

FEATURE HIERARCHIES AND CONTRAST IN VOWEL HARMONY

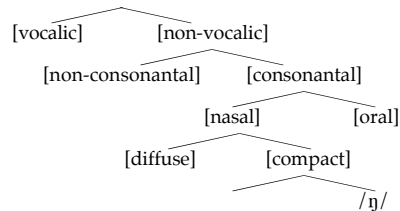
0. Introduction: Why does contrast matter?

- *Hypothesis*
Only contrastive features are *active* in the (lexical) phonology. Redundant features are phonologically *inert*.
- *Corollary*
Only segments with a contrastive specification for a feature [F] can trigger harmony based on [F].

1. Contrast in phonology: How are contrastive features determined?

- *Hypothesis*
Contrast is determined by a series of ordered decisions (Jakobson, Fant & Halle 1952).

1.1. Phoneme identification by ordered binary distinctions (JF&H 1952).

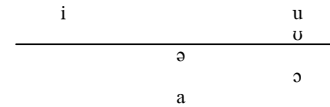


- Observe that this procedure gives only *contrastive* specifications of /ɨ/. In fact, it *defines* which specifications are contrastive.
- Conversely, any specification not required in the series of choices is by definition *redundant*.
- The *ordering* of the choices is crucial: for example, the features [voiced] and [continuant] do not appear because they are ordered too late to matter in the identification of this segment.
- This ordering, or *contrastive hierarchy* (Dresher 1998, 2002, 2003a, b), determines the relative contrastive scope of each feature.

2. Contrast in Manchu vowel systems (Zhang 1996)

Synchronic and diachronic patterning of Manchu vowel systems (Zhang 1996) illustrate the connection between contrastiveness and phonological activity, and support the above hierarchical approach to contrast.

2.1 Written Manchu: Contrasts in the vowel system: Low > Coronal > Labial > ATR



ATR harmony: /u ə/ and /u a/ form two sets that may not co-occur, /i/ is neutral. When a stem has only /i/, it takes suffixes with non-ATR vowels.

2.2. ATR harmony in Written Manchu: /ə/ ~ /a/, /u/ ~ /ɔ/

- | | | | | |
|----|---------|-------------|-----------|-------------------|
| a. | xəxə | 'woman' | xəxə-ŋgə | 'female' |
| | aga | 'rain' | aga-ŋga | 'of rain' |
| b. | xəɣə- | 'ladle out' | xəɣə-ku | 'ladle' |
| | paqt'a- | 'contain' | paqt'a-qu | 'internal organs' |

2.3. Partial merger of /ɔ/ with /u/ (Zhang 1996: 83)

/ɔ/ becomes ATR [u] when not following a back consonant. We assume that this is a late phonetic rule, since it does not affect the behaviour of /u/ with respect to ATR harmony.

2.4. ATR harmony with /u/ not before velar/uvular consonants

- | | | | |
|---------|------------|------------|------------------|
| tat'sun | 'sharp' | tat'su-qan | 'somewhat sharp' |
| tulpa | 'careless' | tulpa-ta- | 'act carelessly' |

2.5. ATR harmony in Written Manchu: /i/ is neutral

- | | | | | |
|----|----------|------------|-------------|---------------|
| a. | əmt'ə | 'one each' | əmt'ə-li | 'alone; sole' |
| | taɣa- | 'follow' | taɣa-li | 'the second' |
| b. | pəki | 'firm' | pəki-lə | 'make firm' |
| | paqtš'in | 'opponent' | paqtš'i-la- | 'oppose' |

2.6. Stems with only /i/: Suffixes with non-ATR vowels

- | | | | |
|---------|---------------------|-----------|------------------|
| fili | 'solid' | fili-qan | 'somewhat solid' |
| ili- | 'stand' | ili-ɣa | 'stood' |
| sifi- | 'stick in the hair' | sifi-qu | 'hairpin' |
| ts'ili- | 'to choke' | ts'ili-qu | 'choking' |

Labial harmony: Two successive /ɔ/ vowels trigger labial harmony of /a/ to [ɔ]. /u/ and /ɔ/ do not trigger labial harmony.

2.7. Labial harmony in Written Manchu

- | | | | | |
|----|--------|------------------|------------|-------------------|
| a. | pəts'ɔ | 'colour' | pəts'ɔ-ŋgə | 'coloured' |
| b. | tə- | 'alight (birds)' | tə-na- | 'alight in swarm' |
| | tə- | 'cross (river)' | tə-na- | 'go to cross' |
| c. | gulu | 'plain' | gulu-qan | 'somewhat plain' |
| d. | ɣətun | 'fast' | ɣətun-qan | 'somewhat fast' |
| | tursun | 'form' | tursu-ŋga | 'having form' |

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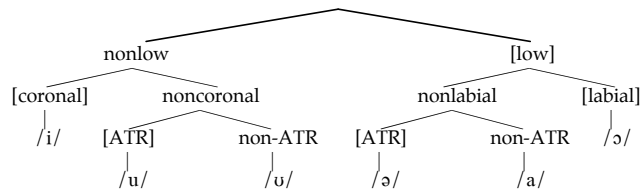
Palatalization: /i/ causes palatalization of preceding consonants, suggesting it has an active feature we will call [coronal].

2.8. Active features in Written Manchu vowels

Phoneme	/i/	/u/	/ʊ/	/ə/	/a/	/ɔ/
Low				✓	✓	✓
Coronal	✓					
Labial						✓
ATR		✓		✓		

Zhang (1996) argues that the active specifications are contrastive, with features ordered: [low] > [coronal] > [labial] > [ATR]

2.9 Written Manchu contrastive hierarchy: [low] > [coronal] > [labial] > [ATR]



The theory is supported in a striking way by subsequent diachronic developments in the modern Manchu languages, Spoken Manchu and Xibe.

2.10 Spoken Manchu (based on Zhao 1989, Ji et al. 1989)

i	y	ə	u
ε		a	ɔ

2.11. Differences between WM and SM vowel systems

- a. Spoken Manchu no longer has a contrast between /u/ and /ʊ/.
- b. In Spoken Manchu /ə/ is a non-low vowel, in Written Manchu it is a low ATR counterpart to /a/.
- c. Spoken Manchu has added coronal phonemes /y/ and /ε/.

2.12. Spoken Manchu after loss of /ʊ/

Coronal	i	ə	u	Labial
Low		a	ɔ	

The elevation of /ə/ to a non-low vowel requires /u/ to be specified Labial in Spoken Manchu. The creation of the new phoneme /y/ supports this analysis.

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2.13 Creation of /y/ from /u/ - /i/ (likewise from /i/ - /u/)



2.14. Xibe (Sibo) (based on Li & Zhong 1986)

Coronal			
i	y	ə	u
ε	æ	a	ɔ
Low			

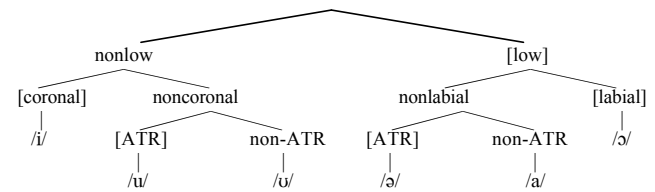
As in Spoken Manchu, Xibe /u/ has acquired a Labial specification. Further support for this analysis comes from labial harmony in Xibe, which is triggered by /u/.

2.15. Alternation between /ə/ and /u/ in Xibe suffixes (Li and Zhong 1986)

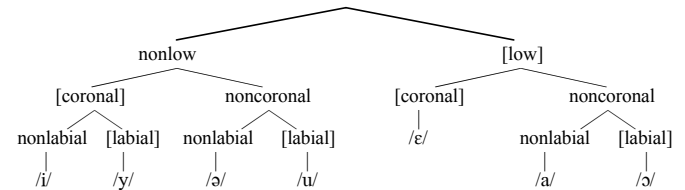
	Written Manchu	Xibe	Gloss
a.	gət'ə-xə	gət'ə-xə	'awoke'
	pu-xə	pu-xu	'gave'
	pəto-χə	pətu-χu	'thought'
b.	nətʃi-kən	nətʃi-kən	'somewhat flat'
	dzyɣuxu-kən	dzyɣuxu-kun	'somewhat sour'
	laptu-qan	lavtu-qun	'somewhat many'

2.16. Increasing feature economy in Manchu vowel systems (cf. Clements 2003, 2004)

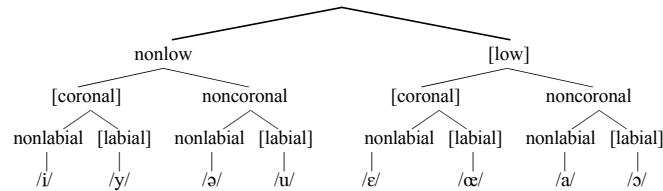
a. Classical Manchu (Zhang 1996)



b. Spoken (modern) Manchu (Zhang 1996)



c. Xibe (Zhang 1996)



3. A perceptual/functional alternative?

Kaun (1995) proposes what appears to be an alternative to a contrastive account of labial harmony systems. Closer inspection reveals, however, that her account presupposes a contrastive analysis such as the one presented here.

3.1. Labial harmony in Manchu-Tungusic: Oroqen (Zhang 1996)

i ii (y)	u uu	Labial harmony limited to the <i>low</i> vowels
e	ə əə	
ɛ	a aa	
	ɔ ɔɔ	

3.2. Labial harmony in Eastern Mongolian: Khalkha (Svantesson 1985, Kaun 1995)

i	u	Labial harmony limited to the <i>low</i> vowels
	ə	
	a	
	ɔ	

3.3. Labial harmony in Turkic: Turkish

i	ü	i	u	Labial harmony <i>targets</i> limited to <i>high</i> vowels; <i>triggers</i> may be <i>high</i> or <i>low</i> .
e	ö	a	o	

3.3. Labial harmony in Turkic: Kachin Khakass (Korn 1969)

i	ü	i	u	Both <i>targets</i> and <i>triggers</i> limited to <i>high</i> vowels.
e	ö	a	o	

3.4. Some constraints governing labial harmony (Kaun 1995)

- a. EXTEND[RD]: The autosegment [+round] must be associated to all available vocalic positions within a word.
- b. UNIFORM[RD]: The autosegment [+round] may not be multiply linked to slots bearing distinct height feature specifications.

- c. *ROLO: Vowels should not be simultaneously specified [+round] and [-high] (Kirchner 1993).
- d. EXTEND[RD]![-HI]: The autosegment [+round] must be associated to all available vocalic positions within a word when simultaneously associated with [-high].

- The problem with this account is that it does not explain the correlation between inventories and type of labial harmony.
- Kaun (1995: 158) suggests that languages with labial harmony confined to low vowels are characterized by greater *crowding* in the non-high vowels than in the high vowels. She proposes that ‘vowel harmony serves to extend the listener’s exposure to a vowel quality which is potentially difficult to identify accurately.’
- To implement this notion in her formal theory, she adopts the convention that EXTEND constraints may operate only on *contrastive* feature values.
- However, Kaun 1995 presents no theory for identifying contrastive features. The intuitive approach to contrast and appeal to crowding create unnecessary problems.

3.5. Labial harmony in Yowlumne Yokuts (Newman 1944, Kuroda 1967)

i	u	Height-bounded labial harmony in <i>both</i> high and low vowels; high vowels have optimal separation.
	a	
	o	

Both /u/ and /o/ are in contrastive in Yowlumne if [labial] > [coronal]. Features can trigger harmony if they are contrastive given a feature hierarchy; the appeal to perceptual crowding is either incorrect or superfluous.

4. Are Structured Specifications an alternative to the contrastive hierarchy?

The Structured Specification Natural Classes approach to contrast (Broe 1993, Frisch 1996, Frisch, Pierrehumbert and Broe 2004) incorporates contrast and a feature hierarchy into representations, but in quite a different way. I will show it does not provide the basis for an adequate account of vowel harmony triggers (see further Mackenzie 2004)

- Representations are based on full specification in terms of a universal set of monovalent features.
- Specifications invoke a redundancy hierarchy of phonological features.
- This hierarchy is unambiguously determined by the set of segments and their feature specifications.
- The hierarchy depends on the natural classes generated by the features applied to the inventory.
- The influence of contrast is felt via the natural classes. Features are not designated contrastive or redundant.

4.1. Assume a five-vowel system /i e a o u/ specified by monovalent features

[syllabic]	/i e a o u/	[high]	/i u/	[nonhigh]	/e o a/
		[low]	/a/	[nonlow]	/i e o u/
[front]	/i e/	[back]	/a o u/	[round]	/o/

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4.2. 14 distinct natural classes generated by (4.1)

[syllabic]	/i e a o u/	[syl, nlo, ft]	/i e/
[syl, nlo]	/i e o u/	[syl, nlo, bk, rnd]	/o u/
[syl, bk]	/a o u/	[syl, nlo, nhi, ft]	/e/
[syl, nhi]	/e a o/	[syl, nlo, hi, ft]	/i/
[syl, nlo, nhi]	/e o/	[syl, bk, nhi, lo]	/a/
[syl, bk, nhi]	/a o/	[syl, nlo, bk, nhi, rnd]	/o/
[syl, nlo, hi]	/i u/	[syl, nlo, bk, hi, rnd]	/u/

4.3. Similarity is computed by calculating the shared and unshared classes

Phonemes	Shared	Unshared	Similarity	
/a, o/		4	5	0.44
/o, u/	4	6		0.40
/e, o/		4	6	0.40
/i, u/	3	5		0.38
/i, e/	3	5		0.38
/a, u/	2	7		0.22
/e, a/	2	7		0.22
/e, u/	2	7		0.20
/i, o/	2	9		0.18
/i, a/	1	8		0.11

- Though calculations of similarity based on structured specifications reflect the contrasts between *phonemes* in an inventory, there is no distinction between contrastive and redundant *features*.
- Thus, there is no way to express the idea that active features are contrastive.

4.4. Structured specifications for Written Manchu. Assume these features

[syllabic]	/i ə a ə u/	[back]	/ə a ə u/	[front]	/i/
[low]	/ə a ə/	[nonlow]	/i u u/	[round]	/ə u u/
[nonround]	/i ə a/	[ATR]	/i ə u/	[non-ATR]	/a ə u/

4.5. Similarity of Written Manchu phonemes by this method

Phonemes	Shared	Unshared	Similarity
/a, ə/	5	6	0.45
/u, u/	5	7	0.42
/ə, a/	5	7	0.42
/u, i/	4	8	0.33
/i, ə/	4	8	0.33
/e, u/	4	10	0.29
/a, u/	3	10	0.23
/ə, u/	3	11	0.21
/ə, ə/	3	11	0.21
/i, u/	2	11	0.15
/i, a/	2	11	0.15
/ə, u/	2	13	0.13
/a, u/	2	13	0.13
/i, ə/	1	13	0.07

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But these similarity measures provide no basis for distinguishing between pairs of vowels that participate in harmony and those that do not.

5. Is Optimality Theory an alternative to a theory of contrastive specification?

It has been claimed (Itô, Mester and Padgett 1995, Kirchner 1997) that contrasts 'emerge' from OT constraint rankings. But an arbitrary constraint ranking will not express a connection between contrast and phonological activity. If there is such a connection, it should be captured in phonological theory.

- A contrastive hierarchy, being essentially a set of wellformedness conditions on representations, can be stated as a set of OT constraints (Mackenzie & Dresher 2004)
- 5.1. Constraints used to model a contrastive hierarchy
 - a. IO-IDENT [F]: 'Correspondent segments must have the same value of the feature [F] (either + or -)'.
 - b. *[F, Φ]: 'Exclude feature [F] in the context Φ', where Φ is the set of features (with wider scope than [F]) forming the context of [F]'.
 - 5.2. (Constraint set for the Classical Manchu contrastive hierarchy
 IO-IDENT [low] >> *[coronal, +low] >> IO-IDENT [coronal] >> *[labial, -low] >> IO-IDENT [labial] >> *[ATR, +coronal], *[ATR, +labial] >> IO-IDENT [ATR] >> *[F]
 - 5.3. Sample tableau: Written Manchu contrastive specifications

Input /-lo +cr -lb +at/	ID lo	*cr +lo	ID cr	*lb -lo	ID lb	*at +cr	*at +lb	ID at	*F
a. -lo +cr -lb +at				*!		*			
b. +lo +cr	*!	*			*			*	
c. -lo -cr +at			*!		*				
d. -lo +cr +at					*	*!			
e. -lo +cr +hi					*			*	*!
f. \varnothing -lo +cr					*			*	

6. Conclusion

A number of conclusions follow from the approach presented here (Dresher 2004):

- First, the kind of contrast discussed here is a *phonological*, not strictly *phonetic*, concept: it refers to *features*, not whole *segments*, and thus cannot be read off of the surface phonetics.
- While the phonetics may enhance phonological contrasts in various ways (Liljencrants and Lindblom 1972, Stevens, Keyser and Kawasaki 1986), it may also obscure them.
- Finally, just as is the case with prosodic representations such as stress and syllable structure (Dresher 1999), segmental representations are not given to the learner in advance, but must be acquired together with the rest of the phonology.

These topics are the subject of ongoing work in the project on Contrast in Phonology at the University of Toronto:

<http://www.chass.utoronto.ca/~contrast/>

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