

Handout #4

Natural classes and distinctive
features

Consonants

	Bila- bial	Labio- dental	Dental	Alveo- lar	Alveo- palatal	Retro- flex	Palatal	Velar	Uvular	Pha- ryngeal
Plosive	p b		t̪ d̪	t d		ʈ ɖ	c ɟ	k g	q	
Trills				r					R	
Nasal	m			n		ɳ	ɲ	ŋ		
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç j̥	x ɣ	χ ʁ	ħ ʕ
Lateral fricative				ɬ ɮ						
Approxi- mant				ɹ			j			
Lateral ap- proximant				l			ʎ			

Other consonant classes

- Affricates: [tʃ, dʒ, pf, bv, ts, dz]
- Labiovelars: [w, kp, gb]
- Placeless aspirated continuant: [h]
- Glottal stop: [ʔ]
- Implosives: [ɓ, ɗ, ɠ]
- Ejectives: [pʰ, tʰ, kʰ]
- Clicks: Dental [kɿ], Alveolar [kʰ!],
Lateral [kɿɿ]

Rounded vowels

	Front	Central	Back
High	y Y	ʉ	u U
Mid	ø œ		o ɔ
Low			ɒ

Unrounded vowels

	Front	Central	Back
High	<i>i</i> <i>ɪ</i>	<i>ɨ</i>	<i>ɯ</i>
Mid	<i>e</i> <i>ɛ</i>	<i>ə</i>	<i>ɤ</i>
Low	<i>æ</i>	<i>ʌ</i> <i>a</i>	<i>ɑ</i>

Diacritics

- Voiceless (for sonorants): [m̥, ɲ̥, l̥, ...]
- Aspirated: [p^h, t^h, k^h, ...]
- Syllabic (for consonants): [n̩, ɹ̩, l̩, ...]
- Breathy-voiced: [z̤, d̤, m̤, ...]
- Creaky-voiced: [z̰, d̰, m̰, ...]
- Nasalized: [ẽ, ã, õ, ...]
- Palatalized: [tʲ, dʲ, pʲ, mʲ, ...]
- Long: [ɪː, eː, tɪː, ...]

Classes of sounds

- Phonological patterns generally involve sets of sounds, not just a single sound.
- Among the classes we've encountered:
 - Voiceless plosives
 - Plosives
 - Alveolar stops
 - High vowels
 - High front vowels

Natural classes

- These are phonetically defined sets - they are the set of all sounds in a language that share a certain phonetic property.
- But phonologists beginning with Jakobson and Trubetskoy in the 1930's observed that not all phonetically defined classes actually play a role in phonological patterns.
- The sets of sounds that occur in phonological patterns are called **natural classes**.

Unnatural classes

- Here are some phonetically-defined classes that never play a role in phonological patterns:
 - The sounds articulated on the upper teeth: labiodentals and dentals.
 - The sounds articulated in front of the hard palate: bilabials, labiodentals, dentals, alveolars, and alveopalatals.
 - The vowels articulated in front of the velum: the front and central vowels

Distinctive features

- Roman Jakobson proposed that there is one universal set of **distinctive features** for all languages, which define classes of sounds relevant to phonology.
 - All contrasts must be stated in terms of these features.
 - All restrictions on distribution must be stated in terms of these features.

The sources of the distinctive features

- Chomsky, N. and Halle, M. (1968). *The Sound Pattern of English*. Harper and Row, New York.
- Halle, M. and K. Stevens (1971). A note on laryngeal features. *Quarterly Progress Report* 101. Research Laboratory of Electronics, MIT. 198-212.
- Jakobson, R., Fant, G., and Halle, M. (1952). *Preliminaries to Speech Analysis*. MIT Press, Cambridge.
- Keating, P. (1988). *A Survey of Phonological Features*. Indiana University Linguistics Club, Bloomington.
- McCarthy, J. (1988). Feature geometry and dependency: A review. *Phonetica* 43. 84-108

The major class features

- The major class features are:
 - [consonantal]
 - [sonorant]
 - [syllabic]
- They define major classes of sounds, such as consonant and vowel, sonorant and obstruent.

The major class features

- **[consonantal]:** A sound is [+cons] if it is produced with significant obstruction of the oral vocal tract; otherwise it is [-cons].
 - [+cons]: Obstruents, nasal stops, liquids (r's and l's).
 - [-cons]: Vowels, semivowels (i.e. glides like [j] and [w]).

The major class features

- **[sonorant]:** A sound is [+son] if it is produced with a vocal tract sufficiently open that with modal voiced airflow there is no turbulence; otherwise it is [-son].
 - [+son]: Vowels, semivowels, approximants, nasal stops, trills.
 - [-son]: Obstruents (oral stops, fricatives)

The major class features

- **[syllabic]:** A sound is [+syll] if it is the most prominent sound in its syllable; otherwise it is [-syll].
 - [+syll]: Vowels, syllabic consonants
 - [-syll]: Semivowels, nonsyllabic consonants.
 - V = [+syll]
 - C = [-syll]

The major class features

	[cons]	[syll]	[son]
Syllabic sonorant consonants, e.g. [ɹ, ɱ]	+	+	+
Nonsyllabic sonorant consonants, e.g. [l, n]	+	-	+
Syllabic obstruents, e.g. [ʃ, ʈ]	+	+	-
Nonsyllabic obstruents, e.g. [s, t]	+	-	-

The major class features

	[cons]	[syll]	[son]
Vowels, e.g. [i, a, u]	-	+	+
Semivowels, e.g. [j, w]	-	-	+
Physically impossible	-	+	-
Physically impossible	-	-	-

Place features

- **[labial]**: A sound is [+lab] if it is articulated with the lips; otherwise it is [-lab].
 - [+lab]: Bilabials, labiodentals, rounded vowels, labiovelars, labialized consonants.
 - [-lab]: All other sounds.

Place features

- **[coronal]**: A sound is [+cor] if it is articulated with the tongue blade or front of the tongue; otherwise it is [-cor].
 - [+cor]: Dentals, alveolars, alveopalatals, retroflexes, palatals, front vowels, palatalized consonants.
 - [-cor]: All other sounds.

Place features

- **[anterior]**: A sound is [+ant] if it is [+cor] and it is produced on or in front of the alveolar ridge; otherwise it is [-ant].
 - [+ant]: Dentals, alveolars.
 - [-ant]: All other sounds.

Place features

- **[distributed]**: A sound is [+dist] if it is [+cor] and it is produced with the whole tongue blade; otherwise it is [-dist].
 - [+dist]: Alveolars, alveopalatals
 - [-dist]: All other sounds.

Place features

- **[back]**: A sound is [+back] if it is articulated behind the hard palate; otherwise it is [-back].
 - [+back]: Velars, uvulars, pharyngeals, back vowels, central vowels, labiovelars, velarized consonants, pharyngealized consonants
 - [-back]: All other sounds.

Place features

	[lab]	[cor]	[back]
Labiovelars, Rounded back vowels	+	-	+
Labiodoronals, Rounded front vowels	+	+	-
Clicks, velarized laterals	-	+	+

Height features

- **[high]**: A sound is [+high] if it is produced with the tongue body raised from neutral (mid central) position; otherwise it is [-high].
 - [+high]: High vowels, high semivowels, velars, palatals, velarized consonants, palatalized consonants.
 - [-high]: All other sounds.

Height features

- **[low]**: A sound is [+low] if it is produced with the tongue body lowered from neutral (mid central) position; otherwise it is [-low].
 - [+low]: Low vowels, pharyngeals, pharyngealized consonants.
 - [-low]: All other sounds.

Height features in vowels

	[high]	[low]
High vowels	+	-
Mid vowels	-	-
Low vowels	-	+
Physically impossible	+	+

Place of articulation in consonants

	[lab]	[cor]	[dist]	[ant]	[back]
Bilabial, labiodental	+	-	-	-	-
Dental	-	+	-	+	-
Alveolar	-	+	+	+	-
Alveopala- tal, palatal	-	+	+	-	-
Retroflex	-	+	-	-	-

Place of articulation in consonants

	[lab]	[cor]	[back]	[high]	[low]
Velar	-	-	+	+	-
Uvular	-	-	+	-	-
Pharyngeal	-	-	+	-	+

Laryngeal features

- **[voice]**: A sound is [+voice] if it is produced with vocal fold vibration; otherwise it is [-voice].
 - [+voice]: All voiced sounds.
 - [-voice]: All voiceless sounds.

Laryngeal features

- **[spread glottis]**: A sound is [+spread] if it is produced with the vocal folds spread far enough apart that there is uninterrupted airflow; otherwise it is [-spread].
 - [+spread]: Aspirated sounds, breathy-voiced sounds
 - [-spread]: Voiceless unaspirated sounds, modal voiced sounds, creaky-voiced sounds.

Laryngeal features

- **[constricted glottis]**: A sound is [+constr] if it is produced with the vocal folds closer than in modal voicing; otherwise it is [-constr].
 - [+constr]: Glottal stop, creaky-voiced sounds, ejectives.
 - [-constr]: All other sounds.

Voiced sounds

	[voice]	[spread]	[constr]
Plain voiced	+	-	-
Breathy-voiced	+	+	-
Creaky-voiced	+	-	+
Physically impossible	+	+	+

Voiceless sounds

	[voice]	[spread]	[constr]
Voiceless unaspirated	-	-	-
Voiceless aspirated	-	+	-
Glottal stop, Ejective	-	-	+
Physically impossible	-	+	+

Manner features

- **[continuant]**: A sound is [+cont] if it is produced without closure in the oral cavity; otherwise it is [-cont].
 - [+cont]: Fricatives, approximants, vowels.
 - [-cont]: Oral stops (including affricates), nasal stops.

Manner features

- **[delayed release]**: A sound is [+del rel] if it is produced with an oral passage so narrow that airflow through it is turbulent; otherwise it is [-del rel].
 - [+del rel]: Fricatives, affricates.
 - [-del rel]: All other sounds.

Manner features

- **[lateral]**: A sound is [+lat] if it is produced with airflow around a side of the oral cavity but not the center; otherwise it is [-lat].
 - [+lat]: Laterals.
 - [-lat]: All other sounds.

Manner features

- **[nasal]**: A sound is [+nas] if it is produced with airflow through the nasal cavity; otherwise it is [-nas].
 - [+nas]: Nasals.
 - [-nas]: All other sounds.

Manner features

- **[Advanced Tongue Root]**: A sound is [+ATR] if it is produced with the tongue root advanced from neutral position; otherwise it is [-ATR].
 - [+ATR]: Tense vowels.
 - [-ATR]: All other sounds.

Some consonant classes

	[son]	[cont]	[del rel]
Plosives	-	-	-
Affricates	-	-	+
Fricatives	-	+	+
Nasals	+	-	-
Approximants	+	+	-

Unrounded vowels ([-lab])

	[-back]	[+back]
[+high, -low, +ATR]	i	ɪ, ʊ
[+high, -low, -ATR]	ɪ	ɪ, ʊ
[-high, -low, +ATR]	e	ə, ʌ
[-high, -low, -ATR]	ɛ	ə, ʌ
[-high, +low, -ATR]	æ	ɑ, ʌ, ɒ

Rounded vowels ([+lab])

	[-back]	[+back]
[+high, -low, +ATR]	y	ʏ, u
[+high, -low, -ATR]	Y	ʘ, ʊ
[-high, -low, +ATR]	ø	o
[-high, -low, -ATR]	œ	ɔ
[-high, +low, -ATR]	œ̃	ɒ

Formal notation for phonological rules

- $A \rightarrow B / C \text{ --- } D$
- Interpretation: Change A into B if it follows C and precedes D
- A, B, C, D are categories defined in terms of features.
- Any of them can also be \emptyset , which is the null string (i.e. nothing).

Formal notation for phonological rules

- $A \rightarrow B$ is the **change** defined by the rule.
- A, to the left of the arrow, is the **target** of the rule.
- $/ C ___ D$ is the **context** of the rule.
- The blank, called the **focus bar**, represents the position of A, the target of the rule.
- So this rule changes CAD to CBD.

Examples

- Zoque

- Prose: “Change a stop into a voiced one if it occurs after a nasal.”
- Formal: [-cont] --> [+voice] / [+nas] _____

- Angas

- Prose: “Change a sonorant consonant into a voiceless one if it occurs at the end of a word”.
- Formal: [+son, +cons] --> [-voice] / ____ #

Examples

- Korean

- Prose: “Change an alveolar fricative into an alveopalatal one if it occurs before [i].”
- Formal:
[+cor, -son, +cont] --> [-ant] / ____ [+syll, +high, -back]

- Tohonno O’odham

- Prose: “Change an alveolar stop into an alveopalatal affricate if it occurs before a high vowel”.
- Formal:
[+cor, -son, -cont] --> [-ant, +delrel] / ____ [+syll, +high]