A contrast-driven typology of the Altaic vowel systems

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1. Introduction

This study attempts to provide a contrast-driven typology of vowel systems of the Altaic languages. Within the framework of modified contrastive specification (Dresher 2009), a contrastive hierarchy for each Altaic vowel system is established based on the phonological behavior and phonetic exponence of vowels in the given language.

According to Whaley (1997:7), language typology can be defined as “the classification of languages or components of languages based on shared formal characteristics,” from which the following three propositions can be extracted.

(1) a. Typology utilizes cross-linguistic comparison.
    b. Typology classifies languages or aspects of languages.
    c. Typology examines formal features of languages.
With respect to the above propositions, the present typological study in this paper has the following characteristics. First, the typology of this paper will be limited to ‘Altaic’ languages, which have been believed to be genetically and/or geographically closely related to one another. Empirical focus will be given to those Altaic languages which have (or once had) a certain type of vowel harmony: Mongolic, Tungusic, Turkic, and Korean. Thus, the result would be an intra-Altaic typology rather than a cross-linguistic typology. Note in this sense that this paper does not attempt to search for language universals. Since typological classification is greatly influenced by genetic, geographic, and demographic factors (Whaley 1997:14), it is not surprising that the result coincides with the traditional groupings of the languages. Second, the classification of languages will be made based on the vowel phonology of the languages. Therefore, investigations on other grammatical aspects of languages might result in a different classification. Third, the paper focuses on the formal aspect of vowel contrast, namely, the contrastive hierarchy. Thus, it differs from the traditional inventory-driven typology (Hockett 1955, Sedlak 1969, Crothers 1978, Maddieson 1984 inter alia), an example of which is given below:

<table>
<thead>
<tr>
<th>No. of vowel qualities</th>
<th>No. of languages</th>
<th>Percent of languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>17</td>
<td>5.4%</td>
</tr>
<tr>
<td>4</td>
<td>27</td>
<td>8.5%</td>
</tr>
<tr>
<td>5</td>
<td>98</td>
<td>30.9%</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td>18.9%</td>
</tr>
<tr>
<td>7</td>
<td>47</td>
<td>14.8%</td>
</tr>
<tr>
<td>8</td>
<td>17</td>
<td>5.4%</td>
</tr>
<tr>
<td>9</td>
<td>25</td>
<td>7.9%</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
<td>4.7%</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>0.6%</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>1.6%</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>0.6%</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>0.6%</td>
</tr>
</tbody>
</table>

Table 1 Number of vowel qualities (Maddieson 1984:127)
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As noted by Maddieson (1999:2523), these traditional typologiological studies have devoted their attention almost exclusively to analyzing the structure of phoneme inventories “since even the relatively modest publications which are all that is available for most languages usually include a phonemic level of analysis.” However, apparently there seems to be little typological work on the phonological contrast of vowels. What is worse, certain vowel contrast such as tongue root contrast has not been considered in many descriptive works, potentially misleading the typological conclusions.

Under the analysis I adopt in this paper, seemingly dissimilar inventories (e.g., Khalkha 7-vowel system and Chakhar 14-vowel system) can receive the same contrastive hierarchy analysis whereas similar inventories (e.g., Monguor and Dagur 5-vowel systems) can be treated as distinct types with different sets and/or orderings of features. This contrast-driven classification seems to correctly reflect the genetic/geographical affinity between languages. It is also shown that the current contrast-driven typology provides a reasonable account for the synchronic variation and diachronic changes of certain vowel systems in terms of the changes in the contrastive hierarchy. All these are not achievable within the traditional, inventory-driven typological approaches.

It should be also noted that the vowel contrast in this paper is phonological rather than phonetic. Thus, it shows a stark contrast with dispersion-based approaches on vowel typology (Liljencrants and Lindblom 1972, Becker-Kristal 2010).

The organization of this paper is as follows: Section 2 introduces the frameworks adopted here. Section 3 presents the contrastive hierarchy analyses of the Altaic vowel systems. Section 4 discusses the typological findings and their implications.
2. Background: features and contrasts in phonology

In modern phonological theory, a phoneme is viewed as a bundle of features (Jakobson, Fant, and Halle 1952, Chomsky and Halle 1968), which are necessary to account for natural classes as well as contrasts in natural languages (Hall 2007:312).

Features can be *contrastive* in some languages while *redundant* in others (e.g., ‘aspiration’ and ‘voicing’ in English vs. Korean). However, it is not self-evident which features are contrastive and which are redundant. It has remained rather unclear until recently how we arrive at certain feature specifications for a given language.

This problem seems to be solved in Dresher’s (2009) theory of *contrastive hierarchy* which holds in its core that only contrastive features are active in phonological computation. Under this theory, the contrastive specifications of phonemes are considered to be governed by language-particular feature hierarchies. Thus, instead of traditional feature matrices (a), we will use hierarchically ordered feature specifications (b).

(2) Feature matrix vs. feature hierarchy

a. feature matrix

<table>
<thead>
<tr>
<th></th>
<th>/p/</th>
<th>/b/</th>
<th>/m/</th>
</tr>
</thead>
<tbody>
<tr>
<td>voiced</td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>nasal</td>
<td></td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

b. feature hierarchy (Dresher 2009:15-6)

i. [voiced] > [nasal]  
   
```
   /p/ [nasal] [voiced] /m/ 
   - + - + 
```

ii. [nasal] > [voiced]  
   
```
   /p/ [nasal] [voiced] /m/ 
   - + - + 
   /b/ /m/ /p/ /b/ 
   - + + -  ```
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Two points should be noted. First, as seen in (b) above, the same inventories with the same set of features can have different feature hierarchies allowing for variability (Avery et al. 2008:1). This characteristic of contrastive hierarchy seems to be very useful in typological formalization. Second, the proposed Successive Division Algorithm (SDA hereafter) given below assigns all and only contrastive features to phonemes. Thus, we can avoid arbitrariness in analysis as long as we identify evidence from phonological patterns supporting the contrastive status and the relative scope of the proposed features.

(3) The Successive Division Algorithm (Dresher 2009:16)

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.

3. A contrast-driven typology

3.1. How to establish a contrastive hierarchy

The general procedure to establish a contrastive hierarchy can be summarized as follows:
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(4) a. Identify vowel phonemes
   b. Identify contrastive features based on the phonological patterns
   c. Apply SDA to the phonemes: the result must conform to the phonological patterns

In this section, we will apply the above procedures to Oroqen (a Tungusic) and Khalkha (a Mongolic) to see how a contrastive hierarchy is established for a given language (Zhang 1996; Ko 2011a,b,c).

First, the Oroqen and Khalkha vowel phonemes are identified as follows. Although it is not a trivial matter at all, let us assume that the above vowel phonemes are uncontroversially given.

(5) Vowel inventory
   a. Oroqen
   i   u
   o
   ø o
   a ð
   b. Khalkha
   i   u
   o
   e o
   a ø

Second, we identify four contrastive features, [coronal], [RTR], [labial], and [low], based on the phonological patterns in Oroqen and Khalkha. The evidence for the contrastive status of the proposed features can be summarized and illustrated as follows:

(6) Summary of evidence for the contrastive status of features
   a. [coronal]: C-palatalization, V-umlaut, Oroqen [j]-formation
   b. [RTR]: RTR harmony
   c. [labial]: labial harmony, Oroqen [w]-formation
   d. [low]: height restriction on the labial harmony trigger restriction in Oroqen [w]-formation
(7) Evidence for [coronal]
a. Oroqen: palatalization of /s/ by /i/ (Zhang 1996:171)
i. [s] before a non-front vowel     ii. [c] before a front vowel
sukə [suxə] ‘axe’                asi [açi] ‘now’
sɔkɔ- [sɔxɔ] ‘fill’
sarbo [sarbo] ‘chopsticks’
b. Khalkha: palatalized consonants (Svantesson et al 2005:26ff)
i. non-palatalized Cs
pʰaɮ ‘splash!’
ag ‘tight’
cam ‘road’
am ‘mouth’

ii. palatalized Cs
pʰaɮ ‘plate’
agʲ ‘wormwood’
čam ‘law’
amʲ ‘life’

(8) Vowel harmony in Oroqen and Khalkha
Oroqen (Zhang 1996)          Khalkha (Ko 2011b)
a. RTR harmony
bəjən-mə ‘moose-DEF.OBJ’   et-eer ‘item-INST’
qəaka-wa ‘thing-DEF.OBJ’   at-aar ‘devil-INST’
b. If /i/ is the only stem vowel, non-RTR suffix is selected
irgi-wə ‘tail-DEF.OBJ’      it-eer ‘strength-INST’
c. high rounded Vs: RTR harmony, but no labial harmony
kuwun-mə ‘cotton-DEF.OBJ’   ut-eer ‘day-INST’
uroon-ma ‘hoof-DEF.OBJ’     ut-aar ‘willow-INST’
d. low rounded Vs: labial harmony
ʨoŋko-wo ‘window-DEF.OBJ’  ot-oor ‘feathers-INST’
ɔlɔ-wo ‘fish-DEF.OBJ’       ot-ɔɔr ‘star-INST’
(9) \(/i/\) is transparent to RTR harmony

a. Oroqen (Zhang 1996)
   nəkin-nə ‘sweat-PAST’ tari-wa ‘that-DEF.OBJ’
   ulin-mə ‘betrothal gift-DEF.OBJ’ murin-ma ‘horse-DEF.OBJ’

b. Khalkha (data from Svaentesson et al. 2005)
   teːj-ig-e: ‘gown-ACC-REFL’ cʰaːs-ig-a: ‘paper-ACC-REFL’
   suːj-ig-e: ‘tail-ACC-REFL’ mʊːr-ig-a: ‘cat-ACC-REFL’

With these four contrastive features, there are twenty four logically possible feature orderings. However, a legitimate ordering must satisfy all the following desiderata given in (10).

(10) Desiderata for desired outcome (Ko 2011a)

   a. D1: \(/i/\) must bear \([+\text{coronal}]\) specification.
   b. D2: \(/i/\) must lack specification for \([\pm\text{RTR}]\).
   c. D3: \(/u, u\)/ must lack specification for \([\pm\text{labial}]\).
   d. D4: \(/e(ə), a, o, ɔ/\) must form a natural class (excluding \(/i, u, u/\)) with respect to labial specification.

(11) Applying SDA to Oroqen and Khalkha (Ko 2011a)

   a. If \([\pm\text{RTR}]\) first: fails, since it assigns \([-\text{RTR}]\) to \(/i/\), contra D2.
   b. If \([\pm\text{lab}]\) first: fails, since it assigns \([+\text{lab}]\) to \(/u, u/\), contra D3.
   c. If \([\pm\text{low}]\) first: assigns \([+\text{low}]\) to \(/e(ə), a, o, ɔ/\) and \([-\text{low}]\) to \(/i, u, u/\).
      i. If \([\pm\text{RTR}]\) second: fails, since it assigns \([-\text{RTR}]\) to \(/i/\), contra D2.
      ii. If \([\pm\text{lab}]\) second: fails, since it assigns \([+\text{lab}]\) to \(/u, u/\), contra D3.
      iii. If \([\pm\text{cor}]\) second: assigns \([+\text{cor}]\) to \(/i/\) and \([-\text{cor}]\) to \(/u, u/\).
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d. If [± cor] first: assigns [+cor] to /i/ and [-cor] to all other vowels.
   i. If [± RTR] second: fails, since it assigns [+RTR] to /u, a, ə/ and [-RTR] to /u, e(ə), o/, contra D4.
   ii. If [± lab] second: fails, since it assigns [+lab] to /u, u/, contra D3.
   iii. If [± low] second: assigns [+low] to /e(ə), a, o, ɔ/ and [-low] to /u, ʊ/.

Only (11c iii) and (11d iii) satisfy all the desiderata and generate four legitimate orderings which, assuming a fixed ordering [labial] > [RTR] considering the suffix allomorphy based on the RTR harmonic pair, will be reduced to the following two:

(12) a. [low] > [coronal] > [labial] > [RTR]
    b. [coronal] > [low] > [labial] > [RTR]

Now we consider the data showing the minimal contrast between Oroqen and Khalkha labial harmony: Tungusic /i/ is opaque whereas Mongolic /i/ is transparent to labial harmony (cf. van der Hulst and Smith 1988; Ko 2011a,c). Note that /u, ʊ/ in both languages are opaque.

(13) Oroqen: a Tungusic (Zhang 1996)
   a. /i/: opaque
      勐獅-勐獵 (*-t加州) ‘round-DIM’
      橄キー-wa (*-w加州) ‘boar-DEF.OBJ’
   b. /u, ʊ/: opaque
      勐獅ko-dulaok (*-dulook) ‘window-PLACE.OF.ORIGIN’
      ключи-dulaak (*-duloಕ) ‘stone-PLACE.OF.ORIGIN’
(14) Khalkha: a Mongolic (Svantesson et al. 2005)

a. /i/: transparent
   poor-ig-o       ‘kidney-ACC-REFL’
   xɔɔɮ-ig-ɔ       ‘food-ACC-REFL’

b. /u, ʊ/: opaque
   og-uɮ-legate (*-l)    ‘to give-CAUS-DIR.PAST’
   ɔr-uɮ-legate (*-l)    ‘to enter-CAUS-DIR.PAST’

Once we assign the hierarchy in (12a) to Oroqen and that in (12b) to Khalkha, respectively, the difference between the two follows in a straightforward manner. Given the hierarchy [low] > [coronal] > [labial] > [RTR], Oroqen /i/ receives the specification [-low, +coronal]. On the contrary, given the hierarchy [coronal] > [low] > [labial] > [RTR], Khalkha /i/ simply receives the specification [+coronal].

(15) Contrastive hierarchy for Oroqen (Zhang 1996)

a. SDA: [low] > [coronal] > [labial] > [RTR]

b. Output specifications
   /i/ = [-low, +cor]
   /u/ = [-low, -cor, -RTR]
   /ʊ/ = [-low, -cor, +RTR]
   /ə/ = [+low, -cor, -lab, -RTR]
   /a/ = [+low, -cor, +lab, -RTR]
   /ɔ/ = [+low, -cor, +lab, +RTR]
Contrastive hierarchy for Khalkha (Ko 2011b)

a. SDA: [coronal] > [low] > [labial] > [RTR]

\[
\begin{array}{c}
\text{[+ coronal]} \\
\text{[-coronal]} \\
/\text{i/} \\
\text{[-low]} \\
\text{[+ low]} \\
\text{[-RTR]} \\
\text{[+ RTR]} \\
\text{[-labial]} \\
\text{[+ labial]} \\
/\text{u/} \\
/\text{u/} \\
/\text{e/} \\
/\text{a/} \\
/\text{o/} \\
/\text{ɔ/}
\end{array}
\]

b. Output specifications

/\text{i/} = [+ cor]  \\
/\text{u/} = [- cor, low, RTR]  \\
/\text{o/} = [- cor, low, + RTR]  \\
/\text{e/} = [- cor, + low, lab, -RTR]  \\
/\text{a/} = [- cor, + low, lab, RTR]  \\
/\text{o/} = [- cor, + low, lab, +RTR]

If we assume both Tungusic and Mongolic labial harmony are ‘height-stratified’ in nature (Mester 1986), it follows that, since Mongolic /i/, unlike Tungusic /i/, lacks a height specification, it is invisible to the ‘height-stratified’ harmony process.

To summarize, despite the strong resemblance of the vowel inventory Oroqen and Khalkha show a microvation in terms of the vowel harmony pattern. This minimal difference cannot be properly dealt with within a inventory-driven typological classification: both languages have a 7-vowel system with almost the same vowel qualities except for the difference between Oroqen /ɔ/ vs. Khalkha /e/. However, the contrast-driven analysis presented here captures the difference between the two vowel systems. The same analysis can be applied to other Tungusic and Mongolic

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1 This view is supported by Kaun’s typology of labial harmony (Kaun 1995, 2004).
languages. For example, the vowel system of Chakhar, a Mongolian Proper spoken in Inner Mongolia, would be analyzed to have exactly the same contrastive hierarchy as that of Khalkha despite its larger vowel inventory. The minimal difference in the relative ordering between [low] and [coronal] is not just a contrast between Oroqen and Khalkha, but one between Tungusic and Mongolic language families: thus, Tungusic [low] > [coronal] vs. Mongolic [coronal] > [low]. No counterexamples have been found in previous analyses on Tungusic and Mongolic languages (Zhang 1996, Dresher and Zhang 2005; Ko 2011b).

3.2. **Contrastive hierarchies of the Altaic vowel systems**

The above analysis can be extended to other Altaic vowel systems. The result is summarized below:

(17) Mongolic vowel systems (Ko 2011b)

<table>
<thead>
<tr>
<th>LANGUAGE</th>
<th>CONTRASTIVE HIERARCHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Khalkha, Chakhar</td>
<td>[cor] &gt; [low] &gt; [lab] &gt; [RTR]</td>
</tr>
<tr>
<td>b. Monguor, Santa, Bonan, Moghol</td>
<td>[cor] &gt; [low] &gt; [lab]( &gt; [RTR])</td>
</tr>
<tr>
<td>c. Dagur, Buriat, Khamnigan</td>
<td>[cor] &gt; [lab] &gt; [RTR]( &gt; [low])</td>
</tr>
<tr>
<td>d. Kalmyk, Oirat</td>
<td>[cor] &gt; [low] &gt; [lab] &gt; [dor]</td>
</tr>
</tbody>
</table>

(18) Tungusic vowel systems (Ko in preparation)

<table>
<thead>
<tr>
<th>LANGUAGE</th>
<th>CONTRASTIVE HIERARCHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Oroqen, Ewen</td>
<td>[low] &gt; [cor] &gt; [lab] &gt; [RTR]</td>
</tr>
<tr>
<td>b. Oroch, Written Manchu</td>
<td>[low] &gt; [cor] &gt; [RTR] &gt; [lab]</td>
</tr>
<tr>
<td>c. Spoken Manchu, Xibe</td>
<td>[low] &gt; [cor] &gt; [lab]</td>
</tr>
</tbody>
</table>

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2 Some of the following hierarchies are preliminary in nature due to insufficient descriptions on the phonological patterns of the relevant languages.

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(19) Turkic vowel systems (Ko in preparation)\(^4\)
   a. Turkish, Uyghur (Vaux 2001) \([\textit{low}] > [\textit{lab}] > [\textit{cor}]\)
   b. Kazakh (Vajda 1994) \([\textit{low}] > [\textit{lab}] > [\textit{RTR}]\)

(20) Korean (Ko 2010a,b)
   a. Middle Korean \([\textit{cor}] > [\textit{low}] > [\textit{lab}] > [\textit{RTR}]\)
   b. Early Mod Korean; NW Korean \([\textit{cor}] > [\textit{low}] > [\textit{hi}] (> [\textit{lab}])\)
   c. Modern SE Korean \([\textit{cor}] > [\textit{low}] > [\textit{lab}]\)
   d. Jeju Korean \([\textit{cor}] > [\textit{hi}] > [\textit{lab}] > [\textit{low}]\)

4. Discussion

The analysis leads to several significant consequences. First, it gives us better understanding of the synchrony and diachrony of the Mongolic vowel systems. Of particular interest is the Kalmyk/Oirat language (17d), which is believed to retain the proposed Proto-Mongolic ‘palatal’ system. However, evidence shows that a proper treatment of vowel system in Kalmyk/Oirat requires two distinct features for the front-back dimension, \([\textit{coronal}]\) for palatalization/umlaut vs. \([\textit{dorsal}]\) for palatal harmony. Thus, the overall hierarchy looks more similar to the Khalkha hierarchy (17a) than the Turkish hierarchy (19a). The Kalmyk/Oirat system should be viewed as an innovation, possibly due to Turkic influence (Kögilütü 1982), rather than the retention of the archaic system (contra Svantesson 1985), which can be formalized as \([\alpha \textit{RTR}] \rightarrow [\alpha \textit{dorsal}]\) (Vaux 2009), a phonetically grounded development (Archangeli and Pulleyblank 1994).

Notably, the residential areas of Oirats are populated largely by Turkic people, the Uyghurs and the Kazakhs (Indjieva 2009:28-32). This is very

\(^{4}\) cf. Walker 1993, D&Z 2005
interesting since, to my best knowledge, Kazakh is the only Turkic language which has been claimed in the literature to have an RTR harmony system (Vajda 1994). This might be due to Mongolic influence, the opposite of the Kalmyk/Oirat case. However, the overall phonological patterns of Kazakh suggest that Kazakh has three, not four, contrastive features as in (19b). Thus, although there might have been contact-induced reinterpretation of the harmonic feature, Kalmyk/Oirat and Kazakh seem to retain the original hierarchical structure of the Mongolic and the Turkic vowel contrast, respectively.

Second, we noticed that there is a minimal but systematic difference between the Mongolic and Tungusic branches: [coronal] > [low] vs. [low] > [coronal]. This minimal difference captures the contrast between the transparency of Mongolic /i/ vs. the opacity of Tungusic /i/ to labial harmony (van der Hulst and Smith 1988). Under the proposed hierarchy, Mongolic /i/ is specified only with [+cor] and requires no further specification. Lacking [± low] value (unlike Tungusic /i/ and other high vowels), it does not block the labial spreading. Although the relative ordering between [low] and [coronal] turned out to be consistently [low] > [coronal], there is a variation of the ordering between [labial] and [RTR]. In particular, Oroch and Written Manchu seem to have the ordering [RTR] > [labial], contra Dresher and Zhang’s (2005) ordering [labial] > [ATR]. Note also that Oroch and Written Manchu are all analyzed as an RTR harmony language, rather than an ATR harmony language. Although there is no consensus on whether ATR and RTR are distinct features or not, it can be safely said that in all Altaic vowel systems (including Written Manchu) RTR is the marked value, and thus an RTR analysis is on the right track.

Third, Middle Korean (20a) used to have a similar vowel feature hierarchy with Mongolic and Tungusic. The difference, however, is found in the inventory: Middle Korean exploits the high back region for the labial
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contrast (/i, ʌ/ vs. /u, o/) instead the low back region (/ə, a/ vs. /o, ɔ/).

The development of Korean vowel systems shows a similar change in the
contrastive hierarchy: a loss of [RTR]. However, there is quite a difference:
the two-way height distinction in Middle Korean changed into the three-
way height distinction. By contrast, the two-way height distinction is very
stable, in other Altaic vowel systems.

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