Articulatory Phonetics and the International Phonetic Alphabet
Supplementary Readings

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!)
Some helpful online tutorials (and related stuff) have been posted to the course website, under the page “Readings and Tutorials”
Review: The Fundamental Question

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

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).
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).

Our Focus (In This Unit):
The sound systems of human languages.

▶️ How they are represented in our brains.
▶️ How they are structured by rules.
The Relevance of Sound

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

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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
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?

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

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.
The Solution:
The International Phonetic Alphabet

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

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 ‘[ ]’
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?
A Problem

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**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: [ᵢ]
- 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*
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
- [ɬ] = a voiceless lateral fricative
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...
The Articulatory System

I’ll walk through each of these quickly at first...
I’ll come back and say more as it becomes important
The Tongue
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

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!
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  ▶ 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 Articulatory System
- Tongue
- Glottis
- Velum
- (Hard) Palate
- Alveolar Ridge
- Alveopalatal Region
- Teeth
- Lips

The IPA: Consonants

Summary
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’)
IPA: The Consonants

► 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.
IPA: The Consonants

We’ll now define the consonant symbols of IPA.

▶ How?
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” 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.
Voicing

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]  (fat vs. vat)
[θ] vs. [ð]  (thin vs. then)
[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

\[ [\text{ʧ}] \text{ vs. } [\text{ʤ}] \] (chump vs. jump)
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!’
Voicing

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

<table>
<thead>
<tr>
<th>Voiceless Sounds</th>
<th>Voiced Sounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>[s]</td>
<td>[z]</td>
</tr>
<tr>
<td>[f]</td>
<td>[v]</td>
</tr>
<tr>
<td>[θ]</td>
<td>[ð]</td>
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<tr>
<td>[ʃ]</td>
<td>[ʒ]</td>
</tr>
<tr>
<td>[tʃ]</td>
<td>[dʒ]</td>
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<tr>
<td>[p]</td>
<td>[b]</td>
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<tr>
<td>[t]</td>
<td>[d]</td>
</tr>
<tr>
<td>[k]</td>
<td>[ɡ]</td>
</tr>
</tbody>
</table>
“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]  nap
The ‘M’-Sound   [m]  map
The ‘NG’-Sound  [ŋ]  bang
Nasality

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

The ‘N’-Sound \([\n]\)  nap
The ‘M’-Sound \([m]\)  map
The ‘NG’-Sound \([\n\]\)  bang

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.

  - **Labials** are sounds made with closure of the lips.
  - **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]
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 are sounds made by placing the tongue against the alveolar ridge.

- **Examples:**
  - [t] (top)
  - [s] (sat)
Alveopalatal Sounds are sounds made by placing the tongue against the alveopalatal region.

Examples:
- [ʧ] (chat)
- [ʤ] (jar)
Palatal Sounds are sounds made by placing the tongue against the (hard) palate.

**Examples:**
- [j] (yard)
**Velars** are sounds made by placing the tongue against the velum.

- **Examples:**
  - [k] (cat)
  - [g] (girl)
Glottal Sounds

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

▶ Examples:
  ▶ [h] (hat)
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 (biliabial or labio-dental)
  - Dental
  - Alveolar
  - Alveopalatal
  - Palatal
  - Velar
  - Glottal
“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
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.
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
Let’s now run through all the stops of English!

We’ll proceed according to place of articulation...
## Bilabial Stops

<table>
<thead>
<tr>
<th>IPA Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>[p]</td>
<td>voiceless oral (non-nasal) bilabial stop</td>
</tr>
<tr>
<td>[b]</td>
<td>voiced oral (non-nasal) bilabial stop</td>
</tr>
<tr>
<td>[m]</td>
<td>voiced nasal bilabial stop</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>[t]</td>
<td>voiceless oral (non-nasal) alveolar stop</td>
</tr>
<tr>
<td>[d]</td>
<td>voiced oral (non-nasal) alveolar stop</td>
</tr>
<tr>
<td>[n]</td>
<td>voiced nasal alveolar stop</td>
</tr>
</tbody>
</table>

**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.
Velar Stops

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>[k]</td>
<td>voiceless oral (non-nasal) velar stop</td>
</tr>
<tr>
<td>[g]</td>
<td>voiced oral (non-nasal) velar stop</td>
</tr>
<tr>
<td>[ŋ]</td>
<td>voiced nasal velar stop</td>
</tr>
</tbody>
</table>

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
[?]  voiceless oral (non-nasal) glottal 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”  [ʔɬ ʔo]
“free evening”  [ʃɹi ʔivniŋ]
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.
Let’s now run through all the fricatives of English!

We’ll proceed according to place of articulation...
## Labio-Dental Fricatives

<table>
<thead>
<tr>
<th>IPA Symbol</th>
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</tr>
</thead>
<tbody>
<tr>
<td>[f]</td>
<td>voiceless oral labio-dental fricative</td>
</tr>
<tr>
<td>[v]</td>
<td>voiced oral labio-dental fricative</td>
</tr>
</tbody>
</table>
## Dental Fricatives

<table>
<thead>
<tr>
<th>IPA Symbol</th>
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</tr>
</thead>
<tbody>
<tr>
<td>[θ]</td>
<td>voiceless oral dental fricative</td>
</tr>
<tr>
<td>[ɹ]</td>
<td>voiced oral dental fricative</td>
</tr>
</tbody>
</table>
### Alveolar Fricatives

<table>
<thead>
<tr>
<th>IPA Symbol</th>
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</tr>
</thead>
<tbody>
<tr>
<td>[s]</td>
<td>voiceless oral alveolar fricative</td>
</tr>
<tr>
<td>[z]</td>
<td>voiced oral alveolar fricative</td>
</tr>
</tbody>
</table>
## Alveopalatal Fricatives

<table>
<thead>
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<tbody>
<tr>
<td>[ʃ]</td>
<td>voiceless oral alveopalatal fricative</td>
</tr>
<tr>
<td>[ʒ]</td>
<td>voiced oral alveopalatal fricative</td>
</tr>
<tr>
<td>IPA Symbol</td>
<td>Definition</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>[h]</td>
<td>voiceless oral glottal fricative</td>
</tr>
</tbody>
</table>
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]
There are only two affricates in English; both are alveopalatal.

<table>
<thead>
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<tr>
<td>[tʃ]</td>
<td>voiceless oral alveopalatal affricate</td>
</tr>
<tr>
<td>[dʒ]</td>
<td>voiced oral alveopalatal affricate</td>
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</tbody>
</table>

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
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**).
The Approximants of English
Part 1

<table>
<thead>
<tr>
<th>IPA Symbol</th>
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<tbody>
<tr>
<td>[j]</td>
<td>voiced oral palatal approximant (‘y’-sound)</td>
</tr>
<tr>
<td>[w]</td>
<td>voiced oral labial approximant</td>
</tr>
</tbody>
</table>

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’
### The Approximants of English

**Part 1**

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**Note 3:**

- Some people (like me) pronounce these words differently:
  - whale / wail
- If you’re like me, the phone in ‘whale’ is the following:
  - [ʍ]: voiceless oral labial approximant (wh-sound)
The Approximants of English

Part 2

IPA Symbol | Definition
---|---
[ə] | 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’ [ə]
- ‘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

IPA Symbol | Definition
--- | ---
[ᵻ] | voiced oral retroflex approximant (‘r’-sound)
[l] | voiced oral lateral approximant (‘l’-sound)

Note 2:
The approximants [ᵻ] and [l] are also called ‘liquids’

Note 3:
In IPA, a right-side-up ‘r’ ([ɾ]) represents the r-sound of Spanish (a ‘tapped-r’)
    ... so be careful to use upside-down ‘r’ ([ᵻ]) in English transcription.
Summary

- We’ve just examined all the consonantal sounds of English.
Summary

- We’ve just examined all the consonantal sounds of English
- We’ve seen how each is represented in IPA
Summary

- We’ve just examined all the consonantal sounds of English
- We’ve seen how each is represented in IPA
- We’ve seen how each is described by its articulatory phonetics
Summary

- We’ve seen how such description consists of specifying four parameters:
Summary

- We’ve seen how such description consists of specifying four parameters:
  - Whether the sound is *voiced* or *voiceless*
Summary

- We’ve seen how such description consists of specifying four parameters:
  - Whether the sound is **voiced** or **voiceless**
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    - Labio-Dental
    - Dental
    - Alveolar
    - Alveopalatal
    - Palatal
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  - The **manner** of articulation
    - Stop
    - Fricative
    - Affricate
    - Approximant
Summary

▶ 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...