The Sounds of Speech: How We Produce Different Sounds

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Today

- We will discuss the anatomy of the vocal tract.
- We will learn the ways we produce different types of speech sounds.
A. Sound is vibration

B. Sound is a mechanical wave that creates areas of high and low pressure.

C. The frequency of a signal is measured in Hz (cycles/sec), and represents the number of times the signal repeats itself within a second.

D. Some sounds are composed of multiple frequencies. Speech is one of those sounds.

E. Human hearing is tuned into the range of human speech, so they work together.
A. Air from the lungs is the power source for speech.

B. The diaphragm allows us to breathe: it expands-> reduces the pressure inside the chest cavity -> allows more air to enter the lungs

C. The vocal folds determine pitch.

D. The vocal tract begins at the vocal cords, continues upwards past the tongue, and it ends at the lips.
• Speech articulators are segmented using a computer

http://sail.usc.edu/span/

http://sail.usc.edu/span/teaching.php
3 Steps in Speech Production

1. Energy source: air from the lungs

2. Voicing: Vibration of the vocal cords (not always)
   a) Vibration for vowels
   b) No vibration for most consonants

3. Articulation: Changing the shape of the vocal tract, which changes the sounds that we hear
• **Lungs** - send air up to the vocal cords and vocal tract

• **Vocal cords** - close and open to change the amount of air going through (pitch)

• **Vocal tract** - air passages above the vocal cords
Speech Production: Some Vocab

• Lungs- Where the air is stored
• Diaphragm- Expands and contracts to change air pressure inside lungs-> breathing
• Larynx- Voice Box, holds the vocal cords
• Vocal cords- reduce air flow by vibrating, creating areas of higher and lower pressure
• Vocal tract- area above vocal folds
• Constriction- Reduced area through which air can flow -> changes the frequencies in a sound
• Articulator- Something in the vocal tract that can make a constriction (for example, tongue and lips)
• Tongue- Can make constrictions at any point along its length with the roof of the mouth (most important).
• Lips- Constrictions at end of vocal tract
• Nasal cavity- cavity behind your nose, used to make nasal sounds like /m/ and /n/.
• Velum- door between vocal tract and the nasal cavity
Vocal Folds

• The vocal folds vibrate to allow more or less air through, done at around 100 or 200 Hz

http://www.youtube.com/watch?v=v9Wdf-RwLcs
3 Steps in Speech Production

1. Energy source: air from the lungs

2. Voicing: Vibration of the vocal chords (not always)

3. Articulation: Changing the shape of the vocal tract, which changes the sounds that we hear
When the vocal folds vibrate, it creates **voiced sounds**.

All vowels are voiced sounds.

A single sound, which we use to make up words, is called a **phoneme**.

Try making the sound /z/

Feel your vocal folds

How do you make the sound /s/?

Is /s/ a voiced sound? Is /z/ a voiced sound?
Vocal Folds: Voiced Sounds

• How do you make the sound /s/?
  • Is /s/ a voiced sound? No, it is an unvoiced sound. But /z/ is a voiced sound.

• Let us try a few more

Tongue against the lips: /f/ and /v/
Lips closed: /p/ and /b/
Tongue near the gums: /d/ and /t/
Tongue at the roof: /c/ and /g/ as in con and gone
Tongue bunched up: [dʒ] and [tʃ] (ch) as in chin and gin
• Phonemes recorded using MRI

http://sail.usc.edu/span/teaching.php

http://sail.usc.edu/span/video.php
Vowels

• Speech sound produced with an open vocal tract

• There is no build up of pressure anywhere in the vocal tract

• Important for your model!
  • Vowel sounds have constrictions at different parts of the vocal tract (front/middle/back of vocal tract).
  • Your tongue tip, body, and root help make those constrictions.

• Match the pairs on your worksheet
• ____________ tongue tip

• ___A_________ tongue body
Consonants

• Articulated with some closure of the vocal tract

• Examples:
  • [p], pronounced with the lips
  • [t], pronounced with the front of the tongue
  • [k], pronounced with the back of the tongue
  • [h], pronounced in the throat
  • [f] and [s], pronounced by forcing air through a narrow channel
  • [m] and [n], which have air flowing through the nose (nasals).
Nasals

- Sound where air passes through the nasal passageway
  - The velum lowers to allow air into the nasal passageway

- Examples: /m/ and /n/

- Have you ever meditated? Make the ohmmmmmm sound.
  - Now close your nose while humming.
    - See, you use your nose to produce sound.
  - Try this exercise with saying the /m/ sound. Try this exercise when saying the /e/ sound.
Remember This

• Pitch is determined by the vocal folds. The vocal folds vibrate faster to produce higher pitch.
• The vocal tract contains: lips, tongue, velum and nasal cavity, and the walls of the throat.
• Voiced sounds require vibration of the vocal cords (for example, all vowels, /z/, and /d/).
• The vocal cords stay open for unvoiced sounds (for example, /s/ and /t/).
• Constriction happens when the airflow is reduced at some point along the vocal tract.

• Constriction location changes sounds. /i/ constriction occurs near the back of the vocal tract, /o/ constriction occurs further toward the lips, and /a/ occurs all the way at the teeth.

• Different vowels have different major frequencies (formants) present in the sounds, allowing us to identify different sounds.
What we will do tomorrow

- Model of the vocal tract (only vowels)
  - Voice box and vocal cords (vocal folds)
  - Vocal tract
  - Vocal constriction