

# Handout 2: Phonetics

Sep 1–8, 2016

Phonetics is the study of speech sounds (phones), i.e., the sounds that we make that are involved in language.

- Articulatory phonetics is the study of how speech sounds are made.
- Acoustic phonetics is the study of the physical properties of speech sounds, i.e., how speech sounds are transmitted from a speaker's mouth to a hearer's ear.
- Auditory phonetics is the study of how speech sounds are perceived (e.g., segmented, categorized).

Our focus will be on articulatory phonetics, and in this part of the course we will be covering the basic properties of speech sounds as well as phonetic features and natural classes.

Different languages may contain different speech sounds, but there are only so many different sounds that the human vocal apparatus can make.

→ **The International Phonetic Alphabet** = standardized transcription system for all the world's spoken languages, typically written between square brackets or slashes.

- (1)
- a. [hɛlow]
  - b. [sɪli]
  - c. [læf]
  - d. [ælfəbɛt]
  - e. [fið]
  - f. [dʒʌdʒ]

A preliminary note: Phonetics (and linguistics more generally) is not concerned with orthography/spelling. English spelling is notoriously unreliable for determining speech sounds:

- (2) Spelled the same, different speech sounds
- a. **cough**, **dough**, **bough**, **bought**
  - b. **comb**, **tomb**, **bomb**
  - c. **the**, **thought**
- (3) Same spelled word, different speech sounds
- a. bow, bow
  - b. close, close
  - c. tear, tear

- (4) Spelled differently, same speech sounds
- made, paid
  - laugh, graph, staff
  - knife, null, gnat
  - true, choose, do, few
  - two, too, to
- (5) Spelled with two letters, pronounced as one sound:
- think
  - kick
  - leek
  - school
- (6) Spelled with one letter, pronounced as two sounds:
- fix
  - one
- (7) Not pronounced at all
- thought
  - writ
  - take
  - knife

How many consonants (distinct consonantal speech sounds) do you think English has?

How many vowels (distinct vocalic speech sounds) do you think English has?

## 1 Articulatory phonetics

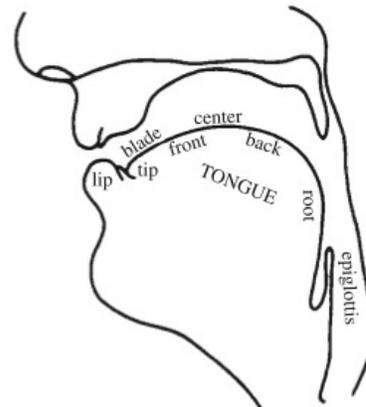
The lay out for today:

- The vocal tract = Larynx, pharynx, oral cavity, nasal cavity
- Consonants = Made with a closure or partial restriction in the vocal tract
  - Voicing quality = State of the vocal folds
  - Place of articulation = Where a speech sound is made
  - Manner of articulation = How a speech sound is made
- Vowels = Made with very little restriction in the vocal tract
  - Closeness = How close the tongue is to the roof of the mouth
  - Backness = How far back in the mouth the highest part of the tongue is
  - Lip rounding = Whether the lips are rounded or not
  - Tenseness = Relative tension of the vocal tract

## 1.1 The vocal tract

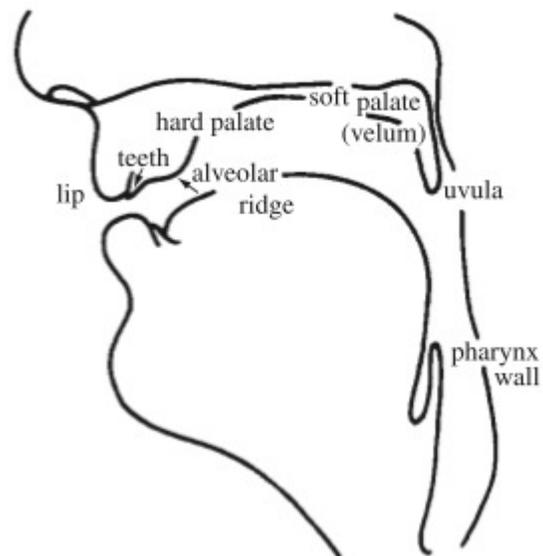
The tongue (typically the “articulator”)

- Tip
- Blade
- Body (front, center, back)
- Root



Everything but the tongue

- Lips
- Teeth
- Alveolar ridge
- Hard palate
- Soft palate
- Velum
- Uvula
- Pharynx
- Glottis / Vocal folds



## 1.2 Consonants

Every consonant can be described along three basic dimensions: voicing, place, manner

### 1.2.1 Voicing quality

Here we will be looking at **pulmonic** consonants, i.e., consonants that are produced with air flowing from the lungs out the mouth or nose. This air flows across the vocal folds, and the way the air interacts with the vocal folds determines the voicing quality.

States of the vocal folds:

- Voiced = vocal folds open and rapidly vibrating ([z], [b], [l], ...)

- Voiceless = vocal folds held open and taut ([s], [p], ...)
- Creaky = vocal folds rapidly opening and closing (Kesha)
- Breathy = vocal folds open (more than regular voicing) and rapidly vibrating (Marilyn)

Correlation with type of speech sound:

- Vowels are (almost) always voiced
- Nasals, trills, taps, and approximants are (almost) always voiced

### 1.2.2 Place of articulation

Consonants are articulated in one of the following places in the vocal tract:

- Bilabial = Lower lip on upper lip, e.g., ...
- Labiodental = Lower lip on upper front teeth, e.g., ...
- Dental = Tongue tip/blade on upper front teeth, e.g., ...
- Alveolar = Tongue tip/blade on the alveolar ridge, e.g., ...
- Postalveolar = Tongue blade on the back of the alveolar ridge, e.g., ...
- Retroflex (not found in English) = Tongue tip on the back of the alveolar ridge
- Palatal = Front of the tongue on the hard palate, e.g., ...
- Velar = Back of the tongue on the soft palate, e.g., ...
- Uvular (not found in English) = Back of the tongue on the uvula
- Pharyngeal (not found in English) = Root of the tongue on the back wall of the pharynx
- Glottal = Articulation involving the glottis/vocal folds, e.g., ...

### 1.2.3 Manner of articulation

- Plosive/Stop = Complete closure of the articulators involved, e.g., ...
- Nasal = Complete closure of the oral cavity (velum lowered) with air flowing instead out of the nasal cavity, e.g., ...
- Trill (not found in English) = Articulators involved held close together, such that airflow sets them in rapid motion, e.g., ...
- Tap or flap = Tongue tip rapidly moving to contact the roof of the mouth and then returning to its resting position, e.g., ...

- Fricative = Articulators involved held close together, such that they create a turbulent airflow, e.g., ...
- Affricate = Plosive+Fricative (into a single speech sound), e.g., ...
- Approximant = Articulators involved held close together, but not close enough to create a turbulent airflow, e.g., ...
- Lateral approximant = Obstruction of the airstream along the center of the oral cavity, with air flowing around this obstruction, e.g., ...

Now let's take a look at the chart that puts this all together. (To be handed out.)

### 1.2.4 Non-intuitive symbols for English sounds

Most of the IPA symbols for English consonants should be intuitive, except the following:

- [ʔ] as in “uh-oh”
- [ŋ] as in “sing”
- [θ] as in “bath”
- [ð] as in “bathe”
- [ʃ] as in “shoe”
- [ʒ] as in “measure”
- [tʃ] as in “chat”
- [dʒ] as in “just”
- [j] as in “you”
- [ɹ] as in “red”
- [ɹ] as in “butter”

#### A little bit of practice:

What is the first sound in... “ride”? “window”? “the”? “knight”? “philosophy”?

How many consonants are in... “splinter”? “singer”? “though”? “silly”?

## 1.3 Vowels

Every vowel can be described along four basic dimensions: closeness, backness, rounding, and tenseness. Aside from rounding, this is much less intuitive than describing consonants.

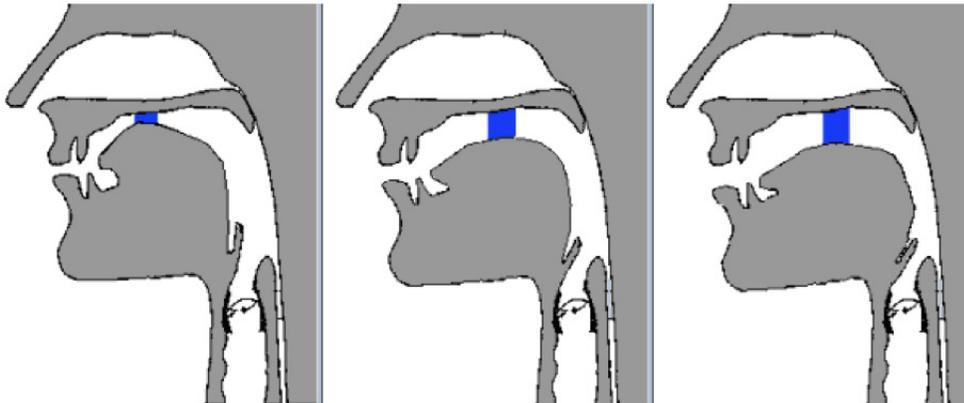
The “vowel space”:

### 1.3.1 Closeness

“Closeness” describes how close or far the tongue is from the roof of the mouth.

- Close (high) = Tongue is very close to the roof of the mouth (tongue is high)
- Close-mid
- Open-mid
- Open (low) = Tongue is very far from the roof of the mouth (tongue is low)

→ Compare [i], [ɛ], and [ɑ]

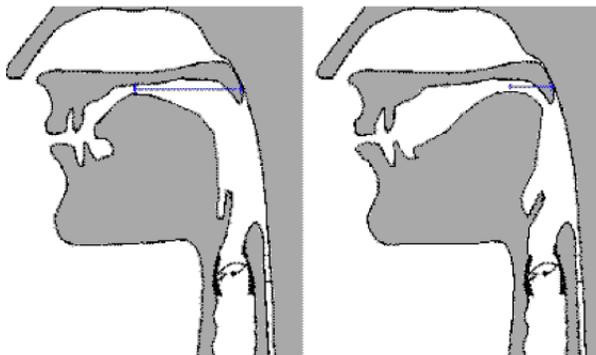


### 1.3.2 Backness

“Backness” describes where in the mouth the highest point of the tongue is.

- Front = Highest point of the tongue is in the front of the mouth
- Central = Highest point of the tongue is in the center of the mouth
- Back = Highest point of the tongue is in the back of the mouth

→ Compare [i] and [u]



### 1.3.3 Lip rounding

“Rounding” describes whether the lips are rounded during the vowel articulation or not.

- Rounded
- Unrounded

→ Compare [i] and [u]



### 1.3.4 Tenseness

“Tenseness” describes the relative tension in the vocal tract, relative tongue height, and relative vowel length. → Compare [i] and [ɪ]

- The tense member of a pair of sounds involves a higher tongue, longer vowel, and more tense vocal tract.
- The lax member of a pair of sounds involves a lower tongue, shorter vowel, and less tense vocal tract.

In English, only tense vowels can grammatically appear in one-syllable words that do not have any ending consonants.

- (8)
- a. [bi]
  - b. \*[bɪ]
  - c. [beɪ]
  - d. \*[bɛ]
  - e. [bu]
  - f. \*[bʊ]

### 1.3.5 Diphthongs

Diphthongs are speech sounds that involve movement from a vowel articulation to a glide. Note a diphthong is still **just one vowel**, a single speech sound. (Similarly, affricates involve two symbols that represent a single speech sound.)

- [ej] as in “hey”
- [aj] as in “buy”
- [aw] as in “cow”
- [oj] as in “boy”
- [ow] as in “tow”

*A final note: stress, unstressed syllables, and [ə]*

## 1.4 Online tools for phonetics

Interactive IPA chart: <http://www.ipachart.com>

IPA keyboard for writing IPA: <http://www.westonruter.github.io/ipa-chart/keyboard>

Fun IPA game: <http://www.academic.muohio.edu/the233/phunwithphonetics/>

**Some practice!** Transcribe the words “Egyptian”, “vital”, “slipped”.

Pronounce these made-up words.

- |     |    |        |    |        |    |        |
|-----|----|--------|----|--------|----|--------|
| (9) | a. | [butʃ] | f. | [nɑʔ]  | k. | [hajl] |
|     | b. | [mæð]  | g. | [ɫʌv]  | l. | [ðejt] |
|     | c. | [ʒow]  | h. | [θɪg]  | m. | [foj]  |
|     | d. | [jɛt]  | i. | [hawŋ] | n. | [jar]  |
|     | e. | [pidʒ] | j. | [ŋʊk]  | o. | [wif]  |

## 1.5 Sounds from around the world

Take a look at the whole IPA chart. (You do not need to memorize the following terms.)

- Uvular, e.g., French
- Pharyngeal, e.g., Arabic
- Non-pulmonic consonants
  - Clicks, e.g., Khoisan languages (S. Africa)
  - Implosives, e.g., Sindhi (Pakistan)
  - Ejectives, e.g., Q’anjob’al (Guatemala)
- Diacritics
  - Aspiration
  - Pharyngealized
  - Nasalized
- Suprasegmentals
  - Stress, e.g., pre’sent vs. ’present (= présent and présént)
  - Length, e.g., Italian [papa] vs. [pappa]

– Tone, e.g., Mandarin:

	Chinese Character	Meaning
○má	媽	mother
○mǎ	麻	hemp
○mǎâ	馬	horse
○mâ	罵	scold

## 2 Natural classes

A **natural class** is a set of speech sounds that can be exclusively characterized using some phonetic feature(s).

- Bilabials, for example, is a natural class that (in English) includes [p, b, m, w].
- Similarly, in English, [s, z] constitute the natural class alveolar fricatives.
- You can refer to as many categories as you need (place, manner, voicing, etc.), but those characteristics must uniquely single out the group of speech sounds, with no sounds left out. Redundant/superfluous categories need not be included.

Here's some practice which will help illustrate some of the pitfalls of natural classes. For each of the following sets of sounds, say (1) whether they constitute a natural class, and if they do, (2) what the natural class is.

- [b, m, w]
- [p, m, w]
- [p]
- [ʃ, tʃ]
- [ʃ, ʒ, dʒ]
- [w, ɹ, l, j]
- [p, t, k, f, θ, s, ʃ, h, tʃ, ʔ]
- [p, t, k, f, θ, ʃ, h, tʃ, ʔ]
- [i, u]
- [i, ʊ]

Some “meta” classes:

- Sonorants (nasals, approximants, taps, vowels) vs. obstruents (all others)
- Noncontinuants (plosives, nasals, affricates, taps) vs. continuants (all others)
- Labials (bilabials and labiodentals) vs. nonlabial (all others)

These will become very important in phonology!

### 3 Features

Features are a notational tool that help us talk about natural classes more precisely and formally.

Remember: A natural class is a set of sounds that all share some phonetic feature(s). The set must contain ALL the sounds that share that/those phonetic feature(s).

Features, too, define natural classes. Features correspond to acoustic or articulatory categories below the level of the speech sound, just like “manner” and “place” refer to properties of speech sounds.

- We’ll need features as a tool for doing phonological analyses.
- Features allow us to generalize over groups of sounds that span different places and manners of articulation.
- There are also features for a lot of the familiar natural classes that we have talked about above.
- *No, you do not need to memorize these. But you do need to know how to use them.*

#### 3.1 General features

[±voice] = whether the segment is voiced (+) or voiceless (–)

- + = all voiced sounds
- – = all voiceless sounds

[±syllabic] = whether the segment is the peak of a syllable (+) or not (–)

- + = all vowels
- – = all consonants

[±consonantal] = whether there is a radical constriction in the vocal tract (+) or not (–)

- + = all consonants except non-lateral approximants
- – = all vowels and non-lateral approximants ([j, w, ɹ])

## 3.2 Some consonant features (some apply to vowels, too)

### 3.2.1 Manner features

[±continuant] = whether airflow out of the mouth is continuous (+) or not (-)

- + = vowels, approximants, fricatives (and trills)
- - = nasals, affricates, plosives, taps

[±sonorant] = whether airflow is rapid enough to cause automatic voicing (+) or not (-)

- + = vowels, approximants, nasals, taps (and trills)
- - = fricatives, affricates, plosives

[±nasal] = whether air flows out of the nasal cavity (+) or not (-)

- + = nasals (and nasalized vowels)
- - = (non-nasal) vowels and non-nasal consonants

### 3.2.2 Place features

[±labial] = whether the lips are used in articulation (+) or not (-)

- + = bilabials, labiodentals
- - = all other consonants

[±coronal] = whether the tip or blade of tongue is used in articulation (+) or not (-)

- + = dentals, alveolars, postalveolars (and retroflexes)
- - = all other consonants

[±dorsal] = whether the tongue body is used in articulation (+) or not (-)

- + = palatals, velars (and uvulars)
- - = all other consonants

[±glottal] = whether the tongue is used in articulation (-) or not (+)

- + = glottals
- - = all other consonants

## 3.3 Vowel place features

- [±close] = close vs. non-close vowels
- [±open] = open vs. non-open vowels
- [±front] = front vs. non-front vowels
- [±back] = back vs. non-back vowels
- [±tense] = tense vs. non-tense vowels
- [±round] = round vs. non-round vowels