

Lecture Notes- Vocal anatomy

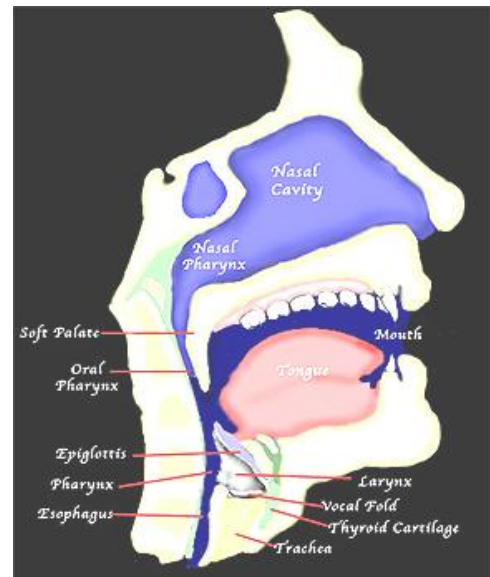
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Voice Production Theory

Both human beings and animal produce sound symbols for communication purposed. The former can articulate the sound to produce and create language through which they communicate with one another. The animals produce vowel like sounds but cannot articulate and thus are unable to create a language of their own. The capability of human being for articulation of the sound distinguishes him from the other species. The parts of the human body which are directly involved in the production of speech are usually termed as the organs of speech. The main organs of speech are the mouth (oral cavity), the nose (nasal cavity), the throat (Pharynx) and the lungs, these organs have other primary biological functions like eating, smelling, breathing etc.

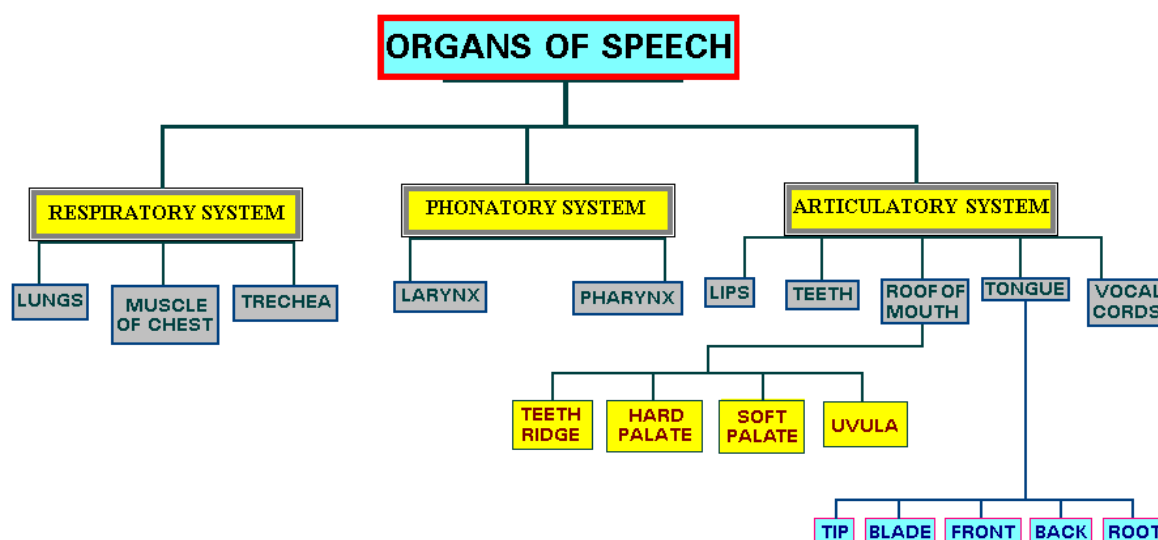
The most important function of the *lungs*, which is relevant to speech production, is respiration and it is responsible for the movement of air. Lungs are controlled by a set of muscles which make them expand and contract alternately so that the air from outside is drawn in and pushed out alternatively. When the air is pushed out of the lungs it passes through the *windpipe or trachea*, which has at its top the *larynx*. Larynx is a cartilaginous structure, which makes the *glottis*.



Glottis is a passage between the two horizontal folds of elastic muscular tissues called the *vocal folds* (vocal cords), which , like a pair of lips, can close or open the glottis (i.e., the passage to the lungs through the windpipe). The main physiological function of the vocal folds is to close the lungs for its own protection at

the time of eating or drinking so that no solid particles of food or liquid enter the lungs through the windpipe.

By virtue of their tissue structure, however, the vocal cords are capable of vibrating with different frequencies when the air passes through and this vibration is called *voice*. After passing through the glottis and reaching the pharynx the outgoing *air stream* can escape either through the nasal cavity having its exit at the mouth. When the air escapes through the mouth, the nasal cavity can be closed by bringing the back part of the soft palate or the velic into close contact with the pharyngeal wall. Such a type of closure of the nasal passage is called *velic closure*. When there is velic closure, the air can escape only from the mouth. The nasal cavity can also be kept open when the air passes through the mouth allowing part of the air to pass through the nose also. The oral passage can be closed at some point so that the outgoing air is temporarily shut up in the *pharyngeal cavity* if the velic is also closed or if the velic is open, the air escapes through the nostrils. Normal breathing occurs with the air generally passing through the nasal cavity. This is a brief account of how some of the organs of speech take part in respiration.



Mechanism of speech production:

Speech may be said to consist of sounds produced by the movements of the various organs of speech disturbing the current of air moving from and into the lungs. Production of speech sounds, therefore, is based on the air stream and the movement of the speech organs, which is called the process of articulation.

The air stream, which acts as the source of speech sounds, may be said to be a column of air, which has the lungs at one end the lips and the nostrils on the other end. This column consists of four cavities, namely, the oral cavity, the nasal cavity, the pharyngeal cavity and the lung cavity with interconnecting passages at the back of the mouth, and the glottis. These cavities are endowed with such muscular devices as would enable them to expand or contract so that the air is drawn into them or pushed out of them. When the air is pushed into the cavity it is called an ingressive air stream. The lungs are the major initiator of the air stream. An air stream initiated by the lungs is called the pulmonic air stream. Most of the human speech sounds have the pulmonic egressive air stream as their source.

Vibration mechanism of vocal folds:



Fig2: Vocal Folds

During phonation, each cycle of vocal fold vibration is caused both by the sub glottal air pressure that has built up sufficiently to separate the folds and to the Bernoulli effect which, as the air rushes through the glottis at an increased velocity, accounts for a sudden drop in pressure against the inner sides of each fold sucks them together again. The whole process is made possible by the fact that the folds themselves are elastic. Their elasticity not only permits them to be blown open for each cycle, but the elastic recoil force (the force that restores any elastic body to its resting place) works along with the Bernoulli effect to close the folds for each cycle of vibration.

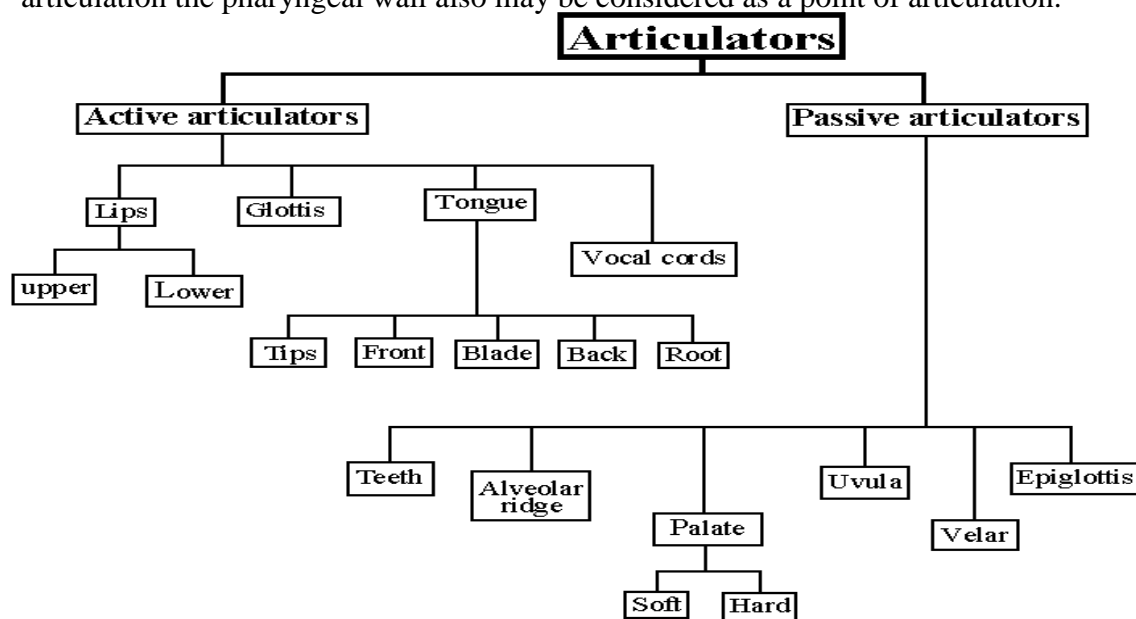
The vocal folds move in a fairly periodic way. During sustained vowels, for example, the folds open and close in a certain pattern of movement that repeats itself. This action produces a barrage of airbursts that set up an audible pressure wave (sound) at the glottis. The pressure wave of sound is also periodic; the pattern repeats itself. Like all sound sources that vibrate in a complex periodic fashion, the vocal folds generate a harmonic series, consisting of a fundamental frequency and many whole-number multiple of that fundamental frequency (harmonics). The fundamental frequency is the number of glottal openings/closing per second.

Articulators: Articulation is a process resulting in the production of speech sounds. It consists of a series of movements by a set of organs of speech called the *articulators*.

The articulators that move during the process of articulation are called **active articulators**. Organs of speech which remain relatively motionless are called **passive articulators**. The points at which the articulator are moving towards or coming in to contact with certain other organ are the *place of articulation*. The type or the nature of movement made by the articulator is called the *manner of articulation*.

Most of the articulators are attached to the movable lower jaw and as such lie on the lower side or the floor of the mouth. The points of articulation or most of them are attached to the immovable upper jaw and so lie on the roof of the mouth. Therefore, nearly all the articulatory description of a speech sound; therefore has to take into consideration the articulator, the point of articulation and the manner of articulation.

While describing the articulators and the points of articulation it would be convenient to take the points of articulation first. The main points of articulation are the upper lip, the upper teeth, the alveolar ridge, the hard palate and the soft palate, which is also called the velum. The upper lip and the upper teeth are easily identifiable parts in the mouth. The alveolar ridge is the rugged, uneven and elevated part just behind the upper teeth. The hard palate is the hard bony structure with a membranous covering which immediately follows the alveolar ridge. The hard palate is immediately followed by the soft palate or the velum. It is like a soft muscular sheet attached to the hard palate at one end, and ending in a pendulum like soft muscular projection at the other which is called the Uvula. Besides the above points of articulation the pharyngeal wall also may be considered as a point of articulation.



The two most important articulators are the lower lip and tongue. The tongue owing to its mobility is the most versatile of articulators. As the surface of the tongue

is relatively large and the different points of tongue are capable of moving towards different places or point of articulation. It may be conveniently divided into different parts, viz, the front, the center, the blade, the back and the root of the tongue. When the tongue is at rest behind the lower teeth then the front part of the tongue, which lies opposite to the hard palate, is called the front of the tongue. The part, which faces the soft palate, is called the back and the region where the front and back meet is known as center. The whole upper surface of the tongue i.e. the part lying below the hard and soft palate is called by some scholars as the dorsum. The part of the tongue at the extreme end and facing the tongue can be further divided into three parts as follows; the tapering section of the front facing the teeth ridge is called the blade. Its extremity is called the tip. The tip and the blade of the tongue are together called sometimes the apex. The remaining part of the front of the tongue is referred to as front only.