Phonetics: the science of speech sounds (Part 1)

Sounds of English Words

Letters or Sounds?

- fun, phonetics, enough
- eye, night, site, by, buy, I
- met, meet, petunia, resume, mite.

Solution

The International Phonetic Alphabet (IPA)
one sound -- one letter!

Usually written between [ ] or / / brackets
Articulatory Phonetics

• Speech sounds are characterized in terms of segments of sounds (segments are the phonetic equivalent of letters).
• Different sounds are made in a manner very similar to the way in which different sounds come out of a trumpet or clarinet
  • Blow air through a sound-creating device (e.g., reed or mouth piece or vocal cords)
  • Change shape of tube to give different acoustics (pressing keys, covering holes, moving tongue, lips, etc.)

The Sound Producing System

Nasal cavity: tube shape 3
Oral cavity: tube shape 2
Pharynx: tube shape 1
Larynx -- the sound source
Lungs: the source of airflow

Stages in Speech Production

• Initiation – muscles force air up from the lungs
• Phonation – the air passes through the larynx, the vocal cords may/may not vibrate
• Articulation – the air passes through the oral cavity (mouth) and the shape of the cavity and placement of the articulators affects the resultant sound
Major Classes of Sounds

- Distinguish 3 major classes of sounds:
  - Consonants
  - Glides (semi vowels)
  - Vowels

These are distinguished in terms of the amount of airflow through the vocal mechanism.

The description of consonants

- Place of Articulation (where they are said)
- Manner of Articulation (how they are said)
- Voicing (whether your vocal cords are vibrating or not)

Voicing

- Put your hand on your throat and say the following words:
  - Sing, think, final, bush
  - Zing, though, vinal, garage

- Sounds without vocal cord vibration are voiceless
- Sounds with vocal cord vibration are voiced.
The Larynx

- Muscles operate on the arytenoids to pull the vocal ligaments tight or loose.
- If they are loose, then air passes through without vibrating creating a voiceless sound.
- Voiced sounds aren’t created by actively vibrating the ligaments. Instead, it is due to a phenomenon called the Bernoulli effect.

Bernoulli Effect

- The arytenoids draw the ligaments close to one another.
- When a fast flowing stream of air (or liquid) occurs, it creates a zone of low pressure, which draws the soft tissues of the larynx together. This creates a momentary closure.
- The buildup of air pressure behind the closed tissues then blows them apart.
- This happens very fast and creates the vibration of the vocal cords.
- The same thing happens when air escapes from the neck of a deflating balloon.
Voicing/Phonation

Voiced

Voiceless

http://www.humnet.ucla.edu/humnet/linguistics/facilities/demos/vocalfolds/vocalfolds.htm

The view from above

The Articulators

Alveolar ridge
Palate
Velum

Nasal Cavity
Lips
Teeth

Tongue

Uvula
Pharynx
Epiglottis
Larynx
Glotis
Places of Articulation

- **Bilabial**: both lips [p, b, m]
- **Labiodental**: lips against teeth [f, v]
- **Interdental**: tongue between teeth [θ, Ө]
- **Alveolar**: tip of tongue against alveolar ridge [t, d, s, n, l, ɾ]
- **Palatal**: blade of tongue against alveopalatal region [ʃ, ʒ, tʃ, dʒ]
- **Velar**: back of tongue against velum [k, g, ɴ]
- **Labiovelar**: made with an articulation both at the mouth and the velum [w]
- **Uvular**: pronounced with the back of the tongue against the uvula, not found in English
- **Pharyngeal**: with root of tongue and pharynx, not found in English
- **Glottal**: made with the glottis [h, ʔ]

Alveolar vs Palatal

[s] and [ʃ]

fMRIs courtesy of Diana Archangeli

Labial and Velar Nasals

[m] and [ɳ]

fMRIs courtesy of Diana Archangeli
Sagittal Sections

[k] [t] [m]

Sagittal Sections

[b] [d] [f]

Sagittal Sections

[n] [v] [b]
Manner of Articulation

- **(oral) Stop**: a complete closure of airflow through the mouth [p,b,t,d,k,g]
- **Nasal (stop)**: complete closure of airflow through the mouth, but airflow through the nose [n,m,n]
- **Fricative**: very narrow passage [f,v,s,z,h]
- **Affricate**: A stop followed by a fricative [t,s,f]
- **Lateral**: open passage down one or both sides of mouth [l]
- **Retroflex**: Tongue curved backwards [r]
- **Flap**: A quick tap of the articulator [r]
- **Trill**: A repeated tapping (caused by Bernoulli effect on tongue), not found in American English

Major Classes of Sounds

- **Continuant**: a cover term for fricatives, liquids, glides and vowels
- **Sonorant**: for liquids, nasals, vowels and glides
- **Obstruent**: non-sonorants
- **Consonant**: A sound with a major obstruction in the mouth
  - Vowel: A sound with wide-open passage
  - Approximants: liquids and glides
  - Liquid: a cover term for laterals and retroflex rs
  - Glides: semi-vowels, very open passage [j,w]
  - Labials: bilabials, labiodentals, labiovelars
  - Coronals: [t, d, n, s, z, ʃ, ʒ, ɾ, ɻ, l] alveolars and palatals

Nasal vs. Non Nasal:

[n] vs [d]

fMRIs courtesy of Diana Archangeli
Describing consonants

- Voicing + place + manner
  - [p] = voiceless bilabial stop
  - [ð] = voiced interdental fricative etc.

The Consonants of English

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<th>Manner</th>
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A small annoyance

- There are actually 2 (or 3) different IPA systems out there...
- Some common equivalences
  - y = j
  - s = ʃ
  - z = ʒ
  - ð = dʒ
  - θ = r
Summary

- Production System
- Structure of the vocal apparatus
- 3 classes of speech sounds
- Phonation (voicing)
- Place of articulation
- Manner