Trade-offs in the contrastive hierarchy: Voicing *versus* continuancy in Slavic

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Outline

- Our approach to phonological representations: The Successive Division Algorithm (SDA)
- Contrast and phonological activity: What does the SDA actually predict?
- Applying the SDA to Russian
  - Revising Halle’s hierarchy
  - Consequences of the change
- Evidence elsewhere in Slavic
Our approach to phonological representations

Two components of a theory of phonemic contrast:

Dresher (2009, 2015); Hall (2007, forthcoming)
Our approach to phonological representations

Two components of a theory of phonemic contrast:

1. The Contrastivist Hypothesis: Only contrastive features are phonologically active.

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Our approach to phonological representations

Two components of a theory of phonemic contrast:

1. The Contrastivist Hypothesis: Only contrastive features are phonologically active.
2. The Successive Division Algorithm: Contrastive features are assigned by recursively dividing the underlying inventory.

Drescher (2009, 2015); Hall (2007, forthcoming)
The Successive Division Algorithm

a. Begin with no feature specifications: assume all sounds are allophones of a single undifferentiated phoneme.
b. If the set is found to consist of more than one contrasting member, select a feature and divide the set into as many subsets as the feature allows for.
c. Repeat step (b) in each subset: keep dividing up the inventory into sets, applying successive features in turn, until every set has only one member.
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\[
V \quad \begin{array}{c}
\text{[+high]} \\
\text{i} \\
\text{[−high]} \\
\text{a}
\end{array}
\]
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Specifications depend on hierarchical order

Two possible ways of dividing the vowel inventory /i u a/ with [±high] and [±back]
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Two possible ways of dividing the vowel inventory /i u a/ with [±high] and [±back]:

high ▶ back

back ▶ high
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Two possible ways of dividing the vowel inventory /i u a/ with [±high] and [±back]:

- high >> back
  - V

- back >> high
  - V
Specifications depend on hierarchical order

Two possible ways of dividing the vowel inventory /i u a/ with [+±high] and [+±back]:

- high >> back

```
V
 /  
 [+high]  [-high]
     a
```

- back >> high

```
V
 /  
 [-back]  [+back]
     i
```

∅
Specifications depend on hierarchical order

Two possible ways of dividing the vowel inventory /i u a/ with \([\pm \text{high}]\) and \([\pm \text{back}]\):

- high \(\gg\) back

\[
\begin{array}{c}
V \\
\quad [+\text{high}] \\
\quad \quad [-\text{back}] \\
\quad \quad \quad i \\
\quad \quad [+\text{back}] \\
\quad \quad \quad u
\end{array}
\]

- back \(\gg\) high

\[
\begin{array}{c}
V \\
\quad [-\text{high}] \\
\quad \quad [+\text{back}] \\
\quad \quad \quad u \\
\quad \quad [-\text{high}] \\
\quad \quad \quad \quad a
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  \item [+] back
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\end{itemize}
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see also Blaho (2008), de Lacy (2010)
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The SDA and the Contrastivist Hypothesis make testable predictions.
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Given just a phonological inventory...
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- We can’t predict exactly what the feature specifications are. The SDA is not deterministic.
- We can make predictions about how many features can be specified/active.
- We can make predictions about trade-offs between potentially contrastive features.
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Back to our three-vowel example:
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We can't use more than two features to specify three vowels. We can have \([+\text{high}]\) on /i/, or \([-\text{high}]\) on /a/, but not both. Our predictions are not \([F]\) will be active and \([G]\) will not, but rather if \([F]\) is active then \([G]\) cannot be.
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The contrastive hierarchy in Russian

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\[ \text{Halle (1959: 34)} \]

“The hierarchy of features seems to provide an explanation for the intuition that not all features are equally central to a given phonological system.”
The contrastive hierarchy in Russian

- Russian offers an exemplary case of a trade-off in the contrastive hierarchy.
- Our starting point is Halle (1959).
- In SPR, Halle uses a contrastive hierarchy, but does not adopt the Contrastivist Hypothesis.

**Halle (1959: 63)**

“[P rules] specify all features which play no distinctive role in the language but are not randomly distributed.”
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**Halle (1959: 63)**

"[P rules] specify all features which play no distinctive role in the language but are not randomly distributed."

- For Halle, the hierarchy primarily serves to simplify underlying representations.
- Redundant features are filled in during the derivation, allowing them to be phonologically active.
Voicing assimilation

Obstruents in clusters undergo regressive assimilation. Assimilation involves both voicing... and devoicing.

/s/-jexatʲ 'move out'

/i/-laɡatʲ 'set out'

/p/-rositʲ 'ask (for)'

/i/-klʲuʧatʲ 'exclude'

/ɡ/-dʲelatʲ 'do'

/ɡ/-natʲ 'drive out'

So [/x] voice] is phonologically active on obstruents. (And it's not active on sonorants.)

Examples from Padgett (2009)
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\[
\begin{align*}
\text{\_\_ SON.:} & \quad \text{s-jexat}^j \quad \text{‘move out’} \\
\text{\_\_ VLS.:} & \quad \text{s-prosit}^j \quad \text{‘ask (for)’} \\
\text{\_\_ VD.:} & \quad \text{z-d}^j \text{elat}^j \quad \text{‘do’}
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\[ \text{\_\_SON.}: \quad \text{s-jexat}^j \quad \text{‘move out’} \quad \text{iz-lagat}^j \quad \text{‘set out’} \quad \text{CONTRAST} \]
\[ \text{\_\_VLS.}: \quad \text{s-prosit}^j \quad \text{‘ask (for)’} \quad \text{is-kl}^ju\text{utfat}^j \quad \text{‘exclude’} \quad \text{VOICELESS} \]
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- So [±voice] is phonologically active on obstruents.

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- So [±voice] is phonologically active on obstruents.
- (And it’s not active on sonorants.)
Voicing assimilation: Features

- Most Russian obstruents come in voiced/voiceless pairs, and sonorants are all voiced.
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- So if [±sonorant] (or the equivalent) takes scope over [±voice], voicing will be specified on obstruents but not on sonorants.

(For Halle (1959), sonorants are distinguished by [±vocalic], [−consonantal], or [±nasal].)
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- Most Russian obstruents come in voiced/voiceless pairs, and sonorants are all voiced.
- So if \([\pm \text{sonorant}]\) (or the equivalent) takes scope over \([\pm \text{voice}]\), voicing will be specified on obstruents but not on sonorants.
- Schematically:

\[
\begin{array}{c}
\text{C} \\
\text{[} -\text{sonorant} \text{]} \\
\text{[} -\text{voice} \text{]} \quad \text{t} \\
\text{[} +\text{voice} \text{]} \\
\text{[} +\text{sonorant} \text{]} \\
\end{array}
\]

(For Halle (1959), sonorants are distinguished by \([+\text{vocalic}], [-\text{consonantal}],\) or \([+\text{nasal}]\).)
Voicing assimilation: The unpaired obstruents

- For pairs like /t/ and /d/, \([\pm\text{voice}]\) must be contrastive.
Voicing assimilation: The unpaired obstruents

- For pairs like /t/ and /d/, [±voice] must be contrastive.
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<td>pʲ</td>
<td>t</td>
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</tr>
<tr>
<td></td>
<td>b</td>
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<td>d</td>
<td>dʲ</td>
</tr>
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<td><strong>AFFRICATE</strong></td>
<td></td>
<td>ts</td>
<td></td>
<td>tʲ</td>
</tr>
<tr>
<td><strong>FRICATIVE</strong></td>
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- These unpaired obstruents were key to Halle’s (1957; 1959) argument against the structuralist separation of morphophonemic and allophonic patterns.

See also Dresher (2011)
Voicing assimilation: The unpaired obstruents

- Unpaired /ts \& x/ undergo regressive assimilatory voicing:
Voicing assimilation: The unpaired obstruents

- Unpaired /ts tf x/ undergo regressive assimilatory voicing:

  \[
  \begin{align*}
  \text{ot'jets} & \quad \text{‘father’} & \quad \text{mox} & \quad \text{‘moss’} \\
  \text{ot'jedz bi'l} & \quad \text{‘father was’} & \quad \text{mo'y bi'l} & \quad \text{‘moss was’} \\
  \text{zef l'i} & \quad \text{‘should one burn?’} \\
  \text{zedz bi} & \quad \text{‘were one to burn’}
  \end{align*}
  \]

examples from Halle (1959), Timberlake (2002)
Voicing assimilation: The unpaired obstruents

- Unpaired /tʃ x/ undergo regressive assimilatory voicing:

  \[\begin{align*} 
  \text{ot}^\text{j} \text{ets} & \quad \text{‘father’} \\
  \text{ot}^\text{j} \text{edz b} \text{il} & \quad \text{‘father was’} \\
  \text{z} \text{etf l} \text{i} & \quad \text{‘should one burn?’} \\
  \text{zedz b} \text{i} & \quad \text{‘were one to burn’} \\
  \text{mox} & \quad \text{‘moss’} \\
  \text{moy b} \text{i} \text{l} & \quad \text{‘moss was’} 
  \end{align*}\]

(Thus Halle’s argument: If processes that produce alternations between phonemes are strictly separate from allophony, then there is no unified account of voicing assimilation.)

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Voicing assimilation: The unpaired obstruents

- Unpaired /ʦ ʧ x/ undergo regressive assimilatory voicing:
  
  otʲets ‘father’
  otʲedz bi ‘father was’
  ʒetʧ li ‘should one burn?’
  ʒedʒ bi ‘were one to burn’
  
  mox ‘moss’
  moy bi ‘moss was’

- They also trigger regressive assimilatory devoicing:
  
  bʲez ozʲera ‘without a lake’
  bʲes xlʲeba ‘without bread’
  bʲes tseni ‘without price’
  bʲes tʃest ji ‘without honour’

Specifying the unpaired obstruents

- Since /ts tf x/ act like other [−voice] obstruents, it would make sense for them to be specified as [−voice].

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contrastive hierarchy for [+consonantal] phonemes from Halle (1959: 46)
Specifying the unpaired obstruents

- Since /ʦ ʧ x/ act like other [−voice] obstruents, it would make sense for them to be specified as [−voice].
- But this is not what Halle does.

contrastive hierarchy for [+consonantal] phonemes from Halle (1959: 46)
Specifying the unpaired obstruents

In Halle's hierarchy:

\([\pm \text{low tonality]} \gg [\pm \text{continuant}] \gg [\pm \text{voiced}] \gg [\pm \text{sharped}]\)
Specifying the unpaired obstruents

In Halle’s hierarchy:

\[[\pm \text{low tonality}] \gg [\pm \text{continuant}] \gg [\pm \text{voiced}] \gg [\pm \text{sharped}]\]

Strident dentals:

\[
/ʦ \ s \ s^j \ z \ z^j/ \\

[−cont] \quad [+cont] \\
[ʦ] \\
[−voice] \quad [+voice] \\
[−sharp] \quad [+sharp] \quad [−sharp] \quad [+sharp] \\
[s] \quad [s^j] \quad [z] \quad [z^j]
\]
Specifying the unpaired obstruents

In Halle’s hierarchy:

$$[\pm \text{low tonality}] \gg [\pm \text{continuant}] \gg [\pm \text{voiced}] \gg [\pm \text{sharped}]$$

Strident dentals:

$$/ts\ s\ s^j\ z\ z^j/$$

- \([-\text{cont}]\) \([-\text{voice}]\) \([-\text{sharp}]\) \(s\)
- \([+\text{cont}]\) \([+\text{voice}]\) \([+\text{sharp}]\) \(s^j\)

Palatals and velars:

$$/tf\ j\ z\ k\ k^j\ x\ g/$$

- \([-\text{low ton}]\) \([-\text{voice}]\) \([+\text{voice}]\) \([-\text{sharp}]\) \(s\)
- \([+\text{cont}]\) \([+\text{voice}]\) \([+\text{sharp}]\) \(s^j\)
- \([-\text{cont}]\) \([-\text{voice}]\) \([+\text{voice}]\) \([+\text{sharp}]\) \(k\)
- \([+\text{cont}]\) \([+\text{voice}]\) \([+\text{sharp}]\) \(k^j\)
Specifying the unpaired obstruents

In Halle’s hierarchy:

\[ [\pm \text{low tonality}] \gg [\pm \text{continuant}] \gg [\pm \text{voiced}] \gg [\pm \text{sharped}] \]

Strident dentals:

\[
\begin{align*}
/t\ s\ s^j\ z\ z^j/ & \quad \begin{array}{c}
[-\text{cont}] \\
\text{ts}
\end{array} & \quad \begin{array}{c}
[+\text{cont}] \\
\text{[+cont]}
\end{array} \\
\begin{array}{c}
[-\text{voice}] \\
\text{[+voice]}
\end{array} & \quad \begin{array}{c}
[-\text{sharped}] \\
\text{s}
\end{array} & \quad \begin{array}{c}
[+\text{sharped}] \\
\text{s}^j
\end{array} & \quad \begin{array}{c}
[-\text{sharped}] \\
\text{z}
\end{array} & \quad \begin{array}{c}
[+\text{sharped}] \\
\text{z}^j
\end{array}
\end{align*}
\]

Palatals and velars:

\[
\begin{align*}
/t\{j\}z\ k\ k^j\ x\ g/ & \quad \begin{array}{c}
[-\text{low ton}] \\
\text{[+low ton]}
\end{array} \\
\begin{array}{c}
[-\text{cont}] \\
\text{t}\{j\}
\end{array} & \quad \begin{array}{c}
[+\text{cont}] \\
\text{[+cont]}
\end{array} \\
\begin{array}{c}
[-\text{voice}] \\
\text{[+voice]}
\end{array} & \quad \begin{array}{c}
[-\text{sharped}] \\
\text{k}
\end{array} & \quad \begin{array}{c}
[+\text{sharped}] \\
\text{k}^j
\end{array} \\
\begin{array}{c}
[+\text{sharped}] \\
\text{x}
\end{array} & \quad \begin{array}{c}
[\pm \text{low ton}] \\
\text{[+low ton]}
\end{array}
\end{align*}
\]
Specifying the unpaired obstruents

In Halle’s hierarchy:

\[ [\pm \text{low tonality}] \gg [\pm \text{continuant}] \gg [\pm \text{voiced}] \gg [\pm \text{sharped}] \]

Strident dentals:

\[
\begin{align*}
/ʦ & s s^j z z^j/ \\
[-\text{cont}] & [+\text{cont}] \\
[-\text{voice}] & [+\text{voice}] \\
[-\text{sharp}] & [+\text{sharp}] \\
&s & s^j & z & z^j
\end{align*}
\]

Palatals and velars:

\[
\begin{align*}
/ʧ & ʃ ʒ k k^j x ɡ/ \\
[-\text{low ton}] & [+\text{low ton}] \\
[-\text{cont}] & [+\text{cont}] \\
[-\text{voice}] & [+\text{voice}] \\
[-\text{sharp}] & [+\text{sharp}] \\
&tʃ & ʃ & ʒ & k & k^j & x & ɡ
\end{align*}
\]

\[ [\pm \text{continuant}] \text{ cuts off } /ʦ/, /tʃ/, \text{ and } /x/ \text{ before } [\pm \text{voiced}] \text{ can be assigned to them.} \]
Specifying the unpaired obstruents

- For Halle, this is not a problem.
Specifying the unpaired obstruents

■ For Halle, this is not a problem.
■ The underlying representations of /ʦ ʧ x/ are kept simple, and redundant values for [±voiced] can be filled in by rule.
Specifying the unpaired obstruents

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- The underlying representations of /ts tʃ x/ are kept simple, and redundant values for [±voiced] can be filled in by rule.

**Rule P 1b** Unless followed by an obstruent, /ts/, /tʃ/, and /x/ are voiceless.
Specifying the unpaired obstruents

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rules: Halle (1959: 63–64)
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**UNDERLYING**

bʲez xlʲeba

[±voiced] : + Ø

rules: Halle (1959: 63–64)
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<table>
<thead>
<tr>
<th>UNDERLYING</th>
<th>RULE P 1B</th>
</tr>
</thead>
<tbody>
<tr>
<td>bʲez xļeba</td>
<td>bʲez xļeba</td>
</tr>
</tbody>
</table>

\[±voiced\]: + ∅          + −

rules: Halle (1959: 63–64)
Specifying the unpaired obstruents

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<th>RULE P 1B</th>
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</tr>
</thead>
<tbody>
<tr>
<td>bʲez xlʲeba</td>
<td>bʲez xlʲeba</td>
<td>bʲes xlʲeba</td>
</tr>
</tbody>
</table>

[±voiced]: + Ø + − − −

rules: Halle (1959: 63–64)
If we adopt the Contrastivist Hypothesis, then [±voiced] must be contrastive on /ʦ ʧ x/ in order to be active.
If we adopt the Contrastivist Hypothesis, then [+voiced] must be contrastive on /ʦ ʧ x/ in order to be active.

/ʦ ʧ x/ don’t have minimally different voiced counterparts */ʣ ʤ ɣ/ in the underlying inventory...
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...but they contrast with voiced obstruents in general.
Specifying the unpaired obstruents

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- /ʦ ʧ x/ don’t have minimally different voiced counterparts */ʣ ʤ ɣ/ in the underlying inventory...
- ...but they contrast with voiced obstruents in general.
- The flexibility of the SDA allows us to give [±voiced] wider scope, so that it is specified on all Russian obstruents.
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But this doesn’t come for free.
Specifying the unpaired obstruents

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If [±voiced] is promoted in the contrastive hierarchy, something else must be demoted.

We predict a trade-off.
Specifying the unpaired obstruents

Revising Halle’s hierarchy...

$$[\pm \text{low tonality}] \gg [\pm \text{continuant}] \gg [\pm \text{voiced}] \gg [\pm \text{sharped}]$$

Strident dentals:

$$/\text{ʦ}s\ s^j\ z\ z^j/$$

$$(\text{cont})$$ $$(\text{cont})$$

$$\text{ʦ}$$ $$(\text{cont})$$ $$(\text{cont})$$

$$\text{s}$$ $$(\text{voice})$$ $$(\text{voice})$$

$$\text{s}^j$$ $$(\text{sharp})$$ $$(\text{sharp})$$

$$\text{z}$$ $$(\text{voice})$$ $$(\text{voice})$$

$$\text{z}^j$$ $$(\text{cont})$$ $$(\text{cont})$$

Palatals and velars:

$$/\text{ʧ}\ ʃ\ ʒ\ k\ k^j\ x\ ɡ/$$

$$/\text{ʧ}\ ʃ\ ʒ\ k\ k^j\ x\ ɡ/$$

$$(\text{low ton})$$ $$(\text{low ton})$$

$$(\text{cont})$$ $$(\text{cont})$$ $$(\text{cont})$$ $$(\text{cont})$$

$$(\text{voice})$$ $$(\text{voice})$$ $$(\text{voice})$$ $$(\text{voice})$$

$$(\text{sharp})$$ $$(\text{sharp})$$ $$(\text{sharp})$$ $$(\text{sharp})$$

$$(\text{x})$$ $$(\text{g})$$ $$(\text{k})$$ $$(\text{k}^j)$$
Specifying the unpaired obstruents

Revising Halle’s hierarchy...

\[ [\pm \text{low tonality}] \gg [\pm \text{voiced}] \gg [\pm \text{continuant}] \gg [\pm \text{sharped}] \]

Strident dentals:

Palatals and velars:

- ...gives us \([-\text{voiced}]\) on /ts \(\text{tʃ} x/\)…
Specifying the unpaired obstruents

Revising Halle’s hierarchy...

\[ \pm \text{low tonality} \] \[ \gg \pm \text{voiced} \] \[ \gg \pm \text{continuant} \] \[ \gg \pm \text{sharped} \]

Strident dentals:

- /ts s sʲ z zʲ/

- \([-\text{voice}] \]
  - \([-\text{cont}] \)
    - ts
  - \([+\text{cont}] \)

- \([+\text{voice}] \]
  - \([-\text{sharp}] \)
    - s
  - \([+\text{sharp}] \)
    - sʲ

- /ʧ ʃ ʒ k kʲ x ɡ/

- \([-\text{low ton}] \)
  - \([-\text{cont}] \)
    - tʃ
  - \([+\text{cont}] \)
    - ʃ

- \([+\text{voice}] \]
  - \([-\text{cont}] \)
    - ʒ
  - \([+\text{cont}] \)
    - x

- \([-\text{sharp}] \]
  - \([-\text{cont}] \)
    - k
  - \([+\text{cont}] \)
    - kʲ

- \([+\text{voice}] \]
  - \([-\text{cont}] \)
    - g

- \([+\text{cont}] \)
  - \([-\text{sharp}] \)
    - z
  - \([+\text{sharp}] \)
    - zʲ

- /ʧ ʃ ʒ k kʲ x ɡ/

- \([-\text{low ton}] \)
  - \([-\text{cont}] \)
    - tʃ
  - \([+\text{cont}] \)
    - ʃ

- \([+\text{voice}] \]
  - \([-\text{cont}] \)
    - ʒ
  - \([+\text{cont}] \)
    - x

- \([-\text{sharp}] \]
  - \([-\text{cont}] \)
    - k
  - \([+\text{cont}] \)
    - kʲ

- \([+\text{voice}] \]
  - \([-\text{cont}] \)
    - g

- \([+\text{cont}] \)
  - \([-\text{sharp}] \)
    - z
  - \([+\text{sharp}] \)
    - zʲ

- /ʧ ʃ ʒ k kʲ x ɡ/

- \([-\text{low ton}] \)
  - \([-\text{cont}] \)
    - tʃ
  - \([+\text{cont}] \)
    - ʃ

- \([+\text{voice}] \]
  - \([-\text{cont}] \)
    - ʒ
  - \([+\text{cont}] \)
    - x

- \([-\text{sharp}] \]
  - \([-\text{cont}] \)
    - k
  - \([+\text{cont}] \)
    - kʲ

- \([+\text{voice}] \]
  - \([-\text{cont}] \)
    - g

- \([+\text{cont}] \)
  - \([-\text{sharp}] \)
    - z
  - \([+\text{sharp}] \)
    - zʲ

...gives us \([-\text{voiced}] \) on /ts tʃ x/...

...but removes \([-\pm\text{continuant}] \) from /z zʲ z g/.
The other unpaired obstruents

- The revised hierarchy shows the gaps in the underlying inventory—*/ʣ ʤ ɣ/*—in a new light.
The other unpaired obstruents

- The revised hierarchy shows the gaps in the underlying inventory—*/dz dz ɣ/*—in a new light.
- What’s missing from the inventory are not the voiced counterparts to /ʦ ʧ x/...
- We predict that [\[x16\] continuant] is not phonologically active on /z zʲ ʒ ɡ/.
- Minimally, we predict that omitting [\[x16\] continuant] from these segments will not lead to what Nevins (2003) calls an ‘Oops, I Need That’ problem.
- More than this, though, there seems to be positive evidence for underspecification of [\[x16\] continuant].
The other unpaired obstruents

- The revised hierarchy shows the gaps in the underlying inventory—\*\(/\text{dz} \ \text{dʒ} \ \gamma/\)—in a new light.
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- …but the \([-\alpha \text{continuant}]\) counterparts to /\text{z} \ \text{z}^j \ \text{ʒ} \ \text{ɡ}/.
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The other unpaired obstruents: Variation

- Circumstantially, we note that Russian /g/ can be realized as [ɣ] or [ɦ] as well as [g].
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This is dialect variation, so it doesn’t necessarily show that the same U.R. surfaces as both stop and continuant in a single grammar.
Circumstantially, we note that Russian \(/g/\) can be realized as \(\gamma\) or \(\ɦ\) as well as \(g\).

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However, to the extent that different dialects of Russian show similar phonological patterns, we expect their inventories to have the same specifications.
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This is dialect variation, so it doesn’t necessarily show that the same U.R. surfaces as both stop and continuant in a single grammar.

However, to the extent that different dialects of Russian show similar phonological patterns, we expect their inventories to have the same specifications.

If this segment variously shows up as [g] and [ɣ] /[ɦ], this is consistent with—but does not entail—the idea that it is unspecified for continuancy.
The other unpaired obstruents: Alternations

Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization
The other unpaired obstruents: Alternations

Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization

\[ [+\text{low tonality}] \rightarrow [-\text{low tonality}] \]
The other unpaired obstruents: Alternations

Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization

\[
\begin{array}{c}
[+\text{low tonality}] \rightarrow [-\text{low tonality}] \\
[-\text{voiced}] & [+\text{continuant}] & x & \rightarrow & \emptyset
\end{array}
\]
The other unpaired obstruents: Alternations

Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization

<table>
<thead>
<tr>
<th>[–voiced]</th>
<th>[+continuant]</th>
<th>[+low tonality]</th>
<th>→</th>
<th>[–low tonality]</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[–voiced]</td>
<td>[–continuant]</td>
<td>k</td>
<td>→</td>
<td>tf</td>
</tr>
</tbody>
</table>

Examples from Lightner (1977).
Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization

| [-voiced]   | [+continuant] | x     | → | ʃ  |
| [−voiced]   | [−continuant] | k     | → | tʃ |
| [+voiced]   | ∅              | g     | → | ʒ  |

The hierarchy that assigns [-voiced] to /ʦ ʧ x/ also correctly identifies /ɡ/ and /ʒ/ as counterparts.

The other unpaired obstruents: Alternations

Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization

<table>
<thead>
<tr>
<th>[+low tonality] → [−low tonality]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[−voiced] [+continuant] x → ʃ</td>
</tr>
<tr>
<td>[−voiced] [−continuant] k → ŋ</td>
</tr>
<tr>
<td>[+voiced] ∅ g → ʒ</td>
</tr>
</tbody>
</table>

Adjectives:

<table>
<thead>
<tr>
<th>POSITIVE</th>
<th>COMPARATIVE</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>tʲixij</td>
<td>tʲife</td>
<td>‘quiet(er)’</td>
</tr>
<tr>
<td>ʒarkij</td>
<td>ʒartʃe</td>
<td>‘hot(ter)’</td>
</tr>
<tr>
<td>dorogoj</td>
<td>doroʒe</td>
<td>‘dear(er)’</td>
</tr>
</tbody>
</table>

examples from Lightner (1965)
The other unpaired obstruents: Alternations

Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization

\[
\begin{array}{cccc}
[-\text{voiced}] & [+\text{continuant}] & x & \rightarrow & \mathfrak{f} \\
[-\text{voiced}] & [-\text{continuant}] & k & \rightarrow & \mathfrak{f} \\
[+\text{voiced}] & \emptyset & g & \rightarrow & \mathfrak{z}
\end{array}
\]

Verbs:

<table>
<thead>
<tr>
<th>3RD PLURAL</th>
<th>3RD SINGULAR</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>maxut</td>
<td>mafjet</td>
<td>‘wave(s), wag(s)’</td>
</tr>
<tr>
<td>pekut</td>
<td>petfjet</td>
<td>‘bake(s)’</td>
</tr>
<tr>
<td>strigut</td>
<td>strizjet</td>
<td>‘shear(s)’</td>
</tr>
</tbody>
</table>

Examples from Lightner (1965)
The other unpaired obstruents: Alternations

Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization

[+low tonality] \rightarrow [−low tonality]

| [−voiced] | [−continuant] | k | \rightarrow | ʧ |
| [−voiced] | [+continuant] | x | \rightarrow | ʃ |
| [+voiced]  | \∅            | g | \rightarrow | ʒ |

Denominal adjectives:

<table>
<thead>
<tr>
<th>NOUN</th>
<th>ADJECTIVE</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>tferepaxa</td>
<td>tferepaʃij</td>
<td>‘turtle’ / ‘testudinian’</td>
</tr>
<tr>
<td>volk</td>
<td>voltʃij</td>
<td>‘wolf’ / ‘lupine’</td>
</tr>
<tr>
<td>vraŋ</td>
<td>vraʒij</td>
<td>‘enemy’ / ‘hostile’</td>
</tr>
</tbody>
</table>

examples from Lightner (1965)
The other unpaired obstruents: Alternations

Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization

| [-voiced] | [+continuant] | x | → | ʃ |
| [−voiced] | [−continuant] | k | → | ʧ |
| [+voiced] | ∅ | g | → | z |

Denominal adjectives:

<table>
<thead>
<tr>
<th>NOUN</th>
<th>ADJECTIVE</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>tferepaxa</td>
<td>tferepafij</td>
<td>‘turtle’ / ‘testudinian’</td>
</tr>
<tr>
<td>volk</td>
<td>voltfij</td>
<td>‘wolf’ / ‘lupine’</td>
</tr>
<tr>
<td>vraŋ</td>
<td>vražij</td>
<td>‘enemy’ / ‘hostile’</td>
</tr>
</tbody>
</table>

The hierarchy that assigns [−voiced] to /ʦ ʧ x/ also correctly identifies /g/ and /ʒ/ as counterparts.

examples from Lightner (1965)
The other unpaired obstruents: Alternations

Some (morpho)phonological evidence:
Alternations resulting from the First Velar Palatalization

\[
/ʧ \, ʃ \, ʒ \, k \, k^j \, x \, ɡ/
\]

The hierarchy that assigns \([-\text{voiced}]\) to /ʦ ʧ x/ also correctly identifies /ɡ/ and /ʒ/ as counterparts.

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The other unpaired obstruents: Alternations

Relics of the Second Palatalization pair velars with dentals:
The other unpaired obstruents: Alternations

Relics of the Second Palatalization pair velars with dentals:

\[
\begin{bmatrix}
+\text{compact} \\
+\text{low tonality}
\end{bmatrix}
\sim
\begin{bmatrix}
-\text{compact} \\
-\text{low tonality}
\end{bmatrix}
\]
The other unpaired obstruents: Alternations

Relics of the Second Palatalization pair velars with dentals:

\[
\begin{array}{ccc}
+\text{compact} & \sim & -\text{compact} \\
+\text{low tonality} & \sim & -\text{low tonality} \\
-\text{voiced} & \sim & -\text{continuant} \\
-k & \sim & -ts \\
\end{array}
\]
The other unpaired obstruents: Alternations

Relics of the Second Palatalization pair velars with dentals:

$$\begin{array}{cccc}
[+\text{compact}] & [+\text{low tonality}] & \sim & [-\text{compact}] \\
[-\text{continuant}] & [-\text{low tonality}] & & \\
[\text{[-voiced]}] & [\text{[continuant]}] & k & \sim & ts \\
[\text{[+voiced]}] & \emptyset & g, g^j & \sim & z, z^j
\end{array}$$
The other unpaired obstruents: Alternations

Relics of the Second Palatalization pair velars with dentals:

\[
\begin{array}{c|c|c|c|c}
\text{[+compact]} & \text{[+low tonality]} & \sim & \text{[–compact]} & \text{[–low tonality]} \\
\hline
\text{[–voiced]} & \text{[–continuant]} & k & \sim & ts \\
\text{[+voiced]} & \emptyset & g, g^j & \sim & z, z^j \\
\end{array}
\]

brja kat^j ‘to let fall w/ a clang’ brjatsat^j ‘to clang’

Examples from Lightner (1965)
### The other unpaired obstruents: Alternations

Relics of the Second Palatalization pair velars with dentals:

<table>
<thead>
<tr>
<th>[-voiced]</th>
<th>[-continuant]</th>
<th>+compact</th>
<th>+low tonality</th>
<th>~</th>
<th>[–compact]</th>
<th>[–low tonality]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[+voiced]</td>
<td>Ø</td>
<td>k</td>
<td>~</td>
<td>~</td>
<td>g, gʲ</td>
<td>z, zʲ</td>
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| brjakatʲ | ‘to let fall w/ a clang’ | brjatsatʲ | ‘to clang’ |
| voskliknutʲ | ‘to exclaim’ (pf.) | vosklitsatʲ | ‘to exclaim’ (impf.) |

Examples from Lightner (1965)
The other unpaired obstruents: Alternations

Relics of the Second Palatalization pair velars with dentals:

\[
\begin{array}{c|c|c}
\text{[−voiced]} & \text{[−continuant]} & \text{[+voice]} \\
\hline
\text{[+ voiced]} & \emptyset & k, g, g^j \\
\end{array}
\]

\[
\text{[−compact} \quad \text{+low tonality} \quad \sim \quad \text{[−compact} \quad \text{−low tonality]}
\]

\[
\text{brjaka}t^j \quad \text{‘to let fall w/ a clang’} \\
\text{voskl}knut^j \quad \text{‘to exclaim’ (pf.)} \\
\text{tjag}at^j\text{sja} \quad \text{‘to sue’} \\
\text{brjats}tsat^j \quad \text{‘to clang’} \\
\text{vosk}litsat^j \quad \text{‘to exclaim’ (imprf.)} \\
\text{sostjazat}^j\text{sja} \quad \text{‘to contend with’}
\]

examples from Lightner (1965)
The other unpaired obstruents: Alternations

Relics of the Second Palatalization pair velars with dentals:

| [−voiced] | [−continuant] | k | ~ | ts |
| [−voiced] | [−continuant] | g, gʲ | ~ | z, zʲ |

| +compact | +low tonality | ~ | −compact | −low tonality |

| brjakatʲ | ‘to let fall w/ a clang’ | brjatsatʲ | ‘to clang’ |
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| tjagatʲsja | ‘to sue’ | sostjazatʲsja | ‘to contend with’ |
| knjagʲinja | ‘princess’ | knjazʲ | ‘prince’ |

examples from Lightner (1965)
The other unpaired obstruents: Alternations

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\[
\begin{array}{c|c|cc}
\text{[–voiced]} & \text{[–continuant]} & \text{k} & \sim \\
\hline
\text{[+voiced]} & \emptyset & \text{g, g\textsuperscript{j}} & \sim \\
\end{array}
\]

<p>| | | | |</p>
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These alternations are not productive in Modern Russian, but they are consistent with the prediction that /z z\textsuperscript{j}/ are also unspecified for continuancy.

examples from Lightner (1965)
Elsewhere in Slavic

Other Slavic languages show similarly asymmetrical inventories, and similar phonological patterns:
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Other Slavic languages show similarly asymmetrical inventories, and similar phonological patterns:

**Serbian:** /ɡ/ has no continuant counterpart, and alternates with /ʒ/ and with /z/. Radišić (2009) argues for a contrastive hierarchy that leaves /ɡ/ unspecified for continuancy.

source: Radišić (2009) on Serbian
Elsewhere in Slavic

Other Slavic languages show similarly asymmetrical inventories, and similar phonological patterns:

**Lower Sorbian:** /g/ has no continuant counterpart.

sources: Radišić (2009) on Serbian; Schaarschmidt (1998) on Sorbian
Elsewhere in Slavic

Other Slavic languages show similarly asymmetrical inventories, and similar phonological patterns:

**Lower Sorbian:** /g/ has no continuant counterpart. Where /k/ alternates with /ʦ/ and /x/ with /ʃ/...

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sources: Radišić (2009) on Serbian; Schaarschmidt (1998) on Sorbian
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<td>‘leg’</td>
</tr>
<tr>
<td>rozg-a</td>
<td>rozʣ-e</td>
<td>‘twig’</td>
</tr>
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</table>

.../g/ becomes either /z/ or /ʣ/, whichever is phonotactically less marked (/ʣ/ after /z/; /z/ elsewhere).

sources: Radišić (2009) on Serbian; Schaarschmidt (1998) on Sorbian
Elsewhere in Slavic

Other Slavic languages show similarly asymmetrical inventories, and similar phonological patterns:

**Ukrainian:** Historical */g/ has become */h/, making its alternations with coronal continuants more transparent phonetically.

sources: Radišić (2009) on Serbian; Schaarschmidt (1998) on Sorbian; Shevelov (1977) on Ukrainian
Elsewhere in Slavic

Other Slavic languages show similarly asymmetrical inventories, and similar phonological patterns:

**Ukrainian:** Historical */g/ has become /h/, making its alternations with coronal continuants more transparent phonetically. A new, marginally contrastive stop /g/ is emerging through borrowings.

sources: Radišić (2009) on Serbian; Schaarschmidt (1998) on Sorbian; Shevelov (1977) on Ukrainian
Conclusions

- The Successive Division Algorithm is not deterministic.
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This makes it compatible with the proposition that features themselves are emergent (Mielke 2001), as discussed by Dresher (2001) and Cowper & Hall (2001). But it does make predictions about how many features can be specified, and about trade-offs between potential specifications. These predictions are, in principle, falsifiable. As regards voicing and continuancy in Slavic, though, it appears that they are not actually false.
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Padgett, Jaye (2002). Russian voicing assimilation, final devoicing, and the problem of [v] (or, the mouse that squeaked). Ms., University of California, Santa Cruz. ROA #528.


