

# Articulatory Phonetics and the International Phonetic Alphabet

# Supplementary Readings

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The following readings have been posted to the Moodle course site:

- ▶ Contemporary Linguistics: Chapter 2 (pp. 15-33)

# Handouts for This Lecture

For this lecture, you should have printed out the following handout, which was posted to the course website:

- ▶ “The International Phonetic Alphabet”

(Definitely make sure to have it for next time!)

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# Online Tutorials

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Some helpful online tutorials (and related stuff) have been posted to the course website, under the page “Readings and Tutorials”

# Review: The Fundamental Question

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The 'big question' linguists are interested in answering:

- What is the system of **rules** and **expressions** that underlies our ability to speak and understand a human language?

# Review: The Fundamental Question

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Summary

A slight - but important - change in the wording:

- What is the system of **rules** and **mental representations** that underlies our ability to speak and understand a human language?

(‘mental representation’ = the information stored in our memory, which the ‘rules’ of our linguistic systems operate over)

# The Relevance of Sound

## Fact:

For spoken language, some of those **rules** and **mental representations** concern the production of ***sound***.

- ▶ When we speak an oral language, we produce sounds.
- ▶ And so, our brains must in some way be encoding those sounds (and how to make them).

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## Our Focus (In This Unit):

The sound systems of human languages.

- ▶ How they are represented in our brains.
- ▶ How they are structured by rules.

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# The Relevance of Sound

## Fact:

For spoken language, some of those **rules** and **mental representations** concern the production of **sound**.

- ▶ When we speak an oral language, we produce sounds.
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## Our Focus (In This Unit):

The sound systems of human languages.

- ▶ How they are represented in our brains.
- ▶ How they are structured by rules.

Some New Vocabulary: **phone** = a speech sound

# Problem: The Representation of Phones

But, before we can start this project, we have a bit of a problem:

- ▶ We're going to be talking about the *sounds* of human languages (phones)...
- ▶ Therefore, we're going to need some way of *representing* those sounds (phones) in *written text*.

# What's the Problem?

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Ok... Why not just use English spelling to represent the speech sounds (phones) of human languages?

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# What's the Problem?

Ok... Why not just use English spelling to represent the speech sounds (phones) of human languages?

- ▶ English spelling is often ambiguous.
  - ▶ 'read' can be read as sounding like 'reed' or 'red'
- ▶ There are phones in other languages that don't exist in English
  - ▶ The sound "ch" in German, or "tl" in Nahuatl.

# The Solution:

## A Specialized Alphabet

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### What We Need:

An alphabet for representing phones (speech sounds) which:

- ▶ Is not ambiguous.
  - ▶ Every symbol stands for just one sound.
  - ▶ Every sound is represented by just one symbol.
- ▶ Is not specific to a single language.
  - ▶ Any sound in any human language can be represented.

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# The Solution:

## The International Phonetic Alphabet

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## International Phonetic Alphabet (IPA):

- ▶ Developed over 100 years by International Phonetic Association
- ▶ Unambiguous (1 symbol per phone; 1 phone per symbol)
- ▶ Universal (all known human phones represented)

# The Solution:

## The International Phonetic Alphabet

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### What does it look like?

- ▶ In some cases, IPA aligns with English spelling:
  - ▶ [s] = an 's' sound
  - ▶ [t] = a 't' sound
  - ▶ [h] = an 'h' sound
- ▶ In other cases, IPA and English spelling diverge:
  - ▶ [i] = an 'ee' sound
  - ▶ [e] = an 'ay' sound

### Note:

To distinguish them, we will enclose IPA symbols in square brackets '[ ]'

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# A Problem

In describing the alphabet just now, we encountered a serious problem:

## The Problem:

How do you precisely define what the symbols mean, what sounds (phones) they stand for?

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# A Problem

In describing the alphabet just now, we encountered a serious problem:

## The Problem:

How do you precisely define what the symbols mean, what sounds (phones) they stand for?

## Illustration:

- ▶ One phone in human languages is this one: [ɸ]
- ▶ The sound doesn't exist in English, so how do we say precisely what sound this is?

# A Solution

The IPA defines symbols through the **articulatory phonetics** of the sounds they represent.

Some Vocabulary:

**Articulatory Phonetics** = the way a phone is *produced*

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# A Solution

The IPA defines symbols through the **articulatory phonetics** of the sounds they represent.

Some Vocabulary:

**Articulatory Phonetics** = the way a phone is *produced*

Illustration:

- ▶ [s] = a voiceless alveolar fricative
- ▶ [t] = a voiceless alveolar stop
- ▶ [h] = a voiceless glottal fricative
- ▶ [ɸ] = a voiceless lateral fricative

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# A New Goal

So...

- ▶ Before we can study sound systems (phonology), we need to learn **IPA**
- ▶ Before we can learn IPA, we need to learn a bit about **articulatory phonetics**

# A New Goal

So...

- ▶ Before we can study sound systems (phonology), we need to learn **IPA**
- ▶ Before we can learn IPA, we need to learn a bit about **articulatory phonetics**
  - ▶ We'll begin by surveying the parts of our body used for speech.
  - ▶ The most important are the following ones...

# Articulatory Phonetics and the International Phonetic Alphabet

## The Articulatory System

Alveolar Ridge

Teeth

Lips

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# The Tongue

## Tongue

Glottis

Velum

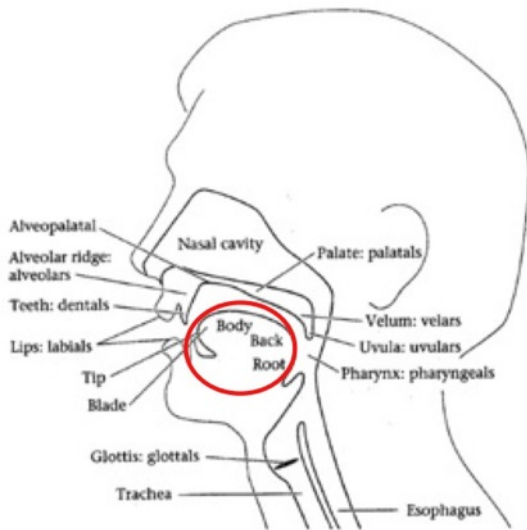
(Hard) Palate

Alveolar Ridge

Alveopalatal Region

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Lips

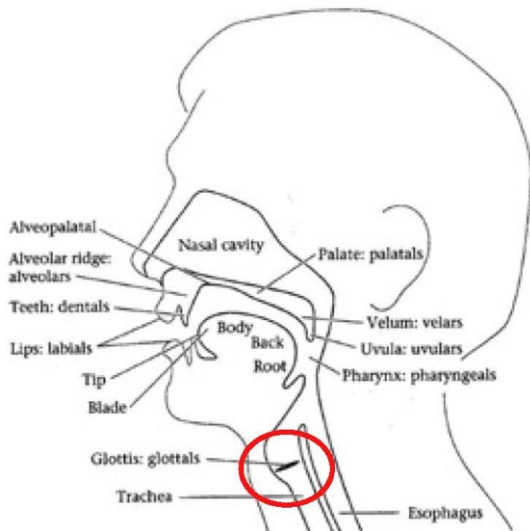


# The Tongue

- ▶ Your tongue is clearly involved in producing speech sounds
- ▶ Phoneticists distinguish subareas of the tongue that are important:
  - ▶ The 'tip' of the tongue
  - ▶ The 'blade' of the tongue (just behind the tip)
  - ▶ The 'body' of the tongue (main surface)



# The Glottis



# The Glottis

What is the glottis?

- ▶ In the middle of your throat is your **larynx** (voice box)
- ▶ Inside your larynx are muscles called the **vocal folds** (vocal cords)
- ▶ The opening between the vocal folds is the **glottis**

# The Glottis

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What does the glottis do in speech?

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# The Glottis

What does the glottis do in speech?

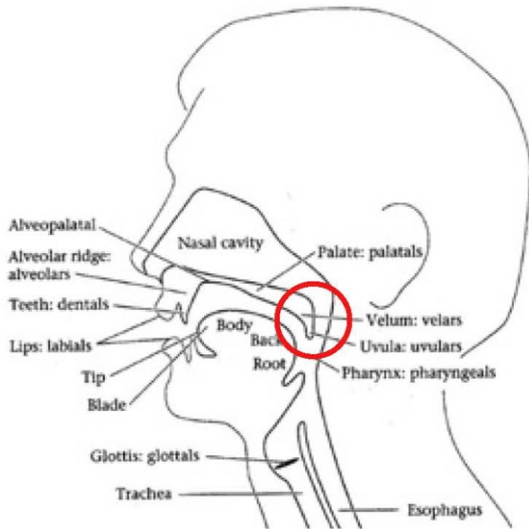
- ▶ The vocal folds have the ability to open/close the glottis
  - ▶ When the glottis is closed, air can't leave the lungs
  - ▶ When the glottis is open, air freely leaves the lungs.

# The Glottis

## What does the glottis do in speech?

- ▶ The vocal folds have the ability to open/close the glottis
  - ▶ When the glottis is closed, air can't leave the lungs
  - ▶ When the glottis is open, air freely leaves the lungs.
- ▶ The vocal folds can also come so close together that the glottis is *almost* closed, but not quite...
  - ▶ When this happens, the vocal folds **vibrate**
  - ▶ This vibration of your vocal folds is your voice!

# The Velum



# The Velum

## What is the velum?

- ▶ The soft area at the very back of the roof of your mouth
- ▶ To feel it with your tongue, make a 'k'-sound

## What does it do?

- ▶ Some sounds are made by putting your tongue there (k)

# The Velum

## What is the velum?

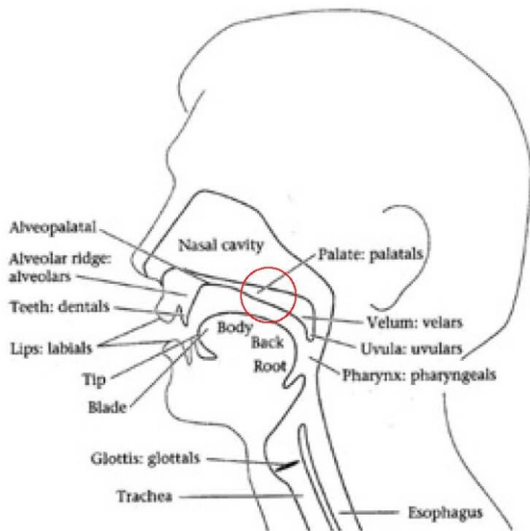
- ▶ The soft area at the very back of the roof of your mouth
- ▶ To feel it with your tongue, make a 'k'-sound

## What does it do?

- ▶ Some sounds are made by putting your tongue there (k)
- ▶ The velum is the **doorway to your nasal passage**
  - ▶ When it's *lowered*, air can go from your lungs to your nasal passage and out your nose.
  - ▶ When it's *raised*, air has to go through your mouth
- ▶ And so, to make some sounds (m), your velum must be lowered.



# The Hard Palate



# The Hard Palate

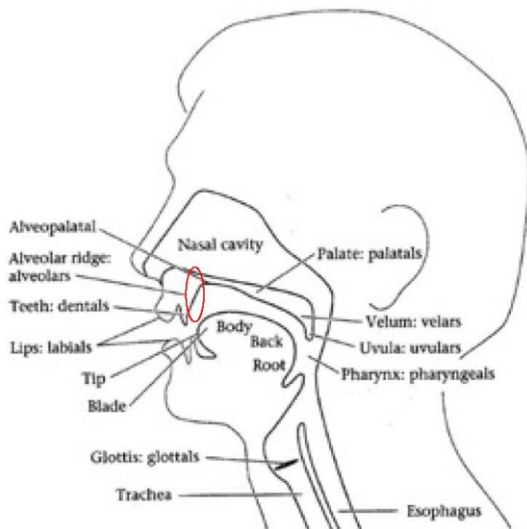
What is the (hard) palate?

- ▶ The hardest area of the roof of your mouth
- ▶ Just before the (soft) velum
- ▶ To feel it with your tongue, make a 'y'-sound

What does it do?

- ▶ Some sounds are made by putting your tongue there (y)

# The Alveolar Ridge



# The Alveolar Ridge

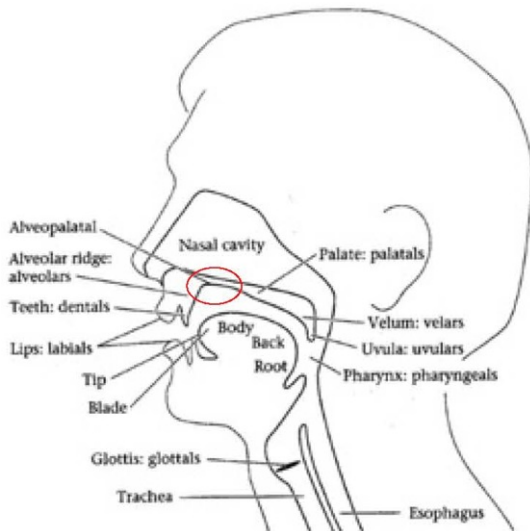
What is the alveolar ridge?

- ▶ The fleshy ridge just behind your top teeth
- ▶ To feel it with your tongue, make a 't'-sound

What does it do?

- ▶ Some sounds are made by putting your tongue there (t)

# The Alveopalatal Region



# The Alveopalatal Region

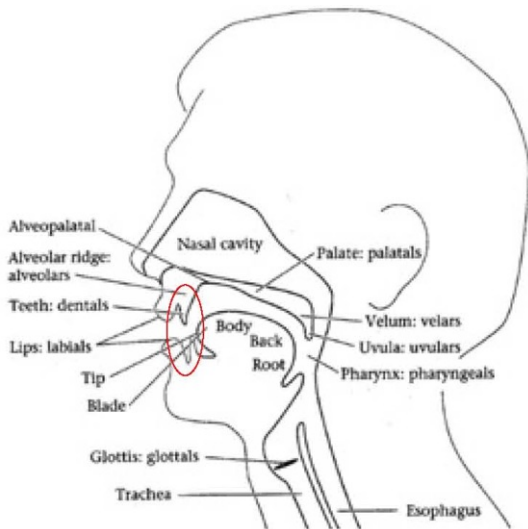
## What is the alveopalatal region?

- ▶ The area between your palate and your alveolar ridge
- ▶ The area where the roof of your mouth rises sharply.
- ▶ (The area where peanut butter and jujubees get stuck)
- ▶ To feel it with your tongue, make a 'ch'-sound

## What does it do?

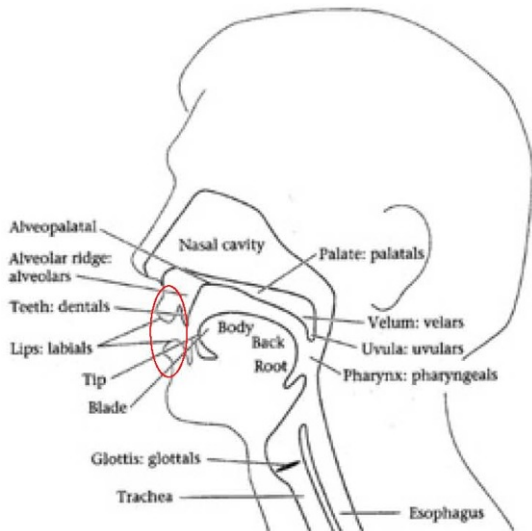
- ▶ Some sounds are made by putting your tongue there (ch)

# The Teeth



Your teeth are involved in making many speech sounds  
(‘th’, ‘f’)

# The Lips



Your lips are also involved in making many speech sounds ('f', 'p', 'm')



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- ▶ With this as background, we can now begin our introduction to IPA.
- ▶ We'll begin with the symbols used to represent the consonants

Vocabulary:

**phonetic transcription** = representing phones in IPA

# IPA: The Consonants

We'll now define the consonant symbols of IPA.

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# IPA: The Consonants

We'll now define the consonant symbols of IPA.

► How?

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# IPA: The Consonants

We'll now define the consonant symbols of IPA.

- ▶ How?

We will *precisely describe* the phone they represent, using four key properties of their articulatory phonetics:

- ▶ Manner of Articulation:

**How** the oral tract is manipulated during production of the sound

- ▶ Place of Articulation:

**Where** the oral tract is manipulated during production of the sound

- ▶ Nasality:

Whether the velum is lowered during production of the sound

- ▶ Voicing:

Whether the vocal folds are vibrating during production of the sound

# Voicing

“**Voicing**” refers to whether the vocal folds are vibrating or not while the phone is being made.

► **Voiced:**

Vocal folds vibrate while the phone is being made

► **Voiceless:**

Vocal folds *don't* vibrate while the phone is made.

## Illustration: ‘S’-Sounds [s] vs. ‘Z’-Sounds [z]

- ▶ Notice they are exactly the same, except that [z] has a ‘buzzing’ sound to it.
- ▶ This ‘buzzing’ aspect of [z] is **voicing**
  - ▶ During [z], the folds vibrate; During [s], they don’t
  - ▶ Thus, [z] is **voiced**, and [s] is **voiceless**

# Voicing

## Tip:

You can actually feel the voicing with your fingers, if you place them over your voicebox.

- ▶ When you pronounce [z], you'll feel your fingers vibrate.
- ▶ When you pronounce [s], you won't feel any vibration

# Voicing

## Some More Examples:

In these pairs, it's easy to perceive which sound is voiced and which is voiceless

[f] vs. [v]                      (**f**at vs. **v**at)

[θ] vs. [ð]                      (**th**in vs. **th**en)

[ʃ] vs. [ʒ]                      (**rush** vs. **rouge**)



# Voicing

## Some More Examples:

In this pair, it's a bit harder to hear, but the distinction is still there

[tʃ] vs. [dʒ]    (**ch**ump vs. **j**ump)

# Voicing

## Some More Examples:

In these pairs, it's much harder to perceive the 'voice-voiceless' distinction, but it is there (trust me).

[p] vs. [b]      (**pat** vs. **bat**)

[t] vs. [d]      (**tip** vs. **dip**)

[k] vs. [g]      (**cap** vs. **gap**)

## Tip:

If you try 'emphasizing' these sounds, you can hear the voicing difference better:

- ▶ 'I said **bat**, not **pat**!'

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## Summing Up:

- ▶ Consonants (in English) can be categorized on the basis of **voicing**
  - ▶ **Voiced** sounds are produced with vibration of the vocal folds.
  - ▶ **Voiceless** sounds are produced with no vibration of the vocal folds

Voiceless Sounds	Voiced Sounds
[s]	[z]
[f]	[v]
[θ]	[ð]
[ʃ]	[ʒ]
[tʃ]	[dʒ]
[p]	[b]
[t]	[d]
[k]	[g]

“**Nasality**” refers to whether the velum is raised or lowered during the production of the sound.

- ▶ **Nasal:** the velum is *lowered* during the sound (and so air is flowing through the nasal cavity)
- ▶ **Oral:** the velum is *raised* during the sound (and so air is flowing through the mouth)

# Nasality

## Illustration:

It's easiest to illustrate this distinction by just listing the nasal sounds in English:

The 'N'-Sound	[n]	<b>nap</b>
The 'M'-Sound	[m]	<b>map</b>
The 'NG'-Sound	[ŋ]	<b>bang</b>

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# Nasality

## Illustration:

It's easiest to illustrate this distinction by just listing the nasal sounds in English:

The 'N'-Sound	[n]	<b>nap</b>
The 'M'-Sound	[m]	<b>map</b>
The 'NG'-Sound	[ŋ]	<b>bang</b>

## The Thing to Observe:

- ▶ Put your hand in front of your mouth when making these sounds.
  - ▶ Notice that *no air is coming out of your mouth*.
- ▶ Put your finger under your nostrils when making these sounds.
  - ▶ Notice that *air is coming out of your nose*.

# Nasality:

## A Few More Notes on Nasals:

- ▶ Aside from [n], [m], and [ŋ], all other phones in English are oral (non-nasal)
- ▶ In English, all nasal sounds are also voiced.

# Places of Articulation

“**Place of articulation**” refers to the location where the oral tract is constricted in order to make the phone.

- ▶ In English, there are 7 places of articulation:
  - ▶ Labial
  - ▶ Dental
  - ▶ Alveolar
  - ▶ Alveopalatal
  - ▶ Palatal
  - ▶ Velar
  - ▶ Glottal



# Labial Sounds

- ▶ **Labials** are sounds made with closure of the lips.

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# Labial Sounds

- ▶ **Labials** are sounds made with closure of the lips.
- ▶ There are two subtypes of labials (in English):
  - ▶ Bilabials:  
Sounds made with closure of *both* lips.
    - ▶ *Examples*: [p], [m]
  - ▶ Labio-Dentals:  
Sounds made with closure of the upper teeth and lower lip.
    - ▶ *Examples*: [f], [v]

# Dental Sounds

**Dentals** are sounds made by placing the tongue against the teeth.

► Examples:

- [θ] (**thin**)
- [ð] (**that**)

# Alveolar Sounds

**Alveolars** are sounds made by placing the tongue against the alveolar ridge.

► Examples:

- [t] (**top**)
- [s] (**sat**)

# Alveopalatal Sounds

**Alveopalatals** are sounds made by placing the tongue against the alveopalatal region.

► Examples:

- [tʃ] (**chat**)
- [dʒ] (**jar**)

# Palatal Sounds

**Palatals** are sounds made by placing the tongue against the (hard) palate.

- ▶ Examples:
  - ▶ [j] (yard)

# Velar Sounds

**Velars** are sounds made by placing the tongue against the velum.

► Examples:

- [k] (**c**at)
- [g] (**g**irl)

# Glottal Sounds

**Glottals** are sounds made by completely or partially closing the glottis.

► Examples:

- [h] (**h**at)



# Interim Summary

## What We've Seen So Far:

The consonants of English can be categorized on the basis of:

- ▶ Whether they are **voiced** or **voiceless**
- ▶ Whether they are **nasal** or **oral**
- ▶ Their **place of articulation**.
  - ▶ Labial (bilabial or labio-dental)
  - ▶ Dental
  - ▶ Alveolar
  - ▶ Alveopalatal
  - ▶ Palatal
  - ▶ Velar
  - ▶ Glottal

# Manner of Articulation

“**Manner of articulation**” refers to the way that the oral tract is constricted to make the phone.

- ▶ In English, there are 4 manners of articulation:
  - ▶ Stops
  - ▶ Fricatives
  - ▶ Affricates
  - ▶ Approximants

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# Manner of Articulation

“**Manner of articulation**” refers to the way that the oral tract is constricted to make the phone.

- ▶ In English, there are 4 manners of articulation:
  - ▶ Stops
  - ▶ Fricatives
  - ▶ Affricates
  - ▶ Approximants

We will now exhaustively list the consonants falling under each manner of articulation.

In doing this, we will also exhaustively list *all* the IPA symbols for the consonants of English.

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# Stops

A **stop** is a phone that involves a complete blockage of the oral tract.

- ▶ (It's a **stop** if there's no air coming out of your mouth when you make the sound.)

Example: [s] vs. [t]

- ▶ When you make [t], airflow stops completely and is released
- ▶ When you make [s], airflow never stops

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# Stops

Let's now run through all the stops of English!

We'll proceed according to place of articulation...

# Bilabial Stops

IPA Symbol	Definition
[p]	voiceless oral (non-nasal) bilabial stop
[b]	voiced oral (non-nasal) bilabial stop
[m]	voiced nasal bilabial stop

## Note:

The 'm-sound' [m] is technically a stop, since (as we saw earlier) no air comes out of your mouth when you make it.

# Alveolar Stops

IPA Symbol	Definition
[t]	voiceless oral (non-nasal) alveolar stop
[d]	voiced oral (non-nasal) alveolar stop
[n]	voiced nasal alveolar stop

## Note:

The 'n-sound' [n] is technically a stop, since (as we saw earlier) no air comes out of your mouth when you make it.

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# Velar Stops

IPA Symbol	Definition
[k]	voiceless oral (non-nasal) velar stop
[g]	voiced oral (non-nasal) velar stop
[ŋ]	voiced nasal velar stop

## Note:

The 'ng-sound' [ŋ] is technically a stop, since (as we saw earlier) no air comes out of your mouth when you make it.



# Glottal Stop

IPA Symbol	Definition
[ʔ]	voiceless oral (non-nasal) <b>glottal</b> stop

## Articulatory Definition:

A pure stoppage of air at the glottis (by closing the vocal folds completely).

## Illustration:

It's the 'stopping sound' that we get between the vowels in expressions like:

"uh oh"	[ʔʌ ʔo]
"free evening"	[fɹi ʔivniŋ]

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# Fricatives

A **fricative** is a phone that is made by a radical narrowing of the oral tract

- ▶ When air moves through this narrow passage, the airflow becomes turbulent.
- ▶ This turbulent airflow makes a characteristic ‘hissing’ sound.

Example: [s] vs. [t]

- ▶ When you make [t], airflow stops completely and is released
- ▶ When you make [s], you make a very narrow constriction, but air still flows out.

# Fricatives

Let's now run through all the fricatives of English!

We'll proceed according to place of articulation...

# Labio-Dental Fricatives

IPA Symbol	Definition
[f]	voiceless oral labio-dental fricative
[v]	voiced oral labio-dental fricative

# Dental Fricatives

IPA Symbol	Definition
[θ]	voiceless oral dental fricative
[ð]	voiced oral dental fricative

# Alveolar Fricatives

IPA Symbol	Definition
[s]	voiceless oral alveolar fricative
[z]	voiced oral alveolar fricative

# Alveopalatal Fricatives

IPA Symbol	Definition
[ʃ]	voiceless oral alveopalatal fricative
[ʒ]	voiced oral alveopalatal fricative

# Glottal Fricative

IPA Symbol

[h]

Definition

voiceless oral glottal fricative



# Affricates

An **affricate** is a phone that is made up of two parts:

- ▶ It begins as a stop (complete closure of the oral tract)
- ▶ It ends as a fricative (narrow closure of the oral tract)

Illustration: ‘top’ vs. ‘shop’ vs. ‘chop’

- ▶ ‘Top’ begins with a stop (total closure, then total release).
- ▶ ‘Shop’ begins with a fricative (narrow closure).
- ▶ ‘Chop’ begins with an **affricate**.
  - ▶ It starts off with a total closure
  - ▶ But, we don’t just totally release it (like a stop)
  - ▶ We partially release it, into a [ʃ]

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# Affricates

There are only two affricates in English; both are alveopalatal.

IPA Symbol	Definition
[tʃ]	voiceless oral alveopalatal affricate
[dʒ]	voiced oral alveopalatal affricate

## Tip:

Notice how the IPA symbol for these sounds is two symbols joined together:

- ▶ [t] or [d] : the beginning stop sound
- ▶ [ʃ] or [ʒ] : the ending fricative sound

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# Approximants

An **approximant** is a phone that involves a narrowing of the oral tract that is:

- ▶ less radical than with a fricative
- ▶ more radical than with a vowel

## Tip:

More informally, **approximants** are somewhere in between consonants and vowels (and so are sometimes called **semi-vowels**).

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# The Approximants of English

## Part 1

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IPA Symbol	Definition
[j]	voiced oral palatal approximant ('y'-sound)
[w]	voiced oral labial approximant

### Note 1:

- ▶ [w] is more accurately called 'labio-velar'...
- ▶ ...since we also raise our tongue to our velum
- ▶ ... but we can forget about that in this class

### Note 2:

The approximants [j] and [w] are also called 'glides'

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IPA Symbol	Definition
[j]	voiced oral palatal approximant ('y'-sound)
[w]	voiced oral labial approximant

### Note 3:

- ▶ Some people (like me) pronounce these words differently:
  - ▶ whale / wail
- ▶ If you're like me, the phone in 'whale' is the following:
  - ▶ [ɰ]: voiceless oral labial approximant (wh-sound)

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# The Approximants of English

## Part 2

IPA Symbol	Definition
[ɻ]	voiced oral retroflex approximant ('r'-sound)
[l]	voiced oral lateral approximant ('l'-sound)

### Note 1:

These approximant sounds are distinguished by the following properties:

- ▶ 'retroflex' [ɻ]
- ▶ 'lateral' [l]

You can think of these other properties as like 'secondary' manners of articulation:

- ▶ 'retroflex': made with tip of tongue curled back
- ▶ 'lateral': made by air escaping out sides of the tongue

# The Approximants of English

## Part 2

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IPA Symbol	Definition
[ɹ]	voiced oral retroflex approximant ('r'-sound)
[l]	voiced oral lateral approximant ('l'-sound)

### Note 2:

The approximants [ɹ] and [l] are also called 'liquids'

### Note 3:

In IPA, a right-side-up 'r' ([r]) represents the r-sound of Spanish (a 'tapped-r')

... so be careful to use upside-down 'r' ([ɹ]) in English transcription.

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- ▶ We've just examined all the consonantal sounds of English



# Summary

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- ▶ We've seen how each is represented in IPA

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- ▶ We've seen how each is described by its articulatory phonetics

# Summary

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  - ▶ Whether the sound is **voiced** or **voiceless**
  - ▶ Whether the sound is **nasal** or **oral**
  - ▶ The **place** of articulation
    - ▶ Bilabial
    - ▶ Labio-Dental
    - ▶ Dental
    - ▶ Alveolar
    - ▶ Alveopalatal
    - ▶ Palatal
    - ▶ Velar
    - ▶ Glottal

# Summary

- ▶ We've seen how such description consists of specifying four parameters:
  - ▶ Whether the sound is **voiced** or **voiceless**
  - ▶ Whether the sound is **nasal** or **oral**
  - ▶ The **place** of articulation
    - ▶ Bilabial
    - ▶ Labio-Dental
    - ▶ Dental
    - ▶ Alveolar
    - ▶ Alveopalatal
    - ▶ Palatal
    - ▶ Velar
    - ▶ Glottal
  - ▶ The **manner** of articulation
    - ▶ Stop
    - ▶ Fricative
    - ▶ Affricate
    - ▶ Approximant

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- ▶ See the class handout for a complete catalog of the consonants of English, their articulatory definition, and their IPA representation
- ▶ In the next class, we will cover vowel sounds...