

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

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- ▶ 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.

An Oversimplification Revealed

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 1st column share a sound: [t]
- ▶ All the words in the 2nd column share a sound: [k]
- ▶ All the words in the 3rd column share a sound: [p]

An Oversimplification Revealed

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'top'	[tap]	'cop'	[kap]	'pop'	[pap]
'stool'	[stul]	'school'	[skul]	'spool'	[spul]
'eat'	[it]	'eke'	[ik]	'eep'	[ip]

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:

'top'	[tap]	'cop'	[kap]	'pop'	[pap]
'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".

An Oversimplification Revealed

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]

Problem:

The actual 'p'-sounds in the 3rd 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”.

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” (C^h).

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

‘top’	[t ^h ap]	‘cop’	[k ^h ap]	‘pop’	[p ^h ap]
‘stool’	[stul]	‘school’	[skul]	‘spool’	[spul]
‘eat’	[it]	‘eke’	[ik]	‘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: [kɑp]
 - ▶ Whether any phones are aspirated: [k^hɑp]

Towards the Aspiration Rule

Wrong Hypothesis:

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- ▶ When we learn a word like ‘cop’, we learn:
 - ▶ The phones that compose it: [kɑp]
 - ▶ Whether any phones are aspirated: [k^hɑp]

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: [kɑp]
 - ▶ Whether any phones are aspirated: [k^hɑp]

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: [kɑp]
 - ▶ Whether any phones are aspirated: [k^hɑp]

Problem for Wrong Hypothesis:

English speakers know where aspiration must go in words they’ve never heard before.

- ▶ You probably pronounced them as follows:

“torble”	[t ^h ɔɹbəl]	“corble”	[k ^h ɔɹbəl]	“porble”	[p ^h ɔɹbəl]
“stib”	[stɪb]	“skib”	[skɪb]	“spib”	[spɪb]
“ort”	[ɔɹt]	“ork”	[ɔɹk]	“orp”	[ɔɹp]

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'	[t ^h ap]	'cop'	[k ^h ap]	'pop'	[p ^h ap]
'stool'	[stul]	'school'	[skul]	'spool'	[spul]
'eat'	[it]	'eke'	[ik]	'eep'	[ip]
'twitter'	[t ^h wɪ.d̩]	'quitter'	[k ^h wɪ.d̩]	'please'	[p ^h liz]
'return'	[ɹi.t ^h ɹɪn]	'recoil'	[ɹi.k ^h ɔɪl]	'repay'	[ɹi.p ^h ej]
'outlier'	[aʊt.laɪɹ]	'rick-roll'	[ɹɪk.rɔʊl]	'lip-lock'	[lɪp.lak]
'wits'	[wɪts]	'licks'	[lɪks]	'lips'	[lɪps]

Towards the Aspiration Rule

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'wits'	[wɪts]	'licks'	[lɪks]	'lips'	[lɪps]

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.

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.

Sounds in Memory vs. Sounds in Speech

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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 ([...]).
 - ▶ [ænd] = 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:
/t^hɔɹbəl/ (with aspiration)
- ▶ Or, does it look like this: /tɔɹbəl/ (without aspiration)

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: /t^hɔɹbɫ/ (with aspiration)
- ▶ Or, does it look like this: /tɔɹbɫ/ (without aspiration)

Answer:

The answer appears to be ‘/tɔɹbɫ/’ (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.

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The Representation in Memory

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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' [t^hap] 'cop' [k^hap] 'pop' [p^hap]
- ▶ We store them in memory like this:
'top' /tap/ 'cop' /kap/ 'pop' /pap/

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A Picture of Speech Production

Step 1: Access memorized representation

/tejb/

Step 2: Apply syllabification rule

tej.b|

Step 3: Apply aspiration rule

t^hej.b|

Step 4: Pronounce word

[t^hej.b|]

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 ‘[t^hej.bɪ]’
 - ▶ 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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Phonemes and Allophones

Vocabulary

- ▶ **Phoneme** =
The sound as represented in memory (/.../)
- ▶ **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
- [t^h] an allophone of /t/ in English
- [t] an allophone of /t/ in English

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Phonemes and Allophones

Vocabulary

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The sound as actually produced by a speaker ([...])

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Illustration:

- /t/ a phoneme of English
- [t^h] an allophone of /t/ in English
- [t] an allophone of /t/ in English

Vocabulary:

We say that [t^h] and [t] are **allophones of the same phoneme** (namely, /t/).

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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 [t^h] are allophones of the same phoneme (/t/).
- ▶ In Thai, [t] and [t^h] are allophones of *two different* phonemes (/t/, /t^h/).

Different Languages, Different Phonemes

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- ▶ In Thai, [t] and [t^h] are allophones of *two different* phonemes (/t/, /t^h/).

How Do We Know?

- ▶ In Thai, the following are *two different words*:
[tam] 'to pound' [t^ham] 'to do'

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How Do We Know?

- ▶ In Thai, the following are *two different words*:
[tam] 'to pound' [t^ham] 'to do'
- ▶ These words look exactly the same, except one has [t] where the other has [t^h].

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How Do We Know?

- ▶ In Thai, the following are *two different words*:
[tam] 'to pound' [t^ham] 'to do'
- ▶ These words look exactly the same, except one has [t] where the other has [t^h].
- ▶ This shows that [t] and [t^h] *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' [t^ham] 'to do'
- ▶ These words look exactly the same, except one has [t] where the other has [t^h].
- ▶ This shows that [t] and [t^h] *must* be allophones of different phonemes...
- ▶ *Why?*... (here comes the 'R2')

The Logic

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

[tam] 'to pound' [t^ham] 'to do'

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The Logic

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

[tam] 'to pound' [t^ham] 'to do'

The Key Reasoning:

- ▶ If [t] / [t^h] were allophones of the same phoneme in Thai

The Logic

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

[tam] 'to pound' [t^ham] '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].

The Logic

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

[tam] 'to pound' [t^ham] '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^ham] is a word, this rule would entail [t^h] before [-am].

The Logic

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

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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^ham] is a word, this rule would entail [t^h] before [-am].
 - ▶ But, since [tam] is also a word, this rule would entail [t] before [-am].

The Logic

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

[tam] 'to pound' [t^ham] 'to do'

The Key Reasoning:

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 - ▶ There would be a rule stating where you use [t] / [t^h].
 - ▶ Since [t^ham] is a word, this rule would entail [t^h] before [-am].
 - ▶ But, since [tam] is also a word, this rule would entail [t] before [-am].
 - ▶ But, one rule couldn't require *both* [t^h] before [-am] *and* [t] before [-am].

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The Logic

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

[tam] 'to pound' [t^ham] '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^ham] is a word, this rule would entail [t^h] before [-am].
 - ▶ But, since [tam] is also a word, this rule would entail [t] before [-am].
 - ▶ But, one rule couldn't require *both* [t^h] before [-am] *and* [t] before [-am].
- ▶ Therefore, there isn't actually a rule in Thai stating where you use [t] and [t^h].

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The Logic

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

[tam] 'to pound' [t^ham] '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^ham] is a word, this rule would entail [t^h] before [-am].
 - ▶ But, since [tam] is also a word, this rule would entail [t] before [-am].
 - ▶ But, one rule couldn't require *both* [t^h] before [-am] *and* [t] before [-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/).**

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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' [ɹæp] 'lap' [læp]

'rip' [ɹɪp] 'lip' [lɪp]

'peer' [p^hiɹ] 'peel' [p^hi:l]

Some Illustrative Examples

Example 1:

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

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'rip'	[ɹɪp]	'lip'	[lɪp]
'peer'	[p ^h iɹ]	'peel'	[p ^h il]

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]

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'last'	[læst]	'lashed'	[læʃt]

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

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Contrast and Perception

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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

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 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. [t^h] in English)

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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

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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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The Analogy:

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

- ▶ “place and time” \approx the surrounding phones
- ▶ If [X] and [Y] show up in the same ‘place / time’, they are two different ‘sounds’ (phonemes) in the language.

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

- ▶ “place and time” \approx 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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Complementary Distribution

Vocabulary:

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**.

Complementary Distribution

Vocabulary:

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 [t^h] in English

- ▶ [t] and [t^h] are allophones of the same phoneme (/t/).
- ▶ So, there's a rule that states whether you say [t] or [t^h]
- ▶ So, **two English words can't be exactly the same, except for [t] and [t^h]**
 - ▶ If you try to replace [t] with [t^h], the result is unpronounceable in English.

[t ^h ap]	*[tap]
[stap]	*[st ^h ap]

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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'

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.
(They just have conflicting schedules or something)

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▶ Analogy:

Even if two people are never in the same room together, they might still be two different people. (They just have conflicting schedules or something)

▶ 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)

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Allophones and Phonemes

- ▶ 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 [t^h] 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 [t^h] 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' [t^ham] 'to do'

Summary

Minimal Pairs and Complementary Distribution

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

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Example (Thai):

[tam] 'to pound' [t^ham] '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 [t^h]...
- ▶ ...but there also aren't minimal pairs for [ŋ] and [h]