

# The role of the Contrastive Hierarchy in positional neutralization

## 1 Introduction

In this talk I propose that one of the key roles that the Contrastive Hierarchy (Dresher 2009) plays in phonology is in determining patterns of neutralization.

I will argue for a model in which non-terminal nodes of the contrastive tree are available in phonological representations as segments in neutralized positions. Essentially, the tree *is* the inventory.

This has several advantages:

- Conceptually, it does not imply a contrast in neutralized positions by giving them contrastive values for neutralized features.
- The phonetic realization of non-terminal nodes follows from their contrastive specifications when interpreted according to model of dispersion outlined by Hall (2011).
- Non-alternating neutralized segments which never surface in a contrastive environment can be represented as “underlyingly neutralized”, without needing additional members of the inventory.

In this model, all nodes of the contrastive hierarchy are available as “phonemes”.

- (1) a. Phonetic similarity alone is not grounds for phonemic identity
  - A terminal and non-terminal node may sound the same or similar to each other
- b. Segments that sound different are not necessarily different from each other phonologically
  - Allophony as we know it still exists
  - Both terminal nodes and non-terminal nodes can show it

I define positional neutralization as the systematic and categorical inability to realize a particular contrast in some phonologically definable environment.

## 2 Vowel reduction

My analysis applies to phonological vowel reduction, not mere phonetic vowel reduction (centralization).

It will be seen, however, that the latter does to some extent follow from the former.

## 2.1 Bulgarian

Stressed syllables in Bulgarian show a six-way vowel contrast:

- (2) Bulgarian stressed vowel inventory (based on e.g. Scatton 1984)

|      | front     | central | back  |
|------|-----------|---------|-------|
|      | non-round |         | round |
| high | i         |         | u     |
| mid  | e         | â       | o     |
| low  |           | a       |       |

In unstressed positions, these neutralize in three pairs, according to a “rigid hierarchy” (Scatton 1984:57):

- (3) Implicational hierarchy of Bulgarian vowel pair neutralizations

$/i/-/e/ > /u/-/o/ > /â/-/a/$   
 (eastern dialects) (informal registers) (all dialects/registers)

This means that depending on dialect and register, Bulgarian can show one of three unstressed inventories:

- (4) Possible unstressed inventories in Bulgarian

|   |   |   |
|---|---|---|
| a.  | b.  | c.  |
| <div style="border: 1px solid black; padding: 10px; display: inline-block;">           i      u<br/>           e      o<br/>                 ə         </div> | <div style="border: 1px solid black; padding: 10px; display: inline-block;">           i      u<br/>           e      o<br/>                 ə         </div> | <div style="border: 1px solid black; padding: 10px; display: inline-block;">           I      ū<br/>                 ə         </div> |

One possible analysis (taken by Scatton) is to say that when a pair neutralizes, its members are changed by rule to the featural representation of the one whose phonetic realization is closest to the neutralized segment:

- (5)
- | Stressed |   | Unstressed |
|----------|---|------------|
| /â/, /a/ | → | /a/        |
| /o/, /u/ | → | /u/        |
| /e/, /i/ | → | /i/        |

But such representations don’t capture the fact that neutralization has taken place. Using members of a fully contrastive inventory implies they are still in contrast.

Rather than assuming that the smaller numbers of contrasts in neutralized positions are literal subsets of the full inventory, or “subinventories”, I argue for the archiphonemic representation of neutralized segments.

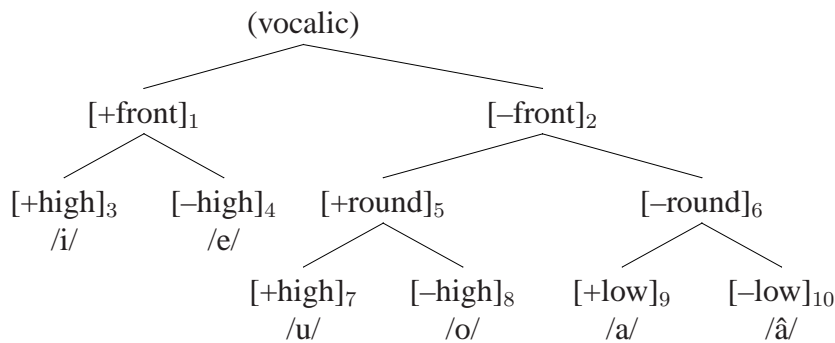
Since they follow from a hierarchically structured inventory, this is in the spirit of Trubetzkoy (1969:228), who said of neutralizations that:

“They are just as characteristic of the phonemic system of the individual languages and dialects as are the differences in the phonemic inventory.”

I propose that this can be formalized in a principled manner by building on contrastive hierarchies (Dresher 2009) such that the non-terminal nodes above neutralized contrasts are interpretable as (archi)phonemes of neutralized positions.

Consider the hierarchy in (6):

(6) Contrastive hierarchy for Bulgarian



Rather than allowing only one of nodes 9 /a/ and 10 /â/ in unstressed position, both are changed instead to the corresponding non-terminal node 6.

Similarly, nodes 7 and 8 are both changed to 5, and nodes 3 and 4 are changed to node 1:

(7)

| Stressed |   | Unstressed |
|----------|---|------------|
| 9, 10    | → | 6          |
| 7, 8     | → | 5          |
| 3, 4     | → | 1          |

This is preferable conceptually because it does not represent a contrastive feature, and thus imply a contrast, in positions where a given contrast is neutralized.

The centralization observed in unstressed positions (phonetic vowel reduction) is also predicted when Hall’s (2011) model of contrastive feature-driven dispersion is applied.

They are free to move within their specified phonetic space because there are no competing phonemes with contrastive height specifications:

(8) Feature specifications of all Bulgarian vowel phoneme nodes

| Phoneme | Node | Feature Specifications  | Phonetic Realization |
|---------|------|-------------------------|----------------------|
| /a/     | 9    | [−front, −round, +low]  | [a]                  |
| /â/     | 10   | [−front, −round, −low]  | [ʌ]                  |
| /a/−/â/ | 6    | [−front, −round]        | [ə]                  |
| /u/     | 7    | [−front, +round, +high] | [u]                  |
| /o/     | 8    | [−front, +round, −high] | [o]                  |
| /u/−/o/ | 5    | [−front, +round]        | [ʊ]                  |
| /i/     | 3    | [+front, +high]         | [i]                  |
| /e/     | 4    | [+front, −high]         | [e]                  |
| /i/−/e/ | 1    | [+front]                | [ɪ]                  |

## 2.2 Russian

Stressed syllables in Russian contrast five different vowels:

(9) Russian stressed vowel inventory

|   |   |
|---|---|
| i | u |
| e | o |
| a |   |

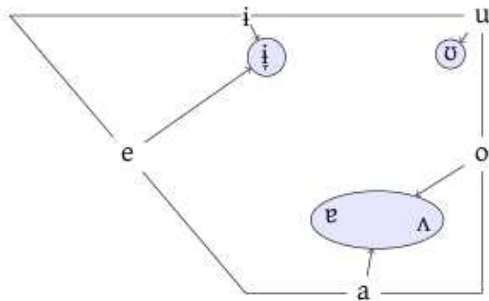
Traditional analyses of Russian vowel reduction distinguish two degrees of neutralization: “moderate” and “radical”.

Moderate environments include (Iosad 2012:524):

- (10)
- The syllable immediately preceding the stressed one (the “first pretonic”);
  - Onsetless syllables, regardless of stress (though this is somewhat contested);
  - Gradient effects in phrase-final unstressed open syllables;
  - Some claim both vowels in a hiatus will undergo moderate reduction.

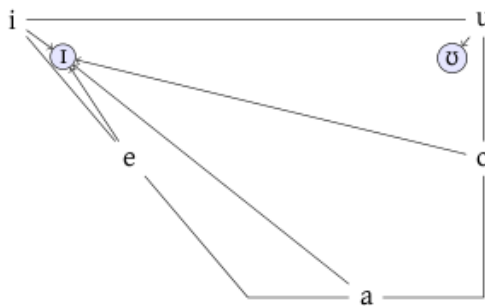
Moderate reduction neutralizes the five-vowel system to a three-vowel system following non-palatalized consonants:

(11) Moderate reduction in a non-palatal context (Iosad 2012:526)



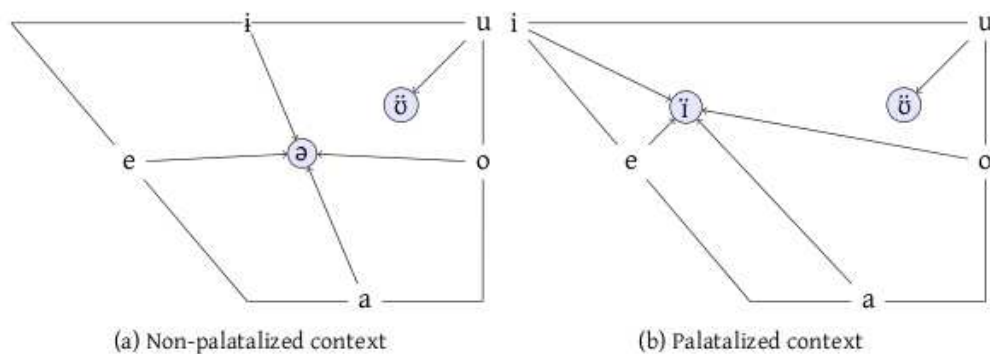
This is reduced to a two-vowel system in palatalized environments:

(12) Moderate reduction in a palatal context (Iosad 2012:527)



In all radical reduction contexts, only two vowels are contrasted:

(13) Radical reduction (Iosad 2012:529)



The crucial distinction between moderate and radical reduction is the realization of the neutralized /a/–/o/. In moderate reduction, it is a lower [ə, ʌ], while in radical reduction it is the higher [ə].

Crosswhite (2001) analyzes the two degrees quite literally:

- Moderate reduction is caused by a desire for **peripheral vowels** in less prominent positions (contrast-enhancing reduction)
- Radical reduction is caused by a desire for **less sonorous vowels** in less prominent positions (prominence-reducing reduction)

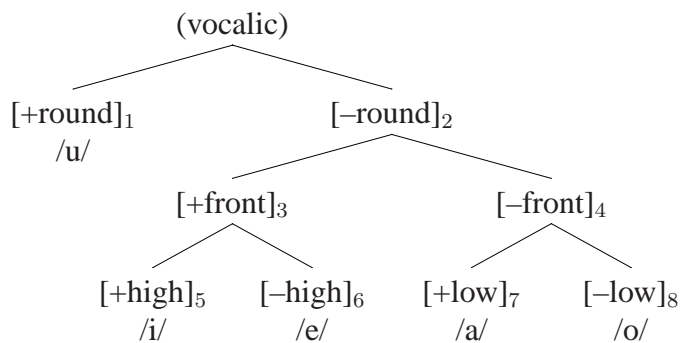
However, this presupposes that [ɐ] and [ə] form clear categories in these contexts.

Barnes (2006) shows that they do not. The height of the vowel is a gradient function of its duration: longer duration yields a lower vowel.

At faster speech rates, moderate contexts with shorter durations can be higher, while at slower speech rates, longer non-moderate contexts can be lower.

Moderate contexts just tend to receive longer duration for independent prosodic reasons (i.e., foot structure).

(14) Contrastive hierarchy for Russian



/u/ is kept separate, with its only contrastive feature being [+round]. This is because it never neutralizes with any other vowel.

In non-palatal moderate positions, 5 /i/ and 6 /e/ become node 3, and nodes 7 /a/ and 8 /o/ become node 4.

Because non-terminal nodes are considered phonemes in this model, they can receive their own allophonic rules. Thus node 4 has predictable allophonic height variation along a continuum depending on its phonetic duration:

(15) Russian feature specifications in a moderate non-palatal reduction context

| Phoneme | Node | Feature Specifications | Phonetic Realization |
|---------|------|------------------------|----------------------|
| /u/     | 1    | [+round]               | [ʊ]                  |
| /i/–/e/ | 3    | [−round, +front]       | [i̟]                 |
| /a/–/o/ | 4    | [−round, −front]       | [ɐ, ʌ]               |

In other contexts (moderate palatal and all radical contexts), all of nodes 5, 6, 7, and 8 are represented as node 2, reflecting a four-way neutralization.

Again, because non-terminal nodes are phonemes in this model, node 2 is entitled to predictable allophony, depending on its duration and proximity to palatalized consonants:

(16) Russian feature specifications in a moderate palatal or radical reduction context

| Phoneme         | Node | Feature Specifications | Phonetic Realization |
|-----------------|------|------------------------|----------------------|
| /u/             | 1    | [+round]               | [ʊ]~[ö]              |
| /i/-/e/-/a/-/o/ | 2    | [-round]               | [ɪ]~[ə]~[ĩ]          |

Another interesting result of applying my model to the Russian data is that the feature representations we arrive at are very similar Iosad's (2012) within the Parallel Structures Model. This includes the lack of rounding on /o/.

(17) Russian feature specifications in my analysis

| Vowel | [±low] | [±high] | [±round] | [±front] |
|-------|--------|---------|----------|----------|
| /a/   | +      |         | (-)      | (-)      |
| /o/   | (-)    |         | (-)      | (-)      |
| /e/   |        | (-)     | (-)      | +        |
| /i/   |        | +       | (-)      | +        |
| /u/   |        |         | +        |          |

(18) Russian privative feature specifications in the PSM (Iosad 2012:538)

| Vowel | V-manner |          | V-place  |           |
|-------|----------|----------|----------|-----------|
|       | [open]   | [closed] | [labial] | [coronal] |
| /a/   | ✓        |          |          |           |
| /o/   |          | ✓        |          |           |
| /e/   |          | ✓        |          | ✓         |
| /i/   |          |          |          | ✓         |
| /u/   |          |          | ✓        |           |

Why the lack of rounding on /o/?

According to Iosad (2012:537–538), /u/ and /o/ in no way pattern together, and /o/ does not behave as phonologically round.

One possibility: Phonetic implementation in Russian requires enhancement of all stressed vowels with at least some degree of one positive-valued feature. If this doesn't happen, then stressed /o/ is the only vowel with no positive values at all.

But in *all* positions except stressed, even pretonic, which has a longer duration than stressed, /o/ is realized with no phonetic rounding at all.

### 3 “Underlying neutralization”

A vowel in Russian which never surfaces as stressed in any forms and is always heard as [ə] may be the derived reduced form of any of /a, o, i, e/.

In a model without archiphonemes, one would need to either assume a phoneme /ə/ just for such cases, or arbitrarily specify one of four possible vowels in such positions underlyingly.

With underlying non-terminal nodes, however, learners of Russian have an (archi)phoneme whose default phonetic realization is precisely [ə], which they can use underlyingly in such positions when there is no evidence to which terminal node is present.

The non-terminal node model gives us extra underlying phonemes “for free”, because they follow systematically from contrastive structure of the inventory.

### 4 Conclusions

- By giving non-terminal nodes of the contrastive hierarchy status as phonemes, both the phonology and phonetics of positional neutralization can be more effectively captured.
- The inventory itself is assumed to have contrastive structure, from which layers are removed for neutralized segments.
- Neutralization resides in the representations allowed by the inventory, not in rules or constraints to derive them.

### References

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