Today’s topics:
• Phonemes and allophones
• Natural classes

Background reading:
• CL Ch 3, §1-3
0. Review: Consonant and vowel symbols

[ ɪf ju kʰ rid ḃɪs
ɹɛjz jɜ hænd ]

- Syllabic consonants are indicated with [ , ] below the consonant symbol
0. Terminology

- **Phonetics**: The physical articulation (and acoustics, and perception) of speech sounds

  **Phonology**: How speech sounds are classified and otherwise treated by the mental grammar

- Now that you have learned some basic phonetics, it’s time to explore some of what the mental grammar does with speech sounds
1. When are two speech sounds “different”? 

• A very important point to remember: 
  Just because two sounds are **physically** different does **not** guarantee that they are treated as two different **contrastive sound categories** in the **mental grammar** of a particular language.

• Are the “p”-sounds in the English words *pan* and *span* the same sound?
  - Physically/phonetically: **no**
    (see discussion of *aspiration* in *CL Ch 2, sec 5.5*)
  - Native speakers of English: Before you took this course, what would you have said?
1. When are two speech sounds “different”?

• Speech-analysis software demo: English vs. Hindi

English: [ pʰawt ]   [ bawt ]   [ spawt ]
   pout   bout   spout

Hindi:   [ pʰal ]   [ bal ]   [ pal ]
   ‘knife blade’   ‘hair’   ‘take care of’

- More Hindi examples are available from Peter Ladefoged’s web site for Vowels & Consonants

• Both languages use all three sounds

• But: The way these sounds are classified by the mental grammar is different in the two languages
2. Contrasting sounds and minimal pairs

• Every language has an inventory of speech sounds that are in contrast

• This means that they are treated as different categories in the phonology component of the mental grammar of a native speaker of that language

• A mental sound category is called a phoneme
  - Note: it’s not “phenome”; phone = ‘sound’

contrasting sounds = separate mental categories
= separate phonemes
2. Contrasting sounds and minimal pairs

- If two sounds are in contrast, we can find a **minimal pair** of words for those two sounds (see CL Ch 3, sec 1)
  - A minimal pair consists of two words that differ in only one sound and are otherwise identical (including the order of the sounds in the word)

- Is each pair of words below a minimal pair? If so, what sounds does it show to be in contrast?
  (a) Sue, zoo
  (b) leap, lip
  (c) I’ve, vie
  (d) boat, both
2. Contrasting sounds and minimal pairs

- If two sounds are in contrast in a language, then they **must** belong to different mental categories.
  - The mental lexicon couldn’t use two sounds to distinguish words if the mental grammar didn’t treat them as distinct categories.

- Example: If I say [su] and [zu], an English speaker knows those two words mean different things (and which is which).
  - This tells us that the mental lexicon of an English speaker treats /s/ and /z/ as two different categories = two different phonemes.
2. Contrasting sounds and minimal pairs

- Example: Are the sounds \([ p^h ] [ b ] [ p ]\) contrastive in Hindi?
  - From this, what do we conclude about the status of these consonants as **phonemes** in Hindi?
3. “Same” and “different” sounds again

• There is a sense in which \([ p ]\) and \([ p^h ]\) are the same to a native English speaker, because they belong to the same phoneme.

• When people think consciously about sounds, they tend to think at the phoneme level.

• Warning: Your phonology controls your brain! (actually, it influences your speech perception)
  - The phonological system of your mental grammar has an enormous effect on how you mentally categorize a phonetic input.
3. “Same” and “different” sounds again

- Many people find it hard to believe that two speech sounds that belong to the same phoneme for them (“the same sound”) could ever be separate phonemes (“different sounds”) in another language.

- Many people find it equally hard to believe that two speech sounds that are separate phonemes for them (“different sounds”) could ever belong to the same phoneme (“the same sound”) in another language.

—> Evidence for mental grammar!
4. Phonemes and allophones

- **phoneme** —> **mental** sound category ( / / )

- **allophone** —> **physical** realization of a phoneme ([ ] )

- Some phonemes have multiple allophones

Hindi: 

/ p / /pʰ /

| | |

[ p ] [pʰ ]

English:

/ p /

∧

[ p ] [pʰ ]

phonemes

allophones
4. Phonemes and allophones

- Words (morphemes) are stored in the mental lexicon in **phonemic transcription**
  - What this means: Every speech sound in the word (morpheme) is stored in the form of its mental sound category

- The phonetic/surface/pronounced forms of words are produced by the **mental grammar**, which applies phonological rules to them as needed
  - When a phoneme has more than one allophone, a phonological rule is needed to determine the appropriate allophone
  - More on phonological rules in the next lecture
5. Determining the status of two sounds

• How do we tell if two physically different sounds belong to different phonemes or to the same phoneme (in a particular language)?

• Step 1. Look for a minimal pair
  - If you find one, the sounds are contrastive — they belong to different phonemes
  - If you do not find any minimal pairs, the sounds may or may not be contrastive; continue to the next step
5. Determining the status of two sounds

- Step 2. Consider the environments where the sounds occur
  - Are the environments non-overlapping?
  - Some particularly useful environments to examine are:
    - preceding context
    - following context
    - (for vowels) other nearby vowels
    - sometimes both preceding and following contexts matter
5. Determining the status of two sounds

• Step 2. Consider the environments where the sounds occur
  - Are the environments non-overlapping?
  - If the environments are non-overlapping, the sounds are in **complementary distribution** — they are **allophones** of the same phoneme. That is, they are part of the **same** mental sound category (and are **not** contrastive).
  - Another way to think about this: If we know the environment, we can **predict** which of the two sounds will appear...
5. Determining the status of two sounds

• Step 2. Consider the environments
  - Example: Suppose there is a language where sounds #1 and #2 occur in these environments:

  \[
  \begin{align*}
  \text{sound #1} & : \quad [ m__ e ] \\
  & \quad [ n__ a ] \\
  & \quad [ m__ i ] \\
  & \quad [ \eta__ o ] \\
  & \quad [ m__ u ] \\
  \text{sound #2} & : \quad [ p__ o ] \\
  & \quad [ z__ e ] \\
  & \quad [ l__ i ] \\
  & \quad [ o__ a ] \\
  & \quad [ f__ u ]
  \end{align*}
  \]

• Are the two sets of environments non-overlapping?
  - What matters? Following sound? Preceding sound?
5. Determining the status of two sounds

- **Step 2. Consider the environments**
  - On the other hand, if the environments where the sounds occur do overlap — the two sounds can occur in the same environments — then we say they are in *contrastive distribution* and are *distinct phonemes*, even if no exact minimal pairs were found.
  
  - In this situation, it is **not possible to predict** which of the two sounds will appear just from knowing what the environment is — the sounds behave independently of each other.
5. Determining the status of two sounds

• Step 3. If you have found that two sounds are allophones of the same phoneme, state the environments where each allophone occurs

  - At least one of the two allophones should have an environment that is statable as a natural class using properties of sounds

  - Sometimes, one allophone has an environment that is nothing more than “wherever the other allophone doesn’t occur” — in this case, we can state the environment as elsewhere
6. Natural classes of sounds

• When two or more sounds have some property or properties in common, we say they are a **natural class** of sounds.

• Natural classes of sounds often **behave as a group** in native-speaker language behavior:
  - We conclude that natural classes are something that the mental grammar uses.
  - Moreover, since natural classes are determined by sound properties, we conclude that **sound properties** are something that the mental grammar uses.
6. Natural classes of sounds

- Practice:

What properties can we use to describe each group of sounds as a natural class, while excluding the other sounds as specified?

- [p g k d b t] but not [s ej w]
- [f θ sʃ h] but not [t z v b]
- [i ow u a ej] but not [ɪ æ k m]
- [i u ʊ ɪ] but not [æ ow ɛ ŋ ʧ]
6. Natural classes of sounds

- Returning to our example from before:

  \[
  \begin{align*}
  \text{Sound #1} & \\
  [ m\_ e ] & [ p\_ o ] \\
  [ n\_ a ] & [ z\_ e ] \\
  [ m\_ i ] & [ l\_ i ] \\
  [ \eta\_ o ] & [ o\_ a ] \\
  [ m\_ u ] & [ f\_ u ]
  \end{align*}
  \]

- Can either (both) environments be stated as a natural class?
7. Preview of the next lecture

• Today, we have discussed:
  - **Phonemes** are mental sound categories
  - Sometimes, one phoneme can have more than one **allophone**
  - When this happens, it is the **environment** that determines which allophone appears

• Next Wednesday (after the holiday):
  - How does the **mental grammar** make sure that the correct allophones appear in the correct environments?
  - Proposal: **Phonological rules**