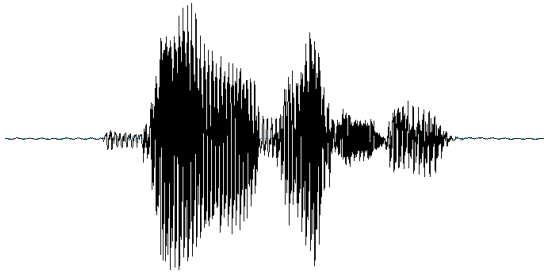
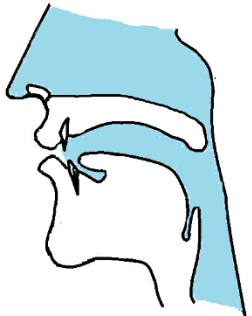


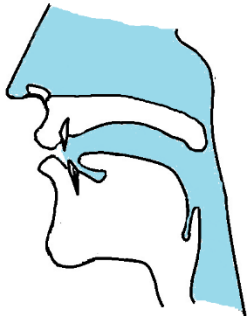
Unit 5

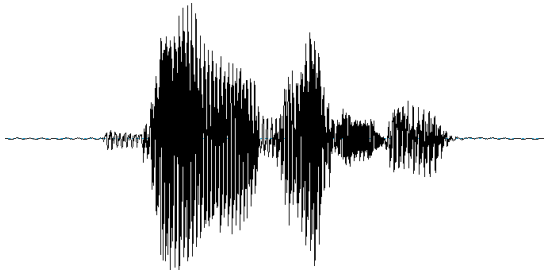
Phonology



What is Phonology?

It is a field of linguistics which studies the distribution of sounds in a language as well as the interaction between those different sounds.

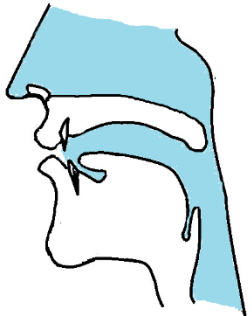


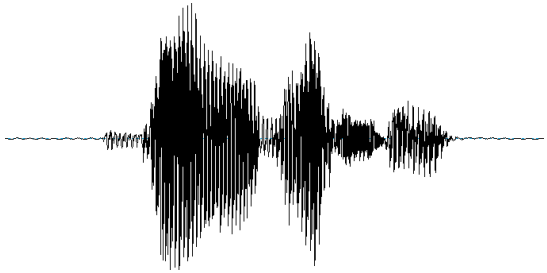


What is Phonology?

Phonology tackles the following questions:

- What are the predictable sounds in a language?
- What is the phonetic context?
- Which sounds affect the meaning of words?

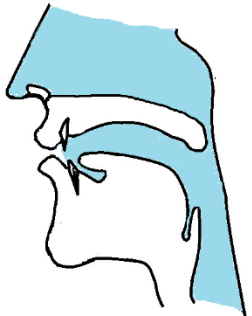




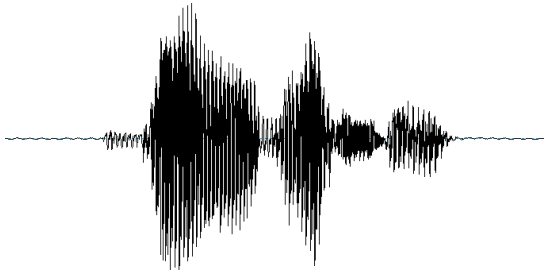
Phonetics Vs Phonology

- Phonetics: studies how speech sounds are produced, their physical properties & how they are interpreted.

- Phonology: studies the organization of speech sounds in a particular language.



Phonology and Phonetics



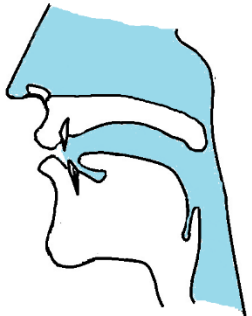
❑Rules studied by phonologists:

1)Phonetics - sounds *vary with their contexts*;

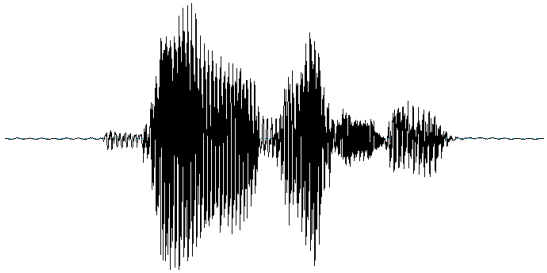
2)Phonology - hypothesizes rules to characterize this variation.

3)The *sequencing and distribution* of speech sounds

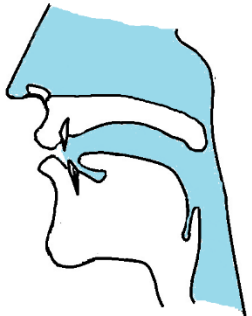
4)Phonology is *interfaced* with other components of the grammar (i.e. *morphology* and *syntax*).

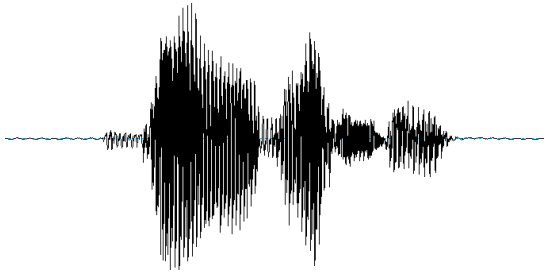


Goals of a phonemic analysis



- Produce a minimal set of phonemes for the language. It will be a set smaller than the set of phones.
- With the set of phonemes, every utterance can be analyzed phonetically.





Distinctive and Non-distinctive Sounds

- Distinctive (contrastive) Sounds: make a difference in meaning; e.g. /p/ & /b/ in pin, bin.

- Non-distinctive (non-contrastive) Sounds:

Do NOT make a difference in meaning; e.g. [p] in pin & spin.

Example:

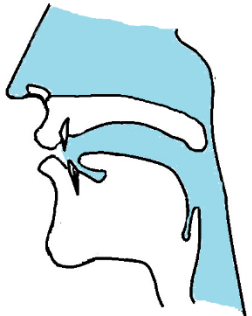
/t/ in : top [t^hɒp]

stop [stɒp]

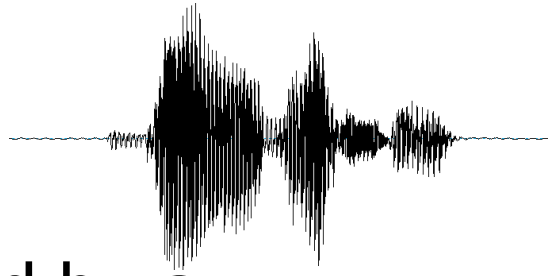
little [lir l]

kitten [kiʔ n] (n is syllabic here)

hunter [hʌ nr]

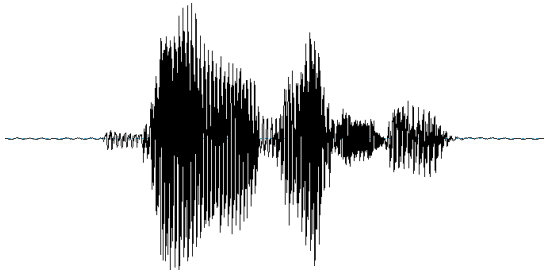


Phoneme and Allophone



- A phoneme: a class of speech sounds that are identified by a native speaker as the same sound; e.g. /t/; unpredictable (given "in" in pin like the example above we CANNOT predict which sound can come before it like tin, din, kin, gin, fin, thin, sin, shin, chin)
- A phoneme is an abstract representation & cannot be pronounced (it is not a speech sound)
- A phone: the actual phonetic segment produced by a speaker & has been classified as belonging to some phoneme; e.g. [t^h]; predictable
- An allophone: a variant of a phoneme, e.g. /t/ = [ʔ], [ɾ]

Phonology and Phonetics



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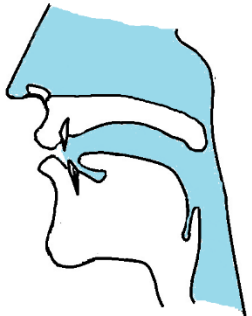
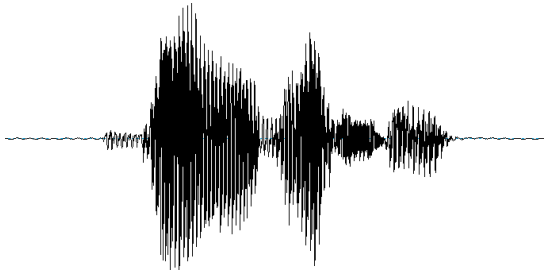
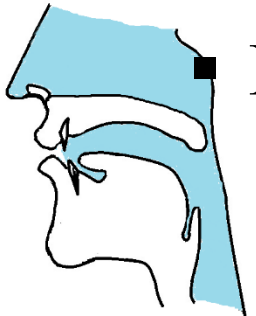


Distinctiveness and Contrast



- The real purpose of a speech sound is to sound ***different*** from the other sounds of the language.
- This is what makes a spoken vocabulary possible.
- To begin the analysis of a language's phonology, we locate all of its basic sounds.
- These basic speech sounds are the ***phonemes*** of the language.
- Languages vary in their *number* of phonemes.



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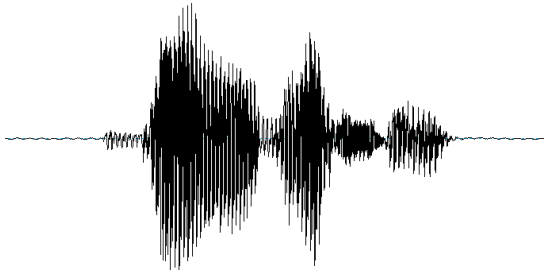


E.g. Low 11 ⟹ Rotokas (East Papuan, New Guinea)

High 160 ⟹ !Xóõ (Khoisan, Botswana/Namibia)

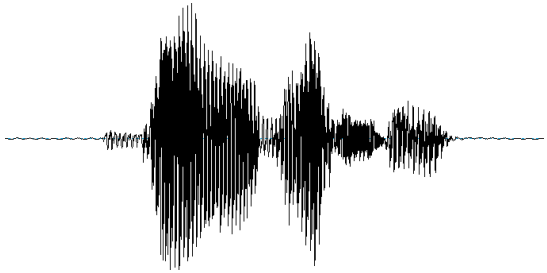
37 - 41 ⟹ English (depending on the dialect)

- If any two words of a language are pronounced differently, they must *differ in at least one phoneme*.

  E.g. *time* [**t**aɪm] vs. *dime* [**d**aɪm] ⟹ (minimal pairs)

- A ***minimal pair*** is the most effective way to show that two sounds are ***distinct phonemes***.

Distinctiveness and Contrast



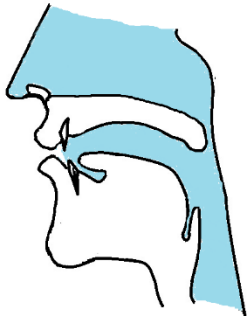
❑ Ways to say two sounds are separate phonemes:

1)Sounds /**t**/ and /**d**/ are in ***contrast***, or

2)They are ***phonemically distinct***, or

3)The difference between them is ***distinctive***.

- A set like *time* [**t**aɪm] – *dime* [**d**aɪm] – *lime* [**l**aɪm] is a minimal triplet.
- /t/, /d/, and /l/ are *distinct phonemes*.



Sounds that Do Not Contrast

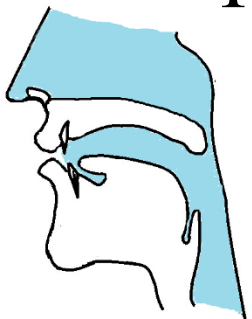
- In any language, there are many pairs of sounds that ***do not contrast***.

E.g. length of vowels in English:

save [seɪv] safe [sĕɪf] shorter

made [meɪd] mate [mĕɪt] shorter

- Although [eɪ] and [ĕɪ] are audibly different, they are not separate phonemes.
- They are in ***<u>complementary distribution</u>***.



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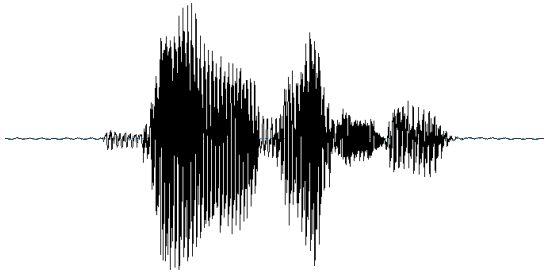
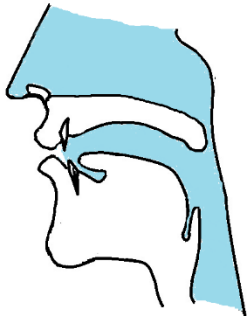
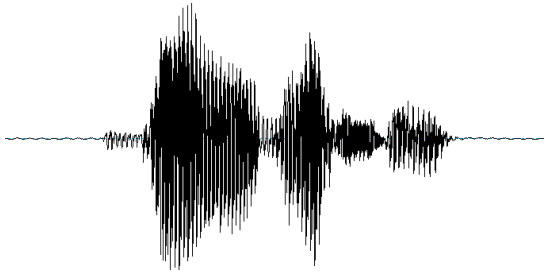


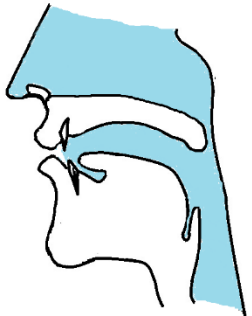
- Two sounds are said to be in ***complementary distribution*** if one sound never occurs in the environments in which the other occurs.
- [eɪ] occurs when next sound in the word is ***voiced***.
- [ĕɪ] occurs when next sound in the word is ***voiceless***.



Phonemes as Categories



- Speakers intuitively accept [eɪ] and [ĕɪ] as being the "*same vowel*."
- Phonologists hypothesize that sounds [eɪ] and [ĕɪ] form an abstract phonological ***categor***y, i.e. the ***phoneme*** /eɪ/.
- The concrete, observable sounds [eɪ] and [ĕɪ] are called the ***allophones*** of /eɪ/.



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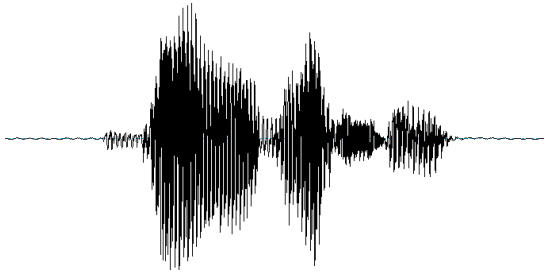


Abstract level: /eɪ/ — phoneme

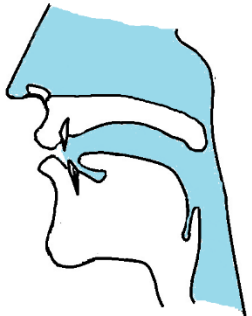
Concrete level: [eɪ] [ĕɪ] — allophones

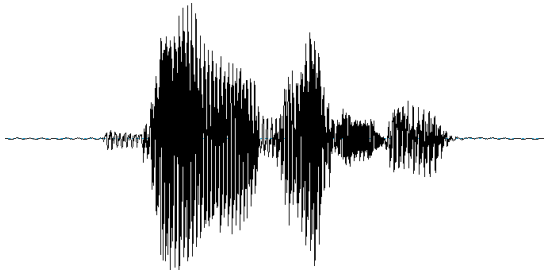
[eɪ]: used before voiced consonants

[ĕɪ]: used before voiceless consonants

environments for allophones

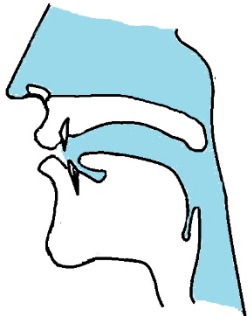
- ***Phonemes*** can be used to ***distinguish*** words from each other, but ***allophones cannot***.



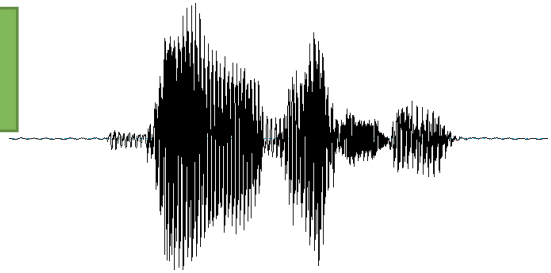


- E.g. **English**

alveolar [n]		**dental [n̪]**	
know	[ˈnoʊ]	tenth	[ˈtenn̪θ]
annoy	[əˈnɔɪ]	month	[ˈmʌnn̪θ]
onion	[ˈʌjən]	panther	[ˈpænn̪θɚ]



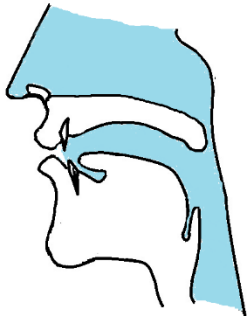
More Instances of Allophonic Variation



Abstract level: /n/ — phoneme

Concrete level: [n̥] [n] — allophones

used before [θ] — used elsewhere — environments for allophones



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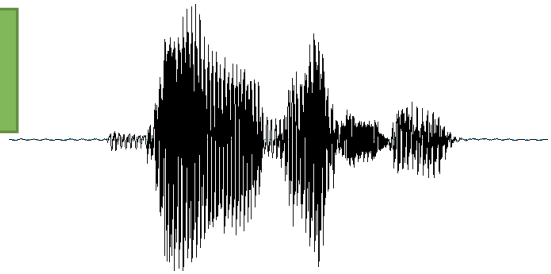
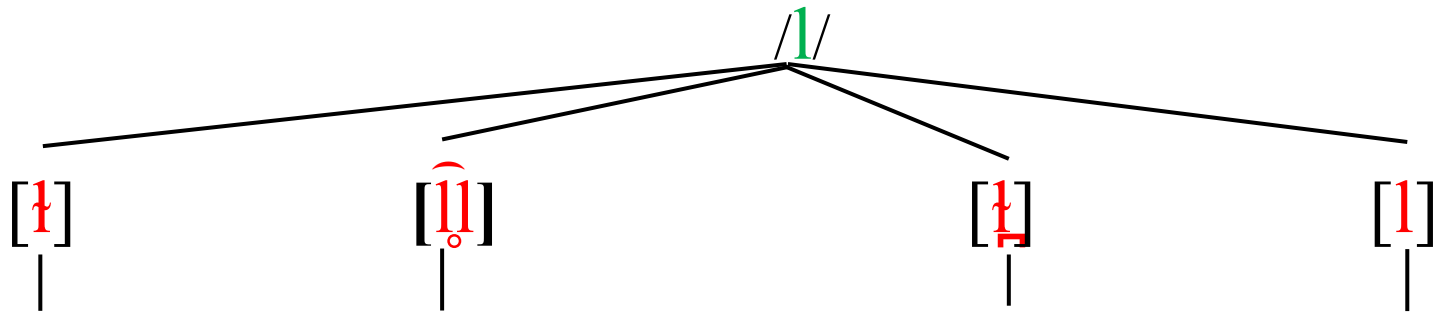
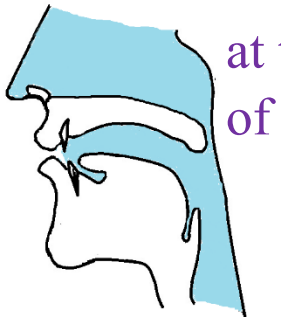


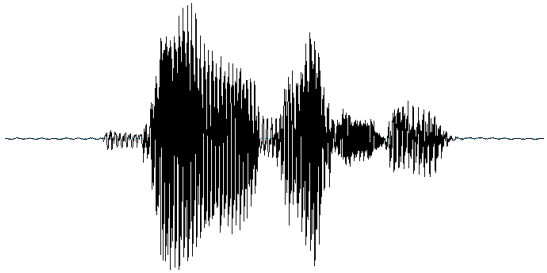
- E.g. **English** /l/

alveolar [ɫ]	**dental [l̪l]**	**Words with [ɫ̪]**	**Words with [l]**
file [ˈfaɪɫ]	slight [ˈs l̪laɪt]	wealth [ˈwɛɫ̪θ]	listen [ˈlɪsən]
fool [ˈfuɫ]	flight [ˈf l̪laɪt]	health [ˈhɛɫ̪θ]	lose [ˈluz]
all [ˈɔɫ]	plow [ˈp l̪laʊ]	filthy [ˈfɪɫ̪θi]	allow [ˈəlaʊ]

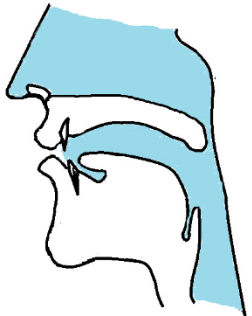




Phonemic Transcription



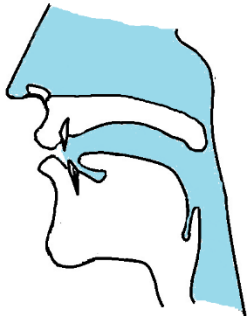
- **Phonemic transcription:** sequences of phonemes of the words recorded by the linguist.
- **Phonetic transcription** includes allophonic details.
- **Orthographic transcription:** words are written down using the customary spelling system (orthography) of the language.



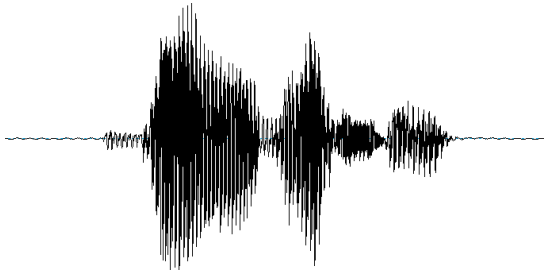
This is an orthographic transcription.

/ðɪs ɪz ə foʊˈnimɪk trænˈskɹɪpʃən/ (This is a *phonemic* transcription)

[ˈdn̪ðɪs ɨz ə fə̃ˈnɛɾɨʔk ʈʂʰɪ̃ɛ̃ə̃n̪ˈskɹɪpʃɨ̃n] (This is a *phonetic* transcription)



Phonological Rules

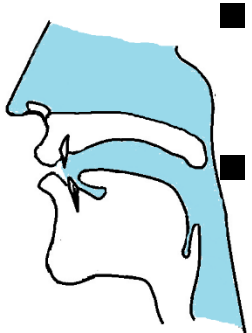


- Generalizations about the patterning of allophones can be stated as phonological rules.

e.g. /eɪ/ **Shortening**

The phoneme /eɪ/ is realized as extra short when a voiceless consonant follows.

- Rules are ***language-specific.***
- Rules are ***productive***. they extend to novel cases.



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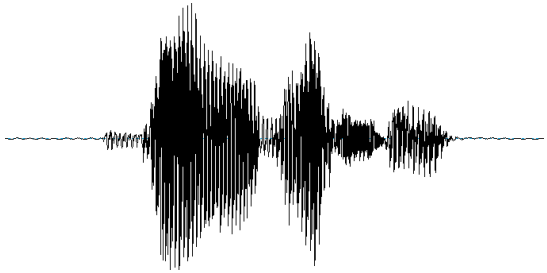
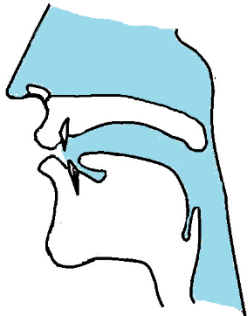
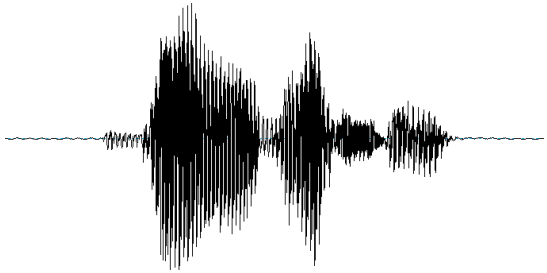


- Rules give rise to ***well-formedness intuitions***.
- Phonological rules are ***untaught***. they are learned intuitively by children from the ambient language data.
- Phonological rules are evidently a form of ***unconscious knowledge***.



Formalizing Phonological Rules



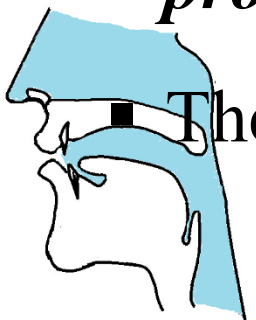
❑Expressing environments

- "/" ⟶ means "in the environment."
- "___" ⟶ where the allophone occurs relative to its neighbors.

E.g. / ___ θ ⟶ "in the environment 'before theta'" or "before theta."

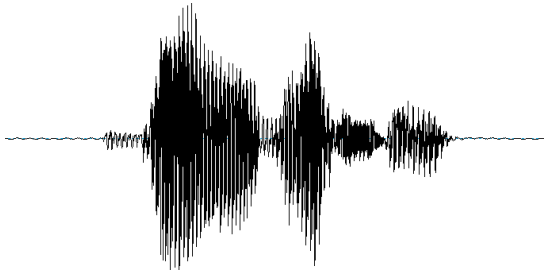
/ θ ___ ⟶ "after theta."

- [ ] ⟶ Used to describe ***classes*** containing particular ***phonetic properties.***



- These are called ***features,*** i.e. they designate the relevant class of sounds.

Formalizing Phonological Rules

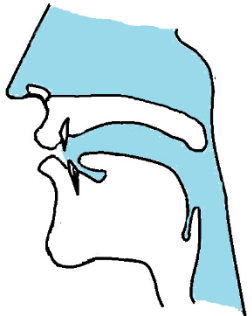


- "+" and "–" ⟶ before feature names to mean that a segment either ***has***, or ***does not have***, the ***phonetic property*** that a feature designates.

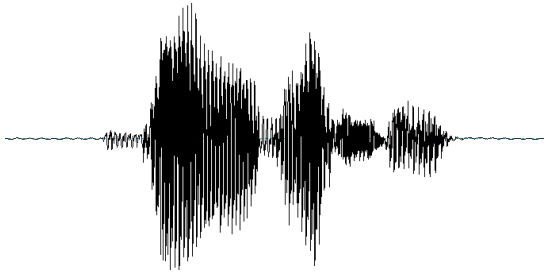
E.g. $\begin{bmatrix} +\text{consonant} \\ -\text{voice} \end{bmatrix}$

/ ____]word___ ⟶ "at the end of a word"

/ [word ____ ⟶ "At the beginning of a word"



Formalizing Phonological Rules



❑ Underlying representations and derivations

- **Underlying representation**: to characterize the phoneme by setting up an abstract level of representation.
- Also called the ***phonemic representation***, ***underlying form***, or ***base form***.

E.g. English phoneme /l/

❖ **/l/ Devoicing**

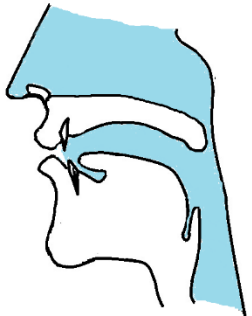
$$/l/ \rightarrow [l̥] / \begin{bmatrix} +\text{consonant} \\ -\text{voice} \end{bmatrix} ___$$

Partially devoice /l/ after a voiceless consonant.

❖ **/l/ Dentalization**

/l/ → [l̪] / ___ θ

/l/ is rendered as velarized and dental before [θ].

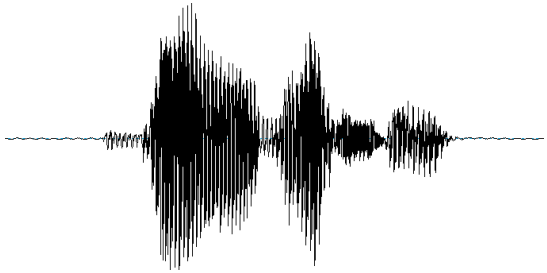


❖ **/l/ Velarization**

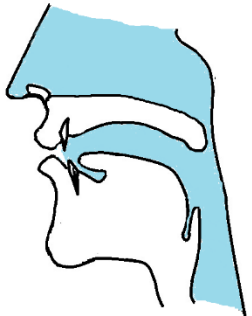
/l/ → [ɫ] / ___]word

/l/ is velarized word-finally.

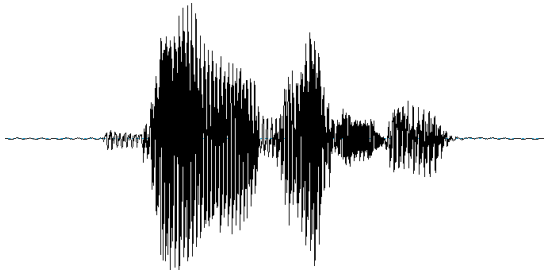
Formalizing Phonological Rules



- A **derivation** consists of a series of lines:
  - The ***first*** line contains the *underlying representations* of a set of forms.
  - The ***last*** line contains the *actual phonetic* forms; (often called ***surface representations).***
  - The ***intermediate*** lines show the *application of the rules* in order.
  - "—" is used to designate that a rule is ***inapplicable***.

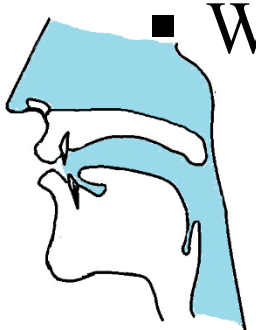


Formalizing Phonological Rules

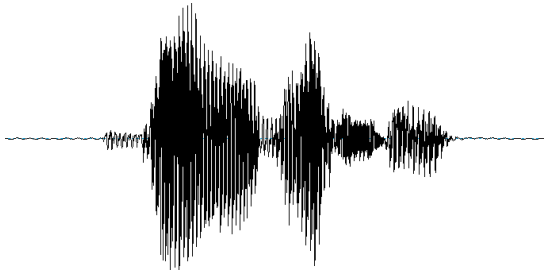


E.g.	file	slight	wealth	listen	
	/ˈfaɪl/ /	ˈslaɪt/	/ˈwɛlθ/	/ˈlɪsən/	underlying forms
	—	s l̥laɪt	—	—	/l/ Devoicing
	—	—	wɛɬθ	—	/l/ Dentalization
	faɪɬ	—	—	—	/l/ Velarization
	[ˈfaɪɬ]	[ˈs l̥laɪt]	[ˈwɛɬθ]	[ˈlɪsən]	surface forms

- We need not specify in this approach that [l] is the elsewhere allophone.

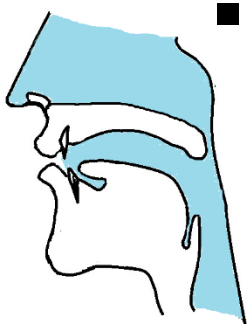


Phonemes in Other Languages



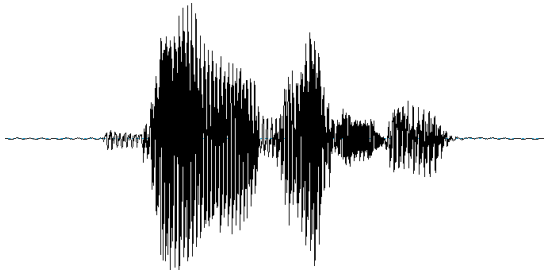
- **Maximally ordinary** phonemic system (Maddieson 1984):

p	t	tʃ	k	i	u
b	d	dʒ	g	e	o
f	s	ʃ		a	
m	n		ŋ		
		l			
		ɾ			
w		j			

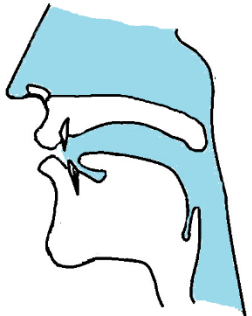


- This set constitutes all the sounds that occurred in at least **40** percent of the languages in Maddieson's (1984) survey of phonemic systems.

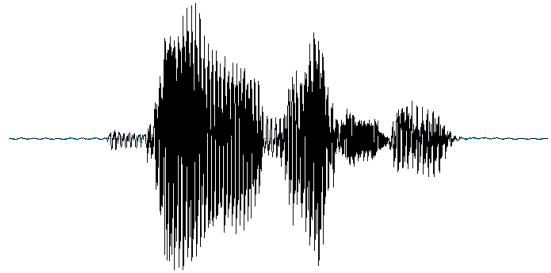
Phonemes in Other Languages



- Normally, an inventory will contain additional, more ***unusual sounds***.
- *Unusual sounds* often occur in multiple languages in the *same geographic area*.
- A ***phonemic*** distinction in one language might be ***allophonic*** in another, e.g. *English* and *Spanish*.



Phonemes in Other Languages



❑ **English:** North American English [ɾ] is an *allophone* of the /t/ *phoneme.*

- The environment for [ɾ] is between ***two vowels*** of which the second is ***stressless***.

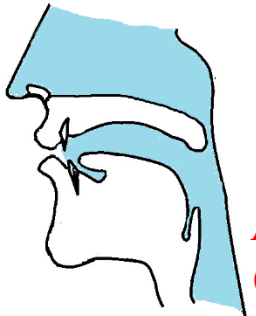
	Phonemic	Phonetic		Phonemic	Phonetic	
data	/ˈdeɪtə/	[ˈdeɪɾə]	tan	/ˈtæn/	[ˈtæn]	(fails to follow a syllabic sound)
latter	/ˈlætɚ/	[ˈlæɾɚ]	cat	/ˈkæt/	[ˈkæt]	(fails to precede a syllabic sound)
eating	/ˈitɪŋ/	[ˈiɾɪŋ]	attend	/əˈtɛnd/	[əˈtɛnd]	(following syllabic sound is stressed)

❖ **Tapping**

/t/ → [ɾ] / [+vowel] ___ [+vowel, -stress]

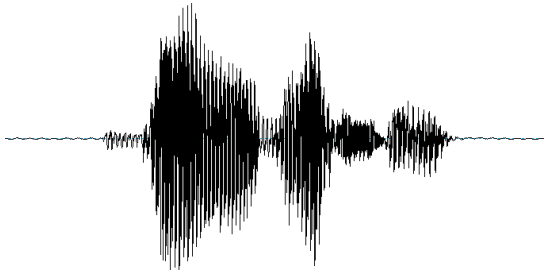
The phoneme /t/ is realized as [ɾ] when it is preceded by a vowel and followed by a stressless vowel.

Derivations:	data	tan	cat	attend	
	/ˈdeɪtə/	/ˈtæn/	/ˈkæt/	/əˈtɛnd/	underlying forms
	ɾ	—	—	—	Tapping
	[ˈdeɪɾə]	[ˈtæn]	[ˈkæt]	[əˈtɛnd]	surface forms



Assignment: where should aspiration be in the examples above?
Can the two allophonic rules 'aspiration' and 'tapping' occur together?

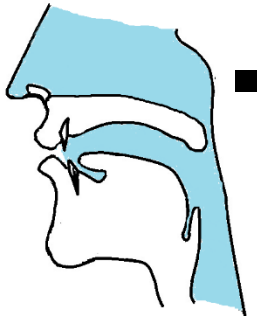
Phonemes in Other Languages



❑**Spanish**: /t/ and /ɾ/ are separate ***phonemes***.

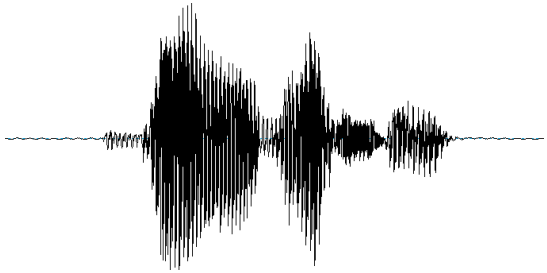
[ˈpita]	‘century plant’	Minimal pairs
[ˈpiɾa]	‘funeral pyre’	

- [t] and [ɾ] are in ***contrast***, and are separate phonemes.
- In **English:** [t] vs. [ɾ] difference is ***allophonic*** (non-distinctive).
- In **Spanish:** [t] vs. [ɾ] difference is ***phonemic*** (distinctive).



- English and Spanish are ***phonetically*** similar but ***phonologically*** different.

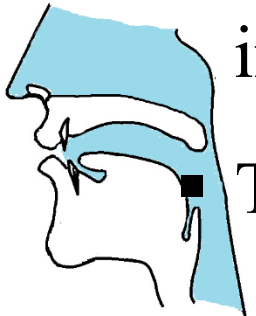
Phonemicization



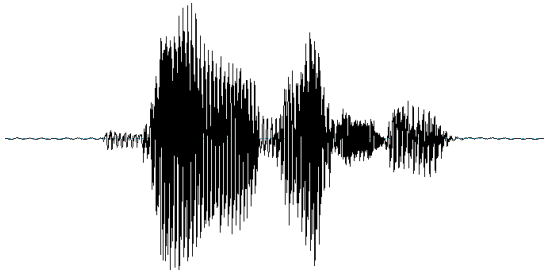
- ***Phonemicization*** is the body of knowledge and techniques that can be used to work out the phonemic system of a language.

❑Minimal pairs

- The most effective method in phonemicization is to look for ***minimal pairs.***
- **Minimal pairs** are two different words that differ in exactly ***one sound*** in the same location.
- The ***absence*** of a minimal pair does not prove much.



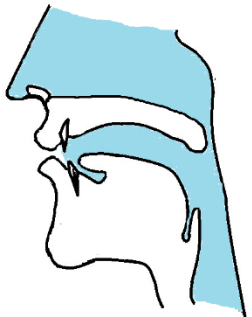
Phonemicization



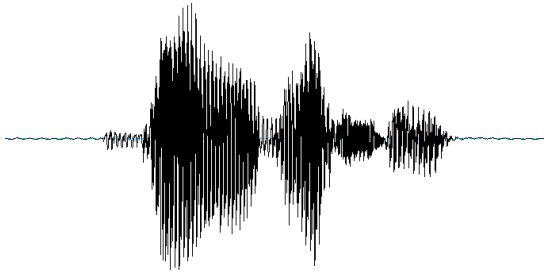
- A language will lack minimal pairs for a pair of relatively rare phonemes ***by accident***.

E.g.

heed [hid]		who'd [hud]
hid [hɪd]		hood [hʊd]
hayed [heɪd]		hoed [hoʊd
head [hɛd]	HUD [hʌd]	
had [hæd]	hod [hɑd]	hawed [hɔd]
hide [haɪd]	how'd [haʊd]	
heard [hɚd]		



Phonemicization

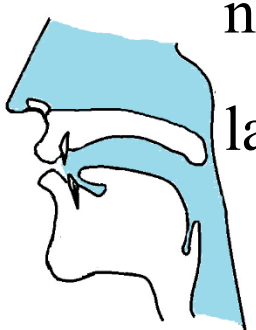


❑Near-minimal pairs

- There are cases in which it is impossible to find minimal pairs for a phoneme.
- This occurs in languages with *long words* and *large phoneme* inventories.
- **Near-minimal pairs** are pairs which would be minimal except for some evidently irrelevant difference.

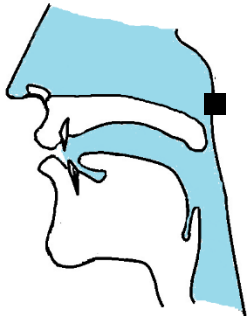
E.g. some near-minimal pairs for /ð/ vs. /ʒ/:

tether	[ˈtɛðɚ]	vs.	pleasure [ˈplɛʒɚ]
neither	[ˈniðɚ]	vs.	seizure [ˈsiʒɚ]
lather	[ˈlæðɚ]	vs.	azure [ˈæʒɚ]

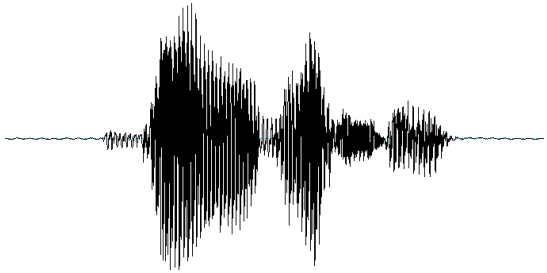


Phonemicization

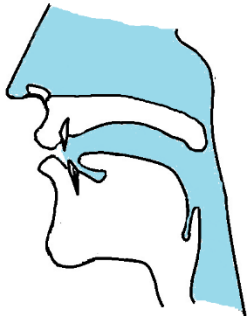
- The phonetic environment has nothing to do with whether [ð] or [ʒ] occurs.
- To find the rules that determine the appearance of [ð] vs. [ʒ] would have to make use of a completely arbitrary collection of "environments" for these phones.
- If the rules cannot be found, then an analysis that claims that [ð] and [ʒ] are allophones ***cannot*** be justified.
- ***Near-minimal pair*** method of establishing phonemes requires ***more*** work than minimal pairs do



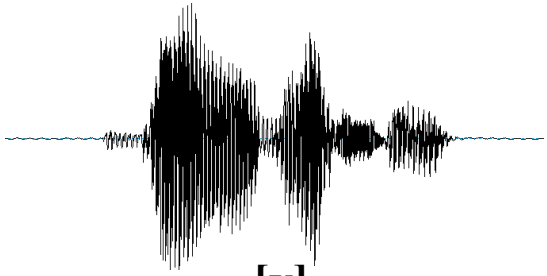
Using local environments to establish complementary distribution



- Minimal and near-minimal pairs are used to establish that two sounds belong to ***separate phonemes.***
- For establishing that two sounds are in the ***same phoneme***, we need to establish that they are in complementary distribution.
- It is useful to follow the method of ***compiling local environments***.
- **Compiling local environments**: for each sound, we construct a list of all its appearances, each time including the preceding segment, if any, and the following segment, if any.



Using local environments to establish complementary distribution



E.g. **Maasai** (Nilotic, spoken in Kenya and Tanzania)

1 [ɓarːiɣoi] ‘reddish brown’
2 [dĩɣai] ‘elsewhere’
3 [eŋgamaniɣi] ‘name of age-set’
4 [eŋgila] ‘garment-diminutive’
5 [eŋgoː] ‘advise him’
6 [eŋgoɣi] ‘sin’
7 [ilarak] ‘murderers’
8 [ilkeːk] ‘trees’
9 [imɓok] ‘you detain’
10 [imbaɣiβak] ‘you are restless’
11 [ijːoːk] ‘we’
12 [kaɣe] ‘but’
13 [keβer] ‘heaven’
14 [kiɓiroðo] ‘stunted’
15 [koɣoː] ‘grandmother’
16 [oldʊɣa] ‘shop’
17 [olkiɣuei] ‘thorn’
18 [olpurkel] ‘dry steppes’
19 [sarkin] ‘intermarriage

[k]

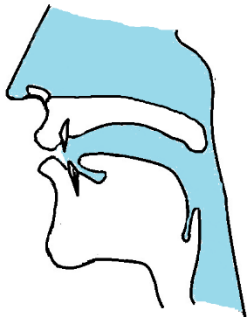
/ [word ___ a (12)
/ [word ___ e (13)
/ [word ___ i (14)
/ [word ___ o (15)
/ l ___ e (8)
/ l ___ i (17)
/ r ___ e (18)
/ r ___ i (19)
/ a ___]word (7, 10)
/ eː ___]word (8)
/ o ___]word (9)
/ oː ___]word (11)

[g]

/ ŋ ___ a (3)
/ ŋ ___ i (4)
/ ŋ ___ o (5)

[ɣ]

/ a ___ e (12)
/ a ___ i (10)
/ i ___ a (2)
/ i ___ i (3)
/ i ___ o (1)
/ i ___ u (17)
/ o ___ i (6)
/ o ___ oː (15)
/ u ___ a (16)



Using local environments to establish complementary distribution

- [k], [g] and [ɣ] are in ***complementary distribution***.
- The environments are:

[g] / ŋ ___
[ɣ] / V ___ V (V stands for any vowel)
[k] / elsewhere

❑ **phonological rules:**

❖ **/k/ Spirantization**

k → ɣ / [+vowel] ___ [+vowel]

/k/ is realized as [ɣ] *between vowels.*

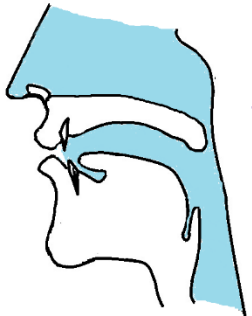
Postnasal Voicing

k → **g** / ŋ ___

/k/ is realized as [g] *after* [ŋ].

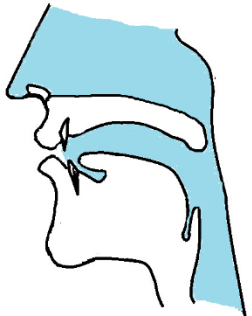
❑ **phonological derivations:**

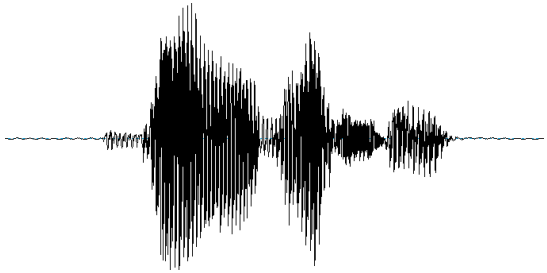
'grandmother'	'garment-dim.'	'trees'	
/ko**k**o:/	/eŋ**k**ila/	/il**k**e:k/	underlying forms
ɣ	—	—	/k/ Spirantization
—	g	—	Postnasal Voicing
[ko**ɣ**o:]	[eŋ**g**ila]	[ilke:k]	surface forms



What is Phonology?

It is a field of linguistics which studies the distribution of sounds in a language as well as the interaction between those different sounds.

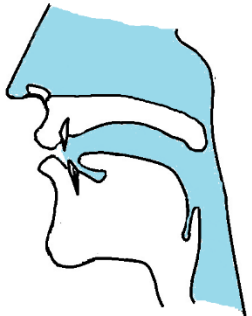


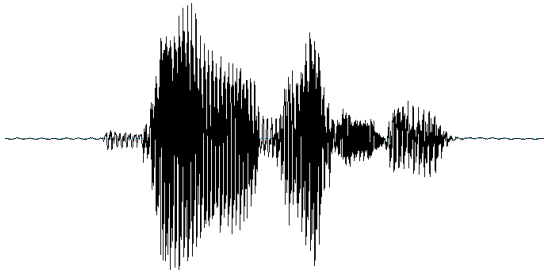


What is Phonology?

Phonology tackles the following questions:

- What are the predictable sounds in a language?
- What is the phonetic context?
- Which sounds affect the meaning of words?

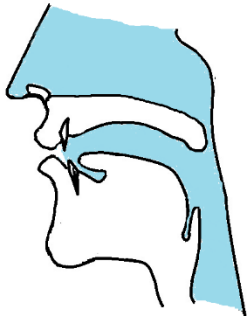




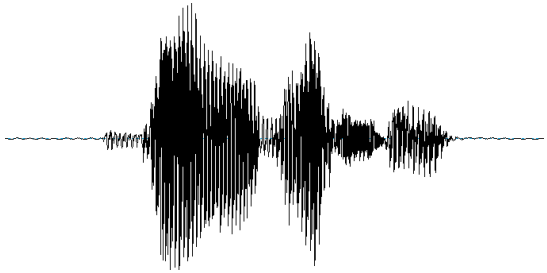
Phonetics Vs Phonology

- Phonetics: studies how speech sounds are produced, their physical properties & how they are interpreted.

- Phonology: studies the organization of speech sounds in a particular language.



Phonology and Phonetics



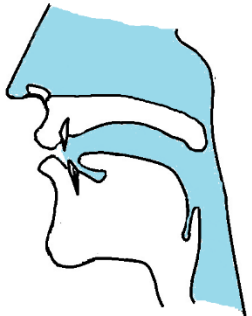
❑Rules studied by phonologists:

1)Phonetics - sounds *vary with their contexts*;

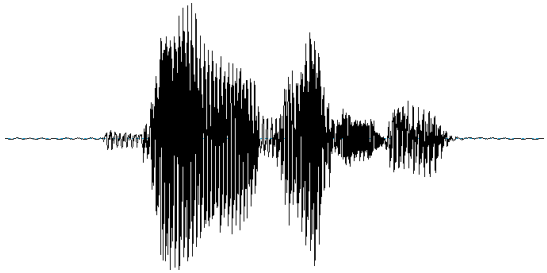
2)Phonology - hypothesizes rules to characterize this variation.

3)The *sequencing and distribution* of speech sounds

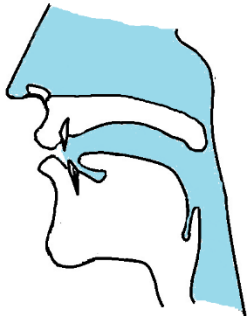
4)Phonology is *interfaced* with other components of the grammar (i.e. *morphology* and *syntax*).

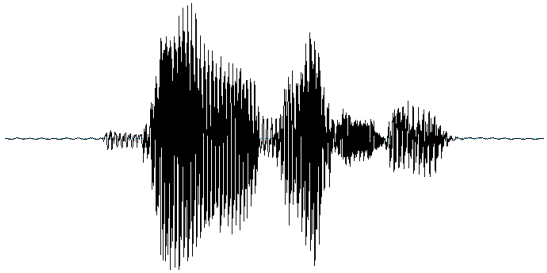


Goals of a phonemic analysis



- Produce a minimal set of phonemes for the language. It will be a set smaller than the set of phones.
- With the set of phonemes, every utterance can be analyzed phonetically.





Distinctive and Non-distinctive Sounds

- Distinctive (contrastive) Sounds: make a difference in meaning; e.g. /p/ & /b/ in pin, bin.

- Non-distinctive (non-contrastive) Sounds:

Do NOT make a difference in meaning; e.g. [p] in pin & spin.

Example:

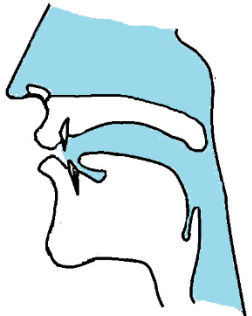
/t/ in : top [t^hɒp]

stop [stɒp]

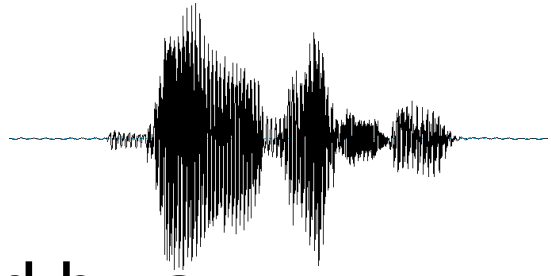
little [lir l]

kitten [kiʔ n] (n is syllabic here)

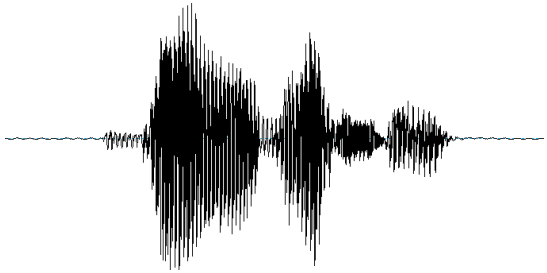
hunter [hʌ nr]



Phoneme and Allophone

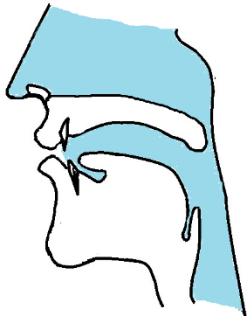


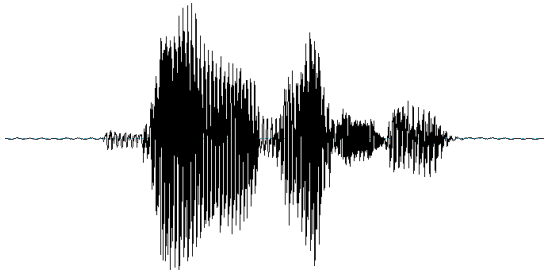
- A phoneme: a class of speech sounds that are identified by a native speaker as the same sound; e.g. /t/; unpredictable (given "in" in pin like the example above we CANNOT predict which sound can come before it like tin, din, kin, gin, fin, thin, sin, shin, chin)
- A phoneme is an abstract representation & cannot be pronounced (it is not a speech sound)
- A phone: the actual phonetic segment produced by a speaker & has been classified as belonging to some phoneme; e.g. [t^h]; predictable
- An allophone: a variant of a phoneme, e.g. /t/ = [ʔ], [ɾ]



Goals of a phonemic analysis

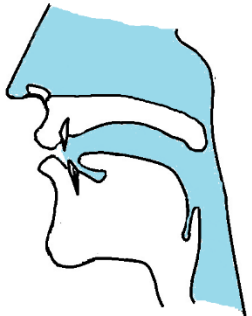
- Produce a minimal set of phonemes for the language. It will be a set smaller than the total number of sounds in that language
- With the set of phonemes, every utterance can be analyzed phonetically.

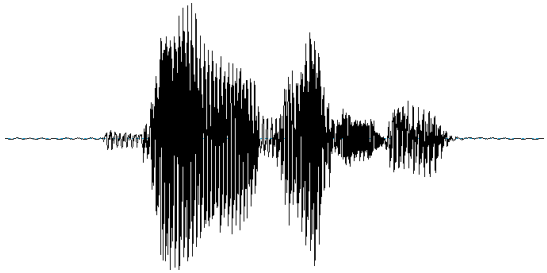




Allophonic rules

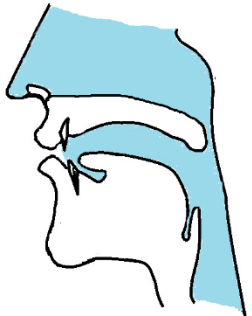
- The allophonic rules must be derived and they should show the realization of each phoneme in the phonetic context.
- We should be able to determine the phonemes behind the phones/ sounds of a language



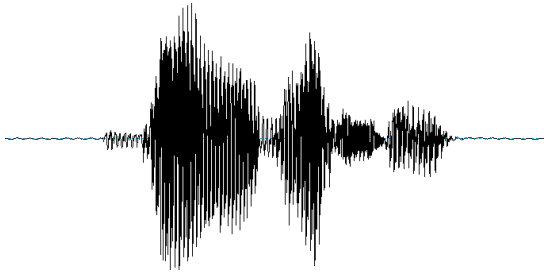


Allophonic rules

- For every pair of phones/sounds, we should be able to determine if they are the allophones of the same phoneme
- or if they are allophones of different phonemes.



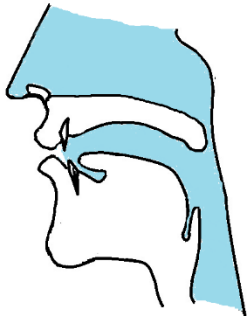
Conclusion

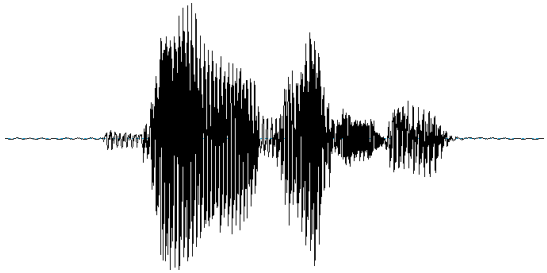


Allophonic rules

- Whether two sounds occur in *free variation*

- only one of the sounds occur - *complementary distribution:*

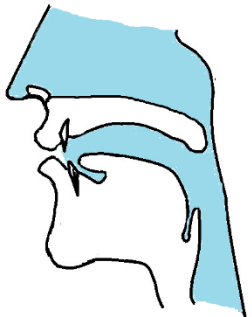


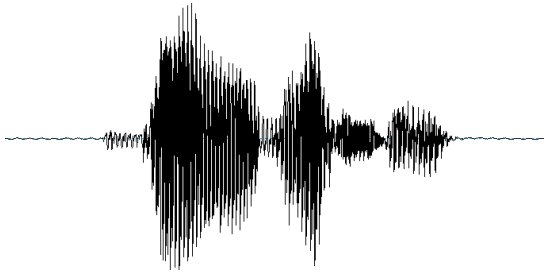


Complementary distribution

Two sounds are in complementary distribution

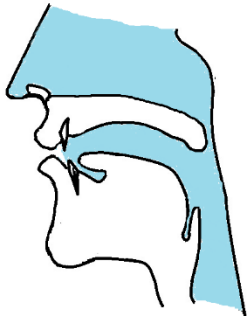
- if the contexts in which they occur do not overlap.
- **the allophones of a phoneme must be in free variation, or in complementary distribution, or both.**



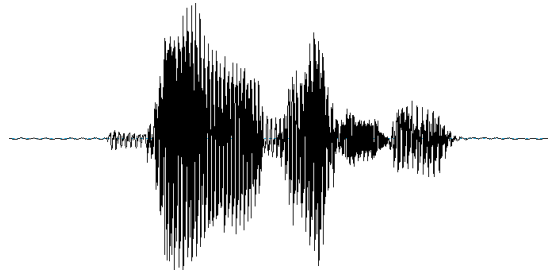


Contexts

- the analysis consists of organizing the *contexts* by seeing which sounds occur in which contexts.
- But the set of possible contexts are large.
- Start with the most general set of contexts and then refine it on the basis of the data.
- The immediate context (what immediately precedes and follows) is most likely to be relevant;
- The major sound categories and the boundaries: C, V, #, ||



Natural Classes



- A **natural class** of sounds is any complete set of sounds in a given language that share the same value for a feature or set of features.

E.g. /**m**/, /**n** /, and /**ŋ**/ in ***Maasai*** and in ***English*** form a natural class because they constitute the complete set of sounds that share the feature [+nasal].

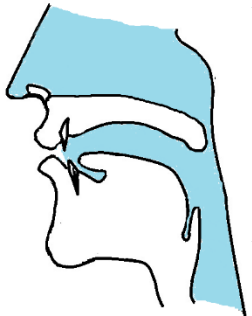
/**t** /, and /**k**/ form a natural class in ***Maasai*** and in ***English*** because they constitute the [+stop, −voiced] sounds of the language.

❑ Using features to write general rules:

❖ **Spirantization**

$$\begin{bmatrix} +\text{stop} \\ -\text{voice} \end{bmatrix} \longrightarrow \begin{bmatrix} +\text{voice} \\ -\text{stop} \\ +\text{fricative} \end{bmatrix} / \; [+\text{vowel}] ___ [+\text{vowel}]$$

A voiceless stop is realized as the corresponding voiced fricative when surrounded by vowels.

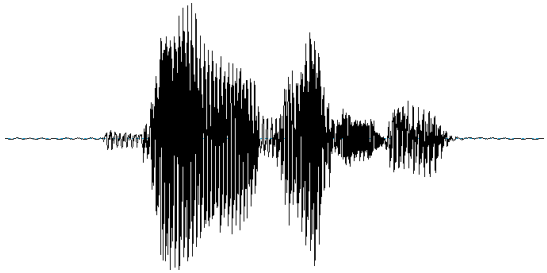


❖ **Post nasal voicing**

[+stop]⟶[+voice] / [+nasal] ___

A voiceless stop is realized as the corresponding voiced stop when it follows a nasal consonant.

Conclusion



- Phonological rules are based on phonetic features:

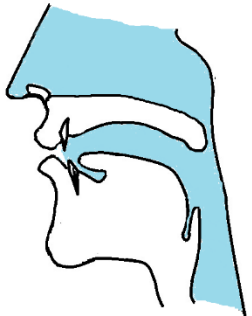
1) The *set of sounds a rule applies to* is a set of sounds that share a particular ***phonetic feature*** or set of ***features***.

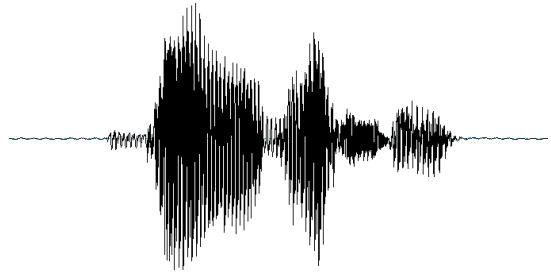
2) Rules often change only *one or two features* of a sound, rather than making massive alterations.

e.g. the rules of ***Maasai*** alter only ***voicing*** and the ***stop***/***fricative*** distinction.

3) The *sounds appearing in the environment of a rule* are almost always a set of sounds that share a particular ***phonetic feature*** or ***features.***

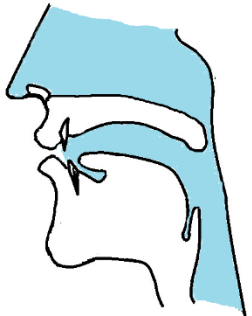
e.g. the rule of ***English*** that shortens vowels applies before the complete *set of consonants* in English [−voice].



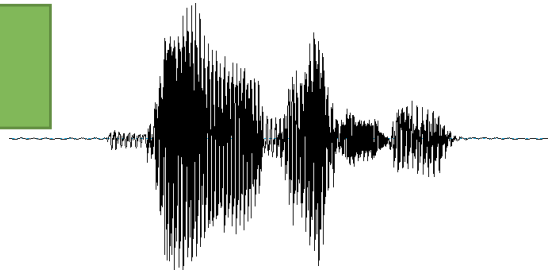


More on Phonemes

Bruce Hayes 2009



The Psychological Reality of the Phoneme



A. Audibility of fine distinctions

- ***Contrastiveness*** plays a major role in the perceptions of language users.
- When phonetically two sounds are heard by two different listeners A and B,
- For listener **A**, the two sounds are ***contrastive*** (distinguish words in her language).
- The two sounds also occur in listener **B**'s language, are ***not*** contrastive (***allophones***).
- **A** can hear the difference between the two sounds with perfect ease, but **B** has great difficulty.

E.g. **A** is a speaker of a dialect of ***Bengali***

(dental stops *contrast* with alveolar stops)

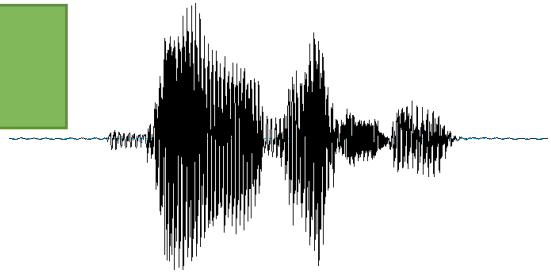
[t̪an] '(vocal) tune'	[tan] 'pull!'
[sat̪] 'seven'	[sat] 'sixty'
[d̪an] 'donation'	[dan] 'right (hand)'
[d̪in] 'day'	[dim] 'egg'

B is a speaker of a variety of ***American English***

(dentals occur as allophones of the alveolars, i.e. alveolars are replaced by dentals before dental fricatives)

/ eɪtθ/ [eɪt̪θ] eighth	/eɪt ðə/ [eɪt̪ ðə] ate the
/wʊd θɪŋk/ [wʊd̪ θɪŋk] would think	/sɛd ðɪs/ [sɛd̪ ðɪs] said this
/ tɛnθ/ [tɛn̪θ] tenth	/ɪn ðə/ [ɪn̪ ðə] in the

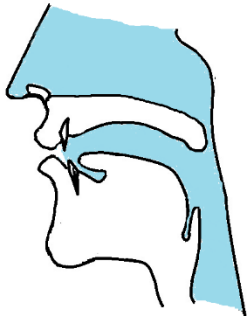
The Psychological Reality of the Phoneme



- Speaker **A** was ***unable*** to learn to hear the ***Bengali*** dental/alveolar distinction.
- Speakre's **A** inability to hear the dental/alveolar distinction is ***not*** due to a lack of experience with dentals.
- This is because Speaker's **A** native language ***does not*** have a ***phonemic contrast*** between alveolars and dentals.

❑ **To summarize:**

- Contrastiveness *of two phonetically similar sounds* leads speakers of the language that has the contrast to focus their perceptual attention on the ***contrasting sounds***, and *fail* to hear other ***distinctions***.
- Native speakers hear the differences between ***phonemes***, but ***not*** between ***allophones***.



The Psychological Reality of the Phoneme

B. The notion of "same sound"

- In **phonemic theory**: Groups of mutually ***non-distinctive*** sounds are grouped together into categories, i.e. the ***phonemes***.
- Speakers usually believe that two ***allophones*** of the same phoneme are the "same sound."

E.g. vowels in *ten* and *Ted*

In *ten*, the phoneme /ɛ/ occurs before a *nasal sound*.

❖ **Vowel Nasalization**

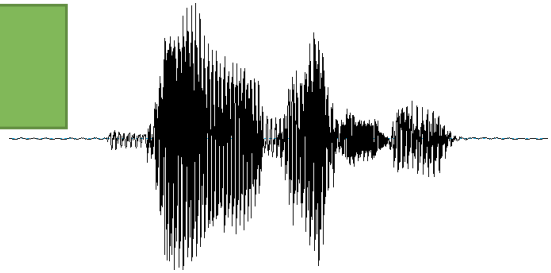
[+vowel] → [+nasal] / ___ [+nasal]

A vowel is realized as nasalized when it precedes a nasal consonant.

ten	Ted	
/tɛn/	/tɛd/	underlying forms
ɛ̃	—	Vowel Nasalization
[tɛ̃n]	[tɛd]	surface forms

- For ***English*** speakers, *ten* and *Ted* have "the ***same vowel***."

The Psychological Reality of the Phoneme



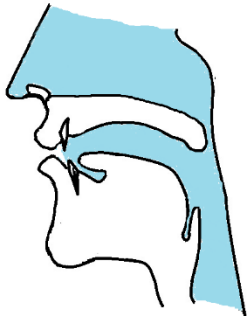
❑ Comparison with ***French*** speakers:

- In French, *nasal vowels* are ***phonemically*** distinct from *oral vowels*.

E.g. [mɛ] 'but' vs. [mɛ̃] 'hand'

[tʁɛ] 'very' vs. [tʁɛ̃] 'train'

- For ***French*** speakers, it is plain that [ɛ] and [ɛ̃] are ***different*** sounds.
- The difference between a ***French*** speaker and an ***English*** speaker is the ***phonemic structure*** of the two languages.
- Corresponding *nasal* and *oral* vowels in ***French*** count as ***different*** sounds because they are ***different phonemes***.
- They count as the ***same*** sound in ***English*** because they are ***allophones*** of the same phoneme.



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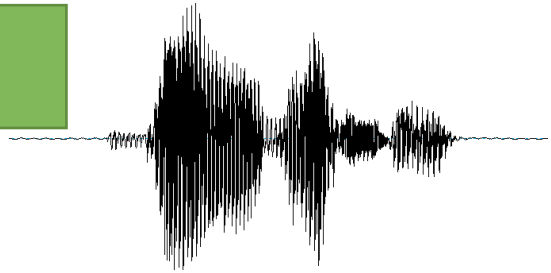
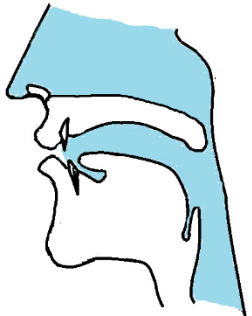


C. Foreign accents and transfer

- Speakers internalize rules that derive the various allophones in their appropriate environments.
- E.g. The behavior of speakers attempting to pronounce the sounds of a language ***new*** to them.
- A ***foreign accent*** persists even after years of practice with a second language (L2).
- The phenomenon of ***mispronunciations*** in a (***L2***) in ways attributable to the phonology of (***L1***) is called ***transfer***.
- **Transfer** is to consider a phonology as specifying the set of ***things that are pronounceable*** in a given language.
- This set consists of the ***legal sequences*** of *phonemes*, realized as the appropriate *allophones* for their context.



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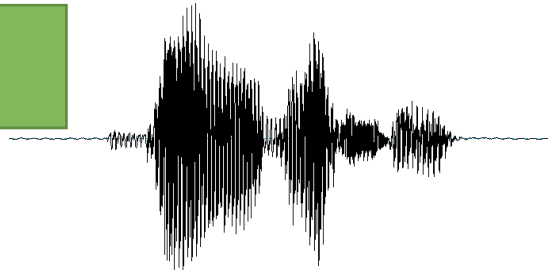


- Anything outside this ***set*** will involve one of three properties:

1) It can be phonologically illegal because it ***contains*** an ***illegal*** phoneme.

E.g. any utterance containing the voiced uvular fricative [ʁ] is ***illegal*** in English.

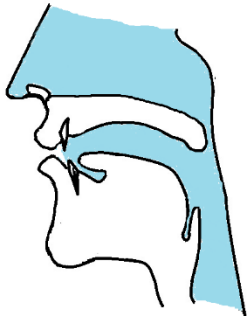
2) It can be phonologically illegal because it corresponds to an ***illegal sequence*** of phonemes.

E.g. English phonology does not permit the ***phonemes order*** in [bnɪk].

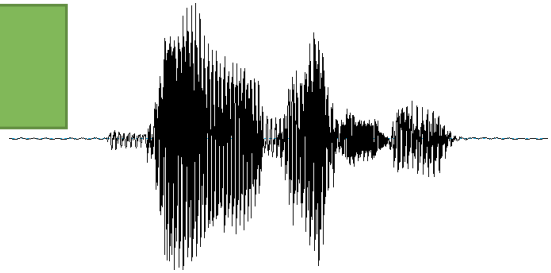
3) It can be phonologically illegal because it corresponds to an ***impossible distribution of allophones***.

E.g. [fil], with a ***non-velarized*** [l], is ***illegal*** in English.

- If a word of a foreign language is ***phonologically illegal*** in English, for any of the three reasons, it will not be pronounced correctly by English speakers.



The Psychological Reality of the Phoneme



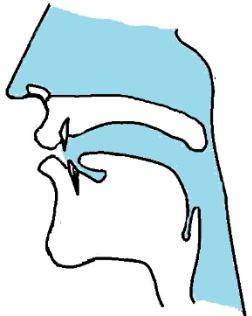
- E.g. French *tante* 'aunt' [t̪ɑ̃t] has a nasalized vowel alien to the English phoneme inventory.
- In an English accent, this comes out [tɑ̃ñt], where [ñ] is a particularly short [n].
- The **derivation**:

/tɑnt/ underlying form: choice of native phonemes

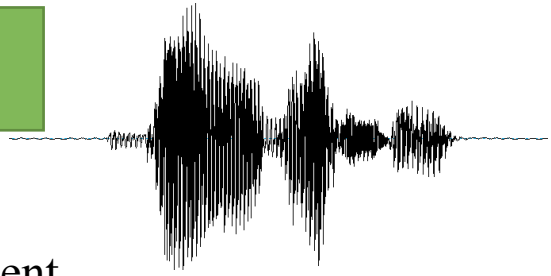
ɑ̃ Nasalization: [+vowel] → [+nasal] / ___ [+nasal]

ñ Nasal Consonant Shortening: $\begin{bmatrix}+\text{consonant}\\+\text{nasal}\end{bmatrix} \rightarrow [+\text{short}] / ___ \begin{bmatrix}+\text{consonant}\\-\text{voice}\end{bmatrix}$

[tɑ̃ñt] surface form



The Criterion of Phonetic Similarity



- In some cases, collecting and arranging the ***non-contrasting*** phonetic segments is insufficient.

E.g. [h] and [ŋ] in English.

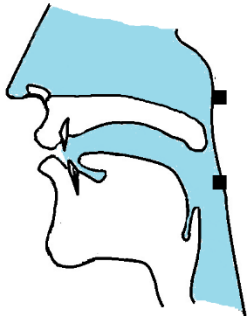
➢ [h] occurs at the *beginnings* of words and before *stressed vowels*.

hill [ˈhɪl]	ahead [əˈhɛd]
how [ˈhaʊ]	behold [biˈhold]

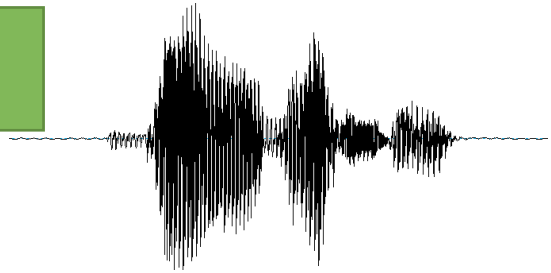
➢ The sound [ŋ] occurs at the ends of words, before consonants, and between vowels of which the second is stressless:

sing [ˈsɪŋ]	sink [ˈsɪŋk]	Singapore [ˈsɪŋəˌpɔɪ]
pang [ˈpæŋ]	anger [ˈæŋgɚ]	dinghy [ˈdiŋi]

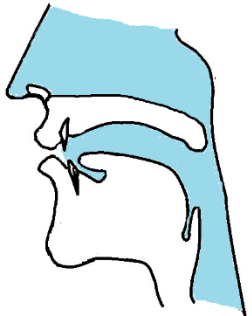
- There are no cases of [h] occurring at *ends* of words, or *before consonants*, or *between vowels* of which the second is *stressless*.
- Likewise, there are no cases of [ŋ] occurring at the *beginning* of a word, or *before a stressed vowel*.
- Therefore, [h] and [ŋ] ***do not contrast***.



The Criterion of Phonetic Similarity



- Since [h] and [ŋ] do not contrast, should we regard them as ***allophones*** of a single phoneme?
- Phonologists' traditional answer is ***no***, simply because:
- When two sounds are ***allophones*** of the same phoneme, they will be felt by native speakers as the ***same sound***.
- This is clearly not the case for [h] and [ŋ].
- Thus, the idea that phonemes can be established purely on *distributional grounds* is ***rejected***.



Other Problems in Phonemicization

A.Contour segments and the segment/sequence problem

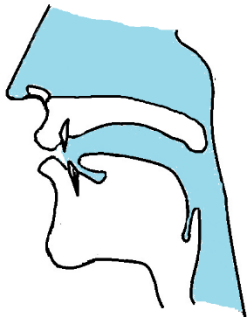
- Sounds like diphthongs ([a͡ɪ]), affricates ([t͡ʃ]), and prenasalized stops ([m͡b]) are often called ***contour segments***.
- They have two phonetic qualities in sequence, but are often treated phonologically as a ***single*** sound.
- Recognition of the contour segments is an analytic difficulty faced in phonemicization.

E.g. we need to decide whether [**ai**] should be treated as a ***diphthong*** or as a sequence of /**a**/ + /**i** /.

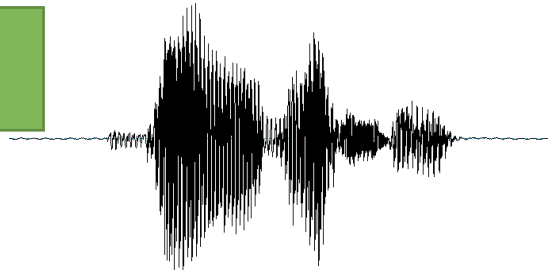
[**tʃ**] as an *affricate* [**t͡ʃ**], or /**t** / + /**ʃ**/

[**mb**, **nd**, **ŋg**] as *prenasalized stops* or *nasal* + *stop* sequences

- This analytical issue might be called the ***segment/sequence problem***.
- This problem is easy to solve if there is an actual ***contras***t between ***segment*** and ***sequence***.



Other Problems in Phonemicization

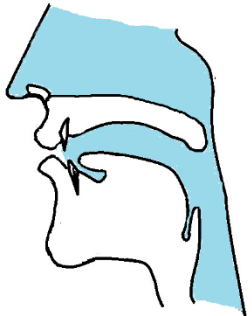


❑ Polish

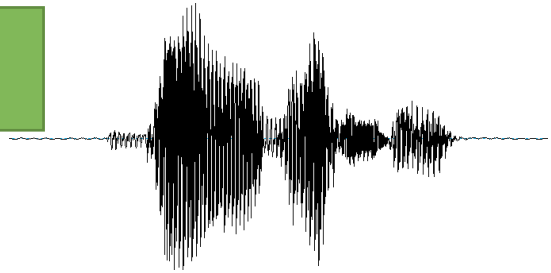
- [ʧ] as an *affricate* is uncontroversial because it contrasts with the *stop* + *fricative* sequence [tʃ].

[tʃɨ]	*trzy*	'three'
[ʧɨ]	*czy*	'if, whether'

- [ʧ] and [tʃ] are phonetically different ([tʃ] is longer than [ʧ]).
- The contrast between ***monosegmental*** /ʧ/ and ***bisegmental*** /tʃ/ could not be expressed.
- Thus the affricate [ʧ] must be analyzed as a ***single segmental unit*** in *Polish*.



Other Problems in Phonemicization

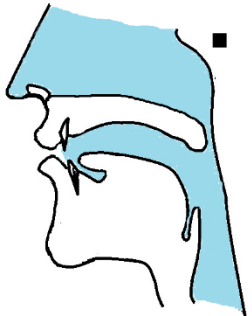


❑ Mandarin

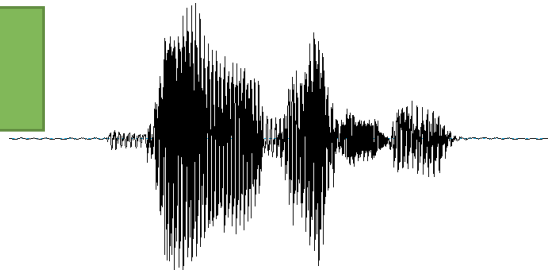
- Mandarin has the following sounds: [ə], [i], [u], [ei], and [ou].
- [e] and [o] never occur alone, but only as part of the diphthongs [ei] and [ou].
- One possible phonemicization is:

/ə/	/əi/	/əu/	/i/	/u/	underlying forms
—	ei	—	—	—	Vowel Assimilation I: ə → e / ___ i
—	—	ou	—	—	Vowel Assimilation II: ə → o / ___ u
[ə]	**[ei]**	**[ou]**	**[i]**	**[u]**	surface forms

- In this analysis we can get by with just ***three*** phonemes (/ə/, /i/, /u/) to derive ***five*** sounds.
- Since assimilation is a very common process in phonology, the rules make sense as ***assimilation*** rules.
- The vowel /ə/ is assimilated to [i] or [u] and become phonetically more similar to its neighbor.



Other Problems in Phonemicization

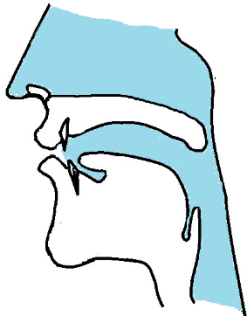


B. Borrowed sounds

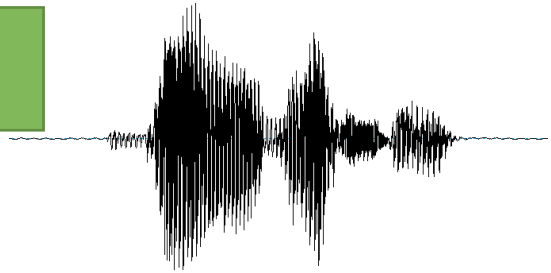
- When a ***borrowed*** sound is used for the very first time by a single speaker, it cannot count as a phoneme of the language.
- With time, borrowed words come to be used by larger numbers of speakers.
- Eventually, they are felt by native speakers to be an ***integral*** part of the language.
- The difficulty for phonological analysis is that the process is ***gradual***.

E.g. **Japanese**: the sound [ɸ] (voiceless bilabial fricative) was plainly an ***allophone*** of /**h**/.

- It occurred only in the environment / ___ **u**, and was in complementary distribution with [**h**].
- [**h**] occurred in most other environments and thus was the ***elsewhere*** allophone.
- Under the influence of English and other foreign languages, [ɸ] has extended its usage to be the usual way to approximate a foreign [**f**] sound.



Other Problems in Phonemicization



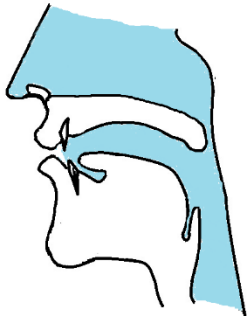
- Phonemicization for [ɸ] vs. [h]:

before /a/: [ɸaito] ‘fight’ vs. [haiku] ‘type of poetry’

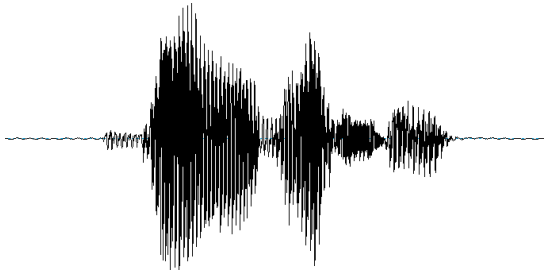
before /e/: [ɸeɾuto] ‘felt’ vs. [hema] ‘blunder’

before /o/: [ʃiɸoŋ] ‘chiffon’ vs. [hoŋ] ‘book’

- Considering the words in the left column to be authentic words in the vocabularies of innovating speakers,
- we must say that the dialect spoken by these speakers has acquired a ***new phoneme***.
- This simply after promoting [ɸ] from ***allophone*** to ***phoneme*** status.



Free Variation



- In phonology, free variation takes two forms:

1) the phenomenon of ***phonological doublets***: one word has two different phonemic forms.

E.g. in many people's speech, the word *envelope* can be pronounced as either [ˈɛnvəˌloʊp] or [ˈɑnvəˌloʊp].

- Phonological doublets have just ***one*** listing for their *syntactic* properties and *meaning*, but ***more*** than one ***phonemic representation*** (figure 1.).

Syntax: common noun

Meaning: "✉"

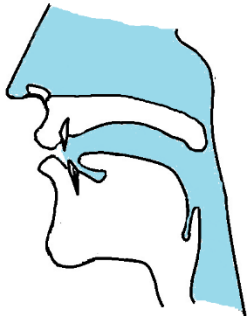
Phonemic forms: /ˈɛnvəˌloʊp/, /ˈɑnveˌloʊp/

Syntax: common noun

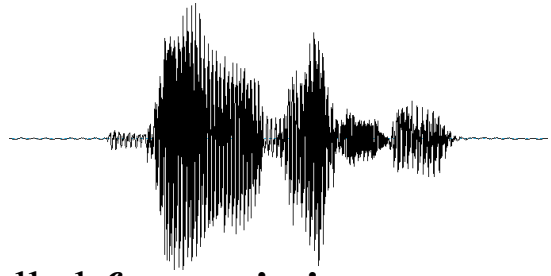
Meaning: "🐱"

Phonemic form: /kæt/

Fig. 1. Lexical entries for "cat" and "envelope"



Free Variation

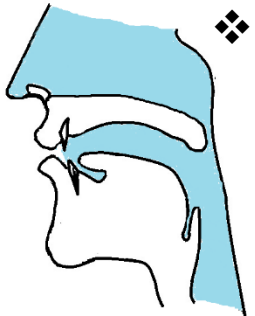


2) when a ***single*** *phonemic representation* gives rise to ***more*** than one *phonetic form*; this is called ***free variation***.

E.g. **American English:** the vowel phoneme /æ/ has a diphthongal allophone I will transcribe as [].

	[æ]			[ɛ̃ə̃]	
Lap	/læp/	[læp]	man	/mæn/	[mɛ̃ə̃n], [mæ̃n]
pal	/pæl/	[pæl]	Spanish	/spænɪʃ/	[spɛ̃ə̃nɪʃ], [spæ̃nɪʃ]
pack	/pæk/	[pæk]	dance	/dæns/	[dɛ̃ə̃ns], [dæ̃ns]

- If an /n/ follows /æ/, then there are two outputs:
- One with [ɛ̃ə̃] and one with [æ̃]. Otherwise, the observed allophone is [æ].
- Nasalization seen on both [ɛ̃ə̃] and [æ̃] is the consequence of ***Vowel Nasalization***.
- The free variation between the ***monophthongal*** and ***diphthongal*** *allophones* can be expressed with a rule:

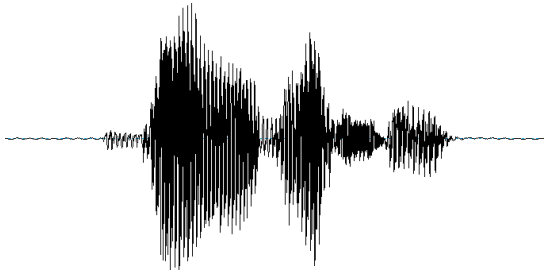


❖ **/æ/ Diphthongization** (preliminary)

æ → ɛə / ___ n

The phoneme /æ/ is realized as [ɛə] *when it precedes* /n/.

Free Variation



- Together with *Vowel Nasalization*, /æ/ *Diphthongization* suffices to derive the [ɛ̃ə̃] variants:

ban: /bæn/ underlying form

bɛən /æ/ Diphthongization

bɛ̃ə̃n Vowel Nasalization

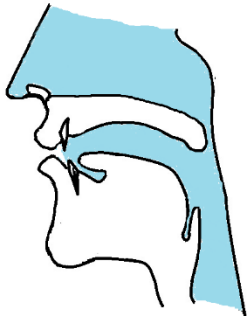
[bɛ̃ə̃n] surface form

- The speaker may apply the rule or not; i.e. /æ/ Diphthongization ***applies optionally***.

❖ **/æ/ Diphthongization (revised)**

æ → ɛə / ___ n (optional)

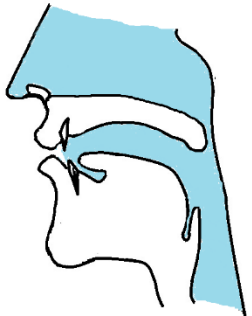
The phoneme /æ/ ***may be*** *realized as* [ɛə] *when it precedes /n/.*



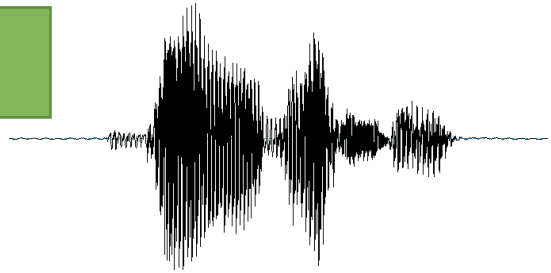
Free Variation

- The effects of optional rules can be shown with ***branching derivations*** which include arrows to indicate what happens when an optional rule does or does not apply.

lap		***ban***	
/læp/		/bæn/	underlying form
___	bɛən	___	/æ/ Diphthongization **(optional)**
___	bɛ̃ə̃n	bæ̃n	Vowel Nasalization
[læp]	[bɛ̃ə̃n]	[bæ̃n]	surface form



Contextually Limited Contrasts and Phonotactics



- ***Phonemic contrast*** is often not an *across-the-board* matter, but is confined to particular contexts.

E.g. in **Toba Batak** (Austronesian, Sumatra)

- There is a general contrast between *voiced* and *voiceless* ***stops*** and ***affricates***.

[**p**inoppar] 'descendant' [**b**iaŋ] 'dog'

[**t**uak] 'palm wine' [**d**ukkar] 'let out'

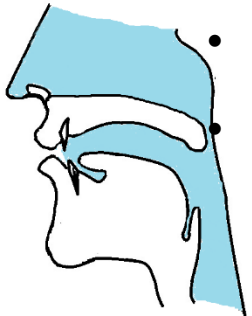
[**k**orea] 'Korea' [**g**arut] (name of town in Indonesia)

- Many words of Toba Batak also end in ***voiceless stops***:

[hotop] 'fast'

[sura**t**] 'letter'

[hala**k**] 'man'



- ***No*** word in the language ever ends in a ***voiced stop***.
- We have a phonological contrast of voicing, but it is a ***contextually limited contrast***.

Contextually Limited Contrasts and Phonotactics

❑ Analyzing phonotactics and contextually limited contrast

- Two formal approaches to contextually restricted contrast:

1) We write rules that would have the effect of *eliminating* the contrast.

❖ **Final Devoicing (Toba Batak)**

[+stop] → [−voice] / ____]word

Stops are devoiced at the end of a word.

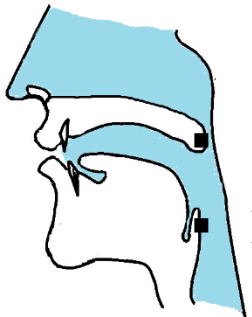
2) phonological theory involves not just rules but also ***constraints***.

- A **constraint** is a formal characterization of a structure that is ***illegal*** in a particular language.

❖ **Constraint against Final Voiced Stops** (Toba Batak)

$$* \begin{bmatrix} +\text{stop} \\ +\text{voice} \end{bmatrix} \quad / ___]\text{word}$$

It is illegal to have a voiced stop in word-final position.



Such constraints are sometimes called ***phonotactic constraints.***

- **Phonotactics** are a general term for the principles of phonological ***well-formedness*** in a particular language.

Contextually Limited Contrasts and Phonotactics

❑ Contrast with zero

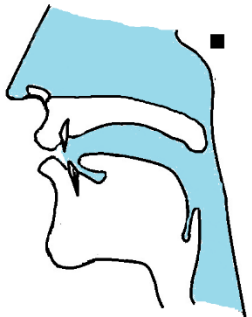
- The notion of phonological contrast can be broadened to include ***contrast with zero***.

E.g. **English** allows contrasts like tax [tæks] vs. tack [tæk].

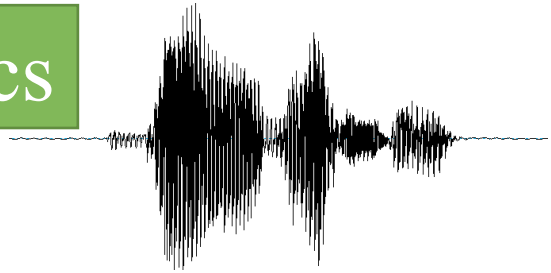
The [**s**] of tax is said to be in contrast with ***zero***.

t æ k **s**
t æ k ∅

- ∅ is the symbol representing the null string.
- Contrast with zero can also be ***contextually limited***.
- **Toba Batak** never permits *two consonants* to occur at the *end of a word* like English.
- In **Toba Batak** consonants may contrast with *zero* only when they are ***adjacent to a vowel***.
- To ban the CC vs. C contrast in final position, we formulate either a *rule* or a *constraint*:



Contextually Limited Contrasts and Phonotactics



- To ban the CC vs. C contrast in final position, we formulate either a *rule* or a *constraint*:

❖ **Rule: Cluster Simplification**

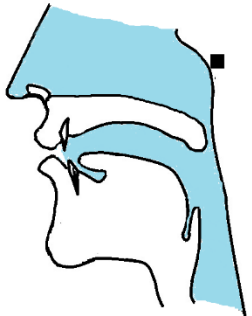
C → ∅ / C ____]word

Delete a word-final consonant if a consonant precedes.

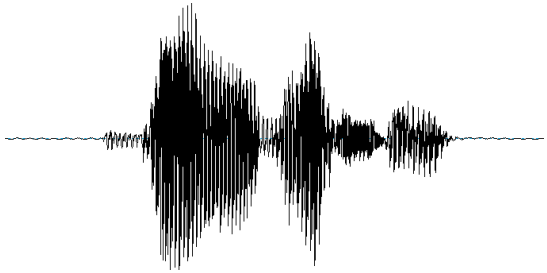
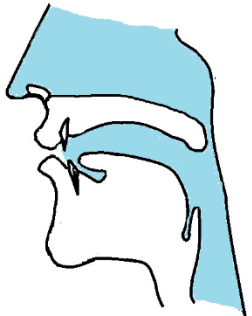
❖ **Constraint: Ban on final clusters**

*CC]word

- Comparing the two approaches, we see one possible ***objection*** to the ***rule-based theory***:
- It often forces us to make *arbitrary* analytic decisions.
- There seems to be no reason to delete the second consonant rather than the first.
- Both rules would suffice to enforce the ***one-consonant*** limit.
- Often, there is further *evidence* from the language that tells us which rule is *correct*.



Conclusion



- In analyzing a language, we seek first to ***isolate*** its inventory of phonemes.
- The allophonic variation of phonemes, both ***contextual*** and ***free***, must be characterized with appropriate ***phonological rules***.
- The limitations on ***contrast***, both between *phonemes* and between *phonemes and zero*, must be characterized with ***rules*** or ***constraints***.