

Where am I?

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

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.

Assimilation

- Pronunciation of the nasal sound of the English negative morpheme

Possible → Impossible

Potent → Impotent

Tolerable → Intolerable

Tangible → Intangible

- Generalization:

➤ The nasal sound of the English negative prefix assimilates to the following stop sound in place.

- Phonological rule:

$C[+\text{nasal}] \rightarrow C[+\text{nasal}, \text{PLACE}]/_C[+\text{stop}, \text{PLACE}]$

Assimilation

- Place assimilation in Hindi.

gəŋga: ‘a river’s name’

ʈəɳʈəl ‘naughty’

ʈiɳʈa: ‘worry’

ghəɳʈa: ‘hour’

ʈəmpa (the name of a flower)’

- Generalization:

➤ Nasals assimilate to the following stop in place.

- Phonological rule:

C[+nasal] → C[+nasal, PLACE]/__C[+stop, PLACE]

Phonological Processes and Analysis

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

Dissimilation

- Nasal dissimilation in Paite (Moi 2015):

Stem		Derived Forms
a) /ŋê:n/ '(to) ask/request'	/ná:/ 'nominalizer'	/ŋétná:/ 'application'
b) /f̪síŋ/ 'kind'	/ná:/ 'nominalizer'	/f̪sítñá:/ 'kindness'
c) /d̪óŋ/ '(to) question'	/ná:/ 'nominalizer'	/d̪ótná:/ 'questioning'

- Generalization:
 - A nasal changes to a voiceless stop with the same place feature as the following nasal.
- Phonological Rule:
$$C[+nasal] \rightarrow C[+stop, -voice, PLACE] / _ C[+nasal, PLACE]$$
- Note: Assimilation in place is also happening.

Phonological Processes and Analysis

- Pronunciation of ‘Suppose’ in American English

Slow speech

[səp^{h'}o:z]

Rapid speech

['spo:z]

- Generalization:

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

- Phonological Rule:

[ə] → Ø / _ [stressed syllable]

- Phonological process:

Deletion

Deletion is the removal of a sound.

Deletion

- Pronunciation of /r/ in British English.

‘far’ /fa:r/ → [fa:]

‘river’ /rivər/ → [rivə]

- Generalization:

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

- Phonological Rule:

[r] → \emptyset / _ #

Phonological Processes and Analysis

- Consider the following pronunciation of American English.

Pronunciation A	Pronunciation B
[səmθɪŋ]	[səmpθɪŋ]
[wɪmθ]	[wɪmpθ]
[lɛŋθ]	[lɛŋkθ]
[prɪns]	[prɪnts]
[tɛnθ]	[tentθ]

- 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:

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

- 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’ /stres/	[əstres]

- Generalization:

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

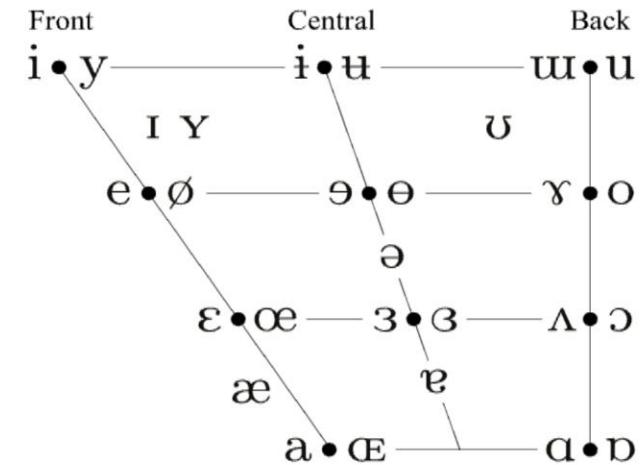
- Phonological rule:

$\emptyset \rightarrow [\text{ə}]/ \# \underline{\quad} \text{CC}$

Epenthesis

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

[woði]	'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'



Where symbols appear in pairs, the one to the right represents a rounded vowel.

- 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 — [n̥] in English:

[no:]	'know'	[tɛn̥θ]	'tenth'
[ənɔj]	'annoy'	[mʌn̥θ]	'month'
[ʌnjən]	'onion'	[pæn̥θər]	'panther'
[nʌn]	'nun'	[krəsæn̥θəməm]	'chrysanthemum'

Some questions:

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

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

- Which is the **underlying phoneme**?

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

- Can you write a phonological rule capturing this alternation?

[n] → [n̥] / _ [θ]

Feature decomposition: Generalizing the rule (Part I)

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

[wʌn̩ðə] ‘won the’

[ɪn̩ðə] ‘in the’

- What does this tell you?
 - We also find [n̩] before the **voiced** [ð] (not just the voiceless [θ]).

- So, we should generalize our rule. How?

[n] → [n̩] / _C[+(inter)dental]

Feature decomposition: Generalizing the rule (Part II)

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

[e:tθ]	'eighth'	[e:tðə]	'ate the'
[wudθiŋk]	'would think'	[sɛdðɪs]	'said this'
[ta:lθɪŋ]	'tall thing'	[hi:lðə]	'heal the'
[mɪsθɪŋkɪŋ]	'miss thinking'	[ke:sðədʒɔ:jnt]	'case the joint'
[dʒa:nzθi:ji:]	'John's theory'	[rawzðə]	'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		v	θ	ð	s	z	f	ʒ		k	g	?
	Fricative			f	v										h
	Affricative								tʃ	dʒ					
	Nasal		m						n				ŋ		
	Flap							r							
	Lateral							l							
	Approximant														
	Retroflex Approximant							t̪							
	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:
 $C[+\text{apical}] \rightarrow C_n / _C[+(\text{inter})\text{dental}]$

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, voiceless, 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 r	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 [?] is [+CG] in English. Found in a work 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
- [\pm 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	r	j	w	ʍ	h	?
<i>Major class features</i>	[consonantal]	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-		
	[sonorant]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	-	-	
	[syllabic]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	
<i>Manner features</i>	[nasal]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	
	[continuant]	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	
	[lateral]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	-	
	[delayed release]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	
<i>Laryngeal features</i>	[voice]	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	+	+	+	+	+	+	+	-	-	
	[CG]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-	
	[SG]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	
<i>Place of articulation features</i>	LABIAL	o	o			o	o									o				o	o						
	[round]	-	-			-	-									-				+	+						
	CORONAL	o	o					o	o	o	o	o	o	o	o	o		o	o								
	[anterior]	+	+					+	+	+	+	-	-	-	-	-	+		o	o							
	[strident]	-	-					-	-	+	+	+	+	+	+	+	-	-	-	-							
	DORSAL	o	o													o			o	o	o						
	[high]	+	+													+			+	+	+						
	[back]	+	+													+			-	+	+						

Note: [low], [tense], and [reduced] are not used for English consonants.
Aspirated stops [p^h, t^h, k^h] 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	ʊ	ʊ	ɔ	ɔ	a/a*
<i>Major class features</i>	[consonantal]	-	-	-	-	-	-	-	-	-	-	-
	[sonorant]	+	+	+	+	+	+	+	+	+	+	+
	[syllabic]	+	+	+	+	+	+	+	+	+	+	+
<i>Manner feature</i>	[continuant]	+	+	+	+	+	+	+	+	+	+	+
<i>Laryngeal feature</i>	[voice]	+	+	+	+	+	+	+	+	+	+	+
<i>Place of articulation features</i>	LABIAL							o	o	o	o	
	[round]							+	+	+	+	
	DORSAL	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

Features: Natural class

○ Some Natural classes of English Vowels

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

Next class

- Syllables and Phonological Analysis