Phonemes and Allophones
Course Readings

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

- Contemporary Linguistics: Chapter 3 (pp. 59-69)
- Language Files: Chapter 3.1 (pp. 101-108)
Handouts for This Lecture

I have also posted to the course website the following handout, which you might find useful over the next couple classes:

▶ “Important Vocabulary Items for Phonology”

(You’ll probably want to have it with you for next class...)
A Review of Where We Are

The Fundamental Question:
What are the **rules** and **mental representations** that underlie our ability to speak and understand a language?

Last Class:
- There are **rules** that affect the **pronunciation** of words.
- The study of these rules is **phonology**.
- There is a **phonological rule** for breaking down words into syllables (syllabification).
A Review of Where We Are

The Fundamental Question:
What are the rules and mental representations that underlie our ability to speak and understand a language?

Last Class:

- There are rules that affect the pronunciation of words.
- The study of these rules is phonology.
- There is a phonological rule for breaking down words into syllables (syllabification).

This Class:
There are phonological rules that affect the pronunciation of single, individual phones.
Right now, we’d transcribe these words as follows:

| ‘top’    | [tAp] | ‘cop’    | [kap] | ‘pop’    | [pap] |
| ‘stool’  | [stul]| ‘school’ | [skul]| ‘spool’  | [spul]|
| ‘eat’    | [it]  | ‘eke’    | [ik]  | ‘eep’    | [ip]  |

Under this transcription:

- All the words in the 1<sup>st</sup> column share a sound: [t]
- All the words in the 2<sup>nd</sup> column share a sound: [k]
- All the words in the 3<sup>rd</sup> column share a sound: [p]
An Oversimplification Revealed

Right now, we’d transcribe these words as follows:

<table>
<thead>
<tr>
<th>Word</th>
<th>Transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>'top'</td>
<td>[tAp]</td>
</tr>
<tr>
<td>'stool'</td>
<td>[stul]</td>
</tr>
<tr>
<td>'eat'</td>
<td>[it]</td>
</tr>
<tr>
<td>'cop'</td>
<td>[kap]</td>
</tr>
<tr>
<td>'school'</td>
<td>[skul]</td>
</tr>
<tr>
<td>'eke'</td>
<td>[ik]</td>
</tr>
<tr>
<td>'pop'</td>
<td>[pap]</td>
</tr>
<tr>
<td>'spool'</td>
<td>[spul]</td>
</tr>
<tr>
<td>'eep'</td>
<td>[ip]</td>
</tr>
</tbody>
</table>

Problem:
The actual ‘t’-sounds in the 1st column are a bit different from each other.

- Put your hand in front of your mouth and say “top”.
- There’s a strong burst of air when you say the “t”.
- This burst isn’t there when you say “stool” and “eat”.
An Oversimplification Revealed

Right now, we’d transcribe these words as follows:

‘stool’ [stul]  ‘school’ [skul]  ‘spool’ [spul]
‘eat’  [it]  ‘eke’  [ik]  ‘eep’  [ip]

Problem:
The actual ‘k’-sounds in the 2nd column are a bit different from each other.

- Put your hand in front of your mouth and say “cop”.
- There’s a strong burst of air when you say the “c”.
- This burst isn’t there with “school” and “eke”.

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An Oversimplification Revealed

Right now, we’d transcribe these words as follows:

<table>
<thead>
<tr>
<th>'top'</th>
<th>[tap]</th>
<th>'cop'</th>
<th>[kap]</th>
<th>'pop'</th>
<th>[pap]</th>
</tr>
</thead>
<tbody>
<tr>
<td>'stool'</td>
<td>[stul]</td>
<td>'school'</td>
<td>[skul]</td>
<td>'spool'</td>
<td>[spul]</td>
</tr>
<tr>
<td>'eat'</td>
<td>[it]</td>
<td>'eke'</td>
<td>[ik]</td>
<td>'eep'</td>
<td>[ip]</td>
</tr>
</tbody>
</table>

Problem:
The actual ‘p’-sounds in the 3\textsuperscript{rd} column are a bit different from each other.

- Put your hand in front of your mouth and say “pop”.
- There’s a strong burst of air when you say the “p”.
- This burst isn’t there when you say “spool” and “eep”.

▶ Put your hand in front of your mouth and say “pop”.
▶ There’s a strong burst of air when you say the “p”.
▶ This burst isn’t there when you say “spool” and “eep”.
Aspiration

Vocabulary:
The strong burst of air when you pronounce [t]/[k]/[p] in “top”/“cop”/“pop” is called **aspiration**.

IPA Representation:
Aspiration on a consonant C is represented in IPA by a superscripted “h” (Cʰ).

Therefore the following is a more accurate transcription of the words we saw before:

- ‘top’ [tʰəp]
- ‘stool’ [stul]
- ‘eat’ [it]
- ‘cop’ [kʰəp]
- ‘school’ [skul]
- ‘eke’ [ik]
- ‘pop’ [pʰəp]
- ‘spool’ [spul]
- ‘eep’ [ip]
Aspiration and Phonology

Key Observation:
English speakers don’t just aspirate any old consonant they want.

- Normal pronunciation requires aspiration to be on [t] in “top”
- Normal pronunciation requires no aspiration on [t] in “stool” and “eat”.

Conclusion:
Part of knowing English is knowing where aspiration can (and must) go.

Question:
How is this information represented in our brains?
Towards the Aspiration Rule

Wrong Hypothesis:
Maybe we just memorize it on a word-by-word basis?

- When we learn a word like ‘cop’, we learn:
  - The phones that compose it: [kəp]
  - Whether any phones are aspirated: [kʰəp]
Towards the Aspiration Rule

Wrong Hypothesis:
Maybe we just memorize it on a word-by-word basis?
▷ When we learn a word like ‘cop’, we learn:
  ▷ The phones that compose it: [kəp]
  ▷ Whether any phones are aspirated: [kʰəp]

Problem for Wrong Hypothesis:
English speakers know where aspiration must go in words they’ve never heard before.

▷ Read the following words to yourselves silently.
  “torble” “corble” “porble”
  “stib” “skib” “spib”
  “ort” “ork” “orp”
Towards the Aspiration Rule

Wrong Hypothesis:
Maybe we just memorize it on a word-by-word basis?

▶ When we learn a word like ‘cop’, we learn:
  ▶ The phones that compose it: [kɒp]
  ▶ Whether any phones are aspirated: [kʰɒp]

Problem for Wrong Hypothesis:
English speakers know where aspiration must go in words they’ve never heard before.

▶ Now say them with your hand in front of your mouth

“torble”  “corble”  “porble”
“stib”     “skib”     “spib”
“ort”      “ork”      “orp”
Towards the Aspiration Rule

Wrong Hypothesis:
Maybe we just memorize it on a word-by-word basis?
▶ When we learn a word like ‘cop’, we learn:
  ▶ The phones that compose it: [kʰap]
  ▶ Whether any phones are aspirated: [kʰap]

Problem for Wrong Hypothesis:
English speakers know where aspiration must go in words they’ve never heard before.

▶ You probably pronounced them as follows:

Towards the Aspiration Rule

Conclusion:
► Since you’d never heard those made-up words before...
► Your knowledge of where aspiration goes couldn’t have been memorized...
► So the ‘Wrong Hypothesis’ is wrong...
Towards the Aspiration Rule

Conclusion:
- Since you’d never heard those made-up words before...
- Your knowledge of where aspiration goes couldn’t have been memorized...
- So the ‘Wrong Hypothesis’ is wrong...

Right Hypothesis
Aspiration in English is governed by a **general rule**.
- This rule tells you which consonants aspiration has to go on.
Towards the Aspiration Rule

So, what is the rule for where aspiration goes?...

The following set of English words is representative of the pattern:

| ‘top’ | [tʰæp] | ‘cop’ | [kʰæp] | ‘pop’ | [pʰæp] |
| ‘stool’ | [stul] | ‘school’ | [skul] | ‘spool’ | [spul] |
| ‘eat’ | [it] | ‘eke’ | [ik] | ‘EEP’ | [ip] |
| ‘twitter’ | [tʰwɪ.dɪ] | ‘quitter’ | [kʰwɪ.dɪ] | ‘please’ | [pʰlɪz] |
| ‘return’ | [ri.tʰɪ.m] | ‘recoil’ | [ri.kʰɔɪl] | ‘repay’ | [ri.pʰeɪ] |
| ‘outlier’ | [ɔw.t.ɪ.lju] | ‘rick-roll’ | [ɔɪk.ɾɔɪl] | ‘lip-lock’ | [ɪp.lɑk] |
| ‘wits’ | [wɪts] | ‘licks’ | [lɪks] | ‘lips’ | [lɪps] |
Towards the Aspiration Rule

So, what is the rule for where aspiration goes?...

The following set of English words is representative of the pattern:

<table>
<thead>
<tr>
<th>Word</th>
<th>Pronunciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘top’</td>
<td>[tʰɑp]</td>
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<td>‘stool’</td>
<td>[stul]</td>
</tr>
<tr>
<td>‘eat’</td>
<td>[it]</td>
</tr>
<tr>
<td>‘twitter’</td>
<td>[tʰtwɪ.dɹ]</td>
</tr>
<tr>
<td>‘return’</td>
<td>[ɹi.tʰɪrn]</td>
</tr>
<tr>
<td>‘outlier’</td>
<td>[ɔw.t.laɪɹ]</td>
</tr>
<tr>
<td>‘wits’</td>
<td>[wɪts]</td>
</tr>
<tr>
<td>‘cop’</td>
<td>[kʰɑp]</td>
</tr>
<tr>
<td>‘school’</td>
<td>[skul]</td>
</tr>
<tr>
<td>‘eke’</td>
<td>[ɪk]</td>
</tr>
<tr>
<td>‘quitter’</td>
<td>[kʰwɪ.dɹ]</td>
</tr>
<tr>
<td>‘recoil’</td>
<td>[ɹi.kʰɔɪl]</td>
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<tr>
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</tr>
<tr>
<td>‘licks’</td>
<td>[lɪks]</td>
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<td>[spul]</td>
</tr>
<tr>
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<td>[ɪp]</td>
</tr>
<tr>
<td>‘please’</td>
<td>[pʰlɪz]</td>
</tr>
<tr>
<td>‘repay’</td>
<td>[ɹi.pʰɛɪ]</td>
</tr>
<tr>
<td>‘lip-lock’</td>
<td>[lɪp.læk]</td>
</tr>
</tbody>
</table>

The Pattern: [t]/[k]/[p] can (and must) be aspirated when they are the first sound in a syllable (onset).
The Aspiration Rule

Interim Summary:

- English has rules for the pronunciation of words (phonology)
- English ‘phonology’ has rules for the pronunciation of individual phones.
- One of those rules states where [t]/[k]/[p] bear aspiration (are ‘aspirated’)

The Aspiration Rule:

[t]/[k]/[p] can (and must) be aspirated when they are the first phone in an onset.
Key Fact:
The Aspiration Rule forces us to distinguish between:

- The phones that are actually produced when we talk
- The way those phones are represented in our memories.
Sounds in Memory vs. Sounds in Speech

Key Fact:
The Aspiration Rule forces us to distinguish between:

- The phones that are actually produced when we talk
- The way those phones are represented in our memories.

Basic Assumption About Memory:
When we learn a word, we store in memory a representation of how it is pronounced

A Special Notation:
- For the actual spoken phones, I’ll continue to put them in square brackets ([...]).
  - [ənd] = the sound produced when we say “and”
- For the representation of the phones in memory, I’ll put them in angled brackets (/.../)
  - /ænd/ = the representation in our memory of how to say “and”
The Representation in Memory

Question:
When we learn a new word like “torble”, do we store in memory which sounds are aspirated?

- Does the representation put into memory look like this: \( /\text{th}^\text{h} \text{rbl}/ \) (with aspiration)
- Or, does it look like this: \( /\text{rbl}/ \) (without aspiration)

Some experimental evidence (psycholinguistics unit).

It also makes the most sense, practically speaking...
The Representation in Memory

Question:
When we learn a new word like “torble”, do we store in memory which sounds are aspirated?

- Does the representation put into memory look like this: /tʰɔrbl/ (with aspiration)
- Or, does it look like this: /tɔrbl/ (without aspiration)

Answer:
The answer appears to be ‘/tɔrbl/’ (without aspiration).

- Some experimental evidence (psycholinguistics unit).
- It also makes the most sense, practically speaking...
The Representation in Memory

General Principle of Simplicity in Memory: If the information already follows from a general rule, we don’t waste time/effort memorizing it.
The Representation in Memory

General Principle of Simplicity in Memory:
If the information already follows from a general rule, we don’t waste time/effort memorizing it.

A Simple Example: Spelling

- When the spelling of a word follows general rules...
  - It’s easier to learn the word.
  - Because, you don’t have to memorize the ‘details’.
    - All that info just follows from the rules...
    - So you don’t have to put it into memory.

- When the spelling of a word is irregular...
  - It’s harder to learn the word.
  - Because, you do have to memorize the ‘details’ (which letters, which order)
    - You do have to put all that info into memory.
    - That takes time and effort.
The Representation in Memory

General Principle of Simplicity in Memory:
If the information already follows from a general rule, we
don’t waste time/effort memorizing it.

The Consequences for Aspiration
Since our Aspiration Rule already says where aspiration
can/must go, we don’t also (redundantly) put that information
into memory.

Therefore, although we pronounce the words like this:
‘top’  [tʰap]  ‘cop’  [kʰap]  ‘pop’  [pʰap]

We store them in memory like this:
‘top’  /tʰap/  ‘cop’  /kʰap/  ‘pop’  /pʰap/
Step 1: Access memorized representation /tejb\l/
Step 2: Apply syllabification rule tej.b\l
Step 3: Apply aspiration rule th\l{e}j.b\l
Step 4: Pronounce word [th\l{e}j.b\l]
The Crucial Distinction

Important Conclusion:
There is an important distinction between:

▶ The sound as **produced** by the speaker.
▶ The sound as **represented in memory**.

Illustration:
▶ In memory, “table” is represented as ‘/tejbl/’
  ▶ No aspiration, No syllabification
▶ When pronounced, “table” is produced as ‘[tʰe.j.b]’
  ▶ Aspiration on [t], Syllabification complete
Phonemes and Allophones

Vocabulary

- **Phoneme** =
  The sound as represented in memory (/.../)

- **Allophone** =
  The sound as actually produced by a speaker ([...])
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Vocabulary:

[X] is an **allophone** of /Y/ if [X] is one way that speakers pronounce /Y/.

Illustration:

/t/ a phoneme of English

[tʰ] an allophone of /t/ in English

[t] an allophone of /t/ in English
Phonemes and Allophones

Vocabulary

- **Phoneme** =
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- **Allophone** =
  The sound as actually produced by a speaker ([...])

Vocabulary:

[X] is an *allophone* of /Y/ if [X] is one way that speakers pronounce /Y/.

Illustration:

/t/ a phoneme of English
[tʰ] an allophone of /t/ in English
[t] an allophone of /t/ in English

Vocabulary:

We say that [tʰ] and [t] are *allophones of the same phoneme* (namely, /t/).
Allophones Across Languages

Key Fact:
Whether or not two phones are allophones of the same phoneme depends on the language in question.

- In one language, [X] and [Y] can be allophones of the same phoneme.
- In another language, [X] and [Y] can be allophones of different phonemes.
Different Languages, Different Phonemes

Example: Aspiration in English and Thai

- In English, [t] and [th] are allophones of the same phoneme (/t/).
- In Thai, [t] and [th] are allophones of two different phonemes (/t/, /th/).
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How Do We Know?

- In Thai, the following are two different words: [tam] ‘to pound’ [tham] ‘to do’
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- In Thai, [t] and [th] are allophones of two different phonemes (/t/, /th/).

How Do We Know?

- In Thai, the following are two different words: [tam] ‘to pound’ [tham] ‘to do’
- These words look exactly the same, except one has [t] where the other has [th].
Different Languages, Different Phonemes

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- In English, [t] and [tʰ] are allophones of the same phoneme (/t/).
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- In Thai, the following are *two different words*: [tam] ‘to pound’ [tʰam] ‘to do’
- These words look exactly the same, except one has [t] where the other has [tʰ].
- This shows that [t] and [tʰ] *must* be allophones of different phonemes...
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How Do We Know?

- In Thai, the following are *two different words*: [tam] ‘to pound’ [tʰam] ‘to do’
- These words look exactly the same, except one has [t] where the other has [tʰ].
- This shows that [t] and [tʰ] *must* be allophones of different phonemes...
- *Why*?... (here comes the ‘R2’)
The Facts: In Thai, these are two different words:

[tam]  ‘to pound’  [tʰam]  ‘to do’
The Logic

The Facts: In Thai, these are two different words:
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The Key Reasoning:

- If [t] / [tʰ] were allophones of the same phoneme in Thai
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[tam] ‘to pound’  [tʰam] ‘to do’

The Key Reasoning:

► If [t] / [tʰ] were allophones of the same phoneme in Thai
  ► There would be a rule stating where you use [t] / [tʰ].
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The Facts: In Thai, these are two different words:

[tam] ‘to pound’  [tʰam] ‘to do’

The Key Reasoning:

- If [t] / [tʰ] were allophones of the same phoneme in Thai
  - There would be a rule stating where you use [t] / [tʰ].
  - Since [tʰam] is a word, this rule would entail [tʰ] before [-am].

Therefore, there isn’t actually a rule in Thai stating where you use [t] and [tʰ]. And so, [t] and [tʰ] are allophones of two different phonemes (/[t]/, / [tʰ]/).
**The Logic**

**The Facts:** In Thai, these are two different words:

- [tam] ‘to pound’
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  - But, since [tam] is also a word, this rule would entail [t] before [-am].

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  ► But, since [tam] is also a word, this rule would entail [t] before [-am].
  ► But, one rule couldn’t require both [tʰ] before [-am] and [t] before [-am].

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  - But, one rule couldn’t require both [tʰ] before [-am] and [t] before [-am].
- Therefore, there isn’t actually a rule in Thai stating where you use [t] and [tʰ].
The Logic

The Facts: In Thai, these are two different words:
[\text{tam}] ‘to pound’  
[\text{t}^\text{h} \text{am}] ‘to do’

The Key Reasoning:

- If \([t] / [t^h] \) were allophones of the same phoneme in Thai
  - There would be a rule stating where you use \([t] / [t^h] \).
  - Since \([t^h \text{am}] \) is a word, this rule would entail \([t^h] \)
    before \([-\text{am}] \).
  - But, since \([\text{tam}] \) is also a word, this rule would entail \([t] \)
    before \([-\text{am}] \).
  - But, one rule couldn’t require both \([t^h] \) before \([-\text{am}] \) and \([t] \) before \([-\text{am}] \).

- Therefore, there isn’t actually a rule in Thai stating where you use \([t] \) and \([t^h] \).

- And so, \([t] \) and \([t^h] \) are allophones of two different phonemes (\(/t/, /t^h/\).
Minimal Pairs

Vocabulary

**Minimal Pairs** = Two words that sound exactly the same, except one has [X] where the other has [Y].

- If two words are minimal pairs differing only in [X] and [Y], then they are **minimal pairs for [X] and [Y]**.

The General Principle:
If there are minimal pairs for [X] and [Y], then [X] and [Y] are allophones of *different* phonemes.
Some Illustrative Examples

Example 1:
The following are minimal pairs for [l] and [ɹ] in English

‘rap’ [ræp]  ‘lap’ [læp]
‘rip’ [ɾɪp]  ‘lip’ [lɪp]
‘peer’ [pʰɪɹ]  ‘peel’ [pʰɪl]

▶ These pairs show that there’s no rule that states whether you say [ɹ]/[l] or [s]/[S].
▶ Thus, they show that these are all allophones of different phonemes.
Some Illustrative Examples

Example 1:
The following are minimal pairs for [l] and [ɾ] in English

‘rap’ [ɾæp] ‘lap’ [læp]
‘rip’ [ɾɪp] ‘lip’ [lɪp]
‘peer’ [pʰɪɾ] ‘peel’ [pʰɪl]

Example 2:
The following are minimal pairs for [s] and [ʃ] in English

‘sip’ [sɪp] ‘ship’ [ʃɪp]
‘mess’ [mɛs] ‘mesh’ [mɛʃ]
‘last’ [læst] ‘lashed’ [læʃt]
Some Illustrative Examples

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The following are minimal pairs for [l] and [ɾ] in English

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‘rip’ [ɾɪp] ‘lip’ [lɪp]
‘peer’ [pʰɪɾ] ‘peel’ [pʰɪl]

Example 2:
The following are minimal pairs for [s] and [ʃ] in English

‘sip’ [sɪp] ‘ship’ [ʃɪp]
‘mess’ [mɛs] ‘mesh’ [mɛʃ]
‘last’ [læst] ‘lashed’ [læʃt]

▶ These pairs show that there’s no rule that states whether you say [ɾ]/[l] or [s]/[ʃ].
▶ Thus, they show that these are all allophones of different phonemes.
Contrast

More Vocabulary:

- If [X] and [Y] are allophones of different phonemes, then they are said to **contrast**.
- If [X] and [Y] are allophones of the same phoneme, then they **don’t contrast**.
Contrast

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Key Fact 1: Contrast Means Perception

When two phones ([X] and [Y]) **contrast** in a language, this means that:

- There are minimal pairs for [X] and [Y].
- So, [X] and [Y] distinguish words of the language.
- So, speakers **must perceive the difference between [X] and [Y]**.
  - (Like [s] vs. [ʃ] in English)
Contrast

More Vocabulary:

- If [X] and [Y] are allophones of different phonemes, then they are said to **contrast**.
- If [X] and [Y] are allophones of the same phoneme, then they **don’t contrast**.

Key Fact 2: No Contrast Means Maybe No Perception

When two phones ([X] and [Y]) **don’t contrast** in a language, this means that:

- There **aren’t any** minimal pairs for [X] and [Y].
- So, [X] and [Y] **don’t** distinguish any words of the language.
- So, speakers **don’t necessarily perceive the difference between** [X] and [Y].
  - (Like [t] vs. [tʰ] in English)
An Analogy That Might Help

If [X] and [Y] are allophones of the same phoneme, the language views them as just ‘versions of the same sound’. (They’re the same sound dressed up in different costumes)

▶ They are represented the same way in memory (/X/)
▶ Speakers don’t necessarily hear the difference
An Analogy That Might Help

If [X] and [Y] are allophones of the same phoneme, the language views them as just ‘versions of the same sound’. (They’re the same sound dressed up in different costumes)

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If X and Y are really ‘the same person’ (in different costumes), we’ll never get them both in the same place at the same time.
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If X and Y are two different people, then we can get them both in the same place at the same time.
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If X and Y are two different people, then we can get them both in the same place at the same time.

The Analogy:
Looking for minimal pairs is like trying to get two people in the same place at the same time.

- “place and time” ≈ the surrounding phones
- If [X] and [Y] show up in the same ‘place / time’, they are two different ‘sounds’ (phonemes) in the language.
An Analogy That Might Help

If [X] and [Y] are allophones of the same phoneme, the language views them as just ‘versions of the same sound’. (They’re the same sound dressed up in different costumes)

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The Analogy:
Looking for minimal pairs is like trying to get two people in the same place at the same time.

- “place and time” ≈ the surrounding phones
- If [X] and [Y] are never in the same ‘place / time’, they might be the same ‘sound’ (phoneme) in the language.
Complementary Distribution

Vocabulary:
If there aren’t minimal pairs for [X] and [Y], then they are in complementary distribution.
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If two phones are allophones of the same phoneme, then they must be in complementary distribution.
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If there aren’t minimal pairs for [X] and [Y], then they are in complementary distribution.

Key Fact:
If two phones are allophones of the same phoneme, then they must be in complementary distribution.

Illustration: [t] and [tʰ] in English

- [t] and [tʰ] are allophones of the same phoneme (/t/).
- So, there’s a rule that states whether you say [t] or [tʰ]
- So, two English words can’t be exactly the same, except for [t] and [tʰ]
  - If you try to replace [t] with [tʰ], the result is unpronounceable in English.
    - [tʰap] *[tap]
    - [stap] *[stʰap]
The Logical Picture

In summary:

- If you can find minimal pairs for [X] and [Y], then
  - [X] and [Y] are **allophones of different phonemes**.
  - [X] and [Y] **contrast** in the language.
  - [X] and [Y] are perceived by speakers as ‘different sounds’.

- If you can’t find minimal pairs for [X] and [Y], then
  - [X] and [Y] are in **complementary distribution**.
  - [X] and [Y] might be **allophones of the same phoneme**.
  - [X] and [Y] might be perceived by speakers as the ‘same sound’.
The Logical Picture

In summary:

- If you can find minimal pairs for \([X]\) and \([Y]\), then
  - \([X]\) and \([Y]\) are **allophones of different phonemes**.
  - \([X]\) and \([Y]\) **contrast** in the language
  - \([X]\) and \([Y]\) are perceived by speakers as ‘different sounds’

- If you *can’t* find minimal pairs for \([X]\) and \([Y]\), then
  - \([X]\) and \([Y]\) are in **complementary distribution**.
  - \([X]\) and \([Y]\) *might* be **allophones of the same phoneme**
  - \([X]\) and \([Y]\) *might* be perceived by speakers as the ‘same sound’.
One Last Point of Logic:

Fact We Just Saw:
If [X] and [Y] are allophones of the same phoneme, then they are in complementary distribution.
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**Key Logical Point:**
But, [X] and [Y] might be in complementary distribution and still be allophones of **different** phonemes.

- **Analogy:**
  Even if two people are never in the same room together, they might still be two different people.
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- **Illustration:** [ŋ] and [h] in English  
  - In English, [ŋ] is never in onsets.
  - In English, [h] is never in codas.
  - However, we still think they are different phonemes... (We’ll see why next class)
The phonology of a language includes rules that affect individual phones.

Example:
In English, [t]/[p]/[k] are aspirated at the beginning of onsets.

Given these rules, we must distinguish between:
- phoneme: the sound as represented in memory
- allophone: the sound as actually produced
Summary

Minimal Pairs and Complementary Distribution

- Languages differ in whether phones are allophones of the same (or different) phonemes.

Example:
In Thai, [t] and [tʰ] are allophones of different phonemes.
Summary

Minimal Pairs and Complementary Distribution

- Languages differ in whether phones are allophones of the same (or different) phonemes.

  **Example:**
  In Thai, [t] and [tʰ] are allophones of different phonemes

- If we can find minimal pairs for two phones, then we know they are allophones of different phonemes.

  **Example (Thai):**
  [tam] ‘to pound’  [tʰam] ‘to do’
Summary

Minimal Pairs and Complementary Distribution

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Example:
In Thai, [t] and [tʰ] are allophones of different phonemes.

- If we can find minimal pairs for two phones, then we know they are allophones of different phonemes.

Example (Thai):
[tam] ‘to pound’ [tʰam] ‘to do’

- If we can’t find minimal pairs for them, then they might be allophones of the same phoneme.

Example:
- In English, there are no minimal pairs for [t] and [tʰ]...
- ...but there also aren’t minimal pairs for [ŋ] and [h]