

# Where am I?

- **HUL242: Fundamentals of Language Sciences**
- **Phonology (Lecture-3)**
- **Monday, Jan 27<sup>th</sup>**

# Today

- Identifying Phonological processes and formulating Phonological Rules
  - Assimilation
  - Dissimilation
  - Deletion
  - Epenthesis
- More on Features

# Phonological Processes and Analysis

- Data from Scots Gaelic (~ over a vowel indicates nasalization):

[mõ:r]	‘big’	[nĩ]	‘cattle’
[mũ]	‘about’	[nẽ:l]	‘cloud’

- Generalization:
  - Vowels following nasal consonants are nasalized.
- Phonological rule:  
$$V[-\text{nasal}] \rightarrow V[+\text{nasal}]/C[+\text{nasal}]$$
- Phonological process:
  - Assimilation of nasal feature

**Assimilation:** a sound becomes more like an adjacent sound.





# Phonological Processes and Analysis

- **For** some American English speakers,  
*fifths* is pronounced as [fɪfts] not as [fɪfθs].
- Generalization:
  - The fricative [θ] is changed to the stop [t].
- Phonological Rule:  
[θ] → [t] / fricative \_ fricative
- Phonological process:  
Dissimilation      **Dissimilation:** a sound becomes less like an adjacent sound.



# Phonological Processes and Analysis

- Pronunciation of 'Suppose' in American English

**Slow speech**

[səp<sup>h</sup>'o:z]

**Rapid speech**

['spo:z]

- Generalization:

➤ [ə] is deleted before a stressed syllable in the rapid speech.

- Phonological Rule:

[ə] → ∅ / \_\_ [stressed syllable]

- Phonological process:

Deletion

**Deletion** is the removal of a sound.



# Deletion

- Pronunciation of /r/ in British English.

‘far’ /fa:r/ → [fa:]

‘river’ /rɪvər/ → [rɪvə]

- Generalization:

➤ [r] is deleted at the end of a word.

- Phonological Rule:

[r] → ∅ / \_ #

# Phonological Processes and Analysis

- Consider the following pronunciation of American English.

Pronunciation A	Pronunciation B
[səmθɪŋ]	[səmpθɪŋ]
[wɔɹmθ]	[wɔɹmpθ]
[lɛŋθ]	[lɛŋkθ]
[pɹɪns]	[pɹɪnts]
[tɛnθ]	[tɛntθ]

- Generalization:

➤ A voiceless stop is being inserted between a nasal and a voiceless fricative, with the same place of articulation as the nasal.

- Phonological rule:

$$\emptyset \rightarrow C \left[ \begin{array}{l} +\text{stop} \\ -\text{voice} \\ \text{place} \end{array} \right] / C \left[ \begin{array}{l} +\text{nasal} \\ \text{place} \end{array} \right] - C \left[ \begin{array}{l} +\text{fricative} \\ -\text{voice} \end{array} \right]$$

- Phonological Process: Epenthesis/insertion

Epenthesis is the insertion of a sound.

# Epenthesis

- Pronunciation of the following English word by a Magahi speaker.

English	Magahi
'school' /sku:l/	[əsku:l]
'stress' /strɛs/	[əstrɛs]

- Generalization:

➤ Schwa [ə] vowel is inserted at the beginning of a word before a consonant cluster

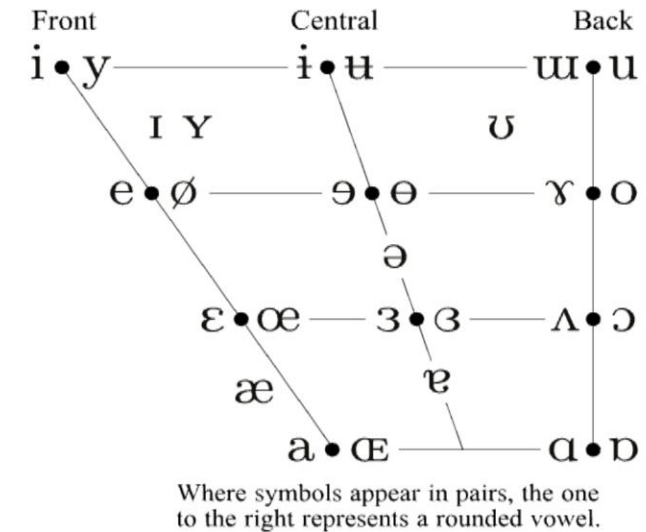
- Phonological rule:

$$\emptyset \rightarrow [ə] / \# \_\_\_ CC$$

# Epenthesis

- Consider the following Tamil data. What do you notice about the distribution of [w]? ([a] is a low front vowel).

[woɖi]	'break'	[arivu]	'knowledge'
[wo:laj]	'palm leaf'	[aintu]	'five'
[wu:si]	'needle'	[a:saj]	'desire'
[wujir]	'life'	[a:ru]	'river'
[wo:ram]	'edge'	[a:di]	'origin'



- Generalization:
  - [w] always occurs before **back vowels** at the beginning of a word.
- Phonological rules:
  - $\emptyset \rightarrow [w] / \# \_ V[+back]$

# Towards the feature decomposition

- [n] sometimes has a **dental** place of articulation — [n̪] in English:

[no:]	‘know’	[tɛn̪θ]	‘tenth’
[əno:]	‘annoy’	[mʌn̪θ]	‘month’
[ʌnjən]	‘onion’	[pæn̪θər]	‘panther’
[nʌn]	‘nun’	[krəsæn̪θəməm]	‘chrysanthemum’

Some questions:

- Is the [n n̪] distinction **contrastive** in English?

**No:** the sounds are in **complementary distribution**.

- Which is the **underlying phoneme**?

[n]: it occurs in many **more environments** than [n̪].

- Can you write a phonological rule capturing this alternation?

[n] → [n̪] / \_ [θ]

# Feature decomposition: Generalizing the rule (Part I)

- Is [n] only pronounced [n̠] before [θ]? Or is the process more general?

[wʌn̠ðə] 'won the'  
[ɪn̠ðə] 'in the'

- What does this tell you?
- We also find [n̠] before the **voiced** [ð] (not just the voiceless [θ]).
- So, we should generalize our rule. How?  
[n] → [n̠] / \_\_C[+(inter)dental]

# Feature decomposition: Generalizing the rule (Part II)

- Is it only [n] that gets dentalized [ɲ] before [ð] and [θ], Or do other consonants participate in this process?

[e:t̪θ]	'eighth'	[e:t̪ðə]	'ate the'
[wʊd̪θɪŋk]	'would think'	[sɛd̪ðɪs]	'said this'
[tɑ:l̪θɪŋ]	'tall thing'	[hi:l̪ðə]	'heal the'
[mɪsθɪŋkɪŋ]	'miss thinking'	[ke:sðədʒɔɪnt]	'case the joint'
[dʒɑ:nzθɪɹi:]	'John's theory'	[raʊzðə]	'rouse the'

- What do you notice about the data?
  - [t], [d], and [l] also become dental before [ð] and [θ]!
  - But [s] and [z] do not!
- So what should our general rule look like? Is [t d l n] a natural class?

# The IPA chart For reference

Place of Articulation																
		Bilabial		Labio-dental		Inter-dental		Alveolar		Alveo-palatal		Palatal		Velar		Glottal
Manner of Articulation	Stop	p	b					t	d					k	g	ʔ
	Fricative			f	v	θ	ð	s	z	ʃ	ʒ					h
	Affricative									tʃ	dʒ					
	Nasal		m						n						ŋ	
	Flap								ɾ							
	Lateral Approximant								l							
	Retroflex Approximant								ɻ							
	Glide		w										j			

State of the Glottis	
Voiceless	Voiced



# Feature decomposition: Generalizing the rule (Part II)

- [t d l n] is not obviously a natural class. They differ in manner and phonation. They're all alveolar, but so are [s] and [z]. Hmm..
- Think about what the tip of your tongue does when you say [t d l n] sounds. Now compare it to [s z]. What do you notice?
- The [t d l n] sounds are all made with the **tip of your tongue**. While [s z] are made with the **blade** of your tongue. In terms of a feature [+/- **apical**]
- So, our rule can be written:  
$$C[+\text{apical}] \rightarrow C_{\text{alveolar}} / \_C[+(\text{inter})\text{dental}]$$

# Features: Smaller units than segments

- So far, we learned about sounds
  - Sounds like [p] and [b] are distinct sounds in English.
- We also learned that sounds/segments are composed of even smaller phonological units
  - [p]: bilabial, voiceless, stop
  - [b]: bilabial, voiced, stop
- Such phonological units are known as **features**. Features are like atoms: they are the smallest units of phonology and as such are the **basic building blocks of human speech sounds**.
- Now we will learn more features.

# Features

# Features

- The features are divided into groups that describe, among other things:
- **Major class features:**
  - Whether the segment is consonantal, syllabic, or sonorant
- **A Laryngeal state:**
  - Whether the segment is voiced or not
- **Place of articulation:**
  - What articulators are active in the oral cavity (lips, tongue tip, or tongue body), and what specific features are associated with that articulator
- All features, except those for the articulators, are written as either "+" or "-". The articulator feature is written with an "o" to show which articulator is active.

# Major class features

- [**±consonantal**]: Sounds that are [+consonantal] are produced with a significant obstruction in the vocal tract. Glides and vowels are [–consonantal].
- [**±syllabic**]: Sounds that can act as syllable nuclei are [+syllabic]; this includes vowels, and syllabic liquids or syllabic nasals. All other sounds are [–syllabic].
- [**±sonorant**]: Sonorant sounds are produced with a continuous airflow with vocal fold vibrating as vowels, glides, liquids, and nasals. Sonorants are more resonant sounds. Non-sonorant sounds are also called **obstruents** like stop, fricatives, affricates.

	<i>Obstruents</i>	<i>Nasals</i>	<i>Liquids</i>	<i>Glides</i>	<i>Vowels</i>
[±consonantal]	+	+	+	–	–
[±syllabic]	–	–/+	–/+	–	+
[±sonorant]	–	+	+	+	+
Examples:	p d v tʃ	m n	l ɹ	j w	i a

# Manner features

## ○ [**±continuant**]

- Sounds produced with free or nearly free airflow through the oral cavity are [+continuant]: vowels, glides, liquids, and fricatives.
- All other sounds are [—continuant]: nasal and oral stops.

## ○ [**±nasal**]

- Sounds produced with a lowered velum are [+nasal]; this includes nasal stops and all nasalized sounds.
- Sounds that are oral, and thus produced with a raised velum, are [—nasal].

## ○ [**±lateral**]

- All and only varieties of 'l' are [+lateral]. All other sounds are [—lateral].

## ○ [**±delayed release**](**[±DR]**):

- All and only affricates (combination of stop and fricative) such as [tʃ] and [dʒ] are [+delayed release]. All other sounds are [—delayed release].

# Laryngeal features

- Depending on different laryngeal states/activity

## [±**voice**]

- All voiced sounds are [+voice]; all voiceless sounds are [-voice].

## [±**spread glottis**] ([±SG])

- All aspirated consonants are [ +SG]; all others are [—SG].

## [ ±**constricted glottis**]( [±CG])

- All sounds made with a closed glottis are [+CG]; all others are [ —CG].
- Only the glottal stop [ʔ] is [+CG] in English. Found in a word like *uh-oh!*

# Place of articulation features

- The place features include three articulator features. Unlike all the other features they are not treated as binary and are written in capital letters.
- These are used to distinguish the articulators that determine the place of articulation:
- [LABIAL]
  - Sounds are made with the lips
- [CORONAL]
  - Sounds are made with the tongue tip or blade
- [DORSAL]
  - Sounds are made with the tongue body.



# LABIAL

- Any sound that is produced with the involvement of one or both of the lips is [LABIAL]. This includes bilabial and labiodental sounds.
- A sound produced with the labial articulator may or may not be produced by protruding the lips
- [±round]
  - Sounds made with lip protrusion are [+round]: rounded vowels and the rounded labiovelar glide [w] are [+round]
  - Sounds made with no lip protrusion are [-round]: such as [p,b,f,v]

# CORONAL

- Any sound that is produced with the involvement of the tongue tip or blade raised is [CORONAL]. Interdental, alveolar, and alveopalatal sounds are all [CORONAL].
- [± apical]
  - Sounds that are all made with the **tip of your tongue** are [+apical]: like [t d l n]
  - Others are [-apical]: like [s z]

## [±laminal]

- Sounds that are all made with the blade of your tongue are [+laminal]: like [s z]
- Others are [-laminal]: like [t d l n]

Note: [t d l n s z] all are alveolar sounds. However, using [± apical] or [±laminal] we can make a further distinction.

# CORONAL

- Any sound that is produced with the involvement of the tongue tip or blade raised is [CORONAL]. Interdental, alveolar, and alveopalatal sounds are all [CORONAL].
- [±anterior]
  - All coronal sounds articulated in front of the alveopalatal region (inter-dentals and alveolars) are [+anterior];
  - Coronal sounds articulated at or behind the alveopalatal region (alveopalatals) are [-anterior].
- [±strident]
  - All "noisy" coronal fricatives and affricates are [+strident]: [s z ʃ ʒ dʒ tʃ]
  - All other coronal fricatives are [-strident]: [θ, ð]

# DORSAL

- Any sound that is produced with the involvement of the body of the tongue is [DORSAL]. This includes vowels and palatal and velar consonants.
- [±high]
  - Dorsal consonants or vowels produced with the tongue body raised from a central position in the oral cavity are [ +high].
  - Sounds produced with a neutral or lowered tongue body are [-high].
- [±low]
  - Vowels produced with the tongue body lowered from a central position in the oral cavity are [ +low]. All other vowels are [-low].
  - Consonants in English do not need the feature [low], although it may be used in languages that have uvular or pharyngeal consonants.

# DORSAL

- [ ±back]

- Dorsal consonants or vowels produced with the tongue body behind the palatal region (hard palate) in the oral cavity are [+back]. Velars and uvulars are [+back]. Sounds produced with the tongue body at the palatal region are [-back].

- [±tense]

- Tense vowels are [+tense]; lax vowels are [—tense].

- [±reduced]

- The schwa ([ə]) is a lax and exceptionally brief vowel and is therefore [+reduced]; all other vowels are [—reduced].

# Features: English consonant sounds

		Stops						Fricatives								Affricates		Nasals			Liquids		Glides			Glottals	
		p	b	t	d	k	g	f	v	θ	ð	s	z	ʃ	ʒ	tʃ	dʒ	m	n	ŋ	l	ɾ	j	w	ɰ	h	ʔ
Major class features	[consonantal]	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
	[sonorant]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-
	[syllabic]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-
Manner features	[nasal]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-
	[continuant]	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
	[lateral]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	-
	[delayed release]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-
Laryngeal features	[voice]	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	+	+	+	+	+	+	+	-	-	-
	[CG]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	[SG]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Place of articulation features	LABIAL	o	o					o	o									o						o	o		
	[round]	-	-					-	-									-						+	+		
	CORONAL			o	o					o	o	o	o	o	o	o	o		o			o	o				
	[anterior]			+	+					+	+	+	+	-	-	-	-	+			+	+					
	[strident]			-	-					-	-	+	+	+	+	+	+	-			-	-					
	DORSAL					o	o																	o	o	o	
	[high]					+	+																+	+	+		
	[back]					+	+																+	+	+		

Note: [low], [tense], and [reduced] are not used for English consonants.  
 Aspirated stops [p<sup>h</sup>, t<sup>h</sup>, k<sup>h</sup>] will have the feature [+SG].  
 Syllabic liquids and nasals will have the feature [+syllabic].

## Features: English vowel sounds

		i	ɪ	e	ɛ	æ	ə	ʌ	u	ʊ	o	ɔ	ɑ/a*
Major class features	[consonantal]	–	–	–	–	–	–	–	–	–	–	–	–
	[sonorant]	+	+	+	+	+	+	+	+	+	+	+	+
	[syllabic]	+	+	+	+	+	+	+	+	+	+	+	+
Manner feature	[continuant]	+	+	+	+	+	+	+	+	+	+	+	+
Laryngeal feature	[voice]	+	+	+	+	+	+	+	+	+	+	+	+
Place of articulation features	LABIAL								o	o	o	o	
	[round]								+	+	+	+	
	DORSAL	o	o	o	o	o	o	o	o	o	o	o	o
	[high]	+	+	–	–	–	–	–	+	+	–	–	–
	[low]	–	–	–	–	+	–	–	–	–	–	–	+
	[back]	–	–	–	–	–	+	+	+	+	+	+	+
	[tense]	+	–	+	–	–	–	–	+	–	+	–	+
[reduced]	–	–	–	–	–	+	–	–	–	–	–	–	

\*Note: While [a] and [ɑ] are phonetically different, in English they have the same phonological features because they are not contrastive—and remember, central vowels (like [a]) are [+back]. For languages in which they contrast phonemically, the two sounds would have distinct feature specifications.

# Features: Natural class

- A welcome reason for viewing segments as composed of features is that doing so gives us an **economical** way of characterizing natural classes.
  - Any natural class requires fewer features to define it than to define any one of its members.
- Every set of sounds that constitutes a natural class has the potential to pattern together in some way in the phonology of a language



# Features: Natural class

- 9 natural classes of English consonants

CONSONANT CLASSES OBSERVED IN ENGLISH

Obstruents	Stops	Fricatives	Voiceless obstruents	Voiced obstruents	Voiceless stops	Voiced stops	Voiceless fricatives	Voiced fricatives
$[-\text{sonorant}]$	$[-\text{sonorant}]$ $[-\text{continuant}]$	$[-\text{sonorant}]$ $[+\text{continuant}]$	$[-\text{sonorant}]$ $[-\text{voice}]$	$[-\text{sonorant}]$ $[+\text{voice}]$	$[-\text{sonorant}]$ $[-\text{continuant}]$ $[-\text{voice}]$	$[-\text{sonorant}]$ $[-\text{continuant}]$ $[+\text{voice}]$	$[-\text{sonorant}]$ $[+\text{continuant}]$ $[-\text{voice}]$	$[-\text{sonorant}]$ $[+\text{continuant}]$ $[+\text{voice}]$
p t k b d g f s ʃ v z ʒ	p t k b d g	f s ʃ v z ʒ	p t k f s ʃ	b d g v z ʒ	p t k	b d g	f s ʃ	v z ʒ

# Features: Natural class

- Some Natural classes of English Vowels

Front vowels		Back vowels	
<div>[ -consonantal +syllabic +sonorant oDORSAL -back ]</div>		<div>[ -consonantal +syllabic +sonorant oDORSAL +back ]</div>	
		<div>[ -consonantal +syllabic +sonorant oDORSAL -back -high +low -tense -reduced ]</div>	
/i/		/u/	
/ɪ/		/ʊ/	
/e/		/o/	
/ɛ/		/ʌ/	
/æ/		/ɑ/	
		/æ/	

# Next class

- Syllables and Phonological Analysis