

LIN1320 - The Sounds of Language

Kevin McMullin | kevin.mcmullin@uottawa.ca

This course is an introduction to the study of the sounds of language (phonetics) and the sound systems of languages (phonology). We will cover, for example, the articulation of sounds, the International Phonetic Alphabet (IPA) and phonetic transcription, as well as sound processes and phonological rules.

Chapter 2 - Phonetics

“We do not need to speak in order to use languages. Language can be written, manually signed, mechanically reproduced and even synthesized by computers with considerable success”

- Speech remains the primary way which humans express themselves through language
- Our species spoke long before we began to write
- Humans appear to have specialized neural mechanisms for the perception of speech sounds.

2.0 PHONETICS

- The inventory and structure of the sounds of speech
- Human languages display a wide variety of sounds, called *phones* or *speech sounds*.
- A very wide range of sounds is found in the human language (600 consonants and 200 vowels)
- Any human, child or adult can learn to produce any human speech sound.
- 2 ways to study phonetics
 1. Articulatory Phonetics: analyzing the physiological mechanisms of speech production
 2. Acoustic Phonetics: measuring and analysing the physical properties of the sound waves we produce when we speak.

2.1 Phonetic Transcription

- Since the 16th century efforts have been made to devise a universal system for transcribing the sounds of speech, the best known system is the International Phonetic Alphabet (IPA).
- This attempts to represent each sound of human speech with a single symbol.
- These symbols are placed within brackets [] to indicate that it is phonetic and not the actual spelling system.
- Uses the symbols to represent the sound in whatever language it is heard.
- *Rough, through, though & cough* all have “ough” but all represent different sounds.
- *Go, hot, women & more* all contain “o” but it is pronounced differently in each.
- Fish → Ghoti (*Enough, women, nation*) - George Bernard Shaw

2.1.1 Units of Representation

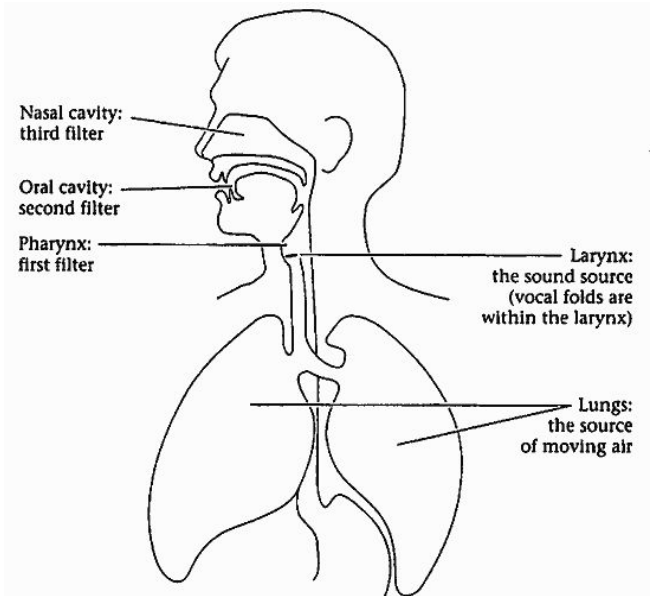
- Anyone who hears a language spoken for the first time finds it hard to break up the flow of speech into individual units.
- When hearing our own language, we do not focus on individual sounds but rather the meaning.
- The IPA represents speech sounds in the form of segments.

2.1.2 Segments

- Segments are produced by coordinating a number of articulatory gestures including jaw movement, lip shape and tongue placement.
- Segment: an individual speech sound (phone).
- Errors in speech production provide the evidence for the existence of segments.
 - Slips of the tongue such as remuneration → “renumeration” or “melcome wat” for welcome mat.
 - These show segments shifting and reversing position within and across words.
- The relative importance of speech sounds in human language also suggests that segmental phonetic transcription is a well-motivated way of transcribing speech.
- The bundle of nerves controlling the vocal folds is among the densest in the whole body. There are about 40 different muscles in the vocal tract. 225 muscle activations are needed to produce just one second of speech.

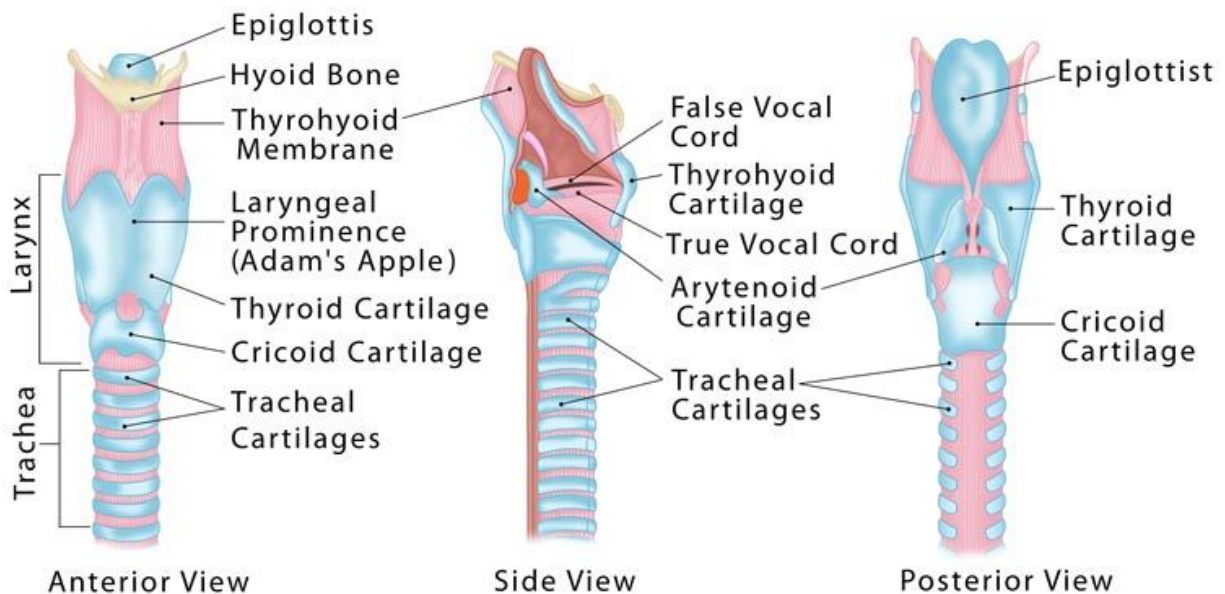
2.2 The Sound-producing System

- Sound is produced when air is set in motion.
- The air supply is provided by the lungs, the sound source is the larynx, where a set of muscles called the vocal folds is located.
- The filters are the passages above the larynx, known as the “vocal tract”: the tube of the throat between the larynx and the oral cavity, (the pharynx); the oral cavity; and the nasal cavity.



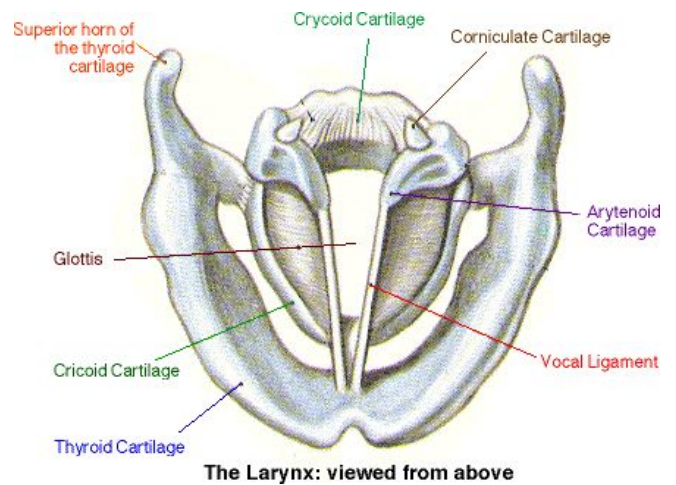
2.2.1 The Lungs

- In order to produce the majority of sounds, we take air into the lungs and expel it during speech.
- A certain level of air pressure is needed to keep the speech mechanism functioning steadily. The pressure is maintained by the action of various sets of muscles.
- The primary set of muscles are intercostals (the muscles between the ribs) and the diaphragm (the large sheet of muscle separating the chest cavity from the abdomen)
- The intercostals raise the rib cage allowing air to flow into the lungs during inhalation, while the diaphragm helps to control the release of air during exhalation for speech.



2.2.2 The Larynx

- As air flows out of the lungs up the trachea (windpipe), it passes through a box-like structure made of cartilage and muscle; this is the Larynx (known as the voice box or the adam's apple)
- The main portion of the larynx is formed by the thyroid cartilage which rests on the ring shaped cricoid cartilage.
- Fine sheets of muscle flare, from the inner sides of the thyroid cartilage form paired vocal folds.
- The inner edges of the vocal folds are attached to vocal ligaments.
- The vocal folds can be pulled apart and drawn closer together; each is attached to one of two small cartilages; the arytenoids.
- Arytenoids: opened, closed and rotated by several pairs of small muscles.
- As air passes through the space between the vocal folds (the glottis), different vocal states are produced, depending on the positioning of the vocal folds.



2.2.3 Glottal States

The vocal folds may be positioned in a number of ways to produce different glottal states. There are more than a dozen.

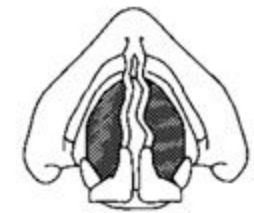
1. Voiceless

- When the vocal folds are pulled apart, air passes directly through the glottis without much interference. Any sound made with the vocal folds in this position is said to be “voiceless”
- The initial sounds of “fish”, “sing” & “house” are all voiceless.
- You can confirm a sound’s voicelessness by touching your fingers to your larynx as you produce it - you will not feel any vibration
- Voicelessness is a true speech state distinct from breathing; the vocal folds are not as far apart during speech voicelessness as they are from silent breathing.



2. Voiced

- When the vocal folds are brought close together, but not tightly closed, air passing between them, causes them to vibrate, producing sounds that are said to be “voiced”
- You can confirm if a sound is voiced by touching your fingers to your larynx as you produce it - you will feel a vibration
- The initial sounds of “zip”, “vow” or any vowel.
- [ffffffvvvvvvv] or [sssssszzzzzzz] (voiceless vs voiced)



3. Whisper

- Whispering is voiceless but the vocal folds are adjusted so that the front portions are pulled close together, while the back portions are apart.



4. Murmur

- Aka. “breathy voice”
- Sounds produced as a murmur are voiced, but the vocal folds are relaxed enough to allow enough air to escape to produce the “breathy effect”
- “dh” in dharma or “gh” in ghee.
- Not commonly used in English

2.3 Sound Classes

The sounds of language can be grouped into classes based on the phonetic properties that they share. The most basic division is vowels and consonants. Another class, glides, shares properties of both.

2.3.1 Vowels & Consonants

- Vowels and consonants can be distinguished on the basis of differences in articulation or by their acoustic properties.
- The Articulatory Difference: Consonant sounds may be voiced or voiceless, are made of either complete closure or narrowing of the vocal tract. The airflow is either blocked momentarily or restricted so much that noise is produced as air flows past the constriction. In contrast, vowels are produced with little obstruction in the vocal tract and are usually voiced.
- The Acoustic Difference: Consonants and vowels differ in the way they sound. Vowels are more sonorous (acoustically powerful) than consonants, and so we perceive them as more powerful and longer lasting.
- Syllabic & Non-syllabic sounds: The greater sonority of vowels allows them to form the basis of syllables. A syllable can be defined as a peak of sonority, surrounded by less sonorous segments.
 - In counting syllables, we are in effect counting vowels.
 - A vowel is known as the nucleus of a syllable.

Vowels (syllabic elements)

- Are produced with relatively little obstruction to the vocal tract
- Are more sonorous

Consonants (non-syllabic elements)

- Are produced with complete closure or narrowing of the vocal tract
- Are less sonorous

2.3.2 Glides

- A type of sound that shows properties of both consonants and vowels is called a glide. They may be thought of as rapidly articulated vowels.
- Glides are produced with an articulation like that of a vowel; however, they move quickly to another articulation, as do the glides in “yet” or “wet”. Or quickly terminate, as do the word-final glides in “boy” and “now”.
- Little movement is necessary to move from a vowel articulation to a glide articulation. “See you later”
- Even though they are vowel-like in articulation, glide patterns are consonants. Glides can never form the nucleus of a syllable.
- Also known as “semivowel” & “semiconsonant”.
- The glide [w] is made with the tongue raised and pulled back near the velum and with the lips protruding, or rounded.

2.4 Consonant Articulation

Airflow is modified in the vocal tract by the placement of the tongue and the positioning of the lips. These modifications occur at specific places of articulation

2.4.1 The tongue

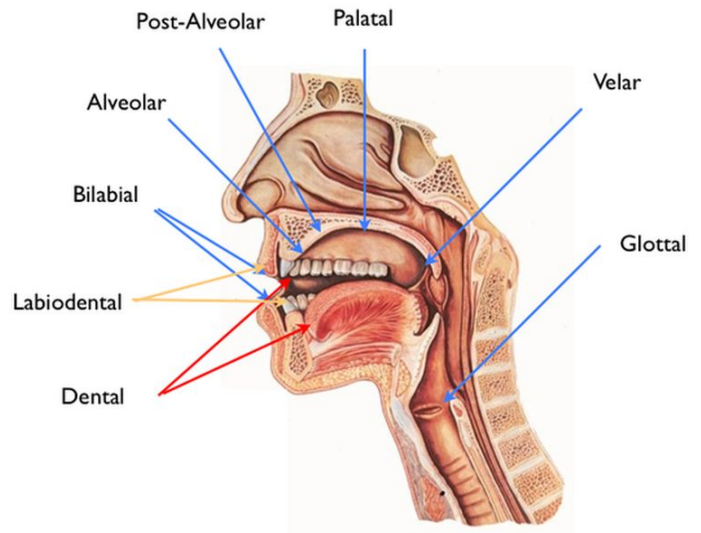
- The tongue is the primary articulating organ. It can be raised, lowered, thrust forward or retracted, even rolled back. The sides of the tongue can also be raised or lowered.

There are 5 areas of the tongue

1. The tip: the narrow area at the front
2. The blade: just behind the tip
3. The body: the main mass of the tongue
4. The back: the hindmost part of the tongue that lies in the mouth
 - a. (body + back = the dorsum)
5. The root: contained in the upper part of the throat (pharynx)

2.4.2 Places of articulation

- Each point at which the airstream can be modified to produce a different sound is called a place of articulation.
- They are found at the lips, within the oral cavity, in the pharynx, and at the glottis.



Labial: any sound made with closure or near-closure of the lips. Sounds involving both lips are “bilabial” (*peer, bin*); sounds involving the lower lip and the upper teeth are “labiodentals” (*fire, vow*).

Dental & Interdental: produced with the tongue placed against or near the teeth. French has dental sounds at the beginning of (*temps, dire, sept*) If the tongue is placed between the teeth it is said to be interdental (*this, thing*).

Alveolar: within the oral cavity, a small ridge protrudes from just behind the upper front teeth - this is called the alveolar ridge. This sound is heard in (*top, deer, soap, zip, lip* and *neck*).

Postalveolar & Palatal: just behind the alveolar ridge, the roof of the mouth rises sharply - this is the alveopalatal area. (show, chip). The highest part of the mouth is called the palate, words produced here are palatals (*yes* is a palatal glide)

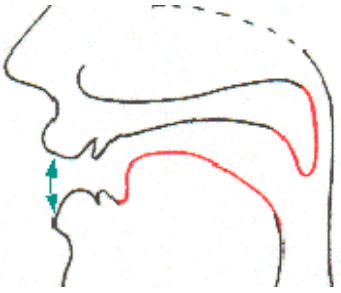
Velar: the soft area at the back of your mouth is called the velum. Sounds made here are velar; (*call & guy*)

Uvular: the small fleshy flap of tissue known as the uvula hangs down from the velum. English has no uvulars but the “r” sound in french is uvular.

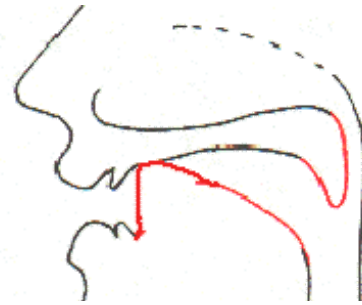
Pharyngeal: the area of the throat between the uvula and the throat is known as the pharynx. Sounds made through the modification of airflow by retracting the tongue or constricting the pharynx. Found in arabic, not english.

Glottal: sounds produced using the vocal folds as primary articulators, (*heave & hog*)

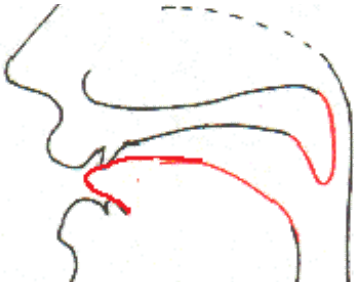
The **Labial** sound at the beginning of “peer”



The **Alveolar** sound at the beginning of “top”



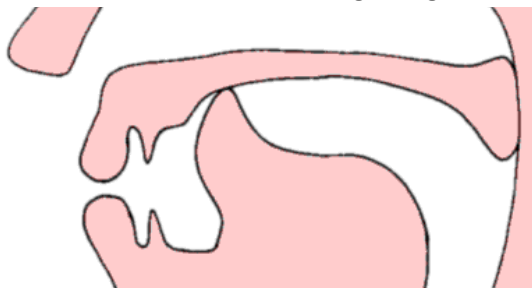
The **Interdental** sound at the beginning of “this”



The **Post Alveolar** sound at the beginning of “show”



The **Retroflex** sound at the beginning of “red”



The **Velar** sound at the beginning of “call”



2.5 Manners of Articulation

The lips, tongue, velum, and glottis can be positioned in different ways to produce different sound types.

2.5.1 Oral vs. Nasal Phones

- When the velum is raised, cutting off the airflow through the nasal cavity, oral sounds are produced.
- The velum can also be lowered to allow air to pass through the nasal cavity, producing a sound that is nasal.
- Both vowels & consonants can be nasal, in which they are generally voiced.
- The consonants at the end of (*sun, sum & sung*) are nasal.

2.5.2 Stops

- Stops are made with a complete closure either in the oral cavity or at the glottis
- Found at bilabial, dental, alveolar, alveopalatal, palatal, velar, uvular, and glottal places of articulation.
- In some British dialects, the glottal stop is heard in the place of [t] in “bottle” and sounds like “bo’l”

	Bilabial	Alveolar	Velar	Glottal
Voiceless	[p]	[t]	[k]	[ʔ]
Voiced	[b]	[d]	[g]	
Nasal	[m]	[n]	[ŋ]	

2.5.3 Fricatives

- Consonants produced with a continuous airflow through the mouth. They belong to a large class of sounds called continuants
- Fricatives are accompanied by a continuous audible note during their production. (Air passes through a very narrow opening either at the glottis or at some point higher in the vocal tract.)
 - **Labiodental:** fan [f] & van [v]
 - **Interdental:** thin [θ] & then [ð]
 - **Alveolar:** sun [s] & zip [z]
 - **Post Alveolar:** ship [ʃ] & measure [ʒ]
 - **Glottal:** hat [h]

2.5.4 Affricates

- When a stop articulation is released, the tongue moves rapidly away from the place of articulation. Some non-continuant consonants show a slow release of the closure; these are affricates.
- English only has 2 affricates, both are alveopalatal (church & chump)
- Noisier fricatives and affricates are called stridents (aka. sibilants)

2.5.5 Voice lag & Aspiration

- After the release of certain voiceless stops in English, you can hear a lag or brief delay before the voicing of a following vowel.
- The lag in the onset of vocalic voicing is accompanied by the release of air.
- Pat (p^hæt), tub (t^hʌb), cope (k^hoʊp)
- **Unreleased Stops:** cap ɪ̚, pot ɒ̚, back ɒ̚

2.5.6 Liquids

- Among the sounds commonly found in the world's languages are l and r and their numerous variants. They form a special class known as **liquids**.
- Although there is a great deal of variation in the production of ls and rs in the languages of the world, they are nonetheless similar enough to be grouped together into a single category: **oral sonorous consonants**.
- English laterals: varieties of "l" are called **laterals** -- the most commonly used lateral liquid is articulated with the tip of the tongue touching the alveolar ridge while air escapes through the mouth along the lowered sides of the tongue
- English "Rs": numerous varieties of "r" are also heard in the world's languages. The R of English is spoken by curling the tongue tip back and bunching the tongue upwards and back in the mouth. (known as a **retroflex**)

2.5.7 Syllabic Liquids & Nasals

- Liquids and nasals are more sonorous than other consonants and in this respect are more like vowels than other consonants. They are so sonorous, that they may function as a syllabic nuclei. When they do they are called **syllabic liquids and nasals**.
- Bottle, funnel, bird, hidden.

2.6 Vowels

Vowels are **sonorous, syllabic sounds** made with the vocal tract more open than it is for consonant and glide articulations.

- Different vowel sounds are produced by varying the placement of the body of the tongue and shaping the lips.
- The shape of the vocal tract can be further altered by protruding the lips to produce rounded vowels or by lowering the velum to produce a nasal vowel.
- Vowels may be **tense or lax**.

2.6.1 Simple vowels and diphthongs

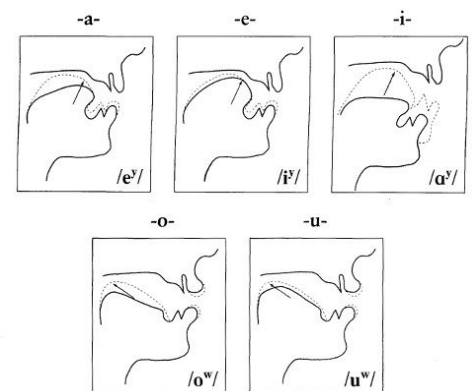
- English vowels are divided into two major types; simple vowels and diphthongs.
- **Simple vowels** do not show a noticeable change in quality during their articulation. (pit, set, cat, dog, put)
- **Diphthongs** are vowels that exhibit a change in quality within a single syllable.
- English diphthongs show changes in quality that are due to tongue movement away from the initial vowel articulation toward the glide position.
- **Diphthongs** are transcribed as vowel-glide sequences; although they are complex in an articulatory sense, they still act as a single vowel. EX: our judgements tell us that both pin (simple vowel) and piny (diphthong) are single syllable words. Having a diphthong doesn't add a syllable to a word.
 - **Major Diphthongs**: the change in articulation is quite extreme and hence easy to hear.
 - **Minor Diphthongs**: the change in position of the articulators is less dramatic.

Simple Vowels	Minor Diphthongs	Major Diphthongs
Pit Set Cut Mat	Say Grow	My Now Boy

2.6.2 Basic parameters for describing vowels

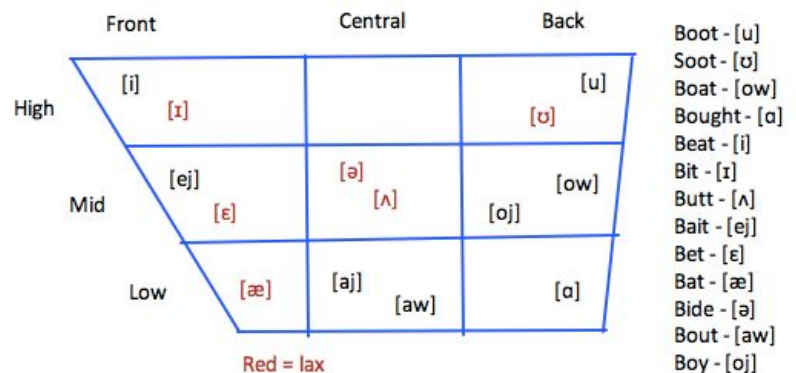
- Vowel articulations are not as easy to feel at first as consonant articulations because the vocal tract is not narrowed as much.
- He/awe: The tongue will move from a high front to a low back position
- Awe/at: The tongue will move from low back to low front position.
- He/who: The tongue will move from high front and high back positions, you are also rounding your lips.
- Vowels for which the tongue is neither raised nor lowered are called **mid vowels**. The front vowel of english made or fame is mid, front, and unrounded. The vowel of code and soak is mid, back and rounded.
- The the case of diphthongs, the articulatory descriptions refer to the tongue position of the vowel nucleus.
- There is no difference between the vowels of a pair of words like cot and caught, both of which contain the vowel [ɑ]

Heat	[i]	High front unrounded
Fate	[eɪ]	Mid front unrounded
Mad	[æ]	Low front unrounded
Sue	[u]	High back rounded
Boat	[ow]	Mid back rounded
Sun	[ʌ]	Mid central unrounded
Cot	[ɑ]	Low back unrounded



2.6.3 Tense lax and vowels

- **Tense vowels**: produced with greater vocal tract constriction than non-tense vowels and are longer in duration than non-tense vowels.
- **Lax vowels**: made with roughly the same tongue position as the tense vowels but with a less constricted articulation.
- **Schwa**: a reduced vowel; in addition to being lax, its duration is briefer than that of any of the other vowels. Frequently appears in unstressed syllables in polysyllabic words (sofa, candle)
- To determine whether vowels are tense or lax - monosyllabic words spoken in isolation do not end in lax vowels.



2.8 Suprasegmentals

- All phones have certain inherent suprasegmental or prosodic properties that form part of their makeup no matter what their place or manner of articulation. (pitch, loudness, and length)
- **Pitch:** the auditory property of a sound that enables us to place it on a scale that ranges from low to high. Especially noticeable in sonorous sounds: vowels, glides, liquids and nasals - even stop and fricative consonants convey different pitches.
- All sounds have some degree of intrinsic loudness as well, or they could not be heard. All sounds occupy a certain stretch of time - they give the subjective impression of length.

2.8.1 Pitch: tone and intonation

- Controlling the tension of the vocal folds and the amount of air that passes through the glottis.
- The combination of tensed vocal folds and greater air pressure results in **higher pitch** on vowels and sonorant consonants
- Less tense vocal folds and lower air pressure result in **lower pitch**.
- **Tone:** a language is said to have tone when differences in word meaning are signalled by differences in pitch.
 - When a speaker of English says "a car?" with a rising pitch, the word car refers to the same object as when it is pronounced on a different pitch level. (This is different for other languages)
 - **Register tones:** level tones that signal meaning differences; two or three register tones are the norm in most of the world's registered tone languages.
 - **Contour tones:** can change pitch within a single syllabic element.
 - Tone can sometimes have a grammatical function; in Bini tone can signal a different tense of verb.
- **Intonation:** pitch movement in spoken utterances that is not related to differences in word meaning.
 - Intonation often does serve to convey information of a broadly meaningful nature; the falling pitch at the end of "Fred parked the car" signals that the utterance is complete.
 - **Terminal contour:** falling intonation at the end of an utterance
 - **Non-terminal contour:** a rising level of intonation signals incompleteness.
 - In questions, final rising intonations also signal a kind of incompleteness in that they indicate that a conversational exchange is not finished: "Are you hungry?"
 - Rising intonation on names or requests is commonly heard in addressing people.
 - Tone and intonation are not mutually exclusive. Tone languages show intonation of all types - tones are not absolute but relative pitches. A tone is perceived as high if it is high relative to the pitches around it.
- **Lengths:** many languages have vowels and consonants whose articulation takes longer relative to that of the other vowels and consonants.
 - Indicated in the phonetic transcription by the use of an IPA colon placed after the segment in question.

2.8.3 Stress

The combined effects of pitch, loudness and length - the result of which is perceived prominence.

- Some vowels are perceived as more prominent than others; "banana" the second syllable is more prominent than the other two. A syllabic nucleus that is perceived to be more prominent than other nuclei in the word is stressed.
- English stressed vowels are higher in pitch, longer and louder than unstressed ones.
- The **acute accent** placed over the vowel nucleus in question to mark the **primary stress** and the **grave accent** to mark the second most prominent or **secondary stress**.