

- Natural classes
- Stating allophone environments
- Phonological rules

Background reading:

• CL Ch 3, sec 1 and Appendix

0. Course information

- Do you have questions about course material?
 - Come to **office hours**! (or make an appointment)
 - **Review** lecture outline slides and past readings
 - "Discussion" thread on Canvas for each topic
 - You are welcome to post questions there
 - Questions may be answered on Canvas or in lecture/recitation
 - You are welcome to answer questions asked by other students

0. Course information

- Do you qualify for **accommodations** from ARS?
 - Remember to send me, and your TA, "**instructor notifications**" through the ARS Hub portal
 - → I will email everyone today to confirm that I have your notification
 - → If you don't hear from me about this by tomorrow (Th) morning, please doublecheck that you sent an instructor notification, and contact me ASAP if there is a problem

0. Course information

- Do you qualify for **accommodations** from ARS?
 - 50% (or similar) extended test time and/or lowdistraction test setting?
 - → Please plan on taking your midterms and final at the ARS testing center
 - → Register soon for the **first midterm**!
 - Other accommodations involving accessibility in the classroom, etc?
 - → Please email me and/or your TA if you have questions or need us to change things

In our scientific model of mental grammar:

- The <u>mental sound categories</u> of a language are the ______ of the language
 - Write them using _____ brackets: _ i _

In our scientific model of linguistic knowledge:

- The <u>mental sound categories</u> of a language are the phonemes of the language
 - Write them using slash brackets: / i /
- A <u>physical pronunciation of a phoneme</u> is an of that phoneme
 - Write them using _____ brackets: _ i _

In our scientific model of linguistic knowledge:

- The <u>mental sound categories</u> of a language are the phonemes of the language
 - Write them using slash brackets: / i /
- A <u>physical pronunciation of a phoneme</u> is an allophone of that phoneme
 - Write them using square brackets: [i]
- Every phoneme has at least one allophone; some phonemes have more than one allophone

- Words (morphemes) are stored in the mental lexicon in their **phonemic representation**
- The phonetic (surface, pronounced) forms of words, containing **allophones**, are produced by the mental grammar, which applies **phonological rules** where needed

/ (stored form of word) / (with phonemes)
↓ Phonological rules ↓
[(pronounced form of word)] (with allophones)

- To analyze the phonology (grammar) of a language:
 - Propose **phonological rules** as needed
- How do we know when a rule is needed?
 - Determine whether two sounds belong to the same phoneme (as allophones) or to different phonemes
 - If one phoneme has multiple allophones,
 we need a rule to determine which allophone
 appears where

Last time, we discussed:

- How can we tell if two phonetically different sounds belong to different phonemes or to the same phoneme in a language we are analyzing?
 - → We have to **look at data** from the language we are analyzing and **make a case** for the status of the pair of sounds **in that language**

Review from last time:

Step 1. Look for a minimal pair → If we find one, ... → If we don't find one, ...

Review from last time:

- Step 1. Look for a minimal pair
 → If we find one, we have separate phonemes
 → If we don't find one, we should go to Step 2
- **Step 2.** Consider the **environments** where the sounds occur are they:

Step 2. Consider the environments where the sounds occur — are they: • predictable (non-overlapping)? • unpredictable (overlapping)?

- If two sounds are <u>allophones of the same phoneme</u>, the mental grammar **chooses** which to use based on their surrounding (sound) **environment**
 - Given the environment, we can reliably **predict** which of the sounds we will see there
- So predictable environments are evidence that the mental grammar decides which sound to put where: the sounds are allophones of the same phoneme

Step 2. Consider the environments where the sounds occur — are they: • predictable (non-overlapping)? • unpredictable (overlapping)?

- If two sounds <u>belong to separate phonemes</u>, they are **independent** of each other, so both can occur in (at least some of) the **same** environments
 - Given just the environment, we **can't predict** which of the sounds will appear there
- So unpredictable environments are evidence that the mental grammar does not determine which sound to put where: separate phonemes

Step 2. Consider the environments where the sounds occur — are they: • predictable (non-overlapping)? • unpredictable (overlapping)?

• Consider this:

If we have a **minimal pair** for two sounds, are the environments for those two sounds **predictable** or **unpredictable**?

- [i]vs.[ɪ] [lip]*leap* [l<u>ɪ</u>p]*lip* [l]_[p] [l]_[p]

- **Step 1.** Look for a **minimal pair** → **separate phonemes**
- **Step 2.** Consider the **environments** where the sounds occur are they:

predictable (non-overlapping)? → allophones **unpredictable** (overlapping)? → separate phonemes

New for today:

Step 3. If you have found that two sounds are allophones of the same phoneme, state the environments where each allophone occurs

But first, some background on **natural classes**

- Which of the sounds of English can be **aspirated**?
 [p] [t] [k]
- Why these sounds and no others?
 - \rightarrow These are the sounds of English that are

- Which of the sounds of English can be **aspirated**?
 [p] [t] [k]
- Why these sounds and no others?
 - → These are the sounds of English that are voiceless oral stops
- This kind of pattern is not unusual!
 - In the languages of the world, groups of sounds with some property or properties in common tend to behave as a group in some way

- A set of sounds with some *property or properties in common* is called a **natural class**
- <u>Data</u>: Natural classes often **behave as a group** in native-speaker language behavior
- <u>Model</u>: What should we propose to account for this in our **model** of the mental grammar?

- A set of sounds with some *property or properties in common* is called a **natural class**
- <u>Data</u>: Natural classes often **behave as a group** in native-speaker language behavior
- <u>Model</u>: What should we propose to account for this in our **model** of the mental grammar?
 - Natural classes are defined by sound properties
 - So, the mental grammar uses sound properties to represent the sounds of language
 → "Phonetic" properties are mentally relevant!

- What does it mean to propose this?
 The mental grammar uses sound properties to represent the sounds of language
 - The mental grammar doesn't actually "see" a speech sound like [u] or [t]
 - Instead, it "sees" a **set of properties** that represents each sound
- In the mental grammar...

[u] is represented as: high back round tense vowel[t] is represented as: voiceless alveolar oral stop

⁻ CL uses "features" to further formalize this concept; we won't!

4. Try it — Natural classes

- Practice: What properties can we use to **describe** each of these groups of sounds as a **single natural class**, while *excluding* other sounds as specified?
 - (a) $[f\theta s \int h]$ but not [tzvb]
 - (b) [pgmdŋt] but not [sejw]
 - (c) [iowuaej] but not [Iækm]

(d) [iɪ] but not [æowεŋʧ]

4. Try it — Natural classes

- Practice: What properties can we use to **describe** each of these groups of sounds as a **single natural class**, while *excluding* other sounds as specified?
 - (a) [fθs∫h] but not [tzvb]
 voiceless fricatives | *it may take >1 property to describe a class*
 - (b) [pgmdŋt] but not [sejw] stops
 - (c) [iowuaej] but not [ıækm] tense
 - (d) [iɪ] but not [uʊæowɛŋʧ] high unrounded

Returning to the topic of allophones:

- Step 3. If you have found that two sounds are allophones of the same phoneme, state the environments where each allophone occurs
- Since putting the allophones of a phoneme in the right places is the job of the **mental grammar**
 - and the mental grammar **represents sounds** in terms of their **properties**
 - → we <u>always</u> state the environment of an allophone in terms of sound properties

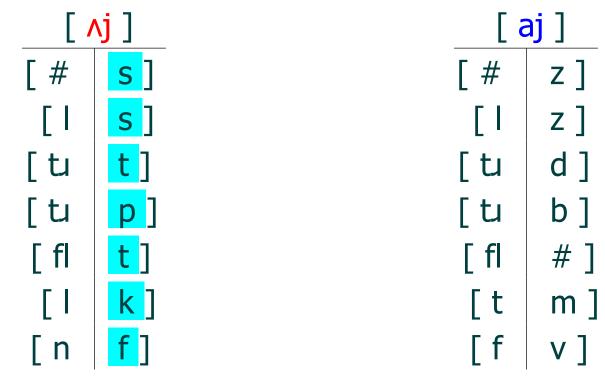
• Back to our Canadian Raising example...

(modified from Table 3.3 in CL, p 74)

[ʌj s]	`ice'	[ajz]	'eyes'
[lʌjs]	`lice'	[lajz]	`lies'
[tɪʌjt]	`trite'	[tı <mark>aj</mark> d]	`tried'
[tɪ <mark>ʌj</mark> p]	`tripe'	[tı <mark>aj</mark> b]	`tribe'
[fl <mark>ʌj</mark> t]	`flight′	[flaj]	`fly′
[`like'	[tajm]	`time'
[n <mark>ʌj</mark> f]	`knife'	[f <mark>aj</mark> v]	`five'

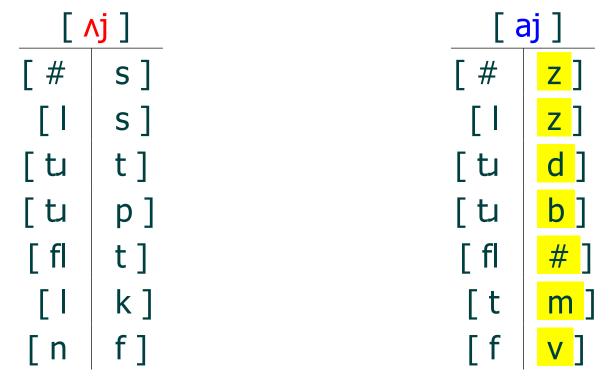
Can either environment (or both) be **stated as a natural class**?

Can either environment be stated as a natural class?



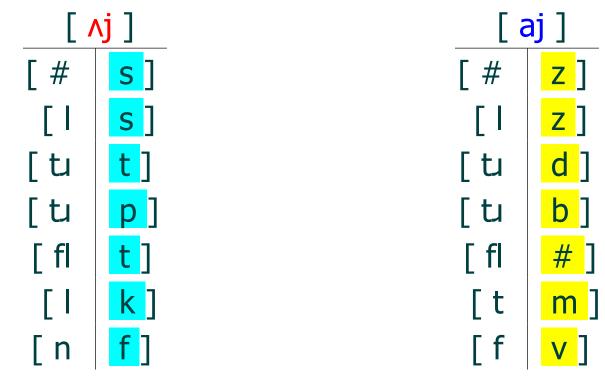
- [**^**j] appears before [s, t, p, k, f] in this data set
 - These sounds are all **voiceless** | *this is a natural class!*

Can either environment be stated as a natural class?



- [aj] appears before [z, d, b, m, v, #] (# = edge of the word)
 - No shared properties (because of #)
 - But this list does **not** include any **voiceless** sounds

Can either environment be stated as a natural class?



- Our analysis of the environments of these diphthongs:
 - [ʌj] appears before **voiceless** sounds
 - [aj] appears elsewhere

Step 3. If you have found that two sounds are allophones of the same phoneme, state the environments where each allophone occurs

Now we can expand on this:

- At least one of the two allophones should have an environment that is statable as a natural class using properties of sounds
- If one allophone has an environment that is
 "wherever the other allophone *doesn't* occur",
 we can state its environment as **elsewhere**

- So far, we have made the following proposals to account for sound-related language behavior:
 - Phonemes are mental sound categories
 - One phoneme may have multiple **allophones**
 - In that case, some factor in the **environment** described in terms of **sound properties** determines which allophone appears
- Next: How does the mental grammar make sure that the correct allophones appear in the correct environments? → Phonological rules

- When one phoneme has multiple allophones, we write a phonological rule (or rules) to determine where each allophone appears
- Remember how our model works:
 - The phoneme appears in its basic form in the mental lexicon
 - When it needs to be changed into a *different* allophone, a phonological rule applies to make that adjustment
 - Phonological rules are part of the mental grammar of a native speaker

- How to write a phonological rule:
- (1) Choose one allophone as the **<u>basic</u>** one
 - If one allophone has the environment
 'elsewhere', pick this one as basic
 - Otherwise, if one allophone has an environment that is a more general natural class, pick this one as basic (this is NOT about which allophone appears "more often" in the data set!)
 - If *no* allophone has a more general environment, just pick any one as the basic one (here, more than one analysis is equally insightful)

(1) Choose one allophone as the **<u>basic</u>** one

- For Canadian Raising, which allophone is basic?

[<mark>ʌj</mark> s]	`ice'	[<mark>aj</mark> z]	'eyes'
[`lice'	[lajz]	`lies'
[tɪ <mark>ʌj</mark> t]	`trite'	[tı <mark>aj</mark> d]	'tried'
[ˈ tɪʌj p]	`tripe'	[tı <mark>aj</mark> b]	`tribe'
[fl <mark>ʌj</mark> t]	`flight'	[flaj]	`fly′
[`like'	[t <mark>aj</mark> m]	`time'
[n <mark>ʌj</mark> f]	`knife'	[fajv]	`five'

- [**^**j] appears before **voiceless** sounds
- [aj] appears elsewhere

(1) Choose one allophone as the **<u>basic</u>** one

- For Canadian Raising, which allophone is basic?

[<mark>ʌj</mark> s]	`ice'	[<mark>aj</mark> z]	'eyes'
[I <mark>ʌj</mark> s]	`lice'	[l <mark>aj</mark> z]	`lies'
[ˈuʌjt]	`trite'	[tı <mark>aj</mark> d]	`tried'
[tɪ <mark>ʌj</mark> p]	`tripe'	[tı <mark>aj</mark> b]	`tribe'
[fl <mark>ʌj</mark> t]	`flight'	[flaj]	`fly′
[`like'	[tajm]	`time'
[nʌjf]	`knife'	[f <mark>aj</mark> v]	`five'

- [**^j**] appears before **voiceless** sounds
- [aj] appears elsewhere ← basic allophone

- (2) The <u>basic</u> allophone is the "name" of the phoneme (what to put inside the / /)
 - This is the allophone we will get when *no* phonological rule applies the **default** option

- (2) The <u>basic</u> allophone is the "name" of the phoneme (what to put inside the / /)
 - This is the allophone we will get when *no* phonological rule applies the **default** option
 - For Canadian Raising, we can now say that the phoneme that has allophones [aj] and [ʌj] is /aj/

(3) For each <u>non</u>-basic allophone of the phoneme, write a **phonological rule**

A phonological rule must state:

- the **segment** or **class of segments** it applies to
- the **properties** that need **changing**, in order to turn the basic form of the phoneme into the appropriate allophone
- the **environment** in which it applies

- (3) For each <u>non</u>-basic allophone of the phoneme, write a **phonological rule**
 - For Canadian Raising, we need the rule to...
 - apply to /aj/
 - change the *low* part of this diphthong to *mid*
 - apply in the environment "before a voiceless sound"

- Conceptually, a phonological rule says, "When phoneme /P/ appears in the designated context, change it into allophone [Q]."
- Reminder: It is sound properties like "voiced" or "nasal" that the mental grammar manipulates, not entire individual speech sounds like [m]
 - Changing [m] to [b] means *changing* "nasal" to "oral", <u>not</u> replacing one sound with another
 - Therefore: Always write your phonological rule in terms of **sound properties**, even when only one sound is affected!

7. Rule notation

• Here is how we will state phonological rules in our model of mental grammar:

$A \rightarrow B / X Y$

- **A** The sound(s) affected by the rule
- **B** The property(ies) that the rule **changes**
- / 'In the environment of'
- __ Where the affected sound(s) are located with respect to the context
- **X** Preceding context, if any
- **Y** Following context, if any

*** **Always** state A, B, X, Y in terms of **properties** ***

7. Rule notation

- For the Canadian Raising example:
 - We haven't specifically talked about how to represent diphthongs with sound properties, since they have two parts
 - Proposal: Describe a diphthong primarily in terms of its first part (with second part in parentheses)
 - /aj/ is therefore described as: *low central unrounded (to palatal glide) diphthong*

7. Rule notation

• Rule for the Canadian Raising example:



- Describe the affected sound in enough detail to identify it
- Indicate only the changed property (don't simply state all the properties of the outcome, [ʌj]—focus on the change)
- Use _____ to show where the affected sound is located with respect to the relevant environment

8. Some key points to remember

Why are we going through all this?

- To analyze the phonology (grammar) of a language:
 - Propose **phonological rules** as needed
- How do we know when a rule is needed?
 - Determine whether two sounds belong to the same phoneme (as allophones) or to different phonemes
 - If one phoneme has **multiple allophones**, we need a **rule** to determine which allophone appears where

8. Some key points to remember

- Our model of the mental grammar can represent natural classes because it represents sounds in terms of properties
- Natural classes are essential in stating allophone distributions or phonological rules
 - The **environment** of a rule is often a natural class
 - An entire class may also **undergo** a rule
- Every part of a rule is stated in terms of properties, even if only one sound is involved. Why?
 - → This is how the mental grammar **represents** sounds
 - → Phonological rules are part of the mental grammar