Lecture 1

SPAU 3343
Phonetics and Phonology

William Katz, Ph.D.
University of Texas at Dallas
(A very brief) history of phonetics

“The history of phonetics—going back some 2.5 millennia—makes it perhaps the oldest of the behavioral sciences and, given the longevity and applicability of some of the early findings from these times, one of the most successful”

-- Prof. John Ohala, UC Berkeley, 1991
Early roots

- India
- Korea
Panini

- India ~ 7th - 4th centuries B.C.E.
- His work on Sanskrit was surprisingly modern and systematic
- Phonology/phonetics was explicitly dealt with
- Discovery of Panini's grammar helped develop today’s linguistic science

King Sejong of Korea

- Wanted his people to be literate, but knew that the existing (Chinese-based) system was too difficult

- Created *by himself* an entirely new, scientific alphabet based on phonetics *(see next slide →)*

- Named this alphabet *Hun Min Jong Um*, “Accurate Sounds to Educate the People”

- His alphabet was largely neglected, almost until the 20th century

- Now in general use in both South and North Korea

1397-1450

Han’gul

<table>
<thead>
<tr>
<th>consonants</th>
<th>vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td>k/g</td>
<td>a</td>
</tr>
<tr>
<td>n</td>
<td>ya</td>
</tr>
<tr>
<td>t/d</td>
<td>o</td>
</tr>
<tr>
<td>r/l</td>
<td>u</td>
</tr>
<tr>
<td>m</td>
<td>yǒ</td>
</tr>
<tr>
<td>p/b</td>
<td>yo</td>
</tr>
<tr>
<td>s/sh</td>
<td>u</td>
</tr>
<tr>
<td>ng (1)</td>
<td>yu</td>
</tr>
<tr>
<td>ch/j</td>
<td>ì (3)</td>
</tr>
<tr>
<td>ch’ (2)</td>
<td>ì (3)</td>
</tr>
<tr>
<td>k’ (2)</td>
<td>i</td>
</tr>
<tr>
<td>t’ (2)</td>
<td></td>
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<tr>
<td>p’ (2)</td>
<td></td>
</tr>
<tr>
<td>h</td>
<td></td>
</tr>
</tbody>
</table>

Han’gul is written in syllabic units made up of two, three, or four letters.

Velars: [Image of velar articulation]
Alveolars: [Image of alveolar articulation]
Dentals: [Image of dental articulation]
Bilabials: [Image of bilabial articulation]
Glottals: [Image of glottal articulation]
Sir William Jones

- British scholar, linguist, and lawyer
- Fluent in 7 languages by age 20
- Came to India as Supreme Court Judge
- In 1786, announced:
  …Sanskrit and the European languages "have sprung from some common source which, perhaps, no longer exists"
- Set a trend for studying Sanskrit as basis for the “Indo-European language family”
- Roots of historical linguistics

1746-1794
Henry Sweet

- English philologist and phonetician
- Authority on Anglo-Saxon and the history of the English language (Oxford, England)
- Pioneer in modern scientific phonetics
- His *History of English Sounds* (1874) was a landmark study.
- Thought to be the model for “Professor Higgins” in G. B. Shaw’s play *Pygmalion*

(although it was actually Daniel Jones…)

1845–1912

“Henry Higgins”

- Phonetician character in the play “Pygmalion” by George Bernard Shaw

→

← “Eliza Doolittle”
Daniel Jones

- Professor at University College London
- Used the term “phoneme” in the modern sense
- Promoted the term “cardinal vowel”
- A father of the IPA
- Suggested a two-parameter diagram to visualize how vowels are produced
- Popularized experimental phonetics
- Developed new alphabets for African and Indian languages

1881 - 1967
Lionel Logue (1880-1953)

- Australian “elocutionist” who worked with speech defects
- Consultant to King George VI
- Featured in 2010 movie


Abbé Rousselot

- 1843 – 1924
- An early innovator in experimental phonetics
- Professor with the College of France
Rousselot cylinders

- Speech sounds and articulatory information were recorded for analysis

- “It will be possible hereafter to note the pronunciation of any language, dialect, or idiom whatever, without relying upon the testimony of the ear, which distinguishes but slight differences between the modes of speaking of several individuals”

International Phonetic Alphabet (IPA)

- (1888) First published by the Association Phonétique Internationale, a group of French language teachers
- Modeled on an 1847 phonetic script for English
- Goal: To devise a system for transcribing speech sounds independent of any particular language and applicable to all languages
IPA - Uses

• Dictionaries, textbooks, phrase books
• Creating new writing systems for previously unwritten languages
• Non-native speakers learning English
• Clinicians in speech language pathology and related disciplines
Modern Phonetics

- **Phonetics** – Scientific study of speech sounds
- **Phonology** – Study of sound systems, patterns, and rules
- Phonetics and phonology are highly related… Both are within the field of …
- **Linguistics** – Scientific study of Language
Important terms:
Communication, human language, speech

 Phonetics is HERE!
Q: How do linguists study language?

• By describing a **grammar**
  
  *(mental representation of language knowledge)*

**GOAL:**

Language-particular → Universal

Q: What are the components of grammar? *(next slide)*
Levels of the grammar

We are HERE! →
Types of phonetics

1. **Articulatory** – *How speech sounds are produced in the human vocal tract*

2. Acoustic

3. Linguistic/Perceptual
Source-filter theory

Vocal source  vocal tract filter  speech
Source-filter system – cont’d

Illustration by Wiley, Composition Services Graphics

Features

- **Feature** – A component of a sound with a discrete phonetic property – “smallest systematic part” of a speech sound
- **Binary** ( + or - )
- **Graded**

Articulatory features

THE BIG THREE!

• Voicing
• Place
• Manner
Voicing - anatomy

Illustration by Wiley, Composition Services Graphics

Voicing

• Property of vibrating vocal folds
• Occurs at the glottis (literally, a hole or aperture)
Laryngoscopy - video


http://auditoryneuroscience.com/vocal_folds
The speech articulators

Places of articulation, parts of tongue

Place – where sounds are produced

- **bilabial**
- **labiodental**
- **dental**
- **alveolar**
- **palato-alveolar**
- **palatal**
- **velar**
- **uvular**

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**Note:**
- Not GAE
- Not English (but e.g., in French and Arabic)

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[http://www.acsu.buffalo.edu/~cdicanio/pdfs/Lect_Place_9-15_9-17.pdf](http://www.acsu.buffalo.edu/~cdicanio/pdfs/Lect_Place_9-15_9-17.pdf)
Manner – **How** sounds are produced

- **Stop**: Nasal vs. oral
- Also – **fricative**, **affricate**, **approximant**, **tap/flap**


### Consonants of GAE

<table>
<thead>
<tr>
<th>Manner</th>
<th>Voicing</th>
<th>Voiced (+)</th>
<th>Voiceless (−)</th>
<th>Bilabial</th>
<th>Labio-Dental</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Palato-Alveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop (nasal)</td>
<td>+</td>
<td>m</td>
<td></td>
<td>n</td>
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<td></td>
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<td>η</td>
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<td>Stop (oral)</td>
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<td>p</td>
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<td>t</td>
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<td>k</td>
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<td>Stop (oral)</td>
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<td>g</td>
</tr>
<tr>
<td>Fricative</td>
<td>−</td>
<td>f</td>
<td>θ</td>
<td>s</td>
<td>j</td>
<td></td>
<td></td>
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<td></td>
<td>h</td>
</tr>
<tr>
<td>Fricative</td>
<td>+</td>
<td>v</td>
<td>ð</td>
<td>z</td>
<td>ʒ</td>
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<tr>
<td>Affricate</td>
<td>−</td>
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<td>tʃ</td>
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<td>Affricate</td>
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<td>Approximant</td>
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<td>m</td>
</tr>
<tr>
<td>Approximant</td>
<td>+</td>
<td>w</td>
<td></td>
<td>l</td>
<td>j</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>w</td>
</tr>
<tr>
<td>(lateral)</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>l</td>
</tr>
</tbody>
</table>

Also /ʔ/ and /ɾ/
How to draw ‘em!

<table>
<thead>
<tr>
<th>I</th>
<th>ɨ</th>
</tr>
</thead>
<tbody>
<tr>
<td>ɛ</td>
<td>ɛ</td>
</tr>
<tr>
<td>æ</td>
<td>æ</td>
</tr>
<tr>
<td>ə</td>
<td>ə</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
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<td>ø</td>
<td>ø</td>
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<tr>
<td>ι</td>
<td>ι</td>
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<td>α</td>
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<td>u</td>
<td>u</td>
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<tr>
<td>c</td>
<td>c</td>
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<tr>
<td>a</td>
<td>a</td>
</tr>
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</table>
The voiceless “w” (/ʍ/)
Other features: Central vs. lateral

<table>
<thead>
<tr>
<th>Manner of articulation</th>
<th>Place of articulation</th>
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</thead>
<tbody>
<tr>
<td>nasal (stop)</td>
<td>bilabial</td>
</tr>
<tr>
<td></td>
<td>m</td>
</tr>
<tr>
<td>stop</td>
<td>p b</td>
</tr>
<tr>
<td>fricative</td>
<td>f v θ ð s z j 3</td>
</tr>
<tr>
<td>(central) approximant</td>
<td>(w)</td>
</tr>
<tr>
<td>lateral</td>
<td></td>
</tr>
</tbody>
</table>

Markedness

• We do not mark the more usual case
• Thus, the less frequent a feature, the more “marked”

Example:
I’m going to the store to get cow milk
I’m going to the store to get soy milk


Let’s relate the features to the anatomy

<table>
<thead>
<tr>
<th>Manner</th>
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<th>Voiced/voiceless</th>
<th>Bilabial</th>
<th>Labio-Dental</th>
<th>Dental</th>
<th>Alveolar</th>
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<th>Velar</th>
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<tr>
<td>Stop (nasal)</td>
<td>+</td>
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<td>m</td>
<td>n</td>
<td>t</td>
<td>d</td>
<td>f</td>
<td>h</td>
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<tr>
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<td>k</td>
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<td>θ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop (oral)</td>
<td>+</td>
<td>Voiced(-)</td>
<td>b</td>
<td>d</td>
<td></td>
<td></td>
<td>s</td>
<td></td>
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</tr>
<tr>
<td>Fricative</td>
<td>-</td>
<td>Voiceless(-)</td>
<td>f</td>
<td>s</td>
<td></td>
<td></td>
<td>f</td>
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<td></td>
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<tr>
<td>Fricative</td>
<td>+</td>
<td>Voiced(-)</td>
<td>v</td>
<td>z</td>
<td></td>
<td></td>
<td>θ</td>
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<td></td>
<td>h</td>
</tr>
<tr>
<td>Affricate</td>
<td>-</td>
<td>Voiceless(-)</td>
<td>δ</td>
<td>z</td>
<td></td>
<td></td>
<td>θ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affricate</td>
<td>+</td>
<td>Voiced(-)</td>
<td>θ</td>
<td>3</td>
<td></td>
<td></td>
<td>s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approximant</td>
<td>-</td>
<td>Voiceless(-)</td>
<td>l</td>
<td>j</td>
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<td></td>
<td>w</td>
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<td></td>
</tr>
<tr>
<td>Approximant</td>
<td>+</td>
<td>Voiced(-)</td>
<td>w</td>
<td>i</td>
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<td>w</td>
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<td>(lateral)</td>
<td>+</td>
<td>Voiced(-)</td>
<td>l</td>
<td>i</td>
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<td></td>
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</tr>
</tbody>
</table>
Great! Now on to vowels
The setting

Figure 3-2: Vowel quadrilateral superimposed on a person’s vocal tract.

GAE vowel quadrilateral

Diphthongs: /ai/ /au/ /iə/
This should help?

/ɑ/

/ə/

Homework/ Reading

• First e-learning homework set!
Lecture 2

- More issues on broad transcription of GAE consonants and vowels
- Finishing up concepts from text, chapters 1-3
Mono – vs. Diphthongs

• **Monophthongs** – constant vowel quality
• **Diphthongs** – sweep across the vowel space


Q: Could there be a ...(shudder).... Triphthong?

A: Yes!

- **Bernese German** (a **Swiss German** dialect):
  - [iɛw] as in *Gieu* 'boy'
  - [yɛw] as in *Gfüeu* 'feeling'
  - [uɛw] as in *Schueu* 'school'
  - [yɛj] as in *Müej* 'trouble'

- **Spanish**:
  - [wej] as in *buey* 'ox'
  - [waj] as in *Uruguay*
Tense vs. lax vowels in English

• English lax vowels: /ɪ/, /ɛ/, /æ/, /u/, /ʌ/, /ʌ̃/
• Originally thought to be physiologically distinct
• Now considered a phonological property
• (Lax vowels cannot occur in stressed, open syllables)
• Thus: “You are really veh!” (is not English)
Tense/lax - examples

- “beat” versus “bit”
- “bait” versus “bet”
- “Luke” versus “look”

<table>
<thead>
<tr>
<th>Table 7-3</th>
<th>Distribution of English Tense and Lax Vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vowel</td>
<td>Stressed Open Syllable</td>
</tr>
<tr>
<td>Tense</td>
<td>/i/</td>
</tr>
<tr>
<td>Lax</td>
<td>/i/</td>
</tr>
</tbody>
</table>

Tense

• Some tense vowels show offglide qualities:

\[
\begin{align*}
/e/ &= /eɪ/ \checkmark \\
/u/ &= /uʍ/ \\
i/ &= /iʃ/ \\
o/ &= /ou/ \checkmark
\end{align*}
\]

• For beginners, I prefer the simpler set on the left

• Our AV materials also include examples from checked set on the right
GAE vowel “r-coloring” (blending)

<table>
<thead>
<tr>
<th>IPA</th>
<th>Example</th>
<th>American English</th>
</tr>
</thead>
<tbody>
<tr>
<td>/i/</td>
<td>seer</td>
<td>/siə/ or /siɛ/</td>
</tr>
<tr>
<td>/ɪ/</td>
<td>fear</td>
<td>/fɪə/</td>
</tr>
<tr>
<td>/ɛ/</td>
<td>payer</td>
<td>/peə/ or /peɛ/</td>
</tr>
<tr>
<td>/ɛɪ/</td>
<td>fair</td>
<td>/fɛɪ/</td>
</tr>
<tr>
<td>/ɜː/</td>
<td>fur</td>
<td>/fɜː/</td>
</tr>
<tr>
<td>/u/</td>
<td>poor</td>
<td>/pʊə/</td>
</tr>
<tr>
<td>/ɔː/</td>
<td>sore</td>
<td>/sɔːr/</td>
</tr>
<tr>
<td>/ɑː/</td>
<td>far</td>
<td>/fɑːr/</td>
</tr>
<tr>
<td>/aɪ/</td>
<td>fire</td>
<td>/faiə/</td>
</tr>
<tr>
<td>/æʊ/</td>
<td>flower</td>
<td>/fləʊər/</td>
</tr>
<tr>
<td>/ɔɪ̯/</td>
<td>foyer</td>
<td>/fɔɪər/</td>
</tr>
</tbody>
</table>
Some vowel “adjustments”

/o/-/ɔ/ and /i/-/ɪ/
→ before /ɹ/,/l/ and nasals

Some examples:
“sore” /sɔɹ/ 
“selling” /ˈsɛlɪŋ/
English diphthongs

American English

British English

(contains one more diphthong)

Segmental vs. supra-segmental

**Segmental**: consonants, vowels

**Supra-segmental**:
- features larger than the individual segment
- includes stress, intonation (“prosody”)
Homework set #2

• e-learning, second set

• Keep practicing with audiovisual and lab materials
Lecture 3

• What is a phoneme?
• What are allophones?
• Why should we care?
Phoneme

• “Smallest systematic unit of sound that changes meaning in a language”
• Abstract
• Psychological
• Can be illustrated in a minimal pair:
  /baet/ - /bit/
  /bit/ - /biz/
Allophone

- Systematic variant of a phoneme
- Show complementary distribution (context-dependent variation)

(...like these guys...)
**Allophone example**

- In GAE, the phoneme /t/ can be... 

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[t]</td>
<td>[bɪt]</td>
</tr>
<tr>
<td>[tʰ]</td>
<td>[tʰɪp]</td>
</tr>
<tr>
<td>[r]</td>
<td>[lɪrɪt]</td>
</tr>
<tr>
<td>[ʔ]</td>
<td>[bʌʔŋ]</td>
</tr>
</tbody>
</table>
Complementary distribution

[t]  [bɪt]  syllable final
[tʰ]  [tʰɪp]  syllable initial
[r]  [lɪrɨl]  btwn stressed & unstressed syllable

* NOTE: As opposed to “free distribution”
### Phoneme/allophone

<table>
<thead>
<tr>
<th>Language 1</th>
<th>Language 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>/dəˈsɪt/</td>
<td>/θuʃ/</td>
</tr>
<tr>
<td>V. “to catch”</td>
<td>N. “female cat”</td>
</tr>
<tr>
<td>/ˈʃeɪrəti/</td>
<td>/saʊˈnɛmit/</td>
</tr>
<tr>
<td>Adj. “clever”</td>
<td>N. “muscle”</td>
</tr>
<tr>
<td>/ˈsɛrloʊk/</td>
<td>/ˈklɛrjɛʃ/</td>
</tr>
<tr>
<td>N. “debate”</td>
<td>Adv. “rapidly”</td>
</tr>
<tr>
<td>/dəˈʃɪt/</td>
<td>/sæfɪmˈi/</td>
</tr>
<tr>
<td>V. “uncover”</td>
<td>V. “speaking”</td>
</tr>
</tbody>
</table>

- In one language there are **two separate phonemes**, /s/ and /ʃ/.
- In the other, /s/ and /ʃ/ seem to be **allophones of one underlying phoneme**.

**Q:** WHICH IS WHICH, AND WHY?
Real language example – Find the phonemes vs. the allophones

Example 2: Papago (Focus: [t, ʈʃ, d, ɖʒ])

1. ['bɪdʒɪm] ‘turn around’ 12. ['hiw gıd] ‘smell’
2. ['tㄩəpən] ‘split’ 13. ['ʈʃihaŋ] ‘hire’
3. ['hidoŋ] ‘cook’ 14. ['təni] ‘become hot’
4. ['ʈʃikid] ‘vaccinate’ 15. ['wədʒut] ‘swing’
6. ['ʈʃuku] ‘become black’ 17. ['ki:ʈʃud] ‘build a house for’
11. ['ɖʒi:k] ‘taste’ 22. ['ʈʃi:wia] ‘settle, esABLish residence’

Look at vowel context.....

### Left Contexts Only: No Pattern

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>tʃ</th>
<th>d</th>
<th>dʒ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,8,14,16,20</td>
<td>[word ___]</td>
<td>4,6,13,21,22</td>
<td>[word ___]</td>
<td>3,4,5,12</td>
</tr>
<tr>
<td>15</td>
<td>u ___</td>
<td>17</td>
<td>i: ___</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>a ___</td>
<td>7,11,18</td>
<td>[word ___]</td>
<td>20</td>
</tr>
<tr>
<td>16,19</td>
<td>a: ___</td>
<td>18</td>
<td>o: ___</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>m ___</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Right Contexts Only

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>tʃ</th>
<th>d</th>
<th>dʒ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,16,19</td>
<td>___a:</td>
<td>13</td>
<td>___i</td>
<td>3,18</td>
</tr>
<tr>
<td>8,14</td>
<td>___o</td>
<td>4</td>
<td>___i</td>
<td>4,5,12,</td>
</tr>
<tr>
<td>10,15</td>
<td>[word ___]</td>
<td>6,17</td>
<td>___u</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>___w</td>
<td>u</td>
<td>___i:</td>
<td>18</td>
</tr>
<tr>
<td>16,19</td>
<td>___a</td>
<td>v</td>
<td>___i:</td>
<td></td>
</tr>
</tbody>
</table>

Answer

• “The palato-alveolar affricates occur before high vowels, and the alveolar stops occur elsewhere”

(or, as formalized….)

\[
\text{Alveolar Palatalization} \\
\begin{array}{c}
\text{stop} \\
\text{alveolar}
\end{array} & \rightarrow & \begin{array}{c}
\text{affricate} \\
\text{palato-alveolar}
\end{array} / \begin{array}{c}
\text{vowel} \\
\text{high}
\end{array}
\]
## English / Thai / Spanish

<table>
<thead>
<tr>
<th>Language</th>
<th>IPA Symbols</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>/p/ → [pʰ] or [p]</td>
<td>/pʰet/ “pet” /[næp]/ “nap”</td>
</tr>
<tr>
<td>Thai</td>
<td>/p/, /pʰ/</td>
<td>/pʰa:/ “forest” /pa:/ “split”</td>
</tr>
<tr>
<td>Spanish</td>
<td>/p/</td>
<td>/ˈpero/ “but”</td>
</tr>
</tbody>
</table>
How are phonemes acquired?

• Infants are born capable of learning any sounds of any language

• They learn the phonemes of their language by ~ 9 - 12 months
  – (by learning to ignore distinctions that are not phonemic)
Q: What about adults?

Are we each a **prisoner** of our phonemic inventory (?)

- Second language issues
- “Phonemic misperception” for disordered speech