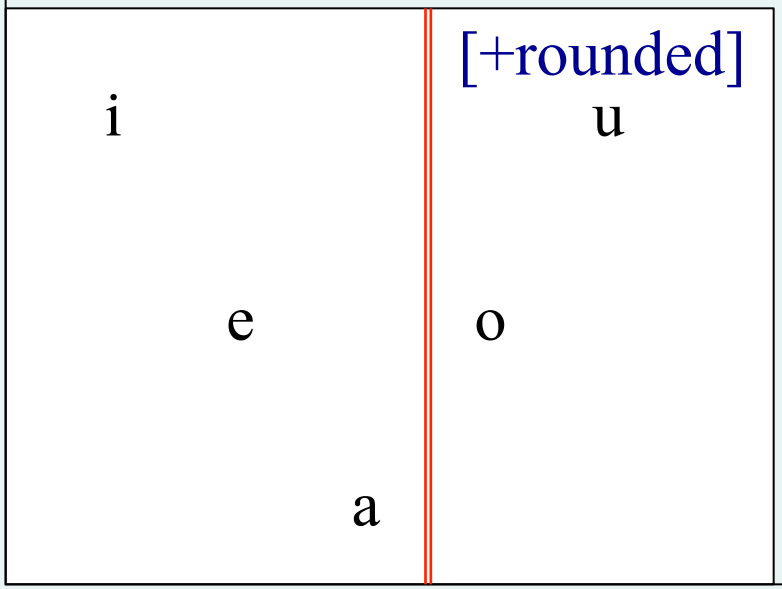


Five-Vowel Systems: Archi

Trubetzkoy observes that other types of 5-vowel systems exist.

In Archi (East Caucasian), a language of Central Daghestan, a consonantal rounding contrast is neutralized before and after the rounded vowels /u/ and /o/. 'As a result, these vowels are placed in opposition with…unrounded *a*, *e*, and *i*'.

Archi



Five-Vowel Systems: Archi

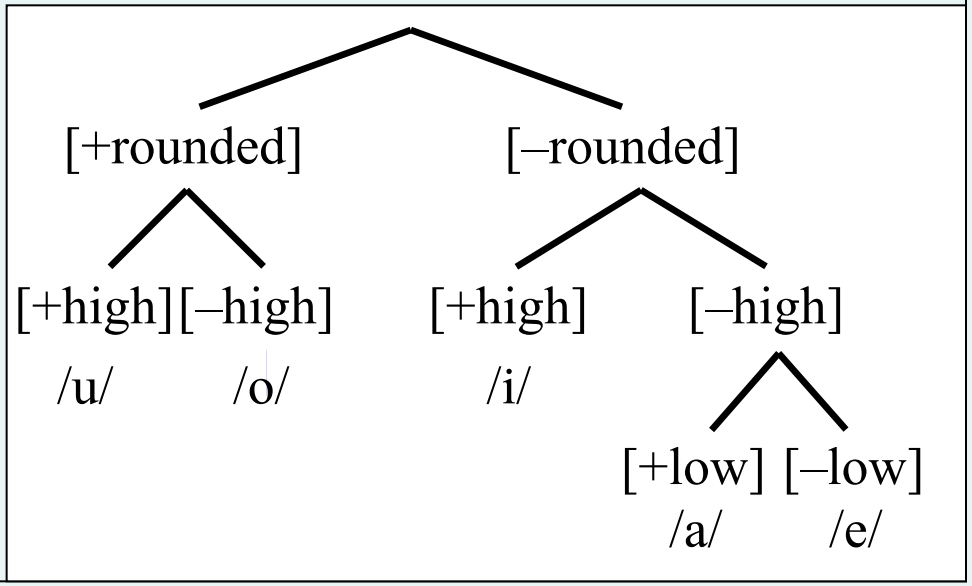
'This means that all vowels are divided into rounded and unrounded vowels, while the back or front position of the tongue proves irrelevant…' (Trubetzkoy 1969: 100-101).

This analysis corresponds to ordering [rounded] first, followed by [high] and [low] (the latter only in the unrounded vowels).

Archi

	[+rounded]	
i	[+high]	u
e		o
[+low]	a	

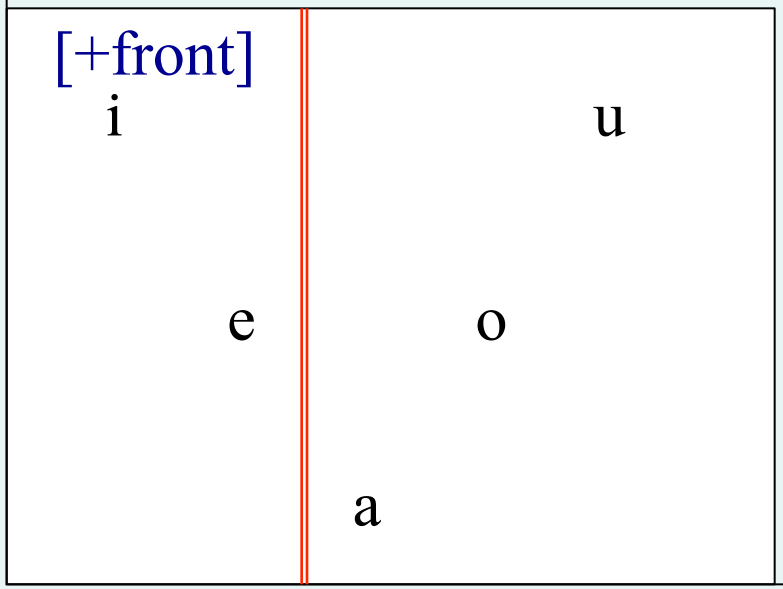
[rounded] > [high], [low]



Five-Vowel Systems: Japanese

Trubetzkoy argues that neutralization of the opposition between palatalized and non-palatalized consonants before *i* and *e* in Japanese shows that these vowels are put into opposition with the other vowels /a, o, u/.

Japanese

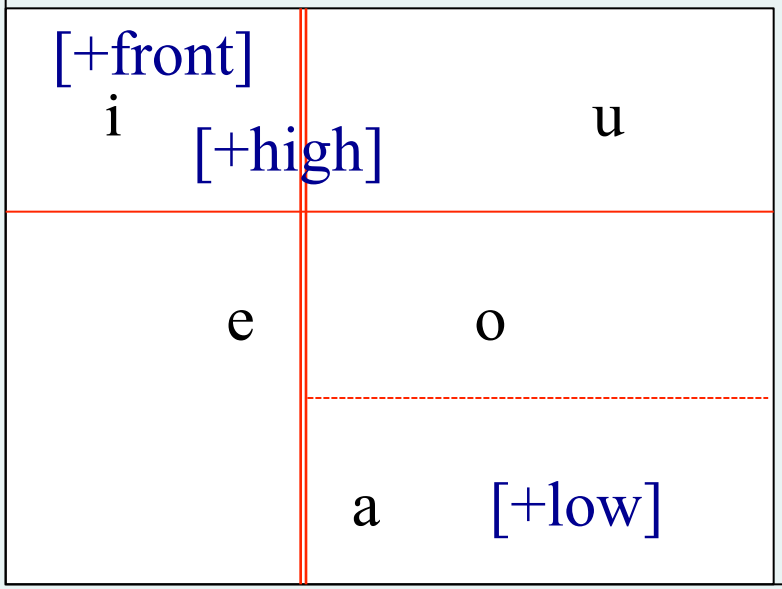


Five-Vowel Systems: Japanese

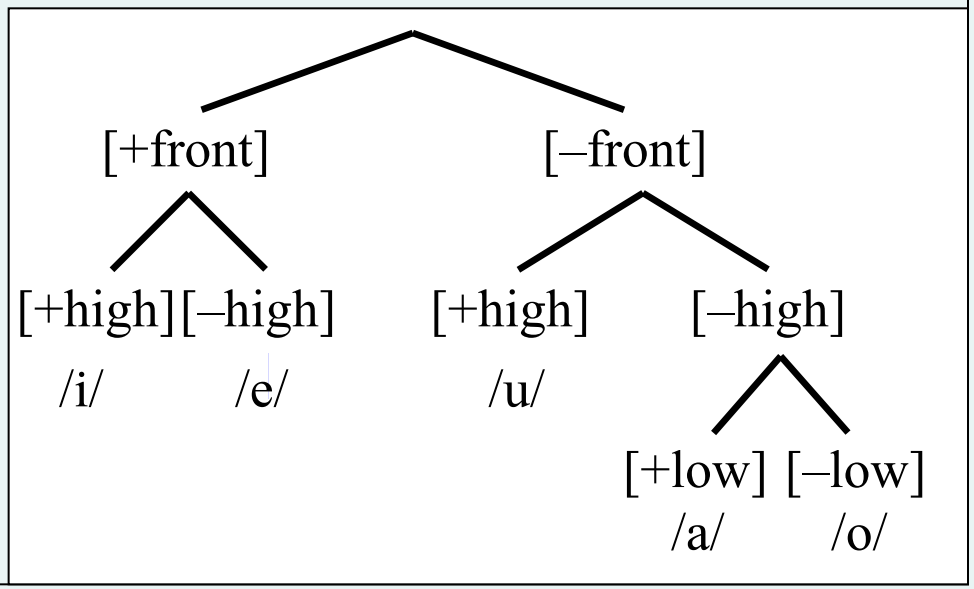
The governing opposition is that between front and back vowels, lip rounding being irrelevant.

This analysis corresponds to ordering [front] first, followed by [high] and [low] (the latter only in the back vowels).

Japanese



[front] > [high], [low]



Contrast Depends on 'Point of View'

Thus we can understand Trubetzkoy's remark in his 1936 article addressed to psychologists and philosophers, that the correct classification of an opposition 'depends on one's point of view';

but 'it is neither subjective nor arbitrary, for the point of view is implied by the system' (Trubetzkoy 2001: 20).

Feature ordering is a way to incorporate 'point of view' into the procedure of determining contrastive properties.

Different orders result in different contrastive features, and hence in different ways of classifying a given contrast.

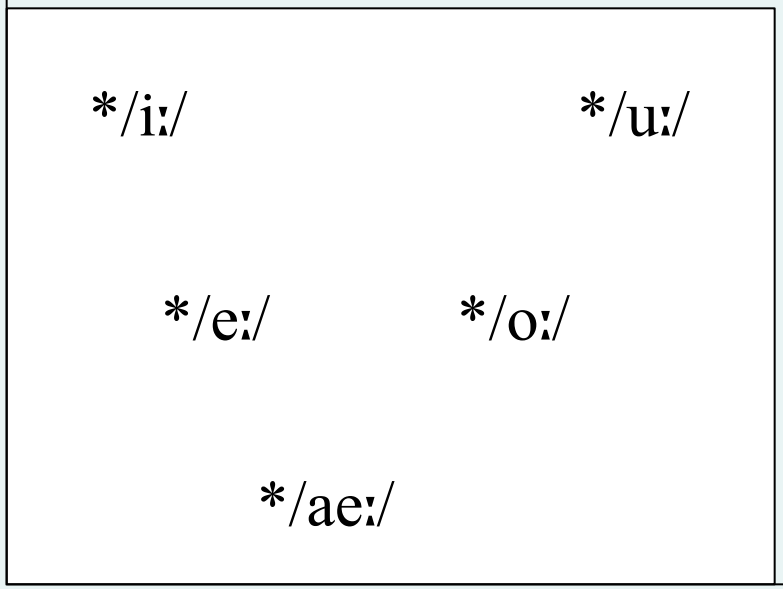
The correct ordering is 'implied by the system', meaning, suggested by the patterns of phonological activity in the system.

West Germanic Long Vowels Again

In light of this review of five-vowel systems, let us consider again Hogg's (1992: 61) statement about the West Germanic low long vowel:

'*/æː/ is the only low long vowel and there is no front/back contrast in operation.'

West Germanic



West Germanic Long Vowels Again

We now understand that this statement reflects a (perhaps tacit) decision to evaluate the low vowel as a separate domain with respect to its contrastive features.

And this is equivalent to ordering [low] highest in the feature hierarchy, as was indeed done by Antonsen and Benediktsson.

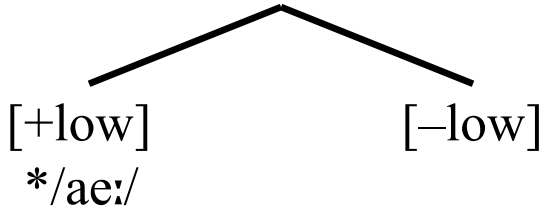
West Germanic

*/iː/ */uː/

*/eː/ */oː/

[+low] */aeː/

[low] > [back/rounded], [high]

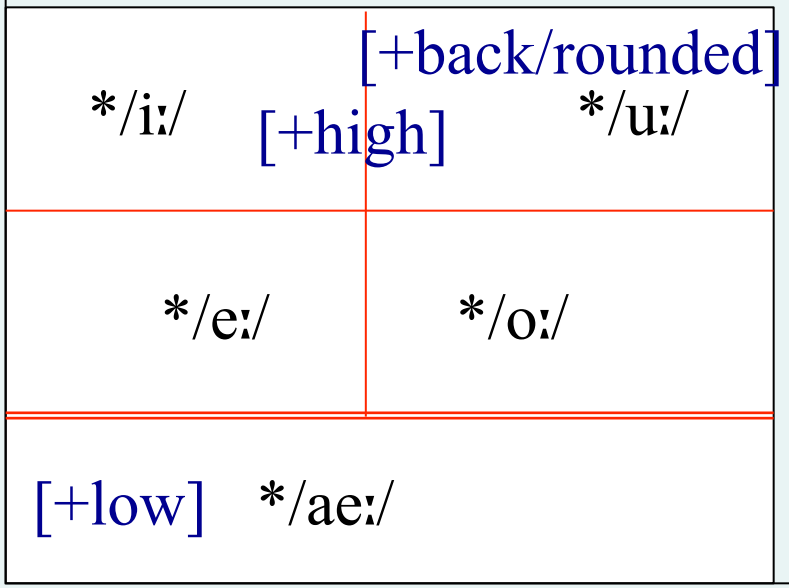


West Germanic Long Vowels Again

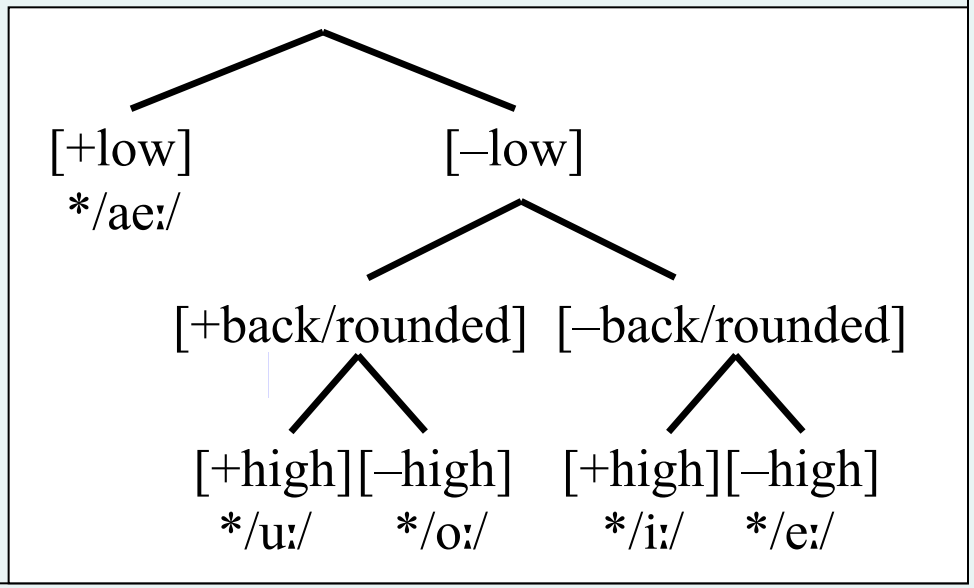
This ordering reflects an analytic choice, and is not dictated by the fact that there is only one low long vowel.

Other ways of dividing up the vowel inventory are logically possible, but this is the correct one, 'implied by the system'.

West Germanic



[low] > [back/rounded], [high]



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Part 7
Halle 1959
A Novel Argument for Branching Trees

Introduction
1. Hogg
2. Antonsen
3. Benediktsson
4. Jakobson et al.
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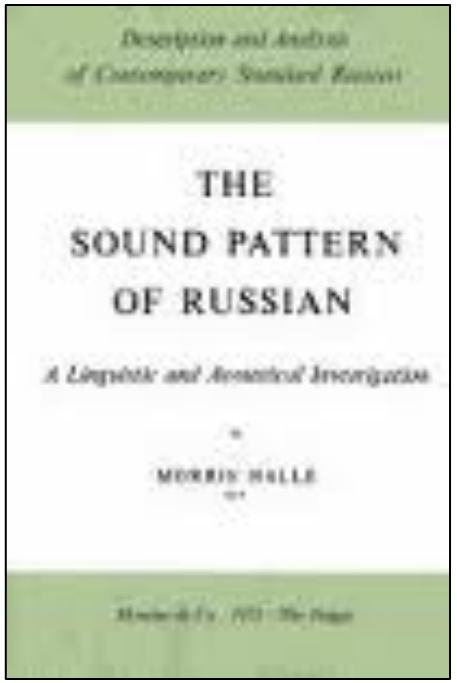
The Sound Pattern of Russian



On page 46 in *The sound pattern of Russian* (Halle 1959) is Figure I–1, a magnificent tree diagram that shows the contrastive feature specifications of every phoneme of Russian.

The Sound Pattern of Russian

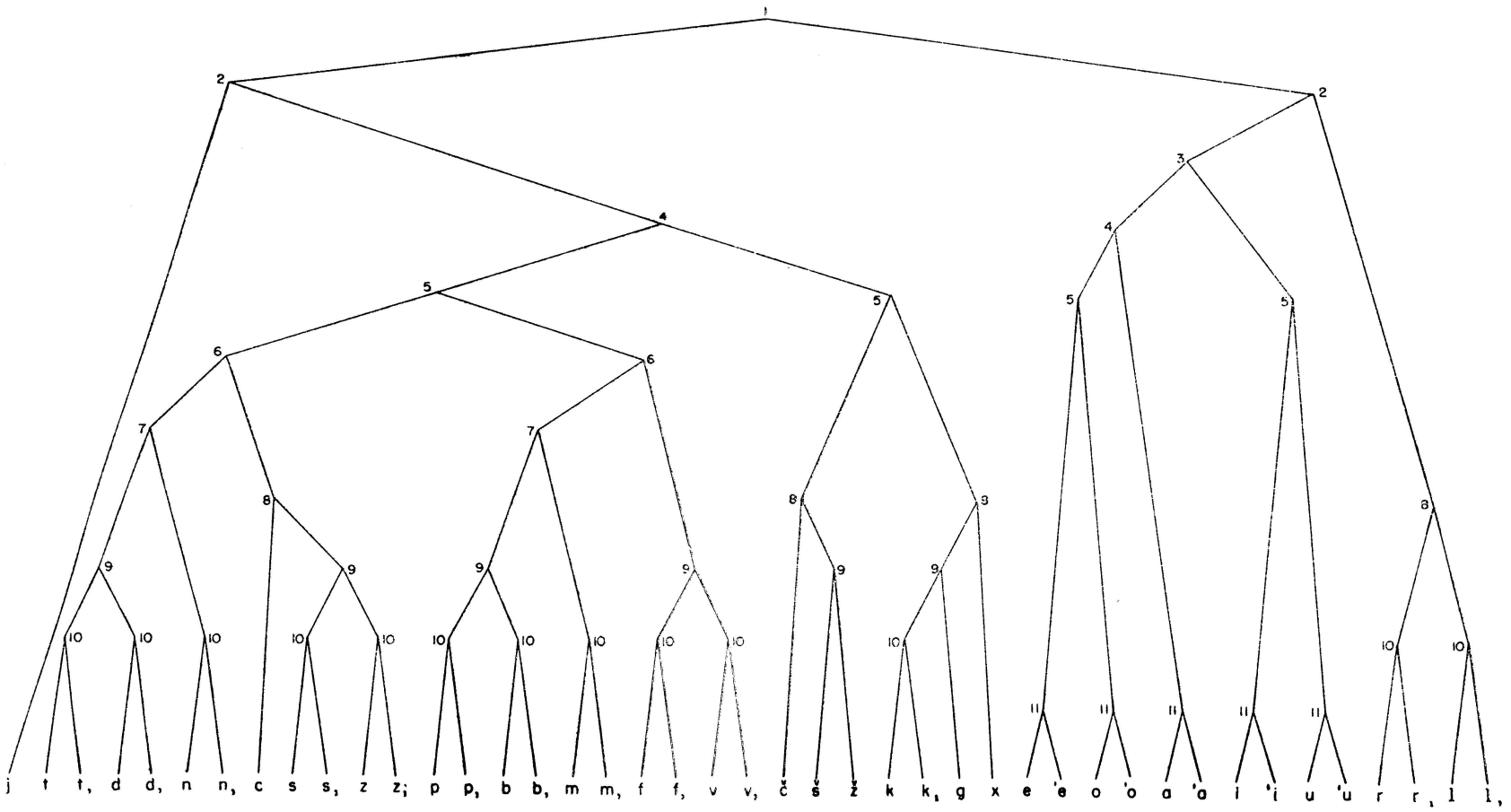


Fig. I-1. Branching diagram representing the morphonemes of Russian. The numbers with which each node is labelled refer to the different features, as follows: 1. vocalic vs. nonvocalic; 2. consonantal vs. nonconsonantal; 3. diffuse vs. nondiffuse; 4. compact vs. noncompact; 5. low tonality vs. high tonality; 6. strident vs. mellow; 7. nasal vs. nonnasal; 8. continuant vs. interrupted; 9. voiced vs. voiceless; 10. sharped vs. plain; 11. accented vs. unaccented. Left branches represent minus values, and right branches, plus values for the particular feature.

An Argument for Branching Trees

The 1950s and early 1960s were prime years for contrastive specification via branching trees.

This approach was imported into the early versions of the theory of Generative Phonology; it is featured prominently in Harms 1968, the first textbook in Generative Phonology.

Underneath the surface, however, the role of contrastive features in phonology was in decline, as the connection between contrastive specification and phonological activity was being eroded for a variety of reasons I have tried to document in detail (Dresher 2009; in press).

An Argument for Branching Trees

By the time of Halle 1959, the main principles governing feature ordering were information-theoretic considerations, such as minimizing redundancy.

Against this general decline, however, Halle (1959) advances a novel argument for specifying features by branching trees.

He argues that phonological features must be ordered into a hierarchy because this is the only way to ensure that segments are kept properly distinct.

The Distinctness Condition

Specifically, he proposes (1959: 32) that phonemes must meet the Distinctness Condition:

The Distinctness Condition

> Segment-type {A} will be said to be different from segment-type {B}, if and only if at least one feature which is phonemic in both, has a different value in {A} than in {B}; i.e., plus in the former and minus in the latter, or vice versa.

This formulation is designed to disallow contrasts involving a zero value of a feature.

The Distinctness Condition

Consider the typical sub-inventory /p, b, m/ shown below, and suppose we characterize it in terms of two binary features, [±voiced] and [±nasal].

In terms of full specifications, /p/ is [–voiced, –nasal], /b/ is [+voiced, –nasal], and /m/ is [+voiced, +nasal].

Which of these features is contrastive? Many people reason as follows:

	/p/	/b/	/m/
[voiced]	–	+	+
[nasal]	–	–	+

The Distinctness Condition

We observe that /p/ and /b/ are distinguished only by [voiced]; so these specifications must be contrastive.

Similarly, /b/ and /m/ are distinguished only by [nasal]; these specifications must also be contrastive.

What about the uncircled specifications? These are predictable from the circled ones:

	/p/	/b/	/m/
[voiced]	(−)	(+)	+
[nasal]	−	(−)	(+)

The Distinctness Condition

Since /p/ is the only [–voiced] phoneme in this inventory, its specification for [nasal] is predictable, hence redundant.

Similarly, /m/ is the only [+nasal] phoneme, so its specification for [voiced] is redundant.

This is a still-popular way of thinking about contrastive specifications; but Halle 1959 argues that it is wrong:

	/p/	/b/	/m/
[voiced]	–	+	+
[nasal]	–	–	+

The Distinctness Condition

Segment-type {A} will be said to be different from segment-type {B}, if and only if at least one feature which is phonemic in both, has a different value in {A} than in {B}; i.e., plus in the former and minus in the latter, or vice versa.

According to the Distinctness Condition, /p/ is 'different from' /b/, because /p/ is [–voiced] and /b/ is [+voiced].

	/p/	/b/	/m/
[voiced]	–	+	
[nasal]		–	+

The Distinctness Condition

Segment-type {A} will be said to be different from segment-type {B}, if and only if at least one feature which is phonemic in both, has a different value in {A} than in {B}; i.e., plus in the former and minus in the latter, or vice versa.

According to the Distinctness Condition, /p/ is 'different from' /b/, because /p/ is [–voiced] and /b/ is [+voiced].

Similarly, /b/ is 'different from' /m/, because /b/ is [–nasal] and /m/ is [+nasal].

	/p/	/b/	/m/
[voiced]	–	+	
[nasal]		–	+

The Distinctness Condition

Segment-type {A} will be said to be different from segment-type {B}, if and only if at least one feature which is phonemic in both, has a different value in {A} than in {B}; i.e., plus in the former and minus in the latter, or vice versa.

But /p/ is not 'different from' /m/: where one has a feature, the other has no specification.

Therefore, these specifications are not properly contrastive.

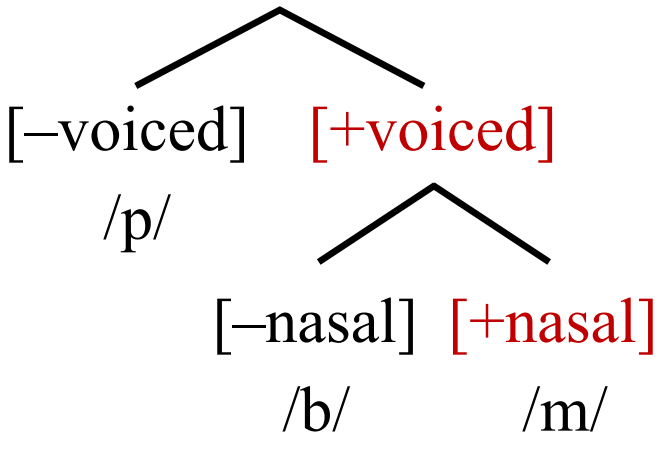
	/p/	/b/	/m/
[voiced]	–	+	
[nasal]		–	+

The Distinctness Condition

The specifications below violate the Distinctness Condition because no feature hierarchy yields this result.

If we order [voiced] > [nasal], we generate an extra specification on /m/.

	/p/	/b/	/m/
[voiced]	–	+	⊕
[nasal]		–	+



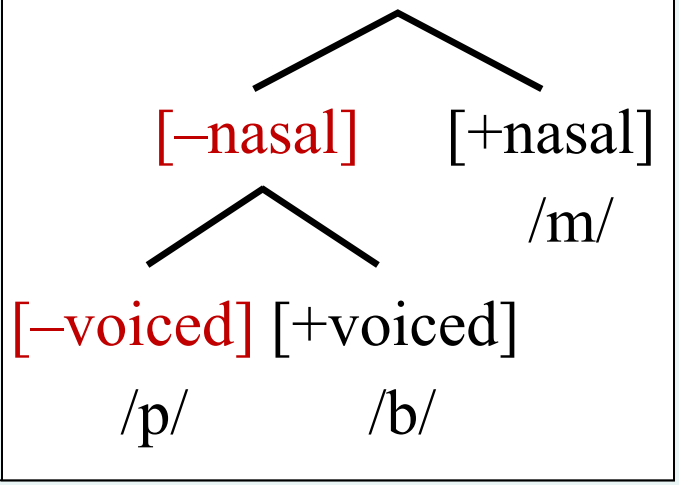
The Distinctness Condition

The specifications below violate the Distinctness Condition because no feature hierarchy yields this result.

If we order [voiced] > [nasal], we generate an extra specification on /m/.

If we order [nasal] > [voiced], we generate an extra specification on /p/.

	/p/	/b/	/m/
[voiced]	–	+	
[nasal]	–	–	+



The Distinctness Condition

The Distinctness Condition is thus an argument against arriving at contrastive specifications by means of pairwise comparisons.

Pairwise comparisons are a popular, if flawed, method of contrastive specification, as documented in Dresher (2009)

I believe that Halle (1959) is correct in arguing that only a hierarchical approach can guarantee that all segments in an inventory are properly contrasted.

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Part 8
A Theory of Contrastive Specification

Introduction
1. Hogg
2. Antonsen
3. Benediktsson
4. Jakobson et al.
5. Sweet
6. Trubetzkoy
7. Halle
8. A Theory
9. i-umlaut
10. Contrast Shift
Conclusions

A Theory of Contrast

At this point I would like to pull together the various ingredients in the works we have reviewed into an explicit theory of how contrast should be implemented in a phonological grammar.

We have been incorporating the above ideas into generative grammar under the name Modified Contrastive Specification (MCS) or 'Toronto School' phonology (Dresher, Piggott & Rice 1994, Dresher & Rice 2007, Dresher 2009).

The central principles should by now be familiar. Recall:

The Contrastivist Hypothesis

- Only some properties of a segment are active, or relevant to the phonology, and these are the distinctive, or contrastive, properties.

This idea has been formulated by Hall (2007) as the Contrastivist Hypothesis:

The Contrastivist Hypothesis

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

Contrast and Phonological Activity

It follows from the Contrastivist Hypothesis that only contrastive features can be phonologically active, where feature activity is defined as follows (adapted from Clements (2001: 77):

Phonological Activity

A feature can be said to be active if it plays a role in the phonological computation; that is, if it is required for the expression of phonological regularities in a language, including both static phonotactic patterns and patterns of alternation.

Contrast and Phonological Activity

If only contrastive features can be active, then it follows as a corollary to the Contrastivist Hypothesis that

Corollary to the Contrastivist Hypothesis

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

Contrast and Hierarchy

- The second major building block is that contrastive features are computed hierarchically by ordered features that can be expressed as a branching tree.

Branching trees are generated by what I call the Successive Division Algorithm (Dresher 1998, 2003, 2009):

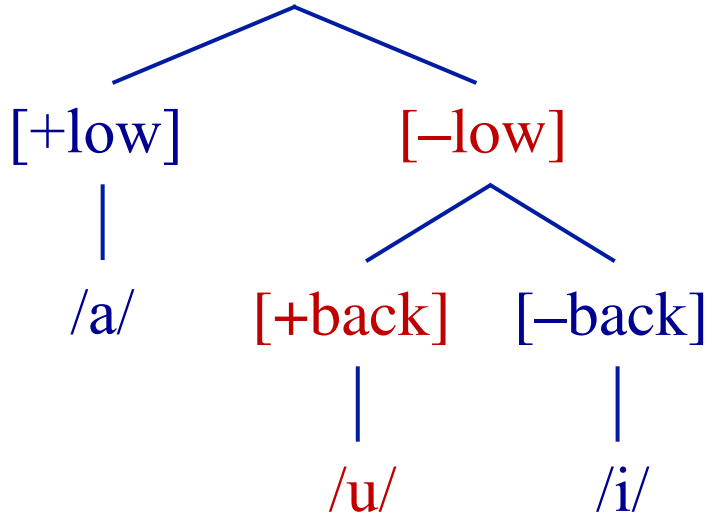
The Successive Division Algorithm

> Assign contrastive features by successively dividing the inventory until every phoneme has been distinguished.

Underspecified Features

Notice that on this view, lexical specifications are limited to contrastive features, so are not pronounceable.

[low] > [back]



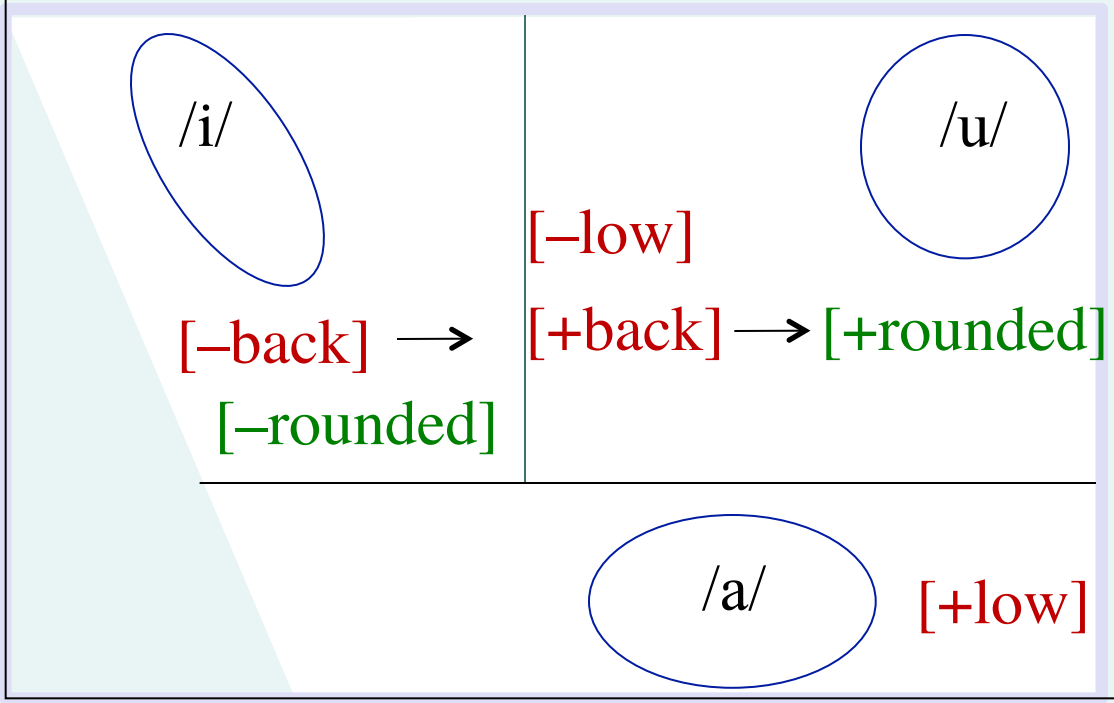
In this example, the phoneme designated /u/ has only two features: [–low] and [+back].

Unless the vowels are further specified in the phonology by other contrastive features, they are made more specific only in a postlexical (phonetic) component.

Enhancement of Underspecified Features

Stevens, Keyser & Kawasaki (1986) propose that feature contrasts can be enhanced by other features that have similar acoustic effects.

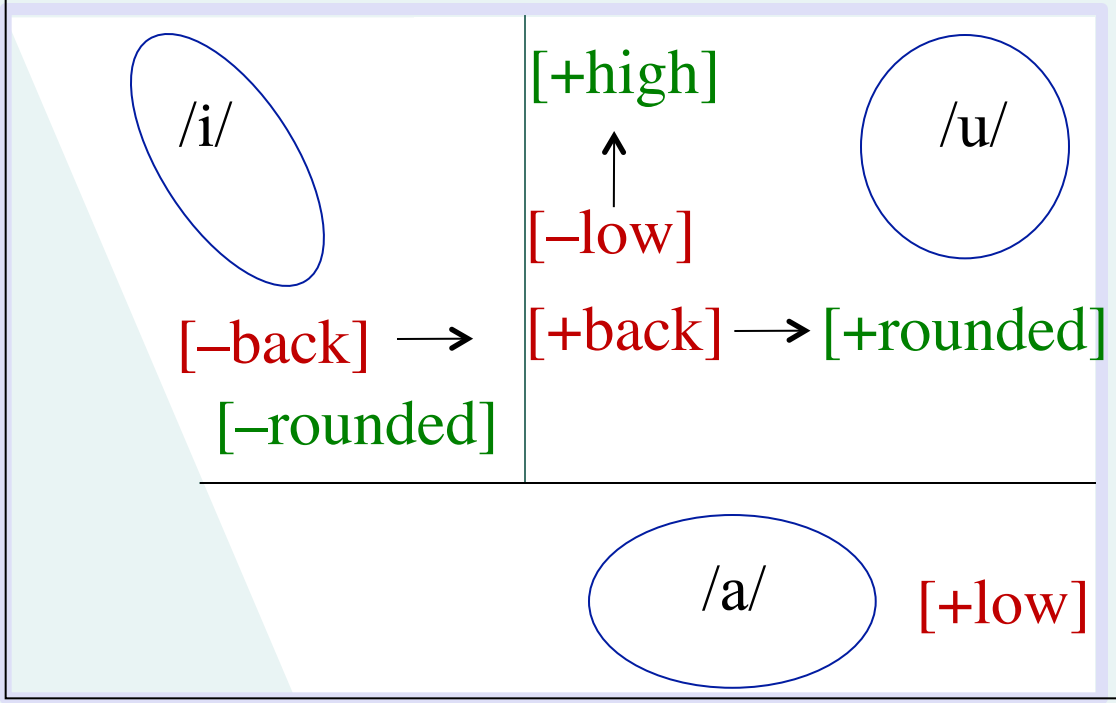
Thus, a non-low vowel can enhance its [+back] feature by adding [+rounded]; [–back] is enhanced by [–rounded].



Enhancement of Underspecified Features

And the feature [–low] can be enhanced by adding [+high].

These enhancements take place after the lexical (contrastive) phonology, in the postlexical component.



They are not necessary, however, and other realizations are possible (see Dyck 1995 and Hall 2011 for discussion).

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Part 9
The origins of *i*-umlaut in West Germanic

Introduction
1. Hogg
2. Antonsen
3. Benediktsson
4. Jakobson et al.
5. Sweet
6. Trubetzkoy
7. Halle
8. A Theory
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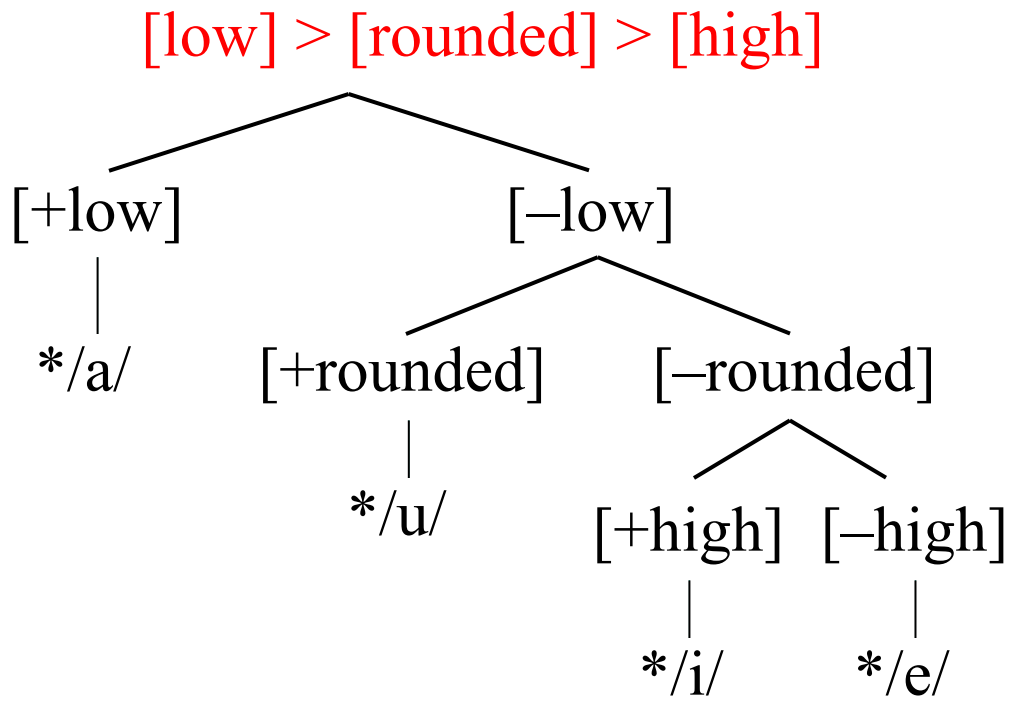
10. Contrast Shift
Conclusions

Proto-Germanic Feature Hierarchy

Let's return to the Proto-Germanic feature hierarchy of Antonsen (1972).

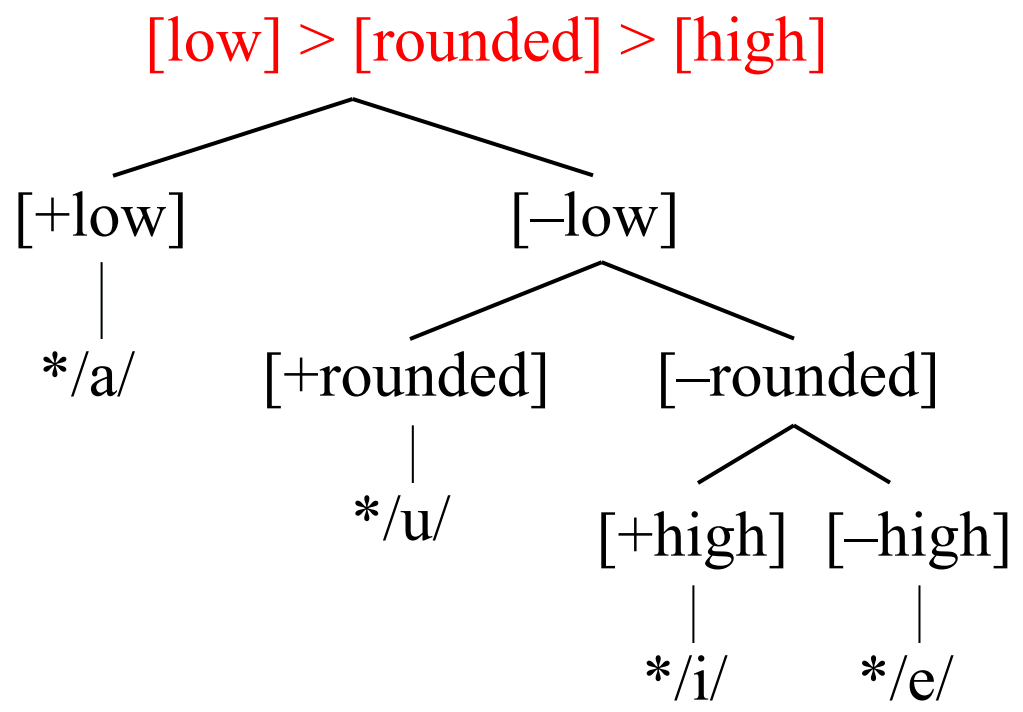
Recall the branching tree that underlies his specifications.



	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

Proto-Germanic Feature Hierarchy

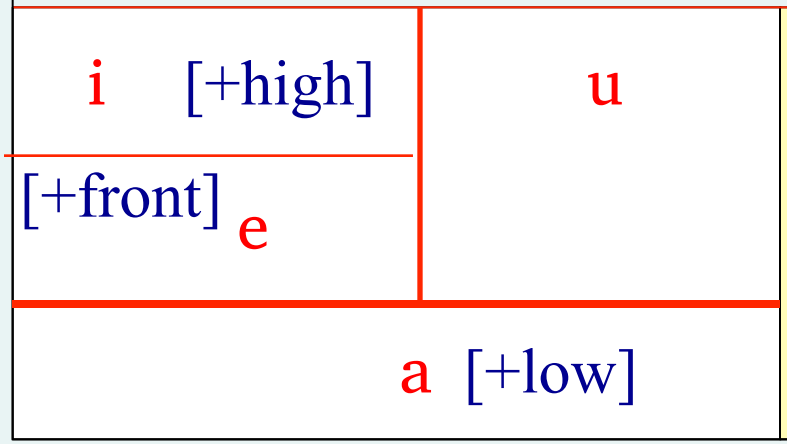
Antonsen (1972) chose [rounded] as the feature that distinguishes */u/ from */i/ and */e/ in early Germanic.



	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Rounded		+	–	–
High			+	–

Proto-Germanic Feature Hierarchy

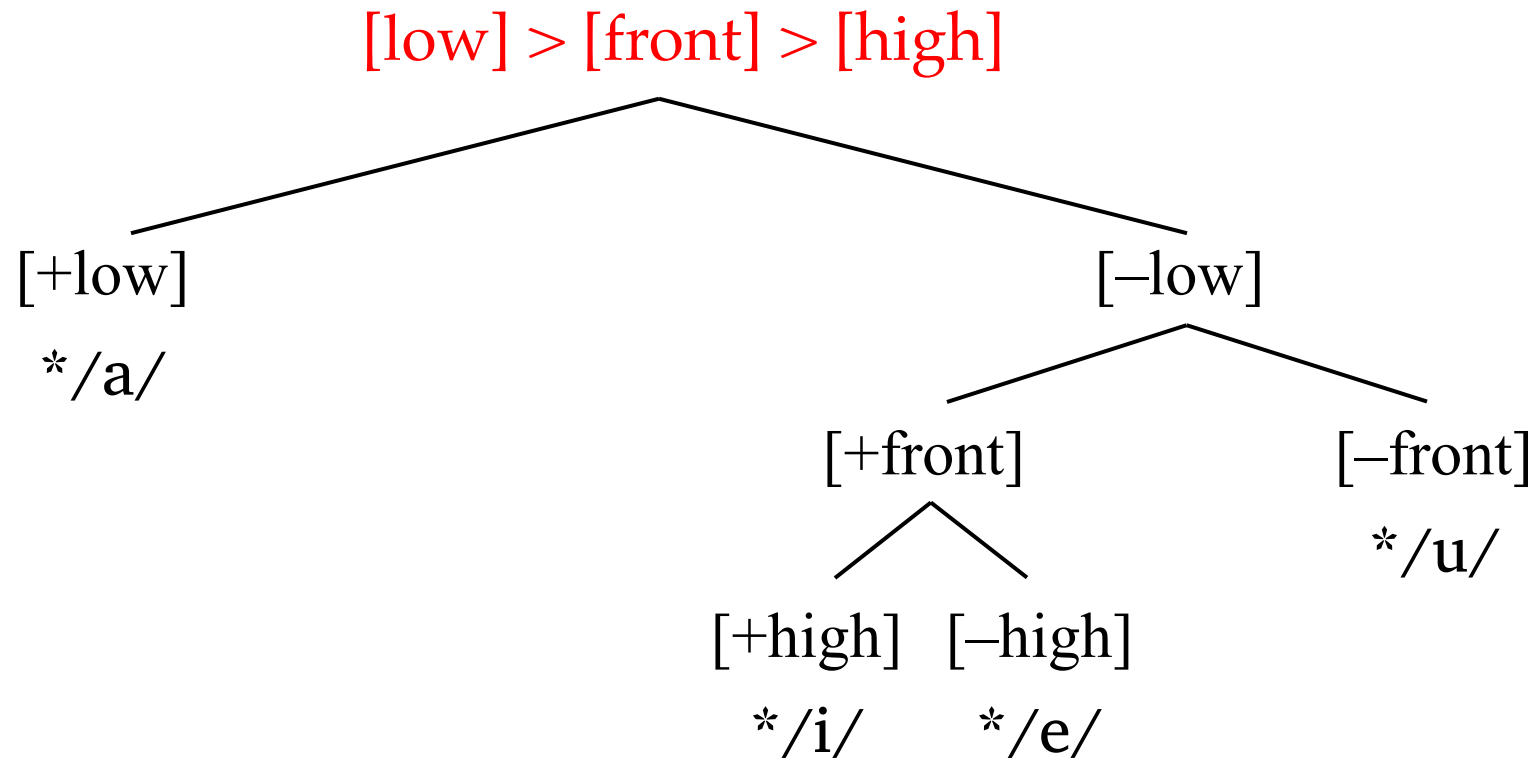
While I agree with the rest of his analysis, I think it is preferable to suppose that the contrastive feature was [front], following Lass 1994, Ringe 2006: 148, Purnell & Raimy in press.



	*/a/	*/u/	*/i/	*/e/
Low	+	–	–	–
Front		–	+	+
High			+	–

Proto-Germanic Feature Hierarchy

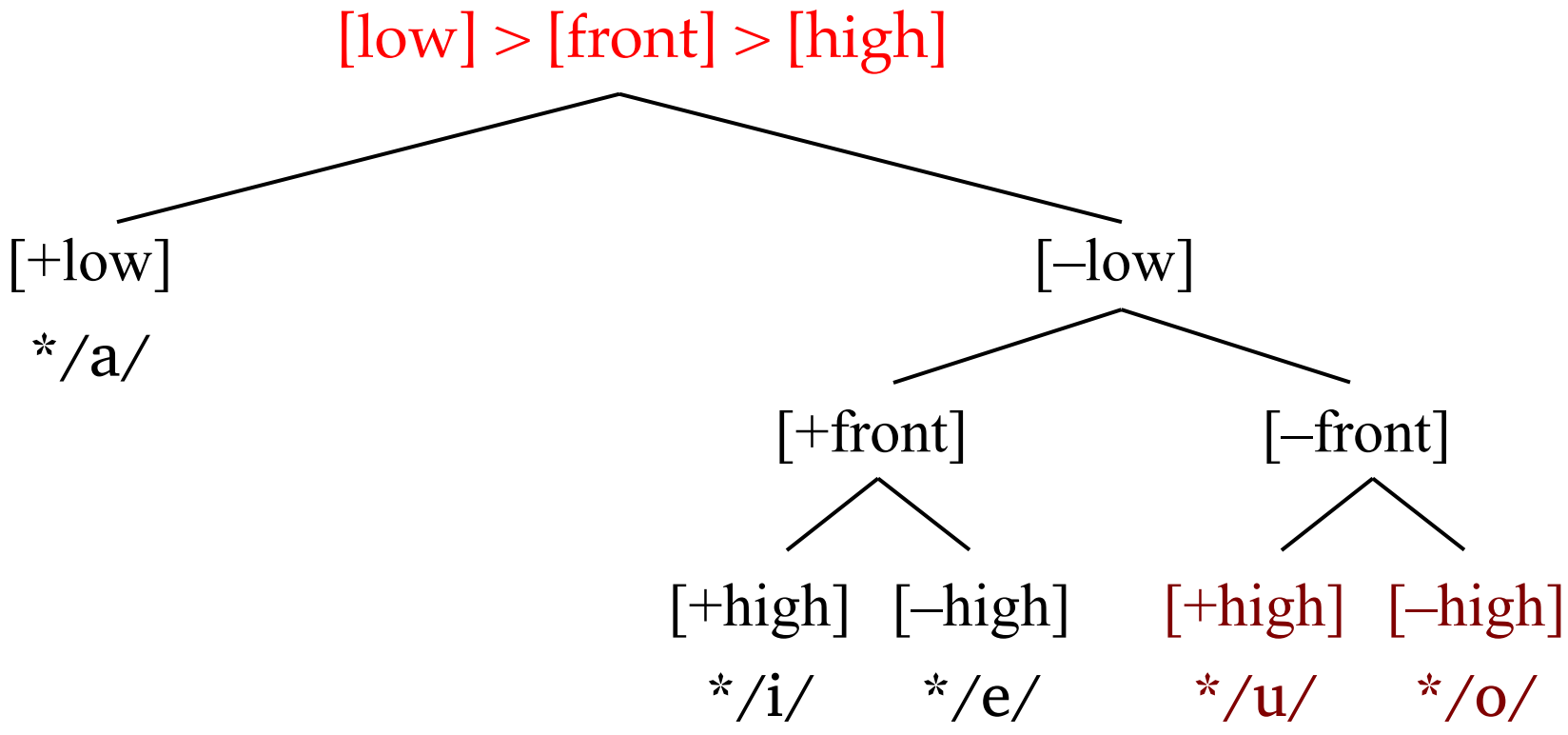
With this revision the Proto-Germanic short vowel feature hierarchy now looks as follows:



West Germanic Feature Hierarchy

Later a new phoneme */o/ developed from the lowered allophone of */u/.

This expansion of the inventory does not require a change in the hierarchy: we just add a [high] contrast under [–front].



The Origins of *i*-umlaut

With other scholars (e.g., Penzl 1972), Antonsen assumes that *i*-umlaut arose rather early in the history of West (and North) Germanic.

i-umlaut, or *i*-mutation, is a process whereby a back vowel is fronted before *i*.

In the examples below, original *uƀil 'evil' changes to *yƀil, and *foːti 'feet' changes to *føːti.

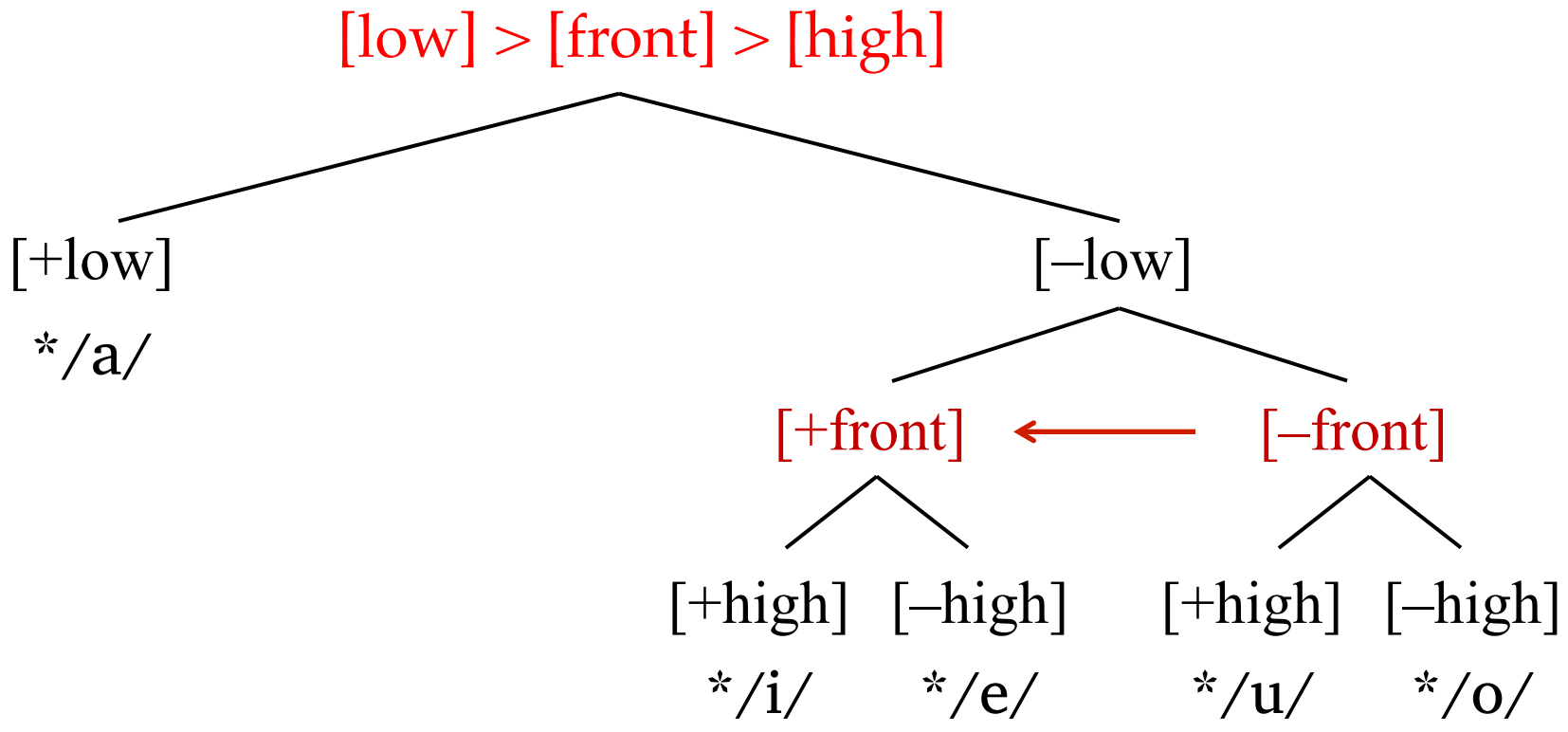
*u ƀ i l ⟶ *y ƀ i l

*f oː t i ⟶ *f øː t i

The Origins of *i*-umlaut

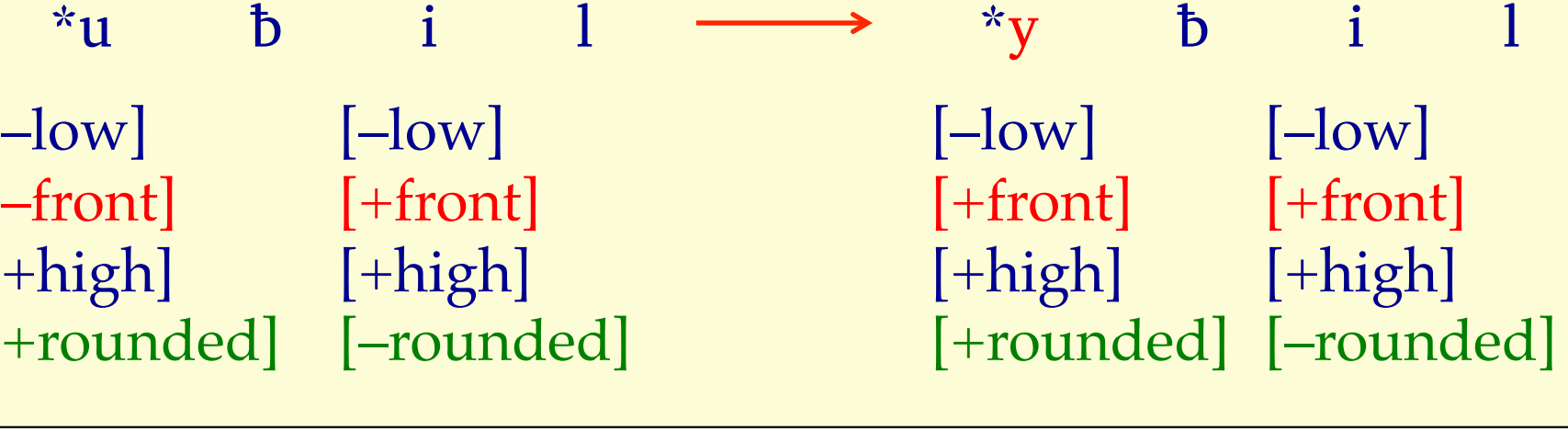
Given our analysis of the West Germanic vowel system, the result of fronting */u, o/ in the contrastive phonology would be to simply make them identical to */i, e/.

i-umlaut crucially preserves the rounded nature of the fronted vowels.



i-umlaut

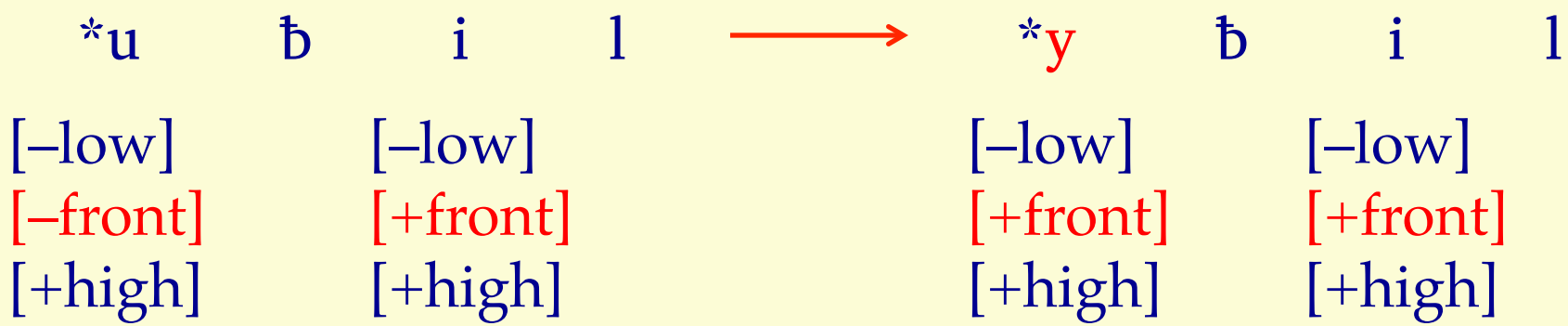
Therefore, the enhancement feature [rounded] must be in play at the point that */u, o/ are fronted.



i-umlaut

Therefore, it is crucial that the enhancement feature [rounded] must be in play at the point that */u, o/ are fronted.

Without [+rounded], the features of *[y, ø] would be no different from those of *[i, e].



i-umlaut

For independent reasons, many commentators, beginning with V. Kiparsky (1932) and Twaddell (1938), assume that *i*-umlaut began as a late phonetic (or postlexical) rule.

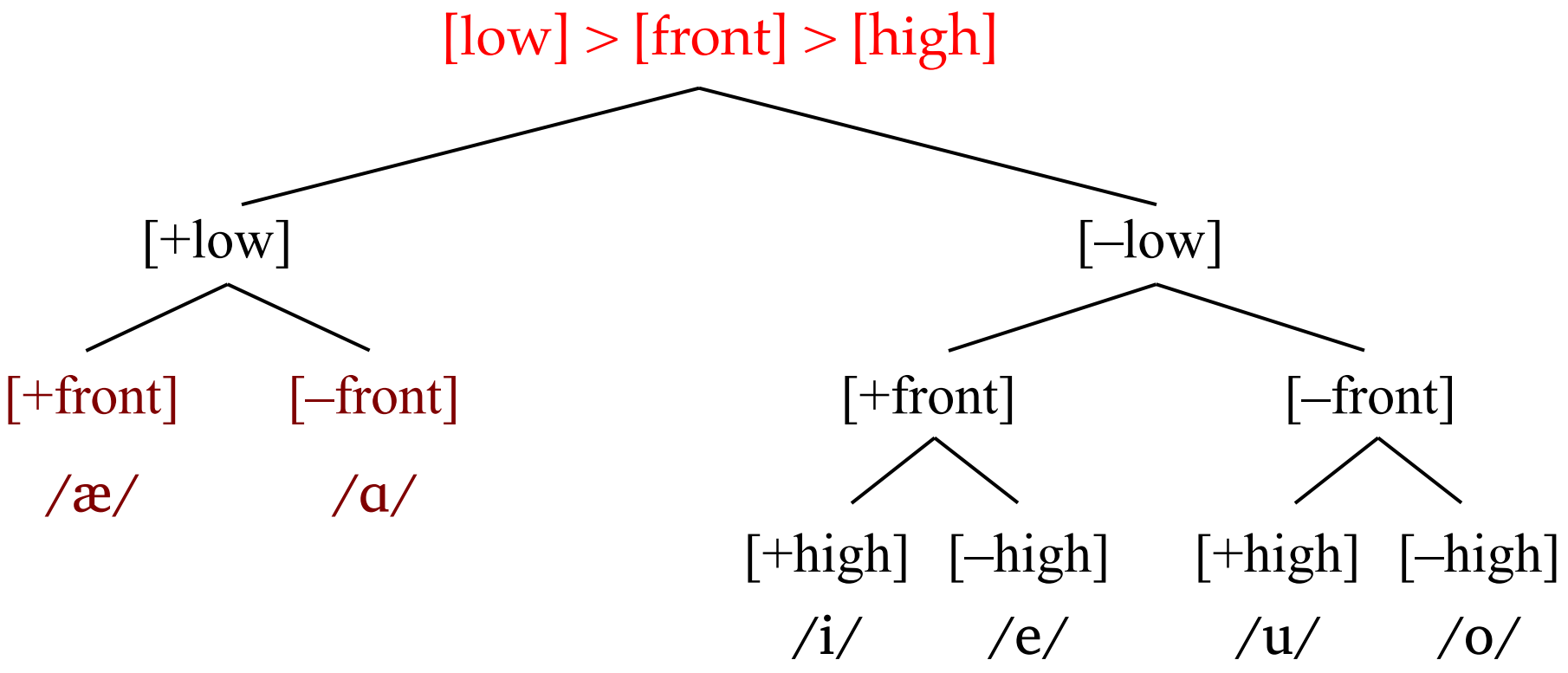
That is, it applies after the features of */u, o/ and */i, e/ have been enhanced by [+rounded] and [–rounded], respectively.

*u	þ	i	l	⟶	*y	þ	i	l
[–low]		[–low]			[–low]		[–low]	
[–front]		[+front]			[+front]		[+front]	
[+high]		[+high]			[+high]		[+high]	
[+rounded]		[–rounded]			[+rounded]		[–rounded]	

Early Old English Feature Hierarchy

In early Old English there developed another low vowel phoneme, at least in some dialects, creating two low vowels.

This further expansion of the inventory also does not require any change in the feature hierarchy.



i-umlaut

However, at some point the contrastive organization of the Old English vowel system must have shifted.

The key evidence involves the rule of *i*-umlaut, which by now had been in the language as a post-enhancement rule for centuries.

Gloss	'evil'	'foot N.P.'
Pre-OE	*uβil	*foːt + i
i-umlaut	*yfil	*føːt + i

i-umlaut Becomes Opaque

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.

In many cases, the *i*-umlaut trigger became unrecoverable to learners.

Gloss	'evil'	'foot N.P.'
Underlying	/ufil/	/foːt + i/
i-umlaut	yfil	føːt + i
i-lowering/deletion	yfel	føːt Ø

i-umlaut Becomes Opaque

According to standard accounts, this led to the phonologization of [y(:)] and [ø(:)] as new phonemes; an example is 'evil', whose underlying form is restructured from /ufil/ to /yfel/.

I assume that *i*-umlaut persisted as a synchronic rule in forms with alternations, like *foːt* ~ *føːt* 'foot ~ feet'.

Gloss	'evil'	'foot N.P.'
Underlying	/yfel/	/foːt + i/
i-umlaut	—	føːt + i
i-lowering/deletion	—	føːt Ø

Phonologization Paradox

A number of scholars have pointed out a problem with this account of the phonologization of the front rounded allophones (see Janda 1999, P. Kiparsky in press):

As long as *i*-umlaut remains a phonetic post-enhancement process, it is not clear how it could survive the loss of its triggering contexts.

Before loss of *i*-umlaut trigger

Lexical Phonology

Underlying /ufil/

Postlexical Phonology

i-umlaut yfil

i-lowering yfel

Phonologization Paradox

Before loss of *i*-umlaut trigger

Lexical Contrastive Phonology

[low], [front], [high]

Underlying /ufil/

Postlexical Post-enhancement

Add [round]

i-umlaut yfil

i-lowering yfel

In the old grammar, the underlying form is */ufil/.

In the Lexical Phonology, only contrastive features are computed, i.e., [low, [front], and [high].

In the Postlexical Phonology, enhancement features are added, notably [round].

i-umlaut applies, and then the triggering *i* is lowered to *e*.

Phonologization Paradox

After loss of *i*-umlaut trigger

Lexical Contrastive Phonology

[low], [front], [high]

Underlying /ufel/

Postlexical Post-enhancement

Add [round]

i-umlaut -----

i-lowering -----

Suppose learners can no longer recover the */i/, and acquire underlying */ufel/, not */ufil/.

In the Postlexical component, *i*-umlaut cannot apply, and we expect the form to surface as **ufel*, which is not correct.

Phonologization Paradox

Before loss of *i*-umlaut trigger

Lexical Contrastive Phonology

Contrastive features?

Underlying /ufil/

i-umlaut yfil

Postlexical Post-enhancement

Enhancement features?

i-lowering yfel

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.

i-lowering continues to apply in the postlexical component.

Phonologization Paradox

After loss of *i*-umlaut trigger

Lexical Contrastive Phonology

Contrastive features?

Underlying /yfel/

i-umlaut -----

Postlexical Post-enhancement

Enhancement features?

i-lowering -----

Then when *i* is lost, the lexical allophone [y] is reanalyzed as a phoneme /y/.

But this account requires that the feature [round] be available in the lexical phonology, contrary to our original assumption.

Phonologization Paradox

This account raises two questions:

- First, why does *i*-umlaut enter the lexical phonology while its products are not contrastive?

P. Kiparsky (in press) suggests that it is because the new front rounded allophones are more perceptually salient than their triggers (Jakobson, Fant & Halle 1952), which were becoming progressively weaker as time when on.

Phonologization Paradox

I find this explanation to be quite compelling; but it raises another question:

- How do the products of *i*-umlaut enter the lexical phonology when they involve non-contrastive features that originate in enhancement?

To this question contrastive hierarchy theory can contribute a new solution based on the notion of contrast shift.

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Part 10
Contrast Shift:
A New Perspective on the Phonologization of *i*-umlaut

Introduction
1. Hogg
2. Antonsen
3. Benediktsson
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Contrast and Phonological Change

‘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] been transformed? Or in other words, has the place of a specific opposition been changed…?’

In an article first published in German in 1931, Roman Jakobson proposed a program for a structuralist diachronic phonology.

Contrast Shift: A New Perspective on the Phonologization of *i*-umlaut

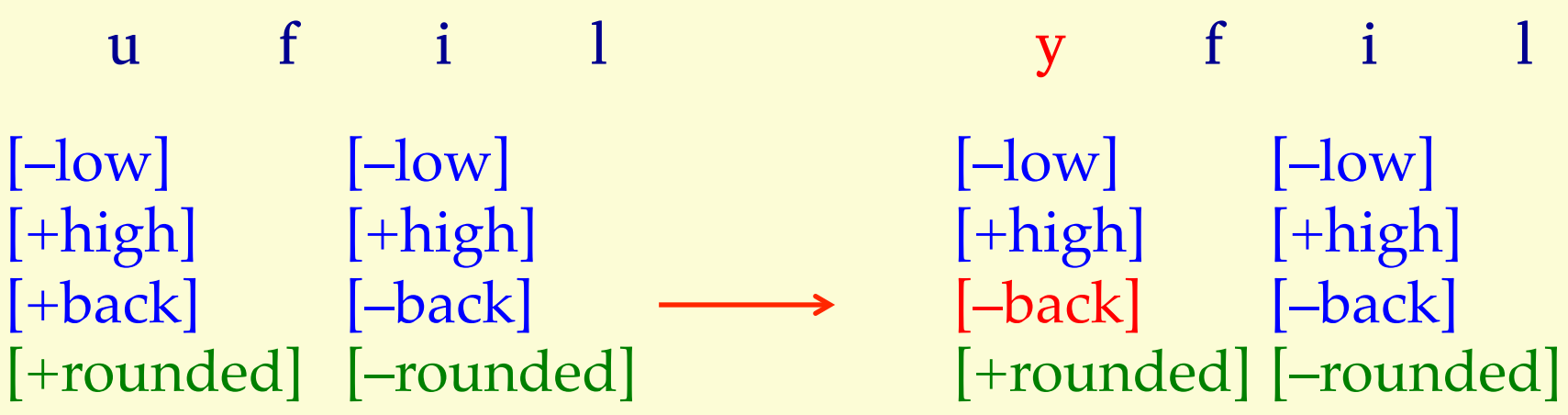
The notion that contrast shift is a type of grammar change has proved to be fruitful in the study of a variety of languages.

Examples include: Zhang (1996) and Dresher and Zhang (2005) on Manchu; Barrie (2003) on Cantonese; Rohany Rahbar (2008) on Persian; Dresher (2009: 215–225) on East Slavic; Compton & Dresher (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 (2012, 2015) on Algonquian.

Salience and Contrast Shift

Let us revisit the early stage of *i*-umlaut as a postlexical and post-enhancement rule.

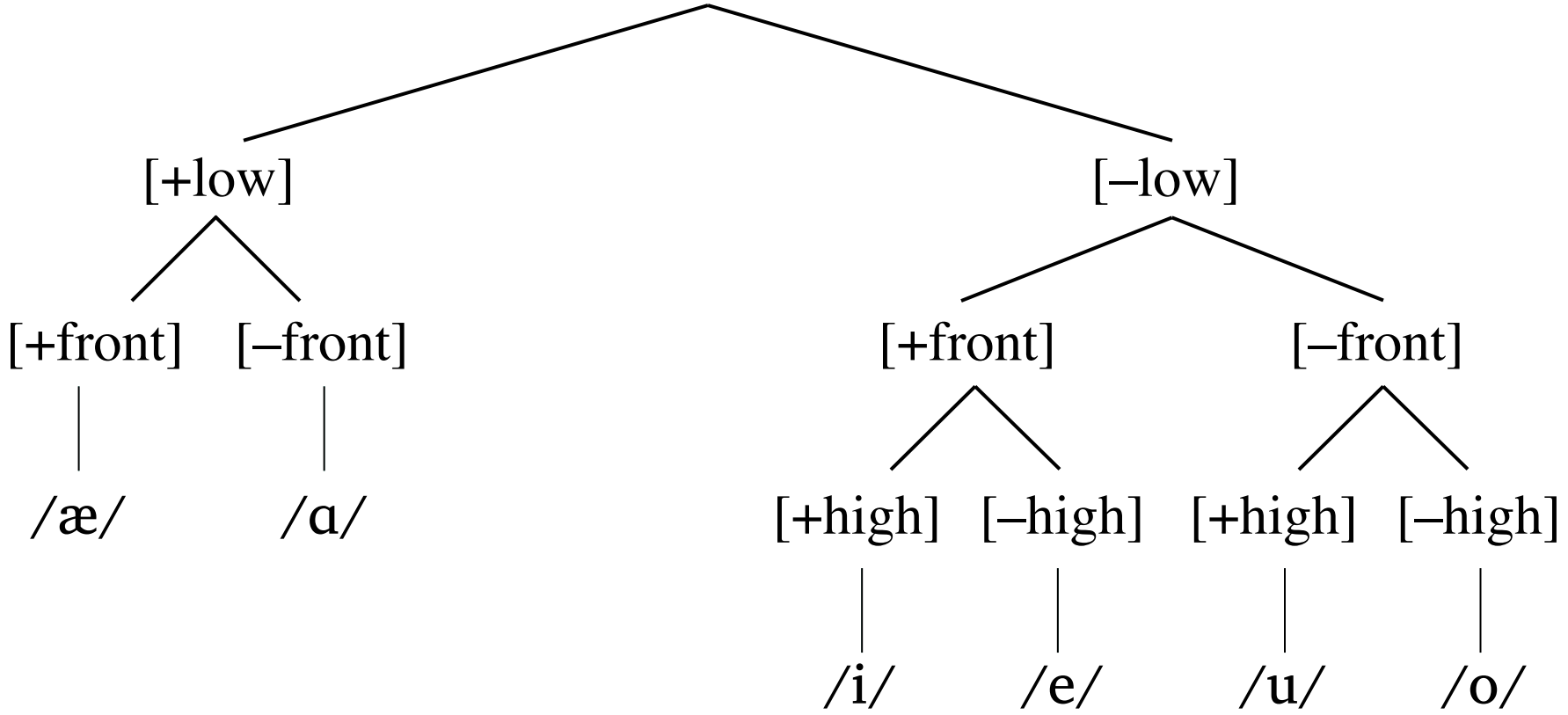
Adapting Kiparsky's formulation, I propose that the perceptual salience of the front rounded allophones could have led learners to hypothesize that [rounded] is a contrastive feature.



Early Old English Feature Hierarchy 1

[low] > [back] > [high]

Recall that this had not been the case in West Germanic and early Old English until that point.



Contrast Shift in Old English Vowels

But another feature hierarchy can be constructed that includes [rounded] as a contrastive feature.

This hierarchy requires demoting [low] to allow [rounded] to be contrastive over the non-low back vowels.

Earlier hierarchy:	[low] > [front] > [high]
Later hierarchy:	[front] > [rounded] > [high] > [low]

Contrast Shift in Old English Vowels

Schematically, the contrasts in the vowel system are redrawn from the diagram on the left to the one on the right.

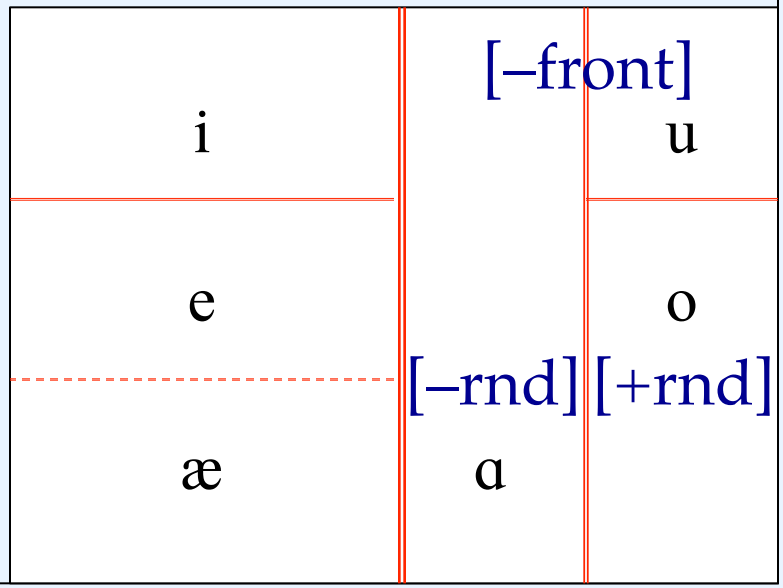
The main difference is in the [–front] vowels, where the [low] contrast has been replaced by a [rounded] contrast.

In tree form the new hierarchy looks as follows:

Earlier Hierarchy

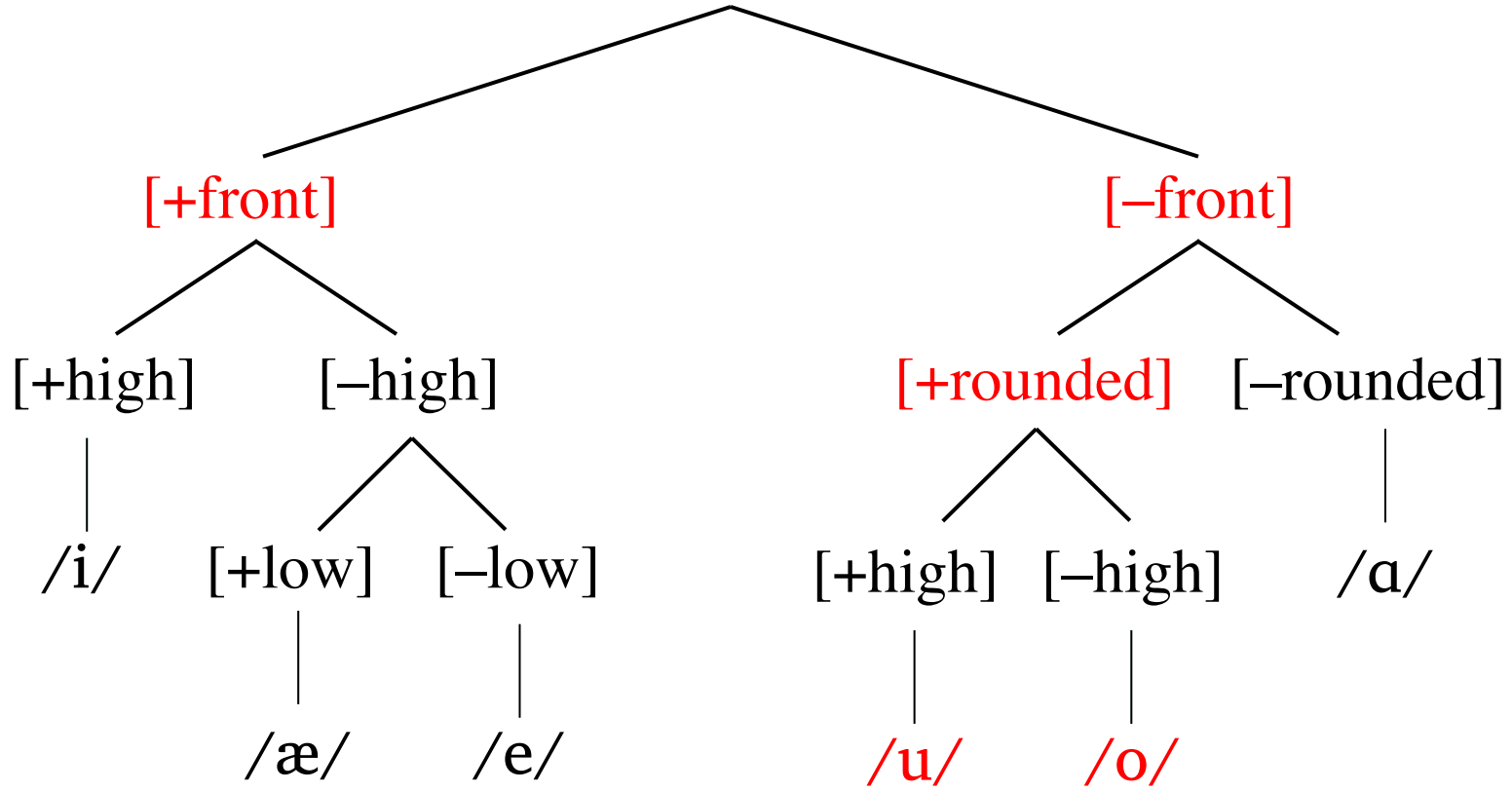
	[–front]
i	u
e	o
æ [+low]	ɑ

Later Hierarchy



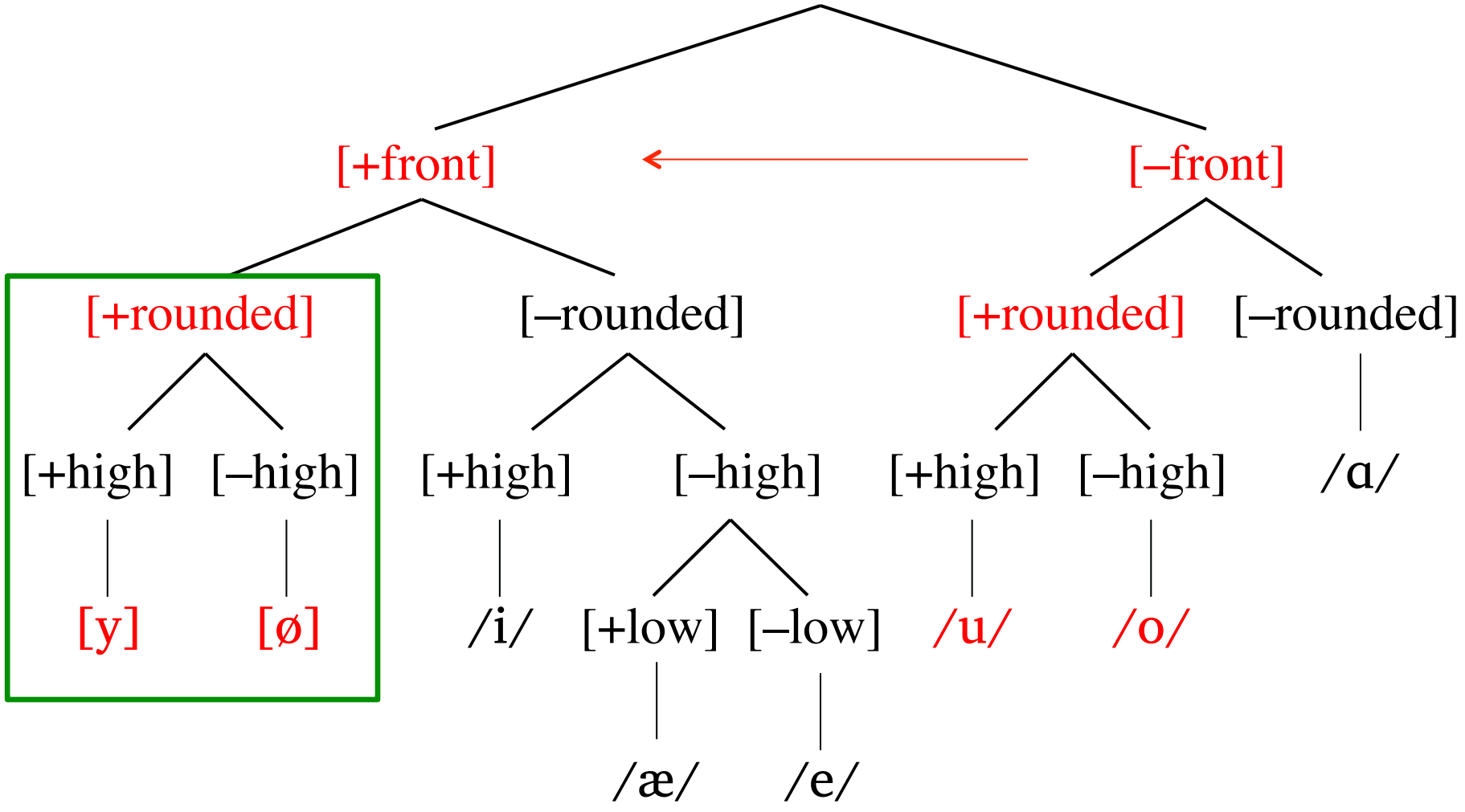
Old English Feature Hierarchy 2

[front] > [rounded] > [high] > [low]



Old English Feature Hierarchy 2

Now changing the [–front, +round] vowels to [+front] results in new front rounded vowels, which begin as allophones.



Deep Allophones

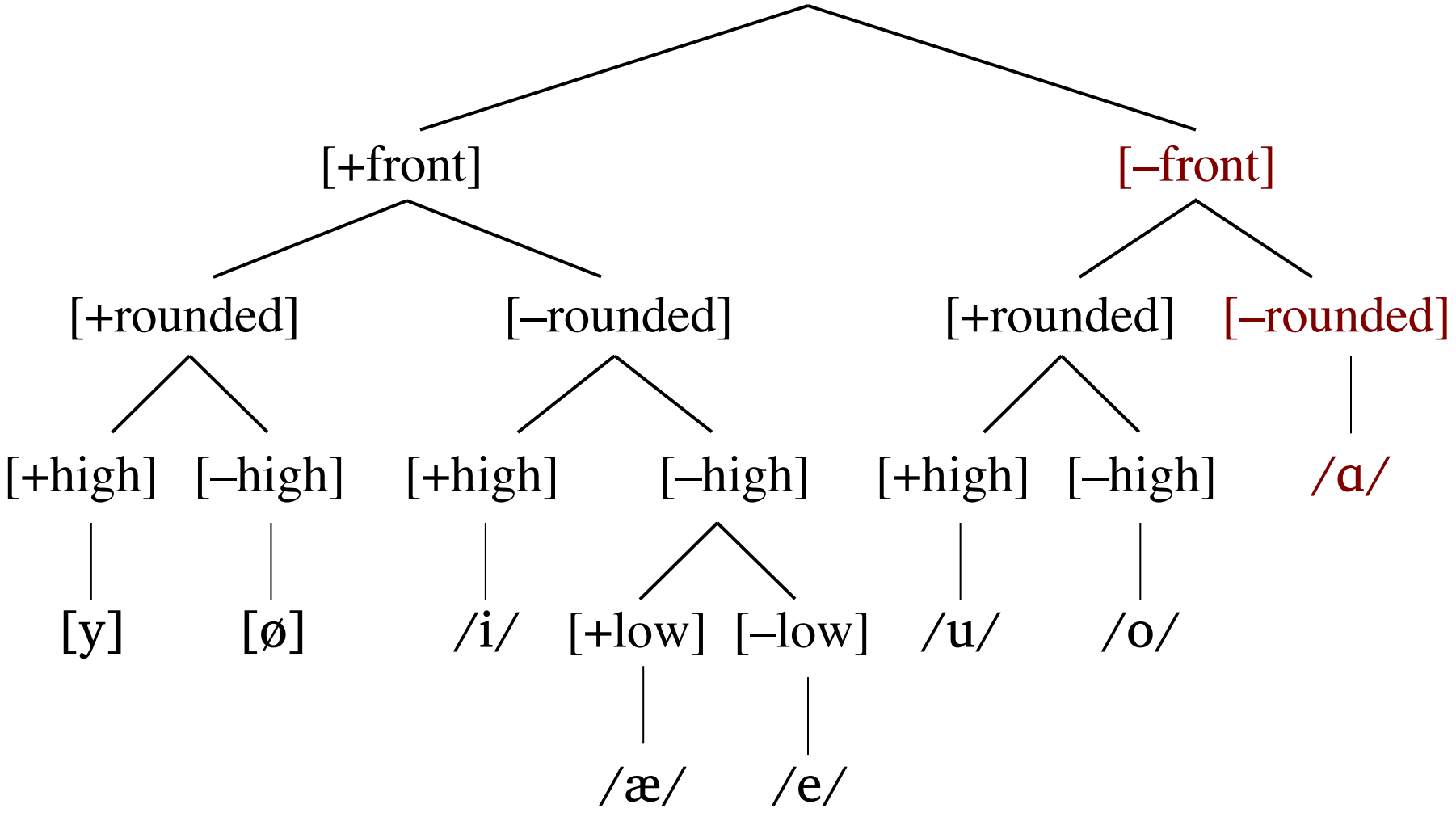
Although they are allophones, they can arise in the lexical phonology because they consist only of contrastive features.

They are thus what Moulton (2003) calls 'deep allophones', referring to the Old English voiced fricatives which also arise in the lexical phonology.

Deep allophones are possible because contrastive features are not all necessarily unpredictable in a hierarchical approach.

Old English Feature Hierarchy 2

In the new hierarchy, the back low vowel /ɑ/ no longer has a [+low] feature.

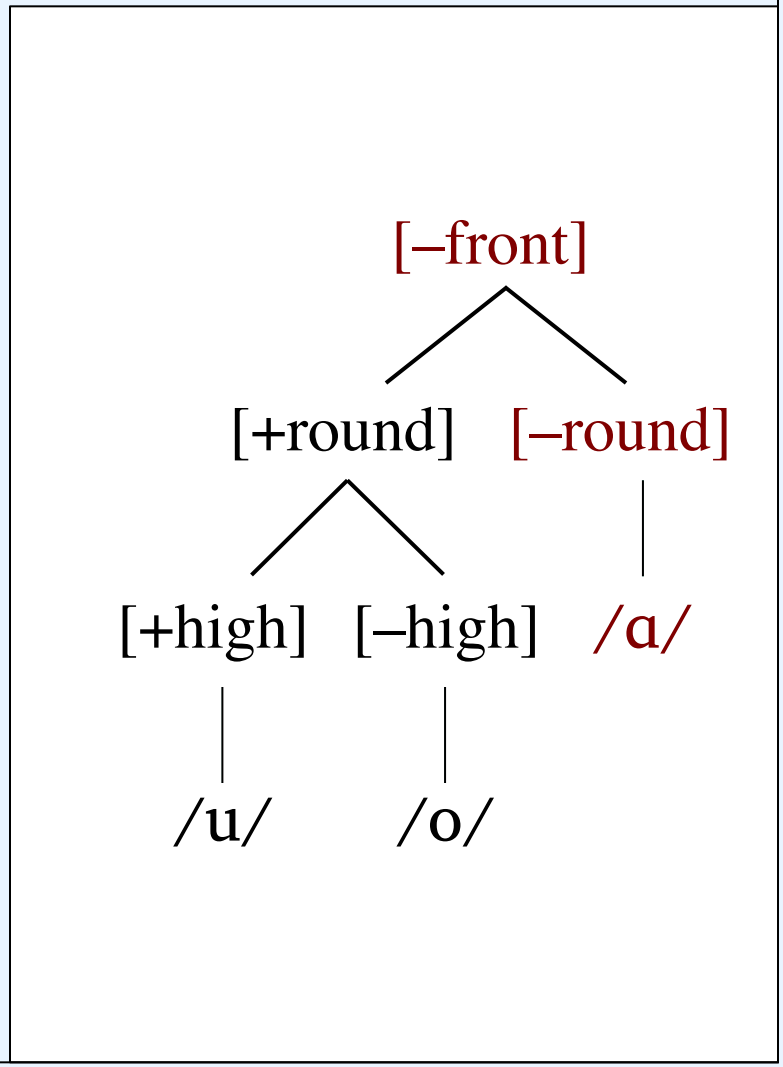


Old English Feature Hierarchy 2

In the new hierarchy, the back low vowel /ɑ/ no longer has a [+low] feature.

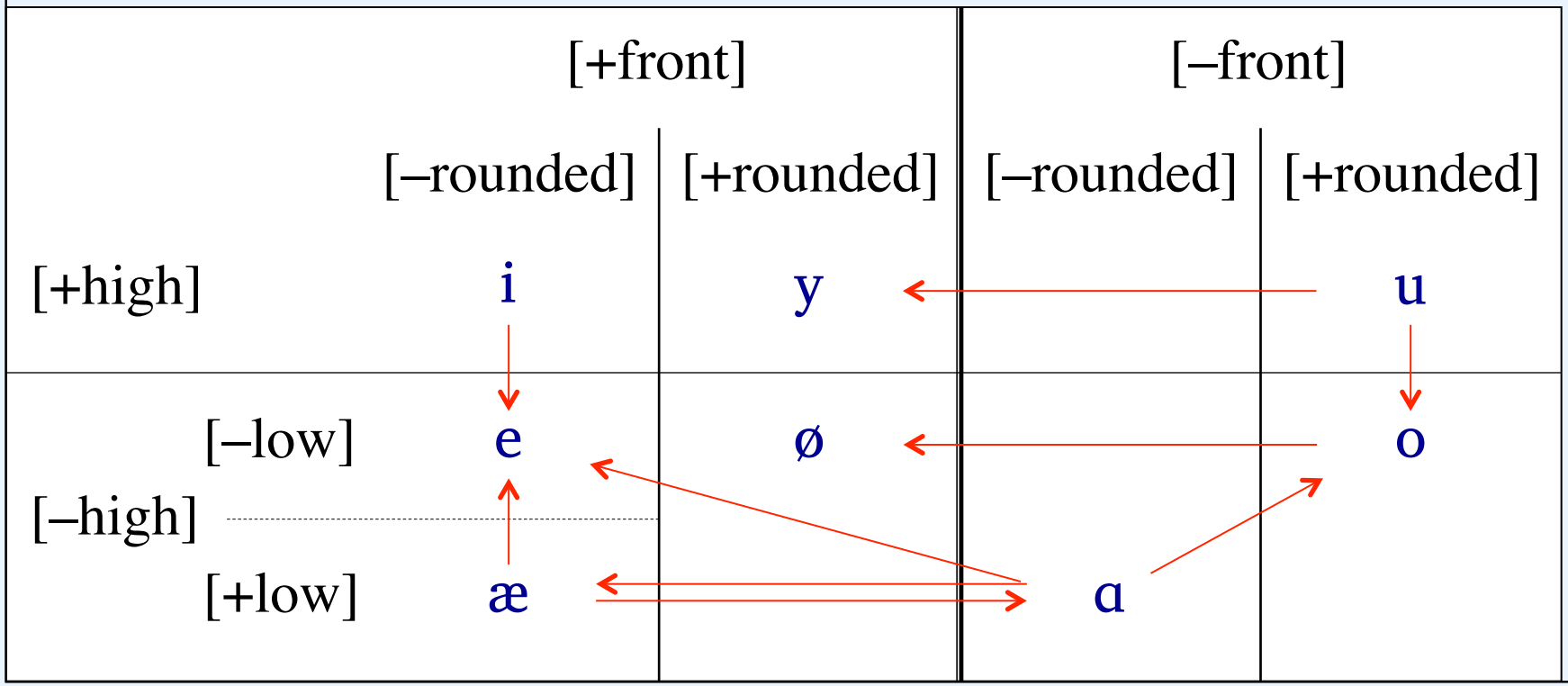
As far as I can tell, however, it does not need one.

Unlike earlier periods of the language, there is no evidence that /ɑ/ causes lowering of other segments, for example.



Old English Vowel Activity

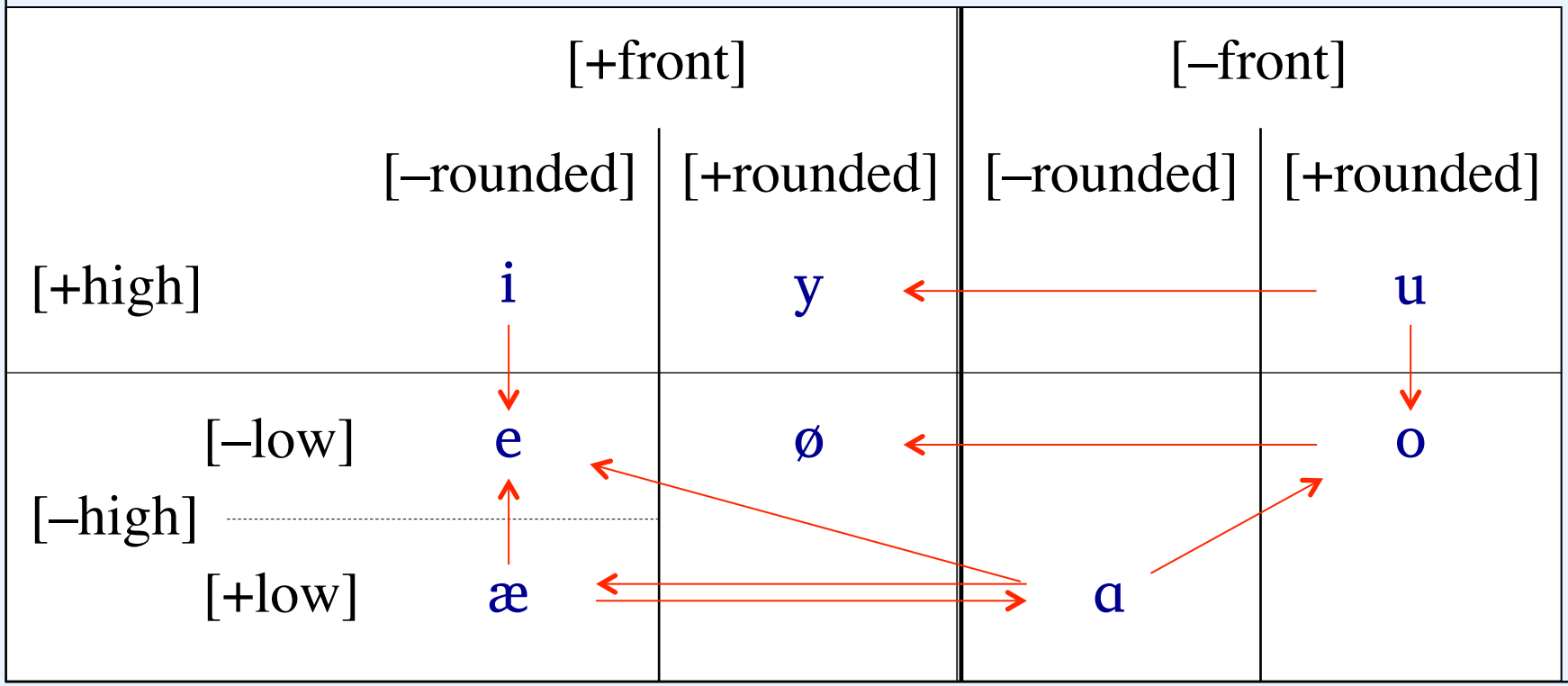
The arrows schematically show the major types of vowel activity in Old English, abstracting away from vowel length: fronting (*i*-umlaut), backing, lowering of high vowels, and raising and rounding of low vowels.



Old English Vowel Activity

In the proposed hierarchy, all the active features are contrastive.

The further consequences of the contrast shift remain to be explored.



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Conclusions

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Conclusions

We began with an observation by Richard Hogg (1992) about the early Germanic vowel system.

In searching for the sources of his analysis we discovered a rich history that connects to major currents of phonology theory.

Once we fill in the supporting assumptions, Hogg's deceptively simple observation turns out to rest on substantial empirical and theoretical foundations that are still capable of yielding insights into phonological systems.

Conclusions

Building on these foundations, I have proposed that phonology operates on contrastive features assigned by hierarchies that can vary across languages 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.

Conclusions

Specifically, the evidence of early Germanic vowel systems is that [low] was highest in the hierarchy of vowel features, and only one of the features [back] and [round] was contrastive.

Later, however, the rise of front rounded allophones created by *i*-umlaut and the weakening of their triggering contexts brought about a contrast shift, whereby both [back] and [round] became contrastive and [low] was demoted.

This approach sheds new light on the apparent paradox of the phonologization of the front rounded allophones as new phonemes, and suggests new avenues to explore.

THANK YOU!

Thanks to Tom Purnell and Eric Raimy, whose analysis inspired the one proposed here, and Patrick Honeybone and Joe Salmons for bringing their work to my attention.

I have benefitted from comments on an earlier version by Jack Chambers, Radu Craioveanu, Ross Godfrey, and Christopher Spahr.

For related papers and talks please see also:
http://homes.chass.utoronto.ca/~dresher/publications.html

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