01:615:201
Introduction to Linguistic Theory
Adam Szczegielniak
Phonology: The Sound Patterns of Language
Phonology: The Sound Patterns of Language

- There are only a dozen or so features needed to describe every speech sound in every human language
  
  - All the languages in the world sound so different because the way the languages use speech sounds to form patterns differs from language to language

- The study of how speech sounds form patterns is phonology

- Phonology tells us what sounds are in a language, how they do and can combine into words, and explains why certain phonetic features are important to identifying a word
The Pronunciation of Morphemes: Plurals

• Sometimes certain morphemes are pronounced differently depending on their context.

• For example, the English plural morpheme has three different pronunciations depending on what noun you attach it to:

  – It gets pronounced as a [z] for words like *cab*, *bag*, and *bar*
  – It gets pronounced as [s] for words like *cap*, *back*, and *faith*
  – It gets pronounced as [əz] for words like *bus*, *garage*, and *match*
The Pronunciation of Morphemes: Plurals

- To determine a rule for when each variant of the plural morpheme, or allomorph, is used, it is useful to create a chart to examine the phonological environments in which each allomorph occurs:

<table>
<thead>
<tr>
<th>Allomorph</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>[z]</td>
<td>After [kæb], [kæd], [bæg], [lʌv], [lɛð], [kæm], [kæŋ], [bæŋ], [kəl], [bar], [spa], [bɔi], e.g., [kæbz], [kædz] . . . [bɔiz]</td>
</tr>
<tr>
<td>[s]</td>
<td>After [kæp], [kæt], [bæk], [kʌf], [feθ], e.g., [kæps], [kæts] . . . [feθs]</td>
</tr>
<tr>
<td>[əz]</td>
<td>After [bʌs], [bʊʃ], [bʌz], [gəraʒ], [mætʃ], [bædʒ], e.g., [bʌsəz], [bʊʃəz] . . . [bædʒəz]</td>
</tr>
</tbody>
</table>
The Pronunciation of Morphemes: Plurals

• To help us figure out what is different between the phonological environments of the words that take the [-s], [-z], and [-əz] allomorphs, we can look for minimal pairs

  – A minimal pair is two words with different meanings that are identical except for one sound that occurs in the same place in each word

  – Minimal pairs whose members take different forms of the plural allomorph are particularly helpful for our purposes

• For example, *cab* [kæb] and *cap* [kæp] differ only by their final sound, so since each word takes a different allomorph, we can assume that the allomorph is selected based on the final sound of the noun
The Pronunciation of Morphemes: Plurals

• Now we can make our chart a little more succinct since we know we are looking only at the final sound of each noun:

<table>
<thead>
<tr>
<th>Allomorph</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>[z]</td>
<td>After [b], [d], [g], [v], [ð], [m], [n], [ŋ], [l], [r], [a], [ɔɪ]</td>
</tr>
<tr>
<td>[s]</td>
<td>After [p], [t], [k], [ʃ], [θ]</td>
</tr>
<tr>
<td>[əz]</td>
<td>After [s], [ʃ], [z], [ʒ], [tʃ], [dʒ]</td>
</tr>
</tbody>
</table>

• Then we can make generalizations about the environment in which each allomorph occurs based on knowledge of natural classes

  – [z] occurs after voiced nonsibilant segments
  – [s] occurs after voiceless nonsibilant segments
  – [əz] occurs after sibilant segments
The Pronunciation of Morphemes: Plurals

• We can simplify this even more by creating a rule that assumes /z/ is the basic or underlying form of the plural, then we have two rules to explain why the other allomorphs occur:

  1. Insert a [ə] before the plural morpheme /z/ when a regular noun ends in a sibilant, giving [əz]

  2. Change the plural morpheme /z/ to a voiceless [s] when preceded by a voiceless sound

  • We can write this in rule format
  • /z/ -> [s] / [-voice] _
The Pronunciation of Morphemes: Plurals

- This chart illustrates how the plurals of *bus*, *butt*, and *bug* are formed by applying these two rules:

<table>
<thead>
<tr>
<th>Basic representation</th>
<th>bus + pl.</th>
<th>butt + pl.</th>
<th>bug + pl.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/bʌs + z/</td>
<td>/bʌt + z/</td>
<td>/bʌg + z/</td>
</tr>
</tbody>
</table>

- Apply rule (1)
  - *bus*: ə
  - *butt*: NA*
  - *bug*: NA

- Apply rule (2)
  - *bus*: NA
  - *butt*: s
  - *bug*: NA

| Phonetic representation | [bʌseəz] | [bʌts] | [bʌgz] |

*NA means “not applicable.”
The Pronunciation of Morphemes: Plurals

• These rules must be ordered so that rule 1 applies before rule 2 otherwise we would derive an incorrect phonetic form.

\[
\text{Basic representation} \quad \text{/bæs} + \text{z/} \\
\text{Apply rule (2)} \\
\text{Apply rule (1)} \\
\text{Phonetic representation} \quad *[^{bæsəz}] \\
\]

• The particular phonological rules that determine the phonetic form of morphemes are morphophonemic rules.
Additional Examples of Allomorphs

- The English possessive morpheme and the third person singular morpheme have allomorphs that take on the same phonetic form as the plural morpheme and are governed by the same rules:

  **Possessive:**
  Add [z] to woman to get woman’s
  Add [s] to ship to get ship’s
  Add [əz] to judge to get judge’s

  **Third person singular:**
  Add [z] to need to get needs
  Add [s] to eat to get eats
  Add [əz] to rush to get rushes
Additional Examples of Allomorphs

• The English past tense morpheme also has different pronunciations depending on the last sound of the verb
  – If the verb ends in any voiced sound except [d], then you add a [d] to make it past tense
  – If the verb ends in any voiceless segment other than [t], then you add [t] to make it past tense
  – If the verb ends in [t] or [d] then you add [əd] to make it past tense

• Most languages have allomorphemic variation. For example, Akan has three allomorphs for a negative marker:
  
mí pɛ  “I like”      mí mɛ pɛ  “I don’t like”
  mí tɛ  “I speak”    mí mɛ  tɛ  “I don’t speak”
  mí kɔ  “I go”       mí ɛ kɔ  “I don’t go”

• The rule that changes the pronunciation of the nasal consonants is called the **homorganic nasal rule**
Phonemes: The Phonological Units of Language

- **Phonemes** are the basic unit of sound and are sensed in your mind rather than spoken or heard.

- Each phoneme has one or more sounds called **allophones** associated with it, which represent the actual sound being produced in various environments.
Vowel phonemes in English

• When you do these substitutions you are creating minimal pairs, such as in this list:

<table>
<thead>
<tr>
<th>beat</th>
<th>[bit]</th>
<th>[i]</th>
<th>boot</th>
<th>[but]</th>
<th>[u]</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit</td>
<td>[bɪt]</td>
<td>[ɪ]</td>
<td>but</td>
<td>[bʌt]</td>
<td>[ʌ]</td>
</tr>
<tr>
<td>bait</td>
<td>[bɛɪt]</td>
<td>[ɛ]</td>
<td>boat</td>
<td>[bɔt]</td>
<td>[o]</td>
</tr>
<tr>
<td>bet</td>
<td>[bɛt]</td>
<td>[ɛ]</td>
<td>bought</td>
<td>[bɔt]</td>
<td>[o]</td>
</tr>
<tr>
<td>bat</td>
<td>[bæt]</td>
<td>[æ]</td>
<td>bout</td>
<td>[bɔut]</td>
<td>[au]</td>
</tr>
<tr>
<td>bite</td>
<td>[baɪt]</td>
<td>[aɪ]</td>
<td>bot</td>
<td>[bat]</td>
<td>[a]</td>
</tr>
</tbody>
</table>

• This list demonstrates that this dialect of English has fourteen different vowel phonemes: /i ɪ e ɛ æ u ʊ o ɔ a ʌ/ and /aɪ/, /au/ and /ɔɪ/
  – And all of these phonemes has at least two allophones;
    • The nasal version, which occurs before nasal consonants
    • The oral version, which occurs elsewhere
Illustration of nasal Allophones

- English contains an allophonic rule that determines contexts in which vowels are nasalized:
  - Vowels are nasalized before a nasal consonant within the same syllable structure
    
    | be   | [bi] | bead  | [bid] | bean    | [bɪn] |
    |------|------|-------|-------|---------|-------|
    | lay  | [le] | lace  | [les] | lame    | [lɛm] |
    | baa  | [bæ] | bad   | [bæd] | bang    | [bæŋ] |
  - You could change the nasalization when you pronounce these words (if you were aware that you did this) and although it would sound strange, it would not change the meaning of the words
  - Because nasalized vowels are not used to make a meaning contrast we tend to not even notice them
Allophones of /t/

• Consonants also have allophones:

  *tick [tʰɪk]  stick [stɪk]  hits [hɪts]  bitter [bɪrər]*

  • /t/ is pronounced [tʰ] before a stressed vowel
  • /t/ is pronounced [t] directly before or after [s]
  • /t/ is pronounced [ɾ] between a stressed and unstressed vowel

• If we pronounce *tick* as [tɪk] or [ɾɪk] instead of [tʰɪk], we are still speaking the same word, even if it sounds strange because these allophones of /t/ do not contrast

  • However, if we tried to pronounce *tick* as [sɪk], we would be saying *sick*, which has a different meaning
  • The meaning changes because /t/ and /s/ are separate phonemes and do contrast
Complementary Distribution

• Allophones of a phoneme are in **complementary distribution** = they never occur in the same environment
  – Like Superman and Clark Kent

<table>
<thead>
<tr>
<th></th>
<th>In Final Position</th>
<th>Before Nasal Consonants</th>
<th>Before Oral Consonants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral vowels</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Nasal vowels</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Complementary Distribution

• Examples from the writing system can help illustrate the idea of complementary distribution

  1. Each letter of English can appear in upper case or lower case form, but upper case only occurs in certain contexts, like the beginning of a word, and everywhere else we get the lower case

  2. In cursive handwriting, letters may get written differently depending on what comes before and after, and each variant (allograph) is dependent on context
Complementary Distribution

• When sounds are in complementary distribution, they do not contrast with each other
  – The replacement of one sound for the other will not change the meaning of the word

• If two sounds are allophones of a single phoneme, they must be in complementary distribution and be phonetically similar
Distinctive Features of Phonemes

• For two **phones**, or sounds, to contrast meaning there must be some difference between them
  
  – For example, the phonetic feature of voicing distinguishes [s] from [z]

• When a feature distinguishes one phoneme from another, it is a **distinctive feature** or a **phonemic feature**
Feature Values

• Features have two values: [+ feature] and [-feature] to indicate the presence or absence of that particular feature
  – For example, [b] is [+voiced] and [p] is [-voiced]

• At least one feature difference must distinguish each phoneme of a language

<table>
<thead>
<tr>
<th>Feature</th>
<th>b</th>
<th>m</th>
<th>d</th>
<th>n</th>
<th>g</th>
<th>η</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Voiced</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Labial</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Alveolar</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Velar</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Nasal</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>
Nondistinctive Features

• When a feature is predictable by a rule for a certain class of sounds, that feature is a **nondistinctive** (or **redundant** or **predictable**) feature for that class

  – For example, nasalization is a redundant feature for English vowels but is distinctive for English consonants

    • But in Akan and French nasalization is a distinctive feature for vowels

  – Also, aspiration is a nondistinctive feature for voiceless stops in English
Phonemic Patterns May Vary Across Languages

• The same phones may occur in two languages but pattern differently because the phonologies of the languages are different

• While aspiration is not distinctive in English, it is distinctive in Thai:

<table>
<thead>
<tr>
<th>Voiceless Unaspirated</th>
<th>Voiceless Aspirated</th>
</tr>
</thead>
<tbody>
<tr>
<td>[paa] forest</td>
<td>[pʰaa] to split</td>
</tr>
<tr>
<td>[tam] to pound</td>
<td>[tʰam] to do</td>
</tr>
<tr>
<td>[kat] to bite</td>
<td>[kʰat] to interrupt</td>
</tr>
</tbody>
</table>
Natural Classes of Speech Sounds

• Phonological rules often apply to **natural classes** of sounds

  – A natural class is a group of sounds described by a small number of distinctive features
  – Natural classes can be defined by + and – feature values

| Feature Specification of Major Natural Classes of Sounds |
|-------------|-------------|-------------|-------------|-------------|-------------|
| Features    | Obstruents  | Nasals      | Liquids     | Glides      | Vowels      |
| Consonantal | +           | +           | +           | –           | –           |
| Sonorant    | –           | +           | +           | +           | +           |
| Syllabic    | –           | +/-         | +/-         | –           | +           |
| Nasal       | –           | +           | –           | –           | +/-         |
### Feature Specifications for American English Consonants and Vowels

#### Features of Some American English Vowels

<table>
<thead>
<tr>
<th>Features</th>
<th>i</th>
<th>l</th>
<th>e</th>
<th>ɛ</th>
<th>æ</th>
<th>u</th>
<th>u</th>
<th>o</th>
<th>[ɔ]</th>
<th>a</th>
<th>Λ</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mid</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Low</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Back</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Central</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Round</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tense</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>
### Feature Specifications for American English Consonants and Vowels

#### TABLE 7.5: Features of Some American English Consonants

| Features          | p | b | m | t | d | n | k | g | η | f | v | θ | ð | s | z | ğ | ʃ | ʒ | ʒ | j | l | r | j | w | h |
| Consonantal       | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Sonorant          | - | - | + | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Syllabic          | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Nasal             | - | - | + | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Voiced            | + | + | + | - | - | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Continuant        | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Labial            | + | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Alveolar          | - | - | + | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Palatal           | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Anterior          | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Velar             | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Coronal           | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Sibilant          | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Note: The phonemes /r/ and /l/ are distinguished by the feature [lateral], not shown here. /l/ is the only phoneme that would be [+lateral].
Assimilation Rules

• An **assimilation rule** is a rule that makes neighboring segments more similar by duplicating a phonetic property
  – For example, the English vowel nasalization rule states that *vowels become nasalized before a nasal consonant within the same syllable*

\[
V \rightarrow [+\text{nasal}] / \_ \_ [+\text{nasal}] \_ \_ [+\text{nasal}] $
\]
Assimilation Rules

- Assimilation rules reflect coarticulation
  - Coarticulation is the spreading of phonetic features either in anticipation or in the preservation of articulatory processes
    - For example, it is easier to lower the velum while a vowel is being produced before a nasal stop than to wait for the completion of the vowel to then lower the velum even more quickly

- There are many assimilation rules in English and other languages
  - English plural and past tense morphemes
  - Akan negative morphemes
Dissimilation Rules

- Languages also have dissimilation rules, in which a segment becomes less like another segment.
  - It is sometimes easier to articulate dissimilar sounds.

- Latin suffix \(-alis\) to form adjectives dissimilates to \(-aris\) when an \(l\) is in the noun and the dissimilation can be seen in the words borrowed into English:

<table>
<thead>
<tr>
<th>-al</th>
<th>-ar</th>
</tr>
</thead>
<tbody>
<tr>
<td>anecdot-al</td>
<td>angul-ar</td>
</tr>
<tr>
<td>annu-al</td>
<td>annul-ar</td>
</tr>
<tr>
<td>ment-al</td>
<td>column-ar</td>
</tr>
<tr>
<td>pen-al</td>
<td>perpendicul-ar</td>
</tr>
<tr>
<td>spiritu-al</td>
<td>simil-ar</td>
</tr>
<tr>
<td>ven-al</td>
<td>vel-ar</td>
</tr>
</tbody>
</table>
Segment Insertion and Deletion Rules

• Phonological rules may also add or delete entire segments
  – Adding a segment is known as **epenthesis**

• The rules for forming plurals, possessives, and third person singular verb agreement in English all involve an epenthesis rule:

  Insert a [ə] before the plural morpheme /z/ when a regular noun ends in a sibilant, giving [əz]

\[
\emptyset \rightarrow \text{ə} / [+\text{sibilant}] ____ [+\text{sibilant}]
\]
Segment Insertion and Deletion Rules

• Segment deletion is more common than insertion
  – The word memory is often pronounced as if it were spelled memry
  – The deletion of [g]:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>sign</td>
<td>signature</td>
</tr>
<tr>
<td>design</td>
<td>designation</td>
</tr>
<tr>
<td>paradigm</td>
<td>paradigmatic</td>
</tr>
<tr>
<td>[sæm] [dɛzæm]</td>
<td>[sɪgnətʃər] [dɛzɪɡnən]</td>
</tr>
<tr>
<td>[pʰærədæɪm]</td>
<td>[pʰærədɪɡmərək]</td>
</tr>
</tbody>
</table>
From One to Many and from Many to One

- In English unstressed vowels are reduced to [ə]

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>/i/</td>
<td>compete [i]</td>
</tr>
<tr>
<td>/ɪ/</td>
<td>medicinal [ɪ]</td>
</tr>
<tr>
<td>/e/</td>
<td>maintain [e]</td>
</tr>
<tr>
<td>/ɛ/</td>
<td>telegraph [ɛ]</td>
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<td>/æ/</td>
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<td>/a/</td>
<td>solid [a]</td>
</tr>
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<td>/o/</td>
<td>phone [o]</td>
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<tr>
<td>/u/</td>
<td>Talmudic [u]</td>
</tr>
<tr>
<td></td>
<td>competition  [ə]</td>
</tr>
<tr>
<td></td>
<td>medicine     [ə]</td>
</tr>
<tr>
<td></td>
<td>maintenance  [ə]</td>
</tr>
<tr>
<td></td>
<td>telegraphy   [ə]</td>
</tr>
<tr>
<td></td>
<td>analytic     [ə]</td>
</tr>
<tr>
<td></td>
<td>solidity      [ə]</td>
</tr>
<tr>
<td></td>
<td>phonetic     [ə]</td>
</tr>
<tr>
<td></td>
<td>Talmud       [ə]</td>
</tr>
</tbody>
</table>

- German has both voiced and voiceless obstruents as phonemes, but when they occur at the end of words, they become voiceless
The Function of Phonological Rules

• Phonological rules provide the phonetic information necessary for the pronunciation of utterances
  – **Derivation**: the way the phonological rules apply to the underlying phonemic representation to create the phonetic representation:

  Underlying phonemic representation: /tempēst/

  - **Aspiration rule**: \( t^h \)
  - **Nasalization rule**: \( ĕ \)
  - **Schwa rule**: \( ə \)

  Surface phonetic representation: \([t^h ə mpəst]\)
Slips of the Tongue: Evidence for Phonological Rules

• Speech errors show phonological rules in action:
  – Intended utterance: *gone to seed*
    
    [găn tə sid]
  – Actual utterance: *god to seen*
    
    [gad tə sĩn]

• Here the reversal of the consonants also changed the nasality of the vowels

  • The vowel [ã] in the intended utterance is replaced by [a] because the vowel is no longer followed by a nasal (since the /n/ and /d/ switched) and the vowel [i] in the intended utterance is nasalized since it was followed by a nasal consonant after the switch
Syllable Structure

• Words are composed of one or more syllables, which are phonological units composed of one or more phonemes
  
  – Every syllable has a nucleus, and the nucleus may be preceded and/or followed by one or more phonemes called the onset and the coda
  
  – The rime is the nucleus + the coda
Word Stress

• In English and many other languages one or more syllables in every word has stress
  – In English stress can be contrastive and helps to distinguish nouns from verbs:
    
    - pérvért (noun) as in “My neighbor is a pervert.”
    - pervért (verb) as in “Don’t pervert the idea.”
    - súbject (noun) as in “Let’s change the subject.”
    - subjéct (verb) as in “He’ll subject us to criticism.”
  
  – British English and American English have different stress patterns which also leads to reduction of different vowels, both of which cause differences in pronunciation
Sentence and Phrase Stress

• When words are combined into phrases and sentences, one syllable receives more stress than others
• Phrasal stress can distinguish a compound noun from an adjective + noun combination

<table>
<thead>
<tr>
<th>Compound Noun</th>
<th>Adjective + Noun</th>
</tr>
</thead>
<tbody>
<tr>
<td>tíghtrope (“a rope for acrobatics”)</td>
<td>tight rópe (“a rope drawn taut”)</td>
</tr>
<tr>
<td>Rédcoat (“a British soldier”)</td>
<td>red cóat (“a coat that is red”)</td>
</tr>
<tr>
<td>hótdog (“a frankfurter”)</td>
<td>hot dóg (“an overheated dog”)</td>
</tr>
<tr>
<td>Whíte House (“the President’s house”)</td>
<td>white hóuse (“a house painted white”)</td>
</tr>
</tbody>
</table>
Intonation

- Pitch is a phonemic feature in some languages, and for these languages the pitches are known as **contrastive tones**

- In intonation languages pitch is important for the **pitch contour** or **intonation**
  - In intonation languages like English, intonation can be used to distinguish questions from statements can also disambiguate sentences in some cases
Sequential Constraints of Phonemes

• Knowledge of phonology includes information about what sequences of phonemes are possible and which are not in a particular language

  – The limitations on sequences of segments are called **phonotactic constraints**

• Phonotactic constraints are based on syllables and vary from language to language

  – In English two stops cannot begin a syllable
  – In Twi a word can only end in a vowel or a nasal consonant
Lexical Gaps

- **Lexical gaps**, or **accidental gaps**, are words that don’t exist in a language but could exist because they conform to the phonotactic constraints of the language.

  - For example, the words *cruke* [kʰrʊk], *cruck* [kʰrʌk], and *crike* [kʰraɪk] are not currently words in English, but they could be.

  - Advertisers make use of their knowledge of phonotactic constraints to create new product names.
    - While *Bic*, *Xerox*, and *Kodak* are OK, we’re unlikely to see a new brand or product called *Zhleet* [ʒlɪt].
Why Do Phonological Rules Exist?

• Many linguists believe that phonological rules exist to ensure that the phonetic forms of words do not violate the phonotactic constraints of the language

  – For example, English has a phonotactic constraint that prevents words from ending with two obstruents whose voicing features don’t match (*walked* pronounced as [wakd] is not possible)

• A phonological rule such as the one that devoices the past tense marker in English changes the pronunciation so that it conforms to this constraint (the pronunciation of *walked* becomes [wakt])
Why Do Phonological Rules Exist?

• **Optimality Theory**: It has been proposed that a universal set of phonological constraints exists and that this set is ordered with some constraints being more highly ranked

  – The rankings differ from language to language

  – The order of the rankings determines the different sound patterns shown across languages
Phonological Analysis

• In order to determine the phonemes and allophones in a language other than English, you should answer the following questions while you examine data:
  – 1. Are there any minimal pairs in the data in which these sounds contrast?
  – 2. Are any noncontrastive sounds in complementary distribution?
  – 3. If noncontrasting phones are found, what are the underlying phonemes and their allophones?
  – 4. What are the phonological rules by which the allophones can be derived?
Phonological Analysis

• In the Greek data below, our task is to determine whether the following sounds are allophones of separate phonemes or allophones of the same phoneme:
  – [x] voiceless velar fricative
  – [k] voiceless velar stop
  – [ç] voiceless palatal fricative
  – [c] voiceless palatal stop

1. [kano] “do”
2. [xano] “lose”
3. [çino] “pour”
4. [cino] “move”
5. [kali] “charms”
6. [xali] “plight”
7. [çeli] “eel”
8. [ceri] “candle”
9. [çeri] “hand”
10. [kori] “daughter”
11. [xori] “dances”
12. [xrima] “money”
13. [krima] “shame”
14. [xufta] “handful”
15. [kufeta] “bonbons”
16. [oçi] “no”
Phonological Analysis

1. Are there any minimal pairs in which the sounds [x], [k], [c], and [ç] contrast?

Phonological Analysis

1. Are there any minimal pairs in which the sounds [x], [k], [c], and [ç] contrast?


From these minimal pairs, we can tell that [k] and [x] contrast and that [c] and [ç] also contrast, but we have no evidence that [k] and [c] contrast, and we also don’t yet know about [x] and [ç].
Phonological Analysis

2. Are any noncontrastive sounds in complementary distribution?
   - One way to determine this is to list each phone with the environment in which it occurs:

   - [k]: before [a], [o], [u], [r]
   - [x]: before [a], [o], [u], [r]
   - [c]: before [i], [e]
   - [ç]: before [i], [e]

   - We can conclude that the stops [k] and [c] are allophones of one phoneme, and the fricatives [x] and [ç] are allophones of one phoneme
3. Which of the phone pairs is more basic, and therefore the underlying phoneme?

- In many languages of the world, velar sounds become palatal before front vowels

  - This is an assimilation rule since palatals are pronounced further forward in the mouth as are front vowels

- Therefore we select /k/ to be a phoneme with allophones [k] and [ç], and /x/ as a phoneme with allophones [x] and [ç]
• 4. We can now state the rule by which the palatals can be derived from the velars:

**Palatalize velar consonants before front vowels**

– Using feature notation we can state the rule as:

\[ [+\text{velar}] \rightarrow [+\text{palatal}] / \_\_\_ [-\text{back}] \]

– Since only consonants can be velar and only vowels have the feature [-back], we don’t have to include information about the features [consonantal] or [syllabic] in order to make our rule as simple as possible