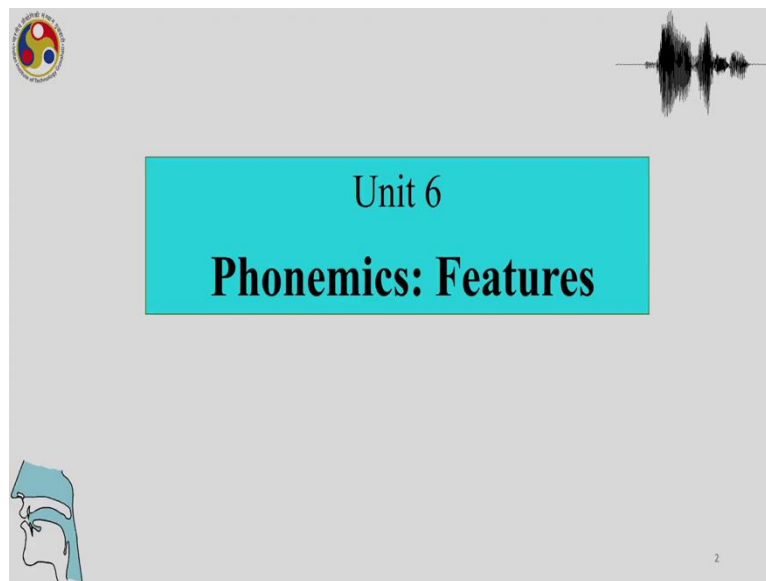


Phonetics and Phonology: A broad overview
Professor Shakuntala Mahanta
Department of Humanities and Social Sciences
Indian Institute of Technology Guwahati
Lecture 21
Distinctive features, feature economy and markedness

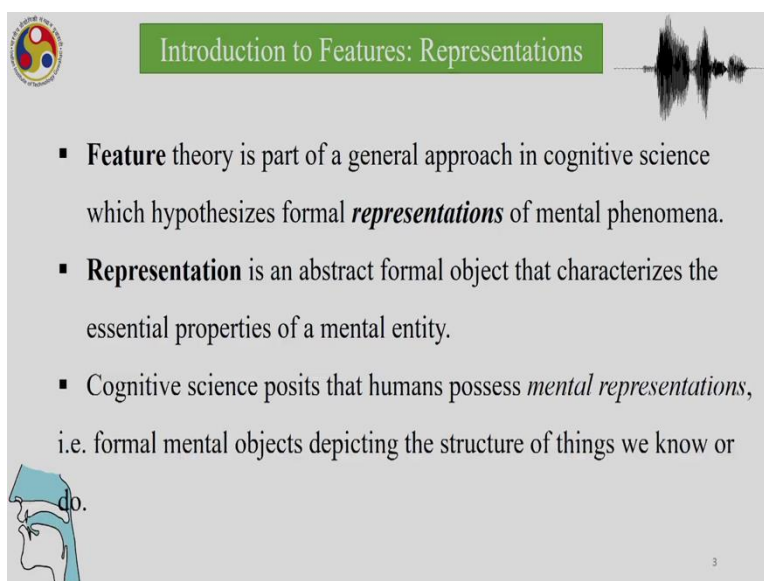
Hello, and welcome to NPTEL MOOC course in phonetics and phonology, a broad overview, we are continuing with phonology and this is the second week of phonology.

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And we are discussing features. We discuss features quite a bit in the last lecture also we are following up in this lecture and showing a few other features which are not shown very much in the last lecture. So, going over what we did in the last lecture.

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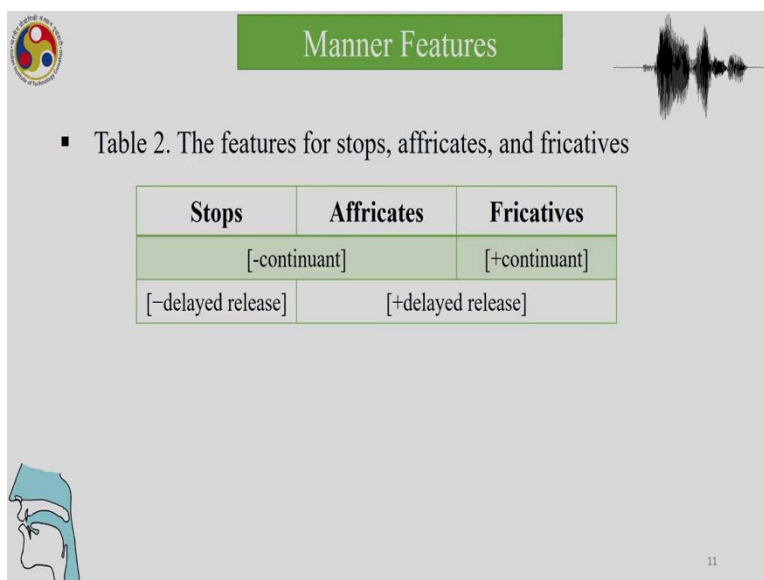
Introduction to Features: Representations

- **Feature** theory is part of a general approach in cognitive science which hypothesizes formal *representations* of mental phenomena.
- **Representation** is an abstract formal object that characterizes the essential properties of a mental entity.
- Cognitive science posits that humans possess *mental representations*, i.e. formal mental objects depicting the structure of things we know or do.

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Feature theory is part of a general approach in cognitive science which hypothesizes formal representations of mental phenomena. Hence, we see representations and we saw those representations of these formal objects, and we saw what the different features are, and why they are considered representations etcetera, in the last lecture.

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Manner Features

- Table 2. The features for stops, affricates, and fricatives

Stops	Affricates	Fricatives
[-continuant]		[+continuant]
[-delayed release]	[+delayed release]	

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And in this lecture, we will go into feature matrices a bit more, and also show that what we learned in the last lecture that how we can represent rule using features. And if we use more pertinent features, then our rules give us more general ideas about phonological processes happening in the data.

So, in the last lecture, this is what we had shown with regard to stops and fricatives that both stops and affricates are within the natural class of minus continuant whereas fricatives fall within plus continuant. And on the other hand, affricates and fricatives fall within the domain of plus delayed release and stops alone belong to the natural class of minus delayed release. Also, we looked a bit at vowel features like backness and height and tenseness.

So, these are all vowel features. And also, we looked at all the different combinations of features which lead to the different vowels that we have seen in all the previous lectures in articulatory phonology also, and the tense and lax vowels differ phonetically, the lax vowels tend to be shorter and more centralized, and the plus tense vowels, diphthongize towards a higher vowel and minus tense vowels diphthongize with an inserted schwa as in bed. So, we have seen the feature chart for vowels in the last lecture.

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Vowel Features

Table 4. Features used for classifying the dorsals:

	[+fron, -back]		[-fron, -back]		[-fron, -back]	
	-round	+round	-round	+round	round	+round
[+high, -low, +tense]	i	y	i	u	ɯ	u
[+high, -low, -tense]	ɪ	ʏ	ɨ	ʉ	-	ʊ
[-high, -low, +tense]	e	ø	ɘ	ɵ	ɤ	o
[-high, -low, -tense]	ɛ	œ	ɚ	ɞ	ʌ	ɔ
[high, +low]	æ	ɶ	a	-	ɑ	ɒ

ə ɘ ɚ ɞ

So, let us summarize the vowel features and show you what are the combinations of features that gives us the particular vowel, so we have plus high, minus low, plus tense, and then minus high, minus low, minus tense would give us this contrast here. And similarly, depending on whether the vowel is front or back, round, or unrounded, we can show the vowels in a matrix like this.

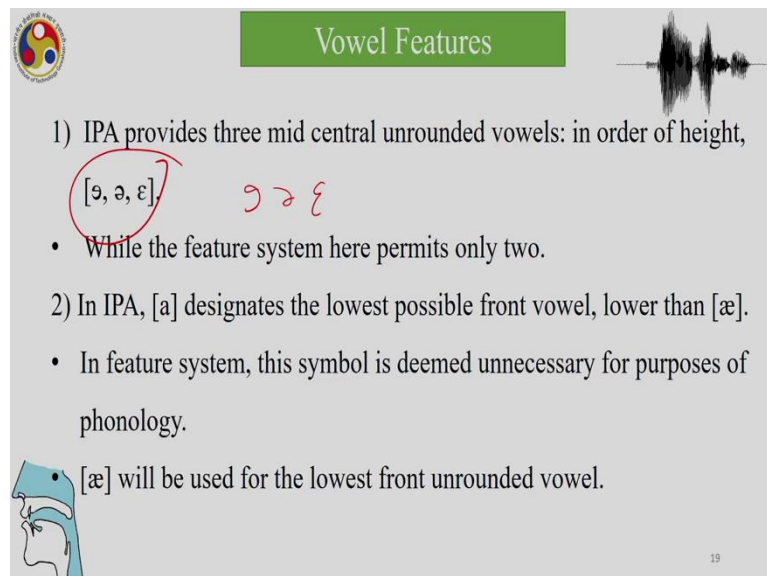
And then we have the unusual vowels like these vowels, which are minus round, yet central, so central vowels are represented as minus front and minus back, which means a neither front nor back. And whereas, u, these are plus round and plus back vowels, so these are the plus

round plus back vowels. These are the minus round vowels, and we also have the rounded and unrounded counterparts of the vowel C and U.

And so, we have these vowels which are minus round, and this is also minus round, but this vowel is front and this is not the front counterpart, whereas this is the front counterpart which is surround for e. So, we have all these vowels which are possible in the languages of the world. And hence, these corresponding symbols which are therefore these vowels are remembered for transcription purposes.

And that is something, this few of the familiar vowels we know the transcriptions for instance, the schwa is written like this, the a vowel is like this, but some of the vowels which do not exist in English, like this vowel, which is minus front minus back yet, it is plus round and which means it is a centralized plus round vowel and this is a centralized minus round vowel. So, all these vowels are not very common in the languages of world. So, we may not know their transcriptions very well, but these are given here.

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The slide is titled "Vowel Features" and includes a waveform at the top right. It contains the following text:

1) IPA provides three mid central unrounded vowels: in order of height, [ə, ə, ɛ].

- While the feature system here permits only two.

2) In IPA, [a] designates the lowest possible front vowel, lower than [æ].

- In feature system, this symbol is deemed unnecessary for purposes of phonology.
- [æ] will be used for the lowest front unrounded vowel.

A small diagram of the human vocal tract is visible in the bottom left corner of the slide.

So, IPA provides the three mid-central vowels. These are the mid-central vowels, which is this vowel, this is the schwa and this is the a. And central unrounded vowels, and the feature system permits only two but we can show them with the additional features. In IPA, a designates the lowest possible front vowel, lower than a. And in future system, this symbol is deemed unnecessary for the purpose of Phonology, most of the time a is used for lowest front unrounded vowel.

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Vowel Features

- ❑ **Other vowel features**
 - Many languages (e.g. sub-Saharan Africa) distinguish vowels with a feature called [Advanced Tongue Root], abbreviated [ATR].
 - This feature is often involved in *vowel harmony* systems.
 - All the vowels in a particular word must be either [+ATR] or [-ATR].

Handwritten notes: [+ATR] and [-ATR] in brackets.

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And then there are other vowel features like advanced tongue root, which is very much seen in the vowel harmony systems of the world. So, all the vowels in a particular word must be plus ATR or minus ATR, and that is called vowel harmony. So, all the vowels will be plus ATR, plus ATR, or there will be minus ATR, minus ATR, minus ATR, and when this happens when one vowel makes a change of value in all the other vowels, then that is called a vowel harmony system.

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Vowel Features

- ❑ Three more features that are relevant to vowel inventories:
 1. [long]: Classical Latin had five contrasting long and five contrasting short vowels: /i i: e e: a a: o o: u u:/.
 - This feature applies also to *consonants*; called *geminates*.
 2. [nasal]: also a feature of consonants, but serves here to distinguish *nasalized* from *non-nasalized* vowels.
 3. [stress]: turns out to be dubious as a vowel feature. considered to be a feature of *syllables*.

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And in vowel, three more features are relevant for vowel inventories and these are long and nasal and stress. So, vowels can differ on the basis of length. So, we have in English itself,

we have e, e and we have long u and o and a and a. And then the other feature is that of nasal, vowels can be nasalized, it can be shown with the nasalization symbol and then vowels are also stressed. So, the vowels bear stress in a language.

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Place Features for Consonants

□ Major articulator features

- We need to distinguish the consonants according to the *active articulator* used in producing them.

[+labial] = articulated with the lips.

[+coronal] = articulated with the tongue blade and/or tip

[+dorsal] = articulated with the tongue body

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So, we have the major articulator features and after the vowels now, let us have a look at the major articulator features. And the major articulator features are plus labial, plus coronal, and plus dorsal and dorsal are those consonants which are articulated with the tongue body, and coronal are those features which are articulated with tongue blade and tip and labial are articulated with the lips.

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Place Features for Consonants

- Often a consonant is made with just *one* articulator, so it gets the value **+** for one of these features and **-** for the others.
- In complex segments *two* articulators are involved.

E.g. a labial-velar like [kp] or [w] involves both *lips* and *tongue body*, thus [+labial, +dorsal].

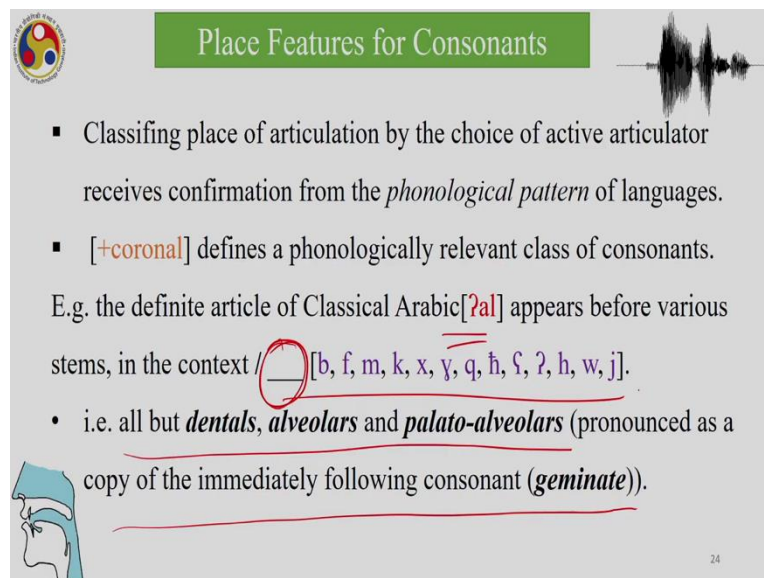
- Clicks, such as [!], involve the tongue tip/blade as well as the tongue body [+coronal, +dorsal].

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So, often a consonant is made with just one articulator, so it gets the value plus for one of these features and minus for the others. In complex segments two articulators are involved and they are represented like this, with a symbol like that showing that two articulators are involved in the production of that segment and these are not two different segments. So, this is the one and this is shown with this symbol.

And clicks, which we looked at a lot in the articulatory phonetics section. So, clicks involve tongue tip, we saw that clicks could be based on, because when we were looking at clicks, we saw that clicks have two places where the occlusion occurs. So, one of them could be tongue tip blade, it could be dental, it could be a bit more back. So, there could be either plus coronal, or plus dorsal along with being a click sound.

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Place Features for Consonants

- Classifying place of articulation by the choice of active articulator receives confirmation from the *phonological pattern* of languages.
- [+coronal] defines a phonologically relevant class of consonants. E.g. the definite article of Classical Arabic [ʔal] appears before various stems, in the context / _____ [b, f, m, k, x, ʕ, q, ʔ, h, w, j].
- i.e. all but *dentals*, *alveolars* and *palato-alveolars* (pronounced as a copy of the immediately following consonant (*geminate*)).

And classifying place of articulation by the choice of active articulator receives confirmation from phonological pattern of languages. And we saw that a little bit in the last part of the lecture on features that you saw in the previous lecture on features. And the plus coronal defines of phonologically relevant class of consonants.

And the definite article of classical Arabic ʔal appears before various stems in context like this, and showing that there is only one feature class before this. So, we saw that what is the purpose of features that with the purpose of features that you capture the idea of a natural class that rules processes in phonology are happening not in a vacuum, but because they are natural classes, which are the targets of rules and processes.

And we saw here, all about dentals, alveolars and palato-alveolars pronounced as a copy of the following consonant geminate. So, except dentals, alveolars and palato-alveolars, all others copy the following consonant, so that is why this can be expressed like this, that is the context.

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Place Features for Consonants

[ʔaθ] / __ θ	[ʔas] / __ s
[ʔaδ] / __ δ	[ʔasʷ] / __ sʷ
[ʔaδʷ] / __ δʷ	[ʔaz] / __ z
[ʔat] / __ t	[ʔazʷ] / __ zʷ
[ʔatʷ] / __ tʷ	[ʔan] / __ n
[ʔad] / __ d	[ʔar] / __ r
[ʔadʷ] / __ dʷ	[ʔaɹ] / __ ɹ


So now, what is the environment for gemination? So, we have all these environments here, we have th, th, d, we have dentals, we have alveolars, we have also nasals. And we have approximants. And these are all coronal or dental.

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Place Features for Consonants

[ʔaθ] / __ θ	[ʔas] / __ s
[ʔaδ] / __ δ	[ʔasʷ] / __ sʷ
[ʔaδʷ] / __ δʷ	[ʔaz] / __ z
[ʔat] / __ t	[ʔazʷ] / __ zʷ
[ʔatʷ] / __ tʷ	[ʔan] / __ n
[ʔad] / __ d	[ʔar] / __ r
[ʔadʷ] / __ dʷ	[ʔaɹ] / __ ɹ


Natural class



Place Features for Consonants




- Classifying place of articulation by the choice of active articulator receives confirmation from the *phonological pattern* of languages.
- [+coronal] defines a phonologically relevant class of consonants. E.g. the definite article of Classical Arabic [ʔal] appears before various stems, in the context / [b, f, m, k, x, ʕ, h, ʔ, h, w, j].
- i.e. all but *dentals*, *alveolars* and *palato-alveolars* (pronounced as a copy of the immediately following consonant (*geminate*)).



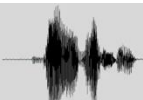
24

So, they could be all expressed with one feature if they belong to one natural class. So instead of the whole purpose of doing feature theory is that instead of putting down in inventory of sounds, you have to capture the generalization of why a process targets all the sounds. And always it seems that it is not random, because the sounds belong to a phonologically relevant class of consonants and that phonologically relevance comes from feature theory.


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Place Features for Consonants



- **Features for classifying the coronals**
- Coronal consonants are classified using four features: [anterior], [distributed], [strident], and [lateral].
- 1. [anterior]
 - The word “anterior” means “towards the front.”
 - [+anterior] coronals are articulated at the alveolar ridge or further forward, i.e. (*inter-*)*dentals* and *alveolars*.



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Place Features for Consonants



- [-**anterior**] coronals are articulated behind the alveolar ridge, i.e. *palato-alveolars* and *retroflexes*.
- [**anterior**] defines natural classes in the process of *sibilant harmony*.
- In sibilant harmony, all *stridents* in a word are required to agree in anteriority.



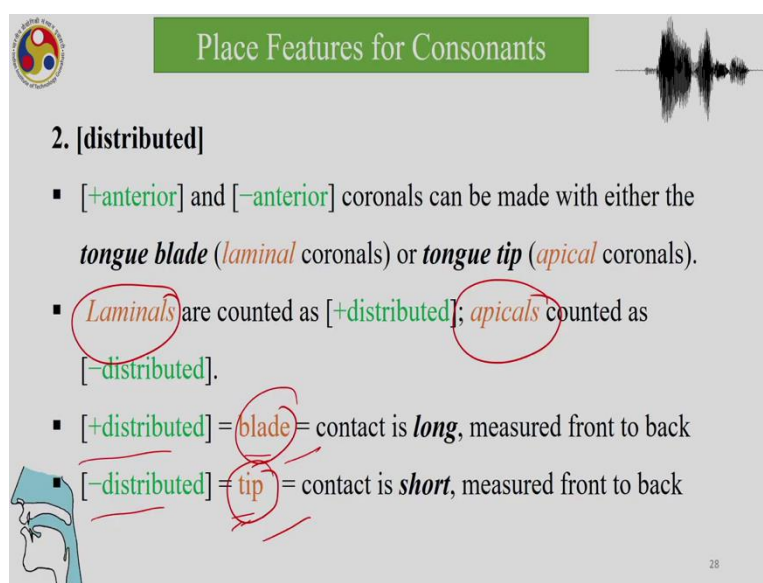
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So, coronal consonants are classified using four features, anterior, distributed, strident, and lateral. So, we saw a bit of this in the previous lecture also, the word anterior means towards the front and anterior coronals are articulated at the alveolar ridge offers a forward into dentals and alveolars. And minus anterior coronals are articulated behind the alveolar ridge and palato-alveolars and retroflexes.

So, minus anterior plus anterior plus distributed minus distributed plus strident minus strident and plus and minus lateral. So, there could be eight ways in which you can express coronal consonants. So, we saw plus anterior and minus anterior, plus anterior are inter-dentals and alveolars. Minus anterior are articulated behind the alveolar ridge mostly palato-alveolars and retroflexes.

And anterior defines natural classes in the process of sibilant harmony. In sibilant harmony, all stridents in a word are required to agree in anteriority. Again, when phonological processes happen, it targets only groups of sounds and in very often that groups of sounds have some phonological regularity, and that regularity is seen from the lens of features, can be explained from feature theory.

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The slide is titled "Place Features for Consonants" and features a logo in the top left, a waveform in the top right, and a diagram of the human vocal tract in the bottom left. The main text is as follows:

2. [distributed]

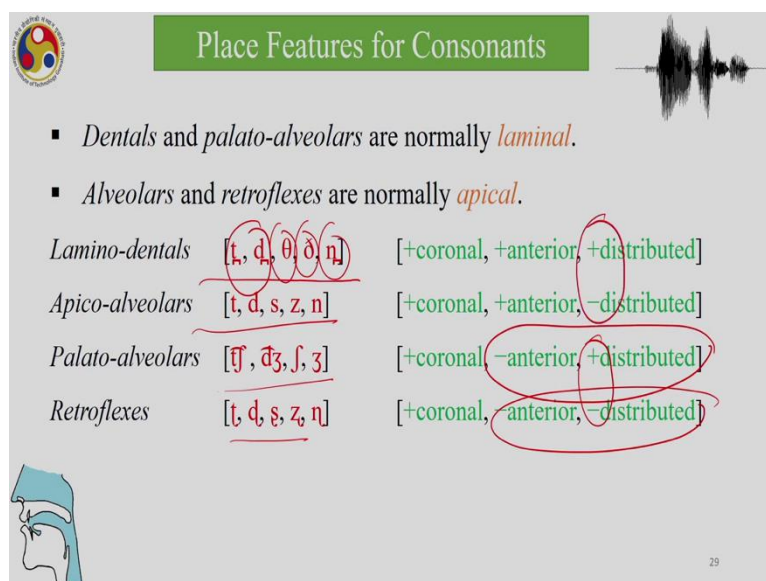
- [+anterior] and [-anterior] coronals can be made with either the *tongue blade* (*laminal* coronals) or *tongue tip* (*apical* coronals).
- *Laminals* are counted as [+distributed]; *apicals* counted as [-distributed].
- [+distributed] = blade = contact is *long*, measured front to back
- [-distributed] = tip = contact is *short*, measured front to back

Handwritten red circles highlight the words "Laminals" and "apicals" in the second bullet point, and "blade" and "tip" in the third and fourth bullet points respectively. A small number "28" is visible in the bottom right corner of the slide.

And if we talk about distributed, we have plus anterior and minus anterior coronals can be made with either the tongue blade or tongue tip. And laminals are counted as plus distributed, apicals counted as minus distributed and plus distributed is when we have the blade of the tongue and minus distributed is when we have the tip of the tongue. So, distributed involves what we studied before.

Remember, when we talked about articulatory phonology, we looked at the linguistic diversity in languages of world and we had looked at laminals versus apicals. So, laminals are the consonants and laminals can be both dental and alveolar. And apicals can also be either of them, and whereas, one involves the tip of the tongue, and the other involves the blade of the tongue. So, plus distributed uses the blade and minus distributed uses the tip. So, laminals and apicals can be understood in terms of feature theory as plus distributed and minus distributed consecutively.

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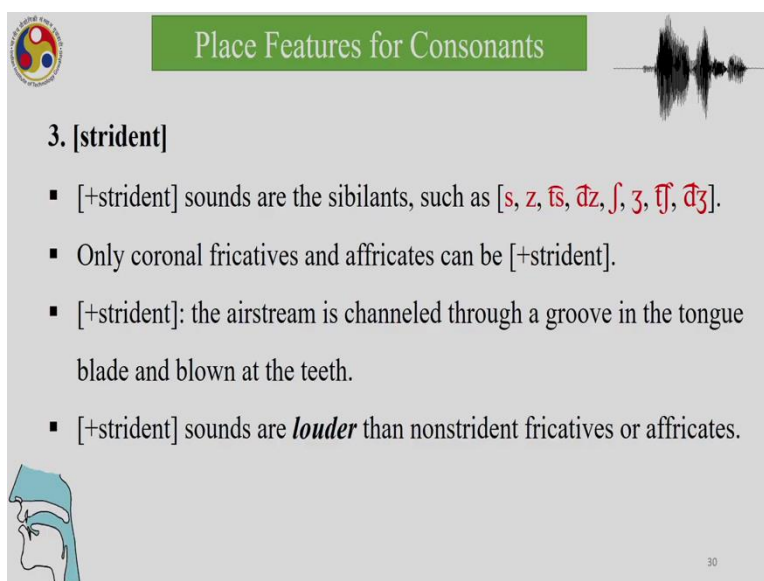
The slide is titled "Place Features for Consonants" and features a logo in the top left, a waveform in the top right, and a sagittal cross-section of the human head in the bottom left. The main content is a table listing consonant classes and their phonetic features. Red circles and underlines are drawn around specific parts of the table.

▪	Dentals and palato-alveolars are normally <i>laminal</i> .	
▪	Alveolars and retroflexes are normally <i>apical</i> .	
Lamino-dentals	[t, d, θ, ð, n]	[+coronal, +anterior, +distributed]
Apico-alveolars	[t, d, s, z, n]	[+coronal, +anterior, -distributed]
Palato-alveolars	[tʃ, dʒ, ʃ, ʒ]	[+coronal, -anterior, +distributed]
Retroflexes	[t, d, ʂ, ʐ, n]	[+coronal, -anterior, -distributed]

And dentals and palato-alveolars are normally laminal, alveolars and retroflexes are normally apical. So, lamino-dentals are all these, which are these dental, stops, fricatives and then nasal and then we have the apico-alveolars, and then we have palato-alveolars and then we have retroflexes, and palato-alveolars fall within minus anterior plus distributed category and retroflexes fall within minus anterior and minus distributed category.

So, the difference between Palato-alveolars and retroflexes is that in terms of distribution, feature of distributed, one is retroflexes minus distributed, palato-alveolars are plus distributed. Similarly, lamino-dentals are plus distributed and apico-alveolars are minus distributed.

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The slide is titled "Place Features for Consonants" in a green header. It features a waveform on the right and a sagittal diagram of the human head and neck on the left, highlighting the vocal tract. The main content is a list of features for the [strident] category.

3. [strident]

- [+strident] sounds are the sibilants, such as [s, z, ʃ, ʒ, tʃ, dʒ].
- Only coronal fricatives and affricates can be [+strident].
- [+strident]: the airstream is channeled through a groove in the tongue blade and blown at the teeth.
- [+strident] sounds are *louder* than nonstrident fricatives or affricates.

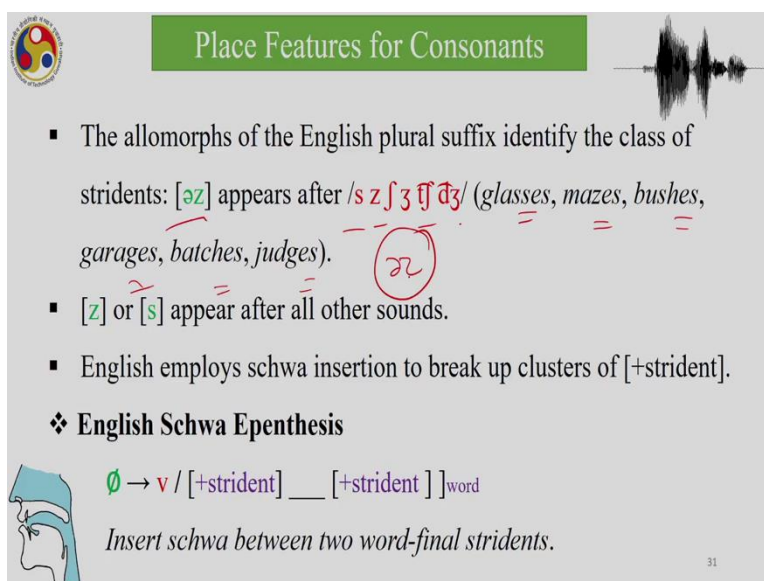
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The other category relevant for coronal is strident. Plus strident sounds on sibilants, such as s, z, cha, z, sh, z, ch, j and only coronal fricatives and affricates can be plus strident and plus strident, the airstream is channelled through a groove in the tongue blade and blown at the teeth. So, strident sounds cannot be pronounced if the front teeth are missing in a person, so it is a bit of a trivia because the air with great force is channelled and it has to hit the front teeth to produce the special effect that is strident sound will produce likes of z.


Strident sounds are louder than non-strident fricatives or affricates, we had seen the acoustic properties, when we had looked at acoustic properties of sounds of different sounds like fricatives and stops, we had seen that the fundamental frequencies show not just fundamental frequency, the noise created because the production stridents are different for different stridents, for different fricatives.

And for s versus sh and versus f all these sounds which are fricatives have their noise component and it can be identified in a spectrogram. And again, even in the phonology strident sounds behave differently because they are louder than non-strident fricatives or affricates.

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Place Features for Consonants

- The allomorphs of the English plural suffix identify the class of stridents: [əz] appears after /s z ʃ ʒ tʃ dʒ/ (glasses, mazes, bushes, garages, batches, judges). 
- [z] or [s] appear after all other sounds.
- English employs schwa insertion to break up clusters of [+strident].

❖ **English Schwa Epenthesis**

$\emptyset \rightarrow v / [+strident] _ [+strident]]_{word}$

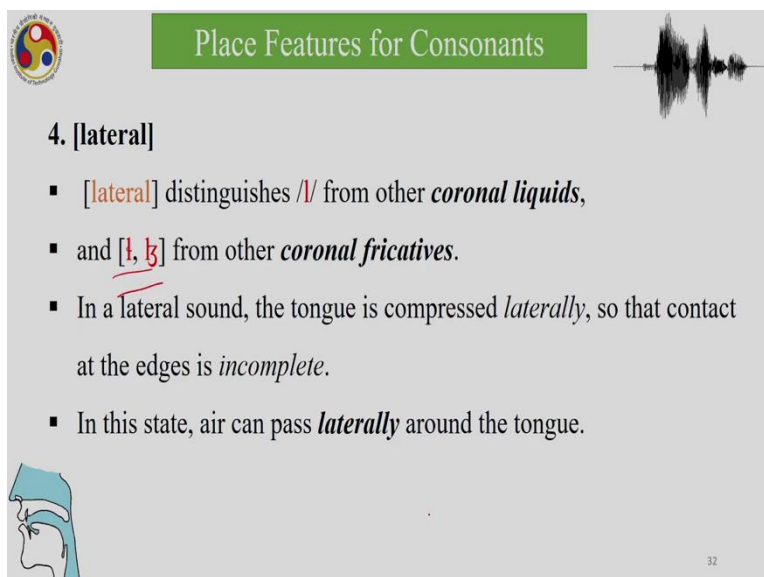
Insert schwa between two word-final stridents.



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And the allomorphs of the plural suffix identify the class of stridents. So, for instance, in English az, whenever the last consonant is one of these stridents, it is always the plural is glasses, or mazes, or bushes, or garages, batches, or judges. And English employs schwa insertion to break up clusters. And so, before strident a schwa is inserted, and then we have this form.


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Place Features for Consonants

4. [lateral]

- [lateral] distinguishes /l/ from other *coronal liquids*,
- and [l, ʎ] from other *coronal fricatives*.
- In a lateral sound, the tongue is compressed *laterally*, so that contact at the edges is *incomplete*.
- In this state, air can pass *laterally* around the tongue.



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So, lateral distinguishes l from other coronal liquids and there could be lateralized fricatives, like a coronal fricative. In the lateral sound, the tongue is compressed laterally so that contact at the edges is incomplete. And in this state, air can pass laterally around the tongue. So that

is what lateral means that there is two sides. And that is why in lateral sounds, air can pass from both sides of the tongue.

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Place Features for Consonants

□ Features used for classifying the labials

[round] = articulated by rounding the lips

[labiodental] = articulated by touching the lower lip to the upper teeth

- Few languages (e.g. Ewe and California Spanish) have phonemic contrasts based on [labiodental] (/ɸ/ vs. /f/, /β/ vs. /v/).
- **labialization** (secondary rounding on consonants, as in [k] vs. [k^w]) can be treated by adding the features [+labial, +round].

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And in features such as round or labio-dental, round is produced by rounding the lips and then labio-dental, which involves touching the lower lip to the upper teeth. And then a few languages have phonemic contrast based on labio-dental and like Spanish ph verses f, b verses v. And then we have labialization where even a stop sound can have a secondary articulation of labial and then it is represented like this as a superscript and can be treated by adding the features plus labial and plus round.

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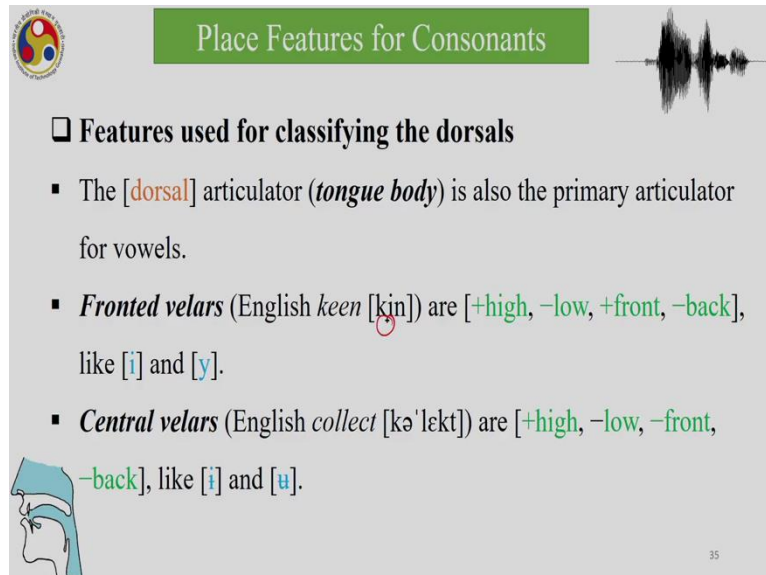
Place Features for Consonants

Plain bilabials	[p, b, m, ɸ, β]	[+labial, -round, -labiodental]
Plain labiodentals	[f, v]	[+labial, -round, +labiodental]
Rounded bilabials	[p ^w , b ^w , m ^w , ɸ ^w , β ^w]	[+labial, +round, -labiodental]
Rounded labiodentals	[f ^w , v ^w]	[+labial, +round, +labiodental]
Rounded velars	[w, k ^w , g ^w , x ^w , g ^w]	[+labial, +dorsal, +round, -labiodental]
Labial-velars	[kp̚, gb̚]	[+labial, +dorsal, -round, -labiodental]
Rounded coronals	[t ^w , d ^w , s ^w , z ^w , r ^w]	[+labial, +coronal, +round, -labiodental]

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So, in place features for consonants, there are plain labials, there are plain labiodentals, there are rounded labials, there are rounded labio-dentals, there are rounded velars, there are labial-velars, and there are rounded coronals.

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Place Features for Consonants

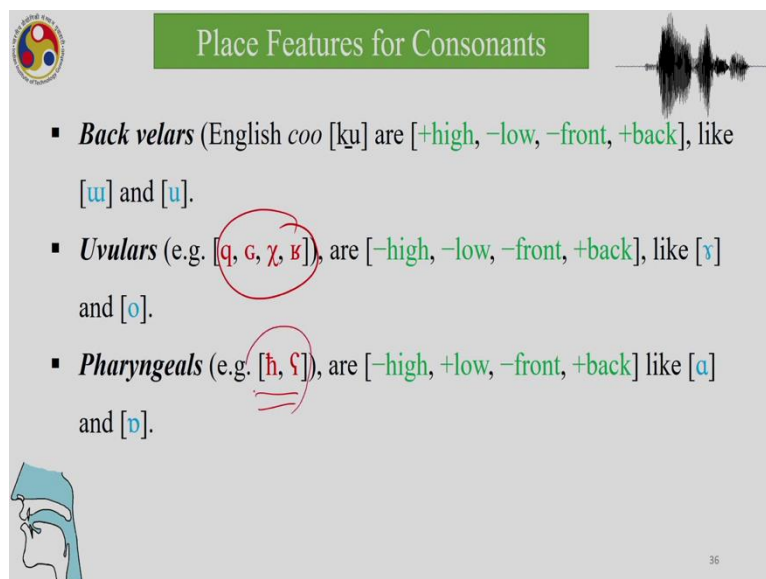
□ **Features used for classifying the dorsals**

- The [dorsal] articulator (*tongue body*) is also the primary articulator for vowels.
- **Fronted velars** (English *keen* [kʰin]) are [+high, -low, +front, -back], like [i] and [y].
- **Central velars** (English *collect* [kə'lekt]) are [+high, -low, -front, -back], like [ɪ] and [ʊ].

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Features used for classifying the dorsals, the dorsal articulator is also the primary articulator for vowels and fronted velars are there. So, this is the subscripts used here to show that this is a fronted velars and as in *keen* means fronted because the front vowel and then central velars like English *collect*, because of the following central vowel.

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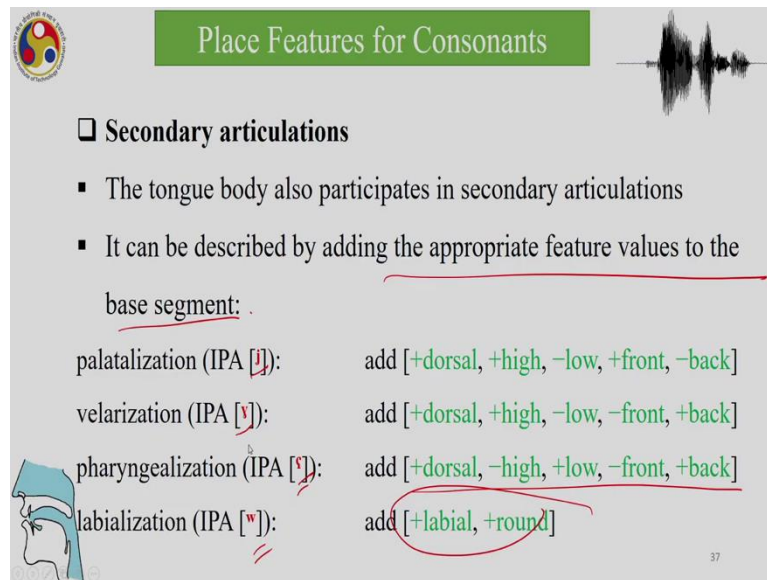
Place Features for Consonants

- **Back velars** (English *coo* [ku]) are [+high, -low, -front, +back], like [u] and [ʊ].
- **Uvulars** (e.g. [q, ɢ, ʁ, ʕ]), are [-high, -low, -front, +back], like [ɣ] and [o].
- **Pharyngeals** (e.g. [ħ, ʕ]), are [-high, +low, -front, +back] like [ɑ] and [ɓ].

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And back velars as in coo are produced a bit back and uvulars which are not there in English at all like h and a have their special symbols. And then we have the pharyngeals, which we studied when we looked at linguistic diversity, these are the two symbols for the pharyngeals.

(Refer Slide Time: 18:47)



Place Features for Consonants

□ **Secondary articulations**

- The tongue body also participates in secondary articulations
- It can be described by adding the appropriate feature values to the base segment:

palatalization (IPA [j]):	add [+dorsal, +high, -low, +front, -back]
velarization (IPA [ɣ]):	add [+dorsal, +high, -low, -front, +back]
pharyngealization (IPA [ʕ]):	add [+dorsal, -high, +low, -front, +back]
labialization (IPA [w]):	add [+labial, +round]

So, secondary articulations are such that they are shown with a superscript like this, like ya or like kha or this pharyngeal sound or the labialize sound. And additionally, these other features that they have, because of the additional secondary articulation, and the appropriate feature values are added to the base segment. So, that is how secondary articulations are represented in the phonology.

(Refer Slide Time: 19:19)

Place Features for Consonants

□ “Place” as a group concept

- The system of features should not be treated as some homogeneous collection, but instead is *internally* structured.
- An interesting aspect of many phonological rules is that they manipulate all the *place features* at once.
- In *Spanish* and many other languages, when underlying /n/ assimilates in place to the consonant it precedes, no matter what place it bears.

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So, a place as a group concept, the system of features should not be treated as some homogeneous collection, but something which has some internal structure to it. And an interesting aspect of many phonology rules is that they manipulate all the feature places at once. So, in Spanish in many other languages when unlike n assimilates in place to the consonant proceeds.

And so, no matter what place it bears, so it is a complete change to the place of the consonant proceeds. So, if the previous consonant is preceded, it is preceded by p then it can become m which becomes bilabial if it is a k it can become n, because velar, etcetera.

(Refer Slide Time: 20:08)

Place Features for Consonants

in <i>isolation</i> :	[un]	(masculine indefinite article)
before a vowel:	[un oso]	'a bear'
before <i>bilabials</i> :	[um peso]	'a peso'
before <i>labiodentals</i> :	[un̪ foko]	'a focus'
before <i>dentals</i> :	[un̪ tjo]	'an uncle'
before <i>alveolars</i> :	[un̪ sako]	'a sack'
before <i>palatoalveolars</i> :	[un̪ tʃarko]	'a pool'
before <i>velars</i> :	[un̪ gato]	'a cat'

❖ /n/ Assimilation

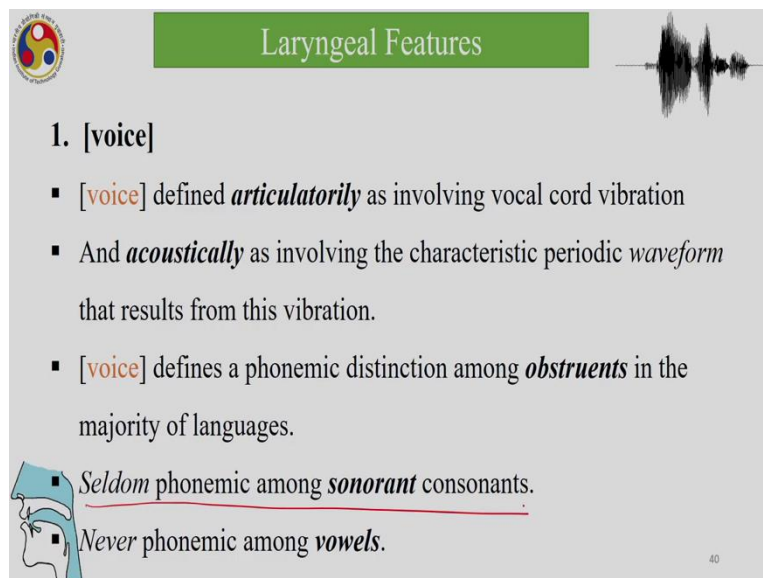
“place:” = “all of the values for the place features.”

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Hence, we have data like this, where, as we just said, depending on the feature of the consonant, it can change to a labial or a labio-dental or a dental or alveolar or palato-alveolar or velar. So, hence data like this have to be represented like in this way, so where the nasal takes the place of articulation of the following consonant.

So, whatever the place of articulation of the following consonant if it is nasal, if it is velars or palato-alveolar or dental or labio-dental, it just takes that exactly the same place of articulation. So, complete replacement of the same place of articulation and that is why it has to be indexed with *i*. The indexation means that whatever the place of articulation of this is, this will just change to that.

(Refer Slide Time: 21:04)



The slide is titled "Laryngeal Features" and includes a waveform of a voiceless stop consonant and a diagram of the human head in profile showing the larynx. The text on the slide is as follows:

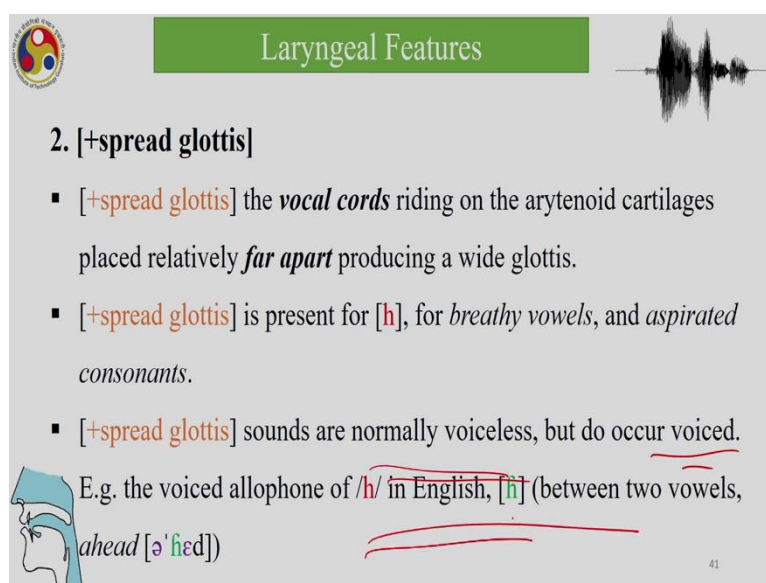
1. [voice]

- [voice] defined *articulatorily* as involving vocal cord vibration
- And *acoustically* as involving the characteristic periodic *waveform* that results from this vibration.
- [voice] defines a phonemic distinction among *obstruents* in the majority of languages.
- *Seldom* phonemic among *sonorant* consonants.
- *Never* phonemic among *vowels*.

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Voice, a voice define articulatory as involving vocal cord vibration, and acoustically as involving the characteristic periodic waveform that results from this vibration and we have seen the category voice and its articulatory as well as acoustic properties in the previous lectures. And voice defines a phonemic distinction among obstruents in the majority of languages and voice is seldom phonemic among sonorant consonants, and never phonemic among vowels. So, the contrast feature for voice and sonorant and vowels is pretty restricted.

(Refer Slide Time: 21:48)



2. [+spread glottis]

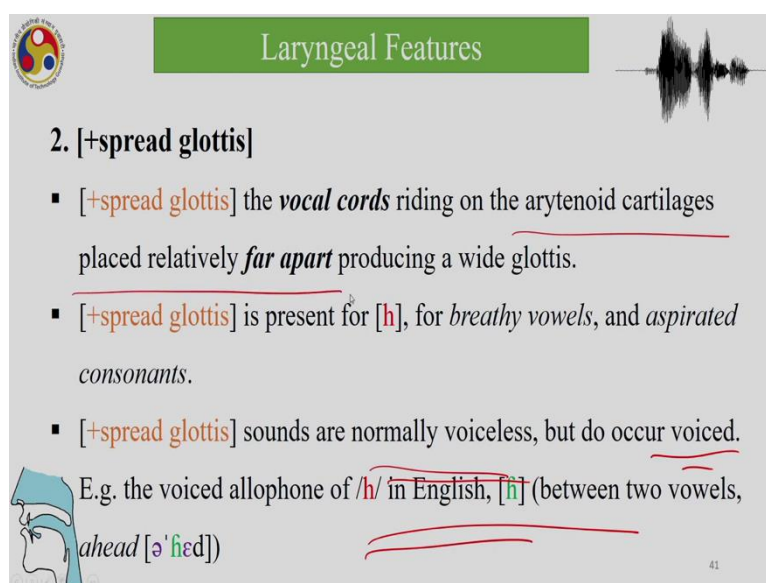
- [+spread glottis] the *vocal cords* riding on the arytenoid cartilages placed relatively *far apart* producing a wide glottis.
- [+spread glottis] is present for [h], for *breathy vowels*, and *aspirated consonants*.
- [+spread glottis] sounds are normally voiceless, but do occur voiced.

E.g. the voiced allophone of /h/ in English, [h̥] (between two vowels, *ahead* [ə'hɛd])

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And then we have a plus spread glottis, when the vocal cords riding on the arytenoid cartilages placed relatively far apart producing a wide glottis and plus spread glottis is present for h, for breathy vowels, and aspirated consonants, plus spread glottis sounds are normally voiceless, but do occur voiced, example, the voice allophone of h in English, and h between two vowels. So, there are normally voiceless but also do occur voiced as in the English examples we have seen here.

(Refer Slide Time: 22:22)

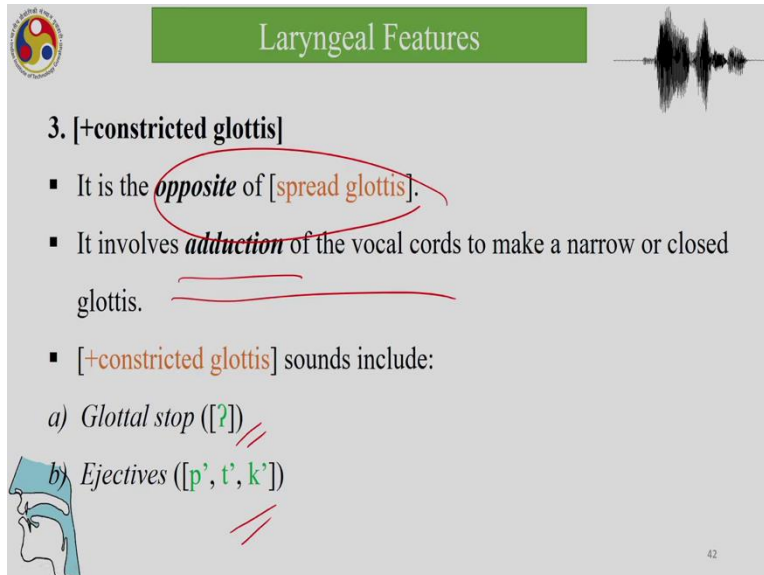


2. [+spread glottis]

- [+spread glottis] the *vocal cords* riding on the arytenoid cartilages placed relatively *far apart* producing a wide glottis.
- [+spread glottis] is present for [h], for *breathy vowels*, and *aspirated consonants*.
- [+spread glottis] sounds are normally voiceless, but do occur voiced.

E.g. the voiced allophone of /h/ in English, [h̥] (between two vowels, *ahead* [ə'hɛd])

41



Laryngeal Features

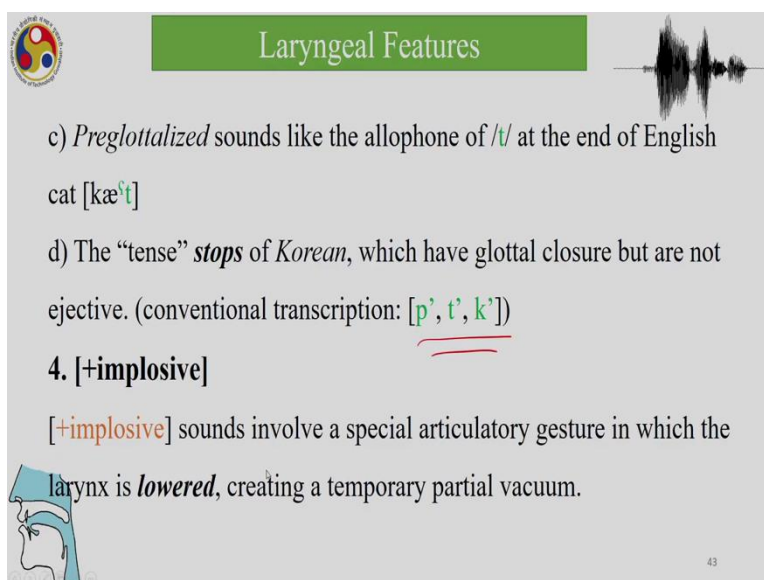
3. [+constricted glottis]

- It is the **opposite** of [spread glottis].
- It involves **adduction** of the vocal cords to make a narrow or closed glottis.
- [+constricted glottis] sounds include:
 - Glottal stop ([ʔ])
 - Ejectives ([p', t', k'])

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And in plus constructed glottis, it is the opposite of a spread glottis involves the arytenoid cartilages place relatively far apart, producing a wide glottis and pushing out a lot of air. And then in constricted glottis, we have the abduction of the vocal cords to make a narrow-closed glottis. And in plus constructed glottis sounds include the glottal stop and ejectives, which we have seen in the articulatory phonetics diversity in the world's languages, classes, lectures.

(Refer Slide Time: 22:58)



Laryngeal Features

c) *Preglottalized* sounds like the allophone of /t/ at the end of English cat [kæʔt]

d) The “tense” **stops** of *Korean*, which have glottal closure but are not ejective. (conventional transcription: [p', t', k'])

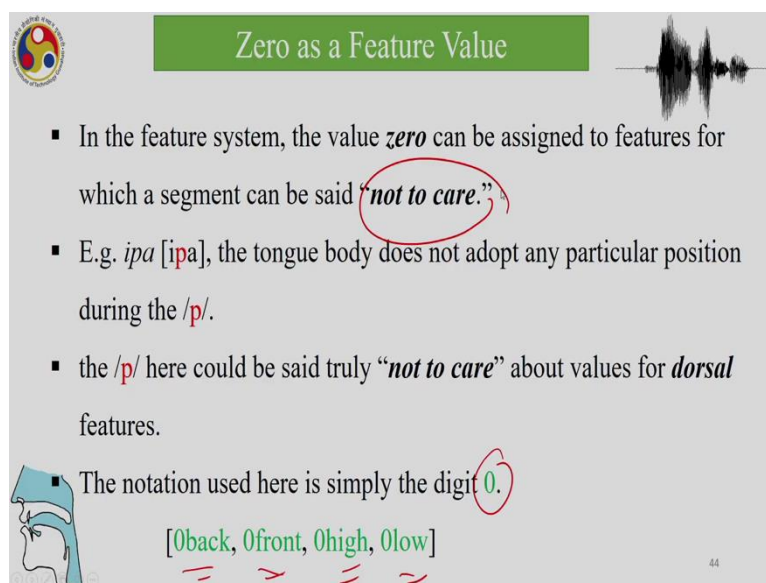
4. [+implosive]

[+implosive] sounds involve a special articulatory gesture in which the larynx is **lowered**, creating a temporary partial vacuum.

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Preglottalized sounds like the allophone of t at the end of English cat. And then the tense stops of Korean, which have glottal closure but are not ejectives. So, these are preglottalized or tense stops, and then implosive which we have seen a bit in the previous lectures. Implosive involve a special articulatory gesture, in which the larynx is lowered, creating temporary partial vacuum.

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Slide 44: Zero as a Feature Value

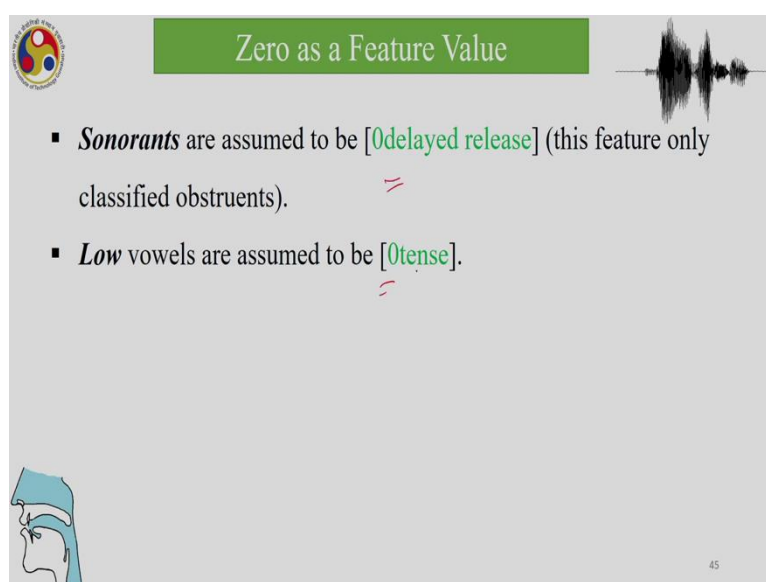
- In the feature system, the value **zero** can be assigned to features for which a segment can be said “**not to care.**”
- E.g. *ipa* [ipa], the tongue body does not adopt any particular position during the /p/.
- the /p/ here could be said truly “**not to care**” about values for *dorsal* features.
- The notation used here is simply the digit **0**.

[0back, 0front, 0high, 0low]

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And then in the feature system, the value zero can be assigned to features for which a segment can be said not to care. So, in the tongue body does not adopt any particular position during the p, the p here could be said truly not to care about the values for dorsal features. The notation here is simply null. So, it is either null back or null front or null high or null low. So, what does null mean it does not care. So, in the zero there assigned features inches, the feature does not matter.

(Refer Slide Time: 24:02)



Slide 45: Zero as a Feature Value

- **Sonorants** are assumed to be [0delayed release] (this feature only classified obstruents).
- **Low** vowels are assumed to be [0tense].

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Sonorants are assumed to be zero delayed release, and low vowels are assumed to be zero tense, because low vowel never contrast for tense. And sonorants never contrast for delayed release.

(Refer Slide Time: 24:19)

When and How to Use Features in Writing Rules

Features vs. phonetic symbols

- A fully explicit phonological analysis of a language would use *no phonetic symbols*.
- Only the *feature matrices* have theoretical status.
- The phonetic symbols are meant only as convenient abbreviations for particular feature matrices.

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Features versus phonetic symbols fully phonological analysis for language would use no phonetic symbols, and only the feature matrices have theoretical status in a language and the phonetic symbols are meant only as convenient abbreviations for particular feature matrices.

(Refer Slide Time: 24:34)

When and How to Use Features in Writing Rules

- Ways in which rules benefit by writing them with features:

- 1. To capture a natural class**

E.g. *Indonesian* has a rule that deletes / η / before *nasals*, *liquids*, and *glides*, the set of sonorant consonants:

❖ **Indonesian /N/ Deletion**

$\eta \rightarrow \emptyset / \left[\begin{array}{l} -\text{syllabic} \\ +\text{sonorant} \end{array} \right]$

47

Ways in which rules benefit by writing them with features. So, we have seen a bit of this in the previous lecture, we will again show a little bit of Indonesian data where there isn't deletion. So, n goes to null in the presence of a following minus syllabic plus sonorant.

(Refer Slide Time: 24:54)

When and How to Use Features in Writing Rules

2. To capture an assimilation

- This is done by showing that the assimilating segment adopts a feature value already *possessed* by one of its *neighbors*.

E.g. English, /k, g, ŋ/ become fronted [k, g, ŋ] before *front vowels*.
keel ['ki:l], *gale* ['geɪl], *dinghy* ['diŋi].

❖ **Velar Fronting**

$\left[\begin{array}{l} +\text{dorsal} \\ +\text{consonantal} \end{array} \right] \rightarrow \left[\begin{array}{l} +\text{front} \\ -\text{back} \end{array} \right] / _ \left[\begin{array}{l} +\text{syllabic} \\ +\text{front} \end{array} \right]$

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And then, to capture assimilation we write rules like this, velar fronting. So, velar is represented as plus dorsal minus plus consonantal, it becomes plus front and minus back. And that is how we express velar fronting in English keel, or gale, or dinghy.

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When and How to Use Features in Writing Rules

3. To show that a change is minor

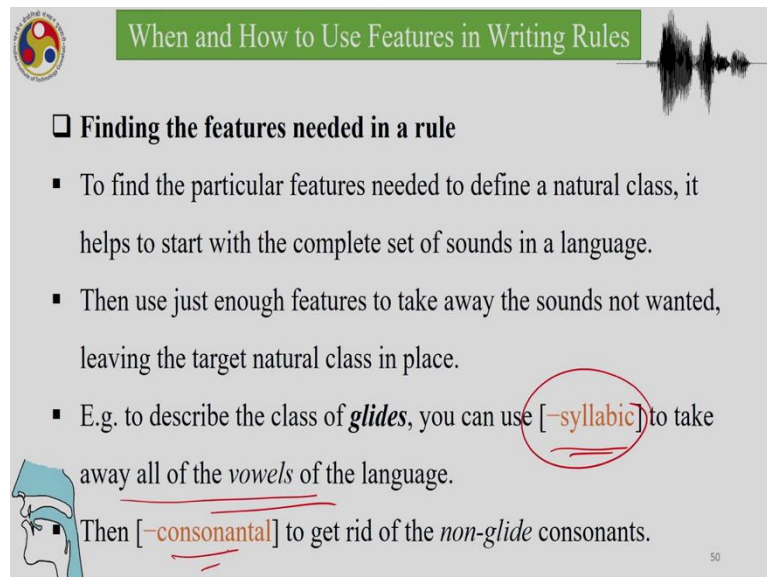
- That is of only one or two feature values.

E.g. if a rule changes (only) /p/ to [b], one would write $p \rightarrow [+voice]$ rather than $p \rightarrow b$, to show that nothing other than [voice] is changing.

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To show that a change is minor that is of only one or two feature values. So, and then if a rule changes only changes p to b, one would write p goes to plus voice rather than p to b, showing that nothing changes other than voice.

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The slide features a green header with the title "When and How to Use Features in Writing Rules" and a waveform graphic on the right. A small logo is in the top left corner. The main content is a list of points under the heading "Finding the features needed in a rule". The text includes examples of phonetic features like [-syllabic] and [-consonantal] with red annotations: a red circle around [-syllabic], red underlines under "vowels" and "non-glide", and a red underline under [-consonantal]. A small icon of a person's head is on the left side of the text.

□ Finding the features needed in a rule

- To find the particular features needed to define a natural class, it helps to start with the complete set of sounds in a language.
- Then use just enough features to take away the sounds not wanted, leaving the target natural class in place.
- E.g. to describe the class of *glides*, you can use [-syllabic] to take away all of the vowels of the language.
- Then [consonantal] to get rid of the non-glide consonants.

So, how do we find the features needed in a rule. To find the particular features needed to define a natural class, it helps to start with the complete set of sounds in a language. So, then we have to just use enough features to take away the sounds not wanted, leaving the target natural class in place. And to describe the class of glides, we can use minus syllabic to take away all the vowels of the language. So, once we say minus syllabic, then vowels are not there in the natural class, then minus consonantal get rid of all the non-glide consonants.


(Refer Slide Time: 26:08)

 **When and How to Use Features in Writing Rules** 



- There are good reasons to include only just as many features in a rule as are needed.

E.g. In *English*, all *voiced fricatives* can be realized as *voiceless* at the *end* of an utterance.

<i>save</i> /serv/	[sɛɪf], [sɛɪv]
<i>bathe</i> /beɪð/	[beɪθ], [beɪð]
<i>maze</i> /meɪz/	[meɪs], [meɪz]
<i>rouge</i> /ʁuʒ/	[ʁu], [ʁuʒ]




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 **When and How to Use Features in Writing Rules** 

❖ **Final Fricative Devoicing**

$\left[\begin{array}{l} -\text{sonorant} \\ +\text{continuant} \\ +\text{voice} \end{array} \right] \rightarrow [-\text{voice}] / \text{] Utterance} \quad (\text{optional})$



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So, there are good reasons to include only just as many features that are needed. So, in English all voiced fricatives can be realized as voiceless at the end of utterance. So, save and bathe and maze etcetera. And final fricative devoicing can be just shown as plus voice going to minus voice at the end of an utterance.

(Refer Slide Time: 26:33)

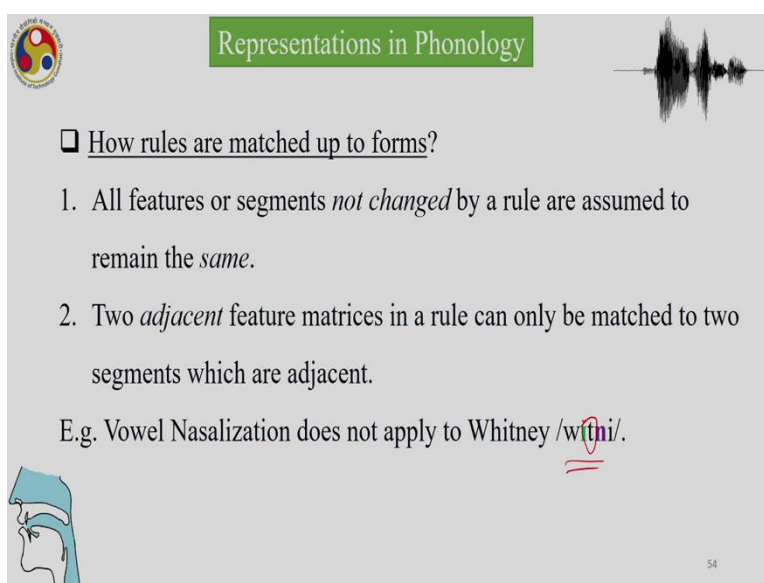
When and How to Use Features in Writing Rules

- Simplifying rules through vacuous application
 - Fricative Devoicing can be made even simpler:
- ❖ Final Fricative Devoicing (shortened)
 - This rule would apply also to *voiceless fricatives* and “devoice” them, making no change at all.

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And simplifying rules through vacuous application. Fricative devoicing can be made even simpler. So, how do you make it simpler? We just say that sonorant minus sonorants become voiceless at the end of an utterance. This rule would apply to voiceless fricatives and devoice them. So, we are not saying anything about the voicing of voice property of minus sonorants, because we want to show that it loses a voice. So, this will also apply to voiceless fricatives and devoice them by saying this we mean that there is no change at all.

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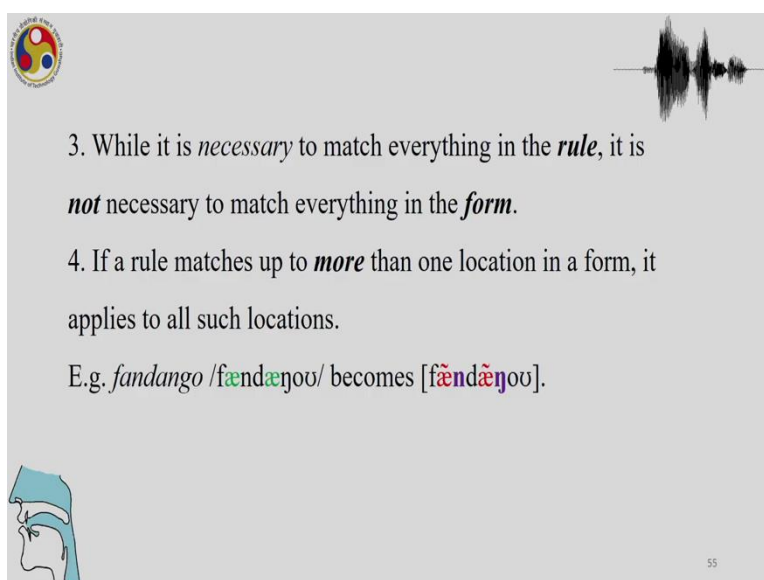
Representations in Phonology

□ How rules are matched up to forms?

1. All features or segments *not changed* by a rule are assumed to remain the *same*.
2. Two *adjacent* feature matrices in a rule can only be matched to two segments which are adjacent.

E.g. Vowel Nasalization does not apply to Whitney /wɪtʰni/.

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Representations in Phonology


3. While it is *necessary* to match everything in the *rule*, it is *not* necessary to match everything in the *form*.
4. If a rule matches up to *more* than one location in a form, it applies to all such locations.

E.g. *fandango* /fændæŋoʊ/ becomes [fændæŋoʊ].


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So, how are rules matched up to forms? All features or segments not changed by rule are assumed to remain the same. Two adjacent feature matrices in a row can only be matched to two segments which are adjacent. So, this rule of locality is important. Vowel Nasalization does not apply to Whitney, why not because there is a t in between, so adjacent features. While it is necessary to match everything in the rule, it is not necessary to match everything in the form. So, if a rule matches up to more than one location in a form, it applies to all such locations.

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A Feature Set: Preliminaries




□ **The goal of characterizing natural classes**


- There are natural classes that are broader than the IPA categories, i.e. the feature [sonorant].
- *Stops, fricatives, and affricates* are [-sonorant] and all other sounds are [+sonorant].




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A Feature Set: Preliminaries



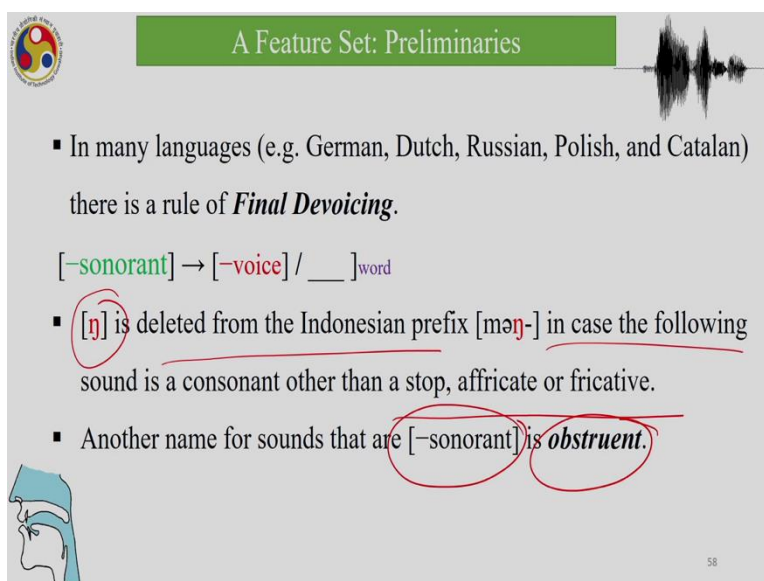
- In Spanish, Japanese, Swahili, and other languages, the class of stops, fricatives, and affricates ([-sonorant]) bears the phonemic contrast for **voicing**.
- Many languages (e.g. *French, Catalan, Russian, Polish, Maltese Arabic*) have a rule of **Voicing Assimilation**. (a consonant is assigned the same *voicing* as an immediately following consonant).
- The set of triggering consonants and those which undergo the rule are restricted to the class of [-sonorant].



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So, the goal of categorizing natural classes is that are broader than the IPA categories, the features sonorant. Stops, fricatives, affricates are minus sonorant, and all the sounds are plus sonorant. In Spanish, Japanese, Swahili, and other languages, the class of stops, fricatives, affricates bears the phonemic contrast voicing many languages have a voicing assimilation rule. And a consonant is assigned the same voicing as an immediately following consonant. And the set of triggering consonants and those which undergo the rule are restricted to class of minus sonorant.

(Refer Slide Time: 28:28)



A Feature Set: Preliminaries

- In many languages (e.g. German, Dutch, Russian, Polish, and Catalan) there is a rule of *Final Devoicing*.

$[-\text{sonorant}] \rightarrow [-\text{voice}] / ___]_{\text{word}}$

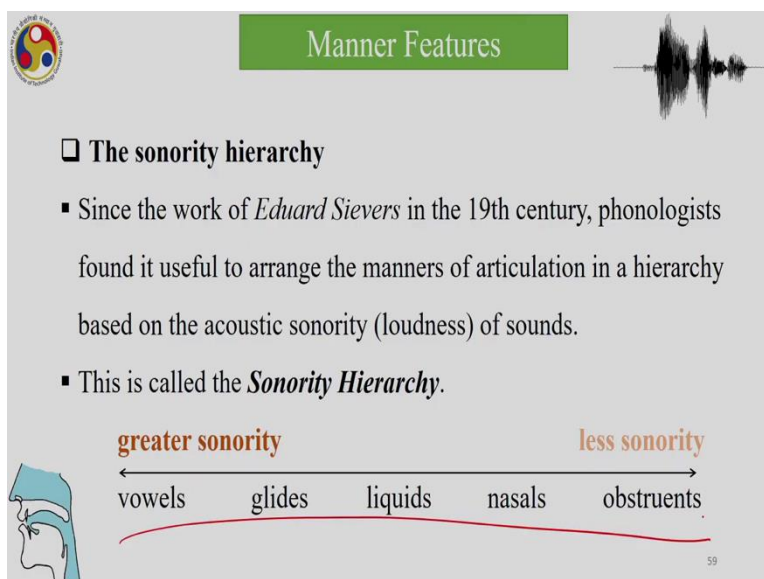
- $[\eta]$ is deleted from the Indonesian prefix $[\text{m}\eta\text{n}-]$ in case the following sound is a consonant other than a stop, affricate or fricative.
- Another name for sounds that are $[-\text{sonorant}]$ is *obstruent*.

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In many languages, example German, Dutch, Russian, Polish, and Catlin, there is a rule of final devoicing, so minus sooner and goes to minus voice, the end of a word and n is deleted from the Indonesian prefix man in the in case the following sound is a consonant as a stop, affricate or fricative.

So, n is deleted from prefix in case the following sound is a consonant other than a stop, fricative, or affricate. So, another name for those sound are minor sonorant, obstruent. So, n is deleted from an Indonesian prefix man in case the following sound is a minus sonorant or obstruent is a rule.

(Refer Slide Time: 29:12)



Manner Features

- The sonority hierarchy
- Since the work of *Eduard Sievers* in the 19th century, phonologists found it useful to arrange the manners of articulation in a hierarchy based on the acoustic sonority (loudness) of sounds.
- This is called the *Sonority Hierarchy*.

greater sonority ← → less sonority

vowels glides liquids nasals obstruents

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The sonority hierarchy which we have seen in the previous lecture also, since the work of Eduard Sievers in 19th century, phonologists found it useful to arrange the manners of articulation in a hierarchy based on the acoustic loudness of sounds and this is called the sonority hierarchy. So, greatest minority and less minority, vowels, glides, liquids, nasals, obstruents is a hierarchy.

(Refer Slide Time: 29:38)

Manner Features

- The natural classes found in phonological rules consist of some *contiguous set* of manner types drawn from the hierarchy, e.g. {vowels, glides, liquids}.
- Noncontiguous sets, like {glides, nasals}, seldom pattern as natural classes.
- To capture this pattern four features are adopted.
[sonorant], [syllabic], [consonantal], and [approximant].

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Manner Features

- Table 1. The sonority hierarchy

vowels	Glides	Liquids	Nasals	Obstruents
[+syllabic]	[-syllabic]			
[-consonantal]		[+consonantal]		
[+approximant]			[-approximant]	
[+sonorant]				[-sonorant]

- In this system, all of the contiguous sets along the hierarchy are expressible as natural classes, e.g. glides, liquids, and nasals with the formula [-syllabic, +sonorant].

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The natural classes found in phonology rules consist of some contiguous set of manner types drawn from the hierarchy example, vowels, glides, and liquids. So non-contiguous sets like glides, nasals, which means here, glides and nasals are non-contiguous. You have liquids between them, then they never pattern as natural classes and to capture this pattern four features are adopted sonorant, syllabic, consonantal, and approximant.

And this is the sonority hierarchy. In this system, all of the contiguous sets along the hierarchy are expressible as natural classes, glides, liquids, and nasals with a formula minus syllabic plus sonorant.

(Refer Slide Time: 30:21)

Reconstructing the traditional manner categories

vowel = [+syllabic]

glide = [-syllabic, -consonantal]

liquid = [+consonantal, +approximant]

nasal = [-approximant, +sonorant]

obstruent = [-sonorant]

So, vowel is plus syllabic, glide is minus syllabic minus consonantal, liquid is plus consonantal plus approximant, nasal is minus approximant plus sonorant, obstruents are minus sonorant. So, this is your most important traditional manner categories.

(Refer Slide Time: 30:40)

Syllabic consonants

- Every syllable has a *nucleus*, which is its most sonorous segment.
- Segments forming the nucleus of a syllable are classified as [+syllabic], the remaining segments as [-syllabic].
- Syllabic liquids and nasals* occur in many languages, e.g. *Serbo-Croatian* [tʃg] 'square' or the last sound of *English* (casual speech) button ['bʌtn].

Syllabic consonants every syllable has a nucleus, which is its most sonorous segment. Segments forming the nucleus of a syllable are classified as plus syllabic, the remaining

segments is minus syllabic. And syllabic liquids and nasals occur in many languages example Serbo-Croatian *trg* 'square' or the last sound of English *button*, so here consonants like syllabic, liquids, and nasals the nucleus of syllable.

(Refer Slide Time: 31:12)

Manner Features

syllabic liquid = [+syllabic, +consonantal, +approximant]

syllabic nasal = [+syllabic, -approximant, +sonorant]

- Syllabic fricatives and stops are quite rare (occur in *Berber languages*)
- *Syllabic glides*, they are the same thing as vowels.
- Syllabic [j] is a rather strange way of describing the vowel [i].
- [ɹ̥] “rhotacized schwa” is used as an equivalent of “syllabic r.” (in IPA is [ɹ̥]).

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So, syllabic liquids even though they are liquids and consonants, they will have the feature of being plus syllabic. So, syllabic fricatives and stops are quite rare. They occur in languages like Berber and some slavic languages, and syllabic guides are the same thing as vowel syllabic j is rather strange way of describing the vowel I, rhoticized schwas used as an equivalent of syllabic r.

(Refer Slide Time: 31:40)

Manner Features

Sonority sequencing

- The Sonority Hierarchy, expressed with the manner features, has a role of governing the legal sequencing of speech sounds.

E.g. Languages which permit clusters of consonants at the margins of syllables (English *trance*).

trance: [t **ɪ** **æ** n s]

obstruent liquid **vowel** nasal obstruent

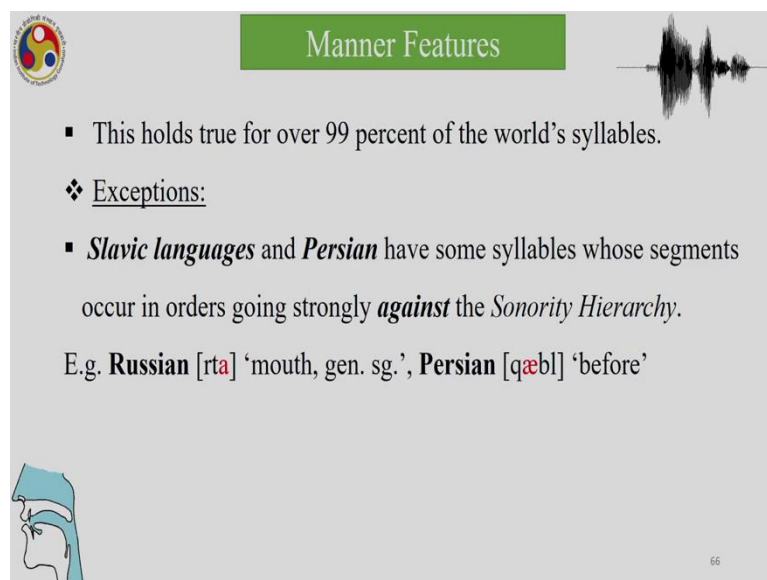
greater sonority ← nucleus → greater sonority

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The sonority hierarchy expressed with the manner features has a rule of governing the legal sequence of speech sounds, example languages, which permit clusters of consonants at the margins of syllables. So, this is word trans, where vowel is the nucleus and we can see the sonority is increasing with the placement of the liquid after the obstruent and sonority has to decrease ideally in the end of a consonant and we have trans and then we have a nasal here.

However, the s in English does not follow the rules of syllabification in English, because we have many clusters in English which start with s and s has greater sonority than the obstruent for instance, t. So, in that way, for instance, t violates its sonority hierarchy. And because this is more sonorous and the sonority should increase, but it is considered to be an exception.

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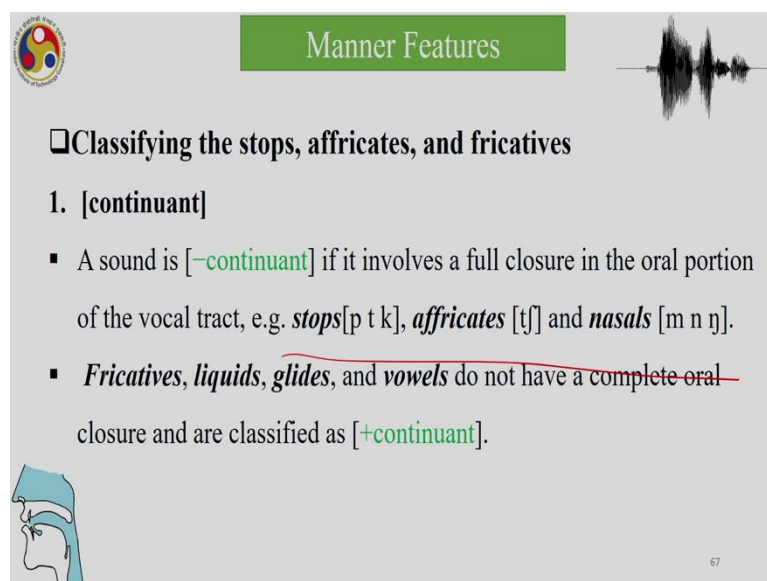


Manner Features

- This holds true for over 99 percent of the world's syllables.
- ❖ Exceptions:
- *Slavic languages* and *Persian* have some syllables whose segments occur in orders going strongly *against* the *Sonority Hierarchy*.

E.g. **Russian** [rta] 'mouth, gen. sg.', **Persian** [qæbl] 'before'

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Manner Features

□ **Classifying the stops, affricates, and fricatives**

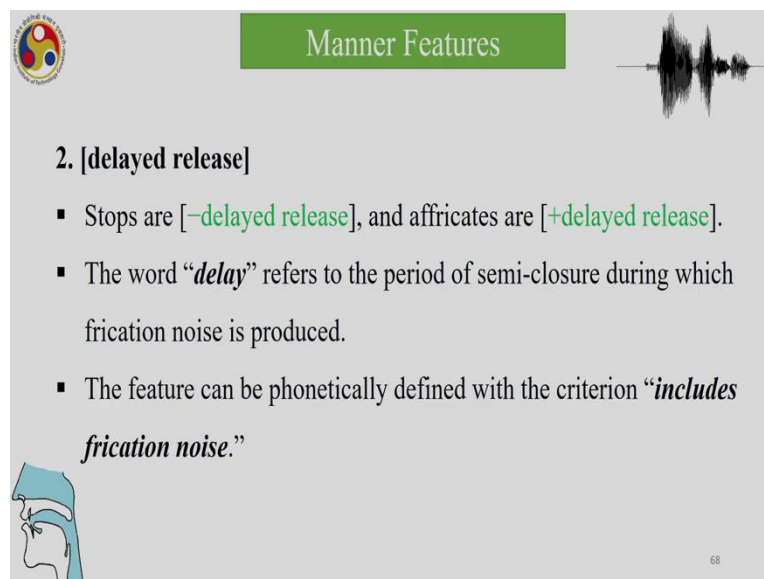
1. [continuant]

- A sound is [-continuant] if it involves a full closure in the oral portion of the vocal tract, e.g. *stops* [p t k], *affricates* [tʃ] and *nasals* [m n ŋ].
- *Fricatives, liquids, glides, and vowels* do not have a ~~complete oral~~ closure and are classified as [+continuant].

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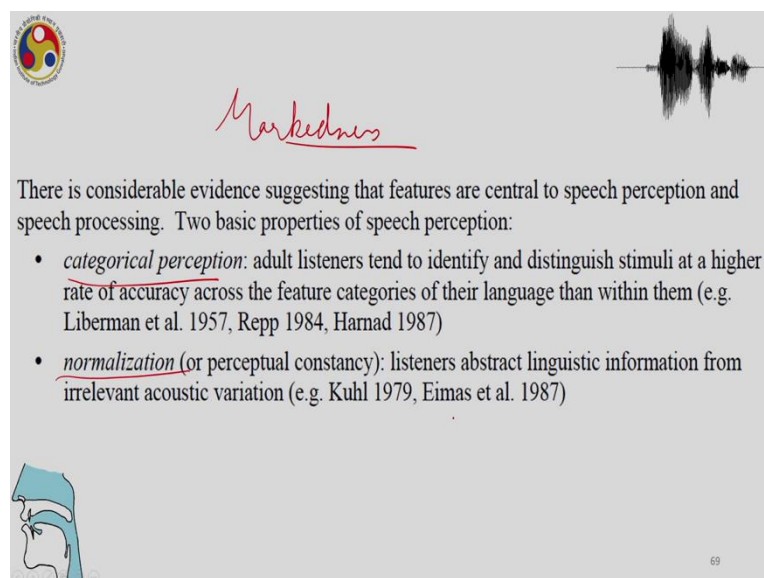
So, this holds true for over 99 percent of the worlds syllables, there are some exceptions like Slavic languages and Persian have some syllables whose segments occur in orders going strongly against sonority hierarchy. And then we have continuant which is most important when we talk about stops, affricates, and nasals. So, what is minus continuant? Stops are minus continuants and all these are belonging to category of minus continuant and fricatives, liquids, glides belong to category of plus continuant.

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2. [delayed release]

- Stops are [-delayed release], and affricates are [+delayed release].
- The word “*delay*” refers to the period of semi-closure during which frication noise is produced.
- The feature can be phonetically defined with the criterion “*includes frication noise.*”



Markedness

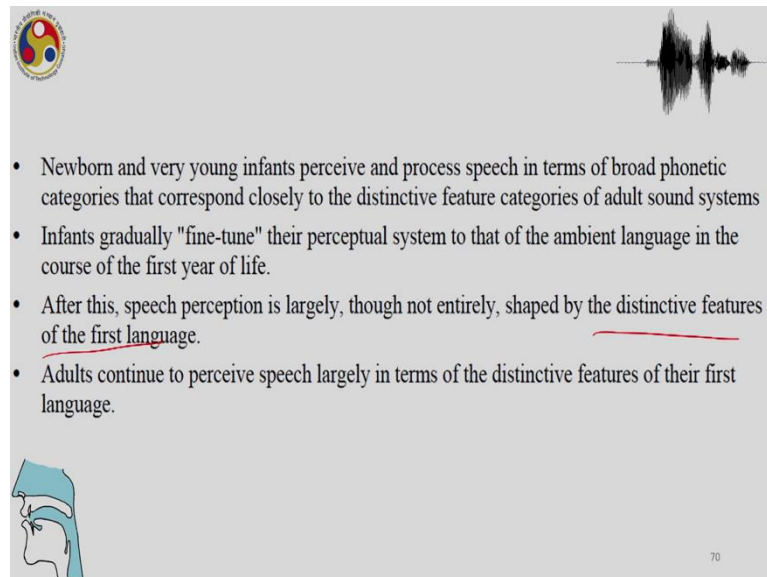
There is considerable evidence suggesting that features are central to speech perception and speech processing. Two basic properties of speech perception:

- categorical perception: adult listeners tend to identify and distinguish stimuli at a higher rate of accuracy across the feature categories of their language than within them (e.g. Liberman et al. 1957, Repp 1984, Hamad 1987)
- normalization (or perceptual constancy): listeners abstract linguistic information from irrelevant acoustic variation (e.g. Kuhl 1979, Eimas et al. 1987)

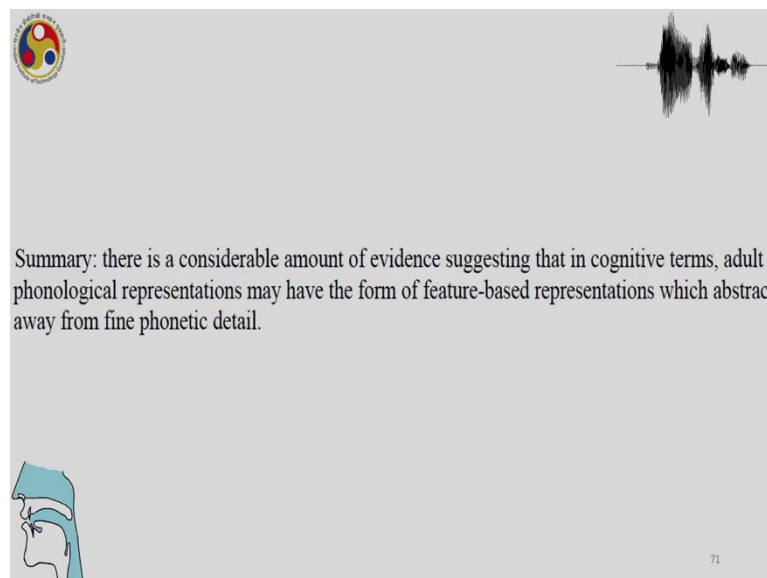
Delayed release stops or minus delayed release, affricates are plus delayed release. So, this is revision of what we have seen already, the feature can be phonetically defined with the criterion includes frication and noise. So, we have come to the end of discussion of our discussion on features. So, I will say a few words about something called Markedness.

So, there is considerable evidence suggesting that features are central to speech perception and speech processing, two basic properties of speech perception and categorical perception which we have seen in our lectures on categorical perception and normalization, that is, listeners, abstract, linguistic information from irrelevant acoustic variation.

(Refer Slide Time: 34:06)



- Newborn and very young infants perceive and process speech in terms of broad phonetic categories that correspond closely to the distinctive feature categories of adult sound systems
- Infants gradually "fine-tune" their perceptual system to that of the ambient language in the course of the first year of life.
- After this, speech perception is largely, though not entirely, shaped by the distinctive features of the first language.
- Adults continue to perceive speech largely in terms of the distinctive features of their first language.

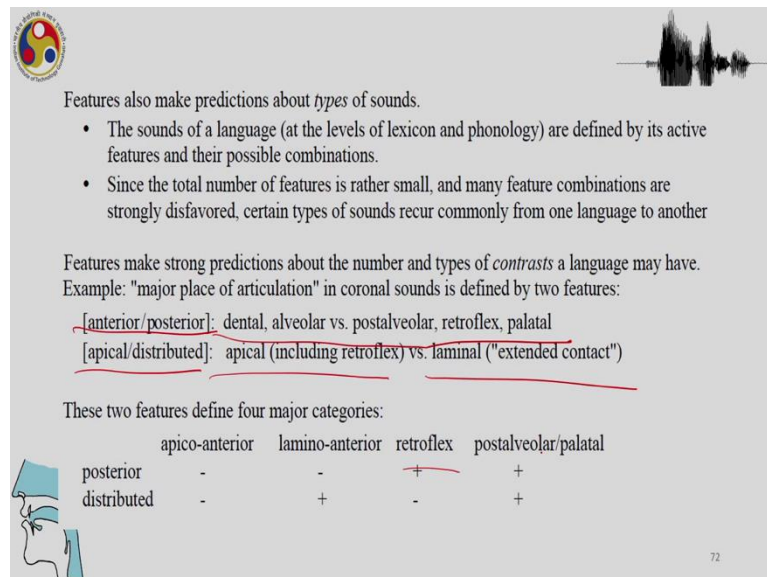


Summary: there is a considerable amount of evidence suggesting that in cognitive terms, adult phonological representations may have the form of feature-based representations which abstract away from fine phonetic detail.

So, a newborn and very young infants perceive and process speech in terms of broad phonetic categories that correspond closely to the distinctive feature categories of adult sound systems. Infants gradually fine-tune their perceptual system to that of the ambient language. And after this, speech perception is largely shaped by distinctive features of the first language and adults continue to perceive speech largely in terms of distinctive features of their first language.

So, there are a considerable amount of evidence suggesting that in cognitive terms, adult phonological representations have the form of feature-based representations, which abstract away from fine phonetic detail.

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Features also make predictions about *types* of sounds.

- The sounds of a language (at the levels of lexicon and phonology) are defined by its active features and their possible combinations.
- Since the total number of features is rather small, and many feature combinations are strongly disfavored, certain types of sounds recur commonly from one language to another

Features make strong predictions about the number and types of *contrasts* a language may have.
 Example: "major place of articulation" in coronal sounds is defined by two features:

[anterior/posterior]: dental, alveolar vs. postalveolar, retroflex, palatal
 [apical/distributed]: apical (including retroflex) vs. laminal ("extended contact")

These two features define four major categories:



	apico-anterior	lamino-anterior	retroflex	postalveolar/palatal
posterior	-	-	+	+
distributed	-	+	-	+

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Features also make predictions about types of sounds. The type of sounds of a language, at the levels of lexicon and phonology are defined by its active features and their possible combinations. And features make strong predictions about the number and types of contrast a language may have. Example, major place of articulation in coronal sounds is defined by two features, anterior and posterior.

So, dental alveolar versus post alveolar, retroflexes, palatal, these can be divided along lines of anterior posterior or minus anterior plus anterior and apical distributed, apical including retroflexes versus laminal. So, we have seen these differences and we have also seen the difference between apico-anterior and the laminal-anterior, retroflexes, post-alveolar, etcetera.


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Phonetic theory, by providing a much larger set of different place distinctions within this region (at least seven: "apico-dental", "apico-alveolar", "lamino-dental", "lamino-alveolar", "palato-alveolar", "retroflex", and "palatal"), projects a much larger number of contrasts:

	Max(sounds)	Max(contrasts)
a. feature theory	4	6
b. traditional phonetic theory	7	21

Table 1. Maximum number of sounds and contrasts predicted by (a) a feature system recognizing two coronal features, and (b) a traditional phonetic theory recognizing seven coronal categories. Contrasts = $(S * S - 1) / 2$, where S = number of sounds.





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So, phonetic theory by providing a much larger set of different place distinctions within this region, projects a much larger number of contrasts. However, phonology predicts the right number of contrasts, which are available in the world's languages.


So maximum number of sounds and contrasts predicted by a) feature system recognizing two coronal features here and b) a traditional phonetic theory recognizing seven coronal categories which we saw in our lectures on articulatory phonetics, where we saw seven coronal categories, but if they were all present, then the max number of contrasts should have been 21. However, the phonology shows the right number of contrasts under the feature system, predicts the right number of contrasts.

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All 6 contrasts projected by feature theory are attested in both simple plosives and affricates (strident plosives):

contrast:	example:	found in e.g.:
apical anterior vs. laminal anterior	apical <i>t</i> vs. laminal <i>t</i>	Temne
apical anterior vs. apical posterior	apical <i>t</i> vs. retroflex <i>ɽ</i>	Yanyuwa
apical anterior vs. laminal posterior	apical <i>t</i> vs. palatal <i>c</i>	Arremte
laminal anterior vs. apical posterior	laminal <i>t</i> vs. retroflex <i>ɽ</i>	Arremte
laminal anterior vs. laminal posterior	laminal <i>t</i> vs. palatal <i>c</i>	Hungarian
apical posterior vs. laminal posterior	retroflex <i>ɽ</i> vs. palatal <i>c</i>	Sindhi



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Features also make predictions about *types* of sounds.


- The sounds of a language (at the levels of lexicon and phonology) are defined by its active features and their possible combinations.
- Since the total number of features is rather small, and many feature combinations are strongly disfavored, certain types of sounds recur commonly from one language to another

Features make strong predictions about the number and types of *contrasts* a language may have.
 Example: "major place of articulation" in coronal sounds is defined by two features:



[anterior/posterior]: dental, alveolar vs. postalveolar, retroflex, palatal
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These two features define four major categories:

	apico-anterior	lamino-anterior	retroflex	postalveolar/palatal
posterior	-	-	+	+
distributed	-	+	-	+




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Phonetic theory, by providing a much larger set of different place distinctions within this region (at least seven: "apico-dental", "apico-alveolar", "lamino-dental", "lamino-alveolar", "palato-alveolar", "retroflex", and "palatal"), projects a much larger number of contrasts:

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So, all six contrasts predicted by feature theory are tested in both simple process and affricates. So, these are the different languages which we have also seen in our previous lectures in the distinction between apicals versus laminal, apicals versus retroflexes, laminal apicals, palatal laminal versus retroflexes, laminal, palatal, laminal versus palatal.

So, feature theory predicts because of these categories post alveolar, retroflexes, lamino-anterior, and apico-anterior which can be divided along the lines of plus distributed minus distributed, we will get only these features, we will not get the 21 predicted by the distribution according to phonetic detail.


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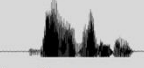
Markedness is understood here as the systematic avoidance of certain widely disfavored feature combinations (see esp. Trubetzkoy 1939, Jakobson 1941, Greenberg 1968, Chomsky & Halle 1968, Kean 1980, and Calabrese 1994, as well as Rice 2002 for a recent overview).

Markedness counteracts the free operation of feature economy.

- in the absence of markedness, sound systems making use of n features would be expected to display the theoretical maximum of 2^n sounds
- but no languages come anywhere close to approaching this maximum; instead, segments characterized by marked feature combinations tend to be absent



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Ideally, one would like to be able to predict the degree of markedness of any given feature combination from the general phonetic (i.e., biological, acoustic, aerodynamic) conditions that underlie the human capacity for speech production.

The problem is that phonetics provides an extremely rich set of interacting principles which frequently lead to conflicting expectations.

Consider, for example, the feature $[\pm\text{voiced}]$. Which value of this feature is marked in stops?

- $[+\text{voiced}]$ is marked in stops because it requires supplementary maneuvers to maintain the aerodynamic conditions required for vocal cord vibration during stop closure
- $[-\text{voiced}]$ is marked in stops because it requires a precise temporal coordination of independent articulatory structures (laryngeal and oral)

No independently-motivated general principle appears to exist that would allow us to predict the preference for one of these statements over the other in all cases.



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So, I will conclude this lecture with a word on markedness. So, markedness is understood here as a system of avoidance of certain widely disfavored feature combinations and markedness counteracts the free operation of feature economy. So, in the absence of markedness, sound systems made up of n features would be expected to display the theoretical maximum of 2 to the power of n features, but no languages come anywhere close to approaching this maximum, because of the number of feature combinations which you can have.

So, everything would be 2 to the power of n but no languages come anywhere close to approaching this maximum. Instead, segments characterized by marked feature combinations tend to be absent. So, feature combinations which are difficult in production in articulation are absent in languages of the world.

And so, ideally, one would like to be able to predict the degree of markedness of any given feature combination from the general phonetic conditions that underlie the human capacity for speech production. And the problem is that phonetics provides an extremely rich set of interacting principles, which frequently lead to some conflicting expectations.

So, for instance, plus minus voice, which of these features is marked in stops? So, plus voice is marked in stops because it requires supplementary manoeuvres to maintain the aerodynamic conditions required for vocal cord. Also, minus voice is marked because it requires very precise temporal coordination of your articulatory structure's laryngeal, and oral. So, no independently motivated general principle appears to exist that will allow us to predict a preference for one of these statements over the other in all cases.

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Universal occurrence: a feature is unmarked if it appears in the sound inventories of all languages; otherwise it is marked. Examples (from UPSID):

<i>all languages have:</i>	<i>some lack:</i>	<i>marked feature (in consonants):</i>
obstruent consonants	sonorant consonants	[+sonorant]
coronal consonants	labial, ¹ dorsal, ² pharyngeal, or laryngeal consonants	[labial], [dorsal], [pharyngeal]
oral consonants	nasal consonants ³	[+nasal]
stop consonants	continuant consonants ⁴	[+continuant]
unaspirated stops	aspirated consonants	[spread glottis]
nonglottalized stops	glottalized consonants	[constricted glottis]
anterior coronal stops	posterior coronal stops	[+posterior]
nonstrident coronals	strident coronals	[+strident]
simple consonants	consonants with secondary articulations	features of secondary articulation

So, a feature is unmarked if it appears in sound inventories of all languages. Otherwise, it is marked, so marked features in consonants plus all languages have obstruent consonants, some lack sonorant consonants. So, all languages have coronal consonants, some lack these labial, dorsal, pharyngeal, laryngeal or oral consonants, but can lack nasal consonant, stop consonants but can lack continuant consonants, unaspirated stops, there are unaspirated stops but aspirate can be missing, non-glottalized can be there, glottalized can be missing.

Anterior coronal stops can be their posterior can be missing, non-strident coronals are there, strident coronals can be missing in simple consonants, but articulatory consonant, secondary articulations are maybe not there in many languages.

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Wider Occurrence: a feature is unmarked if it occurs in the sound inventories of more languages than its contrary; otherwise, it is marked. Consider the feature [voiced]:

- voiceless obstruents occur in 99.1% of UPSID languages, while voiced obstruents are found in only 84.3%. [-voiced] is unmarked, [+voiced] is marked

Prepared with help from Clements (2004) Clements, G. N. (in press). The role of features in speech sound inventories. In Eric Raimy and Charles Cairns (eds.), Contemporary views on architecture and representations in phonological theory. Cambridge, MA: MIT Press.

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So, Wider Occurrence: a feature is unmarked if it occurs in the sound inventories of more languages, than it is contrary, otherwise it is marked. So, this is something we can assume to be correct for languages than the more a feature is preferred in languages, the more unmarked it is. So, voiceless obstruents occur in 99.1 percent of the UPSID languages, while voice substrings are found only in 84.3 percent of them.

So, minus voiced is unmarked plus voiced is marked. This part of the lecture was prepared with help from this paper by Clements 2004. So, thank you for your attention. And we will continue with phonology in the following lectures. Thank you.