Phonological Analysis

• A Phonological Analysis consists of the following elements:
  – List of the phonemes of a language
  – Classification system for categorizing the phonemes
  – Phonotactics - positional and sequential occurrences of phonemes within a language
  – List of the allophonic variations for each of the phonemes
Alternative Classification Systems
For Describing and Categorizing Phonemes

- Classical phonetic features of place and manner, and voicing
- Distinctive Features
Classical Phonetic Features

/p/ specified using articulatory descriptors:

/p/ =

voiceless bilabial stop
Distinctive Features

/p/ described as a bundle of features

| [-Vocalic]  | [- Low]   | [- Continuant] |
| [+Consonantal] | [- Back]  | [+Tense]      |
| [-Sonorant]  | [- Rounded] | [- Voiced] |
| [-Coronal]   | [- Distributed] | [-Strident] |
| [+Anterior]  | [- Nasal]   |               |
| [-High]      | [- Lateral]  |               |
Distinctive Feature Theory

- Roman Jakobson
  - Prague School of Linguistics (Pre-WWII)
  - Massachusetts Institute of Technology (MIT) and Harvard University

- Gunnar Fant
  - KTH - Royal Technical Institute, Stockholm, Sweden

- Morris Halle
  - Massachusetts Institute of Technology
Uses for Distinctive Features

- To specify a phoneme
- To specify a class of phonemes
- To describe the set of speech sounds used in a particular language or dialect
- To write concise rules of phonetic change
- To characterize a speech disorder
  - e.g. substitution, often involving a change of feature)
Distinctive Features

- Features are binary (+ or - values)
- Each speech sound may be described as a “bundle” of features
- Each member of every pair of phones is distinguished from the other member by at least one feature value
- Features are universal, but a given language may use a subset of features as distinctive
Features
(*=Original Jakobson, Fant & Halle features)

- *Vocalic/Nonvocalic
- *Consonantal/Nonconsonantal
- Sonorant/Obstruent
- Rhotic/Nonrhotic (vowels)
- Advanced/Nonadvanced (vowels and diphthongs)
- Front/Nonfront (vowels)
- Coronal/Noncoronal [=*Acute/Grave]
- Anterior/Nonanterior [=*Compact/Diffuse] (consonants)
Features, continued (*=Original Jakobson, Fant & Halle features)

- High/Nonhigh
- Low/Nonlow
- Back/Nonback
Features, continued (*=Original Jakobson, Fant & Halle features)

- Rounded/Nonrounded (*Flat/Plain)
- Distributed/Nondistributed
- *Nasal/nonnasal
- Lateral/Nonlateral
Features, concluded
(*=Original Jakobson, Fant & Halle features)

- *Continuant/Stop
- *Tense/lax (vowels)
- *Voiced/voiceless
- *Strident/Nonstrident (consonants)
Redundancy Rules

- All vowels in English are [+ Voiced]
- All [-Voiced] sounds are [+Consonantal], [-Nasal], [-Sonorant] and [-Vocalic]
- [+Anterior] sounds are [-Distributed]
- Sounds that are both [-Continuant] and [+Anterior] are [-Strident]
- [-Coronal] sounds are [-Lateral]
With Redundancy eliminated

\[ p / = \ [\text{-Voiced}] \]
\[ \text{-Continuant} \]
\[ \text{+Anterior} \]
\[ \text{-Coronal} \]
Features Used to Define A Class

- Class of “Stop Consonants”
- /p,b,t,d,k,g/: [+Consonantal] [-Vocalic] [-Continuant] [-Nasal] [-Distributed]
Concept of “Complement”

A is the complement of B
B is the complement of A

A “complements” B.
A + B = whole
Complementary Distribution

• aspirated /p/ in syllable initial position “pot”
  \[ p^h a t \]

• non-aspirated after /s/ “spot”
  \[ s p^z a t \]
Free Variation

• “cigarette” - stress on first or last syllable
• “economics” - first vowel sound /ɪ/ or /ɛ/
• aspiration of final /p/ in “pop”
Phonotactic Rules

- Some languages permit only CV syllables
- English has consonant clusters “sixths”
- Some languages permit eng (or engma) [ŋ] as first sound in a word
- If a word starts with three consonants, the first must be /s/
Levels of Structure

• Phone
• Phoneme
• Morpheme
• Word
• Phrase
• Sentence
• Paragraph
Phonological Rules

• Sound Changes

• Example:
  “write” / r əi t /

  “writing” / r əiɭ iŋ /

/ t / becomes / ɭ / when it occurs between a preceding vowel and a following non-stressed vowel
Using Distinctive Features To Indicate A Sound Change Rule

[-Voiced] ⇒ [+Voiced]

/+ Vocalic-Consonantal/

[+Coronal +Anterior]

[-Continuant -Nasal]

[+Vocalic -Consonantal -Stress]
Example of a Substitution Rule

\[ /ʃ/ \Rightarrow /s/ \]

A common substitution made by children

“shoe” pronounced as “Sue”
Feature Representation of Rule

\[
\begin{align*}
\text{-Anterior} \\
\text{+High} \\
\Rightarrow \\
\text{+ Anterior} \\
\text{-High}
\end{align*}
\]/

\begin{align*}
\text{+ Consonantal} \\
\text{+ Coronal} \\
\text{- Nasal} \\
\text{- Low} \\
\text{- Strident} \\
\text{-Voiced}
\end{align*}