

LING 190 Module 2: The Study of Speech and The Vocal Tract

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1. Speech as a communication tool

Big ideas:

1. How to describe speech in human vs. animal communication systems
2. **Phonetics** is the study of speech sounds

1.1. Definitions

- **Communication:** Transmission of a message from one organism to another
- **Language:** Communication of culturally acquired arbitrary symbols
 - what?
- **Speech:** Vocally produced (normally) symbols used for linguistic communication

1.1.1. Examples of Linguistic and Non-Linguistic Communication Types

- Linguistic
 - Non-Vocal: bee “dance”, cat scent marking, body language
 - Vocal: Baby cries, coos, giggles; adult sighs, screams; cat meows
 - Synthetic: facial expressions, postures, movements of animated characters
- Non-Linguistic
 - Non-Vocal: writing, sign language
 - Vocal: human speech
 - Synthetic: artificially-generated speech

Speech is **typically** produced using the vocal tract, but can also be generated artificially/synthetically.

1.2. What are some characteristics of Human Speech?

I.e. what makes it different from other non-human communication systems?

Many animal systems have some of these properties, but no animal system has all of them. The following are four of the properties of speech that we will be considering in this course. There are more, but we will not be considering them.

The following are four of Hockett's criteria for language:

Speech is:

- **Arbitrary**
 - There is no clear link between the format of sound and the meaning it represents.
 - Some exceptions, such as *onomatopoeia*
 - In languages that have a very productive system with many types of onomatopoeic linguistic symbols, we can say that those languages have sound symbolism.
 - Nevertheless, in every human language, onomatopoeia are the minority. I.e. the vast majority of linguistic symbols are arbitrary.
- **Discrete**
 - Speech can be broken up into distinct, independent units.
- **Productive**
 - The distinct units of speech can be reordered and recombined arbitrarily.
 - In the case of speech communication, we can recombine the discrete units to create new words.
- And has **Duality of Patterning**
 - This final characteristic of speech means that speech can be analyzed at two levels:
 - In the sounds, and
 - In the meanings (words or 'pieces' of meaning).
 - For example, the word /kæt/ + /s/ can be analyzed as both the sound /kæt/ and the sound /s/, or it can be analyzed as the idea (meaning) of "cat" and the idea that there can be more than one cat.

2. Phonetics (The Science of Speech)

Phonetics is the study of speech sounds of spoken languages and the gestures of signed languages.

In this lecture, we will focus more on an **articulatory** approach. We will be looking at the workings of the vocal tract during the production of speech and how anatomical structures of the vocal tract are used to produce speech sounds.

We can also approach phonetics from an **auditory** perspective. This looks at how we hear and perceive speech sounds, and how listeners understand or decode the stream of speech (i.e. the steady input of sound) that they hear.

We can also think about phonetics from an **acoustic** perspective. This approach to phonetics looks at the acoustic characteristics of speech. For example, the frequency, or the wavelength, or the intensity/loudness of the sound.

2.0.1. Approaches to Phonetics

- **Impressionistic**: careful listening (using the IPA).

- **Instrumental:** using tools for imaging or visualizing speech (MRI, Endoscopes, Praat)
- **Automatic speech processing:** using AI techniques to synthesize or recognize speech
- **Applied:** using our understanding of speech to achieve practical ends

3. The Vocal Tract

The vocal tract is the part of the body that is responsible for producing speech. However, speech is considered an *exaptation*, such that it is really a secondary function of the vocal tract. The primary functions of the vocal tract are:

- Pulmonary ventilation (inhaling and exhaling, i.e. breathing)
- Mastication (chewing), Deglutition (swallowing), Gustation (tasting) and Olfaction (smelling)

Speech, as an exaptation, is built on top of these functions.

3.1. Speech Breathing (to do with the Lungs)

Most speech is produced when exhaling, therefore speech breathing has much longer relative exhalation time than inhalation time compared to tidal breathing (regular breathing). The ratio of inhalation to exhalation time of tidal breathing is roughly 40:60, while the ratio of inhalation to exhalation time of speech breathing is roughly 10:90.

Another feature of speech breathing is that it is much less regular than tidal breathing. We can think of regularity as a measure of the interval between breaths. Non-speech breathing (tidal breathing) intervals are between 2 and 3 seconds, while speech breathing intervals are anywhere between 1 and 6 seconds.

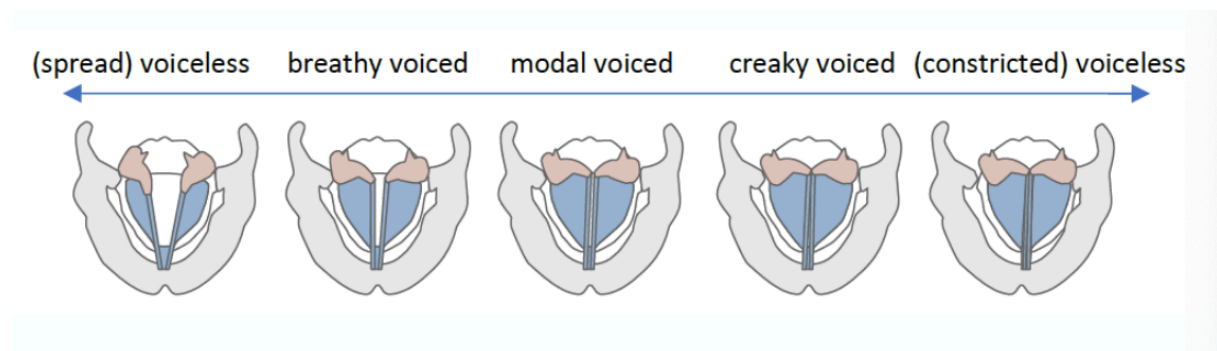
3.2. Phonation (The Larynx)

Phonation: making a sound with the vocal folds (aka the vocal chords) in a pulmonic egressive airstream. (pulmonic = to do with the lungs; egressive = outwards; airstream = the air; i.e. to do with air coming out of the lungs)

- Glottis is the space between the Vocal Folds
 - Abduction: Moving the Vocal Folds apart
 - Adductions: Moving the Vocal Folds together

Sound is produced by the vocal folds rapidly adducting and abducting within the larynx. Around 29:00 in the Module 2 lecture video, we see an example of this process by endoscopic video.

In languages across the world, there are different types of phonation, which we call the *quality* of your voice. See the following image for an example.



In English, we typically use a lot of **modal voice**. This is where you hold the vocal folds together, but there is a little bit of a gap so that the air can go through. If you hold the vocal folds more tightly together, you get a voice quality called **creaky voice**, or **vocal fry**. In other languages, but not in English, **creaky voice** is actually used to indicate a meaningful difference in words. If you hold the vocal chords slightly further apart, you get the **breathy voice**. In English, this only has sociolinguistic significance, but in other languages such as Hindi, it is used to indicate a meaningful difference in words.

At 33:26 in the Module 2 lecture video, we can see a video of an endoscope going into a man's vocal tract.

3.3. False Vocal Chords

You also have a set of **false vocal chords**, that are parts of tissue that lie just above the vocal folds. These false chords can also vibrate. They resonate at certain harmonic frequencies of the vocal chords, which amplifies particular frequencies of the vocal chord vibration. This is used in some cultures for singing, especially in *throat singing* and *polyphonic singing (overtone singing)*. Overtone singing is where a person can sing two notes at the same time, using both the regular *and* false vocal chords.

3.4. Parts of the Vocal Tract

3.4.1. Passive and Active Articulators

- **Passive:** Structures in the superlaryngeal vocal tract that do not move
 - Palate (Hard Palate in the front, Soft Palate in the back)
 - Alveolar Ridge
 - Upper Teeth
 - Velum (Soft Palate)
 - Lower Teeth
 - Pharynx
- **Active:** Structures in the superlaryngeal vocal tract that move
 - Lower Lip
 - Tongue (Tip, Blade, Body, Root; from front to back)
 - Glottis (the space between the vocal folds)
 - Vocal folds can also move up and down, which is important for articulation of certain sounds
 - Uvula

We need to memorize this diagram.

