Lecture 2: Phonetics!
Quick review

- Mental grammar
- Arguments for innate knowledge (paradox of language acquisition)
- Descriptive vs. prescriptive grammar
Today’s agenda

• Articulatory phonetics
  – IPA
  – Consonants
  – Features
  – Vowels
  – Exercises!
How you look to a phonetician
How you look to a phonetician

Tongue
How you look to a phonetician

Palate

Tongue
How you look to a phonetician

- Palate
- Velum
- Tongue
How you look to a phonetician

- Palate
- Velum
- Tongue
- Glottis (vocal folds)
How you look to a phonetician

- Palate
- Velum
- Tongue
- Glottis (vocal folds)
- Lips, teeth etc.
How you look to a phonetician

- Alveolar ridge
- Palate
- Tongue
- Lips, teeth etc.
- Velum
- Glottis (vocal folds)
How you look to a phonetician

Nasal Cavity

Oral Cavity
(1) The speech production mechanism.

Do you remember now?

Tongue

Lips, teeth etc.
But first...
Forget Spelling!

Sounds $\neq$ Spelling
Consonants of Standard American English

The consonants of Standard American English, written with IPA symbols, classified by voicing, place of articulation, and manner of articulation:

<table>
<thead>
<tr>
<th>Manner of Articulation</th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Inter- dental</th>
<th>Alveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop</td>
<td>p</td>
<td>b</td>
<td></td>
<td>t</td>
<td>d</td>
<td>k</td>
<td>g</td>
</tr>
<tr>
<td>Fricative</td>
<td>f</td>
<td>v</td>
<td>θ</td>
<td>s</td>
<td>z</td>
<td>j</td>
<td>3</td>
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<td>Lateral Liquid</td>
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<td>Glide</td>
<td>w</td>
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State of the Glottis: Voiceless | Voiced

Vowels of Standard American English

The vowels of Standard American English, written with IPA symbols, presented using the traditional American classification system:

**Monophthongs:**

**Diphthongs:**
# One Sound - Many Characters

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tr>
<td><strong>he</strong></td>
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<td><strong>seas</strong></td>
<td>ea</td>
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<td>ie</td>
<td><strong>amoeba</strong></td>
<td>oe</td>
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<td>ae</td>
<td><strong>key</strong></td>
<td>ey</td>
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<td><strong>see</strong></td>
<td>ee</td>
<td><strong>machine</strong></td>
<td>i</td>
</tr>
<tr>
<td><strong>people</strong></td>
<td>eo</td>
<td><strong>seize</strong></td>
<td>ei</td>
</tr>
</tbody>
</table>

IPA: [i]
u
# One Sound - Many Characters

<table>
<thead>
<tr>
<th>too</th>
<th>oo</th>
<th>threw</th>
<th>ew</th>
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<td>to</td>
<td>o</td>
<td>lieu</td>
<td>ieu</td>
</tr>
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<td>clue</td>
<td>ue</td>
<td>shoe</td>
<td>oe</td>
</tr>
<tr>
<td>through</td>
<td>ough</td>
<td></td>
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</tr>
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</table>

IPA: [u]
‘a’
One Character - Many Sounds

d åme               e

d_ ad                æ

father               a

call                 ɔ

village              ə, ʌ
m any                ɛ
# One Sound - Multiple Letters

<table>
<thead>
<tr>
<th>Word</th>
<th>Sound</th>
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<tr>
<td>shoot</td>
<td>š</td>
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<tr>
<td>either</td>
<td>ð</td>
</tr>
<tr>
<td>character</td>
<td>k</td>
</tr>
<tr>
<td>deal</td>
<td>i</td>
</tr>
<tr>
<td>Thomas</td>
<td>t</td>
</tr>
<tr>
<td>physics</td>
<td>f</td>
</tr>
<tr>
<td>rough</td>
<td>f</td>
</tr>
</tbody>
</table>
One Letter – 0 Sounds

mnemonic
psychology
resign
ghost
island
whole
debt
Differences across Languages

• English: judge, juvenile, Jesus
• Spanish: jugar, Jesus
• German: Johan, jung
• French: Jean, j’accuse, jambon
Describing Speech Sounds

• Is the air-flow blocked?
  *vowel vs. consonant*

• What are the vocal folds doing? (=voicing)
  *voiced vs. voiceless*

• Where is the air-flow blocked? (=place)
  *labial, alveolar, palatal, velar etc.*

• Where/how is the air flowing? (=manner)
  *nasal/oral, stop, fricative, liquid etc.*
Consonants

• produced by closure/constriction of the vocal tract
IPAs for English consonants
IPAs for English consonants

[p]
pit, tip, spit, appear…
IPAs for English consonants

[b]

ball, globe, brick, bubble…
IPAs for English consonants

[t]
tag, pat, stick, stuffed…
IPAs for English consonants

[d]

dip, card, drop, loved, batted…
IPAs for English consonants

[k]

kit, school, character, critique, exceed…
IPAs for English consonants

[g]

guard, bag, finger, designate, Pittsburgh…
IPAs for English consonants

[ʔ]
uh-oh, haťrack, Batţman (cf. bat)…
IPAs for English consonants

[f]
foot, laugh, philosophy, coffee…
IPAs for English consonants

[v]
vest, dove, average…
IPAs for English consonants

[θ]

through, teeth, thing...
IPAs for English consonants

[ð]

the, their, mother, either…
IPAs for English consonants

[s]
soap, psychology, descent, peace…
IPAs for English consonants

[z]
zip, roads, kisses, Xerox, design…
IPAs for English consonants

[ʃ]
shy, mission, nation, sure…
IPAs for English consonants

[ʒ]
measure, vision, casual, decision…
IPAs for English consonants

[h]
who, hat, rehash, hole, whole…
IPAs for English consonants

[tʃ] (cf. ç)
choke, match, feature, constituent…
IPAs for English consonants

[dʒ] (cf. j)
judge, George, Jell-O, region, residual…
IPAs for English consonants

[m]
moose, lamb, smack, ample…
IPAs for English consonants

\[ n \]
nap, design, snow, know…
IPAs for English consonants

[ŋ]
lung, think, finger, singer (cf. finger)…
IPAs for English consonants

[1]

leaf, feel, mild, applaud…
IPAs for English consonants

[ʃ]

reef, fear, Harris, prune…
IPAs for English consonants

[ɾ]

writer, butter, udder, clutter, cuter…
IPAs for English consonants

[w]

with, swim, mowing, queen, twilight…

(cf. which, where, what, whale, why)
IPAs for English consonants

[j]
you, beautiful, use, yell, yeast...
Another note: syllabic consonants

- Some consonants take up one syllable by itself

<table>
<thead>
<tr>
<th>Syllabic Consonants:</th>
<th>Examples</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>[m]</td>
<td>possum, chasm, Adam, bottomless</td>
<td>syllabic ‘m’</td>
</tr>
<tr>
<td>[n]</td>
<td>button, chicken, lesson, kittenish</td>
<td>syllabic ‘n’</td>
</tr>
<tr>
<td>[l]</td>
<td>little, single, simple, stabilize</td>
<td>syllabic ‘l’</td>
</tr>
<tr>
<td>[ɾ]</td>
<td>ladder, singer, burp, percent</td>
<td>syllabic ‘ɾ’</td>
</tr>
</tbody>
</table>
Describing Speech Sounds

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  *voiced vs. voiceless*

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  *labial, alveolar, palatal, velar etc.*

• Where/how is the air flowing? (=manner)  
  *nasal/oral, stop, fricative, liquid etc.*
Voiced & voiceless consonants

• Consonants either **voiced** or **voiceless**.

• English pairs:
  – b/p
  – v/f
  – d/t
  – z/s
  – ð / θ
(b) Voiced
(Approximated Vocal Folds)
Describing Speech Sounds

• Is the air-flow blocked?  
  *vowel vs. consonant*

• What are the vocal folds doing? (=voicing)  
  *voiced vs. voiceless*

• Where is the air-flow blocked? (=place)  
  *labial, alveolar, palatal, velar etc.*

• Where/how is the air flowing? (=manner)  
  *nasal/oral, stop, fricative, liquid etc.*
Where can you stop the airstream?
Where can you stop the airstream?

bilabial
[b] [p] [m]
Where can you stop the airstream?

labiodental
[v] [f]
Where can you stop the airstream?

[[θ] [θ] interdental]
Where can you stop the airstream?
Where can you stop the airstream?

velar

[g] [k] [ŋ]
Where can you stop the airstream?

uvular
Where can you stop the airstream?

glottis [ʔ][h]
Describing Speech Sounds

- Is the air-flow blocked?  
  *vowel vs. consonant*

- What are the vocal folds doing? (=voicing)  
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  *labial, alveolar, palatal, velar etc.*

- Where/how is the air flowing? (=manner)  
  *nasal/oral, stop, fricative, liquid etc.*
Manner

• Stops: complete stoppage of air
  [p] [b] [t] [d] [k] [g]...

• Fricatives: airflow is severely obstructed
  causing friction
  [f] [v] [θ] [ð] [s] [z] [ʒ] [ʃ] [h] [š]
Fricatives & Affricates

• Palatal sounds [ʒ] [ʃ] [tʃ] [dʒ]

• Palatal Fricatives - [ʒ] [ʃ]
  [note: according to IPA chart these are strictly ‘post-alveolar’]

• Affricates - combination of stop + fricative - [tʃ] [dʒ] as in judge, church
Liquids, glides

• Liquids
  [l][r]
  – Lateral [l]: air escapes along sides of tongue
  – Retroflex [r]: tongue is bunched upward and back in mouth

• Glides: semi-vowels, semi-consonants
  [w] [j]
nasal

• Nasal: velum is lowered, and air flows through nasal cavity
  [m] [n] [ɲ]
Putting them all together…
“Voicing, Place, Manner”

• how do we describe [p]?
  Voiceless, bilabial stop

What about [b]?
Features

- Ways of *describing* sounds
  - e.g., [p] = voiceless bilabial stop
- Stronger claim: features are the *smallest building blocks of language*, used to store sounds in the mind
- *Atoms of Speech*

Roman Jakobson, 1896-1982
(6) The consonants of English classified by voicing, place of articulation, and manner of articulation.

<table>
<thead>
<tr>
<th>Manner of Articulation</th>
<th>Place of Artication</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bilabial</td>
</tr>
<tr>
<td>Stop</td>
<td>p</td>
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<tr>
<td>Fricative</td>
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<tr>
<td>Affricate</td>
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<td>Flap</td>
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<td>Nasal</td>
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<tr>
<td>Lateral Liquid</td>
<td></td>
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<tr>
<td>Retroflex Liquid</td>
<td></td>
</tr>
<tr>
<td>Glide</td>
<td>w</td>
</tr>
</tbody>
</table>

State of the Glottis: Voiceless | Voiced
Features

• Prediction: by combining a small number of atomic features, it should be possible to create a larger number of speech sounds

• Goal: a set of universal features should make it possible to describe the speech sounds of all of the languages of the world

• Different languages choose different feature combinations
Sounds from other languages

• From Spanish: [ɲ] as in año ‘year’
  - voiced, palatal, nasal

• From German: [x] as in Bach
  - voiceless, velar, fricative

• Other languages?
THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993, updated 1996)

CONSONANTS (PULMONIC) © 1996 IPA

<table>
<thead>
<tr>
<th>Place</th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Postalveolar</th>
<th>Retroflex</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
<th>Pharyngeal</th>
<th>Glottal</th>
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<tbody>
<tr>
<td>Stop</td>
<td>p b</td>
<td>t d</td>
<td>l f</td>
<td>ɾ k q g q</td>
<td>ʔ i</td>
<td></td>
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<tr>
<td>Nasal</td>
<td>m ŋ</td>
<td>n ɲ</td>
<td>n ɲ</td>
<td>ɲ ɲ</td>
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<td>Trill</td>
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<tr>
<td>Tap or flap</td>
<td>f ɾ</td>
<td>f ɾ</td>
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<tr>
<td>Fricative</td>
<td>ɸ β f v ʋ</td>
<td>θ δ s z</td>
<td>j z</td>
<td>ɛ ɪ ɣ ʁ x ɣ x ɣ ɣ h ɣ h h h</td>
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<tr>
<td>Approximant</td>
<td>v j</td>
<td>j ʉ</td>
<td>j ʉ</td>
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</tbody>
</table>

Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.

CONSONANTS (NON-PULMONIC)

<table>
<thead>
<tr>
<th>Place</th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Postalveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
<th>Pharyngeal</th>
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<tbody>
<tr>
<td>Clicks</td>
<td>ʘ ǀ</td>
<td>ɗ ɗ</td>
<td>T d</td>
<td>L f</td>
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<td>Voiced</td>
<td>b b</td>
<td>d d</td>
<td>p p</td>
<td>b b</td>
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<td>t t</td>
<td>d d</td>
<td>b b</td>
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<tr>
<td>Fricatives</td>
<td>ɸ β f v ʋ</td>
<td>Ʌ d s z</td>
<td>j z</td>
<td>ɛ ɪ ɣ ʁ x ɣ x ɣ ɣ h ɣ h h h</td>
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<td>j ʉ</td>
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<td>l Ʉ</td>
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</tbody>
</table>

OTHER SYMBOLS

| W | Voiceless labiodental fricative | Ʌ | Alveolo-palatal fricative |
| H | Voiceless labiodental approximant | Ɇ | Alveolo-palatal lateral fricative |
| Χ | Voiceless labiodental approximant | ɇ | Postalveolo-palatal approximant |
| Σ | Voiceless palatal fricative | ɤ | Palatal fricative |
| Ξ | Voiceless palatal approximant | ɔ | Palatal approximant |

OTHER SYMBOLS

| Α | Voiceless labiodental fricative | ζ | Alveolo-palatal fricative |
| Ω | Voiceless labiodental approximant | η | Alveolo-palatal lateral fricative |
| Π | Voiceless labiodental approximant | ι | Postalveolo-palatal approximant |
| Κ | Voiceless palatal fricative | ι | Palatal fricative |
| Λ | Voiceless palatal approximant | ι | Palatal approximant |

DIACRITICS

<table>
<thead>
<tr>
<th>Primary accent</th>
<th>Secondary accent</th>
<th>Tones and Word Accents</th>
<th>LEXIS</th>
<th>CONTOUR</th>
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<tbody>
<tr>
<td>Voiceless</td>
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<td>Retracted</td>
<td>Advanced</td>
<td>Retracted Tongue Root</td>
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<td></td>
<td>Retracted Tongue Root</td>
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VOWELS

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<tr>
<th>Front</th>
<th>Central</th>
<th>Back</th>
</tr>
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<tbody>
<tr>
<td>Close</td>
<td>Y y</td>
<td>U u</td>
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<tr>
<td>Close-mid</td>
<td>O o</td>
<td>O o</td>
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<tr>
<td>Open-mid</td>
<td>E e</td>
<td>A a</td>
</tr>
<tr>
<td>Open</td>
<td>E e</td>
<td>A a</td>
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</table>

Where symbols appear in pairs, the one to the right represents a rounded vowel.

SUPRASEGMENTALS

<table>
<thead>
<tr>
<th>Primary accent</th>
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<th>Tones and Word Accents</th>
<th>LEXIS</th>
<th>CONTOUR</th>
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| | | | | |

TONES AND WORD ACCENTS

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<th>High</th>
<th>Low</th>
<th>Filling</th>
<th>Rising</th>
<th>Falling</th>
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<th>Rising</th>
<th>Falling</th>
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<table>
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<th>Word Accent</th>
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<tbody>
<tr>
<td>High</td>
<td>e e</td>
</tr>
<tr>
<td>Low</td>
<td>e e</td>
</tr>
<tr>
<td>Rising</td>
<td>e e</td>
</tr>
<tr>
<td>Falling</td>
<td>e e</td>
</tr>
</tbody>
</table>
### THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993, updated 1996)

#### CONSONANTS (PULMONIC)

<table>
<thead>
<tr>
<th></th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Postalveolar</th>
<th>Retroflex</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
<th>Pharyngeal</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plosive</td>
<td>p b</td>
<td></td>
<td>t d</td>
<td></td>
<td></td>
<td>t q</td>
<td>c j</td>
<td>k g</td>
<td>q G</td>
<td></td>
<td>?</td>
</tr>
<tr>
<td>Nasal</td>
<td>m m̃</td>
<td>n</td>
<td>n̄</td>
<td>n̄</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trill</td>
<td>B</td>
<td>r</td>
<td></td>
<td></td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tap or Flap</td>
<td>f v θ ð</td>
<td>s z</td>
<td>l z</td>
<td>x y</td>
<td>χ k h f h h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fricative</td>
<td>φ β</td>
<td>f v θ ð</td>
<td>s z</td>
<td>l z</td>
<td>x y</td>
<td>χ k h f h h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral fricative</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Approximant</td>
<td>u</td>
<td>j</td>
<td></td>
<td></td>
<td>u j</td>
<td>u j</td>
<td>u j</td>
<td>u j</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Lateral approximant</td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.

Spanish: *año*

German: *Bach*
Consonant exercises

For the following group of sounds, state the phonetic feature(s) they all share.

1. [g], [p], [t], [d], [k], [b]
2. [m], [n], [ŋ]
3. [t], [s]
4. [ʒ] [ʃ] [j]
5. [ʔ], [h]
More consonant exercises

Write the symbol that corresponds to each of the phonetic descriptions, then give an English word that contains this sound.

1. voiceless bilabial stop
2. voiced labiodental fricative
3. voiced alveolar lateral liquid
4. voiceless palatal affricate
5. voiced alveolar nasal
6. voiced bilabial glide
• What are the features of the following sounds:

1. [t]
2. [ð]
3. [ʃ]
4. [dʒ]
5. [ɾ]
6. [h]
7. [w]
8. [r]
Even more consonant exercises

• See handouts
Phonetics page

http://www.uiowa.edu/~acadtech/phonetics/english/frameset.html
use the chart to learn!

• handout
What can you do to alter the shape of your vocal tract?
You can....

• Raise or lower your tongue
• Advance or retract your tongue
• Round or not round your
• Tense or lax
Test

- slowly pronounce the vowels, feel where the tongue is
- look in the mirror as you pronounce them
- close your mouth and try to pronounce the vowels
- use a lollipop
So what vowels do you have?
So what vowels do you have?

"sheep, sleep"
So what vowels do you have?

"sheep, sleep"
So what vowels do you have?

- \textit{i} “sheep, sleep”
- \textit{ɪ} “ship, slip”
So what vowels do you have?
So what vowels do you have?
So what vowels do you have?

i
I
ε
“led, sped, tread”
So what vowels do you have?
So what vowels do you have?

ɪ ɪ 
ɪ ɪ 
ɛ ɛ
æ “bat, lad”
So what vowels do you have?

- i
- u
- ì
- ɛ
- æ
So what vowels do you have?

“Luke, who’d, suit”
So what vowels do you have?

“Luke, who’d, suit”
So what vowels do you have?

“Luke, who’d, suit”

“look, hood, soot”
So what vowels do you have?
So what vowels do you have?
So what vowels do you have?
So what vowels do you have?

“caught, tall, dawn”
So what vowels do you have?
So what vowels do you have?
So what vowels do you have?
So what vowels do you have?

"but, putt, rut"
So what vowels do you have?

“but, putt, rut”
So what vowels do you have?

“metallic, Texas”

“but, putt, rut”
Here they all are...
Vowel features

• **High/mid/low**: raise or lower the tongue
• **Front/central/back**: advance or retract tongue
• **Round/unrounded**: round or spread lips
• **Tense/lax**: tense tongue muscles or not
(1) The vowels (monophthongs) of English
Vowel features

- High/mid/low: raise or lower the tongue
- Front/central/back: advance or retract tongue
- Round/unrounded: round or spread lips
- Tense/lax: tense tongue muscles or not

E.g.

[i] is a high, front, (unrounded) tense vowel.
[u] is a high, back, round tense vowel.
Some dialectal differences

- caught/cot, dawn/Don [Mid back lax vowel and mid back tense vowel]: many American speakers do not have both of these.
- aunt/ant, plaza, etc
Diphthongs: two-part vowels (cf. monophthongs)

1. [æɪ]    bite, aisle, choir, island
2. [ɑʊ]    brown, doubt, loud, hour
3. [ɔɪ]    boy, rejoice, annoy, poison
4. [ɵu]    boat, grow, though, over
5. [eɪ]    bait, reign, great, they, gauge
Diphthongs:

I → a
Diphthongs:

“side, my, kind”
Diphthongs:
Diphthongs:
Diphthongs:

“loud, brow, hour”
Diphthongs:
Diphthongs:
Diphthongs:

“boy, annoy, toil”
Two-part articulations of the alphabets of English (arrows indicate the relations).

Diagram of vowel positions:
- **Front**: i, e, æ
- **Central**: æ, ə, o
- **Back**: u

**High** vs **Low**
- **High**: i, e, æ, ə, u
- **Low**: æ, ə, o, ð

**Tense** vs **Lax**
- **Tense Vowels**: i, u, ð
- **Lax Vowels**: e, æ, ə, o

**Round**
Now you have vowels & consonants

• …so you can transcribe sounds of words!

write
throw
textbook
Vowel exercises

• handouts
Speech Production - Summary

- Airflow set in vibration by vocal folds
  Airflow modified by vocal tract
- **Vowels**: shaping of oral cavity
- **Consonants**: narrowing or blocking of oral/nasal cavity
- Different languages choose different selections of articulatory gestures
Speech Perception

• Speech production processes must be undone by the ear
• Motions of articulators must be reconstructed from patterns of air vibration
• Requires extremely precise hearing, possibly a system specialized for hearing speech
• Substantially developed at birth
For tomorrow

• Phonetics Quiz (closed book)! Go over the exercises, and remember the consonant and vowel features
  - no need to remember…
    syllabic consonants
    flap “r” [ɾ]
• Read LF phonology (up to 3.3) & Jackendoff Ch 5