Ch. 10  Places of articulation

1) Primary places of articulation
   a) Labials: made with one or both lips
      i) Bilabial: two lips. Bilabial stops and nasals are common, while fricatives are uncommon.
      ii) Labiodental: lower lip against upper teeth (although it could be switched, it almost never is). The fricative is most common across languages.
         • Spectrogram: The transition next to labials points down. Fricatives have fairly faint noise.

   iii) Lingualabial: tip or blade of the tongue articulating with upper lip. Very rare.
   b) Coronals: made with the apex or lamina of the tongue.
      i) Dental: apico-dental and lamino-dental varieties. The only dental sounds with their own IPA characters are the fricatives; all others are shown with the diacritic.
      ii) Alveolar: apico-alveolar and lamino-alveolar varieties.
         • Spectrogram: Dentals and alveolars both have a transition which points to the middle. If the vowel has a high F2, the transition will point down; if F2 is low, it will point up. Dental fricatives have fairly faint noise, while alveolar fricatives have quite strong, higher-frequency noise.
iii) Alveolo-palatal: tip of the tongue behind the upper teeth, with the blade close to the back of the alveolar ridge and front of the hard palate; only the fricatives [ɕ ʑ] exist in the IPA and the distinction from postalveolar may or may not be warranted.

iv) Postalveolar: blade of the tongue at the border of the alveolar ridge and palate. Stops are rare, while fricatives and affricates are common.
   - With both alveolar and postalveolar fricatives, precise placement seems less important than getting the air stream to produce the right turbulence. Alveolar fricative air stream hits the upper teeth, while with postalveolar it hits the lower teeth.
   - Postalveolar fricatives have random noise in higher freq., but lower than alveolars.

v) Retroflex: “apico-postalveolar”; the underside of the tip of the tongue at the border of the alveolar ridge and palate.
   - Spectrogram: As with rhotics, F3 will be lowered.

c) Dorsals: made with the front, back, or root of the tongue.
   i) Palatal: front (dorsum) of the tongue at the palate; tip of the tongue often points down, touching lower teeth. Stops are somewhat less common, nasal is common.
   ii) Velar: back of the tongue at the velum. Velars are often conditioned by the front/backness of neighboring vowels.
      - Spectrogram: “Velar pinch,” where F2 and F3 come together at the end of a preceding vowel.
iii) Uvular: dorsum of the tongue at the uvula; stop, fricative, nasal, and trill, approximant.

iv) Pharyngeal: root of the tongue moved close to the pharyngeal wall; fricatives only (maybe approximants).

v) Epiglottal: the epiglottis is folded back in some Arabic/Hebrew pharyngeals, and epiglottal stops are claimed in some Caucasian languages.

d) Glottal
   i) Glottal or laryngeal: a stop and voiced/voiceless fricatives (which phonetically are simply a voiceless vowel and a breathy vowel).

2) Double articulations: two stops articulated simultaneously at different points of articulation. Most common are labial-velars [kp, gb, nm], and occasionally labial-alveolars [pt, bd, mn].

3) Secondary points of articulation
   a) Labialization: lip rounding
   b) Palatalization: front of the tongue is more towards the palate than normal, like [i] position
   c) Velarization: tongue is more towards the velum than normal, like [uu] position.
   d) Pharyngealization: back of the tongue is lowered and root is retracted, so pharynx is narrowed.

![Secondary points of articulation](image)

<table>
<thead>
<tr>
<th>Secondary articulation</th>
<th>Vowel quality</th>
<th>Symbol</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labialisation</td>
<td>[a]</td>
<td>[*]</td>
<td>[i] p[=][e] o[=][i]</td>
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<tr>
<td>Palatalisation</td>
<td>[i]</td>
<td>[i]</td>
<td>[i] p[=][s]</td>
</tr>
<tr>
<td>Velarisation</td>
<td>[y]</td>
<td>[-]</td>
<td>[I] n[=][s] or [I] t[=] n[=] s[=]</td>
</tr>
<tr>
<td>Pharyngealisation</td>
<td>[a]</td>
<td>[-]</td>
<td>[I] n[=][s] or [I] t[=] n[=] s[=]</td>
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</tbody>
</table>

Ch. 11 Manner of articulation

1) Consonant manner = degree of stricture + nasality + lateralness
   a) Degrees of stricture: There are four, from vowels (least stricture) to approximants, fricatives, and stops.

2) Obstruents
   a) Oral stops: closure of both the oral and nasal passages; may be voiced or voiceless, although the loudness of voicing is muted since the vibration has to pass through the soft tissues of the head.
   b) Fricatives: oral cavity constriction allows air to leave the mouth, but causes turbulence in the air stream; fricatives occur at all places of articulation.
      i) Also known as spirants.
      ii) Though [h] is technically a fricative and phonologically a consonant, it behaves like a voiceless version of whatever vowel follows.
      iii) Alveolar and postalveolar fricatives are known as sibilants.
   c) Affricates: a stop immediately followed by a homorganic fricative (labial, coronal, or dorsal).
      - Spectrogram: Notice the “spike” of the aspirated P in Peggy and the stop + noise of the postalveolar affricate.
3) Approximants: articulatory constriction is closer than the front high vowel, but without frication.
a) Any fricative can turn into an approximant by widening the constriction until frication stops. Try [v].

<table>
<thead>
<tr>
<th>Table 11.2</th>
<th>Approximants and fricatives</th>
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<tbody>
<tr>
<td></td>
<td>bilabial</td>
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<tr>
<td>fricative</td>
<td>φ β</td>
</tr>
<tr>
<td>approximant</td>
<td>u</td>
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</tbody>
</table>

|             | retroflex | palatal | velar | uvular | pharyngeal | labial-palatal | labial-velar |
| fricative    | s z       | ç j      | x y   | x ù     | h ē          |               |             |
| approximant  | å j       | w œ      |        | w œ     | œ w          |               |             |

b) Liquids: laterals and rhotics; not all of these are approximants.
   ○ Spectrogram: Very similar to vowels; glides have formants like their corresponding vowels.
4) Laterals: sides of the constriction are open, allowing air to escape.
   a) Dental and alveolar laterals can take on the color of any vowel, but it is sufficient just to distinguish between front unrounded \( \text{l} \) and back unrounded \( \text{l}^{\text{m}} \) (clear and dark \( \text{l} \)).
   b) Laterals are either approximants or fricatives. (See chart.)

<table>
<thead>
<tr>
<th></th>
<th>voiced</th>
<th>alveolar</th>
<th>retroflex</th>
<th>palatal</th>
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<tr>
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<td>( \text{fl} )</td>
<td>( \text{fl}^{\text{m}} )</td>
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<td>( \text{l} )</td>
<td>( \text{l} )</td>
<td>( \text{l}^{\text{m}} )</td>
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<td>( \text{r} )</td>
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<td>( \text{r}^{\text{m}} )</td>
</tr>
</tbody>
</table>

○ *Spectrogram.* Laterals have weak formants around 250, 1200, and 2400 Hz.

5) Nasals: velum is open, with air going out through the nasal passage; ordinarily voiced. Usually just stops, although fricatives and approximants can occur as a result of being next to a nasal vowel.
   a) Prenasalization: a short, non-syllabic homorganic nasal precedes an oral stop.
   b) Spectrogram: Nasals show weak formants, with one around 250 Hz and another around 2200.

6) Taps, flaps, and trills
   a) Trills: only two types commonly found, dental/alveolar (apex of tongue hits upper articulator) and uvular (uvula hits dorsum). There is also a rare bilabial trill.
      i) Accomplished by the Bernoulli effect.
   ○ *Spectrogram.* Trills have a bumpy start-and-stop appearance.
b) Taps and flaps: “one trill”. With a tap, the active articulator goes back to where it came from; with a flap, the articulator starts in one position, hits the POA in passing, and ends up in a different position.

Ch. 12 Phonation

1) Larynx

![Larynx Diagram]

a) Vocal folds: two horizontal shelves of muscle and ligament just below the adam’s apple; can assume a variety of position to affect the pulmonic air stream.

b) Trachea: tube of cartilaginous rings resembling a vacuum hose, from lungs to oral & nasal tracts.

c) Cricoid cartilage: shaped like a signet ring

d) Epiglottis: its function is uncertain, but it lies over the main part of the larynx.

e) Thyroid cartilage: “adam’s apple,” can pivot back and forth on the cricoid cartilage, and provides a shield for the vocal folds which are attached behind the adam’s apple.

f) Hyoid bone: U-shaped, behind the chin, supports the muscles of the tongue above it, and is only attached to muscle, not another bone.

2) Vocal folds: two horizontal shelves of ligament and muscle joined together at the front to the thyroid cartilage and behind each arytenoid cartilage.

a) Glottis: vocal folds + arytenoid cartilages.
   i) Ligamental glottis: between the vocal folds
   ii) Cartilaginous glottis: between the arytenoid cartilages, which are able to rotate on their base.

b) False vocal folds: not used distinctively in speech, but possibly used in scat singing and Tibetan monk singing. Between the false and true vocal folds is the cavity known as the ventricle of Morgagni.
3) States of the glottis

The "natural" state of the glottis, quiet breathing, simply means that the glottis is more open than for voiceless to allow more air through, so the pressure is low enough that there is little or no frication. Glottal stop is a complete closure of the folds and arytenoids.

With voiceless, the vocal folds are partially open, but not totally; there is still soft frication. Voiceless is a specific positioning of the glottis, and not the absence of voicing.

Voicing depends on the Bernoulli effect: A speaker holds the vocal folds closely, but not closed, at a suitable tension. Then, when a pulmonic air stream passes between the vocal folds, the Bernoulli effect pulls them together. As soon as they come together, the effect ceases, so the air stream pushes them apart again, only for them to be pulled back together — over and over at a certain speed (vibration rate).

- Lower tension, lower frequency, lower pitch
- Greater length, lower frequency, lower pitch
- Length and tension can be altered by
  - Tilting thyroid cartilage forward, stretching the vocal folds
  - Moving the arytenoid cartilages
  - Tensing the muscles of the vocal folds

Breathy voice is accomplished either by holding the vocal folds a little farther apart than for voicing (but not as far as voiceless), or having an open cartilaginous glottis that allows air to escape.

Creaky voice has tightly closed arytenoids, which allows only a portion of the vocal folds to vibrate in a slow, low-pitched vibration.

Falsetto is tightly held vocal folds that allow vibration only at the edges, creating a high frequency. Whisper is mentioned as distinct from voiceless, but the mechanism is never explained.

- Spectrogram: Various states of the glottis create stronger or weaker formants.
4) Voice onset time
   a) While many languages have phonological pairs of voiced and voiceless stops (e.g., /t d/), these pairs are not always voiced and voiceless in a strict phonetic sense. Languages differ in the timing of the onset of voicing (as well as the duration of the voicing).
   i) This is why some linguists use the term fortis and lenis for the phonological difference, instead of merely voiceless and voiced which are phonetic terms.

![VOT of /t/ and /d/ in French, English and Scots Gaelic](image)

b) Breathy voiced stops (voiced aspirates): found in proto-IE and some languages of India, much the same process as aspiration but with voicing, so that the release and following vowel take a breathy quality.

![Breathy voiced stop](image)

Ch. 13 Air stream mechanisms

1) Air pressure
   a) Boyle's law: the pressure of a gas is inversely proportionate to its volume. Also, gases will move so as to equalize pressure.
   a) In speech, our body is like a container, with our mouth and nose as the door. Changing the volume in our lungs causes pressure change, and opening our oral/nasal passages causes the pressure to equalize.

2) Pulmonic: lungs as initiator (air pressure source). Most languages use only pulmonic egressive sounds.
   a) External intercostals muscles lift the rib cage and hold it up, inflating the lungs (ingressive)
   b) Internal intercostals pull the rib cage down and deflate the lungs (egressive)
   c) Pulmonic ingressive example: lovesick boys in Switzerland; Swedish /ja/ ‘yes’

![Air pressure diagram](image)
3) Glottalic  
   a) Glottalic egressive (ejectives): if the vocal folds are closed and the larynx is raised, the air pressures of the pharynx and mouth are raised; when the mouth is opened, pressure is released outward. 
   b) Glottalic ingressive (implosives): if the vocal folds are closed and the larynx is lowered, the air pressures of the pharynx and mouth are lowered; when the mouth is opened, pressure rushes inward. The larynx being pushed downward through the air creates vocal fold vibration (voicing). 

4) Velaric  
   a) Velaric ingressive (clicks): the back of the tongue and the velum close and act as the initiator; simultaneously, a closure is made further forward (e.g. at the lips) to seal the oral tract. The tongue enlarges the oral cavity, which lowers air pressure; when the lips are opened, air flows in. 
   (1) Only S. African languages have velaric ingressives as consonants. With five places of articulation and voiced, voiceless unaspirated, aspirated, delayed aspiration, nasal, and glottal closure varieties possible, some languages have as many as 20 contrastive clicks. 
   b) Velaric egressive: not found in speech, but used in circular breathing for sustaining air stream while playing wind instruments. 

5) Esophageal: individuals with tracheal or laryngeal ailments can use air from the stomach pushed through the esophagus, which misses the vocal folds but leads to the oral and nasal cavities.