Introduction to Phonetics

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Questions

Why do languages sound different?

How do you know if someone speaks a different dialect than you?

What is it that makes someone’s pronunciation of the word “bad night” sound different? How can we capture this? Reproduce it? Understand it?
Describing consonant sounds

Using a writing system based on English (or any other language) does not allow us to capture phonetic differences in speech. We must refer to how the sounds are physically produced.

- **Place of articulation**: sounds differ in where they are produced in the oral cavity and in what articulators are used, e.g. “f” [f] vs. “th” [θ].

- **Manner of articulation**: sounds differ in their degree of constriction, e.g. “t” [t] vs. “s” [s].

- **Voicing**: sounds differ in whether they involve vibration of the vocal folds or no vibration of the vocal folds, e.g. “s” [s] vs. “z” [z].
Describing vowel sounds

Vowels are distinguished using different parameters than consonants, via height, backness, and rounding.

- **Height**: how open your jaw is in the production of the vowel, e.g. “heed” > “hid” > “head” > “hod”; [i, ɪ, ɛ, a].

- **Backness**: how forward your tongue is in the production of the vowel, e.g. “heed” > “hud” > “who’d”; [i, ə, u].

- **Rounding**: whether your lips are rounded in the production of the vowel, e.g. “heed” and “head” vs. “hood” and “who’d”; [i, ɛ, ʊ, u].
Our speech articulators

Speech involves a number of articulators. Controlling these articulators allows us to make different speech sounds.

- Active articulators move toward a passive target. These include the lips, the tongue, the jaw, and the velum.

- Passive articulators are the target of movement. These include the lips, the teeth, the alveolar ridge, the hard palate, the velum, and the pharynx.

- Speech sounds also involve the lungs and the larynx, where the vocal folds are located.
Speech Parameters: pulmonic system, laryngeal cavity, and the oral cavity
**Areas of phonetics**

1. **Descriptive phonetics** seeks to understand the speech articulations used in the production of sounds in individual languages/dialects and the corresponding acoustic properties of such sounds.

2. **Explanatory phonetics** seeks to explain linguistic/phonological patterns in terms of phonetic principles.

3. **Clinical phonetics** seeks to describe how speech is misarticulated by speakers who are either slow to acquire speech sounds or who have a speech disorder.
Introduction to Phonetics

Traditional split between phonetics and phonology

**Phonetics**
- Speech anatomy & mechanics
- Speech acoustics & perception
- Sounds as physical, decomposable entities.

**Phonology**
- Sound patterns in language.
- Structure of sounds in the linguistic system.
- Sounds as discrete, cognitive entities.

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The IPA

To represent speech sounds, we use the international phonetic alphabet (IPA), which allows us to represent any speech sound produced in human language.

Each character within the IPA corresponds to a single speech sound. Each IPA character has one and only one pronunciation.

Speech sounds in the IPA are written in brackets, e.g. [...].

e.g. [bɛd næʔt], [beɪ.əd naːt], [bæd naɪt]

There are many characters representing different speech sounds in the IPA. For now, we’ll use both English orthography (writing) and IPA.
Voicing

- When the vocal folds are spread apart (abducted, air passes through the folds without causing vibration. When the folds are brought together adducted, passing air causes vibration.
- Voicing occurs when the air passing between the vocal folds causes vibration.
All languages have vowels and at least a few consonants which are voiced and all languages have some voiceless consonants too (Maddieson, 1984; Ladefoged and Maddieson, 1996).

### Voicing contrasts in English

<table>
<thead>
<tr>
<th>Voiced</th>
<th>Voiceless</th>
</tr>
</thead>
<tbody>
<tr>
<td>[v]</td>
<td>[f]</td>
</tr>
<tr>
<td>[θ]</td>
<td>[θ]</td>
</tr>
<tr>
<td>[z]</td>
<td>[s]</td>
</tr>
<tr>
<td>[ʒ]</td>
<td>[ʃ]</td>
</tr>
<tr>
<td>[b]</td>
<td>[p]</td>
</tr>
<tr>
<td>[m]</td>
<td>[h]</td>
</tr>
</tbody>
</table>

- [væt] ‘vat’
- [fæt] ‘fat’
- [tʰiθ] ‘teethe’
- [θiθ] ‘teeth’
- [zit] ‘zit’
- [sit] ‘sit’
- [mɛʒ] ‘measure’
- [mɛʃ] ‘mesher’
- [bæt] ‘bat’
- [pʰæt] ‘pat’
- [mæt] ‘mat’
- [hæt] ‘hat’
Places of articulation
Labial consonants

Consonants involving contact between the upper and lower lips are called **bilabial** consonants, e.g. “p”, “b”, “m”.

Consonants involving contact between the lower lip and the upper incisors are called **labiodental** consonants, e.g. “f”, “v”.

![Labial Consonants Diagram](image-url)
Coronal consonants

Consonants involving contact between the tongue tip/blade and some other passive articulator are coronal consonants.

The tongue tip can protrude slightly between the teeth in the production of interdental consonants, e.g. “th” in “thick” [θ] and “th” in “this” [ð].

Consonants involving contact between the tongue tip and the alveolar ridge are alveolar consonants, e.g. “t”, “d”, “s”, “z”, “n”.

Consonants involving contact between the tongue blade and the post-alveolar region are post-alveolar consonants, e.g. “ch” [tʃ], “j” [dʒ], “sh” [ʃ], “zh” [ʒ].

What part of the tongue is the active articulator in the post-alveolar consonant [ʃ]?
Dorsal consonants

Consonants involving contact between the tongue center/back and some other passive articulator are dorsal consonants.

The tongue center is the active articulator with the hard palate in the production of **palatal** consonants; e.g. “y” in “yet” [j]. The tongue back (or dorsum) is the active articulator with the velum in the production of **velar** consonants; e.g. “k”, “g”, and the “ch” in “loch” [lax].
Two velar contrasts: palatal and velar, e.g. [jouk] ‘yoke’, [kouk] ‘coke’. 
Nine places of articulation which are possible with the lips and the tongue (non-exhaustive).
Manner of articulation

- Manner of articulation describes the degree of narrowing in the oral tract (the degree of stricture). However, manner labels also specify the *escape channel*, the initiating source of the airflow involved, and certain acoustic or perceptual characteristics.

- Escape channel is either **oral** or **nasal** (or both – *nasalized* segments), and when it is oral it can be **central** or **lateral**.

- The airstream mechanism used for most speech articulations is **pulmonic**.

- The degree of stricture can be complete closure, producing **stops** and **nasals**. Pulmonic stops made with outward-flowing air are called **plosives**.
Manners of articulation heavily constrained by articulatory apparatus and the acoustic consequences of changes in the degree of constriction in the oral cavity.

Essentially four types of constrictions between articulators:

1. Complete constriction (full closure): stops, e.g. [p, b, t, d, k, g]
2. Close constriction: fricatives, e.g. [θ, ð, f, v, s, z, ʃ, ʒ, h]
3. Open constriction: approximants, e.g. [w, j, l, ɹ]
4. No constriction: vowels, e.g. [i, ɪ, ei, ɛ]
Example

Constriction for alveolar stop [t], alveolar fricative [s], and vowels [i, e, ɛ, a].
Stops (plosives) involve complete closure between articulators in the oral cavity, which prevents the sound from continuing since airflow is stopped.

Compare the stop “t” in “touch” [tʌtʃ] with the fricative sound “s” in “such” [sʌtʃ]. Which sound continues? What are the places of articulation of the stops below?
Fricatives and Approximants

Fricatives involve the flow of air through a narrow channel in the oral cavity. This narrow channel produces a characteristic “hissing” sound due to the airflow turbulence. This narrow channel can be produced at many different places of articulation.

Which fricative sounds higher to you? [s] “s” or [ʃ] “sh”?

Approximants involve the flow of air through a wider channel in the oral cavity. This wider channel does not produce any characteristic “hissing” because the air can flow more smoothly, e.g. [j] “y”, [w], “w”, [ɹ] “r”, [l], “l”.
The difference between fricatives and approximants lies in how much airflow constriction is required to cause turbulence.

- **Laminar airflow**: particles exhibit no sudden changes in direction or velocity - stream lies parallel with sides of channel.

- **Turbulent flow**: streamlines do not follow a path determined by the channel - intercross and mix with small irregular motions superimposed on main fluid motion. Turbulence occurs when the airflow velocity reaches a critical velocity (esp. voicelessness) and when the constriction is narrow.

- Approximants have laminar airflow while fricatives have turbulent airflow.
Affricates involve two articulatory gestures: the closure of the oral cavity and subsequent release with frication at the same place of articulation.

Nasals and Laterals

- **Nasal consonants** involve two gestures: closure between two articulators in the oral cavity (a stop) and lowering of the velum to permit airflow to exit through the nasal cavity, e.g. [m] “m”, [n] “n”, [ŋ] “ng.”

- **Lateral approximants** involve medial lingual contact with another articulator in the oral cavity, but with a portion of the sides of the tongue body lowered so as to permit airflow, [l] “l.”

- Nasals and lateral approximants can be produced at a number of places of articulation, but more than one or two contrasting places of articulation for laterals is quite rare.
Taps and Trills

- **Taps** involve a ballistic movement between the tongue tip and either the alveolar ridge or the hard palate. The tongue is thrust upward to create quick contact between the articulators. Unlike stops, taps involve only very brief closure.

- **Trills** involve the bracing of one articulator near another. Unlike other speech sounds, it is not the muscular contraction of the speech articulator that causes motion, but the high velocity airflow which causes vibration between the articulators (*Bernoulli principle*) (Solé, 2002).
Vowels

Vowels are distinguished by three major parameters: jaw height, tongue backness, and lip rounding.

Try saying the vowels “ee” [i], “ay” [eɪ], “eh” [ɛ], “ah” [a]. Note how the jaw moves. These vowels are mainly distinguished in terms of jaw (and therefore tongue) height.

Now try saying the vowels “ee” [i] and “oo” [u]. Feel for which portion of your tongue is raised and notice your lips. These vowels are distinguished both by tongue backness and lip rounding.
American English monophthongs
American English diphthongs
“R”-colored vowels

Certain vowels preceding the English alveolar approximant, [ɹ], are colored by the consonant to a significant degree, so much so that we describe these vowels as *rhotacized* (“r”-colored) vowels.

- The vowel in the word ‘ear’ is [u].
- The vowel in the word ‘air’ is [ɛɹ].
- The vowel in the word ‘or’ is [ɔɹ].
- The vowel in the word ‘ire’ is [ɑɹ].

The “r” sound can also act like a vowel on its own, e.g. [ɚ] in ‘sir’ [sɻ].

Dialects of English also differ in how many vowel sounds are distinct before [ɹ], e.g. *mary, merry, marry*. In British English, the final “r” has been lost and replaced with a schwa, e.g. [ɪə] for ‘ear’.
Defining consonants by place of articulation

- Phonetic description of consonant types: voicing + place of articulation + manner of articulation, e.g. voiced labiodental fricative, [v].

- Specification of place of articulation in terms of active articulator + passive articulator, e.g. voiceless apico-alveolar stop [t]

- The lips are both active and passive. In a labiodental fricative, [f], the lower lips moves towards the upper teeth.
### Description of Speech Sounds

<table>
<thead>
<tr>
<th>Active Articulator</th>
<th>Label</th>
<th>Passive Articulator</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lips</td>
<td>Labial / Labio-</td>
<td>Lips</td>
<td>Labial</td>
</tr>
<tr>
<td>Tongue tip</td>
<td>Apical / Apico-</td>
<td>Teeth</td>
<td>Dental</td>
</tr>
<tr>
<td>Tongue blade</td>
<td>Laminal / Lamino-</td>
<td>Alveolar ridge</td>
<td>Alveolar</td>
</tr>
<tr>
<td>Tongue body</td>
<td>Dorsum / Dorso-</td>
<td>Palate</td>
<td>Palatal</td>
</tr>
<tr>
<td>Tongue root</td>
<td>Radical / Radico-</td>
<td>Velum</td>
<td>Velar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uvula</td>
<td>Uvular</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pharynx</td>
<td>Pharyngeal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glottis</td>
<td>Glottal</td>
</tr>
</tbody>
</table>

- e.g. a voiceless **labiodental** fricative, [f]
- e.g. a voiced **lamino-alveolar** fricative, [z]

What would a voiced dorsovelar stop sound like?  
A voiced apico-labial stop?  
A voiced lamino-palatal approximant?
Places of Articulation

Upper Surface

Lower Surface

- lip
- teeth
- alveolar ridge
- pharynx wall
- soft palate (velum)
- hard palate
- uvula
- lamina/lamino-
- dorsum / dorsal
- radical
- labial / labio-
- apex/apico-
- blade
- center
- back
- root
- TONGUE
Defining vowels

Unlike consonants, vowels do not involve near contact with speech articulators. Instead, we describe them using rounding, height, and backness, usually in this order.

Examples: an unrounded front low vowel: [æ], a rounded mid-high back vowel [ʊ].

For diphthongs, we have to describe the vowels with two targets, e.g. an unrounded mid front to mid-high front vowel [eɪ].

Thinking of the chart, what would the vowel [ɔ] be? what about [ɛ]?
Transcription and meaning

The goal to phonetic transcription can vary depending on what one wishes to look at.

- **Broad phonetic transcription** is used to capture only those sounds which contrast meaning in words, e.g. [pɪk, tɪk, kɪk]. Differences in pronunciation which arise from context but do not contrast meaning are not captured.

- **Narrow phonetic transcription** is used to capture, as much as possible, differences in sound production as a function of context and dialect, including all sounds which also contrast in meaning, e.g. [pʰɪt] vs. [spɪt] vs. [liːp̩].
