



FACULTY OF
**LINGUISTICS,
PHILOLOGY
AND
PHONETICS**

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ICHL 25 — Oxford, 1-5 August 2022

Diachronic Phonology with Contrastive Hierarchy Theory

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1. Introduction

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 1931, Roman Jakobson proposed that diachronic phonology must look not only at individual sound changes, but at changes in the contrastive structure of the phonological system (Jakobson 1972 [1931]).

Contrast and phonological change

Attempts to carry out this program have been hampered by the lack of a precise way to characterize ‘the structure of individual oppositions’ within a phonological system.

I will show that Contrastive Hierarchy Theory provides the sort of concrete implementation of contrastive structure that Jakobson’s diachronic program requires.

And I will present some case studies that show the potential of this theory to advance illuminating and empirically testable accounts of phonological change.



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2. *Main Tenets of Contrastive Hierarchy Theory (CHT)*

Contrastive Hierarchy Theory

Contrastive Hierarchy Theory builds on ideas that go back to Roman Jakobson and N. S. Trubetzkoy and their collaborators; cf. Jakobson (1962 [1931]); Trubetzkoy (1939); Jakobson (1941); Jakobson & Lotz (1949).

The approach, which came to feature ‘branching trees’, had its heyday in the 1950s (Jakobson, Fant, & Halle 1952; Cherry, Halle, & Jakobson 1953; Jakobson & Halle 1956; Halle 1959).

This approach was imported into early versions of the theory of generative phonology; it is featured prominently in the first generative phonology textbook by Robert T. Harms in 1968.

Contrastive Hierarchy Theory

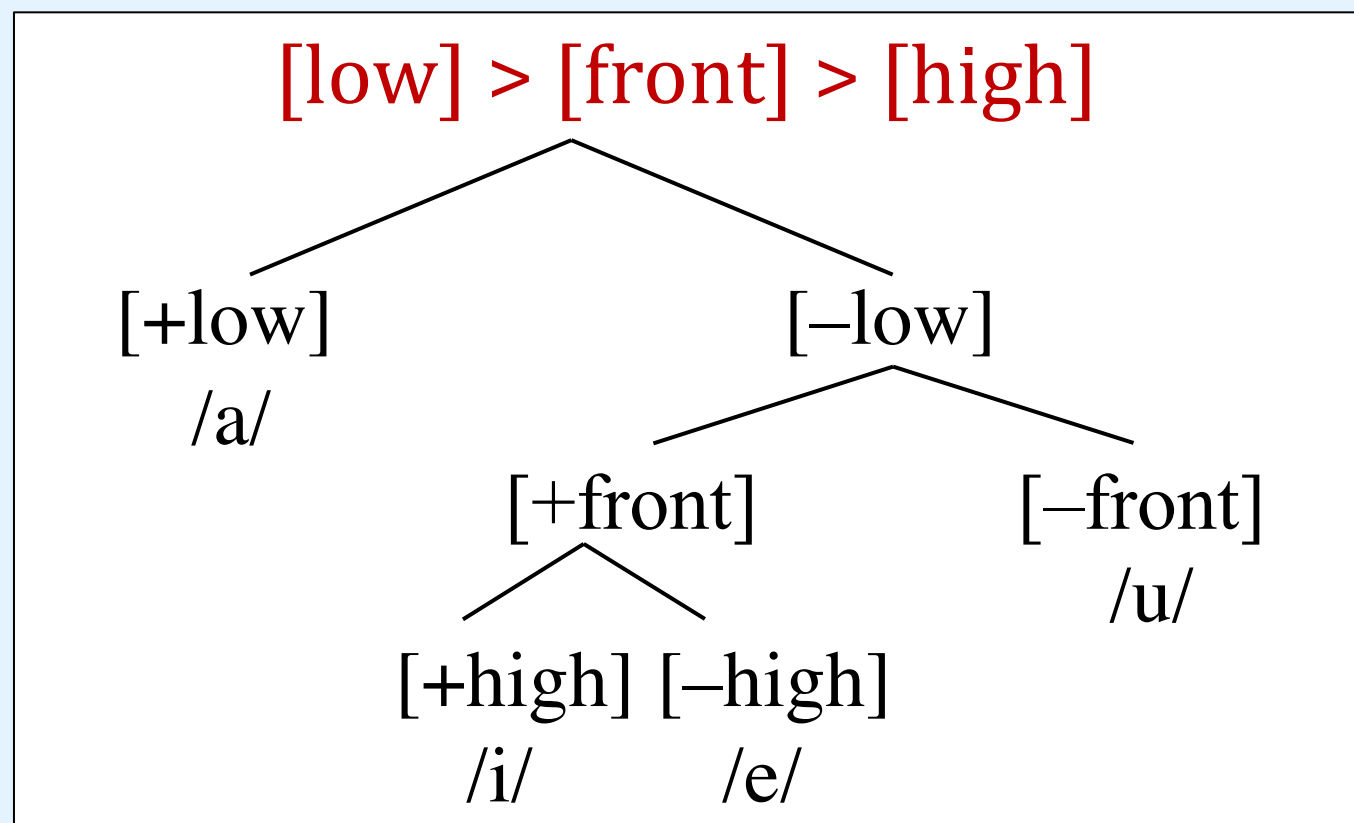
For reasons I have discussed elsewhere (Dresher 2009; Dresher 2016; Dresher & Hall 2021), the ‘branching trees’ did not make it into Chomsky & Halle’s (1968) *The Sound Pattern of English*, and subsequently disappeared from mainstream phonological theory for the rest of the twentieth century.

A version of this approach was revived by Clements (2001; 2003; 2009), and independently at the University of Toronto, under the name Modified Contrastive Specification (MCS; Dresher, Piggott, & Rice 1994; Dyck 1995; Zhang 1996; Dresher 1998; Dresher & Rice 2007; Hall 2007; Dresher 2009; Mackenzie 2013, Dresher, Harvey, & Oxford 2018; etc.).

The theory has since gone under other names—‘Toronto School’ phonology, or Contrast and Enhancement Theory—I will refer to it as Contrastive Hierarchy Theory (CHT).

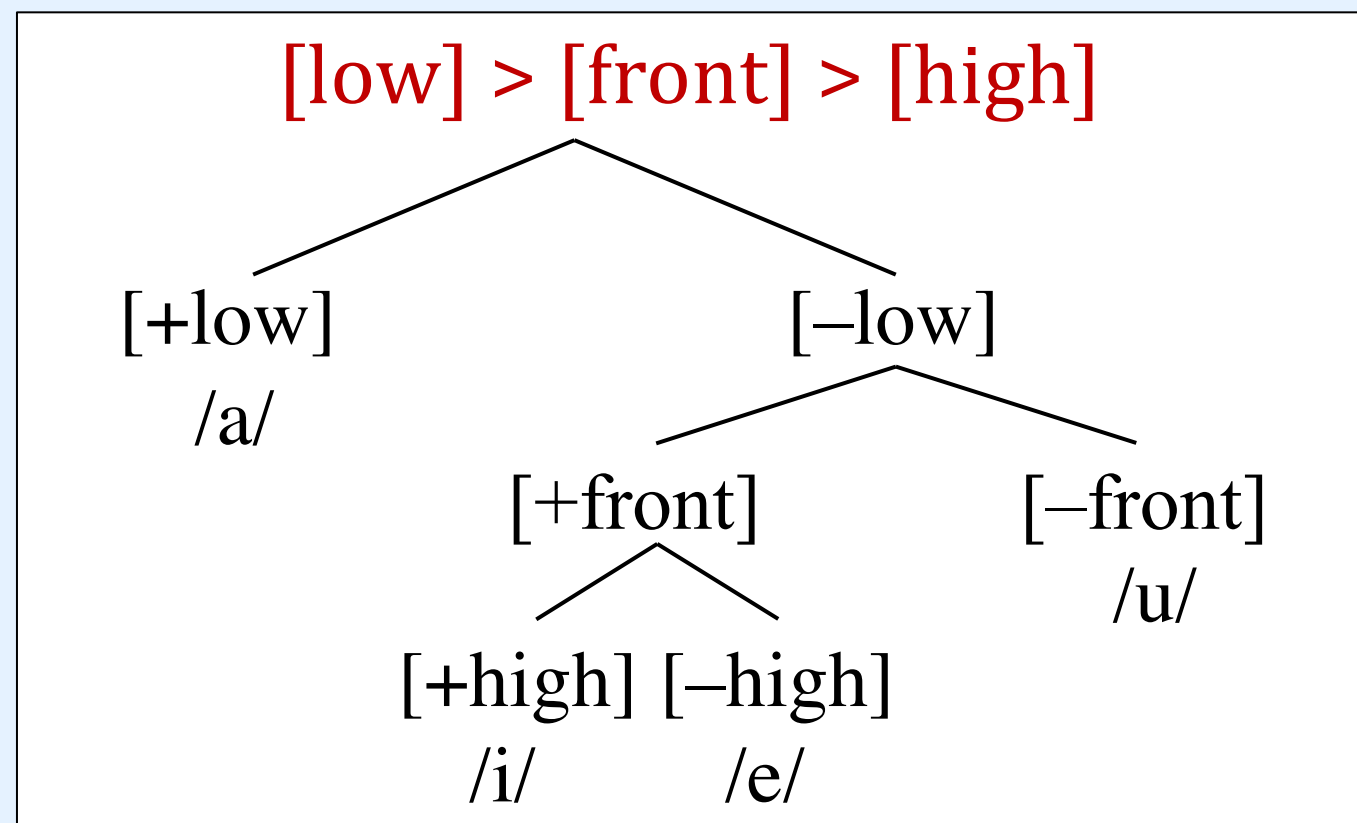
Contrast and hierarchy

The first major building block of our theory is that contrasts are computed **hierarchically by ordered features** that can be expressed as a branching tree.



Contrast and hierarchy

Branching trees are generated by the **Successive Division Algorithm** (Dresher 1998, 2003, 2009), which states, informally:



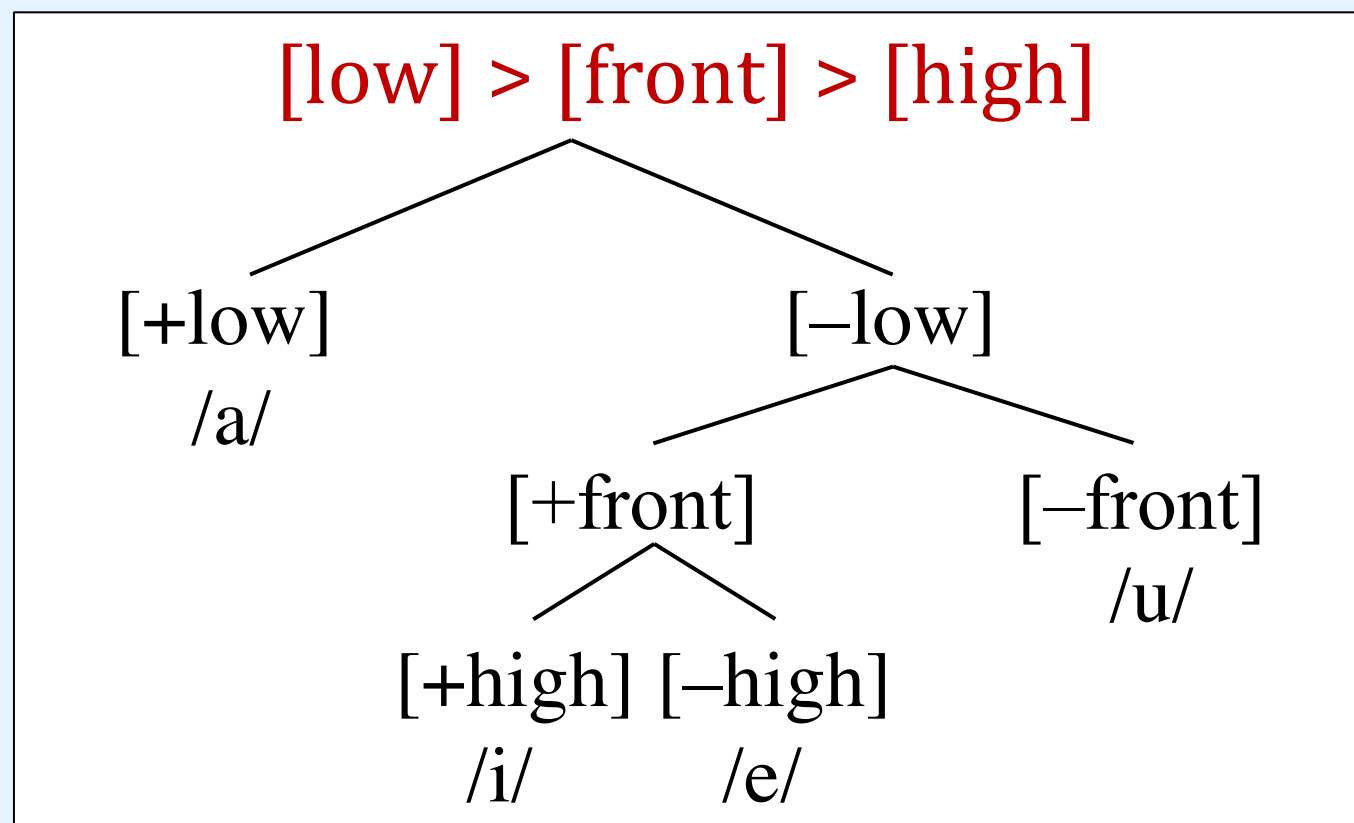
The Successive Division Algorithm

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

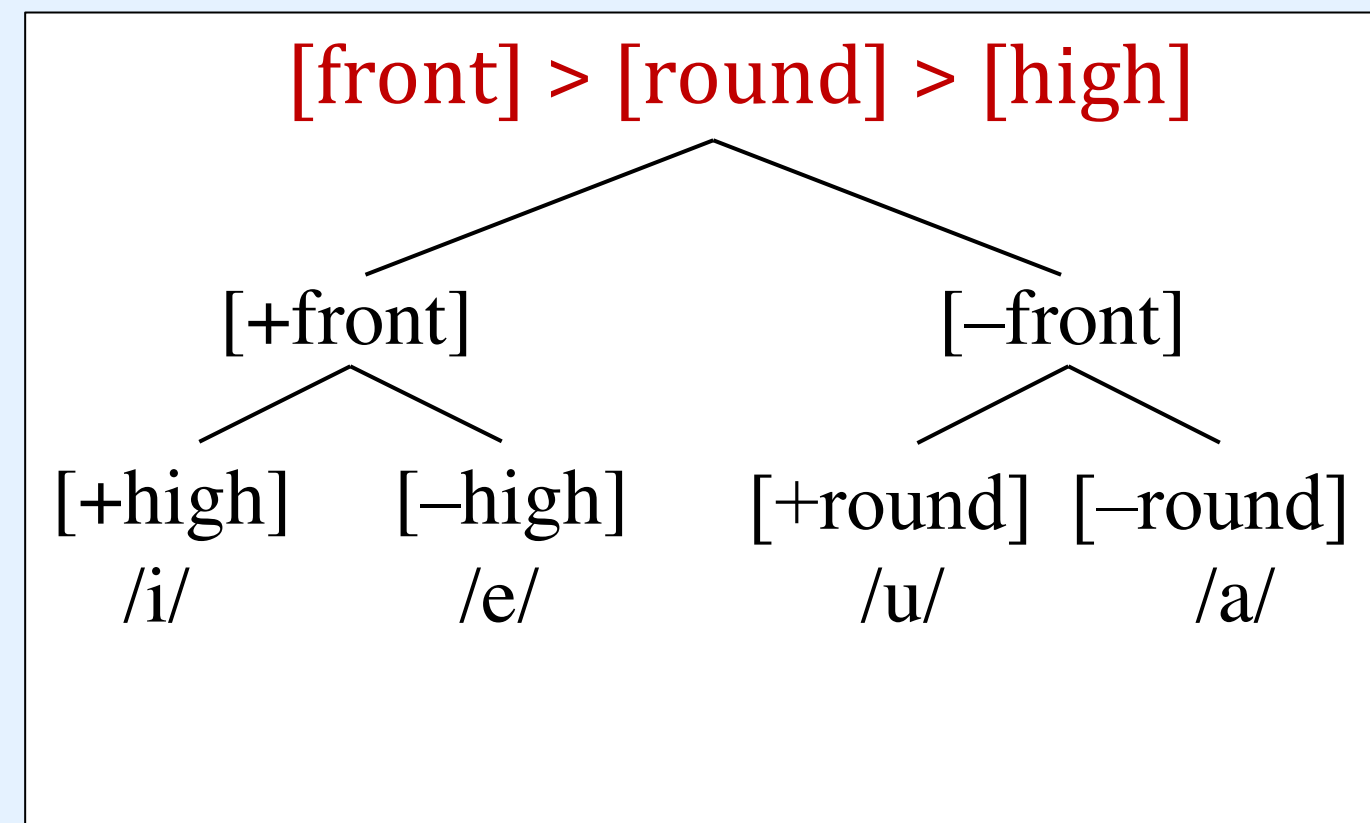
Feature hierarchies are language particular

Moreover, we assume that features and feature ordering are **language particular** and thus can **vary** over space and time.

Dialect 1



Dialect 2

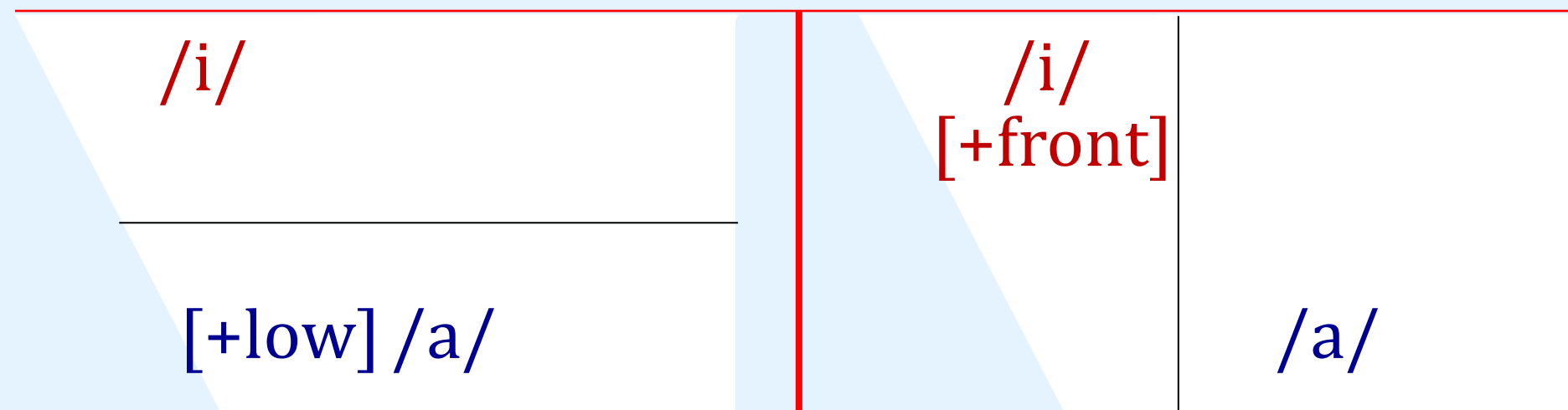


Criteria for ordering features

What are the criteria for selecting and ordering the features?

Phonetics is clearly important, in that the selected features must be consistent with the phonetic properties of the phonemes.

For example, a contrast between /i/ and /a/ would most likely involve a height feature like [\pm low] or [\pm high], though other choices are possible, e.g. [\pm front] or [\pm advanced/retracted tongue root].



Criteria for ordering features

Of course, the contrastive specification of a phoneme could sometimes deviate from the surface phonetics.

In some dialects of Inuktitut, for example, an underlying contrast between /i/ and /ə/ is neutralized at the surface, with both /i/ and /ə/ being realized as phonetic [i] (so-called ‘strong *i*’ and ‘weak *i*’, respectively; Compton & Drescher 2011).

In this case, underlying /i/ and /ə/ would be distinguished by a contrastive feature, even though their local surface phonetics are identical.

/i/ [+front]	/ə/	/u/ [+round]
[+low] /a/		

That there are two distinct phonemes can be recognized by their differing effects on neighbouring segments, or by the different ways they are affected by other segments.

Contrast and phonological activity

As the above example shows, the way a sound **patterns** can override its phonetics (Sapir 1925).

Thus, we consider as most fundamental that features should be selected and ordered so as to reflect the **phonological activity** in a language, where 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.

A theory of contrastive specification

Another major tenet 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.

That is, **only** contrastive features can be phonologically active. If this hypothesis is correct, it follows as a corollary that

Corollary to the Contrastivist Hypothesis

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

Domain of the Contrastivist Hypothesis

On this hypothesis, underlying lexical representations consist only of contrastive specifications.

These representations form the input to the **contrastive phonology**, which is the domain in which the Contrastivist Hypothesis applies.

Underlying Lexical Representations



Output of Contrastive Phonology

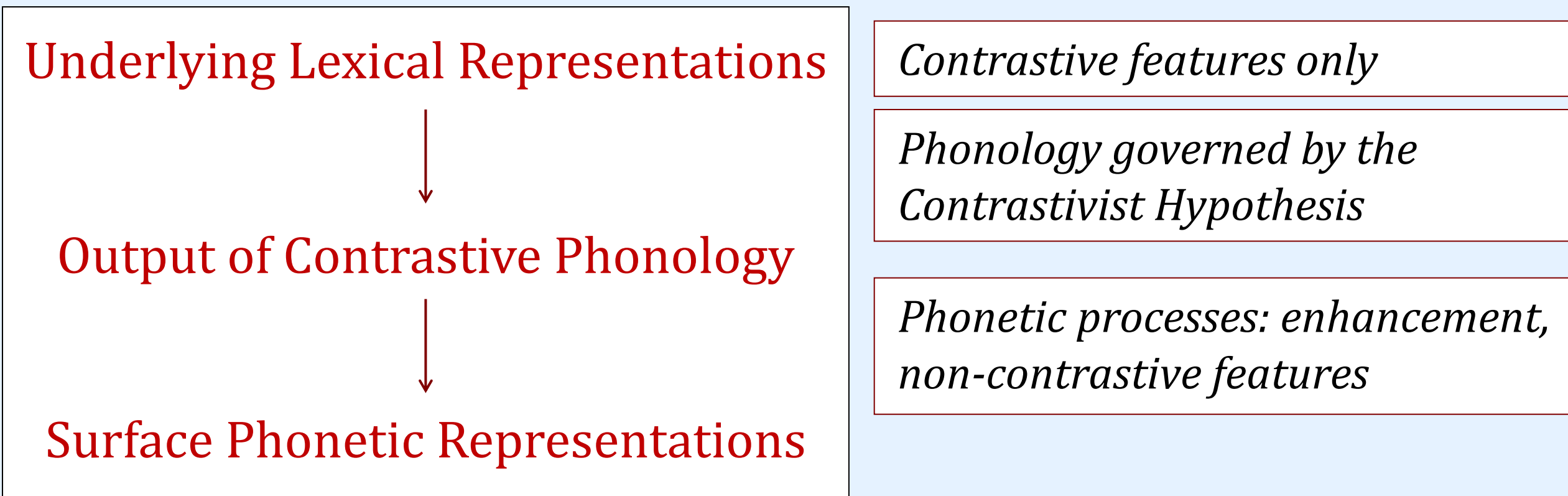
Contrastive features only

*Phonology governed by the
Contrastivist Hypothesis*

Domain of the Contrastivist Hypothesis

Stevens, Keyser & Kawasaki (1986) propose that feature contrasts can be **enhanced** by other features with similar acoustic effects (see also Stevens & Keyser 1989; Keyser & Stevens 2001, 2006).

Our hypothesis is that enhancement takes place after the contrastive phonology, when further phonetic detail is specified.



Enhancement of underspecified features

For example, a vowel such as /u/ below that is contrastively underspecified as [+back] and [-low] can potentially be any of these vowels: [ɨ, ʉ, ɤ, ʌ, u, ʊ, o, ɔ].

[+back] (low F2) can be enhanced by {+round} (gives [u, ʊ, o, ɔ], not [ɨ, ʉ, ɤ, ʌ])

[-low] (low F1) can be enhanced by {+high} (gives [u, ʊ], not [o, ɔ])

[-low] and {+high} can be further enhanced by {+ATR} (gives [u], not [ʊ])

/i/	(/u/)
[-back]	{+ATR} {+high} {+round} [-low]
/a/	[+low]

I designate enhancement features with green curly brackets { }.

These enhancements are not necessary, however, and other realizations are possible (Dyck 1995; Hall 2011).

Markedness

A further assumption that I will make here is that features are **binary**, and that every feature has a **marked** and **unmarked** value.

I assume that markedness is language particular (Rice 2003; 2007; cf. Trubetzkoy 1939) and accounts for asymmetries between the two values of a feature, where these exist.

For example, we expect that unmarked values serve as **defaults**, and may be more or less inert.

Where it is relevant to indicate markedness, the marked value of a feature F is designated as [F], and the unmarked value as [non-F]. Where markedness is not relevant to an analysis, [\pm F] designates both values.

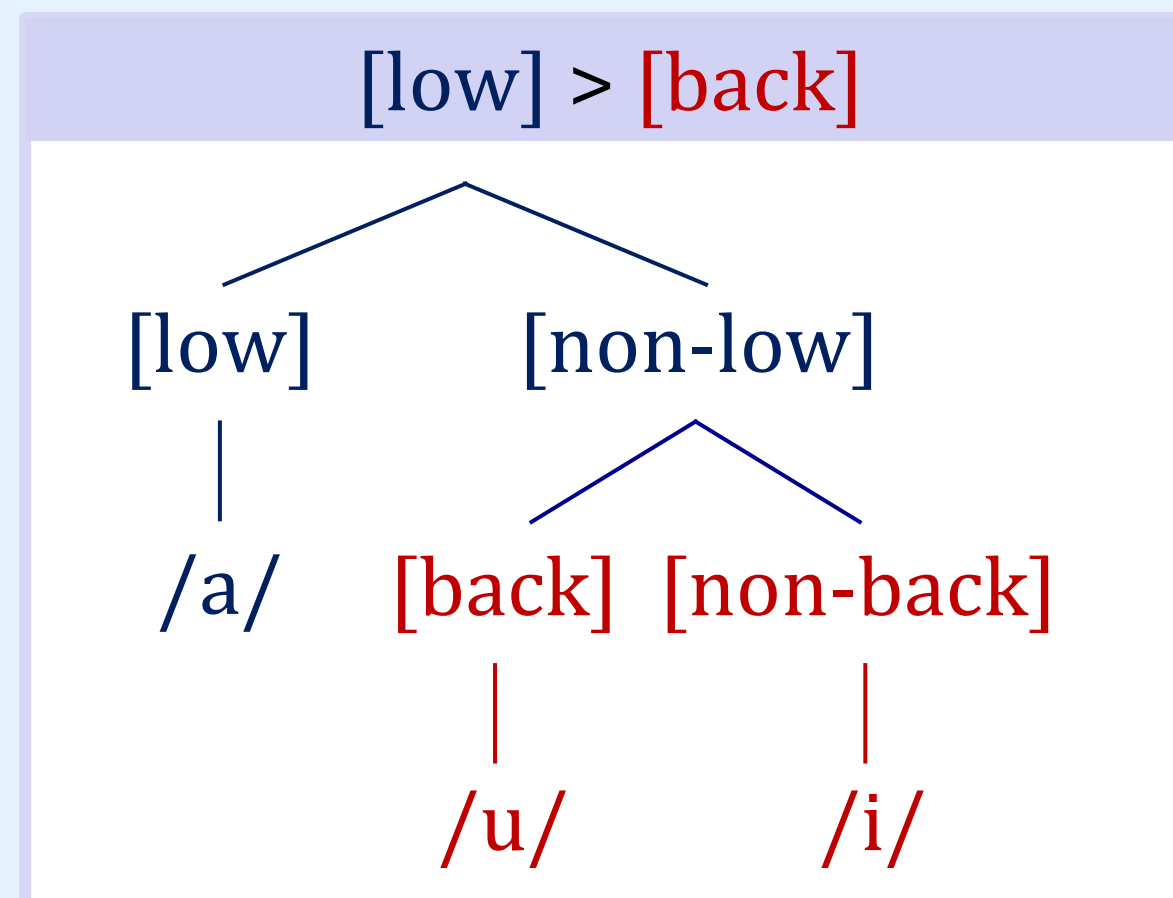
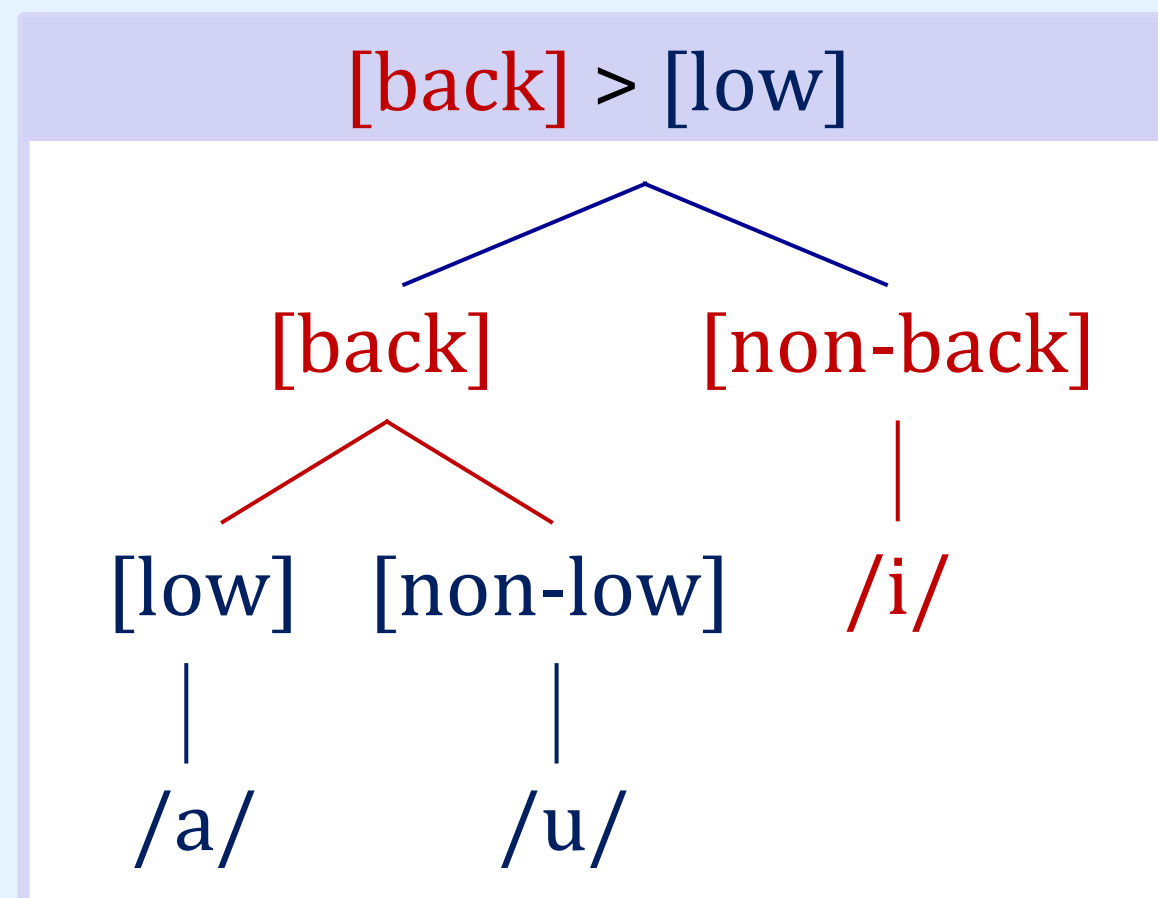
How the contrastive hierarchy works

For example: if a language has three vowel phonemes /i, a, u/, and if the vowels are split off from the rest of the inventory so that they form a sub-inventory, then they must be assigned a contrastive hierarchy with exactly **two** vowel features.

Though the features and their ordering vary, the limit of two features constrains what the hierarchies can be.

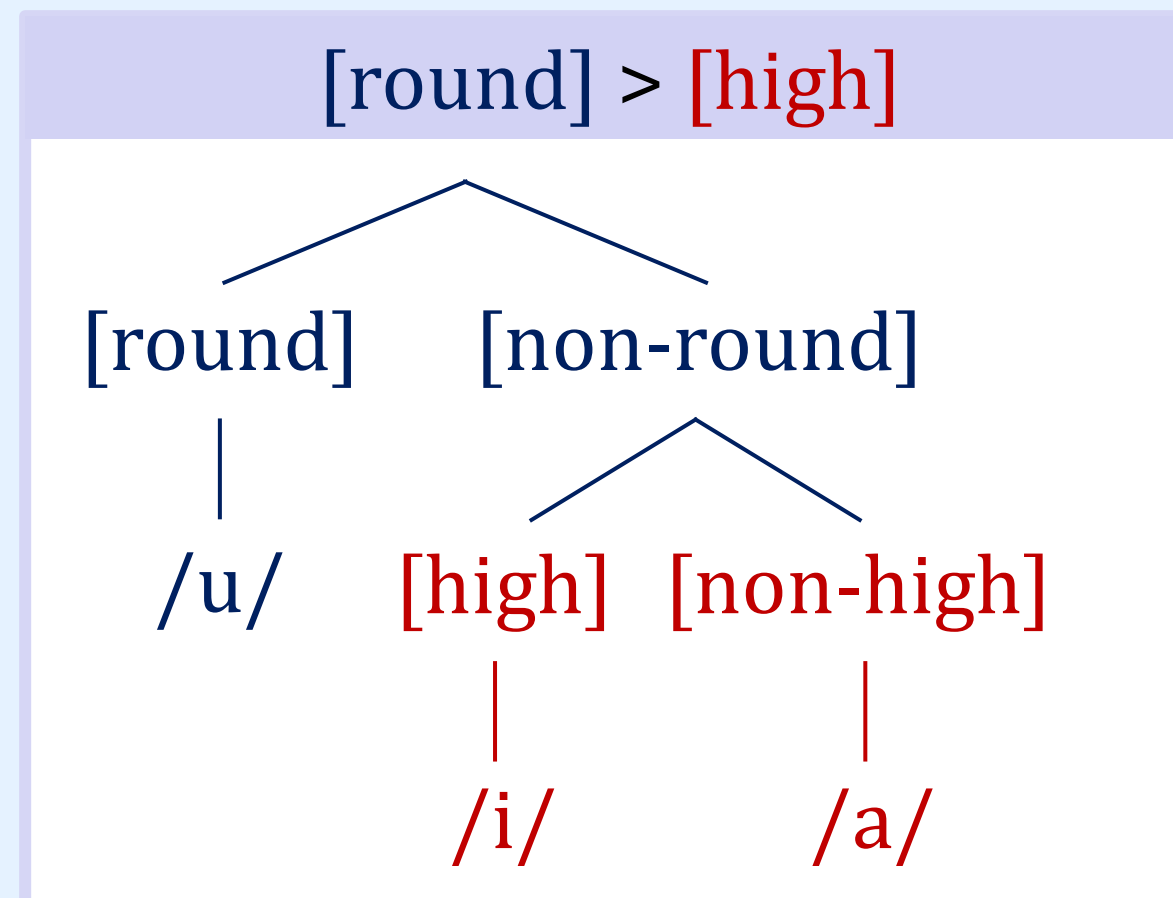
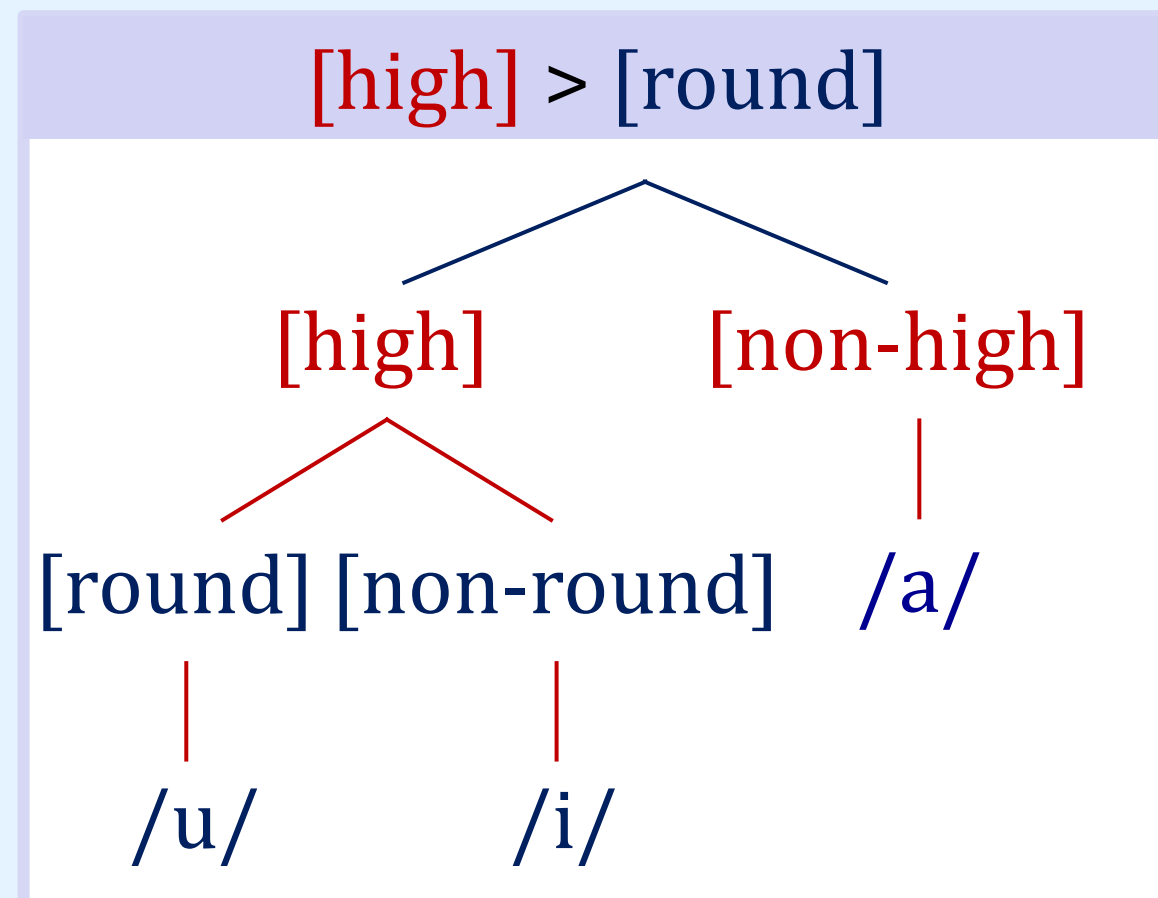
How the contrastive hierarchy works

Here are two possible contrastive hierarchies using the features **[back]** and **[low]**; on the left, **[back]** has scope over **[low]**; on the right, **[low]** has scope over **[back]** (marked values are indicated in these trees.)



How the contrastive hierarchy works

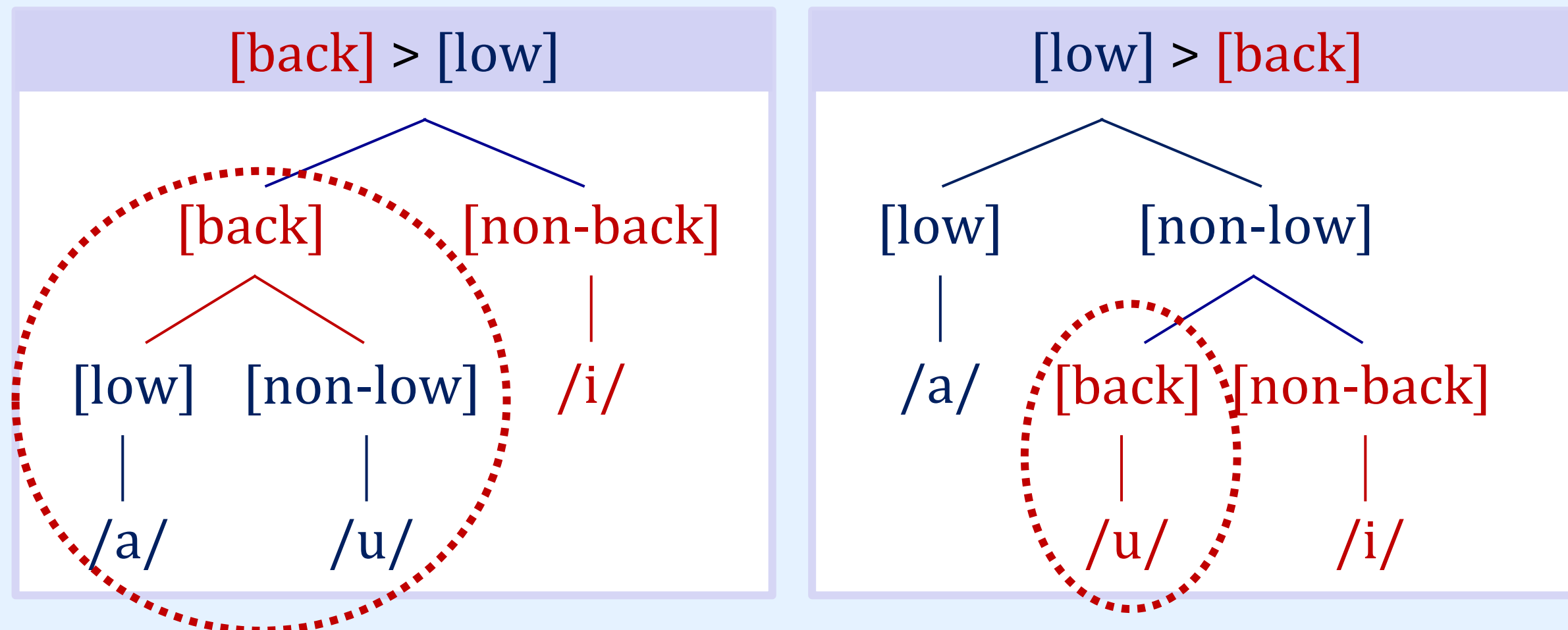
Here are two more hierarchies, using [high] and [round].



What does the hierarchy do? Synchrony

1. The hierarchy constrains phonological activity: Only **contrastive** features can be phonologically active.

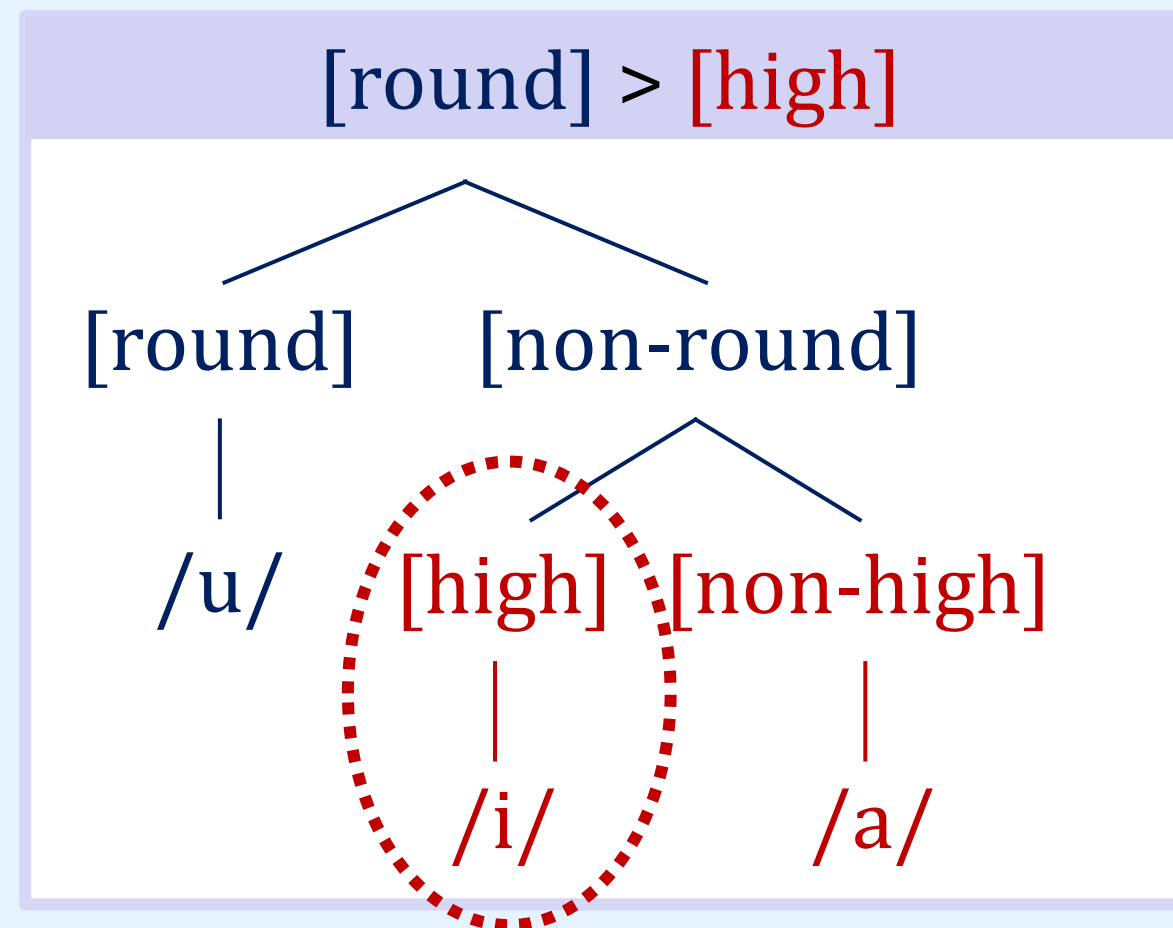
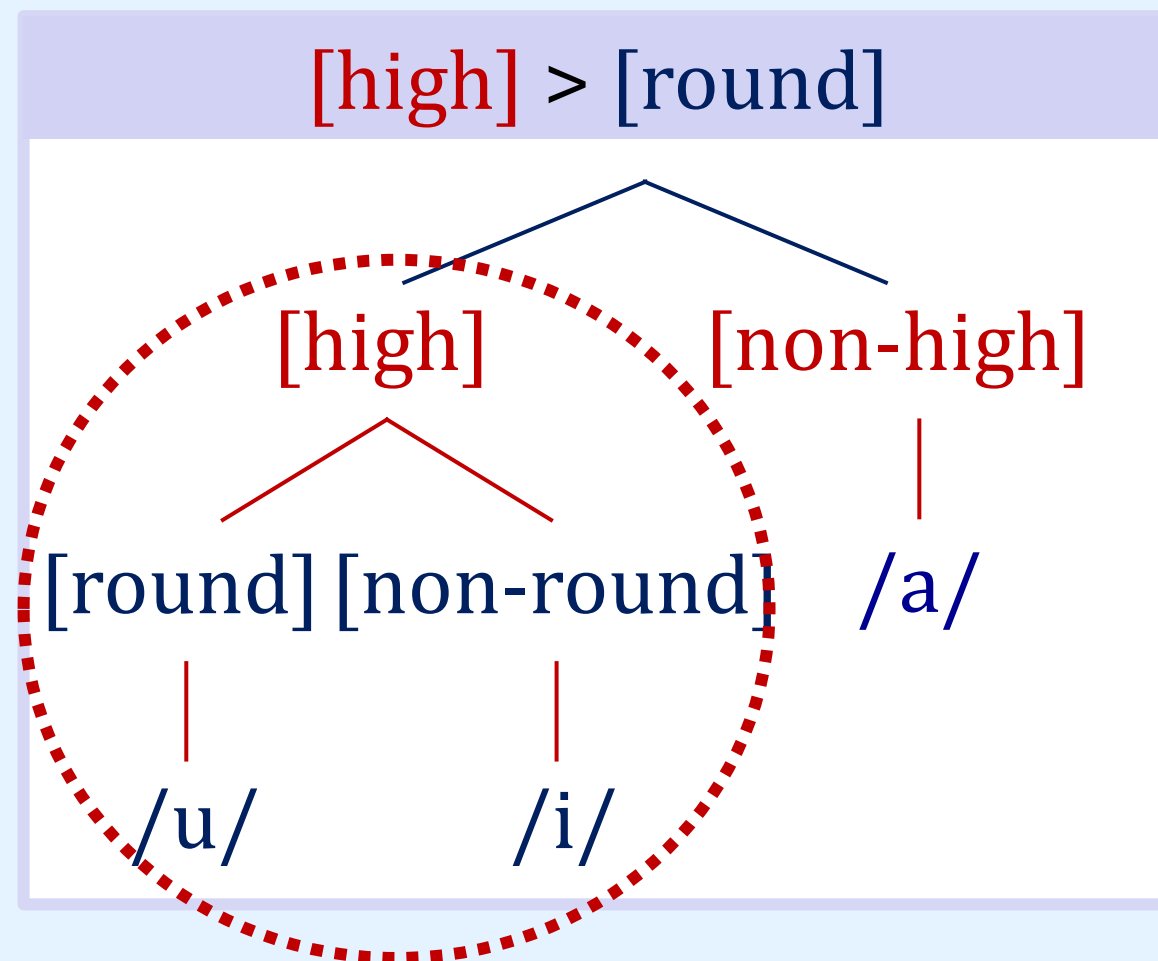
Which phonemes can trigger backing?



What does the hierarchy do? Synchrony

1. The hierarchy constrains phonological activity: Only **contrastive** features can be phonologically active.

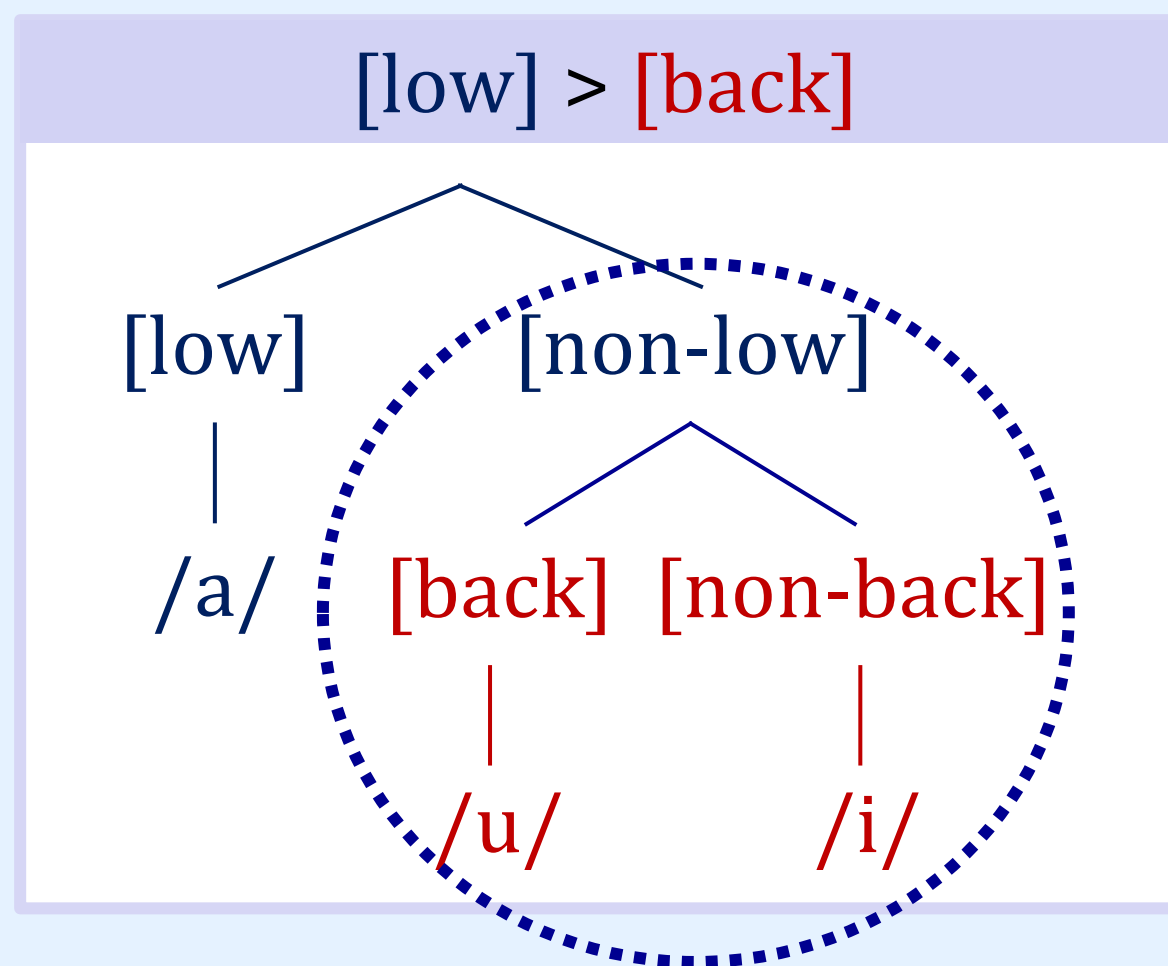
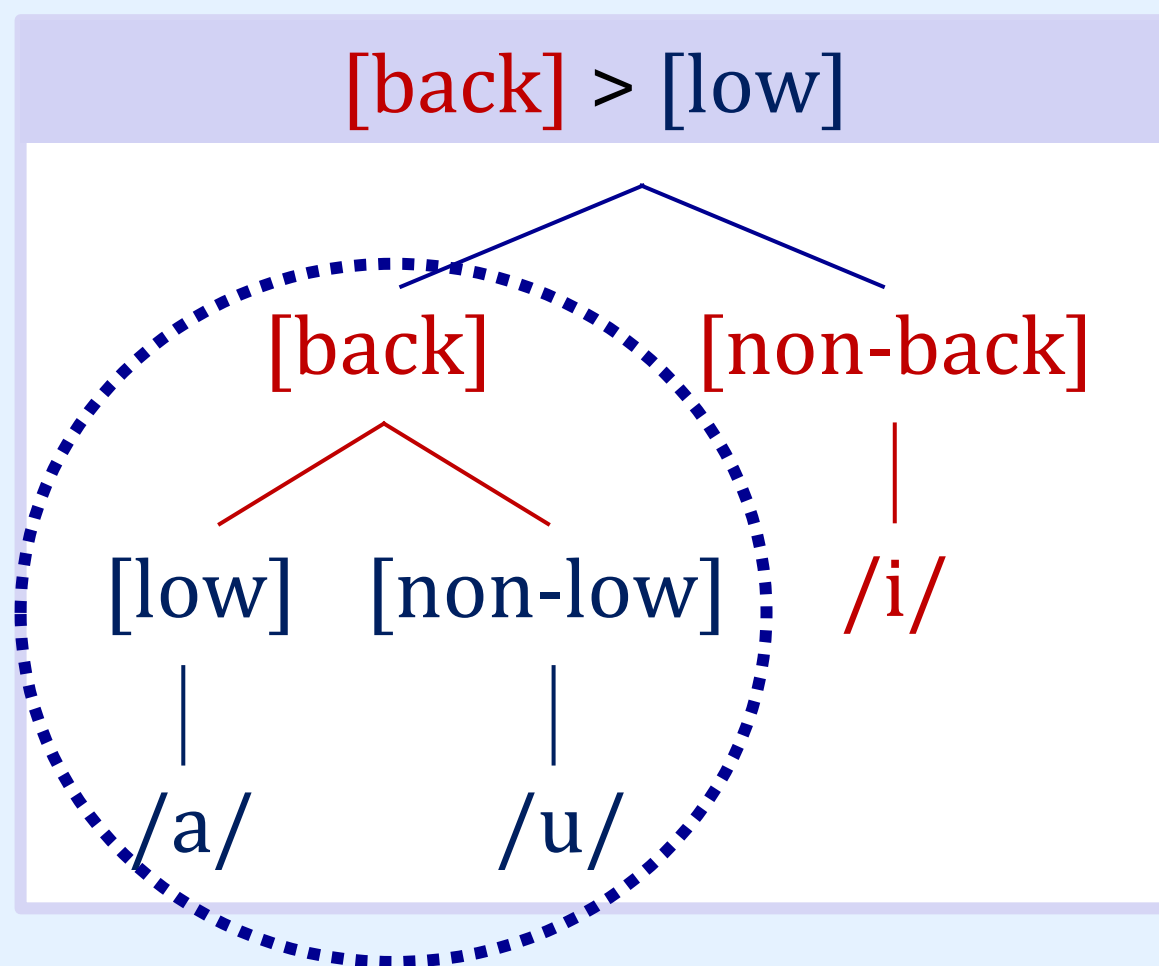
Which phonemes can trigger raising?



What does the hierarchy do? Diachrony

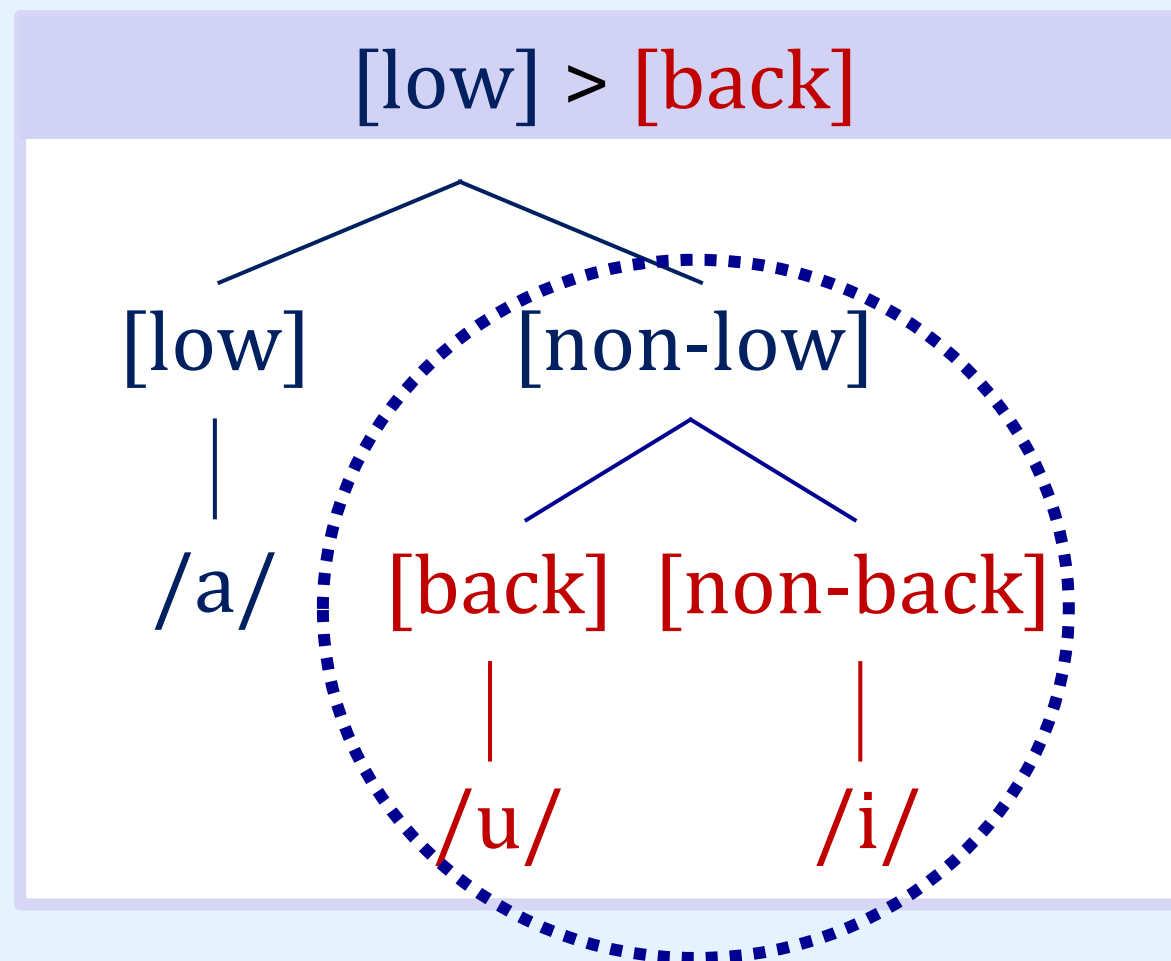
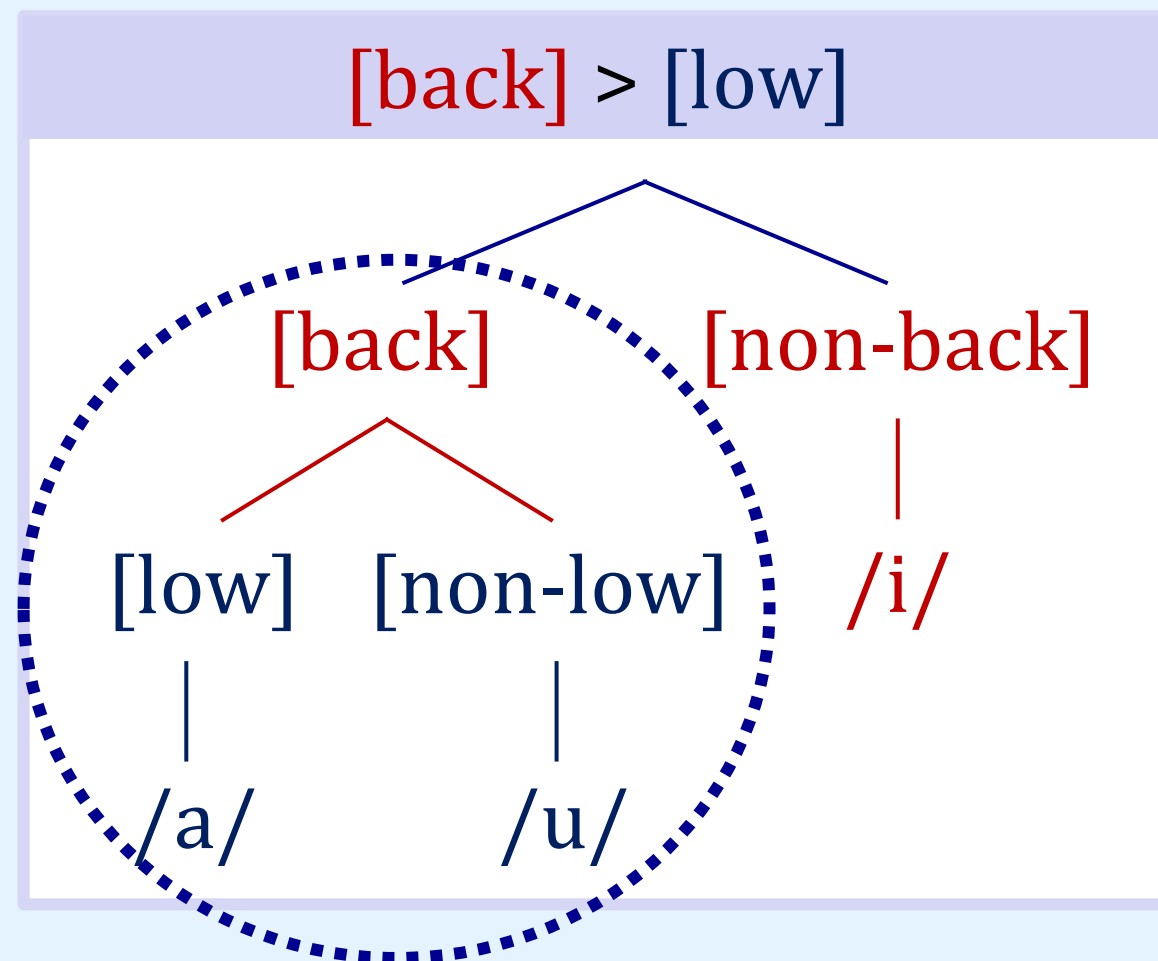
2. The hierarchy constrains neutralization and merger: We expect mergers to affect phonemes that are **contrastive sisters** (Ko 2010, 2018; Oxford 2015).

Which phoneme can /u/ merge with?



What does the hierarchy do? Diachrony

Oxford (2015) gives examples of merger patterns just like these in the history of the Algonquian languages.





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3. Brief Example: Diachronic Change in Algonquian

The Algonquian short vowel system

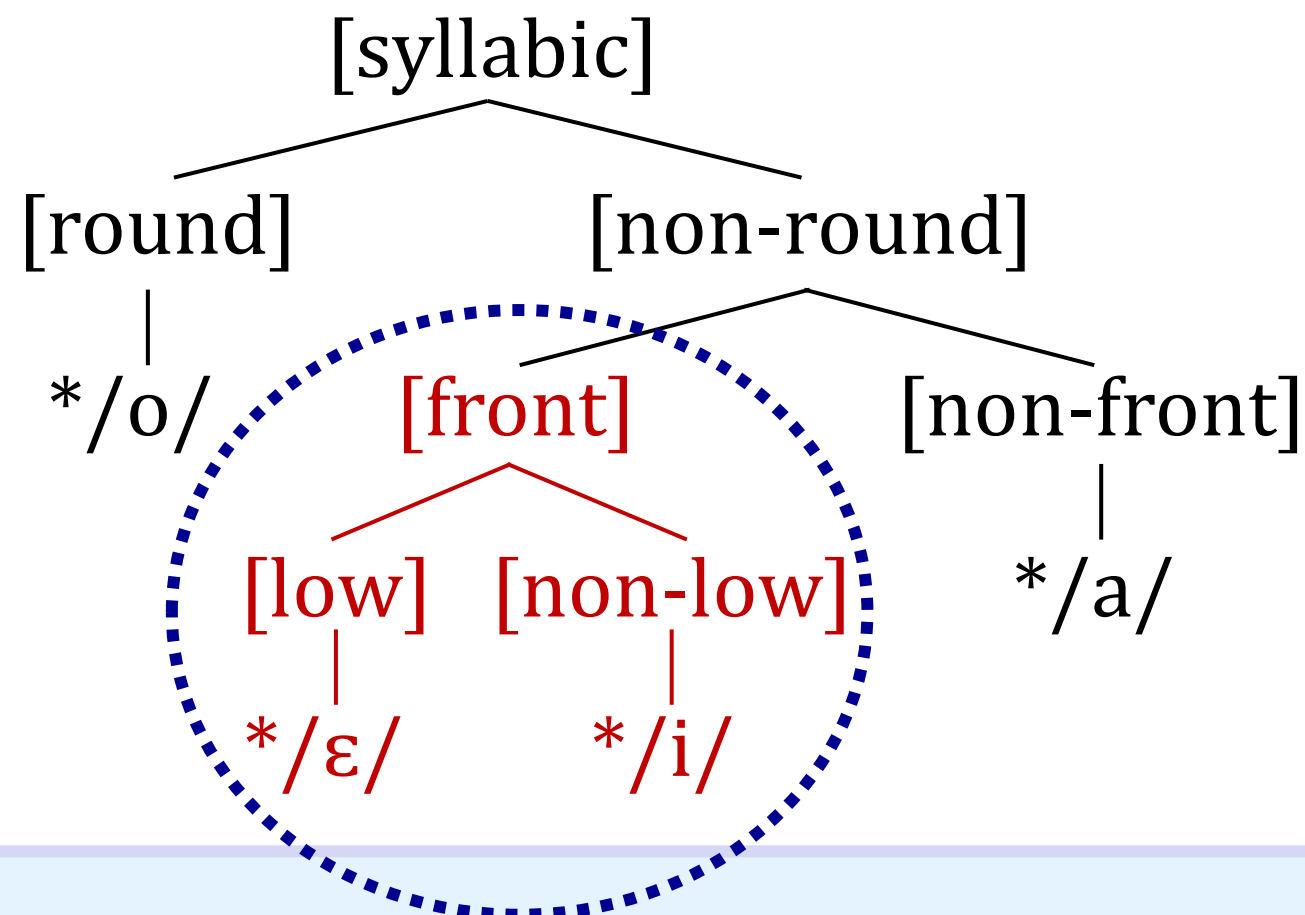
Oxford (2015) argues that Central Algonquian (all except the languages in the red circles) inherited the Proto-Algonquian vowel feature hierarchy.



Proto-Algonquian and the Central Algonquian languages

In this hierarchy $*/\epsilon/$ and $*/i/$ are contrastive sisters, i.e., minimally contrastive segments differing only by one feature, $[\pm\text{low}]$. In these languages:

PA and Central languages



$*/\epsilon/$ regularly merges with $*/i/$:

Partial or complete mergers of short $*/\epsilon/ > /i/$ occur in Fox, Shawnee, Miami-Illinois, Cree-Innu, Ojibwe, and Blackfoot.

Long $*/\epsilon:/ > /i:/$ in Woods Cree, Northern Plains Cree, and Blackfoot.

The Algonquian short vowel system

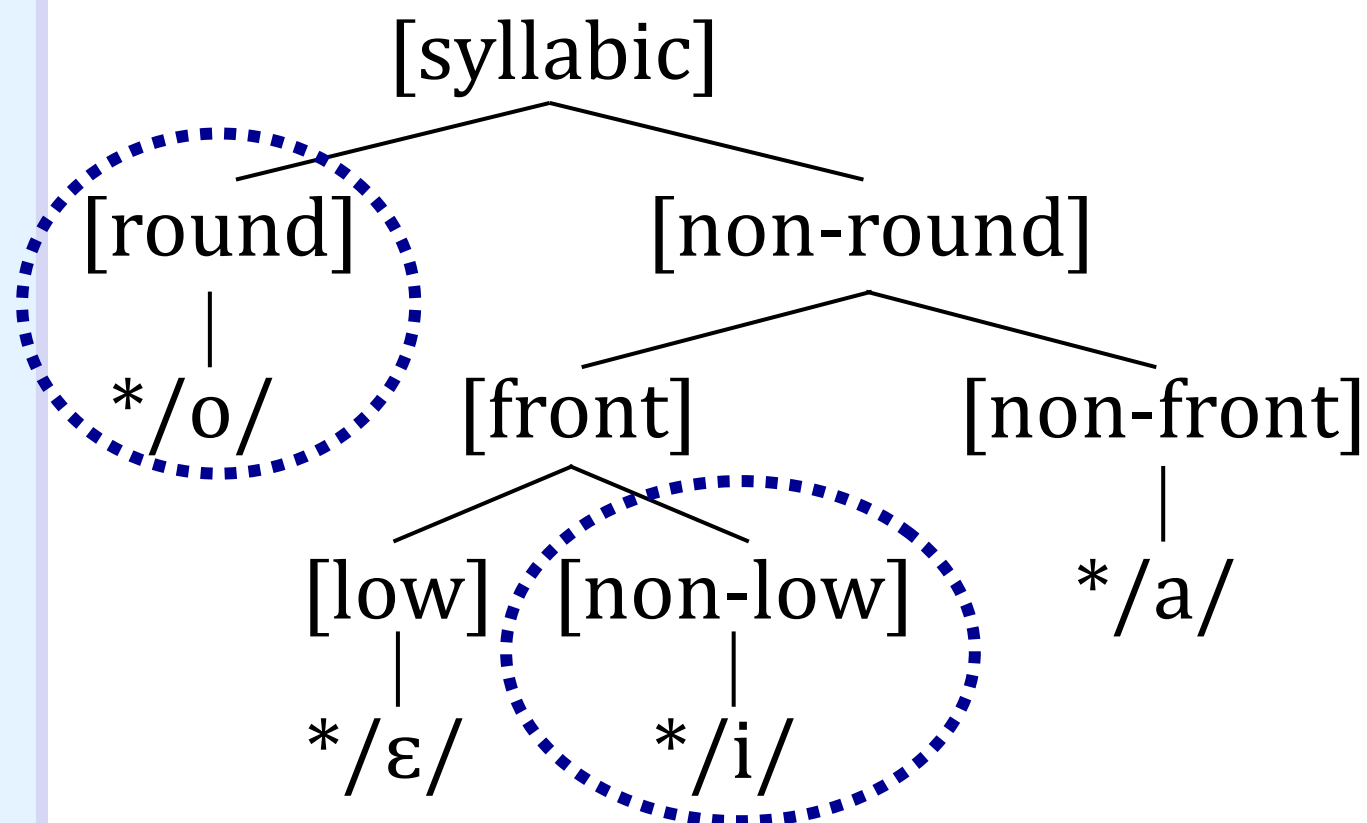
On the eastern and western edges of the Algonquian area (in the red circles), developments diverge from the predictions of the Proto-Algonquian hierarchy.



Eastern and Western Algonquian

In these areas, */o/ became a high vowel and began to pattern together with */i/, which provoked a reorganization of the contrastive hierarchy.

PA and Central languages



Oxford (2015) proposes that the height feature changed from $[\pm\text{low}]$ to $[\pm\text{high}]$ and came to outrank the place contrasts.

That is, the hierarchy changed from

[round] > [front] > [low]
to [round] > [front] > [high]
to [high] > [round] > [front]

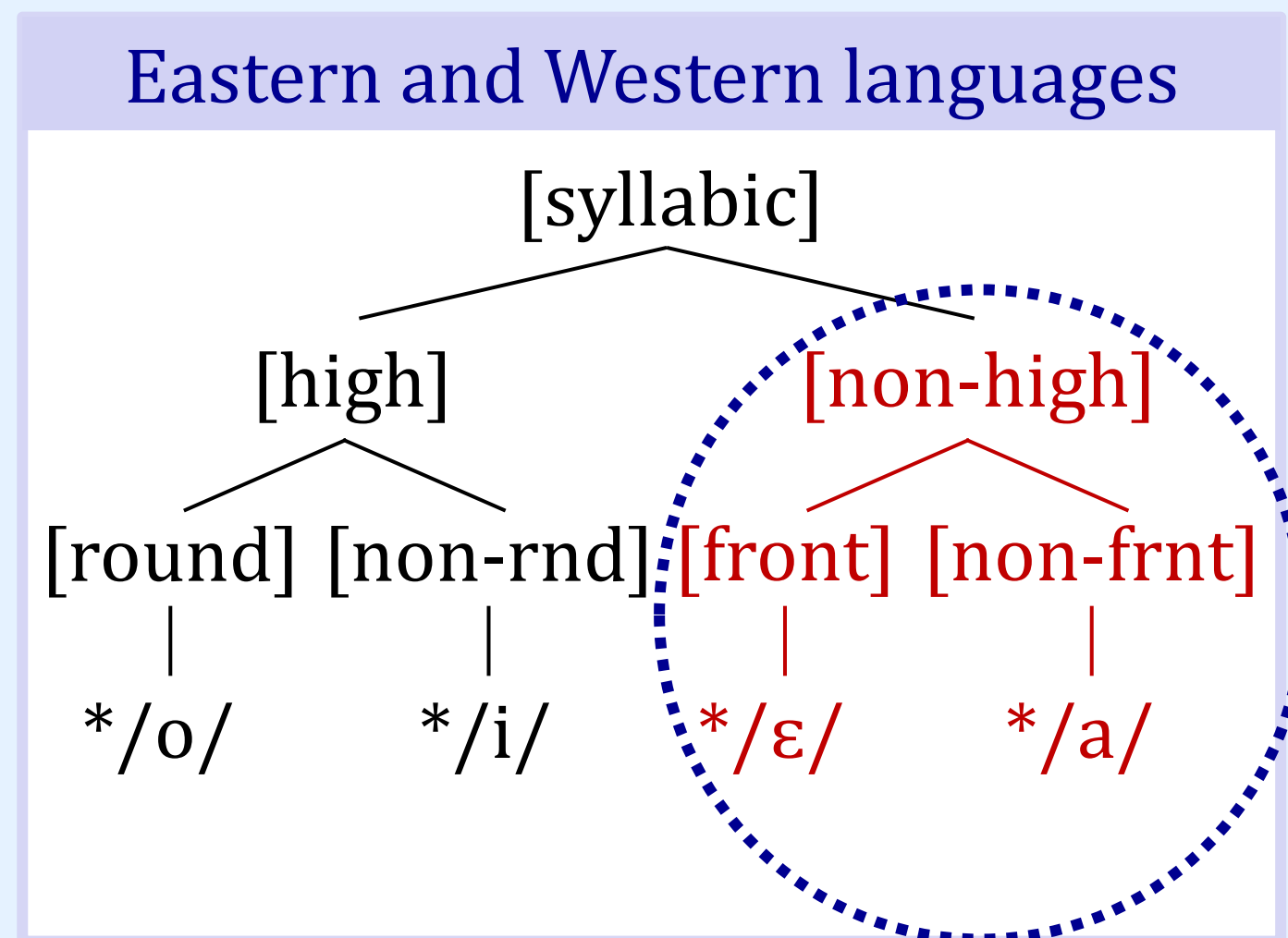
Eastern and Western Algonquian

Unlike in the previous hierarchy where */ε/ and */i/ were contrastive sisters, in the new hierarchy */ε/ and */a/ are contrastive sisters. In these languages:

*/ε/ merges with or shifts to */a/:

Partial or complete mergers of PA short */ε/ with */a/ occur in *Abenaki*, *Mahican*, *Mi'kmaq*, and *Maliseet-Passamaquoddy*.

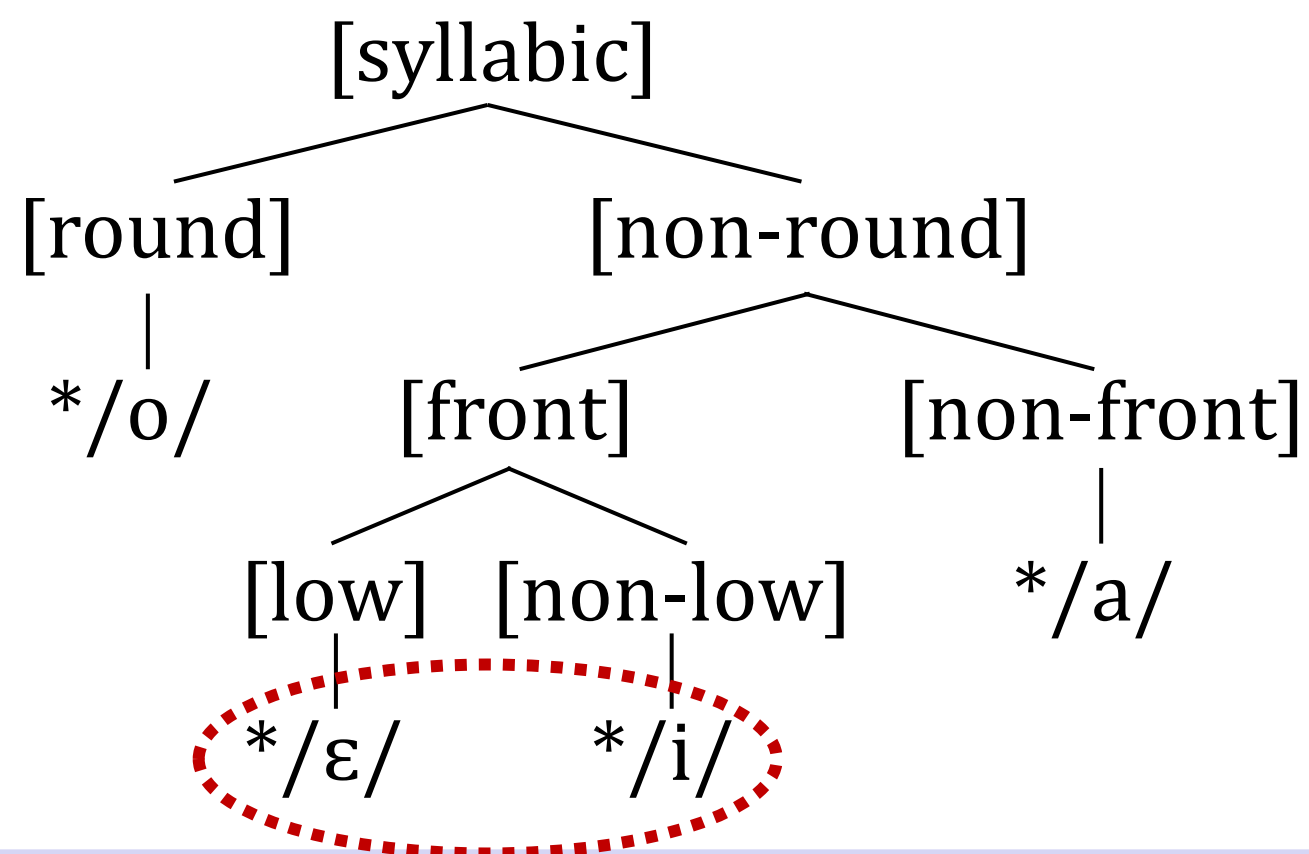
PEA long */ε:/ shifts to /a:/ in *Massachusetts* and merges with */a/ in *Western Abenaki*.



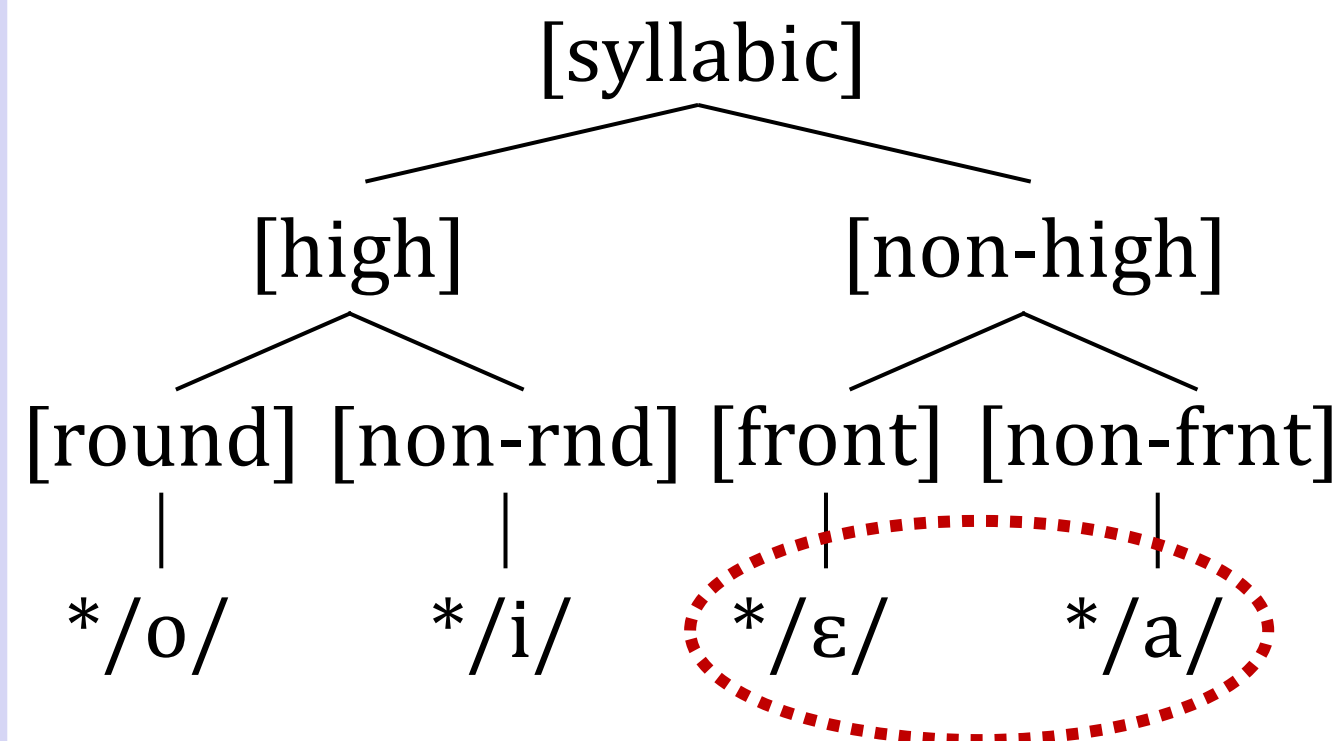
What does the hierarchy do? Diachrony

Thus, the Eastern/Western contrast shift accounts for the distinct patterning of many phonological changes in the two branches of the Algonquian family.

PA and Central languages



Eastern and Western languages





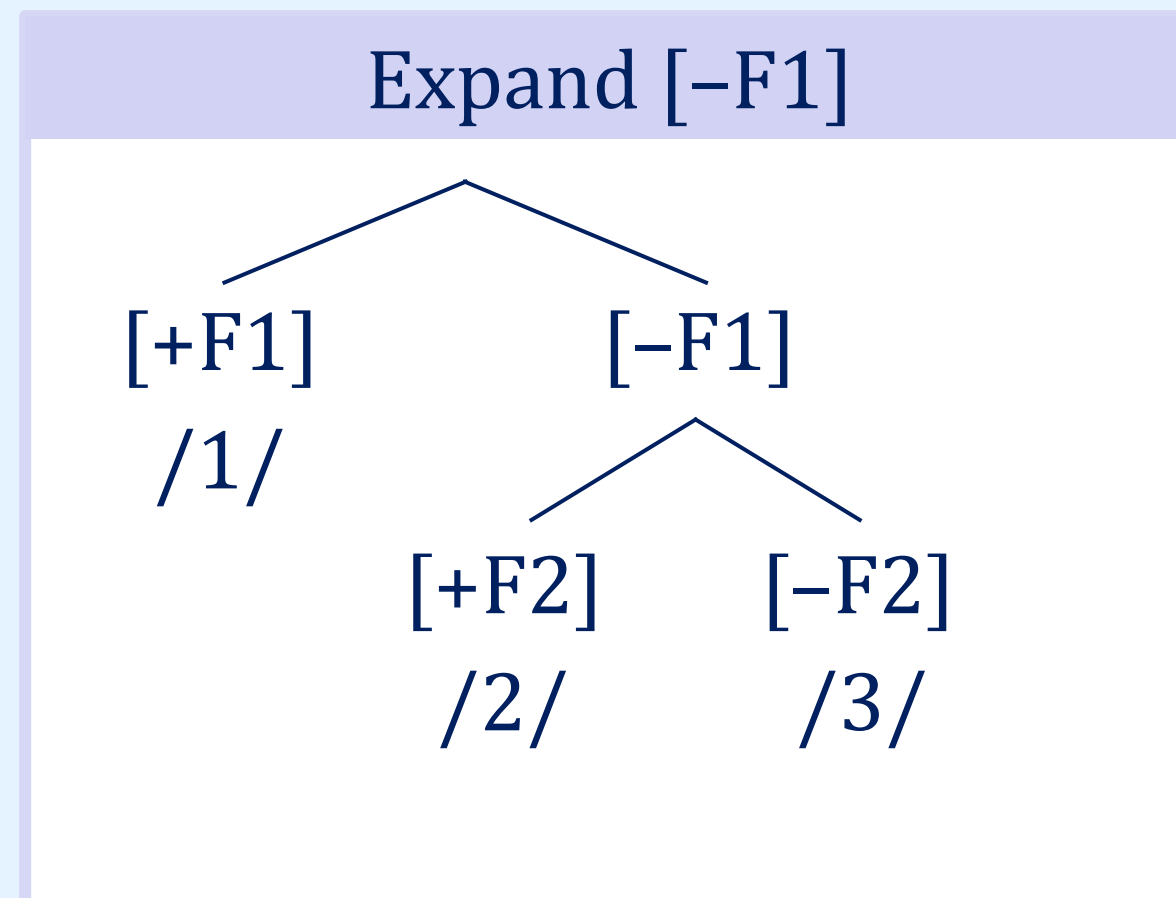
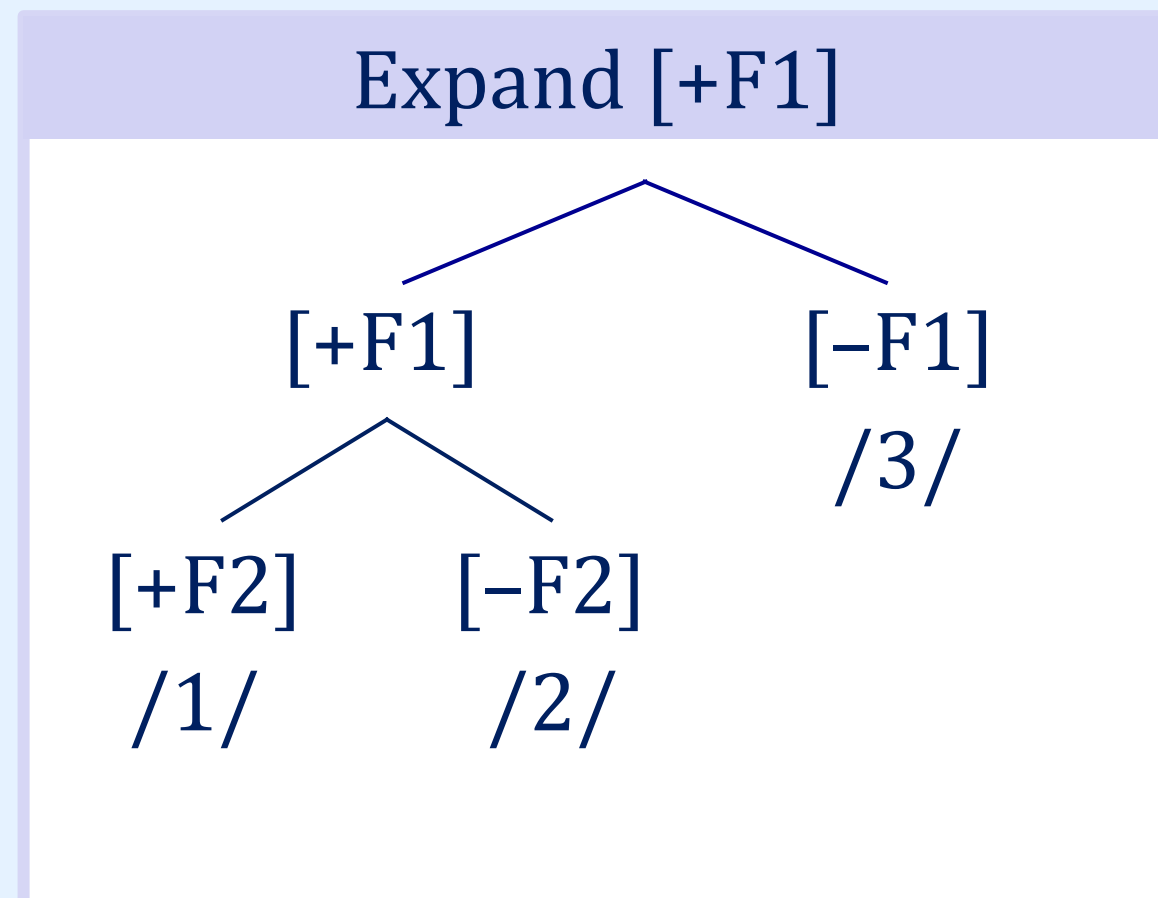
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4. An Empirical Theory: The 'Oops, I Need That' Problem

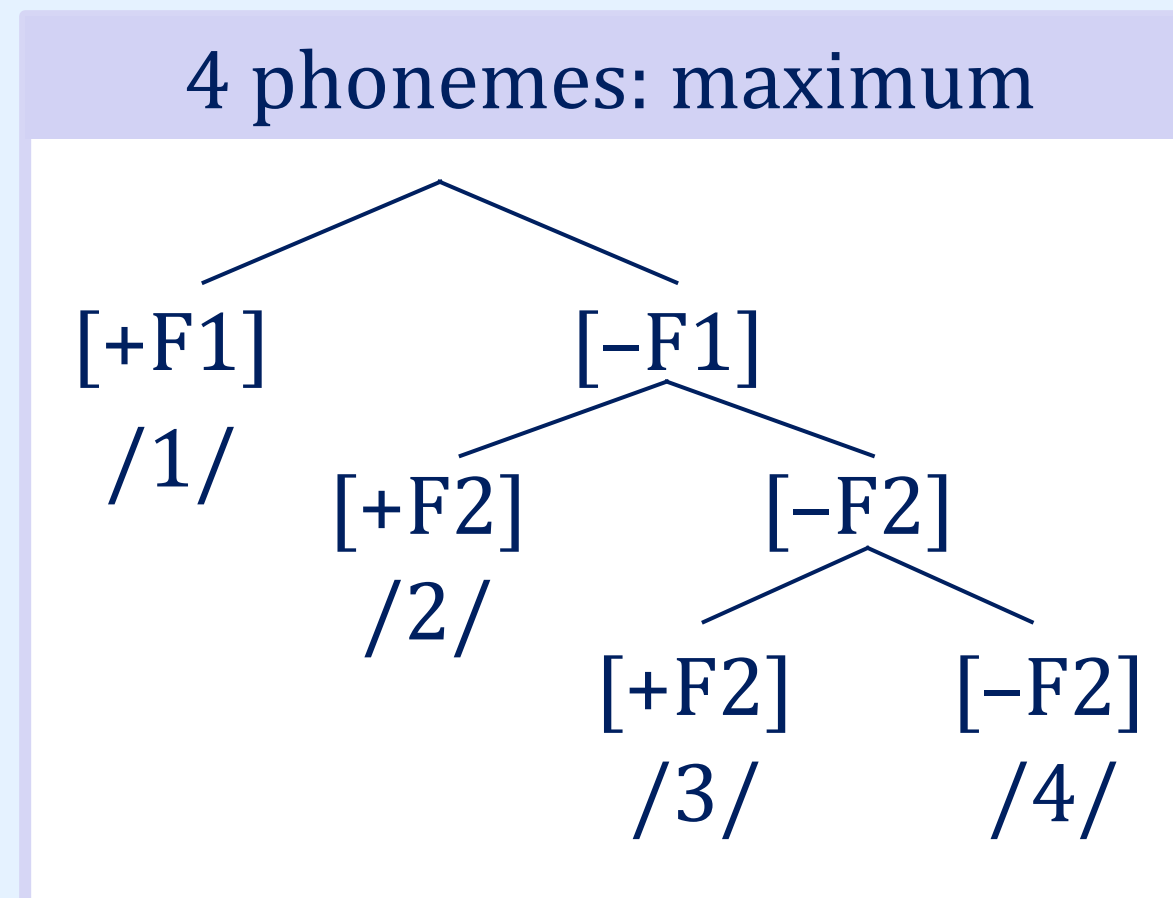
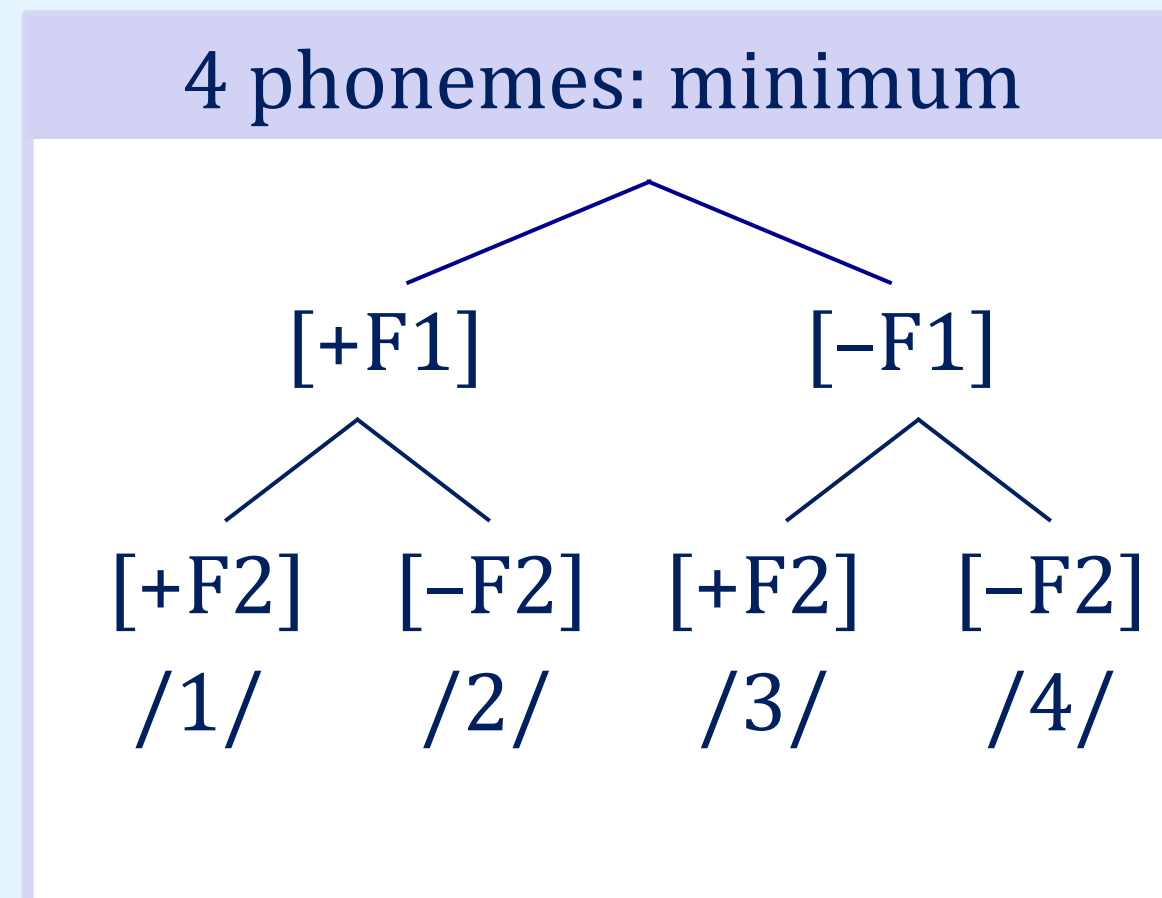
The Contrastivist Hypothesis is an empirical hypothesis

It is important to stress that the Contrastivist Hypothesis is an empirical hypothesis; although a three-vowel system might be characterized in different ways, it can never have more than two contrastive features (here we are not concerned with markedness).



The Contrastivist Hypothesis is an empirical hypothesis

A 4-phoneme inventory can have a minimum of 2 features and a maximum of 3.



The Contrastivist Hypothesis is an empirical hypothesis

In general, the minimum number of features required by n elements = the smallest integer $\geq \log_2 n$, and the maximum number of features = $n-1$.

Phonemes	$\log_2 n$	min	max
3	1.58	2	2
4	2	2	3
5	2.32	3	4
6	2.58	3	5
7	2.81	3	6
8	3	3	7

Phonemes	$\log_2 n$	min	max
10	3.32	4	9
12	3.58	4	11
16	4	4	15
20	4.32	5	19
25	4.64	5	24
32	5	5	31

The 'Oops, I Need That' Problem

Thus, it is potentially possible that a phonological system might display more activity than the number of contrastive features can support; this is what Nevins (2015) calls the 'Oops, I Need That' Problem.

This problem refers to a situation where a non-contrastive feature is needed by the phonology.

According to the Contrastivist Hypothesis, this situation should not arise, because only contrastive features should be active.

Thus, the 'Oops, I Need That' Problem would indicate an apparent counterexample to the Contrastivist Hypothesis.

The 'Oops, I Need That' Problem

I observe that the 'Oops, I Need That' Problem is a typical problem of the sort that empirical theories should have: that is, there are situations in which the theory might be wrong.

Thus, this is a good problem to have; phonological theories that never have this kind of problem may not be making any empirical claim.

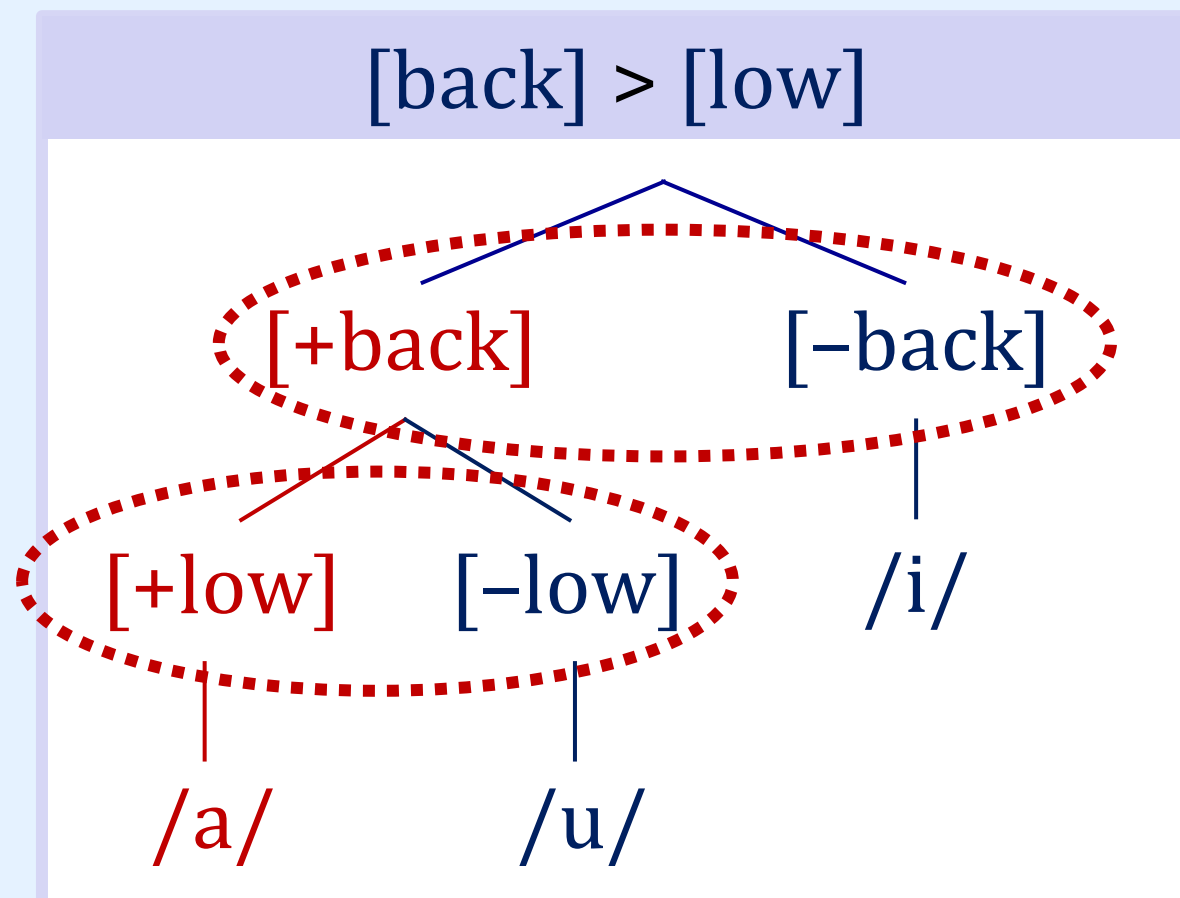
Of course, the best situation is where we could **potentially** have an 'Oops, I Need That' Problem that does **not** arise.

I will show some cases where this problem could easily arise but doesn't; these cases thus provide support for the theory.

Contrastive features may be predictable

In testing the Contrastivist Hypothesis it is important to understand that, in a hierarchical system, it is possible to have contrastive features that are technically predictable from the other features.

Consider, for example, the features of /a/ in the system below:



Since /a/ is the only vowel in the system that is [+low], its [+back] specification is redundant.

It is not removed, however, because in a feature hierarchy contrasts exist at different levels:

[±back] groups /a, u/ against /i/

[±low] distinguishes /a/ from /u/

Contrastive features may be predictable

Thus, it is **not** the case that all redundant feature specifications must be removed from a system of contrastive specification.

This fact often puts a few more features in play than would be the case in non-hierarchical contrastive approaches.

This characteristic will play an important role later: it makes possible the existence of ‘deep allophones’, allophones that consist only of contrastive features.



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5. From the Classical Manchu Vowel System to the Modern Manchu Languages

Classical Manchu to the modern Manchu Languages

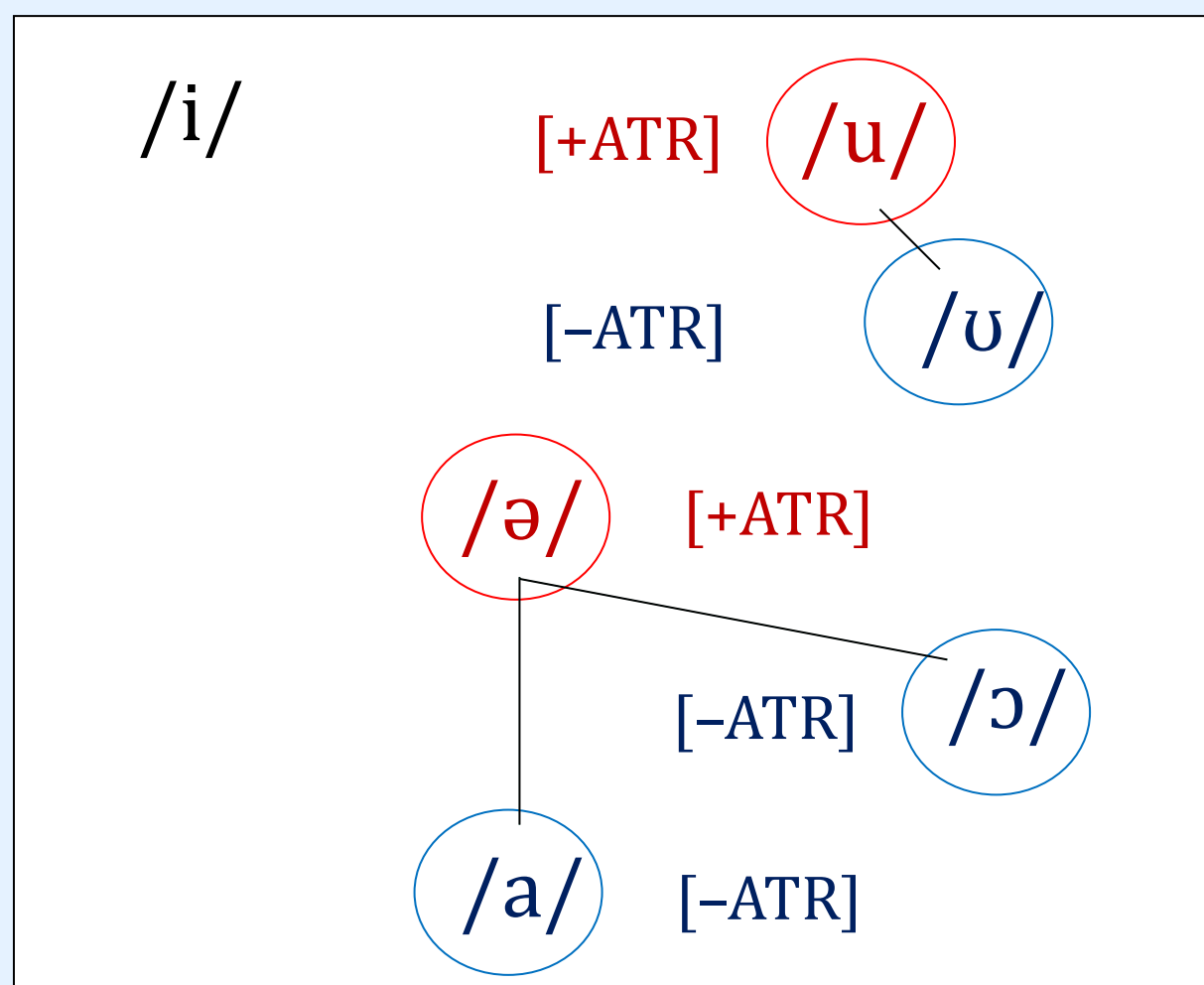
The evolution of the Classical Manchu vowel system to the vowel systems of Spoken Manchu and Xibe provides a nice illustration of Jakobson's point:

An individual change in one part of the system can alter the contrastive status of other parts of the system in important ways that lead to further changes.

This case also shows the close connection between contrast and activity posited by Contrastive Hierarchy Theory, as well as between synchrony and diachrony.

Classical Manchu vowel system (Zhang 1996)

Classical Manchu has 6 vowel phonemes. Three notable kinds of phonological activity involving vowels are ATR harmony, labial harmony, and palatalization.

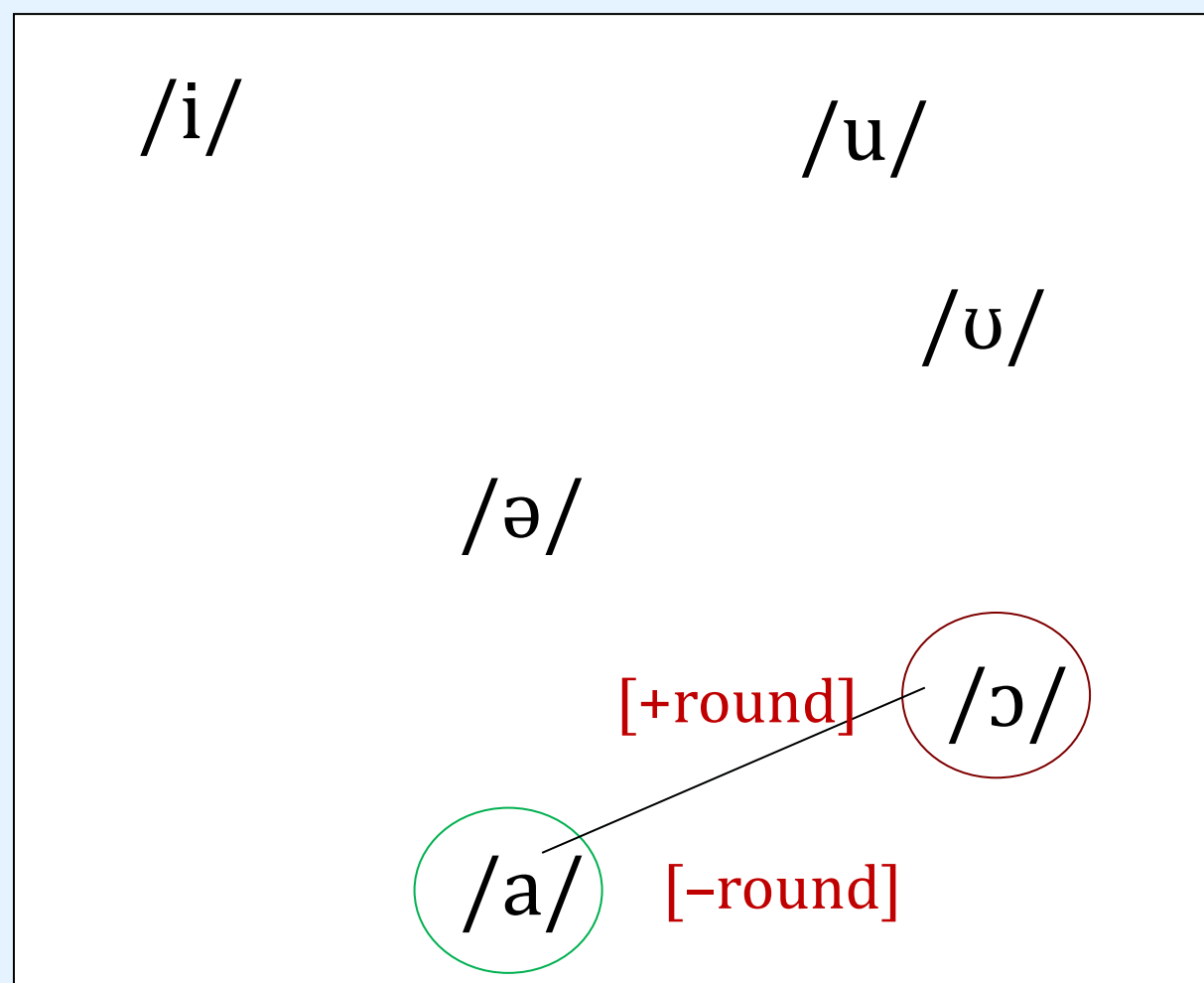


ATR harmony: /u, ə/ are [+ATR], /ʊ, ɔ, a/ are [-ATR], and /i/ is neutral. All vowels in a word except /i/ must agree in [±ATR].

/u/ alternates with /ʊ/, and /ə/ alternates with /a/ and /ɔ/.

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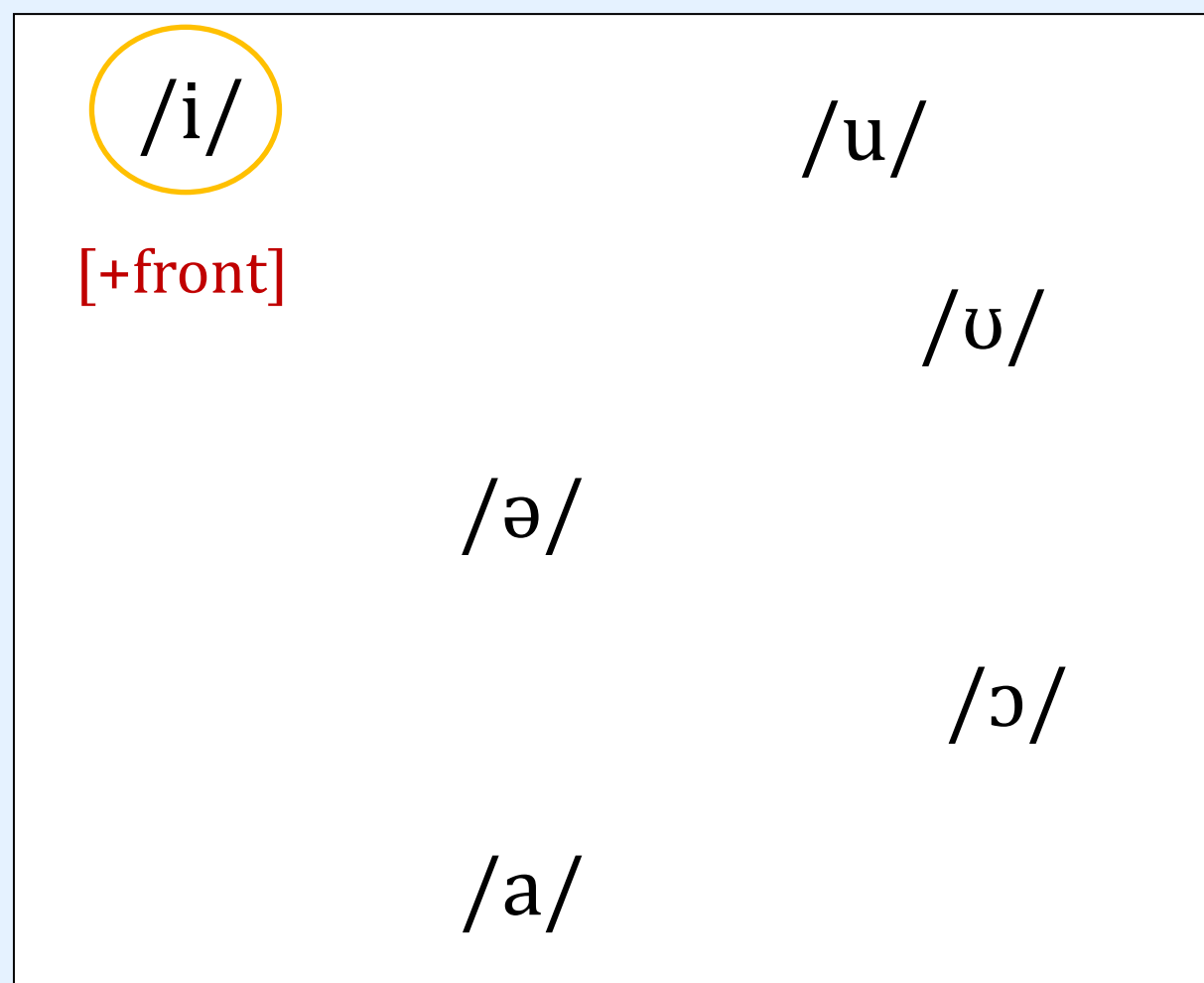


Labial (rounding) harmony: A suffix vowel /a/ becomes /ɔ/ when preceded by a non-initial /ɔ/ (or by two successive /ɔ/ vowels).

We assume that this harmony involves the feature [\pm round] (or [\pm labial]).

Classical Manchu vowel system (Zhang 1996)

Classical Manchu has 6 vowel phonemes. Three notable kinds of phonological activity involving vowels are ATR harmony, labial harmony, and palatalization.

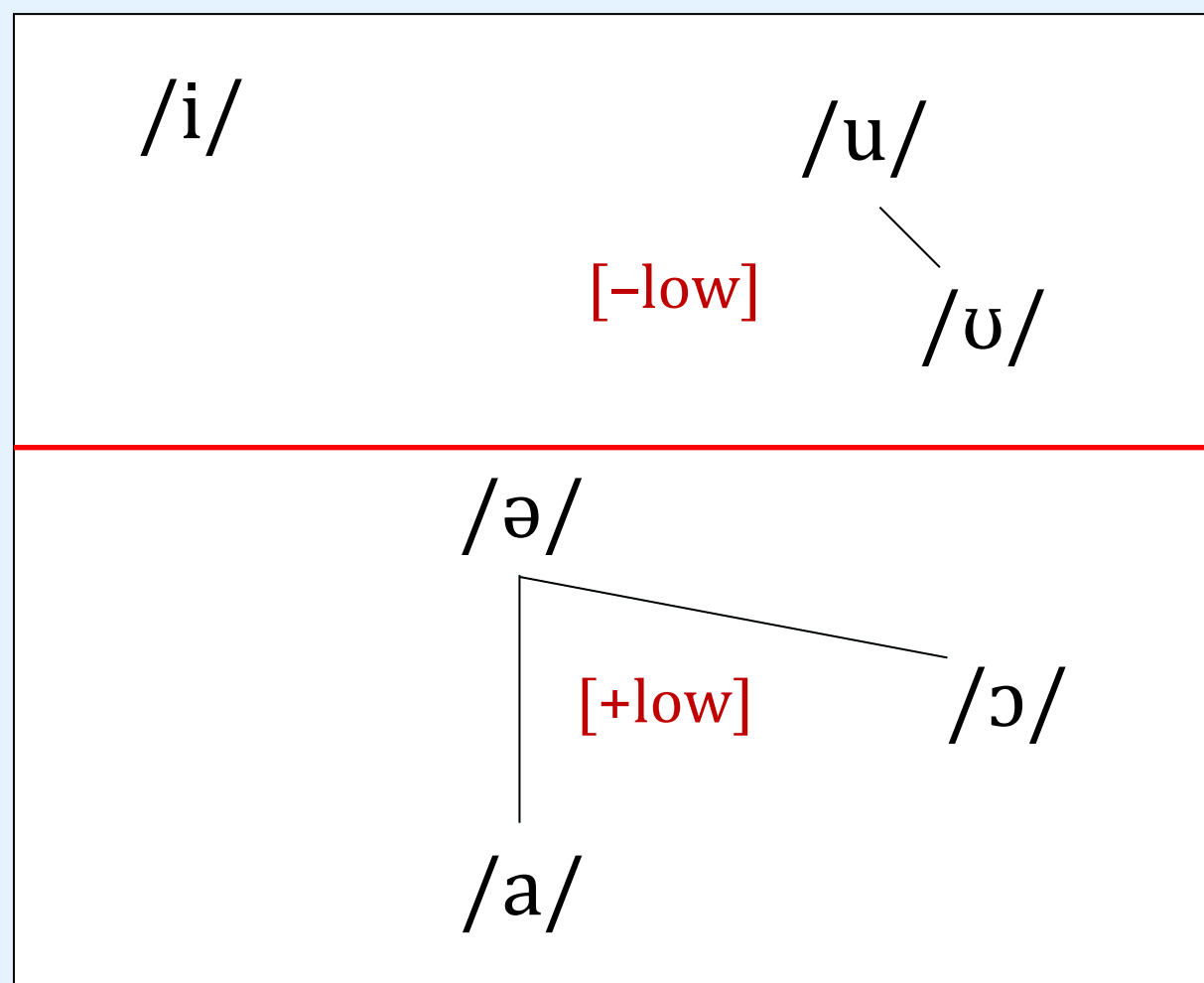


Palatalization: The vowel /i/ provokes the palatalization of neighbouring consonants.

/i/ must therefore have a feature that can do this, which we call [\pm front] (or [\pm coronal]).

Classical Manchu vowel system (Zhang 1996)

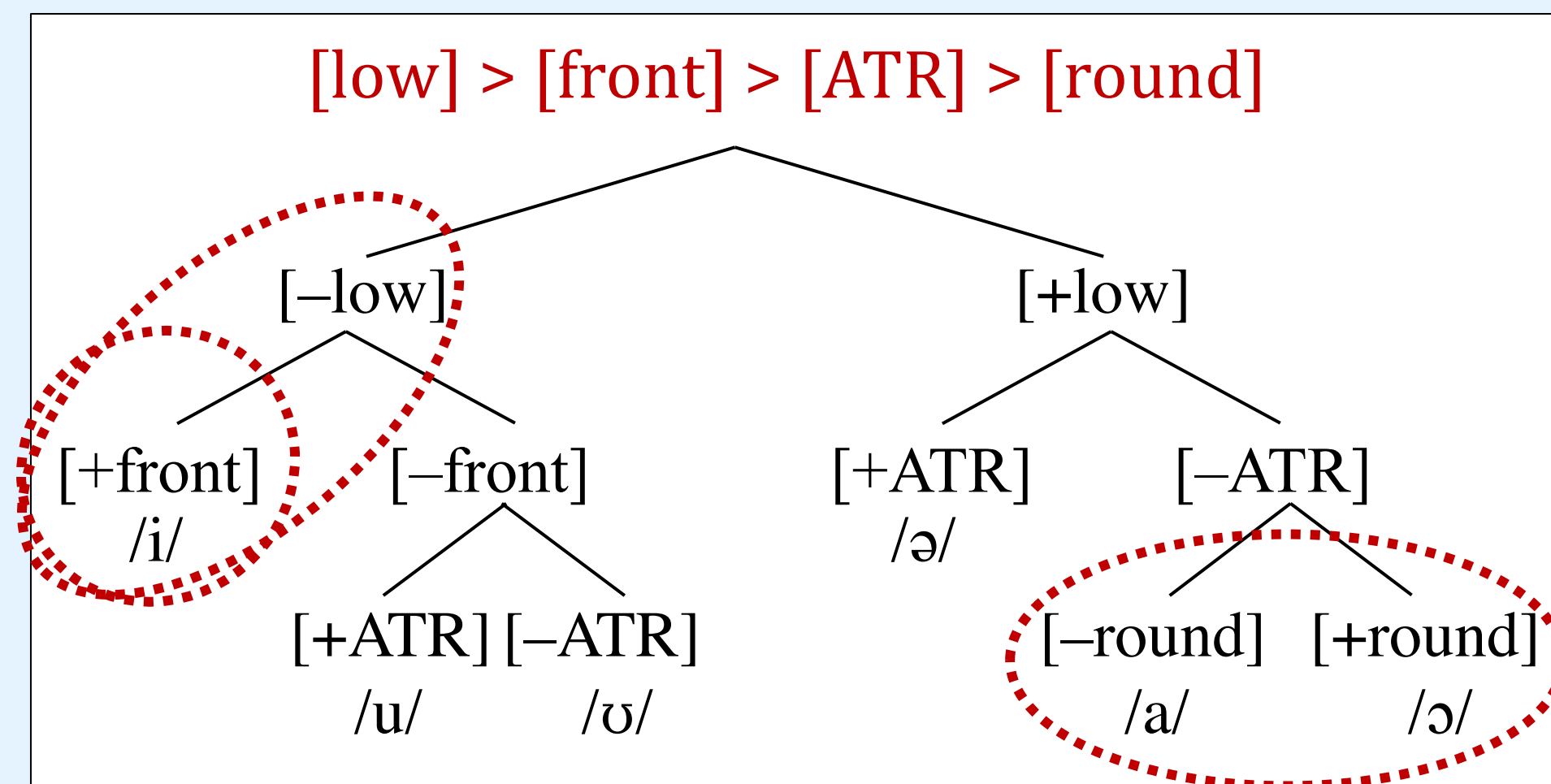
Finally, we need to assume a height contrast to distinguish between the two [+ATR] vowels /u, ə/, and to divide the [-ATR] /ʊ/ from /a, ɔ/.



The patterns of alternation suggest that we need only one height feature, which we can call [\pm low] (or [\pm high]).

Classical Manchu feature hierarchy

The patterns of feature activity are consistent with the following feature hierarchy, which is based on Zhang (1996) as modified by Ko (2018):



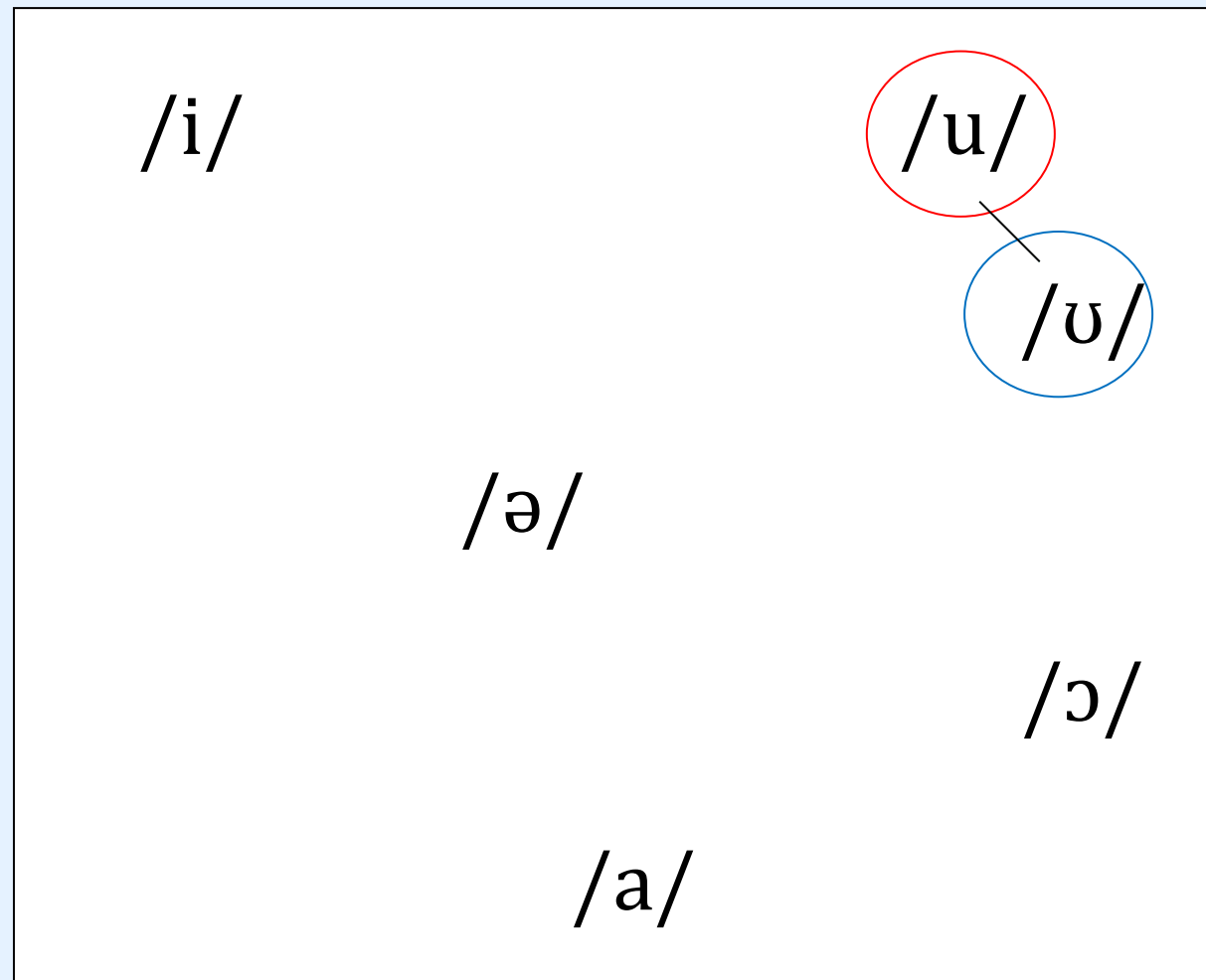
ATR harmony: /i/ is the only vowel that lacks [ATR].

Labial harmony: Only the low vowels participate; the high vowels /u, ʊ/ lack a contrastive [round] feature.

Palatalization: Only /i/ is [+front].

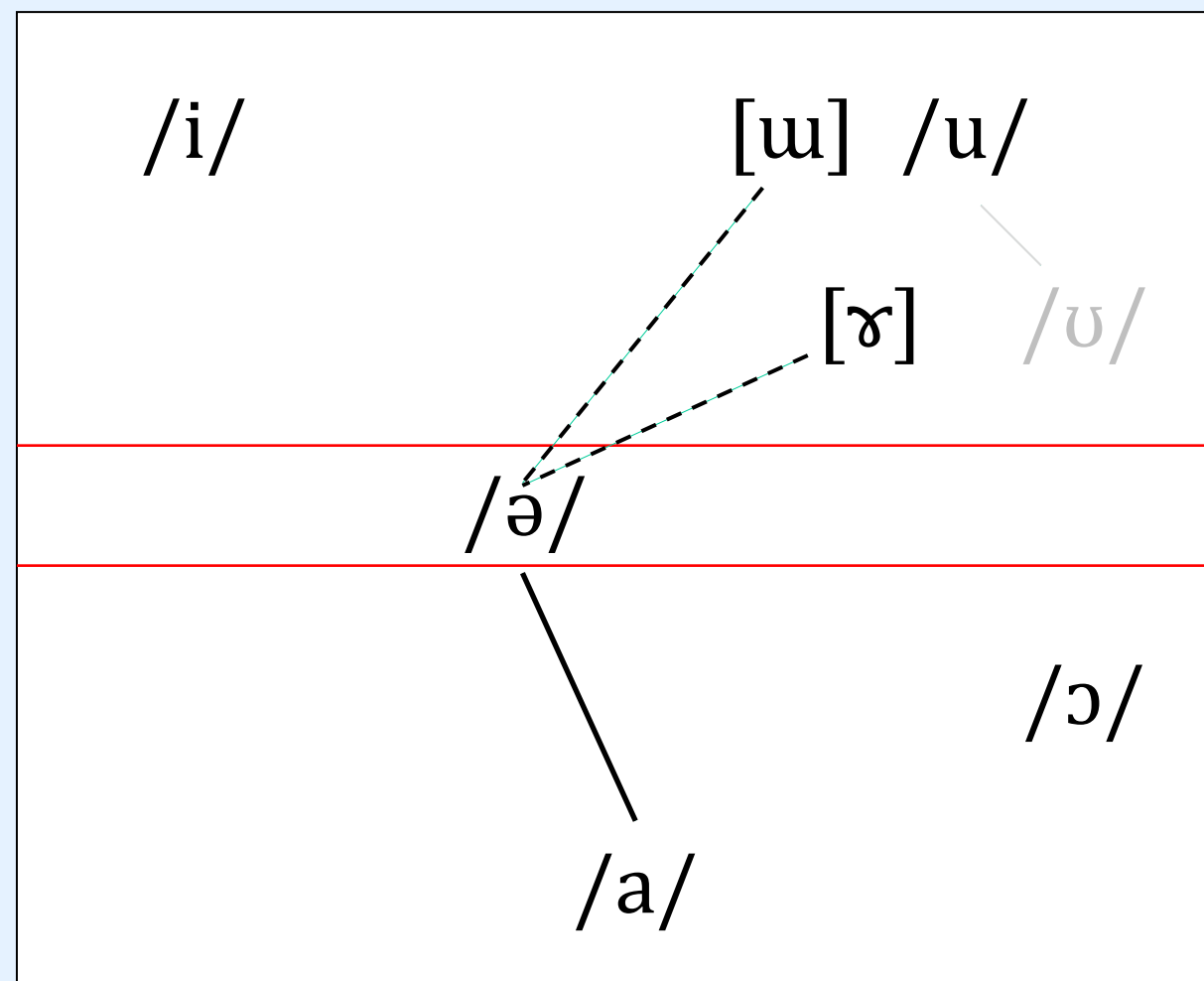
Diachronic developments

Already in Classical Manchu the distinction between /u/ and /ʊ/ was being lost: /ʊ/ was neutralized to [u] except after back consonants.



Diachronic developments

Eventually, /ʊ/ was lost completely as a contrastive phoneme.



Now the entire burden of the [ATR] contrast fell on the contrast between /ə/ and /a/.

But in the absence of the /u/ ~ /ʊ/ contrast, this contrast could easily be reinterpreted as a height contrast.

Indeed, in Spoken Manchu the reflex of the old /ə/ has mid-high or high allophones, supporting the idea that it has been reclassified as a high (or non-low) vowel.

Diachronic developments

But the new status of /ə/ provoked a change in the specification of /u/.

/i/ [+front]	/ə/ [-round]	/u/ [+round]
	/a/ [+low]	/ɔ/ [+round]

Because now a new contrast must be drawn between /u/ and the new [-low] /ə/.

An obvious candidate is [±round], which already marks a contrast in the [+low] vowels.

Zhang (1996) and Dresher & Zhang (2005) propose that the [±round] contrast is extended into the [-low] region.

Diachronic developments: Spoken Manchu

The new [+round] specification of /u/ had some interesting consequences which provide support for our analysis.

<i>/i/</i> [+front]	<i>/y/</i> [+front]	<i>/ə/</i> [-round]	<i>/u/</i> [+round]
<i>/ɛ/</i> [+front] [+low]	<i>/a/</i> [+low]		<i>/ɔ/</i> [+round]

First is the creation of two new vowels in Spoken Manchu, /ɛ/ and /y/.

Zhang (1996) observes that /ɛ/ often corresponds to Classical Manchu *a* followed by *i*.

/ɛ/ ([+low, +front]) is thus a combination of the features of /i/ ([+front]) and /a/ ([+low]).

Diachronic developments: Spoken Manchu

Similarly, /y/ corresponds to sequences of Classical Manchu *i...u* or *u...i*.

<div style="display: flex; justify-content: space-between;"> [-round] [+round] </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> /i/ [+front] </div> <div style="text-align: center;"> /y/ </div> <div style="text-align: center;"> /u/ [+round] </div> </div>	/ə/
[+front] /ɛ/ [+low]	[+low] /a/ [+round]
	/ɔ/

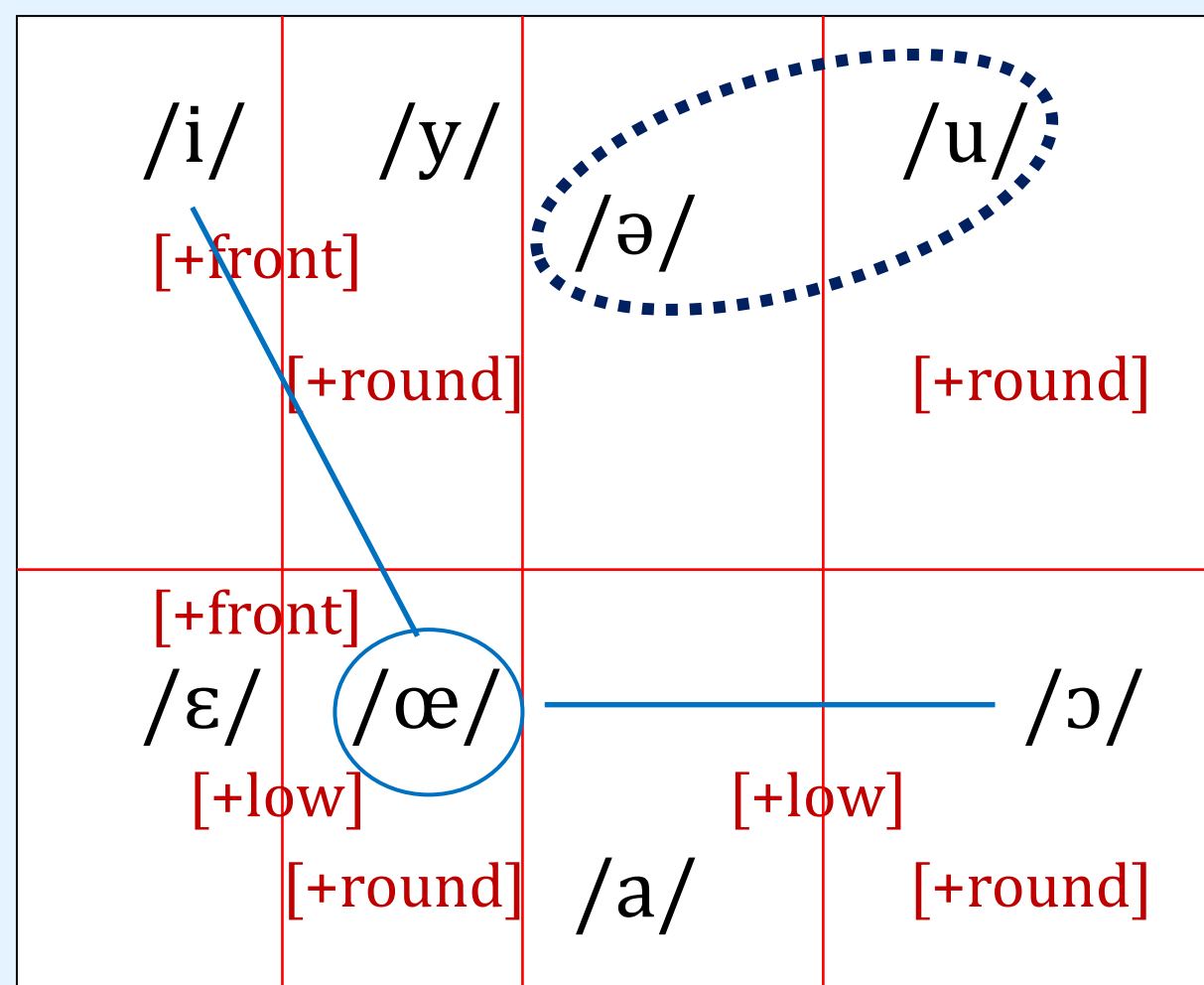
Its [+front] feature clearly comes from /i/; its [+round] feature can only come from /u/.

The fact that /u/ can contribute [+round] to a new phoneme indicates that [+round] is an active feature on /u/.

By hypothesis an active feature must be contrastive; that /u/ is contrastively [+round] in later Manchu is a prediction of our analysis.

Diachronic developments: Xibe

Like Spoken Manchu, the modern Manchu language Xibe (or Sibe) has the new phonemes /ɛ/ and /y/, as well as /œ/, most likely derived from *ɔ...i* sequences.



Unlike Spoken Manchu, Xibe retains a labial harmony rule in which /ə/ alternates with /u/ in suffixes.

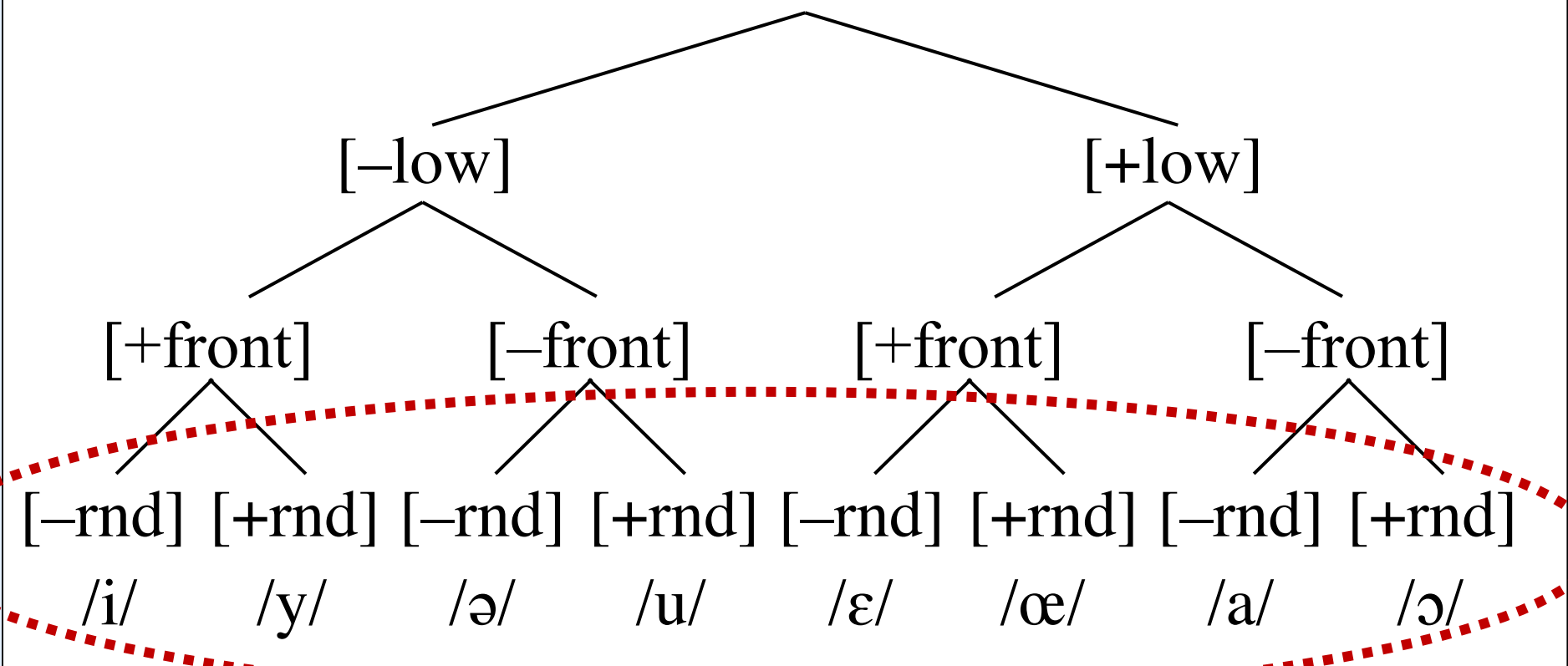
As far as I know, this is the only Manchu-Tungus language in which /u/ participates in labial harmony (see Ko 2018 for a survey).

This is explained by the contrastive status of /u/ following the reclassification of /ə/ as a [-low] vowel following the loss of /ʊ/.

Xibe feature hierarchy

To sum up, here is the contrastive hierarchy of Xibe; though having one feature less than Classical Manchu, it has three more vowels, using every slot in the tree.

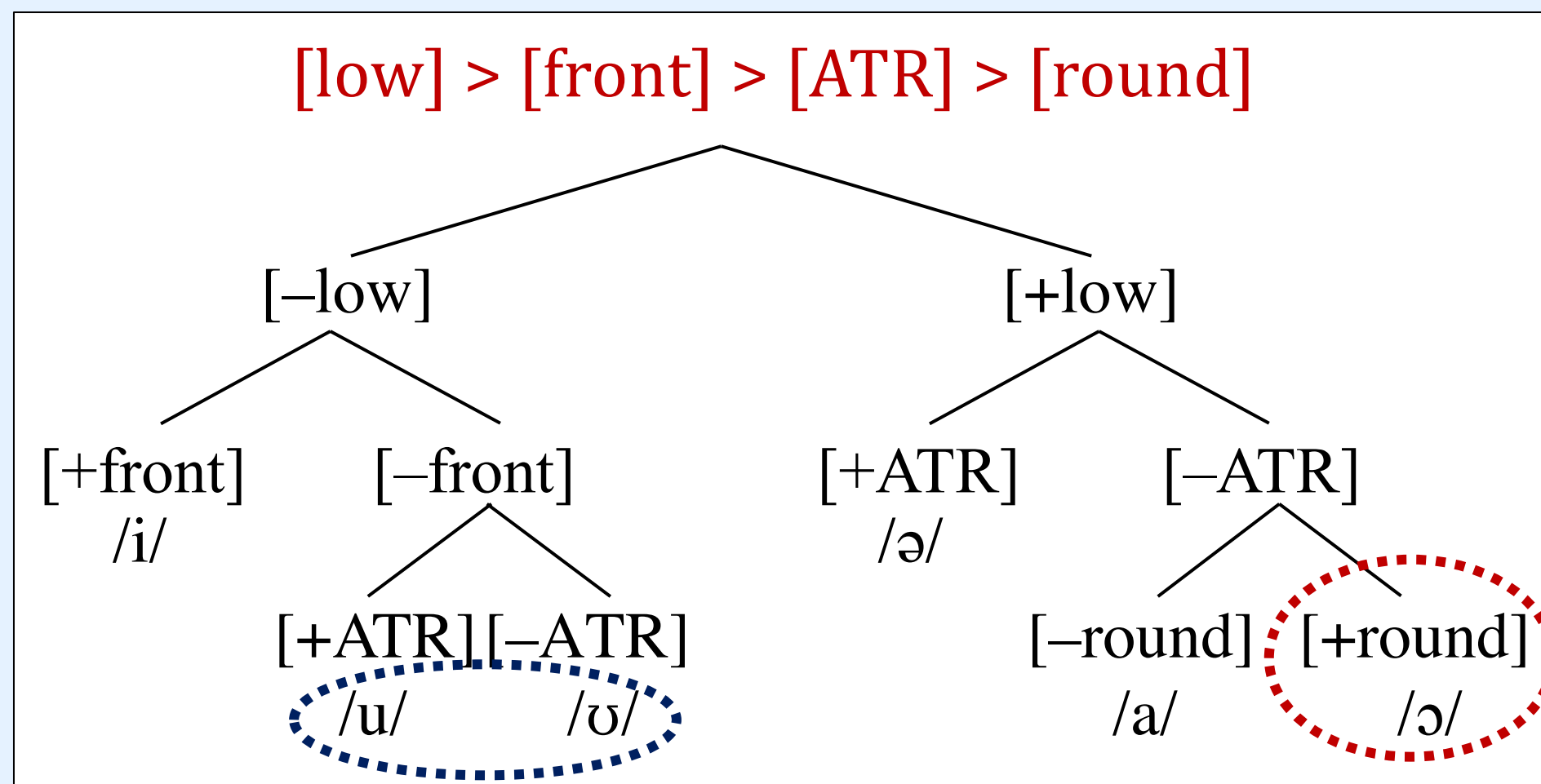
[low] > [front] > [round]



[±round], confined to the [+low] vowels in most Manchu-Tungusic languages, is extended to the [-low] vowels with dramatic effects.

Classical Manchu feature hierarchy again

In our account, it is not a coincidence that in Classical Manchu, shown again below, labial harmony could be triggered only by /ɔ/ and not by /u, ʊ/.

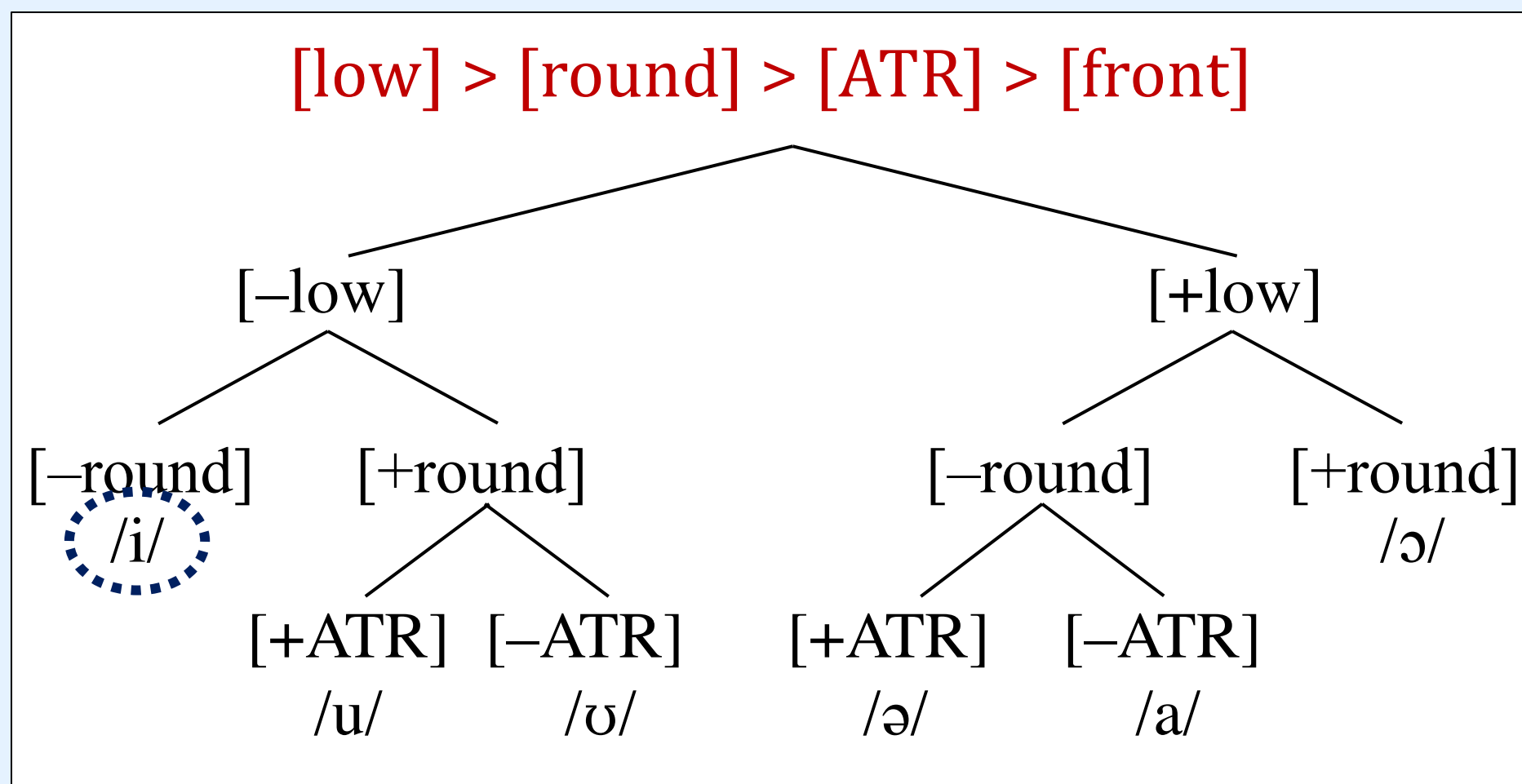


The ordering of the features makes it impossible for /u/ and /ʊ/ to be assigned contrastive [+round].

Could the features have been reordered to allow for this? Not easily:

Classical Manchu feature hierarchy again

If we were to move $[\pm\text{round}]$ up higher in the hierarchy, then $/u, \upsilon/$ are assigned $[\text{+round}]$; but now $/i/$ has no $[\text{+front}]$ feature that can trigger palatalization.

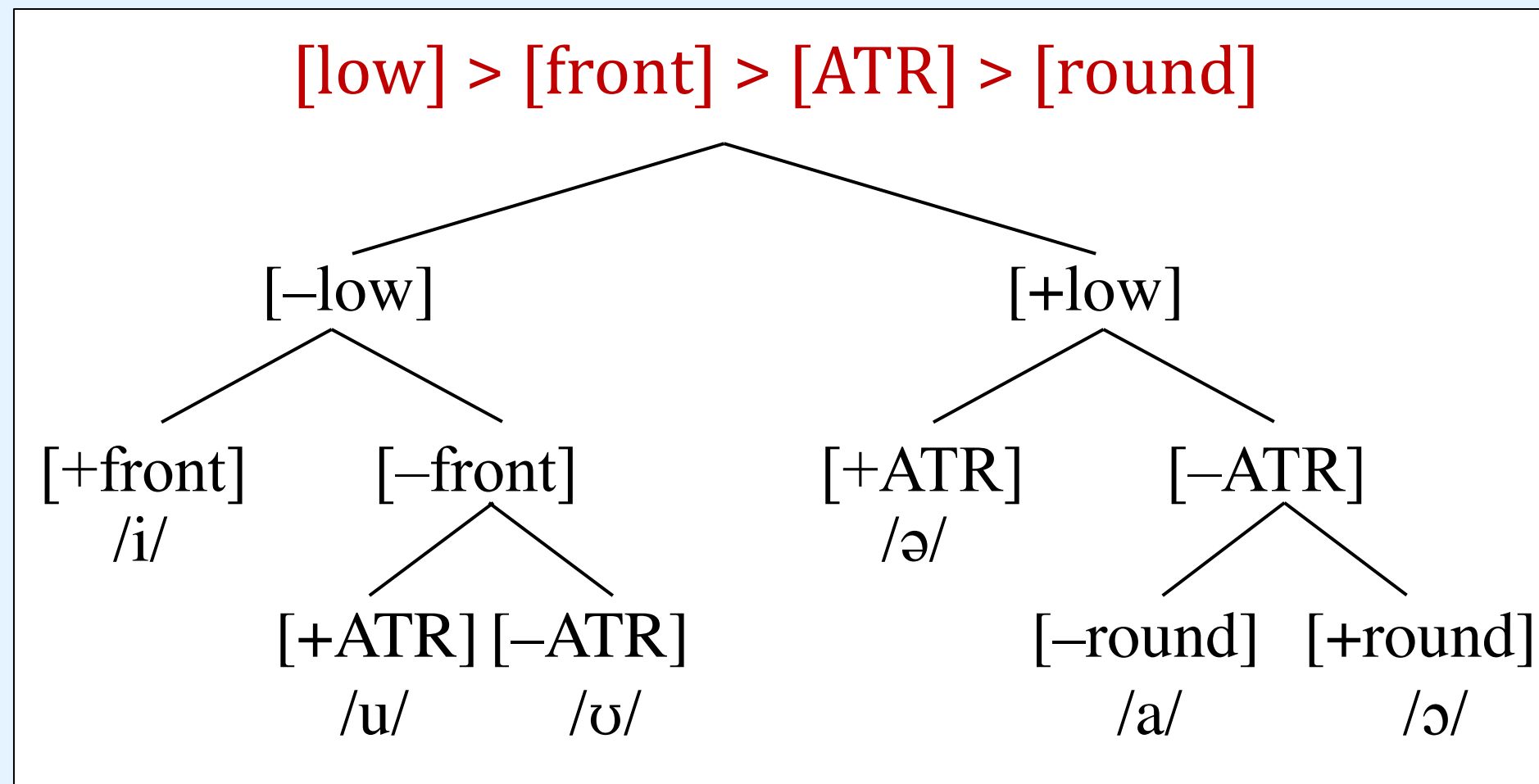


Oops, I Need That!

What if we put both $[\pm\text{front}]$ and $[\pm\text{round}]$ at the top?

Classical Manchu feature hierarchy again

Rather, the account we originally proposed, in which $[\pm\text{round}]$ is confined to the low vowel /ɔ/, appears to best account for all the data.



Contrast and phonological change

As Trubetzkoy (2001: 20 [1936]) remarked:

The correct classification of an opposition ‘**depends on one’s point of view**’; by which I understand that a system of contrasts can be analyzed in different ways.

But ‘**it is neither subjective nor arbitrary, for the point of view is implied by the system**’; that is, the patterns of phonological activity suggest what the correct analysis is.



As we will see, the status of the feature [\pm round] is an important issue also in the history of Old English, to which we now turn.



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6. From Proto-Germanic to Old English: The Short Vowels

This section is based on Dresher 2018

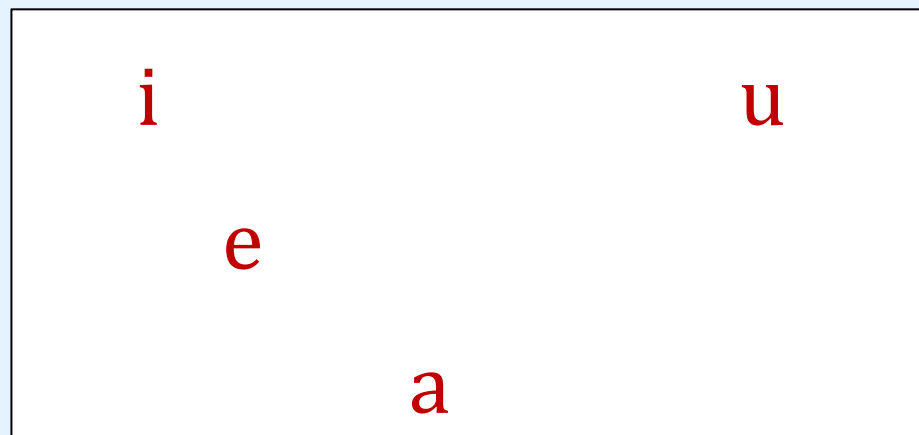
Proto-Germanic short vowels

Consider Proto-Germanic, which is commonly assumed to have had the four short vowels */i/, */e/, */a/, */u/ (Ringe 2006).

It also had long vowels, but these will not be relevant here (see Dresher 2018 for discussion of the long vowels).

Why Proto-Germanic? I pick it for two reasons:

Short vowels



First, because its later evolution into West Germanic and Old English raises some interesting diachronic issues that we will look at soon.

Proto-Germanic Contrastive Features

And second, because all the ingredients of a CHT analysis have already been assembled by Antonsen (1972)!

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



His utilization of a contrastive feature hierarchy is only implicit: he draws no trees and he does not discuss it at all. However, his article is a nice illustration of CHT argumentation *avant la lettre*.

I have found (Dresher 2018) that Antonsen is only one of several 20th century Germanic phonologists who made implicit use of contrastive feature hierarchies.

Proto-Germanic Contrastive Features

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

Notice that they show a pattern of underspecification that is characteristic of a branching tree: the first feature applies to all the phonemes, and the scopes of the remaining features get progressively smaller.

	<i>i</i>		<i>u</i>		<i>*/a/</i>	<i>*/u/</i>	<i>*/i/</i>	<i>*/e/</i>
Low					+	-	-	-
Rounded		<i>e</i>				+	-	-
High			<i>a</i>				+	-

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, ʊ], which all have in common that they are [+low].

	i	u	*/a/	*/u/	*/i/	*/e/	
			Low	+	–	–	–
	e		Rounded		+	–	–
		a [+low]	High		+	–	–

Proto-Germanic Contrastive Features

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

And 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).

i	u	*/a/	*/u/	*/i/	*/e/
e		Low	+	-	-
		Rounded		+	-
	a [+low]	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 shortly to this specific aspect of the analysis.

			*/a/	*/u/	*/i/	*/e/
i		u	Low	+	-	-
e		[+round]	Rounded	+	-	-
a		[+low]	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 supports distinguishing */i/ and */e/ by one feature, [high].

He notes that the negative specifications of */e/ are consistent with it being ‘the only vowel which does not cause umlaut assimilations in a preceding root syllable’.

i	[+high]	u	*/a/	*/u/	*/i/	*/e/
e		[+round]	Low	+	–	–
			Rounded	+	–	–
	a	[+low]	High		+	–

Proto-Germanic Contrastive Features

As elegant as this analysis is, I will follow the majority, including Lass (1994), Ringe (2006: 148), and Purnell & Raimy (2015), in assuming that the feature that distinguishes */i, e/ from */u/ is [front], not [rounded].

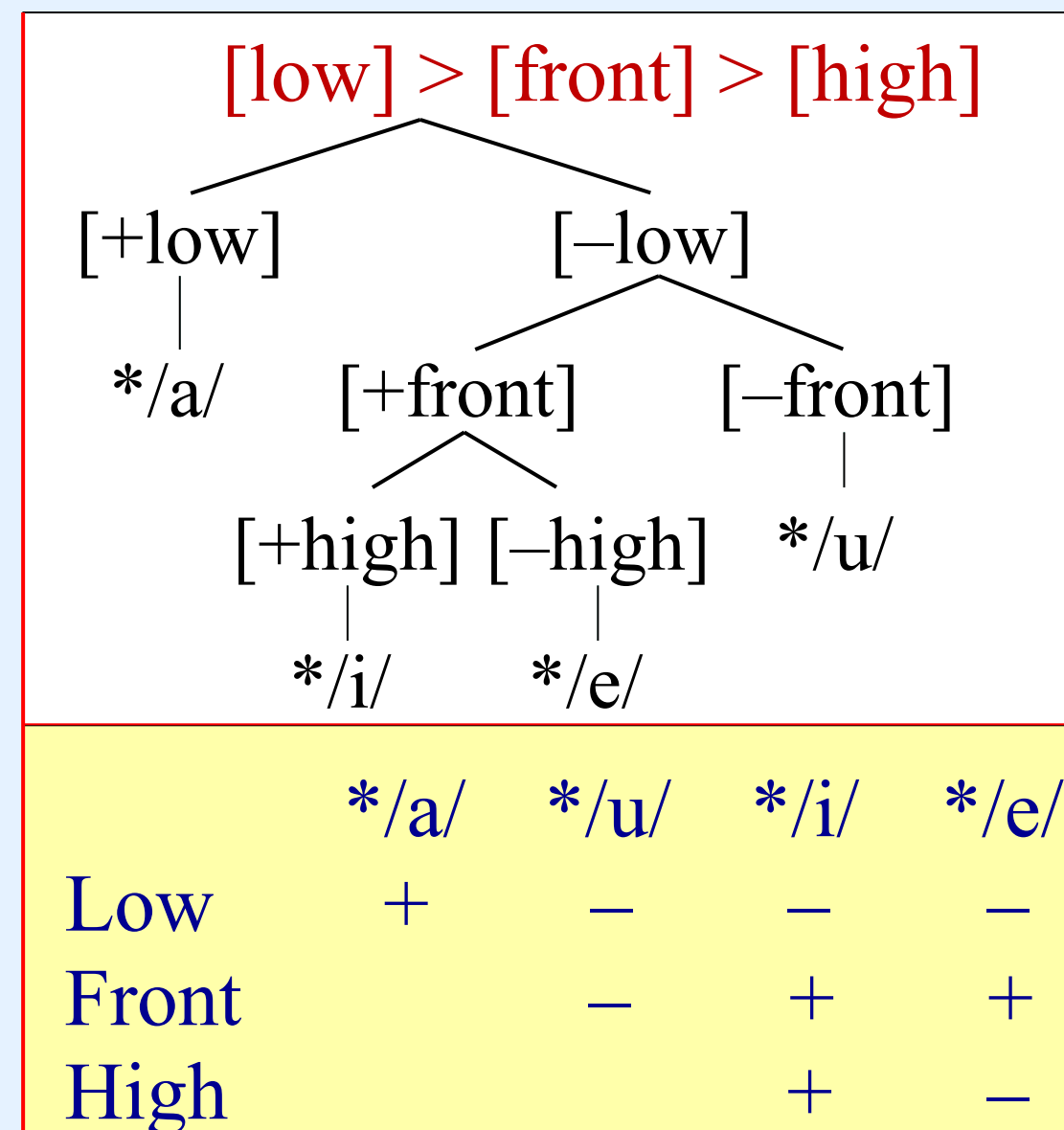
The reason is that */i/ could cause allophonic fronting of */u/, which suggests it had an active feature [+front].

<i>i</i> [+high] [+front]	<i>u</i>	<i>*/a/</i>	<i>*/u/</i>	<i>*/i/</i>	<i>*/e/</i>
<i>e</i>		Low	+	-	-
		Front	-	+	+
<i>a</i> [+low]		High		+	-

Proto-Germanic feature hierarchy

With this amendment, the contrastive feature hierarchy for the Proto-Germanic short vowels looks like this.

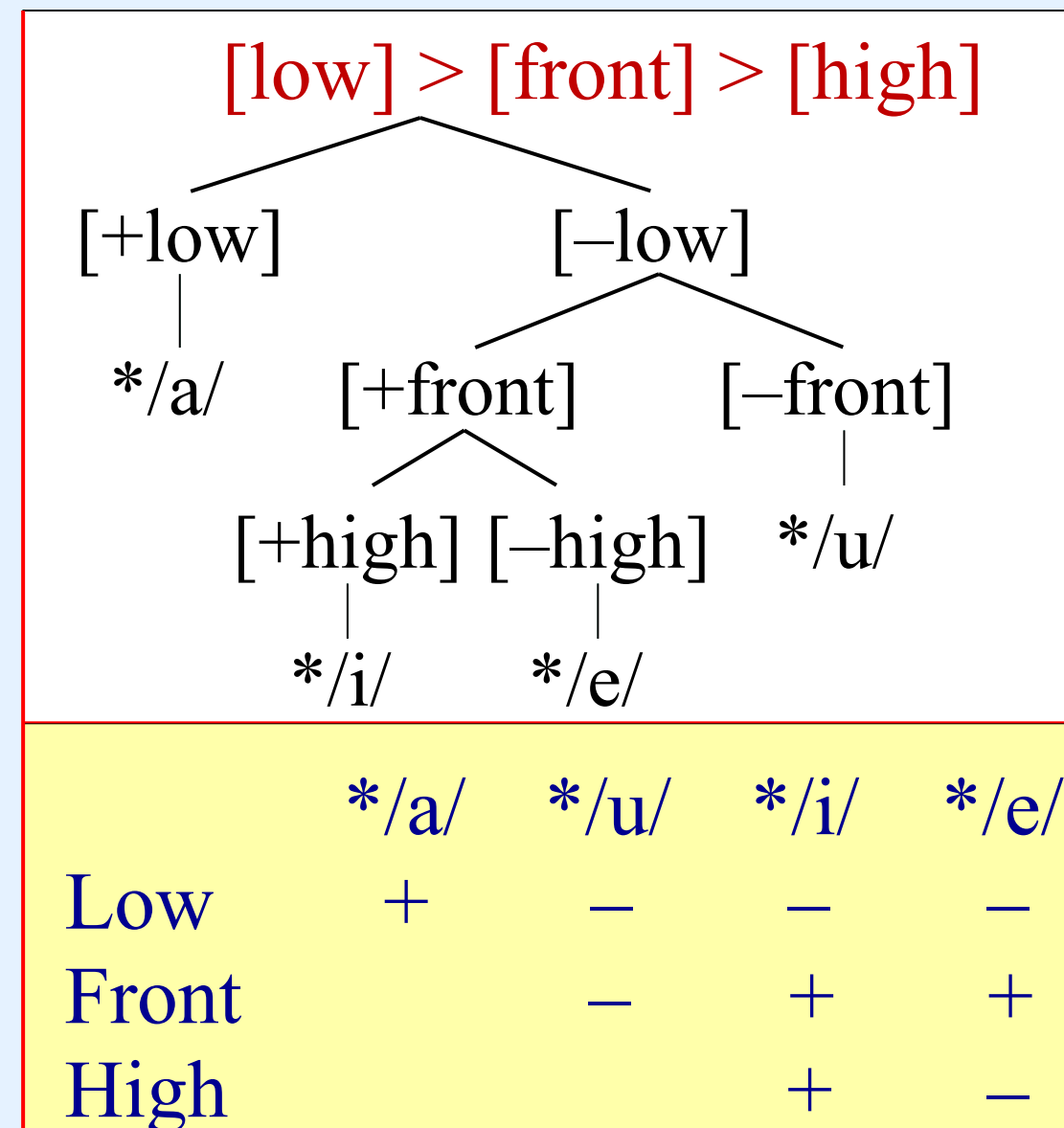
All the active features are contrastive, as per the Contrastivist Hypothesis.



Proto-Germanic feature hierarchy

Notice that the feature [round] plays no role in the contrastive phonology at this point.

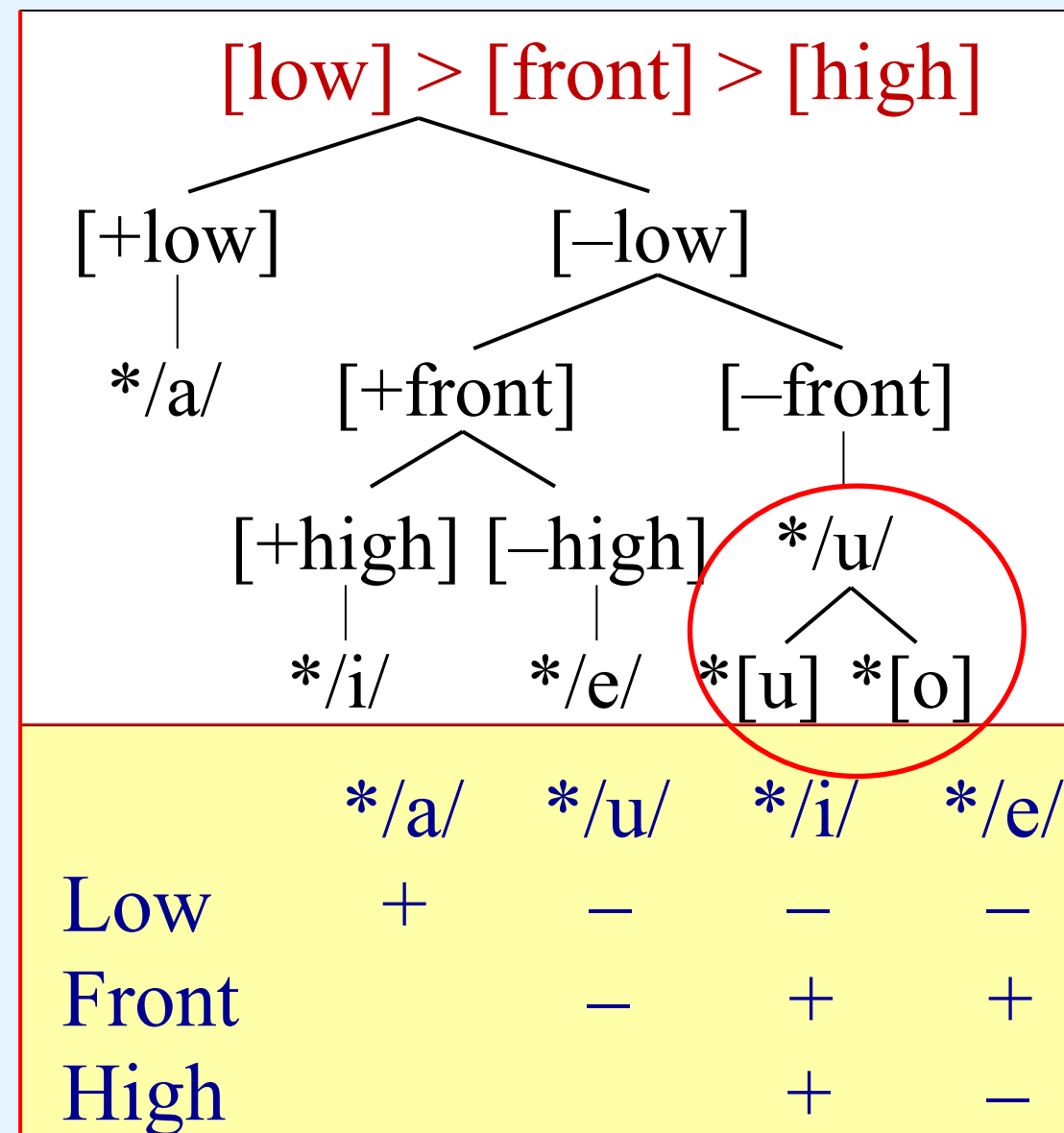
This aspect of the analysis will soon become very significant!



Proto-Germanic feature hierarchy

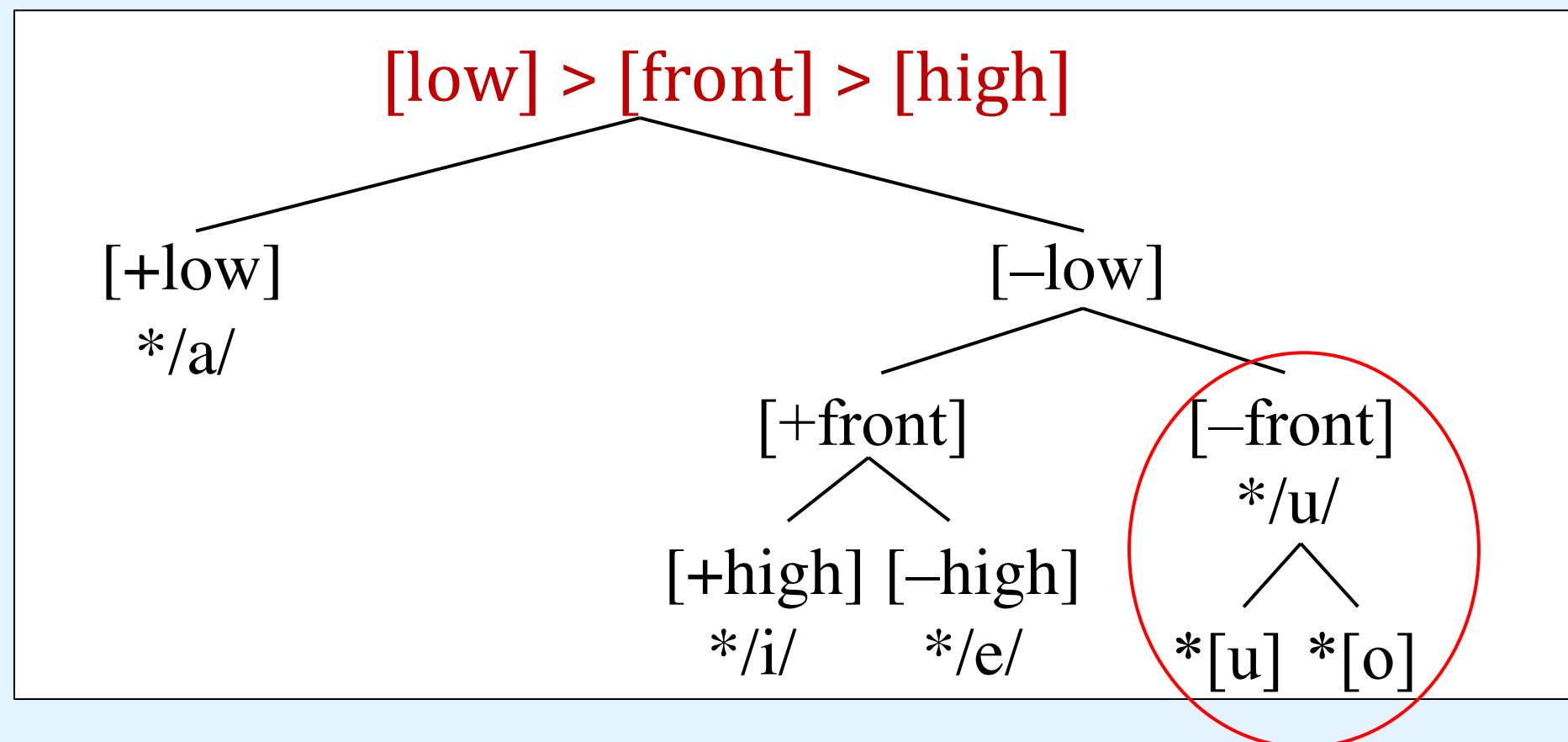
Recall that */i/ and */u/ had lowered allophones due to the influence of the [+low] */a/.

In West Germanic, the lowered allophone of */u/ developed into a new phoneme */o/.



West Germanic feature hierarchy

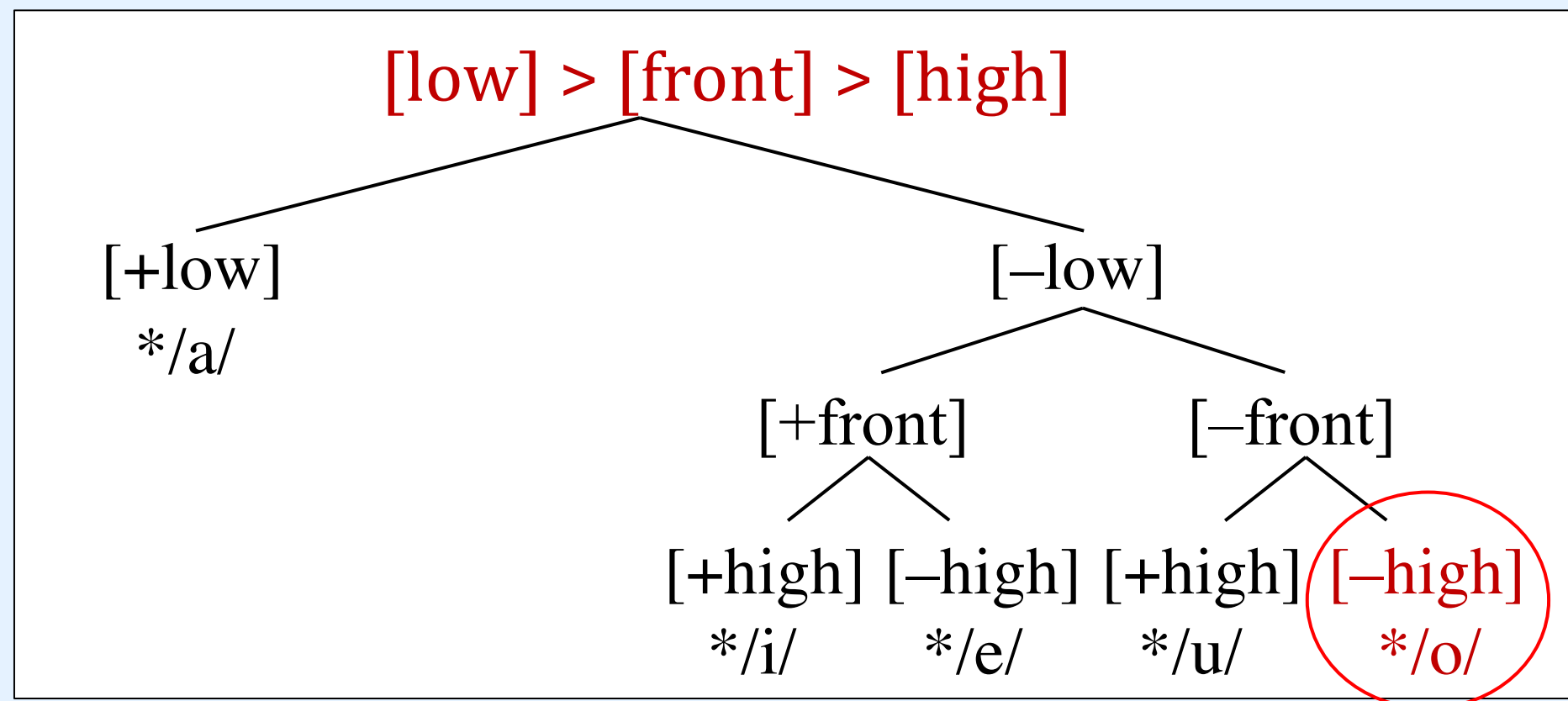
This new phoneme filled a gap in the system and brought the [-front] branch into symmetry with the [+front] branch.



West Germanic feature hierarchy

Therefore, the new vowel did not require a change to the inherited Proto-Germanic short vowel feature hierarchy.

Note that the feature [round] is **still not** contrastive at this point.



And note also that */a/ has the feature [+low], which it needs to have because this feature is what created the new phoneme */o/.

West Germanic *i*-umlaut

Contrastive Hierarchy Theory can shed new light on a long-standing conundrum in the history of West Germanic.

It concerns the rule of *i*-umlaut, and illustrates:

- how a post-lexical phonetic rule can become lexical;
- how an enhancement feature can become contrastive;
- and how a predictable allophone can arise in the contrastive phonology.

It also provides a nice empirical test of the ‘Oops, I Need That’ Problem.

West Germanic *i*-umlaut

The rule of *i*-umlaut began in early Germanic as a phonetic process that created fronted allophones of the back vowels when */i(:)/ or */j/ followed (V. Kiparsky 1932; Twaddell 1938; Benediktsson 1967; Antonsen 1972; Penzl 1972).

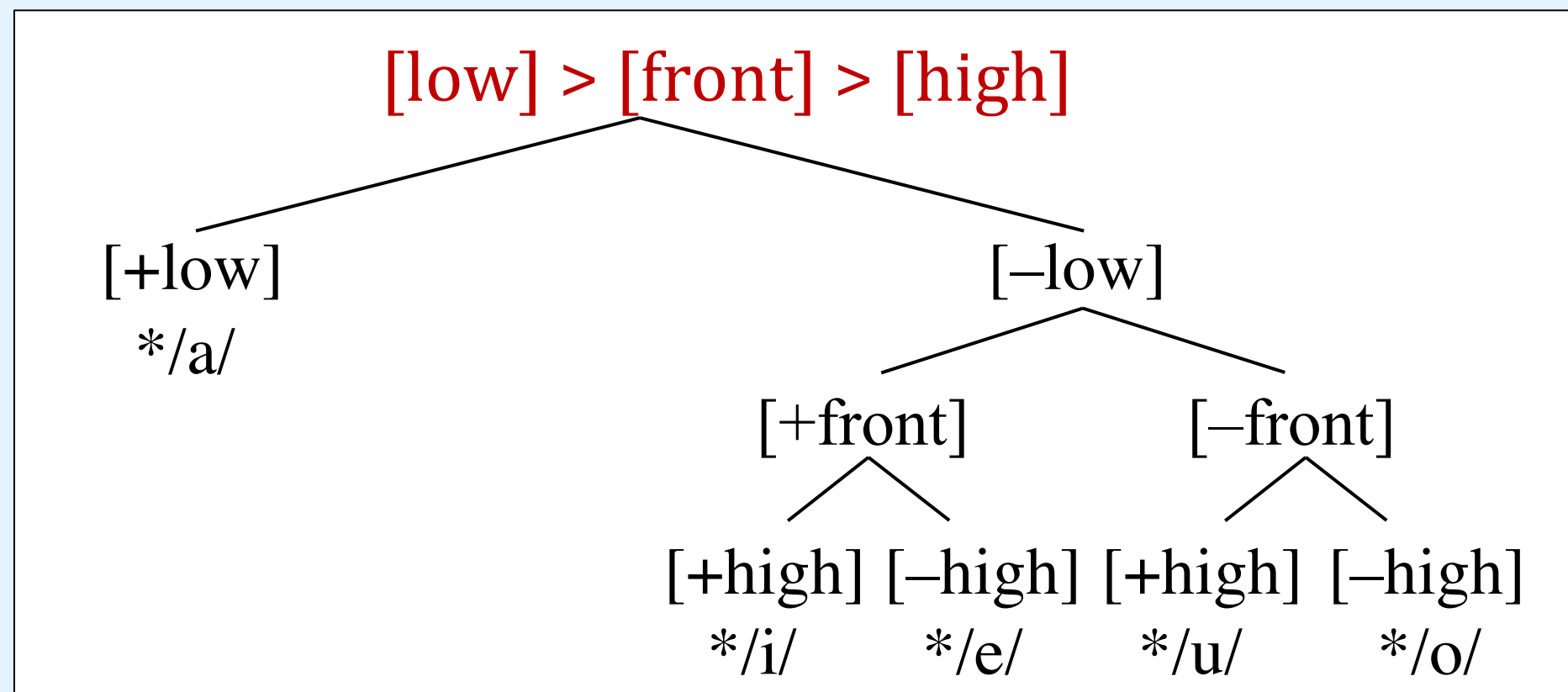
In the examples below, */u/ and */o:/ are both fronted (to *[y] and *[ø], respectively) before /i/ in the following syllable:

<i>Gloss</i>	'evil N.S.'	'foot N.P.'
West Germanic	*ubil	*fo:t+i
<i>i</i> -umlaut	*ybil	*fø:t+i

i-umlaut: Oops, I need that?

i-umlaut crucially preserves the rounded nature of the fronted vowels; but in our analysis of the West Germanic vowel system, [round] is not contrastive.

Uh-oh! Is this an 'Oops, I Need That' Problem?



i-umlaut: I don't need it, it's an enhancement feature!

No! For independent reasons, many commentators, beginning with V. Kiparsky (1932) and Twaddell (1938), proposed that *i*-umlaut began as a late **phonetic** rule, and was **not** part of the contrastive phonology.

Therefore, **{round}** is available as an enhancement feature at the point that */u, o/ are fronted.

*u	b	i	l	→	*y	b	i	l
[-low]		[-low]			[-low]		[-low]	
[-front]		[+front]			[+front]		[+front]	
[+high]		[+high]			[+high]		[+high]	
{+round}		{-round}			{+round}		{-round}	

Pre-Old English *i*-umlaut

Over time, however, there is evidence that *i*-umlaut became a lexical rule; that is, it became a part of the contrastive phonology.

<i>Gloss</i>	‘evil N.S.’	‘foot N.P.’
Pre-Old English	*ubil	*fo:t+i
<i>i</i> -umlaut	*ybil	*fø:t+i

i-umlaut becomes opaque

Already in early Old English, the unstressed /i/trigger of *i*-umlaut was either lowered after a light syllable, as in *yfel*,

or deleted after a heavy syllable, as in *fø:t*. These changes made *i*-umlaut **opaque** on the surface (i.e., its phonetic motivation is obscure on the surface).

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

<i>Gloss</i>	‘evil N.S.’	‘foot N.P.’
Pre-Old English	*ubil	*fo:t+i
<i>i</i> -umlaut	*ybil	*fø:t+i
<i>i</i> -lowering/deletion	yfel	fø:t

A similar weakening of the *i*-umlaut triggers occurred in Old High German.

i-umlaut becomes opaque

According to standard accounts, this eventually led to the **phonologization** of [y(:)] and [ø(:)] as new phonemes.

An example is 'evil', whose underlying form is restructured from /u ϕ il/ to /y ϕ el/.

	Older grammar	Newer grammar
<i>Gloss</i>	'evil N.S.'	'evil N.S.'
Underlying	/u ϕ il/	/y ϕ el/
<i>i</i> -umlaut	y ϕ il	—
<i>i</i> -lowering/deletion	y ϕ el	—
Surface	[y ϕ el]	[y ϕ el]

Phonologization paradox?

This account has led to considerable discussion (Lieberman 1991; Fertig 1996; Janda 2003; P. Kiparsky 2015); here I will focus on two questions:

- First, **why** do *i*-umlaut and the front rounded allophones /y, ø/ enter the contrastive phonology?

P. Kiparsky (2015) suggests that it is because the front rounded allophones were perceptually more **salient** than their triggers (cf. Jakobson, Fant, & Halle 1952 on Russian [i]), which were becoming progressively weaker as time went 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 contrastive phonology when they involve non-contrastive features that originate in enhancement?

As we have seen, this type of change can come about when the linguistic data that form the input to a new generation of learners is critically different from that to which the previous generation was exposed.

In that case, the new learners are liable to see the contrastive structure of the phonological system in a new way.

Saliency and contrast shift

Let us revisit the stage when *i*-umlaut was still a post-enhancement rule.

Adapting Kiparsky's idea, I propose that the perceptual saliency of the front rounded allophones caused learners to hypothesize that **{round}** is a contrastive feature.

*u	b	i	l	→	*y	b	i	l
[-low]		[-low]			[-low]		[-low]	
[-front]		[+front]			[+front]		[+front]	
[+high]		[+high]			[+high]		[+high]	
{+round}		{-round}			{+round}		{-round}	

Contrast shift in West Germanic

It was not part of the earlier West Germanic feature hierarchy.

But another contrastive hierarchy that includes [round] can be constructed.

One such hierarchy is shown below.

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

Later hierarchy: [front] > [round] > [high]

Contrast shift in West Germanic

This new hierarchy, however, requires demoting [low] to make room for [round].

This is how contrastive hierarchies work: one can introduce or promote a feature, but there is a trade-off: another feature has to be demoted.

Hopefully not a feature that we need!

Earlier hierarchy:

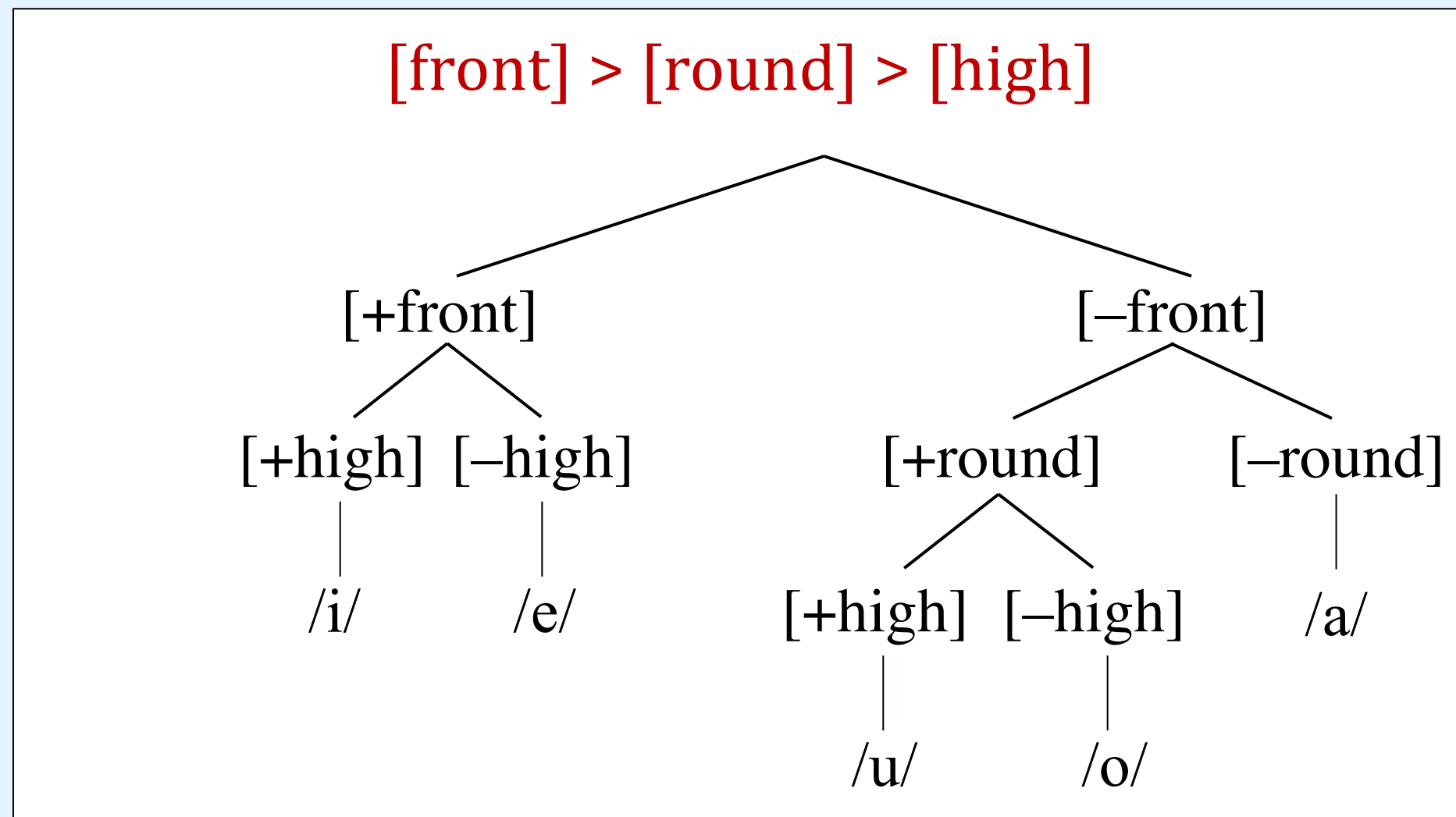
[low] > [front] > [high]

Later hierarchy:

[front] > [round] > [high]

West Germanic feature hierarchy 2

In the new feature hierarchy, the vowels are first divided into [+front] /i, e/ and [-front] /u, o, a/.

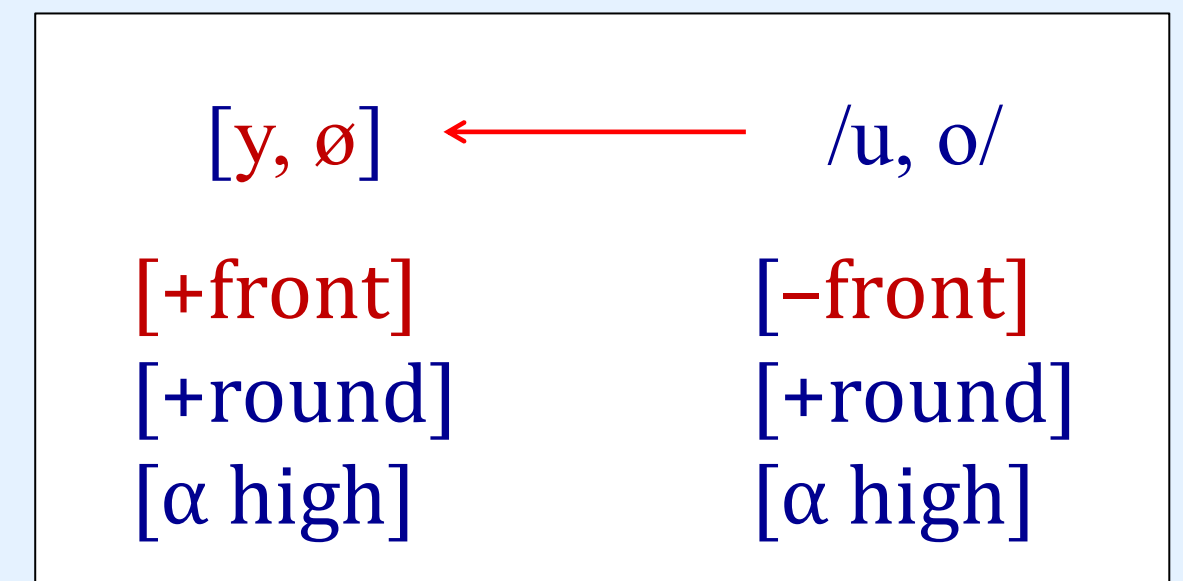


Then [\pm round] divides /u, o/ from /a/.

Finally, [\pm high] completes the contrastive features.

West Germanic feature hierarchy 2

Now, when *i*-umlaut changes the **[-front, +round]** vowels /u, o/ to **[+front]**, the result is new front rounded vowels, which begin as allophones.



Deep allophones

They are thus what Moulton (2003) calls ‘deep allophones’; he was referring to the Old English voiced fricatives, which also arise early in the contrastive (lexical) phonology as allophones of the voiceless fricatives.

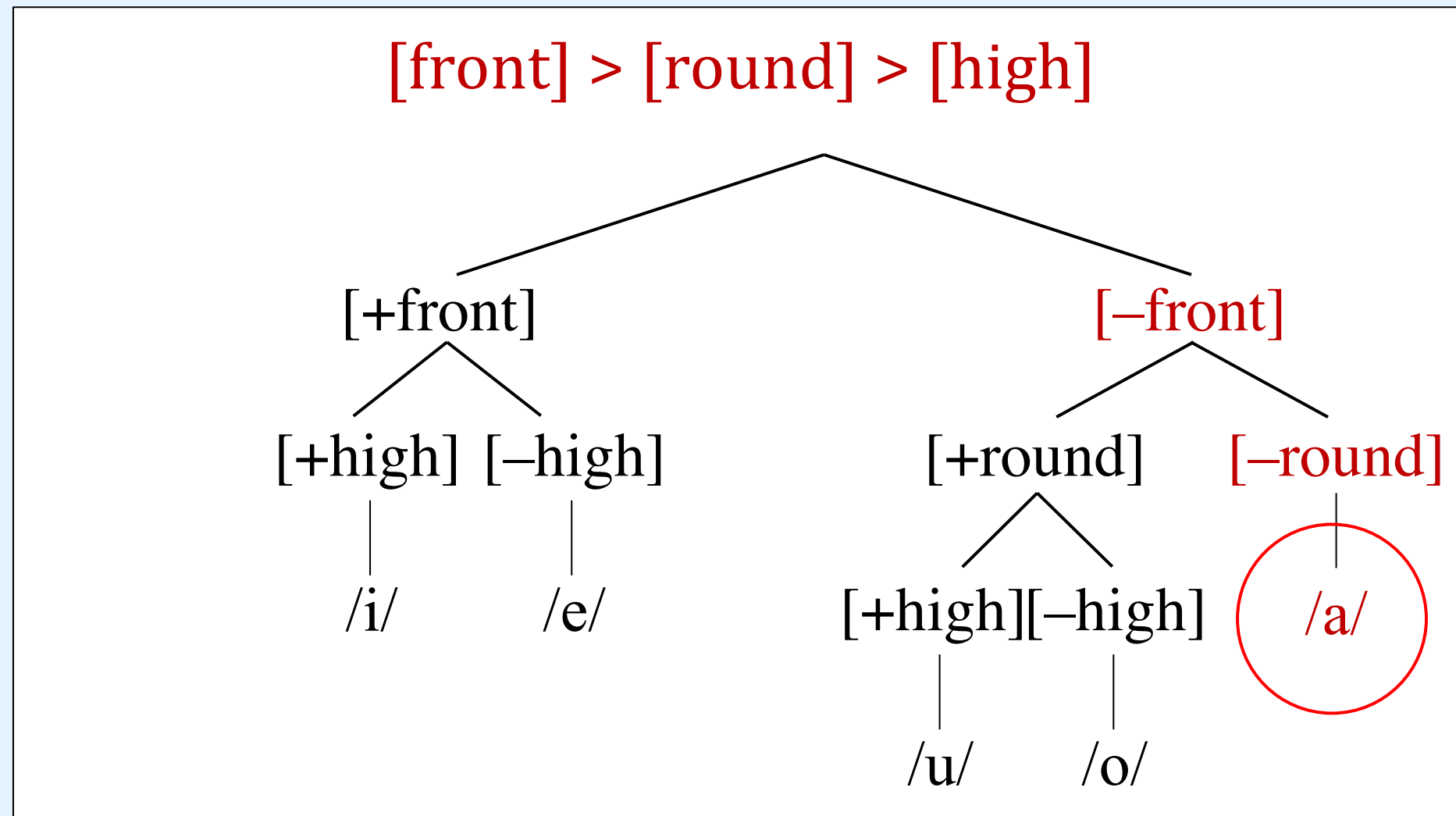
Deep allophones are possible because contrastive features can be predictable in a hierarchical approach.

As discussed by Kiparsky (2015), these deep, or ‘lexical’ allophones are what Korhonen (1969) has called ‘quasi-phonemes’.

One question has been left hanging...

West Germanic feature hierarchy 2: Oops, I need that?

Recall the trade-off that this analysis requires:



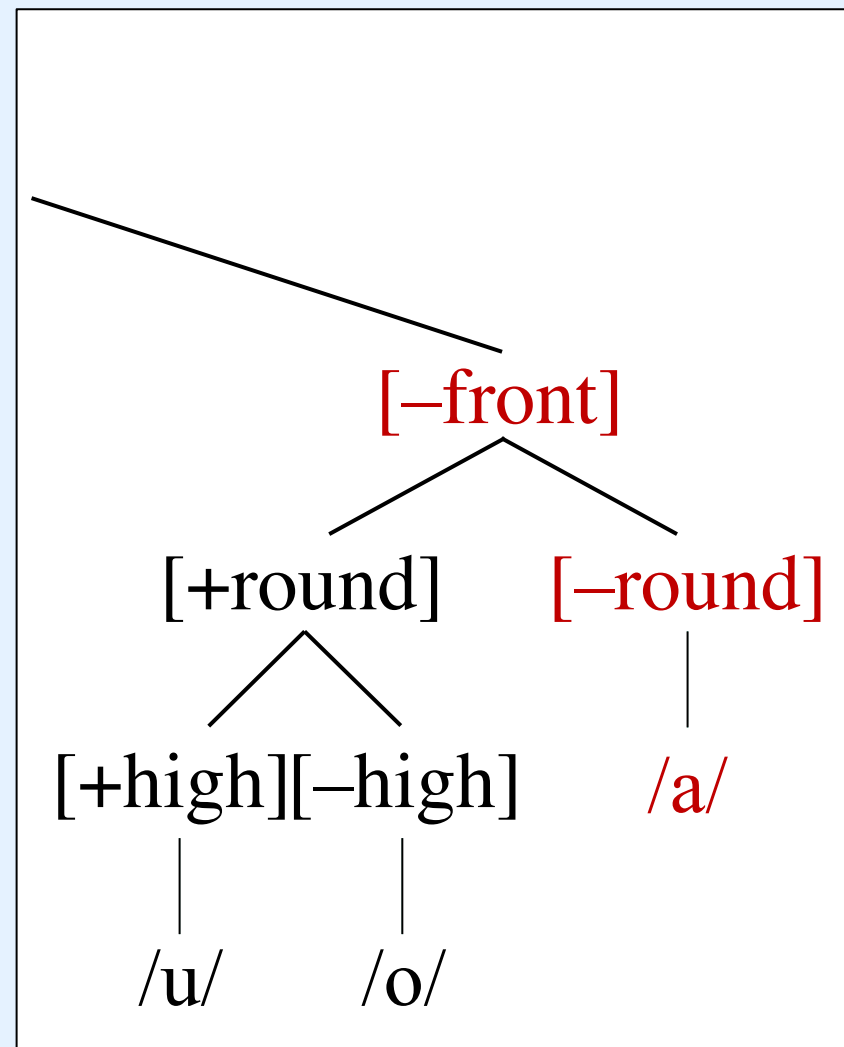
In the new hierarchy, /a/ no longer has a [+low] feature.

Recall that this feature was very important at an earlier period.

Uh oh! Do we now have a 'Oops, I Need That' Problem?

West Germanic feature hierarchy 2: No, I don't need it!

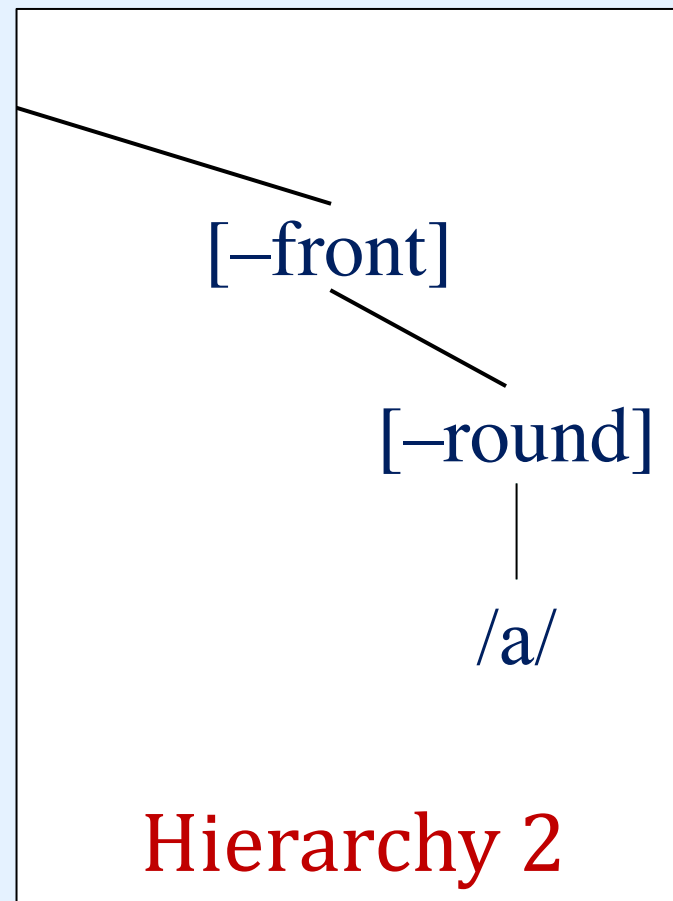
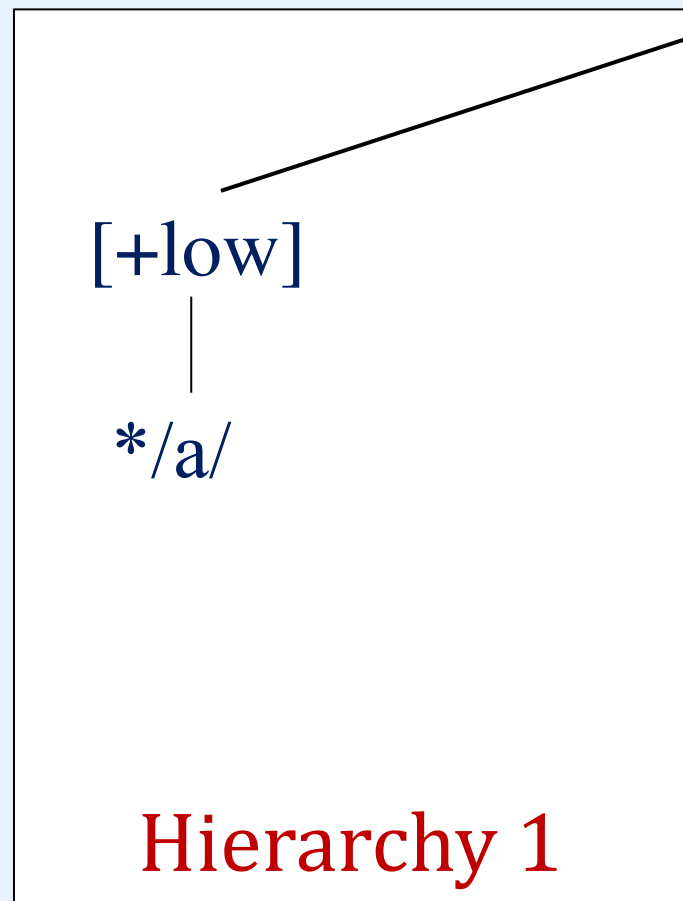
No! /a/ no longer needs a [+low] feature!



I know of no evidence— in Old English, for example— that /a/ causes lowering of other segments, or otherwise needs an active [+low] feature.

West Germanic feature hierarchy 2: No, I don't need it!

Recall that this is in striking contrast to earlier stages of the language, where there is evidence that */a/ caused lowering.



This connection between contrast and activity is exactly what Contrastive Hierarchy Theory predicts.

When an active feature is demoted so that it is no longer contrastive, it may not remain active.



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7. Conclusion

Conclusion

I have shown some examples of how Contrastive Hierarchy Theory can contribute to diachronic phonology.

Contrastive hierarchies have been fruitfully applied to phonological change in a variety of languages; some of these studies are listed below:

Some diachronic studies using contrastive feature hierarchies:

Zhang (1996) and Dresher & Zhang (2005) on Manchu; Barrie (2003) on Cantonese; Rohany Rahbar (2008) on Persian; Dresher (2009: 215–225) on East Slavic; Ko (2010, 2011, 2018) on Korean, Mongolic, and Tungusic; Compton & Dresher (2011) on Inuit; Roeder & Gardner (2013), Purnell & Raimy (2013), and Gardner & Roeder (2022) on North American English vowel shifts; Harvey (2012) on Ob-Ugric (Khanty and Mansi); Oxford (2012, 2015) on Algonquian; Voeltzel (2016), Schalin (2017), and Sandstedt (2018) on Scandinavian; Krekoski (2017) on Chinese tonal systems.

Conclusion

There is reason to suppose that a similar contrastive hierarchy approach can be fruitful also with respect to morphosyntactic features, as has been argued in several publications by Cowper & Hall (2013, 2014a, b, 2017, 2019).

Finally, contrary to the tendency in some earlier theories—and again in some contemporary ones—to see sound change as totally separate from the synchronic grammar, in the cases I have discussed there is a connection between synchronic contrastive structure and the type of changes that it is liable to undergo.

Conclusion

I will conclude by recalling the last line of Jakobson's (1972 [1931]) article with which I started:

He writes that we must not fall for **'the superficial and harmful illusion of an abyss between the problems of synchrony and diachrony'**.



Jakobson, Roman. 1972 [1931]. Principles of historical phonology. In Allan R. Keiler (ed.), *A reader in historical and comparative linguistics*, 121–38. New York: Holt, Rinehart & Winston. [English translation of Prinzipien der historischen Phonologie, *Travaux du cercle linguistique de Prague* 4: 247–67, 1931. Copenhagen: Nordisk Sprog- og Kultur Forlag.]

THANK YOU!



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