Phonology II

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Week 3

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LING 20001: Introduction to Linguistics

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'eighteenth'

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- This tells us that at least the following are observable sounds of English:

$$[\text{eɪ}], [\text{t}^{\text{h}}], [\tilde{\text{ɪ}}], [\underset{=}{\text{n}}], [\theta]$$

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- This tells us that at least the following are observable sounds of English:

$$[\text{eɪ}], [\text{t}^{\text{h}}], [\tilde{\text{ɪ}}], [\underset{\text{n}}{\text{n}}], [θ]$$

- Do all of these belong to the basic inventory of sounds?

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[pʰaʊɹ]	'power'	[spaʊs]	'spouse'	[tɹɪp]	'trip'
[əˈpʰoʊz]	'oppose'	[spaɪdɹ̩]	'spider'	[hip]	'heap'

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- The distribution of certain sounds is predictable: [p] and [pʰ] are in **complementary distribution**.

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- Their distribution is predictable: aspirated voiceless stops like [pʰ] always occur in onset of a stressed syllable, while unaspirated [p] occurs everywhere else.
- If [pʰ] were part of the basic inventory of sounds, what stops it from occurring at the end of a word?

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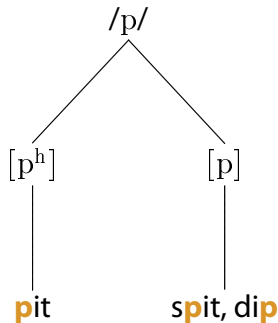- An abstract **underlying representation** (/X/)

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underlying representation $\longrightarrow$ (phoneme)

surface representation $\longrightarrow$ (allophones)

$$/p/$$

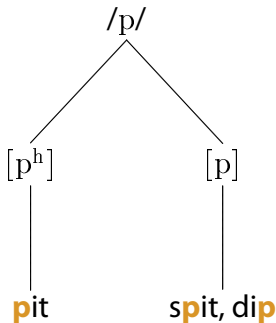$$[p^h] \qquad\qquad [p]$$

pit $\qquad$ s**p**it, di**p**

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/p/

$[p^h]$ $[p]$

pit   s**p**it, di**p**

/p/ surfaces as $[p^h]$ at beginning of a stressed syllable, $[p]$ in the middle and at the end of a word (everywhere else).

At the phonemic level, the words *pit* and *spit* have the same sound /p/.
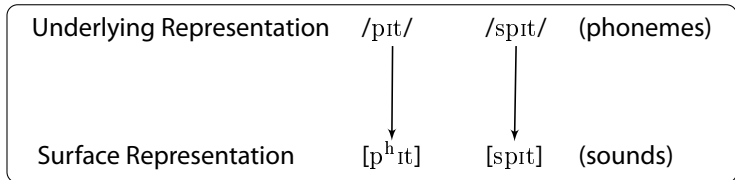
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Underlying Representation   /pɪt/   /spɪt/   (phonemes)

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	↓	↓	
Surface Representation	[pʰɪt]	[spɪt]	(sounds)

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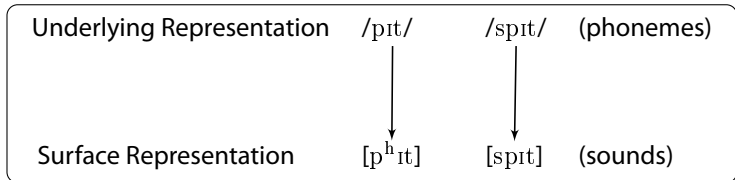| Underlying Representation	/pɪt/	/spɪt/	(phonemes)
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How do we get from the UR to the SR?

Phonological rules
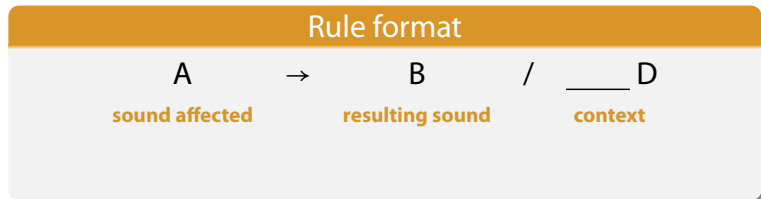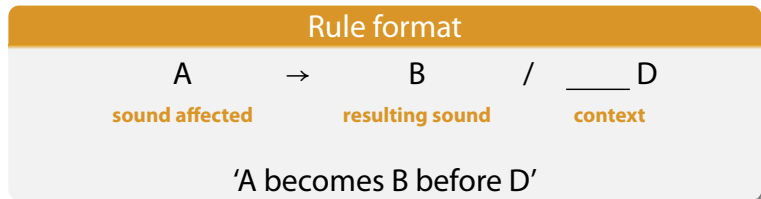
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'A becomes B before D'

underlying representation ⟶ (phoneme)

surface representation ⟶ (allophones)

$$/p/$$

$$[p^h] \qquad\qquad [p]$$
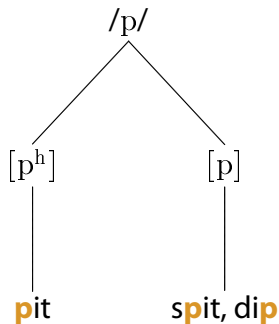
pit   s**p**it, di**p**

What are the rules for deriving the allophones of /p/ in English?

[pʰɪt]	'pit'	[spɪt]	'spit'	[dɪp]	'dip'
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$$p \rightarrow p^h / [_\sigma \; ' \underline{\quad\quad}$$ (Aspiration Rule)

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'/p/ becomes [pʰ] at the beginning of a stressed syllable'

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Surface Representation			

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Surface Representation			

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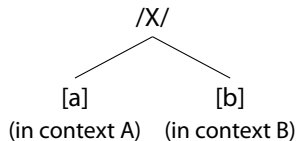
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```
              /X/
             /   \
           /       \
        [a]         [b]
   (in context A)  (in context B)
```
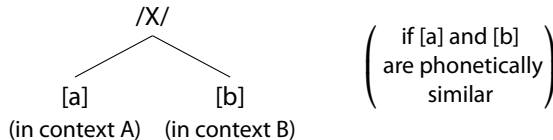
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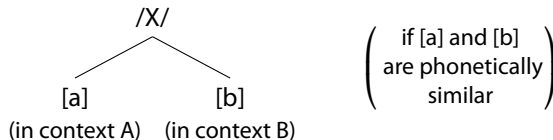
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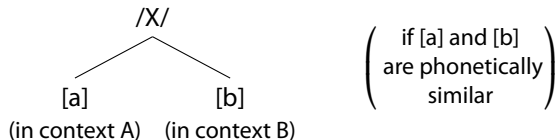The sound with more general distribution is taken to be /X/

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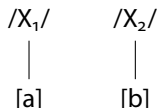
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$$/X/$$

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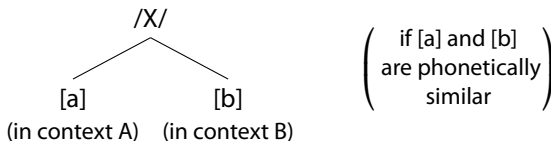$$\left(\begin{array}{c} \text{if [a] and [b]} \\ \text{are phonetically} \\ \text{similar} \end{array} \right)$$

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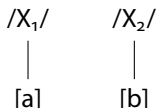
$$/X_1/ \qquad /X_2/$$

```
   /X₁/     /X₂/
    |        |
   [a]      [b]
```

If [a] is the only allophone then it is also the underlying representation (the phoneme /a/).

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- How do we know what the underlying segment is?
- In many cases, it will the sound itself but we have to check that it isn't an allophone of another sound!

Diagnosing phonemes and allophones

- We compare can with further sounds of English:

$$/X_1/ \qquad /X_2/ \qquad\qquad /X_3/$$

$$| \qquad\quad | \qquad\qquad\quad |$$

$$[g] \qquad [t^h] \qquad [t] \qquad [v]$$

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$$/g/ \qquad /X_2/ \qquad\qquad\qquad /X_3/$$

/g/ → [g]

/X_2/ → [t^h], [t]

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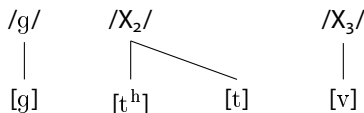- [t] forms minimal pairs with [g] ('let' vs. 'leg') and [v] ('sit' vs 'sieve').
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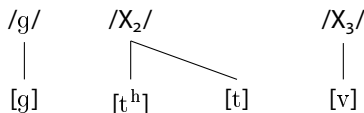- Are there minimal pairs with [t] and [t^h]? No, they are in complementary distribution and therefore allophones of the same underlying sound.
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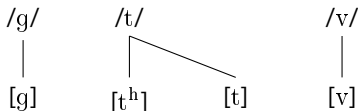- We will assume the surface allophone with the more general distribution is the underlying one.
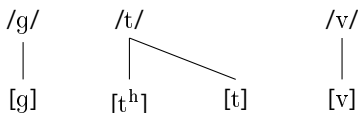
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- Are there minimal pairs with [t] and $[t^h]$? No, they are in complementary distribution and therefore allophones of the same underlying sound.
- We will assume the surface allophone with the more general distribution is the underlying one.
- /g/, /t/, /v/ are phonemes, but there is no phoneme $*/t^h/$ in English.

Free variation

- For some speakers, a final stop can be optionally **unreleased** [˺]:

[tɑp]	~	[tɑp˺]	'top'
[tɹɪp]	~	[tɹɪp˺]	'trip'
[hip]	~	[hip˺]	'heap'

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- These two sounds are not in complementary distribution.
- However, they also don't form any minimal pairs (no change in meaning)
- There are no words distinguished by [p] and [pˀ] → Not phonemes
- In such a case, we say that these sounds are allophones in **free variation**

A similar case of free variation can be seen with the alveolar tap [ɾ] and an alveolar stop like [t]:

[ɹaɪt̬]	~	[ɹaɪɾ̬]	'writer'
[bɪt̬]	~	[bɪɾ̬]	'bitter'
[wʌtɛv̬]	~	[wʌɾɛv̬]	'whatever'

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[ɹaɪt̪ɹ]	~	[ɹaɪɾɹ]	'writer'
[bɪt̪ɹ]	~	[bɪɾɹ]	'bitter'
[wʌtɛvɹ̪]	~	[wʌɾɛvɹ]	'whatever'

The same is true with the glottal stop [ʔ] in British varieties:

[ɹaɪt̪ə]	~	[ɹaɪʔə]	'writer'
[bɪt̪ə]	~	[bɪʔə]	'bitter'
[ɡlɪt̪ə]	~	[ɡlɪʔə]	'glitter'

Diagnosing phonemes and allophones

① If two sounds [a] and [b] are in **complementary distribution**, then

```
        /X/
       /    \
     [a]      [b]
(in context A)  (in context B)
```

$$\left(\begin{array}{c} \text{if [a] and [b]} \\ \text{are phonetically} \\ \text{similar} \end{array} \right)$$

② If two sounds [a] and [b] form a **minimal pair**, then

```
/X_1/        /X_2/
  |            |
 [a]          [b]
```
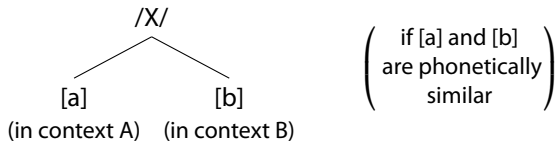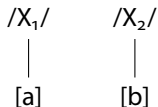
③ If two sounds [a] and [b] are **neither** in complementary distribution **nor** form a minimal pair, then they are allophones of the same underlying phoneme /X/:
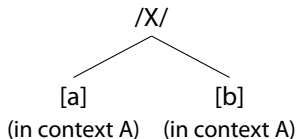
```
            /X/
           /    \
         [a]      [b]
   (in context A)  (in context A)
```

Are the sounds in
complementary distribution?

Are the sounds in
complementary distribution?

Yes

Are the sounds
phonetically similar?

Categorizing sounds

Are the sounds in
complementary distribution?

Yes

Are the sounds
phonetically similar?

Yes

They are allophones
of the same phoneme

Categorizing sounds

Are the sounds in
complementary distribution?

Yes

Are the sounds
phonetically similar?

Yes

They are allophones
of the same phoneme

e.g. [pʰ] vs. [p]

Categorizing sounds

Are the sounds in
complementary distribution?

Yes

Are the sounds
phonetically similar?

Yes　　　　No

They are allophones
of the same phoneme

They belong to
different phonemes

e.g. [pʰ] vs. [p]

Categorizing sounds

Are the sounds in
complementary distribution?

Yes

Are the sounds
phonetically similar?

Yes   No

They are allophones of the same phoneme	They belong to different phonemes

e.g. [pʰ] vs. [p]   e.g. [h] vs. [ŋ]

Categorizing sounds

Are the sounds in
complementary distribution?

Yes

No

Are the sounds
phonetically similar?

Does replacing one sound
with the other change
the meaning?

Yes

No

They are allophones
of the same phoneme

They belong to
different phonemes

e.g. [pʰ] vs. [p]

e.g. [h] vs. [ŋ]

Categorizing sounds

Are the sounds in
complementary distribution?

Yes   No

Are the sounds
phonetically similar?

Does replacing one sound
with the other change
the meaning?

Yes   No   Yes

They are allophones
of the same phoneme

They belong to
different phonemes

e.g. [pʰ] vs. [p]

e.g. [h] vs. [ŋ]

Categorizing sounds

Are the sounds in
complementary distribution?

Yes — No

Are the sounds
phonetically similar?

Does replacing one sound
with the other change
the meaning?

Yes — No — Yes

They are allophones of the same phoneme	They belong to different phonemes

e.g. [pʰ] vs. [p]

e.g. [h] vs. [ŋ]

e.g. [b] vs. [p]

Categorizing sounds

Are the sounds in complementary distribution?

- Yes → Are the sounds phonetically similar?
  - Yes → **They are allophones of the same phoneme**

    e.g. [pʰ] vs. [p]
  - No → **They belong to different phonemes**

    e.g. [h] vs. [ŋ]
    e.g. [b] vs. [p]
- No → Does replacing one sound with the other change the meaning?
  - Yes → **They belong to different phonemes**
  - No → **They are allophones in free variation**

Categorizing sounds

Are the sounds in
complementary distribution?

Yes — No

Are the sounds
phonetically similar?

Does replacing one sound
with the other change
the meaning?

Yes — No   Yes — No

| They are allophones of the same phoneme | They belong to different phonemes | They are allophones in free variation |

e.g. [pʰ] vs. [p]

e.g. [h] vs. [ŋ]
e.g. [b] vs. [p]

e.g. [t] vs. [ɾ]/[ʔ]
e.g. [p] vs. [p˺]

English /p/ again

underlying representation $\longrightarrow$ (phoneme)

/p/

surface representation $\longrightarrow$ (allophones)

$[p^h]$ $[p]$ $([p^{\urcorner}])$

pit   s**p**it, di**p**   (di**p**)

What are the rules for deriving all of the allophones of /p/ in English?

[pʰɪt]	'pit'	[spɪt]	**spit**	[dɪp] ~ [dɪp˺]	'dip'
[pʰeɪn]	'pain'	[speɪn]	**Spain**	[eɪp] ~ [eɪp˺]	'ape'

What are the rules for deriving all of the allophones of /p/ in English?

[pʰɪt]	'pit'	[spɪt]	**spit**	[dɪp] ~ [dɪp˺]	'dip'
[pʰeɪn]	'pain'	[speɪn]	**Spain**	[eɪp] ~ [eɪp˺]	'ape'

$$p \rightarrow p^h \ / \ [_\sigma \ ' \ \_\_\_\_\_ \qquad \text{(Aspiration Rule)}$$
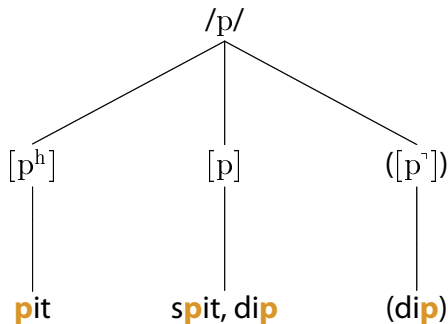
English /p/ again

What are the rules for deriving all of the allophones of /p/ in English?

[pʰɪt]	'pit'	[spɪt]	'spit'	[dɪp] ~ [dɪp˹]	'dip'
[pʰeɪn]	'pain'	[speɪn]	'Spain'	[eɪp] ~ [eɪp˹]	'ape'

$$p \rightarrow p^h / [_\sigma \, ' \underline{\quad\quad}$$ (Aspiration Rule)

'/p/ becomes [pʰ] at the beginning of a stressed syllable'

What are the rules for deriving all of the allophones of /p/ in English?

| [pʰɪt] | 'pit' | [spɪt] | 'spit' | [dɪp] ~ [dɪp̚] | 'dip' |
| [pʰeɪn] | 'pain' | [speɪn] | 'Spain' | [eɪp] ~ [eɪp̚] | 'ape' |

$$p \rightarrow p^h / [_\sigma \text{ }' \underline{\quad\quad}$$ (Aspiration Rule)

'/p/ becomes [pʰ] at the beginning of a stressed syllable'

$$p \rightarrow p^˺ / \underline{\quad\quad}\#$$ (No Release Rule)

What are the rules for deriving all of the allophones of /p/ in English?

| [pʰɪt] | 'pit' | [spɪt] | 'spit' | [dɪp] ~ [dɪp̚] | 'dip' |
| [pʰeɪn] | 'pain' | [speɪn] | 'Spain' | [eɪp] ~ [eɪp̚] | 'ape' |

$$p \rightarrow p^h \; / \; [_\sigma \; ' \underline{\hspace{1cm}} \qquad \text{(Aspiration Rule)}$$

'/p/ becomes [pʰ] at the beginning of a stressed syllable'

$$p \rightarrow p^˥ \; / \; \underline{\hspace{1cm}}\# \qquad \text{(No Release Rule)}$$

'/p/ becomes [p̚] at the end of a word'

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Surface Representation			

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration (p → pʰ / [σ ' ___)			
Surface Representation			

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration ($p \rightarrow p^h$ / [$_\sigma$ ' ____)	p^hɪt		
Surface Representation			

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration (p → pʰ / [$_\sigma$ '____)	pʰɪt	—	
Surface Representation			

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration ($p \to p^h$ / $[_\sigma{}'$___)	p^hɪt	—	—
Surface Representation			

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration (p → pʰ / [σ' ____)	pʰɪt	—	—
No Release (p → p˺ / ____#) (Optional)			
Surface Representation			

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration $(p \to p^h / [_\sigma{'} \_\_\_\_)$	pʰɪt	—	—
No Release $(p \to p^{\gamma} / \_\_\_\_ \#)$ (Optional)	—		
Surface Representation			

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration ($p \to p^h$ / $[_\sigma '$____)	p^hɪt	—	—
No Release ($p \to p^{\lnot}$ / ____#) (Optional)	—	—	
Surface Representation			

English /p/

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration (p → pʰ / [σ ' ____)	pʰɪt	—	—
No Release (p → pˀ / ____#) (Optional)	—	—	dɪpˀ/—
Surface Representation			

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration ($p \rightarrow p^h$ / [$_\sigma$ '____)	p^hɪt	—	—
No Release ($p \rightarrow p^\urcorner$ / ____#) (Optional)	—	—	dɪp$^\urcorner$/—
Surface Representation	[p^hɪt]		

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration (p → pʰ / [$_\sigma$ ′____)	pʰɪt	—	—
No Release (p → pˀ / ____#) (Optional)	—	—	dɪpˀ/—
Surface Representation	[pʰɪt]	[spɪt]	

Underlying Representation	/pɪt/	/spɪt/	/dɪp/
Aspiration (p → pʰ / [$_\sigma$ '____)	pʰɪt	—	—
No Release (p → pˀ / ____#) (Optional)	—	—	dɪpˀ/—
Surface Representation	[pʰɪt]	[spɪt]	[dɪpˀ]/[dɪp]

- Look at this list of words from Korean:

[koːɾi]	'distance'	[talda]	'sweet'
[ɔːlmana]	'how much'	[noɾɛ]	'song'
[puɾida]	'to use'	[sɔlhwa]	'legend'
[pulgogi]	'barbecued meat'	[saɾam]	'person'
[tal]	'moon'	[iɾɯm]	'name'
[kɯːɾida]	'to draw'	[sul]	'water'

- Look at this list of words from Korean:

[kɔːɾi]	'distance'	[tɑldɑ]	'sweet'
[ɔːlmɑnɑ]	'how much'	[noɾɛ]	'song'
[puɾidɑ]	'to use'	[sɔlhwɑ]	'legend'
[pulgogi]	'barbecued meat'	[sɑɾɑm]	'person'
[tɑl]	'moon'	[iɾɯm]	'name'
[kɯːɾidɑ]	'to draw'	[sul]	'water'

- Are [ɾ] and [l] allophones or phonemes?

Step 1: Look for minimal pairs

[kɔːɾi]	'distance'	[tɑldɑ]	'sweet'
[ɔːlmɑnɑ]	'how much'	[noɾɛ]	'song'
[puɾidɑ]	'to use'	[sɔlhwɑ]	'legend'
[pulɡoɡi]	'barbecued meat'	[sɑɾɑm]	'person'
[tɑl]	'moon'	[iɾɯm]	'name'
[kɯːɾidɑ]	'to draw'	[sul]	'water'

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[tal]	'moon'	[iɾɯm]	'name'
[kɯːɾida]	'to draw'	[sul]	'water'

- No minimal pairs, so we can assume that do not belong to the same underlying phoneme.

Step 1: Look for minimal pairs

[kɔːɾi]	'distance'	[talda]	'sweet'
[ɔːlmana]	'how much'	[noɾɛ]	'song'
[puɾida]	'to use'	[sɔlhwa]	'legend'
[pulgogi]	'barbecued meat'	[saɾam]	'person'
[tal]	'moon'	[iɾɯm]	'name'
[kɯːɾida]	'to draw'	[sul]	'water'

- No minimal pairs, so we can assume that do not belong to the same underlying phoneme.

- Probably two allophones of a single phoneme if in complementary distribution (since they are phonetically similar sounds – both voiced alveolar sounds)

Step 2: Organize the forms by alternant

	[l]			[ɾ]	
ta	l	da	kɔː	ɾ	i
ɔː	l	mana	no	ɾ	ɛ
sɔ	l	hwa	pu	ɾ	ida
pu	l	gogi	sa	ɾ	am
ta	l	#	i	ɾ	ɯm
su	l	#	kɯː	ɾ	ida

Step 2: Organize the forms by alternant

	[l]			[ɾ]	
ta	l	da	kɔː	ɾ	i
ɔː	l	mana	no	ɾ	ɛ
sɔ	l	hwa	pu	ɾ	ida
pu	l	gogi	sa	ɾ	am
ta	l	#	i	ɾ	ɯm
su	l	#	kɯː	ɾ	ida

- Are [ɾ] and [l] in complementary distribution?

Step 2: Organize the forms by alternant

	[l]			[ɾ]	
ta	l	da	kɔː	ɾ	i
ɔː	l	mana	no	ɾ	ɛ
sɔ	l	hwa	pu	ɾ	ida
pu	l	gogi	sa	ɾ	am
ta	l	#	i	ɾ	ɯm
su	l	#	kɯː	ɾ	ida

- Are [ɾ] and [l] in complementary distribution? Yes!

Step 3: Identify the conditioning environment

	[l]			[ɾ]	
ta	l	da	kɔː	ɾ	i
ɔː	l	mana	no	ɾ	ɛ
sɔ	l	hwa	pu	ɾ	ida
pu	l	gogi	sa	ɾ	am
ta	l	#	i	ɾ	ɯm
su	l	#	kɯː	ɾ	ida

Step 3: Identify the conditioning environment

	[l]				[ɾ]	
ta	l	da		kɔː	ɾ	i
ɔː	l	mana		no	ɾ	ɛ
sɔ	l	hwa		pu	ɾ	ida
pu	l	gogi		sa	ɾ	am
ta	l	#		i	ɾ	ɯm
su	l	#		kɯː	ɾ	ida

- [ɾ] only occurs **before a vowel**

Step 3: Identify the conditioning environment

	[l]			[ɾ]	
ta	l	da	kɔː	ɾ	i
ɔː	l	mana	no	ɾ	ɛ
sɔ	l	hwa	pu	ɾ	ida
pu	l	gogi	sa	ɾ	am
ta	l	#	i	ɾ	ɯm
su	l	#	kɯː	ɾ	ida

- [ɾ] only occurs **before a vowel**

- [l] occurs **everywhere else** (before oral and nasal stops [d, m], fricatives [h] and word boundaries #)

Step 4: determine the underlying representation.
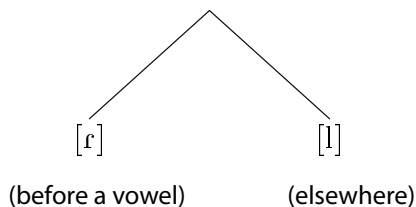
[ɾ]   [l]

(before a vowel)   (elsewhere)

Step 4: determine the underlying representation.

$$[\text{ɾ}] \qquad\qquad [\text{l}]$$

(before a vowel)   (elsewhere)
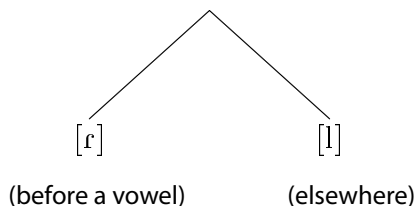
- Usually, we select the allophone with the more general distribution as the underlying phoneme.

Step 4: determine the underlying representation.
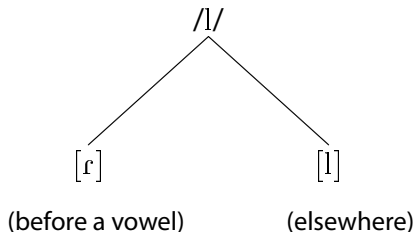
$$/l/$$

[ɾ]   [l]

(before a vowel)   (elsewhere)

- Usually, we select the allophone with the more general distribution as the underlying phoneme.

Step 5: Write the rule and check that it applies.

What is the rule that ensures we have [ɾ] before vowels in Korean?

Step 5: Write the rule and check that it applies.

/l/ →

What is the rule that ensures we have [ɾ] before vowels in Korean?

Step 5: Write the rule and check that it applies.

$$/l/ \;\rightarrow\; \left[\text{ɾ} \right]$$

What is the rule that ensures we have $\left[\text{ɾ} \right]$ before vowels in Korean?

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [\text{ɾ}] \ / \ \_\_ \ V(owel)$$

What is the rule that ensures we have [ɾ] before vowels in Korean?

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow \left[\, \mathfrak{r} \, \right] \, / \, \underline{\quad} \, V$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V		
SR		

UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V		
SR		

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [ɾ] \ / \ \_\_ \ V$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V	—	
SR		

UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V		
SR		

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [\text{ɾ}] \; / \; \underline{\quad} \; V$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V	—	
SR	[sul]	

UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V		
SR		

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [ɾ] \; / \; \underline{\quad} \; V$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V	—	saɾam
SR	[sul]	

UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V		
SR		

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [ɾ] / \_\_\_ V$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V	—	saɾam
SR	[sul]	[saɾam]
UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V		
SR		

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [ɾ] / \_\_\_ V$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V	—	saɾam
SR	[sul]	[saɾam]
UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V	—	
SR		

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [ɾ] / \_\_\_ \text{ V}$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V	—	saɾam
SR	[sul]	[saɾam]
UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V	—	
SR	[pulgogi]	

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [ɾ] / \_\_\_ V$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V	—	saɾam
SR	[sul]	[saɾam]

UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V	—	puɾida
SR	[pulgogi]	

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [ɾ] / \_\_\_ V$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V	—	saɾam
SR	[sul]	[saɾam]
UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V	—	puɾida
SR	[pulgogi]	[puɾida]

Step 5: Write the rule and check that it applies.

$$/l/ \rightarrow [ɾ] / \_\_ V$$

UR	/sul/	/salam/
/l/ → [ɾ] / ___ V	—	saɾam
SR	[sul]	[saɾam]
UR	/pulgogi/	/pulida/
/l/ → [ɾ] / ___ V	—	puɾida
SR	[pulgogi]	[puɾida]

Even though [l] and [ɾ] are not allophones of the same underlying phoneme in English, they are in Korean!

Here is some data from Eastern Inuktitut:

[aniguvit]	'if you leave'	[iglumit]	'from a house'
[ukiaq]	'late fall'	[pinna]	'that one up there'
[ani]	'female's brother'	[iglu]	'(snow)house'
[aiviq]	'walrus'	[panna]	'that place up there'
[aglu]	'seal's breathing hole'	[ini]	'place, spot'
[aivuq]	'she goes home'	[ukiuq]	'winter'
[iglumut]	'to a house'	[anigavit]	'because you leave'

Here is some data from Eastern Inuktitut:

[aniguvit]	'if you leave'	[iglumit]	'from a house'
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[aglu]	'seal's breathing hole'	[ini]	'place, spot'
[aivuq]	'she goes home'	[ukiuq]	'winter'
[iglumut]	'to a house'	[anigavit]	'because you leave'

Are the vowels [i], [a] and [u] phonemes or allophones?

We can arrange the data into minimal pairs:

[iglum**u**t]	'to a house'	[iglum**i**t]	'from a house'
[p**a**nna]	'that place up there'	[p**i**nna]	'that one up there'
[**a**ni]	'female's brother'	[**i**ni]	'place, spot'
[uki**a**q]	'late fall'	[uki**u**q]	'winter'
[**a**glu]	'seal's breathing hole'	[**i**glu]	'(snow)house'
[aiv**u**q]	'she goes home'	[aiv**i**q]	'walrus'
[anig**u**vit]	'if you leave'	[anig**a**vit]	'because you leave'

We can arrange the data into minimal pairs:

[iglum**ut**]	'to a house'	[iglum**it**]	'from a house'
[p**a**nna]	'that place up there'	[p**i**nna]	'that one up there'
[**a**ni]	'female's brother'	[**i**ni]	'place, spot'
[uki**aq**]	'late fall'	[uki**u**q]	'winter'
[**a**glu]	'seal's breathing hole'	[**i**glu]	'(snow)house'
[aiv**u**q]	'she goes home'	[aiv**i**q]	'walrus'
[anig**u**vit]	'if you leave'	[anig**a**vit]	'because you leave'

They are all phonemes: /a/, /i/, /u/

Consider these Spanish data:

[d̪rama]	'drama'	[kaða]	'each'
[sentiðo]	'felt'	[fiðel]	'Fidel'
[d̪aɾ]	'to give'	[d̪exo]	'I leave'
[oðio]	'hatred'	[nuðo]	'knot'
[estuðiante]	'student'	[d̪os]	'two'
[d̪ond̪e]	'where'	[eðað]	'age'

Consider these Spanish data:

[d̪rama]	'drama'	[kaða]	'each'
[sentiðo]	'felt'	[fiðel]	'Fidel'
[d̪aɾ]	'to give'	[d̪exo]	'I leave'
[oðio]	'hatred'	[nuðo]	'knot'
[estuðiante]	'student'	[d̪os]	'two'
[d̪ond̪e]	'where'	[eðað]	'age'

Are [d̪] and [ð] phonemes or allophones?

[d]		[ð]	
[d̪rama]	'drama'	[senti̪ðo]	'felt'
[d̪exo]	'I leave'	[fiðel]	'Fidel'
[d̪ar]	'to give'	[kaða]	'each'
[d̪os]	'two'	[nuðo]	'knot'
[d̪ond̪e]	'where'	[eðað]	'age'
		[oðio]	'hatred'
		[estuðiante]	'student'

[d]		[ð]	
[d̺rama]	'drama'	[senti̺ðo]	'felt'
[d̺exo]	'I leave'	[fiðel]	'Fidel'
[d̺ar]	'to give'	[kaða]	'each'
[d̺os]	'two'	[nuðo]	'knot'
[d̺ond̺e]	'where'	[eðað]	'age'
		[oðio]	'hatred'
		[estuðiante]	'student'

[d̺] and [ð] are allophones.

[d]		[ð]	
[d̪rama]	'drama'	[sentiðo]	'felt'
[d̪exo]	'I leave'	[fiðel]	'Fidel'
[d̪ar]	'to give'	[kaða]	'each'
[d̪os]	'two'	[nuðo]	'knot'
[d̪ond̪e]	'where'	[eðað]	'age'
		[oðio]	'hatred'
		[estuðiante]	'student'

[d̪] and [ð] are allophones.

Conditioning environment: [ð] after a vowel, [d̪] occurs everywhere else

$$
\overbrace{\begin{array}{cc}
\begin{array}{c}
[\eth] \\
\left(\begin{array}{c} \text{after a} \\ \text{vowel} \end{array}\right)
\end{array}
&
\begin{array}{c}
[\d{d}] \\
\left(\begin{array}{c} \text{everywhere} \\ \text{else} \end{array}\right)
\end{array}
\end{array}}
$$

/d̪/

[ð]
$\begin{pmatrix} \text{after a} \\ \text{vowel} \end{pmatrix}$

[d̪]
$\begin{pmatrix} \text{everywhere} \\ \text{else} \end{pmatrix}$

/d̪/

[ð]
$\begin{pmatrix} \text{after a} \\ \text{vowel} \end{pmatrix}$

[d̪]
$\begin{pmatrix} \text{everywhere} \\ \text{else} \end{pmatrix}$
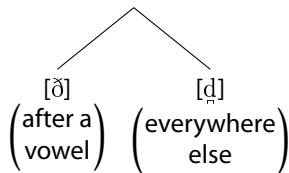
What's the rule?
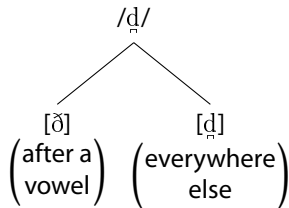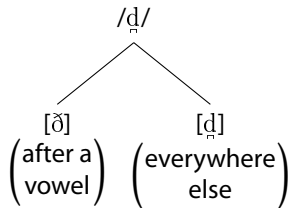
/d̪/
├── [ð̪]
│   (after a vowel)
└── [d̪]
    (everywhere else)
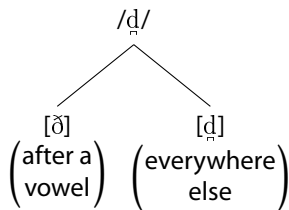
What's the rule?

$$/d̪/ \rightarrow [ð̪] \: / \: V\_\_\_$$

'A dental stop becomes a dental fricative after a vowel'