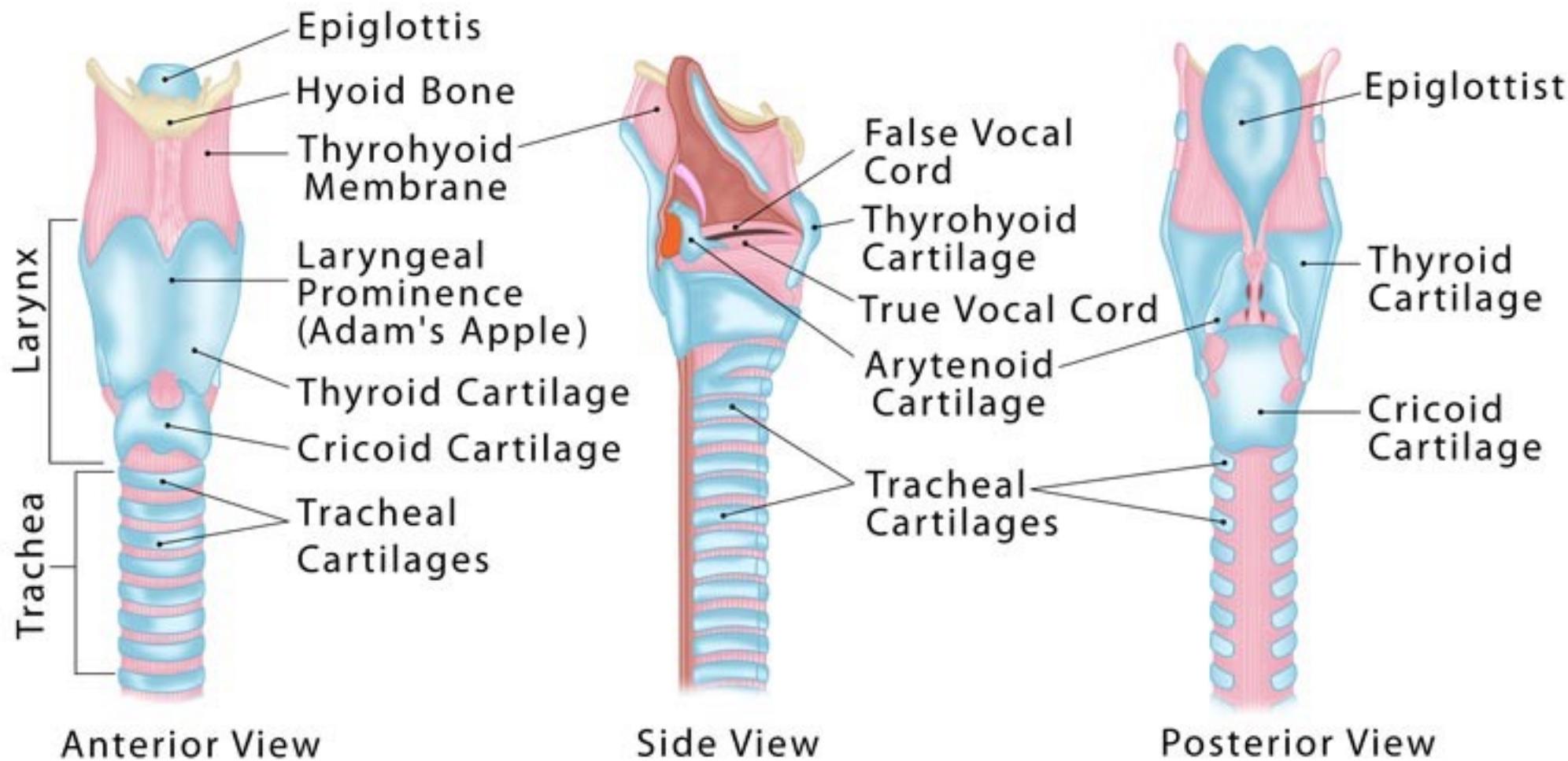


(extra material)



# Anatomy of the Larynx



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# The voice

- psychological as well as physical
- our sounds reflect our inner state of mind
- stress tightens the muscles around your voice, closes off the throat and restricts breathing
- kind of an aural fingerprint that projects your uniqueness
  - research 2018: voices are processed in a part of the auditory cortex cabled directly to the brain region that recognizes faces

# Prosody

- the natural variation in pitch and volume that people use to give color, animation, expression, and personality to their speech
- the melody of everyday speech
- from the Greek pro “toward” + sody “song”
  
- even animals have prosody
- <https://vimeo.com/62757294>

# Baby talk

- by about 28 weeks, a fetus can detect sounds
- by the 3<sup>rd</sup> trimester, the fetus can distinguish its mother's voice and is emotionally affected by it
- newborns are born prepared to learn any language, but after a few months, lose the ability to hear speech sounds not relevant to their native language
- the babbling stage mimics the music of speech children have heard, and emerges before words:

[https://www.youtube.com/watch?v=\\_JmA2ClUvUY&t=4s](https://www.youtube.com/watch?v=_JmA2ClUvUY&t=4s)

# children

- babies produce their first spoken word around age one (after the larynx has moved down the throat)
- children can learn up to one new word every 2 hours, and keep up this pace for 15 years
- by the end of high school, children know an average of 60K words

# learning grammar

- around age 2, children start combining words to make a ‘sentence’
- by age 3, they speak in multi-word sentences
- Chomsky argued that the ‘poverty of input’ means they could not have learned grammar from just listening
- others disagree; the use of ‘motherese’ in speaking to babies teaches subject - verb structure and ‘motherese’ becomes more complex as children age

# prosody as a teacher

- Daniel Levitin ‘This is Your Brain on Music’ states that when music resolves (arrives back at the note of the song’s key) this causes the release of dopamine in the brain
- Experiment: 4-month old babies are read a 3-sentence story with normal prosody; then read the same with awkward pauses
- at 4 months, they don’t understand the words, but the wrong ‘linguistic prosody’ caused the babies to turn away from the speaker
- Darwin believed that our speech evolved from music
- <https://www.ucsf.edu/news/2018/06/410986/music-speech-linked-brain-area-unique-humans>

# Discourse analysis

- branch of linguistics that studies conversation
- pauses are important:
  - a pause > 200 ms means that the person is thinking about their response
  - a pause > 2 seconds is socially awkward
  - varies by language and region
- pitch is important:
  - we respond with the same pitch when we agree with what we heard, and a much lower pitch if agreement is obvious
  - we respond with a higher pitch if we disagree

# evolution of language

- lungfish have the equipment needed for language: lungs and vocal cords
- their lungs evolved from their swim bladder
- vocal cords evolved to keep water out of these proto-lungs
- <https://www.youtube.com/watch?v=G0xu6jHPQWU>
- during evolution, the larynx began to descend from the back of the mouth into the throat
- Neanderthal man's larynx was higher and couldn't speak as well

# evolution of language

- our language comprehension and production evolved in connection with our hearing, about 150,000 years ago
- some anthropologists believe that the emotive content of all vocal expression - singing, poetry, oratory - is an inheritance from our animal ancestors

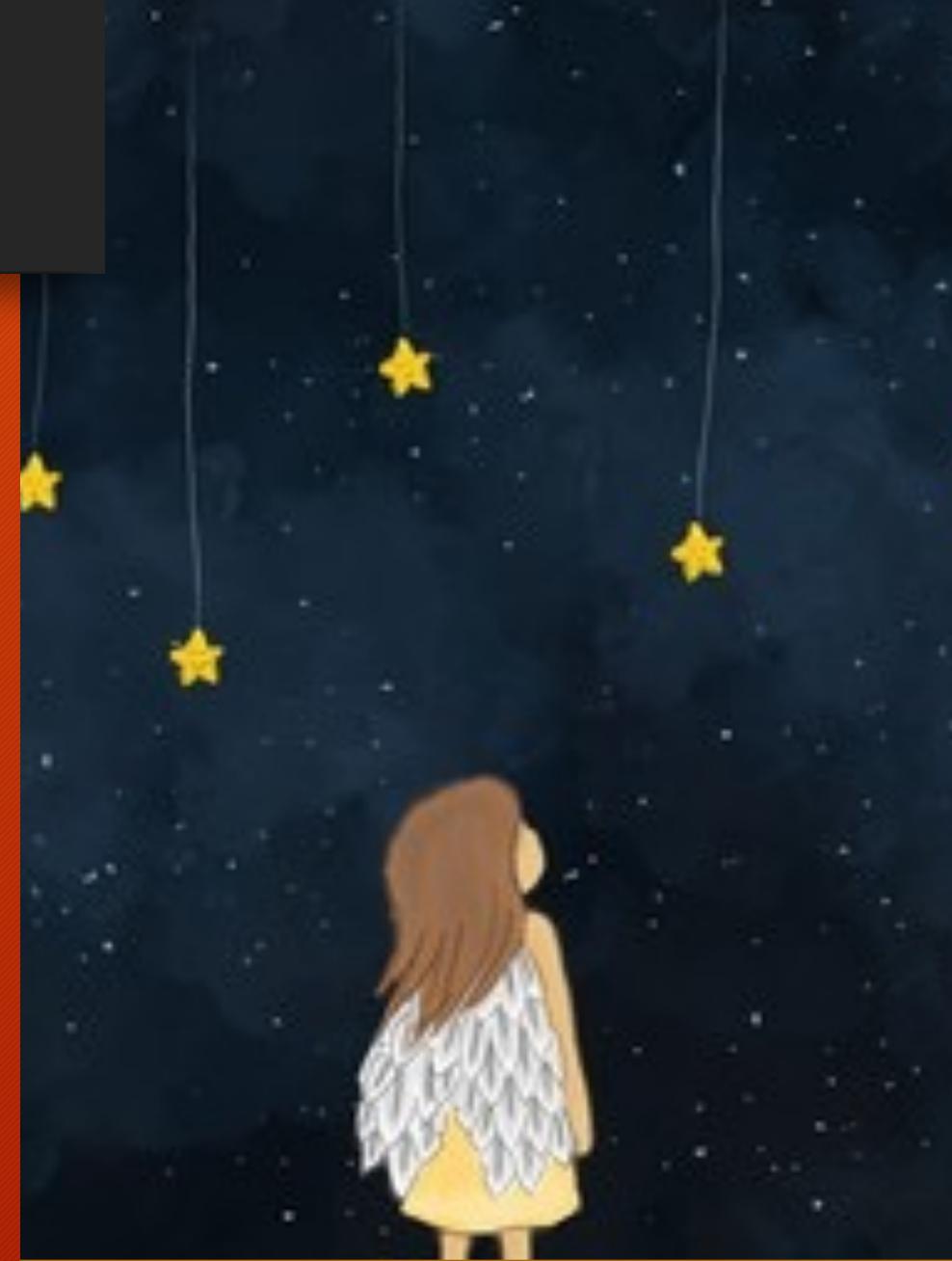


# evolution of language

- influential leaders still know the power of voice and musical techniques such as rhythm, rhetorical techniques such as alliteration:
  - Cicero
  - Lincoln
  - Churchill
  - MLK, Jr.

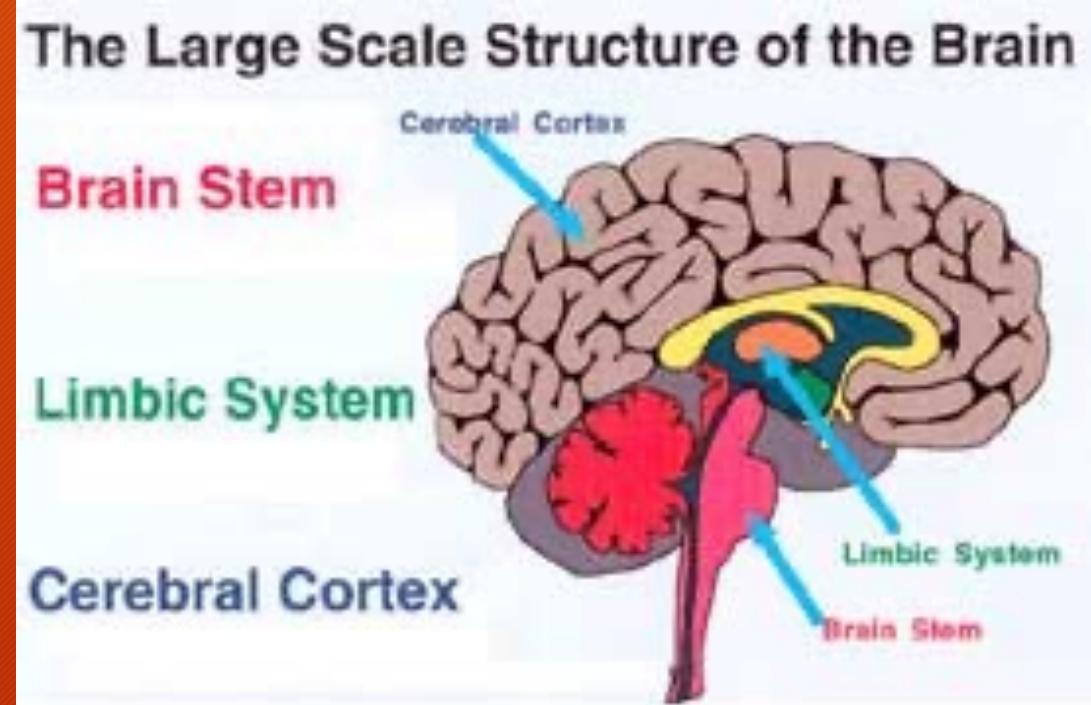
# Mentalese?

- the language of thought (LOTH) hypothesis proposes that thinking occurs in a mental language ‘mentalese’
- this mentalese is converted into brain signals to produce speech
- <https://plato.stanford.edu/entries/language-thought/>



# brain structures

- brainstem - involuntary processes like breathing
- limbic system - generates emotions by releasing neurotransmitters
  - also controls social signals of face, voice, etc
- cortex - computational power, intelligence
  - modulates our social signals



# emotions

- vocal emotions seem to be universal but there are cultural differences in what emotions are desirable
- <https://nobaproject.com/modules/culture-and-emotion>
- at present, computers can recognize specific vocal emotions 65-70% of the time

# Male/female

- we are the only mammals that exhibits sexual dimorphism in voice
- all other mammals are monomorphic: roars, barks, meows, etc.  
are the same whether made by a male or a female
- all children's voices are the same, but at puberty male voices deepen
- male voices also tend to be louder
- males unconsciously raise/lower pitch when speaker to higher/lower males on their perceived hierarchy

# vocal fry

- [https://www.youtube.com/watch?v=s\\_LmC-ynqGM](https://www.youtube.com/watch?v=s_LmC-ynqGM)

# accent

- some linguists called voice and accent the last socially acceptable form of prejudice
- George Bernard Shaw (*Pygmalion*) ‘it is impossible for an Englishman to open his mouth without making other Englishmen hate or despise him’
- activity in our limbic brain decides whether a speaker is a member of our ‘in-group’ or an outsider

- Language that does not sing, that does not acknowledge the stirring melody and movement of thought, that is not animated by the dancelike syncopations of rhythm, of linguistic and emotional processes, is dead language.

Teach that to  
a computer!