

Airstream mechanisms and phonation types

Outline

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3. Glottalic AM
4. Velaric AM
5. **Phonation types**
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7. Whisper
8. Breathiness
9. Voice
10. Creak
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Airstream mechanisms:

General classification

Airstream mechanism	Airflow initiator	Airflow direction	language
Pulmonic egressive	lungs	outwards	Most languages, for many it is the sole AM
Velaric ingressive	velum	inwards	Zulu (S. Africa)
Glottalic egressive	glottis	outwards	Navajo (N. America)
Glottalic ingressive	glottis	inwards	Sindhi (India)

Pulmonic (lung) AM (1)

Pulmonic egressive AM

- basic to speech production
- standard AM (e.g. English, Spanish, Polish, Indonesian, Chinese)
- the sole AM

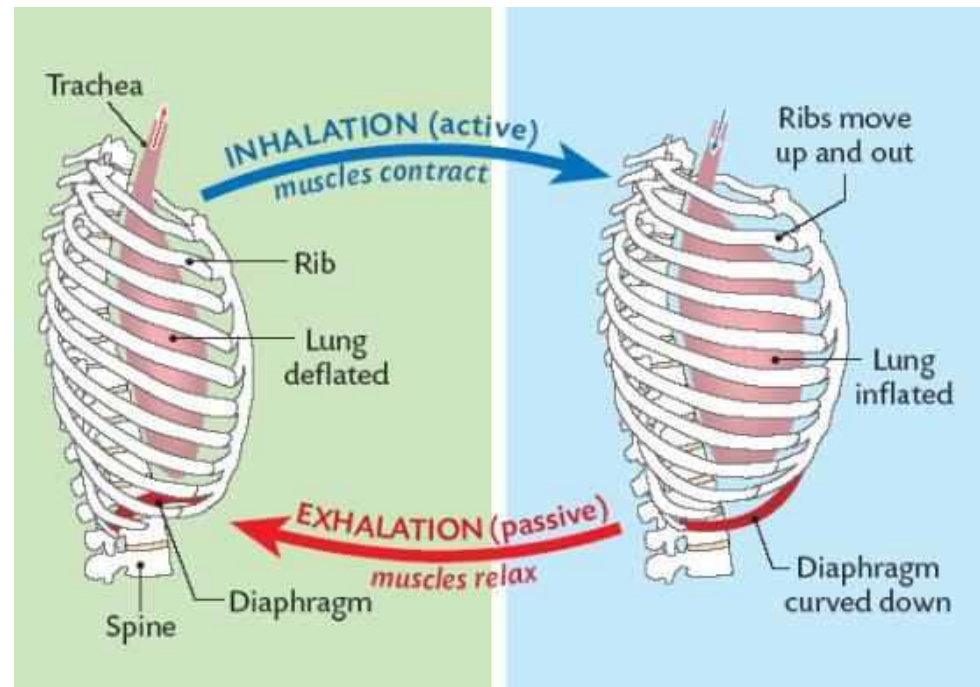
Pulmonic ingressive AM

- possible
- isn't used systematically for distinctive phonological purposes
- paralinguistic uses (Western cultures):
- [ja] in Norwegian and Danish – sympathy, agreement or commiseration
- [nei] – surprise (Norwegian and Danish), sympathy (Danish)

Pulmonic (lung) AM (2)

Pulmonic egressive AM

- generator of the airstream – **the respiratory system**
 - inspiration – active
 - expiration – passive*
- easier to control
- less overall articulatory effort



Pulmonic (lung) AM (3)

Different activity of the respiratory system:

- breathing
 - about 12 inspirations and expirations per minute
 - expiration phase only slightly longer
 - inspiration – muscular action (active process)
 - expiration – mechanical and elastic recoil force (passive process)
- speech
 - expiration phase much longer
 - expiration – a controlled process with co-activation of the inspiratory and expiratory muscles

Glottalic AM (1)

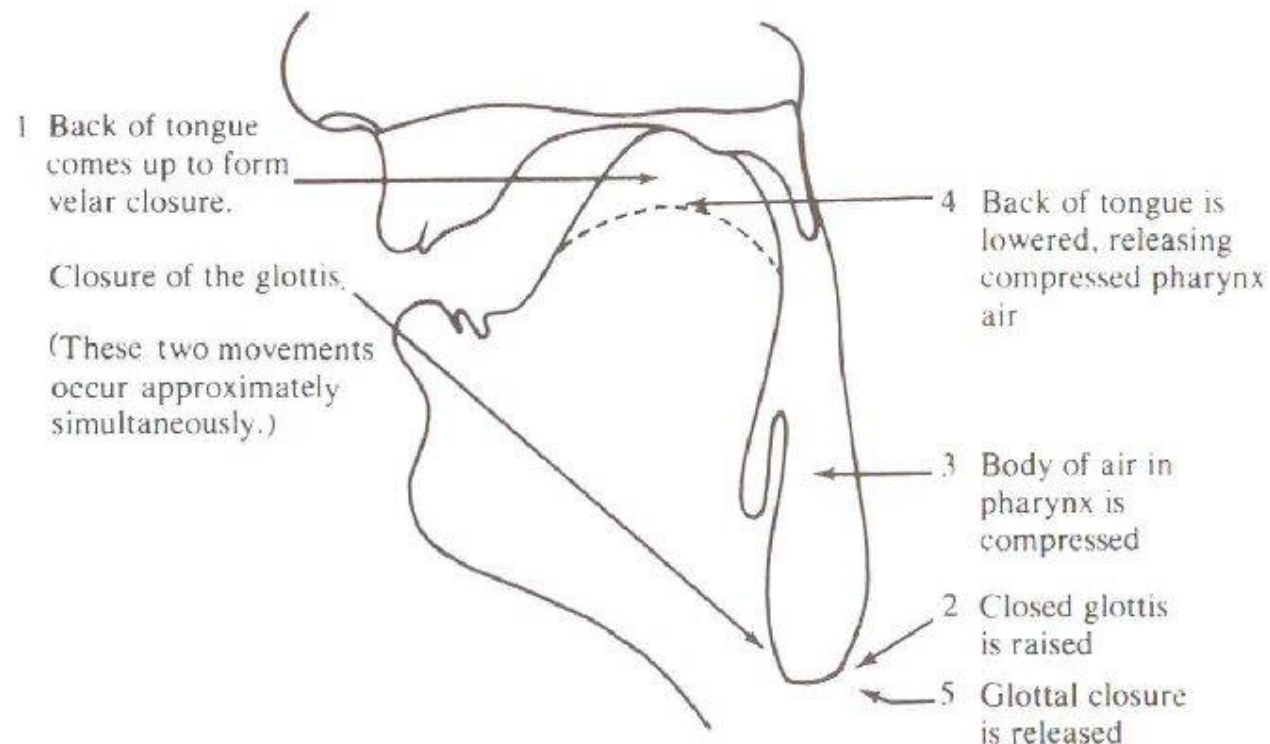
- glottis (larynx) – initiator of an airstream
- glottis closed – the air in the lungs blocked off
- movement of the larynx in the pharynx
 - controlled by elevator and depressor laryngeal muscles
 - upward – egressive AM – **ejectives**
 - downward – ingressive AM – **implosives**

Glottalic AM (2)

EJECTIVES

- stops, fricatives and affricates
- precede or follow sounds using pulmonic AM

Pronunciation
of a glottalic
egressive velar
stop [k']:



Glottalic AM (3)

Ejectives are found in languages of:

- Africa (*Hausa*),
- North ([Montana Salish](#), *Lakhota*, *Navajo*),
Central ([K'ekchi](#)) and South Am.
- Asia (mainly in the Caucasus area: *Georgian*
and *Circassian*)
- Sound examples:
<http://www.yorku.ca/earmstro/ipa/nonpulmonics.html>

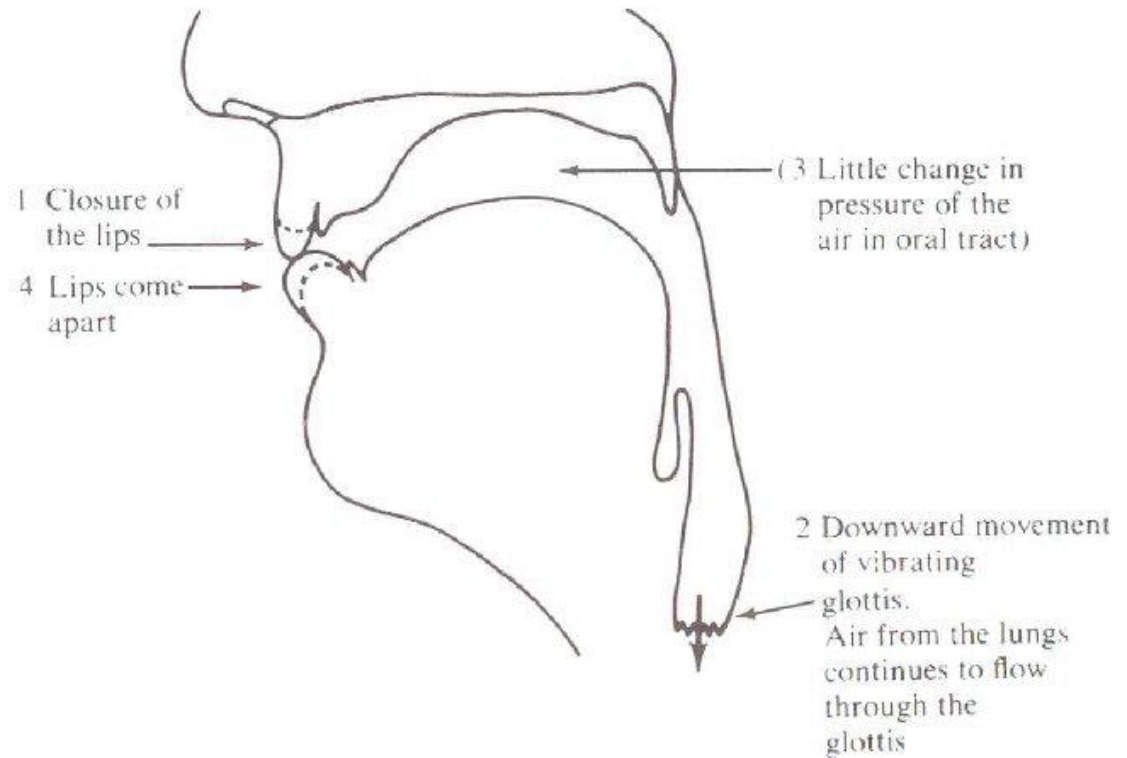
Glottalic AM (4)

IMPLOSIVES

- incomplete closure of the glottis – voicing
- voiceless implosives – extremely rare
- only stops
- languages: African (*Zulu, Hausa, Margi*), Asian (*Sindhi*), American (*Maidu*)

Glottalic AM (5)

Pronunciation of a
glottalic bilabial
implosive [ɓ]:



Sound examples – go to

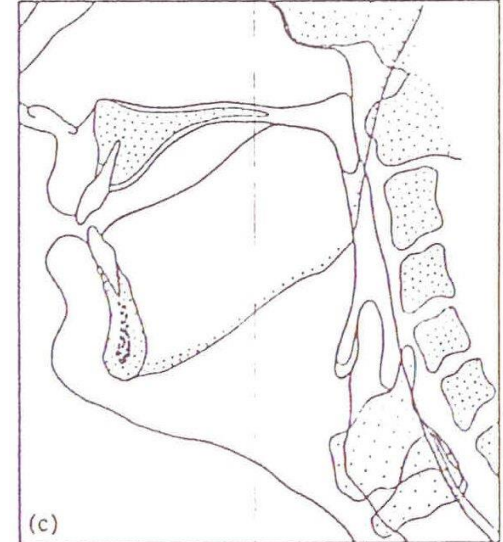
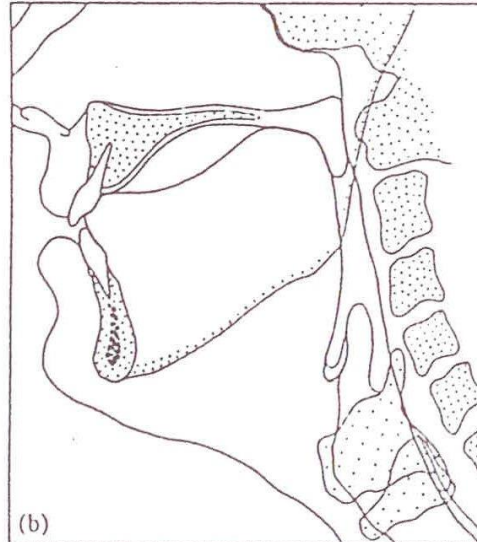
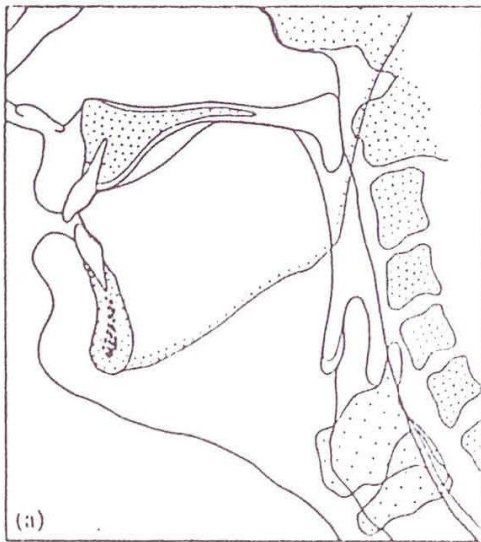
<http://www.paulmeier.com/ipa/nonpulmonics.html>

Velaric AM (1)

- oral cavity
- 2 closures – double articulation:
 - the back of the tongue – velum
 - anterior closure – the lips, the tip, blade or front of the tongue
- only ingressive airflow
- cliks – stops and affricates
- phonological distinctions – rather uncommon (African languages of Angola, Botswana, Namibia, Tanzania)
- paralinguistic uses of clics: *tsk, tsk* signalling impatience or exasperation

Velaric AM (2)

Pronunciation of a velar ingressive voiceless dental [k]:



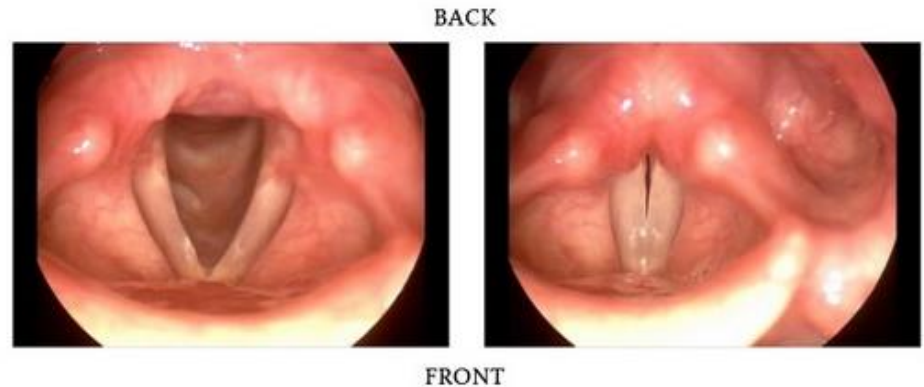
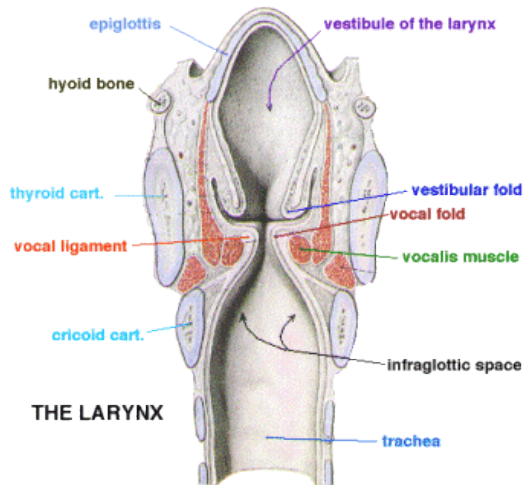
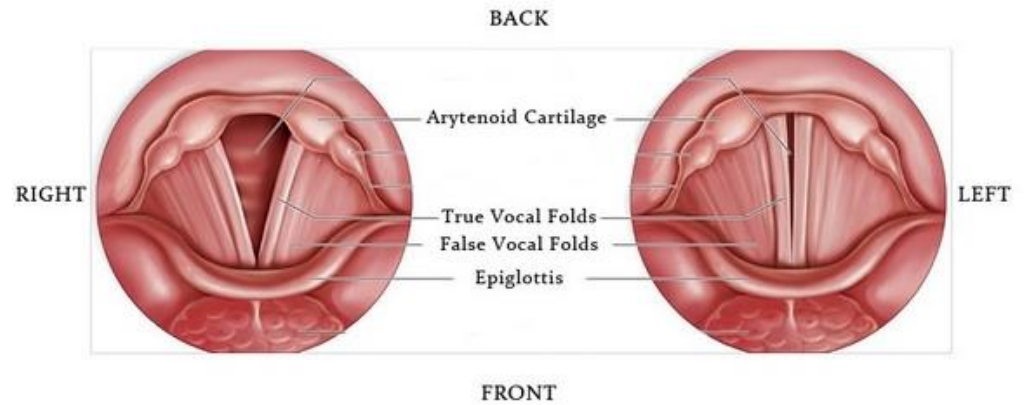
Sound examples – go to

<http://www.paulmeier.com/ipa/nonpulmonics.html>

Phonation types

- Phonation:
 - vocal fold vibration
 - any state of the glottis
- Phonation modes:
 - voicelessness
 - voice (voicing)
 - breathiness (breathy voice, murmur)
 - creak (creaky voice, laryngelization)
 - whisper

Anatomy of the larynx



Laryngeal parameters (Laver, 1994)

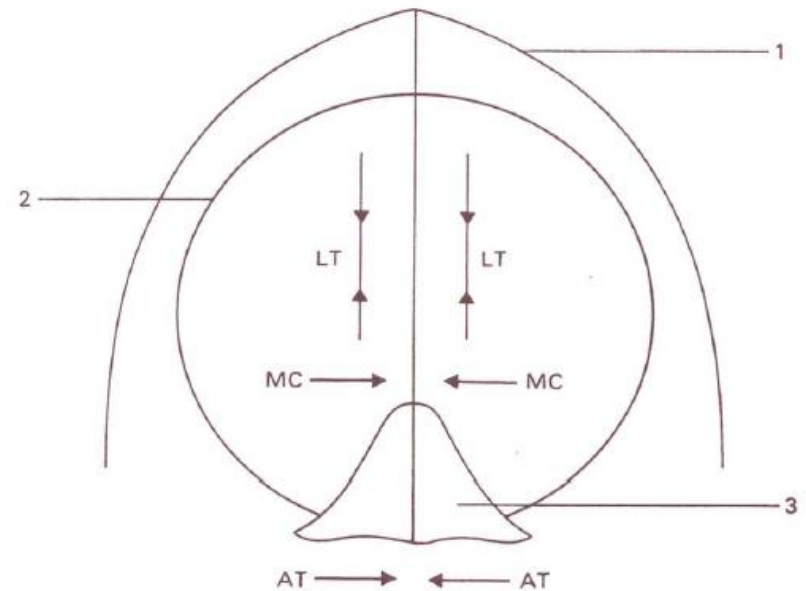
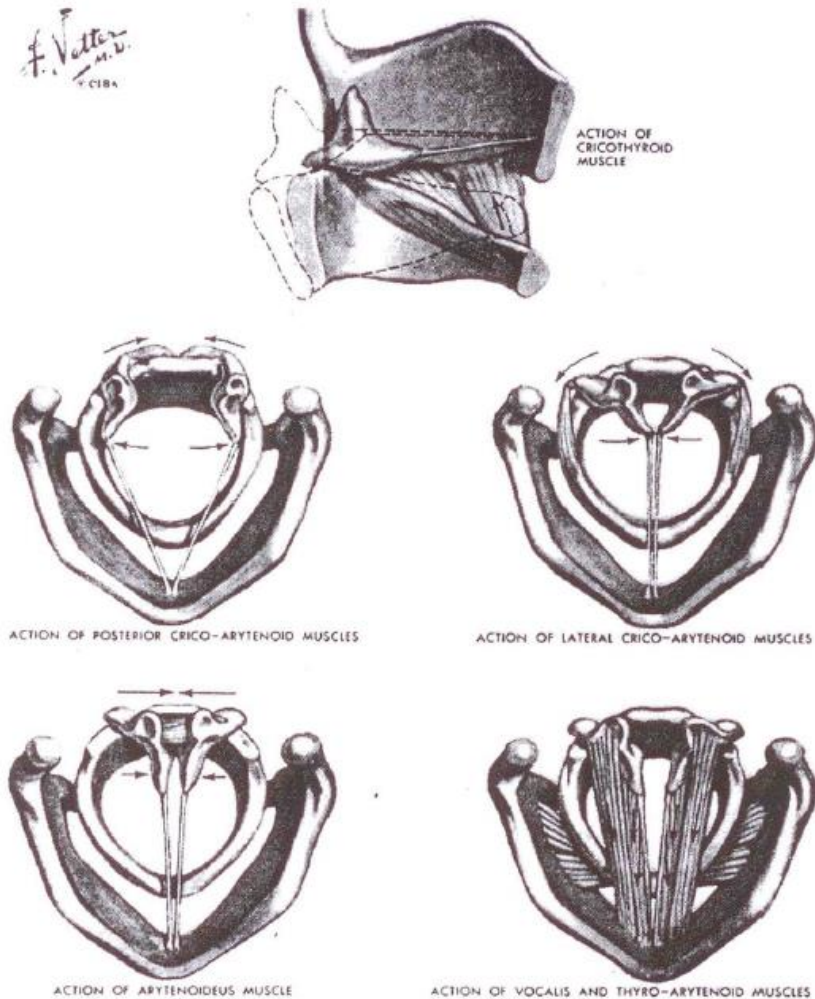
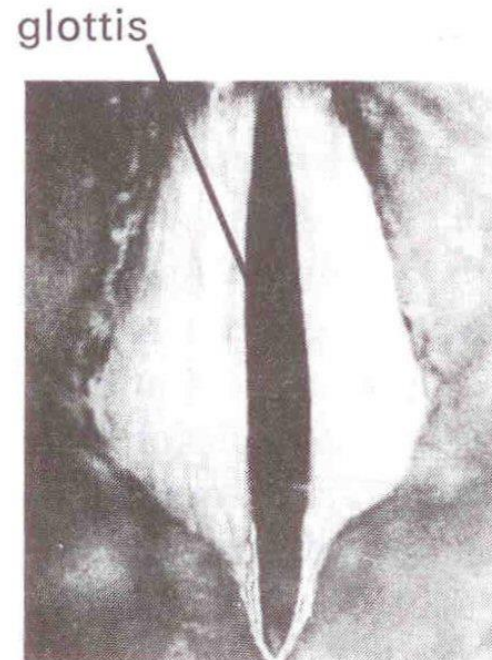


Figure 16. Geometric relationship between three laryngeal parameters
 LT - longitudinal tension
 MC - medial compression
 AT - adductive tension

1. Thyroid cartilage
 2. Cricoid cartilage
 3. Arytenoid cartilage

Voicelessness

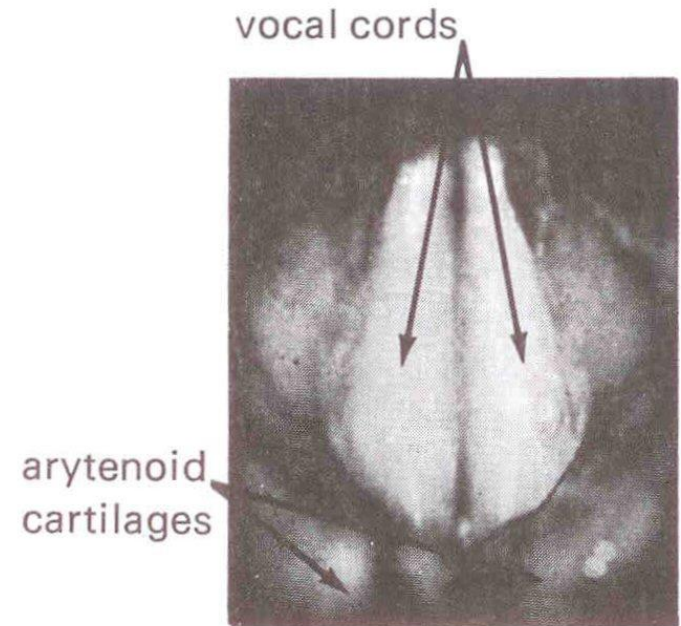
- absence of any phonation
- widely or fully opened glottis (60-95% of the maximum possible glottal area) – a non-turbulent airflow



Audio examples of different phonation types and descriptions in terms of laryngeal parameters can be found here: <http://www2.ims.uni-stuttgart.de/EGG/page10.htm>

Voice

- normal vocal fold vibration along the length of the glottis
- a number of subtypes in between breathy and creaky voice
- variation in voice quality (from *dark* or *mellow* to *bright* or *sharp* voice quality)
- voicing – normal for vowels, nasal and lateral consonants

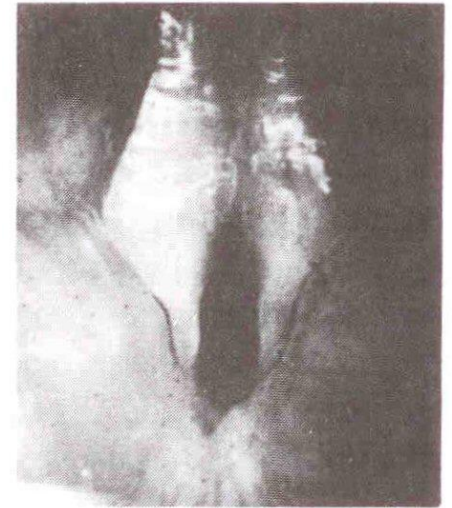


Whisper

- greater constriction of the glottis (>25% of the possible glottal area)
- adduction of the vocal folds, an opening between the arytenoid cartilages
- characteristic flow rates about 25-30 cc/s
- linguistic uses – rare
- paralinguistic uses – signals *secrecy* or *confidentiality*
- only voiced sounds can be whispered

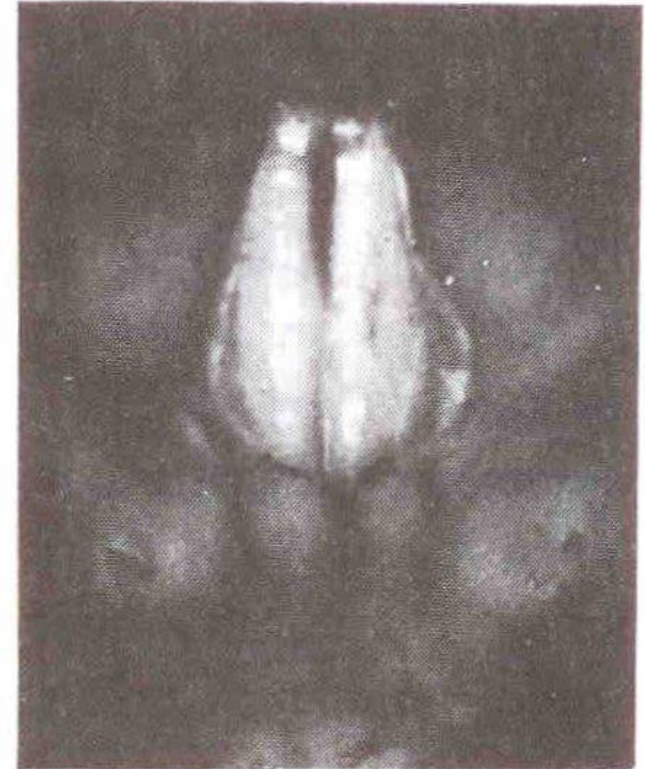
Breathiness (murmur)

- vocal folds are pulled apart + continuous turbulent airflow (vibration)
- incomplete glottal closure, the arytenoid cartilages slightly apart
- characteristic flow rates above 200-300 cc/s
- systematic distinctions e.g. *Hindi, Urdu* (contrast bh-b, gh-g), *Tsonga* (plain and breathy nasals)
- English: [h] between vowels (ahead, behind), voice quality, laryngeal disorders



Creaky voice (laryngelization)

- low frequency vibration of the vocal cords
- irregular and short period of the opening of the glottis
- the vibration occurs in the anterior part
- flow rate of 12-20 cc/s



Creaky voice (2)

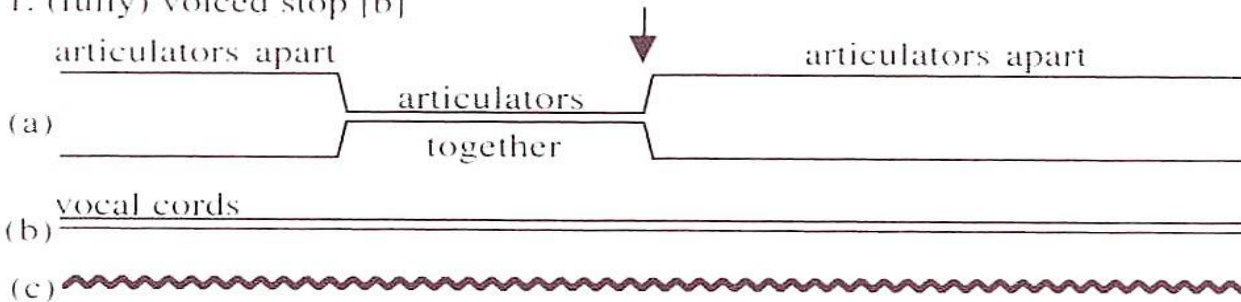
- phonological distinction:
 - between voiced vs. creaky consonants: West African languages (Hausa, Bura, Margi)
 - between „normally“ voiced vs. creaky vowels: Ateso (Kenia), Lango (Uganda, Sudan)
 - between modal, creaky and breathy voiced vowels: [Mazatec](#) (Central Am.)
- in English, Polish:
 - in utterances with falling intonation in the end
 - feature of a speaker or effect of a speaking disorder

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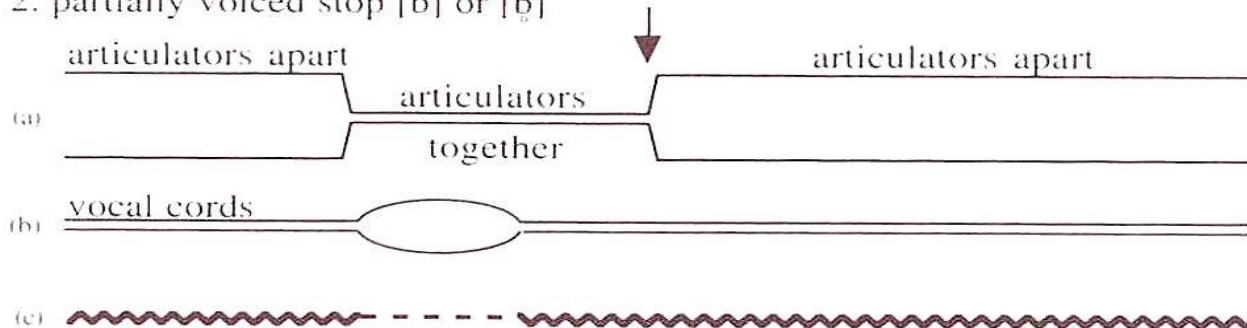
Voice onset time (1)

- refers to the *start* of the phonation relative to the *release* of the closure
- mainly relevant to *stops*

1. (fully) voiced stop [b]



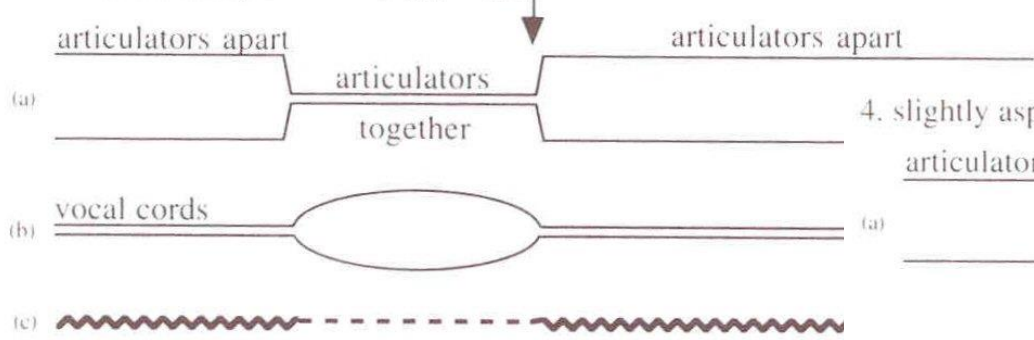
2. partially voiced stop [b̥] or [b̰]



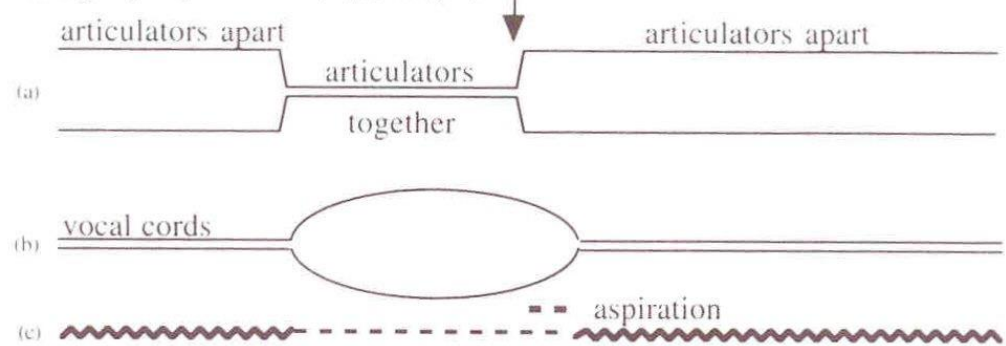
Stops (between vowels) distinguished by VOT (adapted from P. Ladefoged, *A course in phonetics*)

Voice onset time (2)

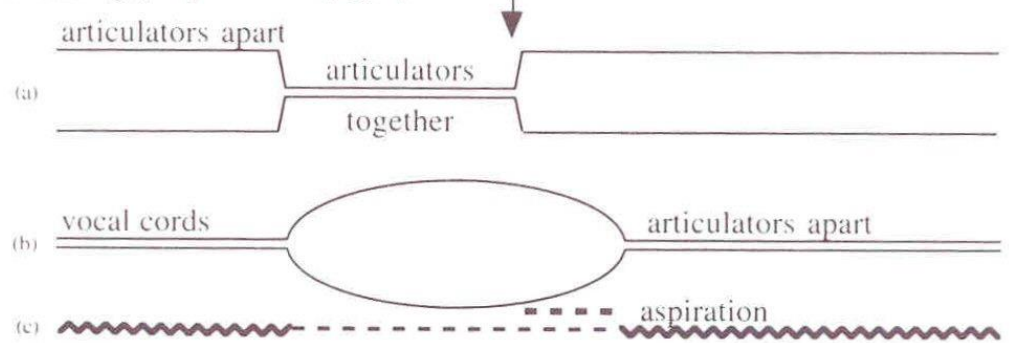
3. voiceless unaspirated stop [b] or [p]



4. slightly aspirated stop [p] or [p^h]



5. strongly aspirated stop [p^h]



Voice onset time (3)

- VOT is a secondary factor in e.g. English, German
 - [p], [t], [k] : word initial, before a vowel, stressed – aspirated (identification of voicelessness)
 - word initial [b], [d], [g] – partially voiced
 - in *Polish, French, Dutch* – only voiceless vs. voiced
- Primary factor – phonological distinctions in:
 - *Thai, Burmese*: voiceless aspirated, voiceless unaspirated and voiced
 - *Nepali*, *Hindi*: voiceless plain, voiceless aspirated, voiced and breathy voiced