Phonetics and Phonology: A broad overview
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Lecture 07
Linguistic Diversity - Conclusion

Welcome to this course in phonetics and phonology: a broad overview, a NPTEL MOOC course. I am Shakuntala Mahanta and I am continuing with the earlier classes on articulatory phonetics, acoustic phonetics and in this unit, you have been exposed to the variety of sounds in the world's languages. This is the third and final unit of sounds of the world's languages where we are talking about diversity in the world's languages.

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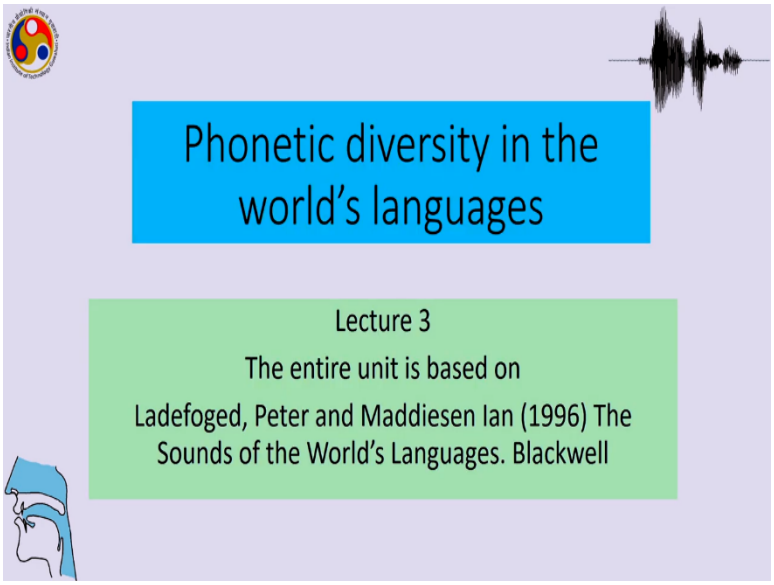

So, most of the unit is based on Ladefoged and Maddiesen, 1996, the sounds of the world's languages.

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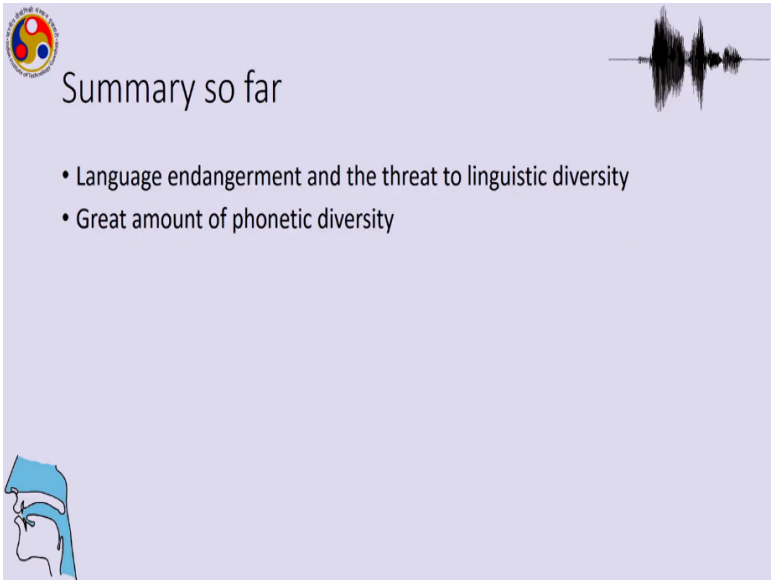

And we have so far looked at language endangerment and the threat to linguistic diversity and how a great amount of phonetic diversity will be lost once more and more languages disappear.

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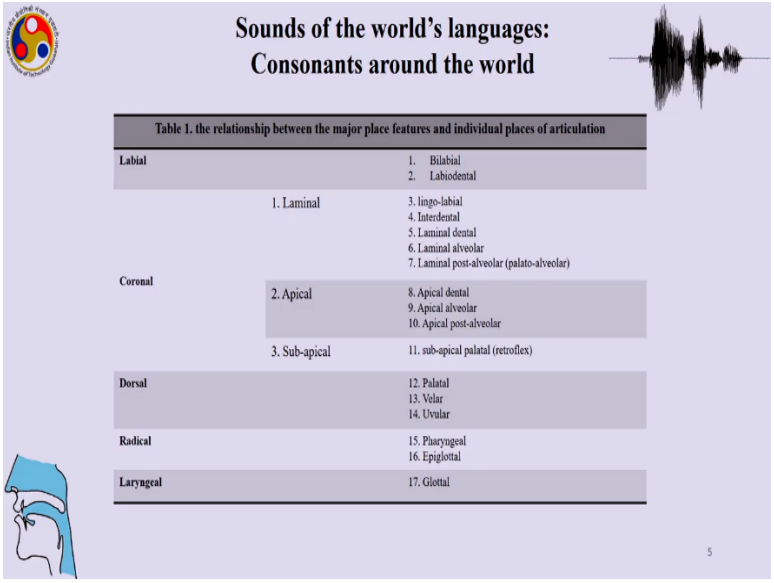

We have also summarized in last class about sound of the world's languages, how there are a wide variety of sounds apart from the sounds that you saw when we looked at English, which covered only a few labial, coronal and dorsal sounds. If you look at the languages of the world, then we find a wide variety among labial sounds where we can have bilabial, labiodental; among Laminal sounds, we can have lingo labial, the interdental, Laminal dental, Laminal alveolar, Laminal post alveolar.

Among apical sounds we have apical dental, apical alveolar, apical post alveolar, subapical retroflex sounds. And also dorsal sounds, among the dorsal sounds, we have palatal, velar,

Uvular. In radical we have pharyngeal and epiglottal and also in the laryngeal sounds we have glottal stops.

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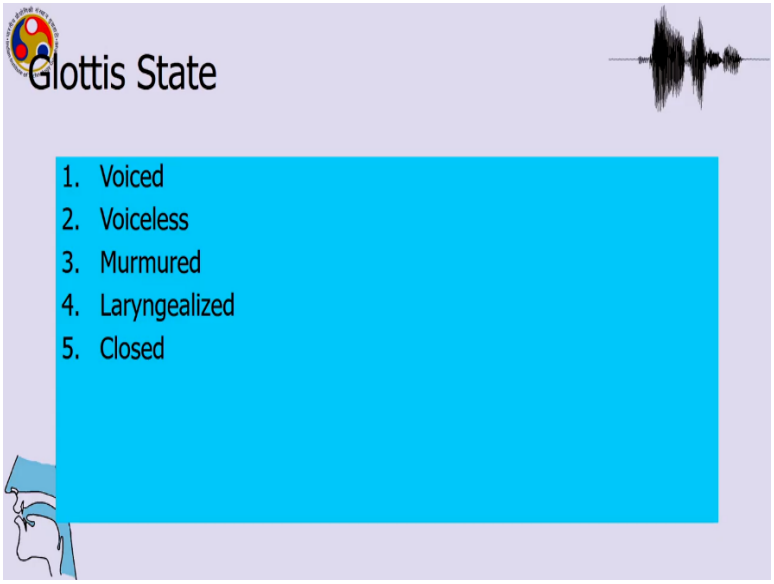

So, after summarizing this, we also said that the state of the glottis can be a few other states apart from the basic voiced and voiceless states. So, apart from voice and voiceless, we can have laryngealized sounds, we can have breathy sounds, etcetera.

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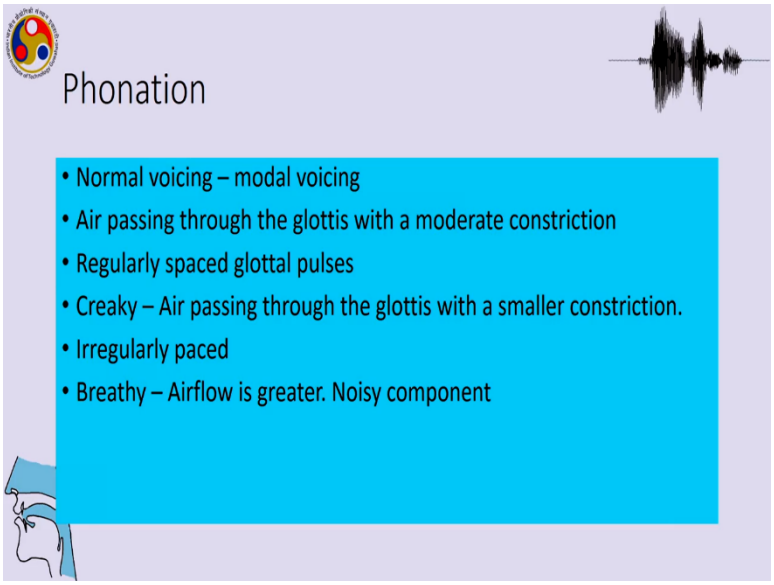

So, talking about the state of the glottis, what we will now call phonation and phonation involves couple of different types of sounds, phonation can give a special quality to vowels and consonants. So, when we talk about a phonation we have normal voicing, which is called modal voicing, in which air passes through the glottis with some moderate constriction and vocal cord vibration, of course, and regularly spaced normal vibration with glottal pulses.

Unlike that we have we can have creaky and breathy, which can also be called murmur, the breathy sound and the creaky involves air passing through the glottis with a smaller constriction and irregularly paced glottal pulses. So in breathy, sound airflow is greater and there is a noisier component in that sound. So we will look at these differences in this lecture and also look at how vowels can be different in languages of the world. And after that, we will wrap up this unit on the sound of the world's languages.

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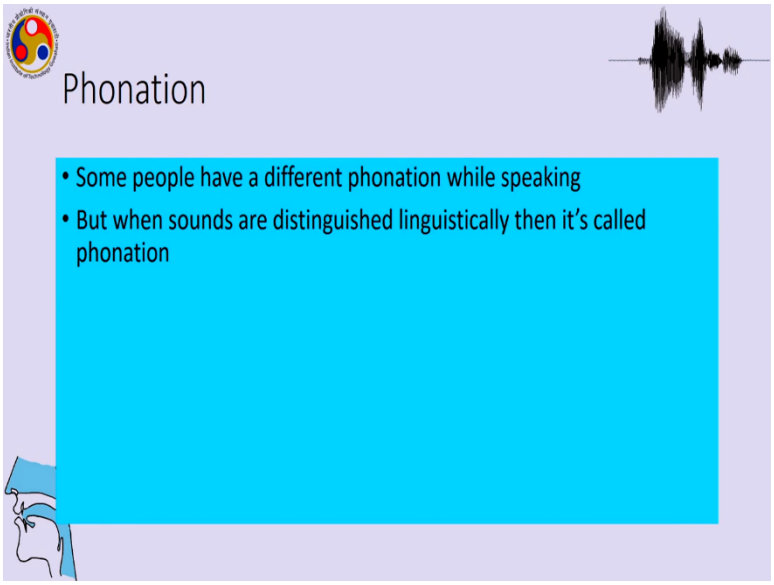

Talking about phonation some people have different phonations while speaking. So, you can hear that some people use their glottis to produce more breathy sounds, more creaky sounds, so depends on, so that those properties, which can be very idiosyncratic, can actually be linguistically distinguished in some languages and when that happens, that is called phonation.

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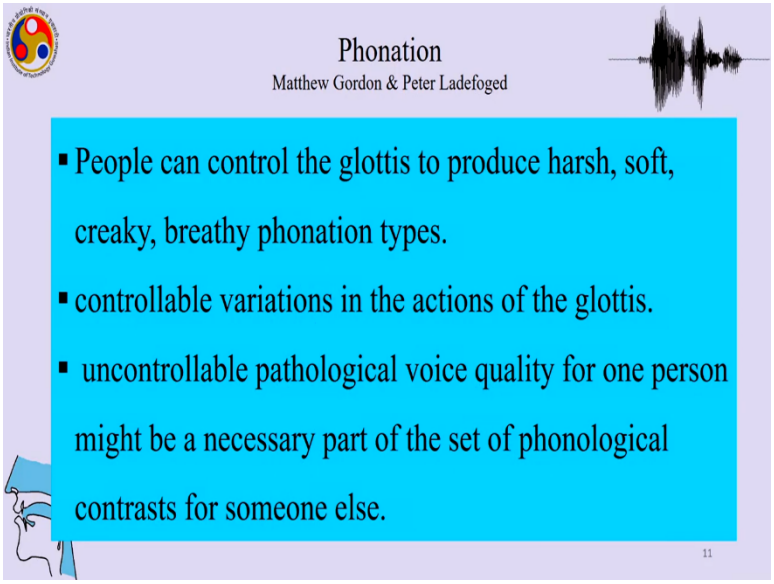

So, most of this section on phonation is based on Gordon and Ladefoged Peter. And just as we had just said, that people can control the glottis to produce harsh, soft and also different phonation types. And those are controllable variations. We will talk about those controllable variations. Also, very soon, however there can be some uncontrollable pathological voice quality. And what is pathological voice quality for one person actually could be a phonological contrast for some other languages.

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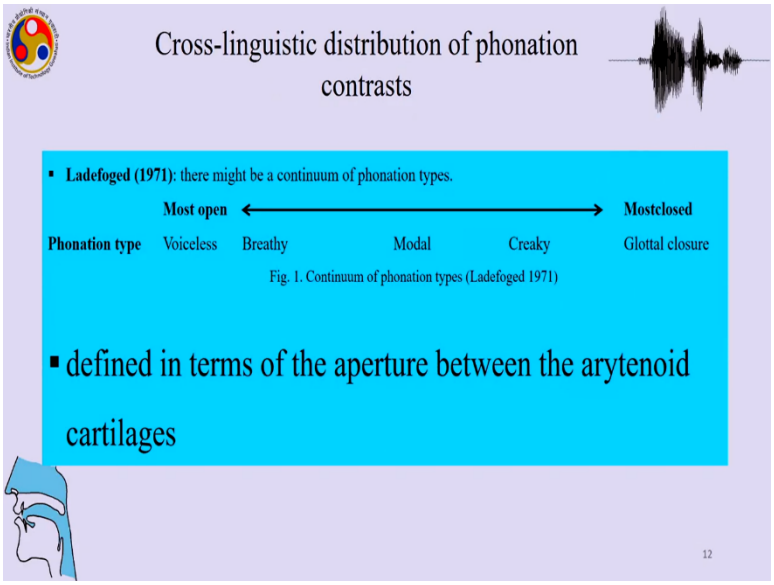

So, this is the cross linguistic distribution of phonation contrast that you see in front of you. This is from Ladefoged 1971, we see this is a simplistic diagram of the continuum of phonation types, so where you see the most open. So, this is all this is defined in terms of the aperture between the arytenoid cartilages of the larynx. So, here when aperture is as most open, we have a voiceless sound. And we know that in sound like p verses b, they are different based on voicing. But in between those two, between voiceless and modal voicing between p and b, we can have breathy sounds, where the aperture is not as open as voiceless, but not as close as modal.

And there can be some amount of noise which can be called breathiness. And between glottal closure for a glottal stop and modal voice and on one extent, we have the most closed gesture of the larynx of the two vocal chords in the most closed gesture and between the modal voicing, we can have creaky phonation. So, now we can see that between voiceless modal and glottal closure, we can have two very distinct phonation properties and language, there are languages of the world which contrasts based on those places in between in the continuum of phonation the types.

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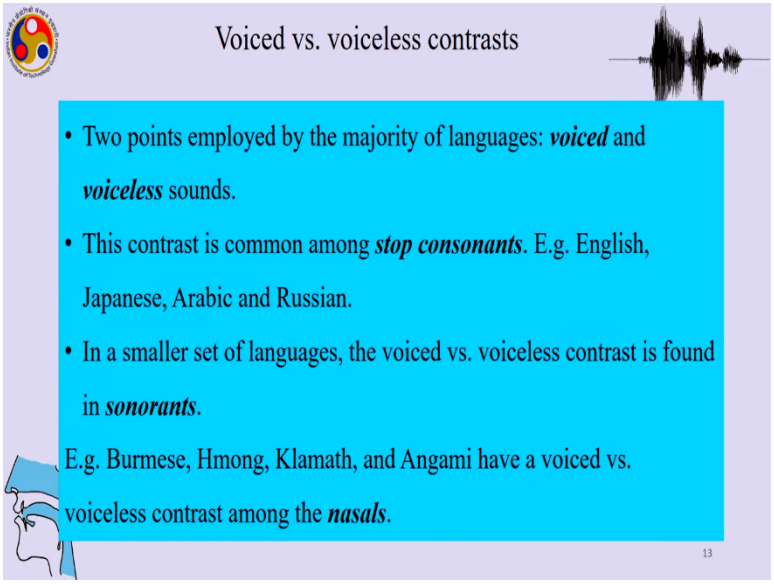

So, the two points employed by the majority of the languages for making a distinction in terms of the glottal state is voiced versus voiceless sounds. And the contrast is very clear and stop consonants also other obstruents, in a smaller set of languages we have voiced versus voiceless contrast.

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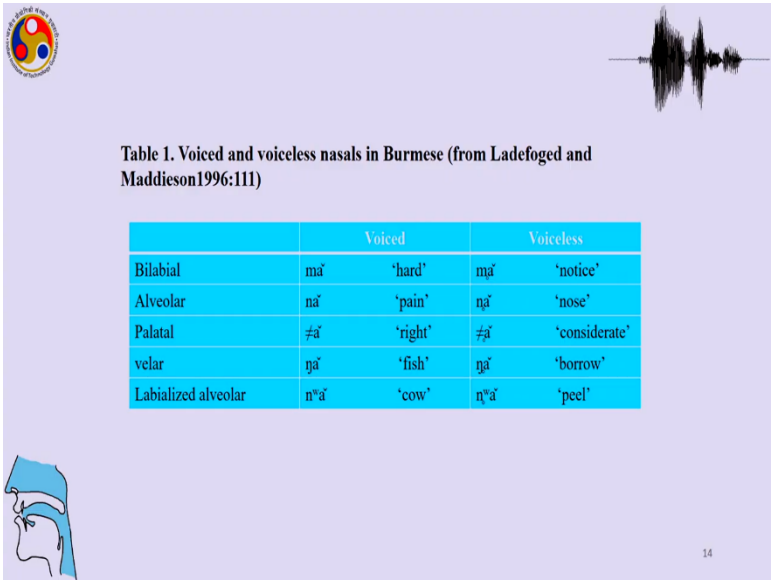

And in Burmese and we had already played these sounds before for Burmese voiceless nasals.

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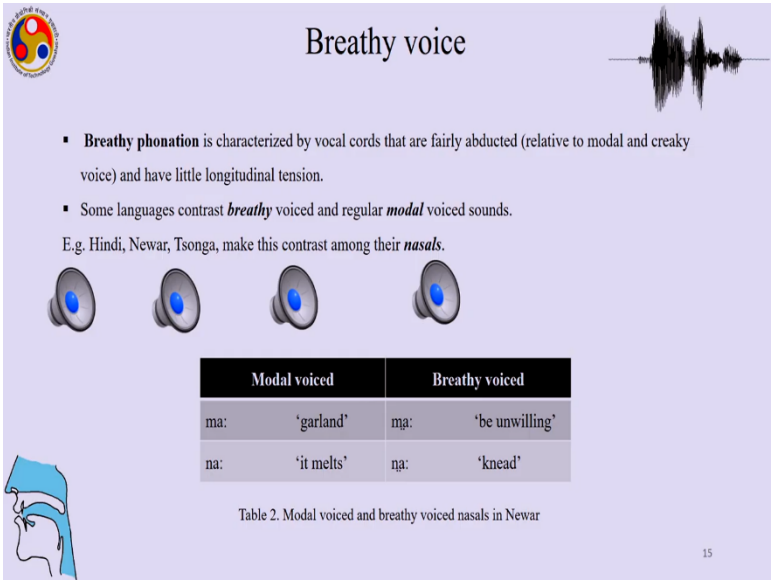

Now coming to breathy voiced, breathy phonation is characterized by vocal chords that are fairly abducted. So, we now from the continuum that you just saw, we saw that breathy occurs between the most open and the modal voicing. So, they have little longitudinal in the kind of tension that there is. And they are fairly open, not as open as voiceless, fairly open and have some tension, some languages contrast breathy voice and regular voice, regular modal voice sounds.

So, the examples I play here are from Newar, (pronouncing Newar). So, you hear this modal voice (pronouncing Newar) versus this voice (pronouncing Newar). And some languages contrast breathy voice and regular modal voice sounds which you just heard it from Newar, we have Ma which is Garland and the breathy voice Ma which is be unwilling.

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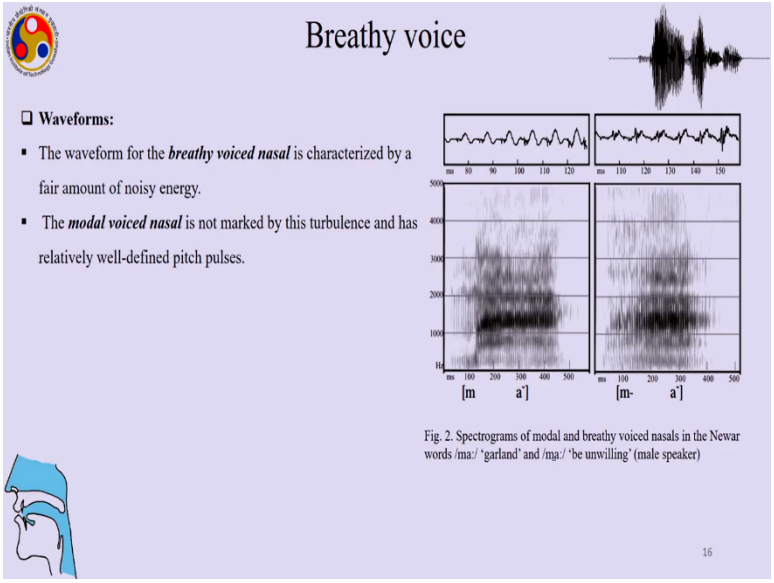

So, now let us look at the waveforms as to how they are different. The waveform for the breathy voice nasal is characterized by fair amount of noisy energy and that we had already mentioned.

And the modal voiced nasal is not marked by this turbulence and has relatively well-defined pitch pulses. This is the difference in terms of the spectrograms, you see that you have fairly well defined pitch pulses for the modal voice, nasal and irregularly paced atleast till the half of the sound for and then the regular pitch starts. And also, if you look at the waveform, the breathy voice, the difference, you can see around the transition to the vowel, you can see around 150 pulse.

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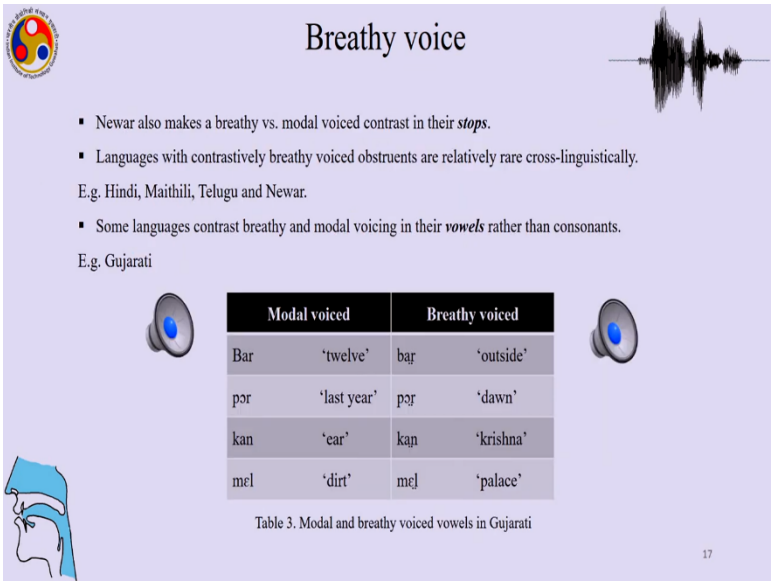

So, Newar also makes breathy verses modal voiced contrast in their stops. And there are many very languages which have breathy voice obstruents and relatively even though that is relatively rare cross linguistically, it is common in south Asia and quite a few of the largest big languages like Hindi, Maithili etcetera have breathy voice obstruents. And the contrast between breathy and modal voice stops. So, two sounds that I would play between the difference between modal voice and breathy voice, these two examples are from Gujarati. So, this is modal voice (pronouncing Gujarati) and this is breathy voice (pronouncing Gujarati).

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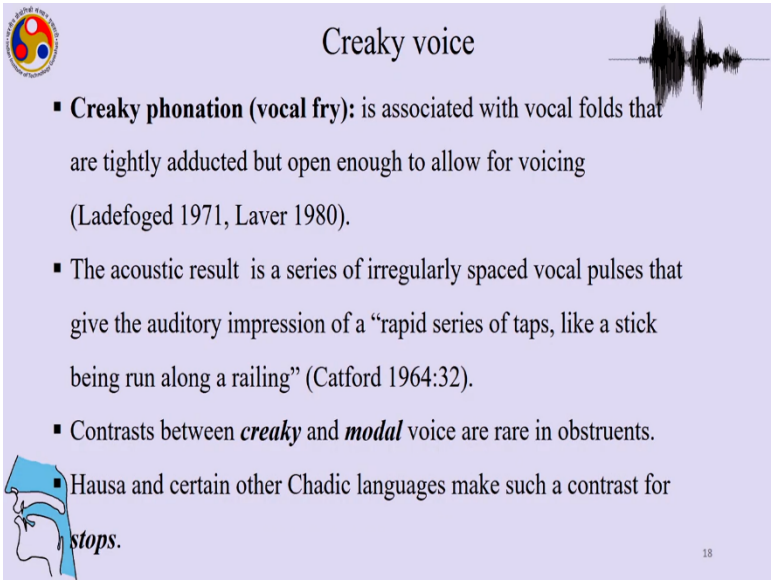

Now moving on to creaky voice which you saw in that continuum occurs between the most closed in the glottal aperture and between modal and the closed gesture, we have creaky voice, which is also called vocal fry. It is associated with vocal folds that are very tightly abducted. Remember that breathy was not very abducted. This is very tightly abducted, but open enough to allow for some voicing.

So, the result is a series of irregularly paced voiced pulses that give the impression of a series of taps like you can imagine what a series of taps will sound like with the sound, which sounds like tak, tak, tak. So, that is a tap series of tap sounds. Contrasts between creaky and modal voice are rare in obstruents. And Hausa and some other Chadic languages make such a contrast for stops.

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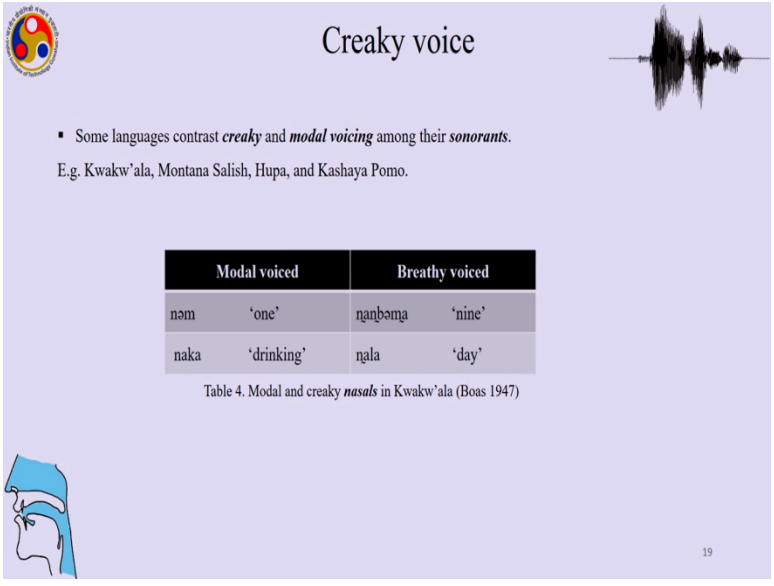

So, these are Kwakw'ala examples from Boas 1947.

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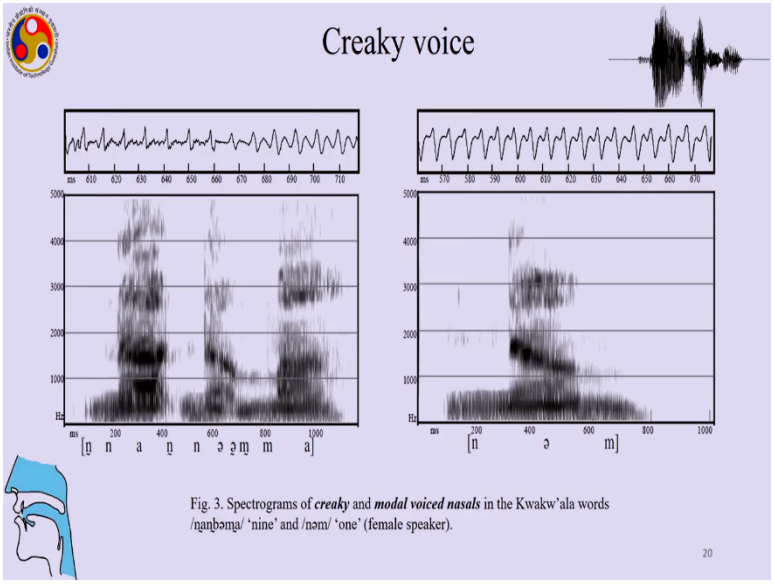

And you can see the spectrogram and wave forms here of creaky and modal voiced nasals. So, it is important to see here the difference between the irregularly paced pulses and the regular pulses. So, irregularly paced pulses are the distinguishing feature for creaky voice.

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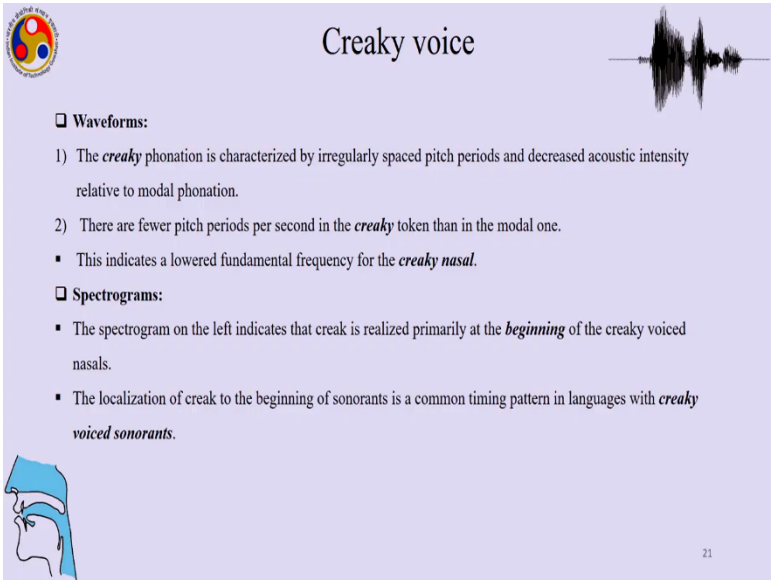

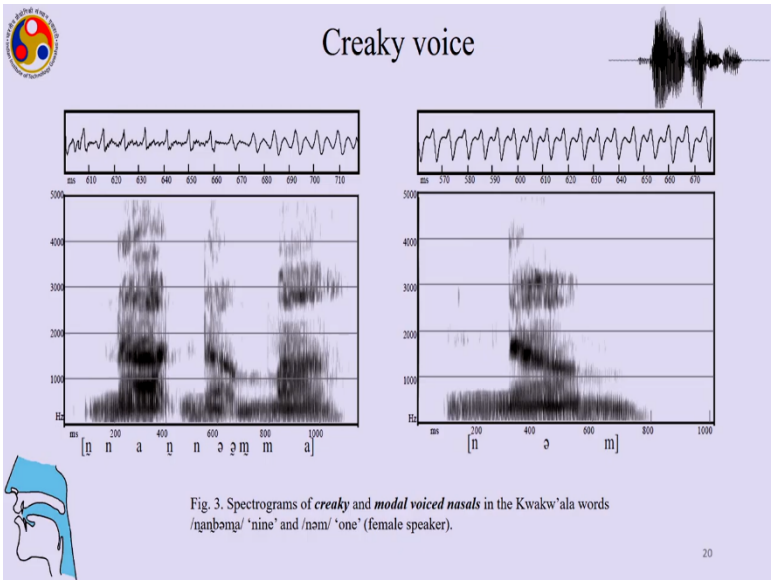

So, irregularly paced pitch periods which you just saw and decreased acoustic intensity, which you will also see here, the decrease in the acoustic intensity here. And there are fewer pitch periods per second in the creaky token than in the modal one. So, lowered fundamental frequency is one characteristic for creaky nasal. In the spectrogram also, we saw that the creak is realized at the beginning of a voice of the voiced nasal. And something very important when you talk about phonation is that there is a localization of these aspects of phonation. So, which means that it only is, it is localized to a certain part of the vowel or nasal.

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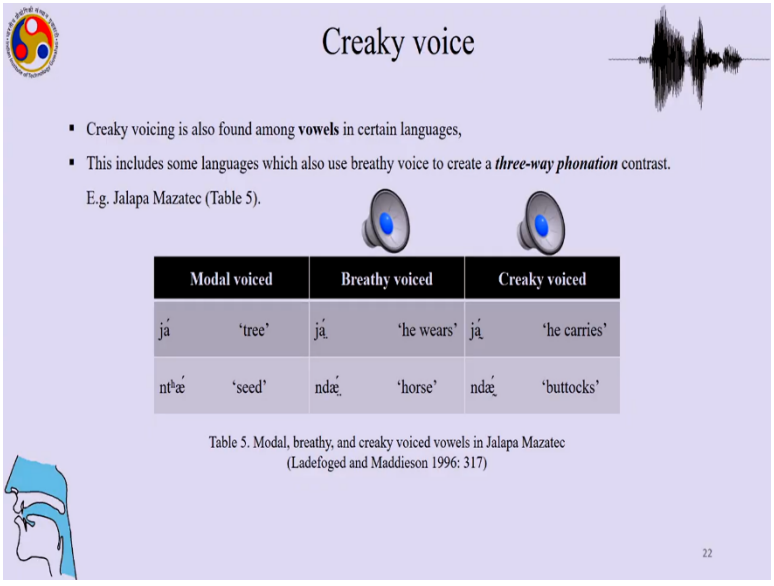

Creaky voicing is found among vowels in certain languages, and Jalapa Mazatec has a three-way phonation contrast. And we will play the breathy voiced and the creaky voice examples here, (pronouncing Jalapa Mazatec) versus the creaky voice (pronouncing Jalapa Mazatec).

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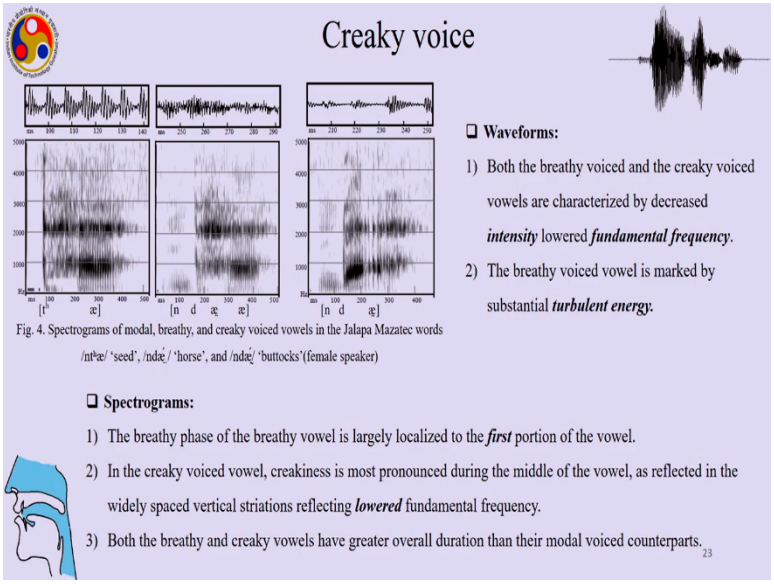

So, what are the characteristics of these types of phonation? Breathy voice and creaky voice vowels are characterized by decrease intensity and lowered fundamental frequency. So, the breathy voice vowel is marked by a very substantial, turbulent energy and in the spectrograms above, so we can see that here we have three examples of Jalapa Mazatec and we see that first we have the breathy voice and in the creaky voice vowels.

So we can see lowered intensity for both unlike the first one here, in the vowels we see the intensity. But here, wherever we have the creaky voice, the intensity goes down, creaky and breathy. And the breathy voice is also marked by turbulent energy. So, this is the modal and breathy and creaky. We see the energy going down and we also see that the breathy voice has more turbulent energy unlike the creaky voice.

The breathy pulse of the breathy vowel is largely localized to the first portion of the vowel we can see. And in the creaky voice, also creakiness is pronounced here in the middle part of the vowel, we can see it here as reflected in the widely spaced vertical striations reflecting lowered fundamental frequency. So, lowered fundamental frequency, irregularly paced vertical striations, these are the common properties of creaky voice.

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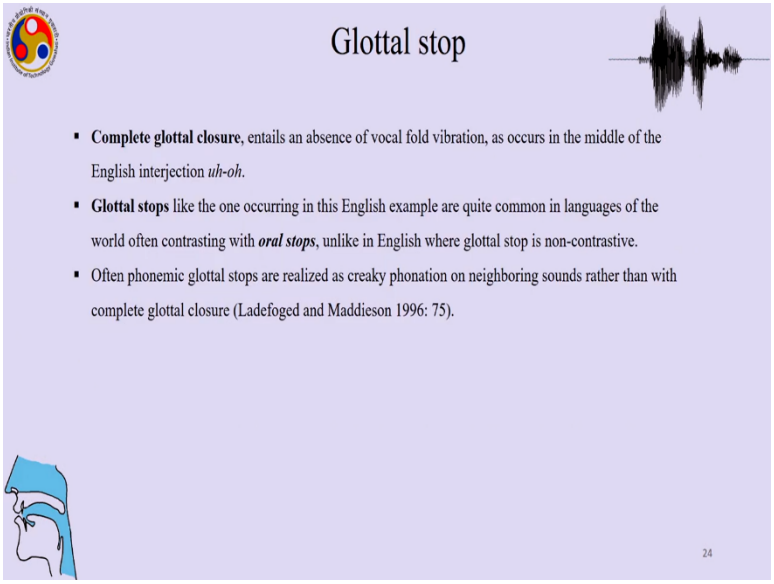

So, I like that in the continuum, if you remember, the glottal stop is the last in terms of its aperture closure. And so complete glottal closure entails an absence of vocal fold vibration as it occurs in the middle of the English interjection. So, it is common in English interjections. Lot of stops also occurs in English, contrasting with oral stops, sometimes in English they are not contrastive in other languages, they are contrastive with other stops.

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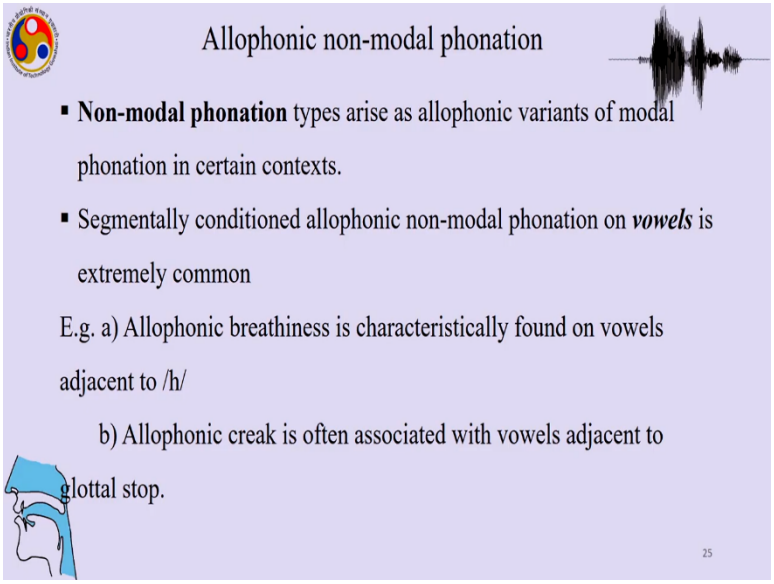

So, there can be also allophone non-modal phonation and like in English, the glottal stop. It can be allophonic and there can be variants of modal phonation in different contexts and segmentally conditional allophonic non-moral phonation vowels is extremely common. So, allophonic breathiness is characterized, characteristically found on vowels adjacent to the sound h and also allophonic creak is often associated with vowels adjacent to a glottal stop.

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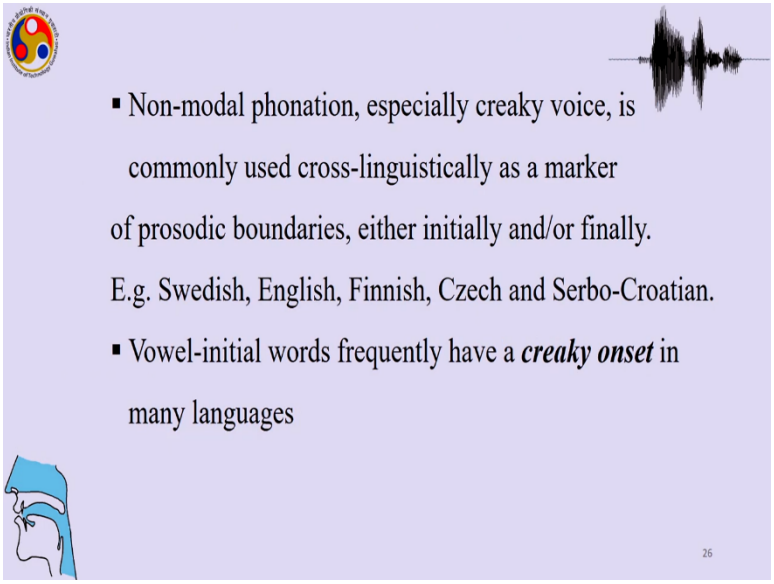

So, these occur allophonically which means they are determined by the context. Non-modal phonation especially creaky voice, is commonly used cross linguistically as a marker of prosodic boundaries, either initially or finally. So, just as we had mentioned in the beginning of the talk, there are conditionally determined occurrences of phonation and now we can see that prosodic boundaries are also some conditions which allow for the occurrence of phonation differences. And vowel initial words frequently have creaky onset in many languages.

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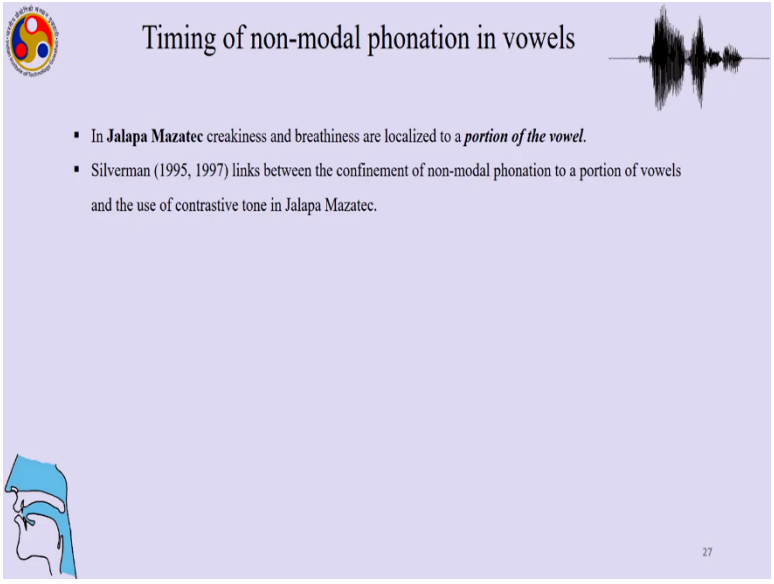

Again, recall, the Jalapa Mazatec creakiness and breathiness that we saw and that it is localized to only a portion of the vowel. And there have been many analysis of this. Silverman links this to the confinement of non-modal phonation to a portion of vowels and the use of contrastive tone in Jalapa Mazatec with Jalapa Mazatec also has tones. And this is sort of a trade-off.

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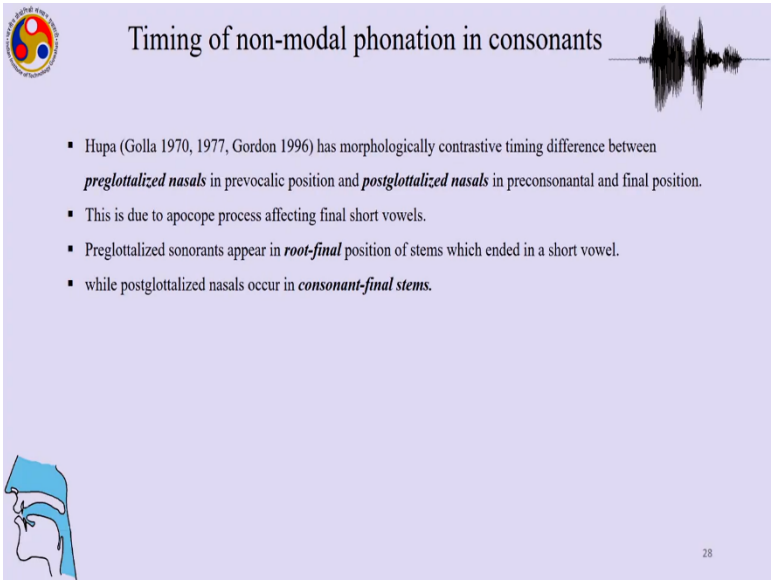

Ahupa has morphologically contrastive timing difference between preglottalized nasals in prevocalic position and postglottalized nasals in preconsonantal and final position. Preglottalized sonorants appear in root final position of stems, while postglottalized nasals occurring consonant final stems. So, there can be those differences as well. The timing of non-modal phonation consonant. It can be either preglottalized or postglottalized.

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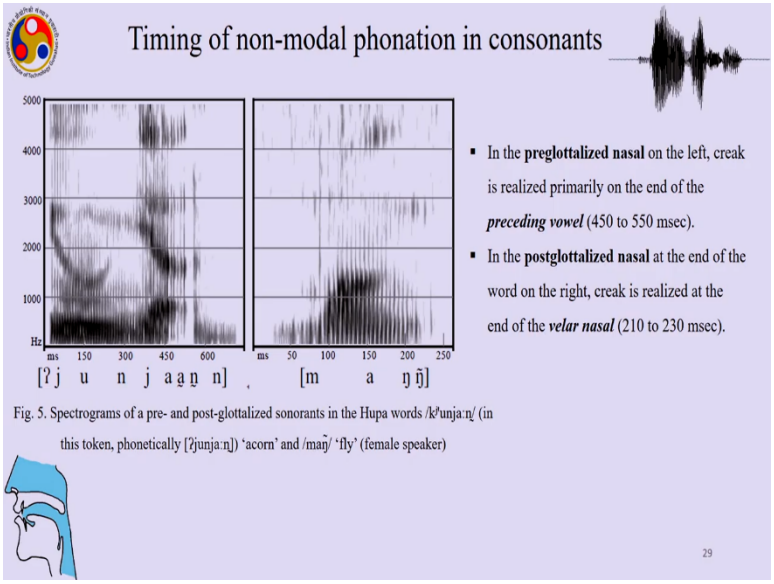

In the preglottalized nasal on the left, as we can see this, the creak is realized primarily on the end of the preceding vowel and in the postglottalized nasal at the end of the word creak is realized at the end of the velar nasal here.

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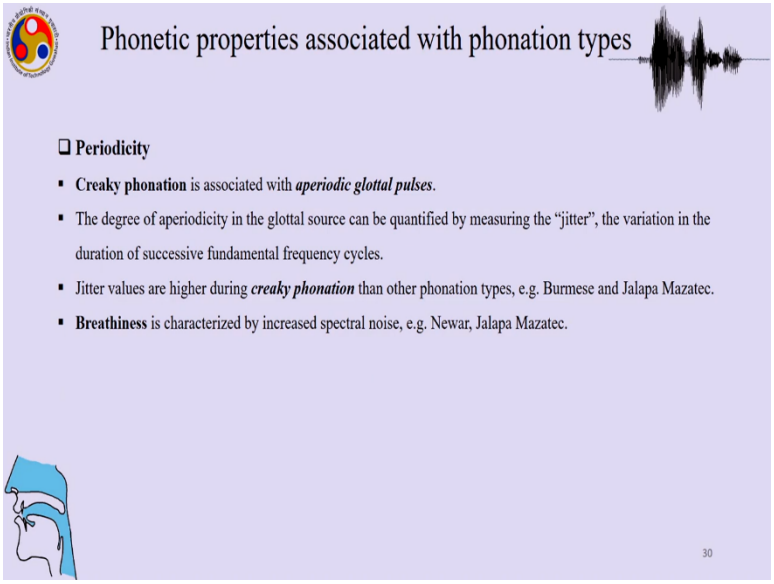

So, as we had already mentioned, creaky phonation is associated with aperiodic glottal pulses and the degree of aperiodicity in the glottal source is quantified by measuring jitter just a variation in the duration of successive fundamental frequency cycles. And jitter values are higher during creaky phonation and then other phonation types, and breathiness is characterized by increased spectral noise.

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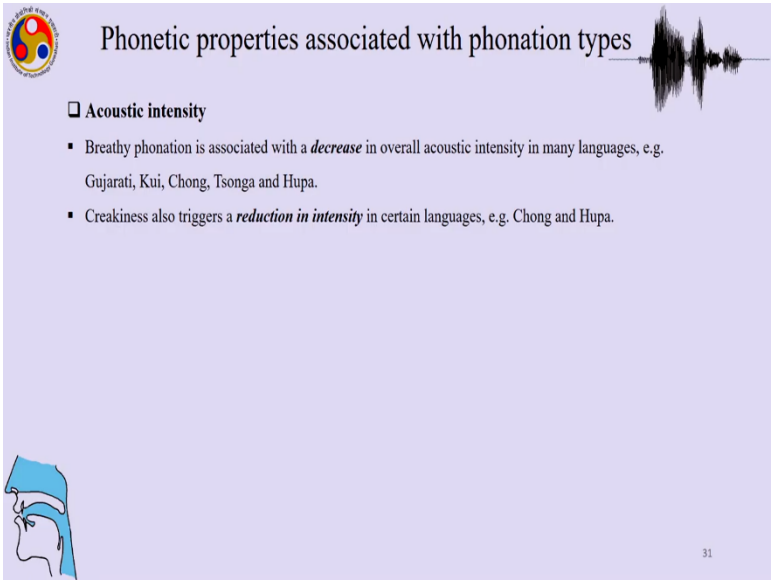

And breathy phonation is associated with a decrease in overall acoustic intensity in many languages, we already saw that decrease in acoustic intensity. Creakiness also triggers a reduction in intensity. We already saw the decrease in acoustic energy and a decrease in overall intensity is also seen in many languages.

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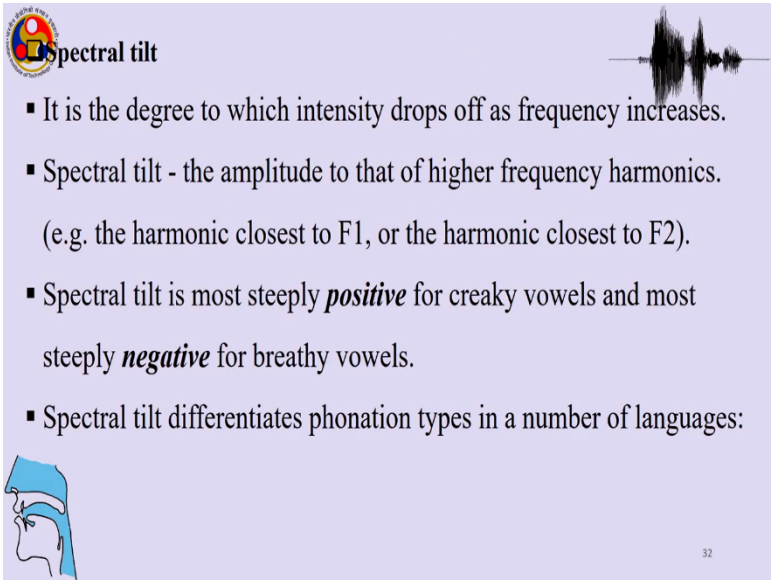

Another important property we talk about when you talk about phonation is what is known as spectral tilt. Spectral tilt is a degree to which intensity drops off as frequency increases. That is, how do we quantify spectral tilt? We calculate the amplitude, relative amplitude and compare it with that of higher frequency harmonics, that is the harmonics closest to F1 and harmonic closest to F2, we compare that with the amplitude. And when we compare that with the amplitude, we find that the spectral tilt is mostly positive for creaky vowels and steeply negative for breathy vowels. And spectral tilt also differentiates phonation types in a number of languages.

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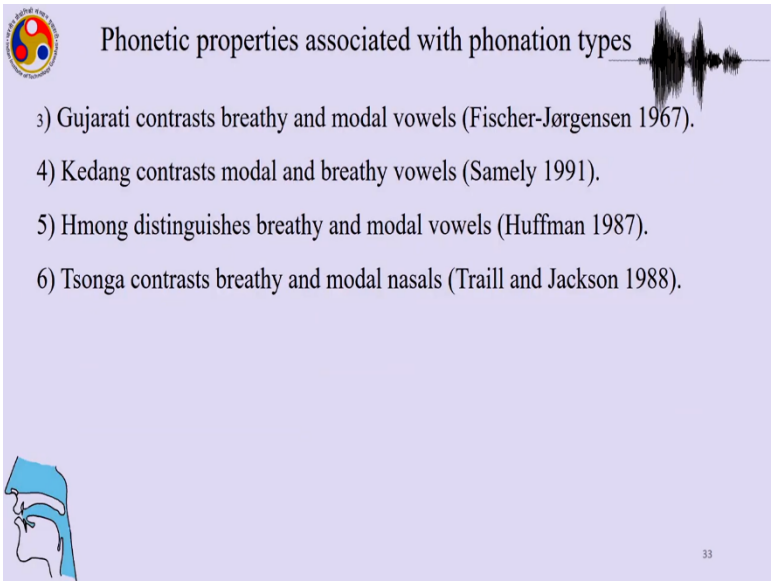

So, now talking about the differences in different languages with regard to phonetic properties associated with phonation types, we find that Gujarati contrast breathy and modal vowels. Kedang contrasts modal and breathy vowels. And Hmong distinguishes breathy and moral vowels and also Tsonga contrasts breathy and modal nasals.

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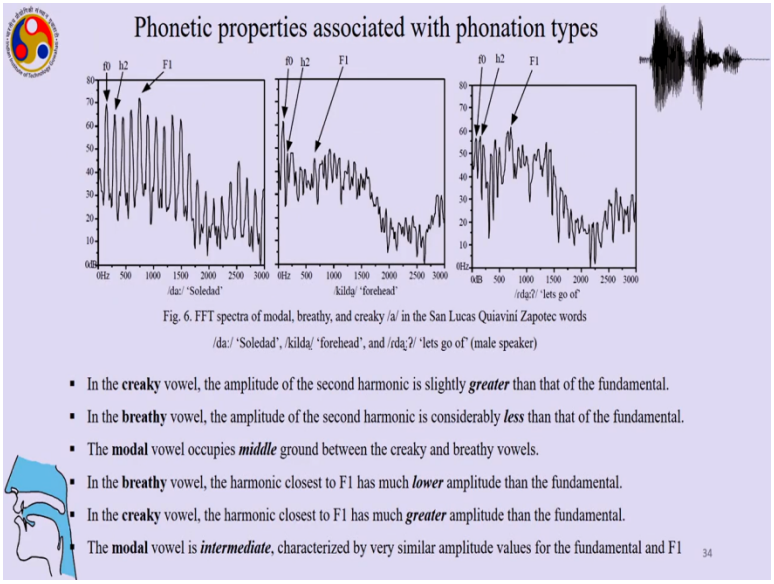

So, now if we look at this spectra modal, breathy and creaky are and we see what we have been talking about with regard to spectral tilt. In the creaky vowel, the amplitude of the second harmonic. So, this is breathy modal and creaky. In the creaky one we see this is the second harmonic and the second harmonic is slightly greater than that of the fundamental. We can see the fundamental here.

And all this information is possible only if we look at the spectra and not at the spectrogram. So, which means we need the information with regard to the harmonics. If you go back to your acoustic classes, recall, then for all the information regarding harmonics, we have to take into account the spectra and not the spectrogram. So, this is DFFT Spectra.

And if we look at the harmonics, we see that H2 is higher than the fundamental. In the breathy vowel the amplitude of the second harmonic is considerably less than that of the fundamental. The modal vowel occupies middle ground and here between creaky and breathy vowels. And this is a breathy vowel, so the harmonic closest to F1, this is the F1 and the harmonic closest to F1 has much lower amplitude than that of the fundamentals. So, here is a fundamental and here is the F1 and harmonic here is much lower.

In the creaky vowel, the harmonic close to F1 has much greater amplitude, as we can see. And in the modal vowel, the modal vowel is intermediate. So, F1 is this regularly spaced striations as we can see, the harmonics are much more regular than the breathy and creaky and in the modal vowel is intermediate, characterized by similar amplitude values for the fundamental and F1, whereas you see quite a bit of difference between the fundamental an F1 for the breathy one and in the creaky one F1 is higher than the fundamental.

In the breathy vowel, we see that the F1 is lower than the fundamental, whereas in the modal voicing we see F1 and Fundamental are pretty close to each other. So, this information is very

considered. There is acoustic information is considered very important in distinguishing the differences between breathy modal and creaky, even though we initially saw that the there was a continuum which is proposed based on the aperture. But as you can see, we need more fine grained acoustic information to distinguish between these phonation types.

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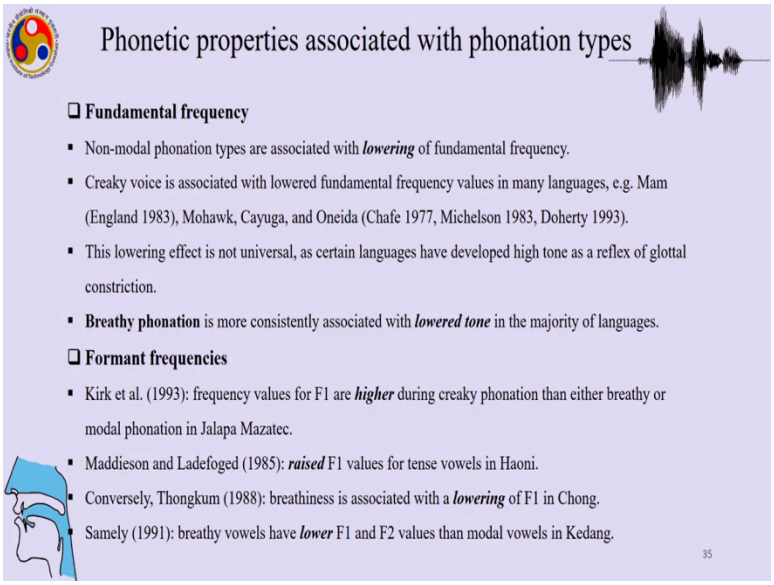

So, non-modal phonation types are associated with lowering a fundamental frequency. And something important to remember is that lowering effect is not universal, as some languages have developed high tone as a reflex of glottal constriction. So, there are interactions with tone, which we have to remember. And breathy phonation is more consistently associated with lower tone in the majority of languages.

And that is why when we look at tone, we also very often look at phonation and how they interact, how these properties of harmonics and their amplitude, how they interact is important. And when you talk about formants F1 frequency values for F1 are higher during creaky phonation than either breathy of modal and Maddieson and Ladefoged 1985 on raised F1 values for tense vowels in Haoni. And conversely, Thongkum found breathiness in 1988, found breathiness associated with lowering of F1 and breathy vowels have lower F1 and F2 values than modal voicing in Kedang.

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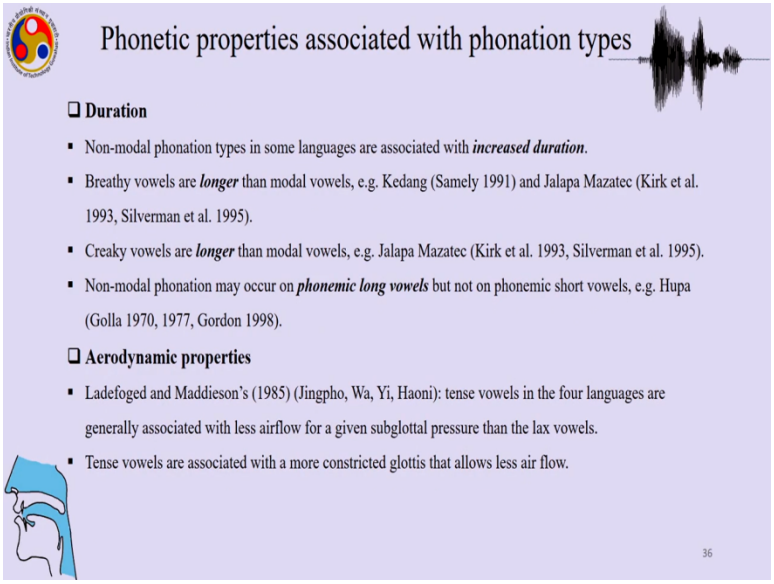

Increased duration is another property of non-modal phonation, and breathy vowels are longer than modal vowels, creaky vowels are also longer than modal vowels and non-modal phonation may occur on phonemic long vowels, but not on phonemic short vowels because of the property of length associated with it. So, there are other aerodynamic properties associated tense vowels in four languages are generally associated with less airflow for a given sub glottal pressure than lax vowels and tense vowels are associated with more constricted glottis that allows less airflow.

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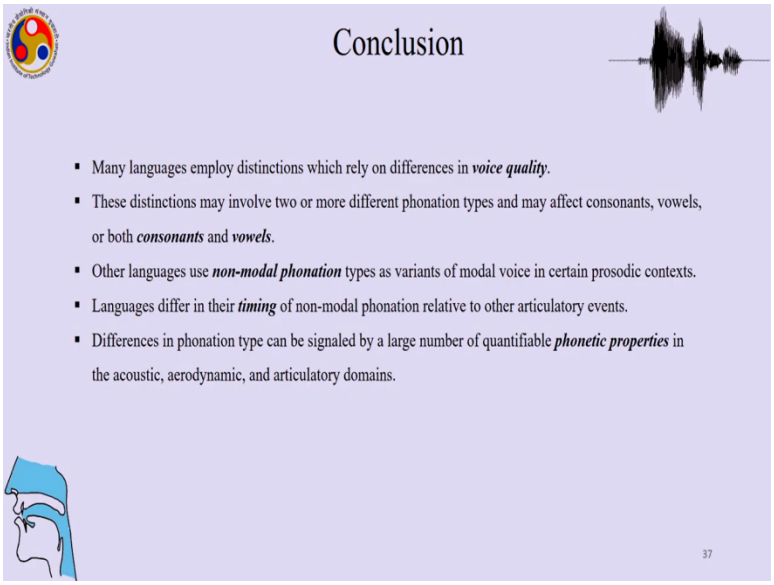

Concluding all these properties that we just saw articulatory, acoustic etcetera, many languages employ distinctions that rely on differences in voice quality, and these distinctions may involve two or more different types and may affect vowels, consonants or both consonants and vowels. Other languages use non-modal phonation types as variants of modal voice in certain prosodic contexts and languages differ in their timing of non-modal phonation relative to other

articulatory events and differences in phonation type can be signaled by a large number of quantifiable phonetic properties in the acoustic, aerodynamic and articulatory domains.

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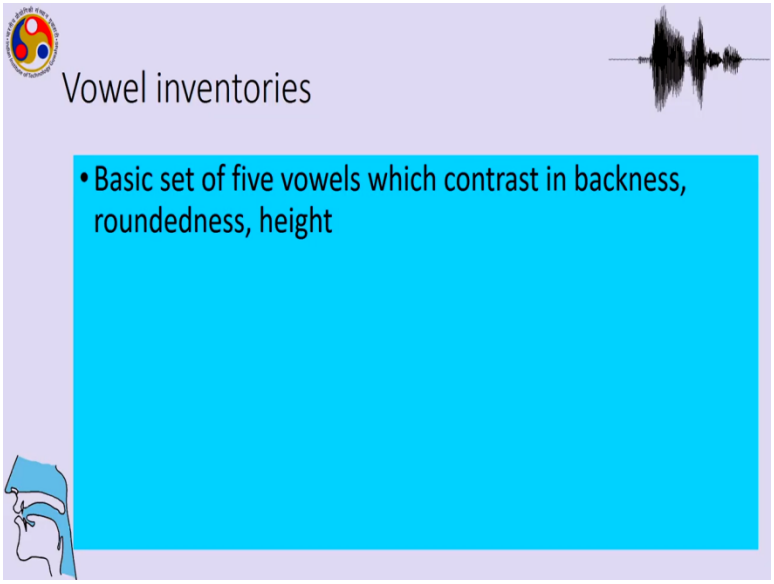

So, coming now to vowel inventories, we have now finished discussing most of the aspects of consonants, we have finished discussing about space of articulation, manner of articulation, airstream mechanism, direction of airstream, nasality, lateral, central aspects of sound and nasality is another aspect of, another aspect of consonants.

So, we have talked about all these dimensions in the production of consonants. Now, looking at vowel inventories, we can say that although the vowel inventories that we talked about in when we talked about articulatory phonetics. So, remember the triangular shape that we talked about when we talked about cardinal vowels and we talked about cardinal vowels and how the outer edges have the most common vowels in the languages of the world.

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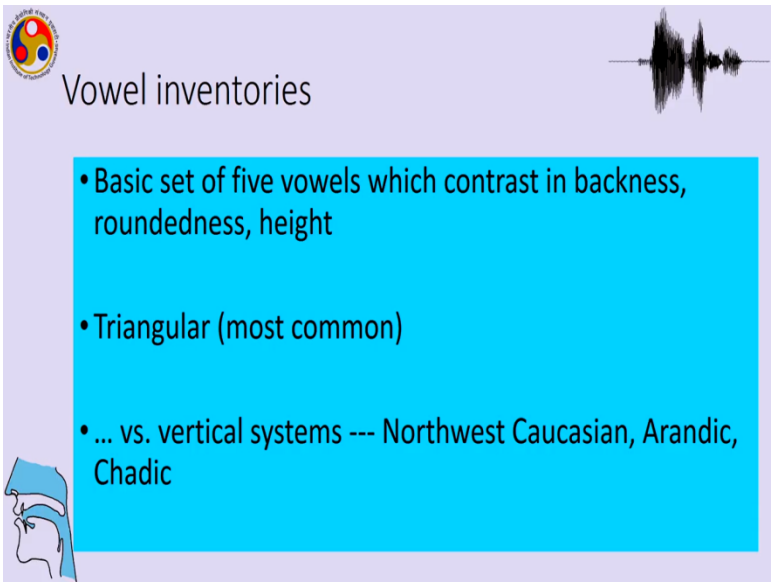

So, the triangular part is most common. If you remember what is the triangular if you recall the vowel diagram, then you will remember that the two edges on of the high vowel are the E and U is front on his back. And what is triangular? It is the one which is at the bottom, which is A versus vertical systems, where you have a contrast between front and back and high and low vowels in each of the corners of the vowel diagram.

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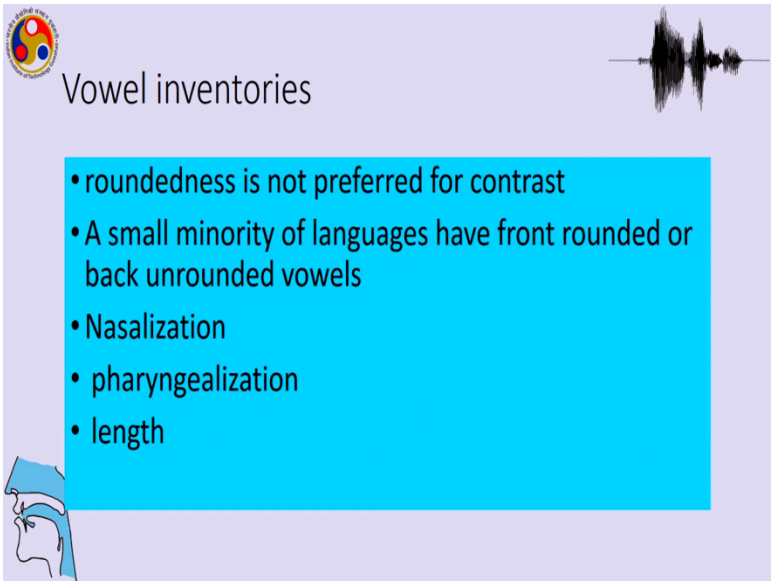

So, high contrast is important and roundedness is not preferred for contrast. A small minority of languages are front rounded, rounded back unrounded vowels. There is also nasalization, pharyngealization and length when you talk about different vowel inventories in the languages of the world.

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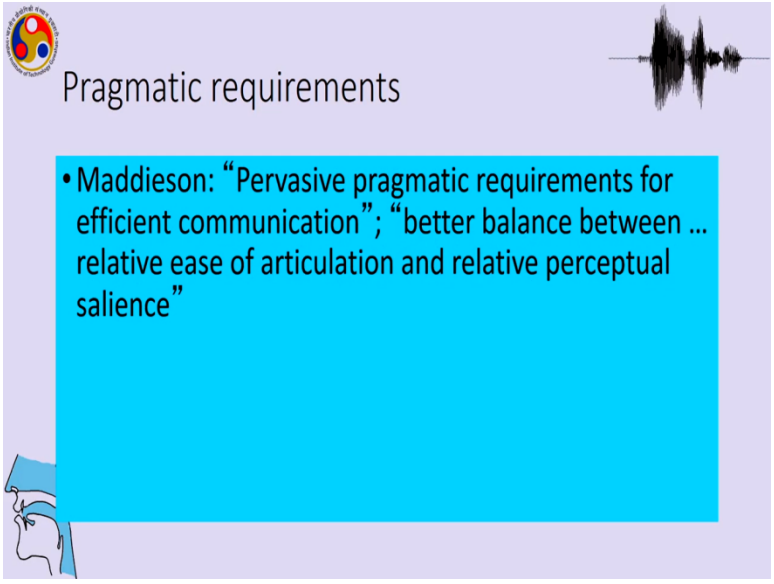

So, what are pragmatic requirements? So, Maddieson says that pervasive pragmatic requirements for efficient communication and better balance between ease, relative ease of articulation and

relative perceptual salience determines the vowel inventory of languages. So, that is why the triangular shape is most common. And apart from that, if we add two more vowels to a triangular shape, then we have two mid vowels contrasting in front and back.

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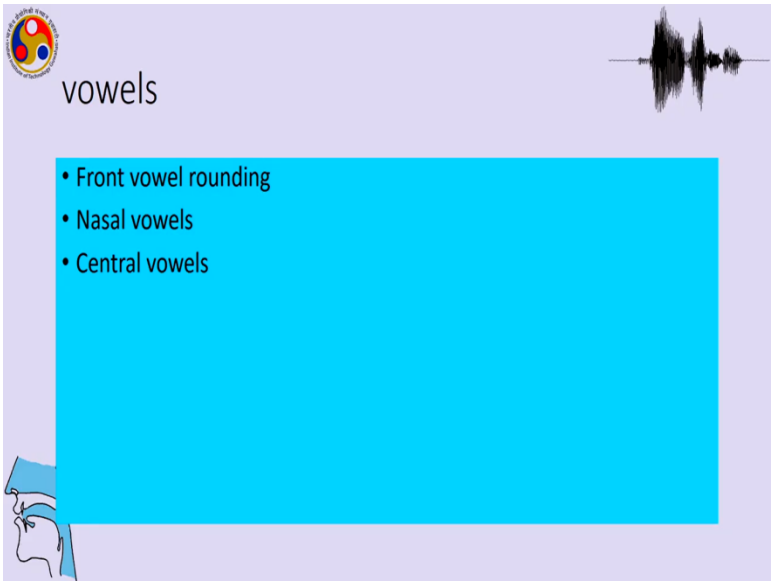

So, some properties which are not so commonly seen, our front vowel rounding, nasal vowels and central vowels.

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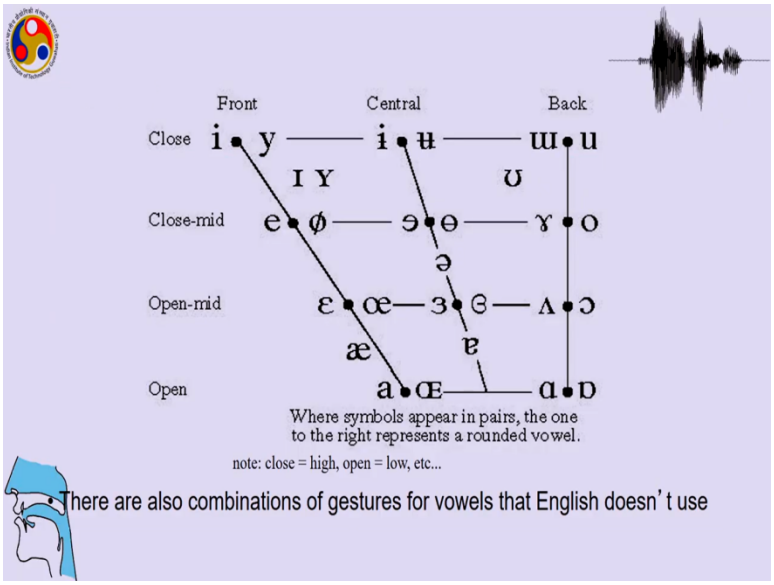

So, we have the front, central, back and this is the vowel diagram, if you recall, and these are the cardinal vowels. And we have discussed extensively how we determine the differences between the cardinal vowels and what are the most important properties when we need to talk about vowels with regard to their height, their frontness, backness and roundedness which are the most important properties. And the vowels are paced like they are in the cardinal vowel set.

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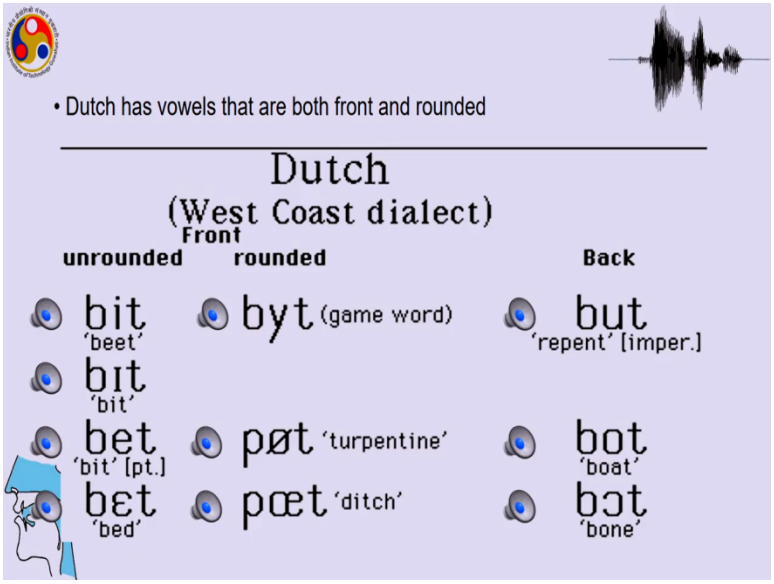

So, we will not go into those things. We will just talk about a few uncommon properties. So, Dutch as well as both front and rounded (pronouncing Dutch). So, among these vowels, these are the rounded vowels in Dutch, and this is (pronouncing Dutch) vowel in Dutch and also the round front high vowel and this is the round front and mid vowel and then these other vowels which are rounded back.

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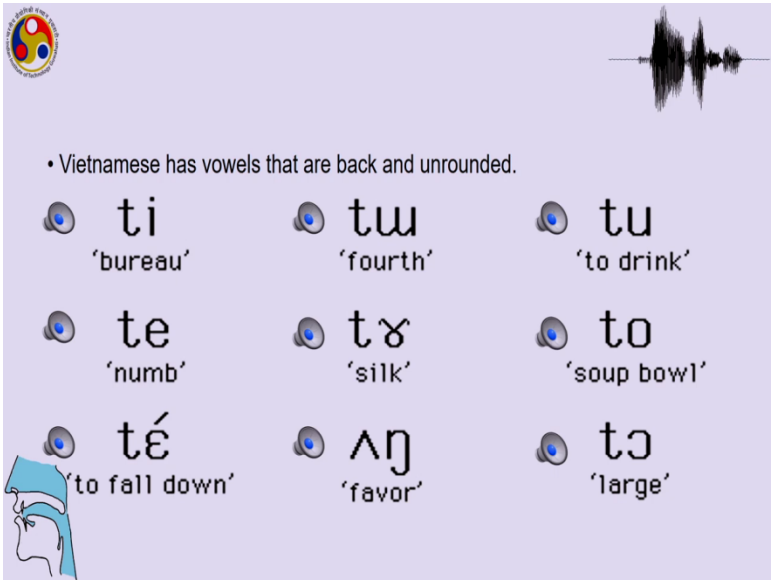

So, Vietnamese has vowels that are back (pronouncing Vietnamese) unrounded, and these are the examples (pronouncing Vietnamese). So these are uncommon combinations for vowels and should not be seen very often that is front and rounded back and unrounded and but there are languages which show both.

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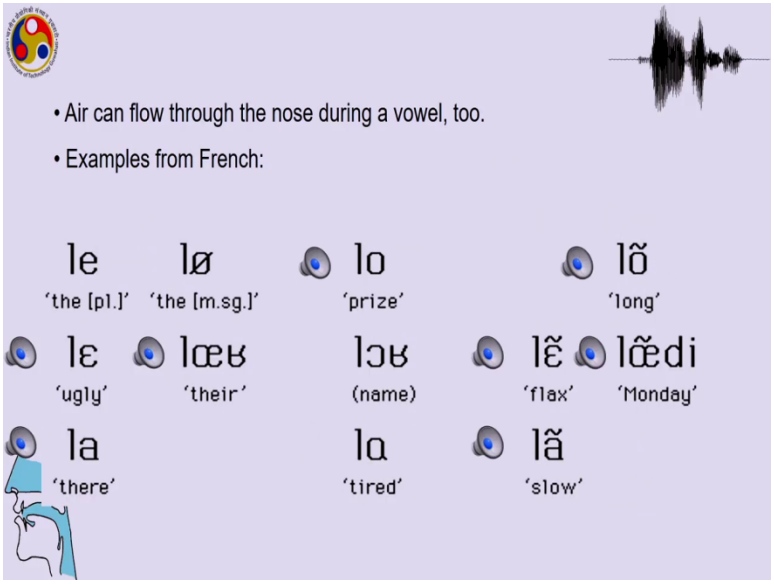

So nasalized vowels in some languages, vowels can be nasalized, you can hear this contrast from French, (pronouncing French) so this is the oral vowel. (pronouncing French) that is the nasal vowel. So, that is the difference between oral and nasal in French.

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So, the other property which is important, is that of length and it is seen in vowels and consonants you see in gemination, but there are languages which are post vowel and consonant lengthening, and Japanese is one of those examples.

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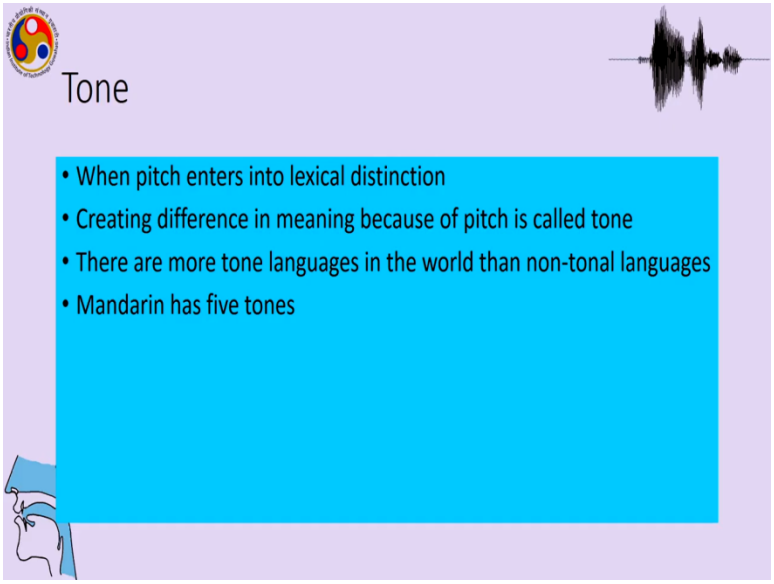

Finally, when we talk about a variety of sounds in the languages of the world, the one aspect which we have not talked about at all is tone. So, the reason we have not talked about tone is because we have an entire unit devoted to tone. So, what is tone, when pitch enters into lexical distinction, which means when two words are different entirely based on pitch. There are many complications to this assertion. We will talk about those things, when we talk about tone.

And apart from lexical distinction, which we just talked about, most important thing is that presence of 2 different changes in pitch also signals, so meaning difference. And that is why tone languages are different from non-tonal languages, which do not make such a linguistic use of pitch. So, there are tonal languages in the world and non-tonal languages. Mandarin has five tones; Mandarin, Cantonese and many languages other languages in spoken in various parts of the world, irrespective of regional differences have tone.

And there are many aspects of this aspect of pitch that has to be studied and linguists studied this to a large extent. There are many aspects of tone that we need to study about which we will probably not be able to cover in this course. But we will definitely in the last unit, we will cover tone and intonation and discuss many aspects of tone and also another aspect of pitch called intonation. Thank you for listening. We will start the next unit from the next lecture. Thank you.