Phonetics and Phonology: A broad overview
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Lecture 3
Articulation of Vowels

We continue our discussion on production of sounds, that is articulation of sounds and in this class we will see how vowels are produced.

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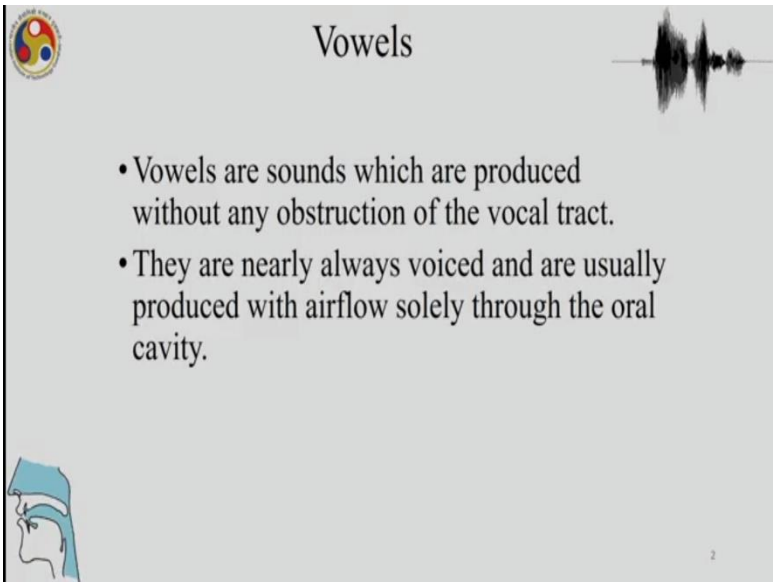

Vowels are produced without any obstruction inside the vocal tract. They are nearly always voiced and are usually produced with airflow solely through the oral cavity. So when we are talking about consonants, we saw that consonants may be distinguished by the property of voicing that in production of some consonants there is vocal fold voicing, the vocal folds vibrate and as a result gives the distinctive property of voicing.

However, unlike that in vowels, we always see that they are always voiced. We can talk about voiceless vowels and what are their restrictions in the production of voiceless vowels and when you talk about sounds of the world's languages, but it is almost a given that almost always the vowels are voiced.

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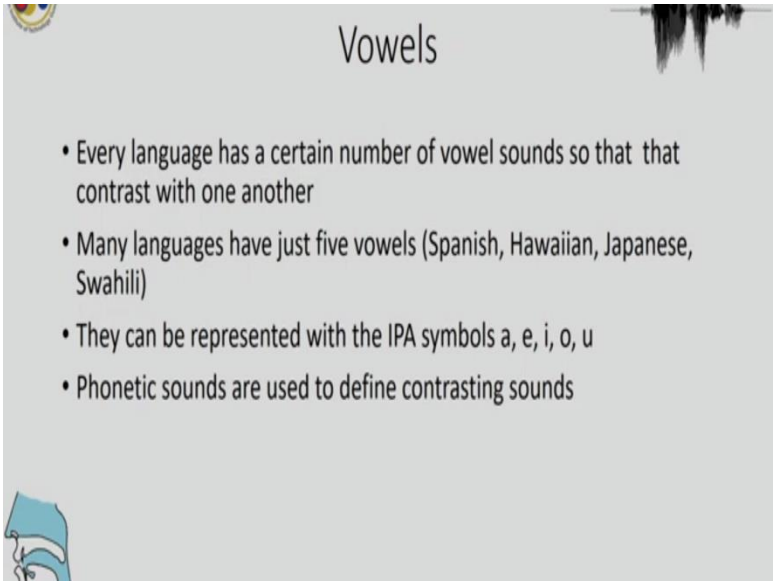

So every language has a certain number of vowels so that they have words which contrasts with each other. So as a result in English we can have tip and tap as 2 different words because the vowel, the 2 vowels in those 2 words are different. However, there may be differences in the number of vowels that are there in different languages. For instance, for some languages, it is very common in languages to have only 5 vowels. We have given some examples here. We have Spanish, Hawaiian, Japanese, Swahili for instance, but not restricted to them. There may be many languages where we have only 5 vowels.

They can be represented with the IPA symbols and these are what we have, we already know them as Roman vowels as a, e, i, o, u but then they are also represented in the IPA vowel chart. We will talk very soon about that. So these sounds represent words meaningfully and make them contrast. So that is why we need the most number of vowels and consonants in a language so that the words can be formed in a way that they contrast from each other.

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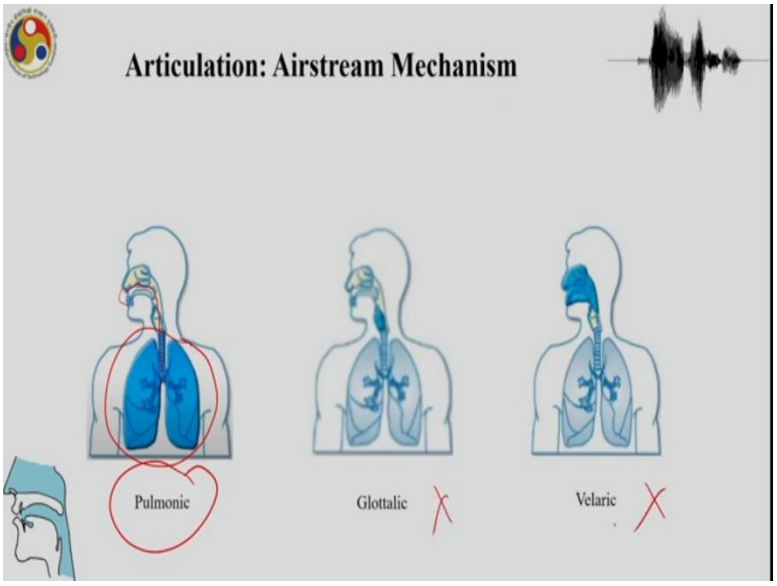

We had studied about airstream mechanism in our class on consonants and we know that these are the airstream mechanisms. All vowels are produced as a result of the pulmonic airstream that is the lungs push out the air and which is modified in the vocal tract. These are not possible as airstream mechanisms in the production of vowels.

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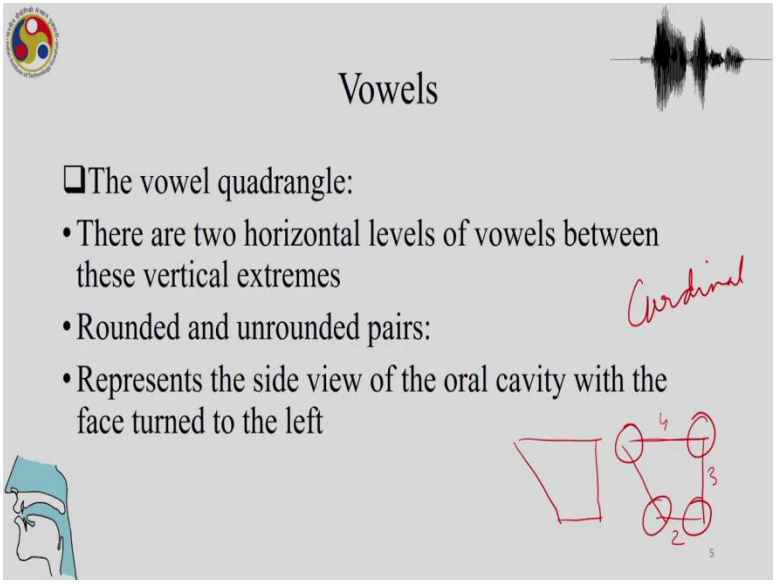

How are vowels represented in phonetics? So when we are talking about vowels, we have to talk about certain representational mechanism that we use for the representation of vowels and that is called the vowel quadrangle. So the vowel quadrangle as the name suggests, so there are 2

horizontal levels. This is about the shape. This is the shape of a quadrangle that we use. Note that it is neither rectangular nor square. This is always measured to scale. This has to be measured to a scale of 4 points, this to 3, assuming that this to 2 and they are connected and these are always at 90 degree angles.

So the importance of this quadrangle is that it gives us a way of representing vowels. How? Because it assumes that there are certain vowels which are cardinal vowels which are produced in these 4 extremes and the other vowels are then understood, after we understand that this quadrangle represents the extremes of the vowel space. So this is essentially called our vowel space and it represents the side view of the oral cavity with the face turned to the left. Now, you have to imagine this as placed inside the mouth and it is a side view with the face turned to left.

So which means it gives us the way, the amount of space that we can utilize to produce vowels inside our vocal tract and as a result of which you can think about this as the uppermost part of your vowel space. So the top part we have vowel space and this is the back part, this is the low and this is front of your vowels base and then after that we can talk about rounded and unrounded vowels as to how they are represented in this vowel space because in this vowel space it only talks about these extremes. So roundedness involves the lips, which is outside of this vowel space.

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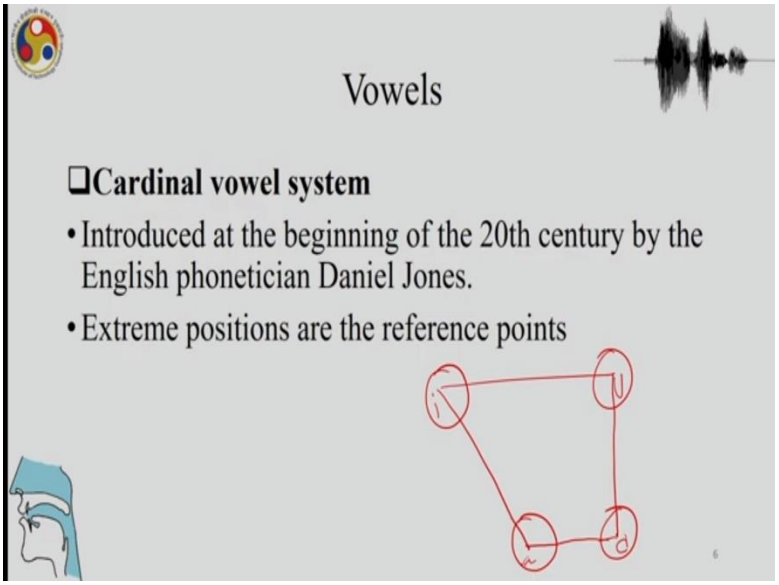

So the quadrangle that we just talked about which gives us the extreme, the reference points for the production of 4 basic vowels was a system introduced in the beginning of the 20th century by the English phonetician Daniel Jones. So the extreme points that we have other reference points. So what are these? This is not an exact, but sort of a representation of what we are talking about- the Cardinal vowel system and the reference points.

These are the reference points. So this is the reference point for the high front vowel e, this is a reference point for the high-back vowel u, this is the reference point for the high front vowel and this is for the low front vowel, this is a reference point for the back low vowel. Now once we have these reference points, we can talk about all the vowels that appear occur within this vowel space.

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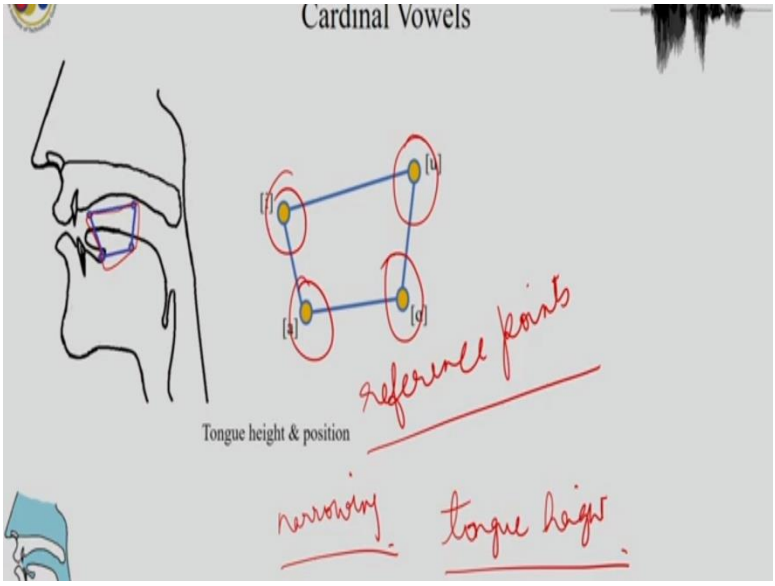

So what does the cardinal vowel system and the vowel quadrangle do? Basically it is trying to assume that this is the space that one has got inside the mouth to produce the vowels and it is understood in terms of mainly two things. Either the amount of narrowing that the space will provide and also the other thing which guides this is tongue height. So for the production of each of these sounds, either the tongue is high or the tongue is low and offer the production of back vowels for instance, the amount of narrowness that is there in the back cavity of our mouths.

So these other 4 vowels that we just talked about, the reference points that will give us the other vowels, which is produced in different languages. So this is a cardinal vowel system which takes

into account 4 positions inside the vocal tract and however, these are only the reference points and based on these reference points, all the other vowels that we have in the IPA system can be then understood in terms of their tongue height and narrowing in terms of whether it is front or back, in terms of whether it is high or low.

So these differences can be understood properly if we talk about these reference points and how if the reference points change then we get a different quality of a vowel but it is important to understand that this is only a representation which tries to understand what are the properties which gives the distinctive quality to the vowels that we produce.

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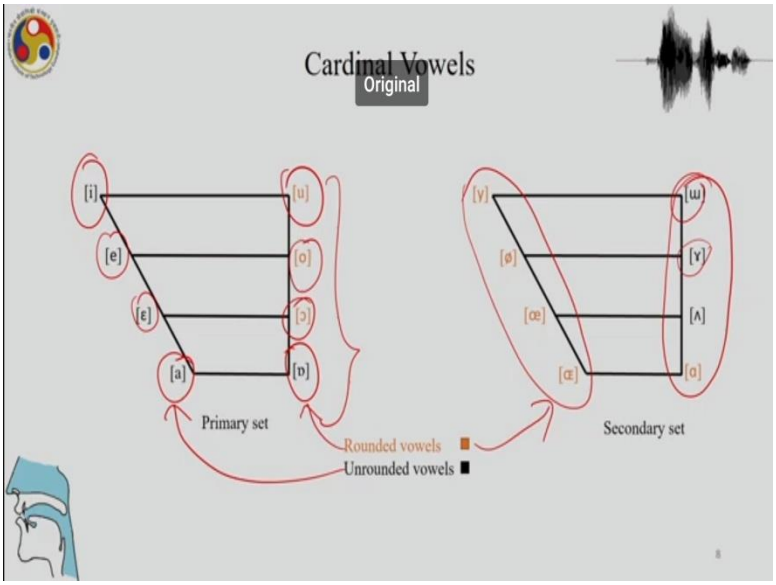

So the cardinals is a vowel system that has a primary set of vowels, then a secondary set of vowels and then these are always divided or you have sets of rounded and unrounded. So because the cardinal vowel system cannot, this represents roundedness, which is a property of lips. However, it can represent the vowel space inside the mouth to understand how much narrowness we have while we are producing a vowel and what is the tongue height. So the tongue height for instance like in a vowel is e, it is a high vowel, whereas in a vowel like u, which is also a high vowel, the narrowness is in the back cavity of the mouth.

So whereas these are both high vowels, one is a front vowel, one is a back vowel. Additionally, we have the property of roundedness. This is unrounded, this is a rounded vowel and our cardinal vowel system helps us to understand exactly the height which we know that they are both high

vowels so they were very close to the reference e, u, and that the narrowness for one is happening in the front cavity and narrowness for the other is happening in the back cavity.

So our primary vowels now are again derived from the reference points that we just had talked about. So these are the reference points. If we add more horizontal lines, then we get the mid vowels which are found in languages. So these mid vowels are a and o and eh and oh. Again, notice that depending on the height the vowels change.

So the tongue maybe positioned like eh and ah and a and e and it can be like oh and oh and o and ooh. So for the production of all these sounds, the back cavity has a narrowness and here, it is in the front cavity and again by introducing more lines within this cardinal vowel system we get these 8 vowels. So now we can understand the rounded set. If we again take the same vowel quadrangle and put them in the place where you have the unrounded set, so you have the unrounded set here and you have the rounded set here.

So these are nothing but the rounded and unrounded, whereas these are all unrounded and in the primary set, the front vowels are all unrounded, the back vowels are all rounded. In the secondary set, we have the opposite of this. We have all the rounded front vowels, the secondary set and all the unrounded back vowels in this set.

So note that these are exactly the same positions with the change in roundness. So there are languages which make use of these properties. So there are languages which differ based on an unrounded e versus rounded eee and there are languages which differ based on back rounded ooh and a back unrounded ooh.

The languages which again can make use of this difference between each vowel based on height as well as roundedness. So the languages which will differ based on height so they will be higher mid vowel like a which is unrounded and in a same vowel a which you have a rounded counterpart like a oh or like a o which is rounded but it might, but the languages which have a unrounded counterpart of the o and it is oh.

So and there is a back depending on whether it is front e or back oh. This could be all different and there are plenty of languages which have these rounded and unrounded sets and they are very often seen in languages which have roundedness, rounded harmony. So vowels change based on the roundedness property. So, if there is a one rounded vowel, it can change the other

following rounded vowel to become round and then we will find that there we have the high rounded front vowel, the mid rounded front vowel and these languages offer these varieties for us to see inside the vowel space.

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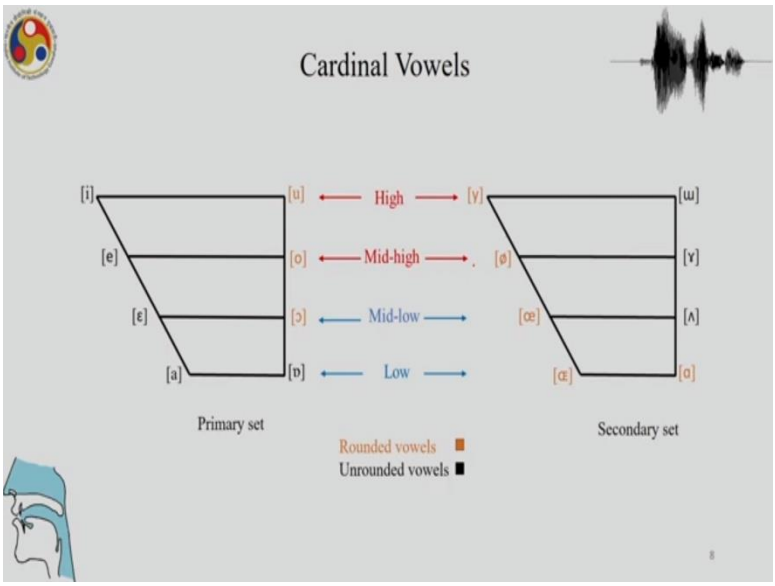

So now we have seen the primary set and the secondary set where the primary the front vowels are unrounded, the back vowels are rounded and the secondary set where the front vowels are rounded and the back vowels are unrounded and these are the different heights which are being exploited, these horizontal lines represent differences in height. So we have the extreme reference points in high vowels and then we have this slightly lower mid high vowels and the slightly lower than that mid low and then finally the low vowels.

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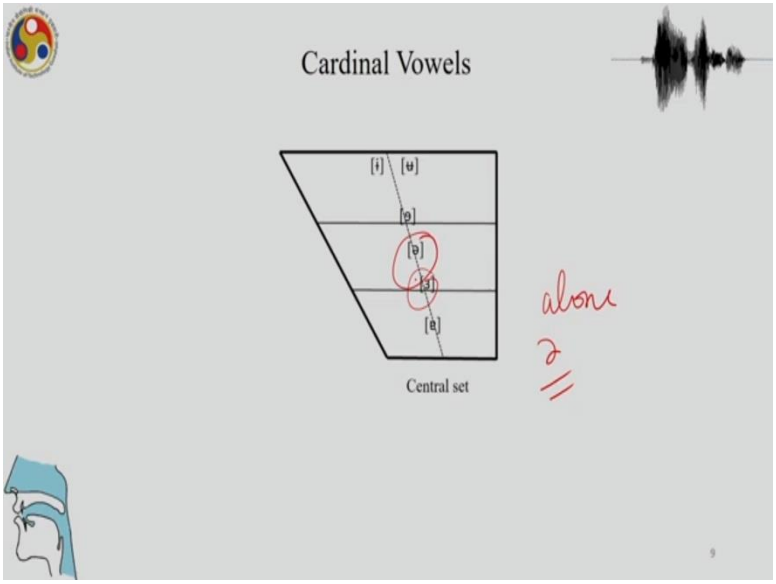

So, languages exhibit not just differences between front and back, rounded, unrounded. There are languages which make use of this space in the middle also and which is represented with the line going and drawn along the front space of the, so they are not very common sounds but we still have a lot of their languages which have central vowels which have e and u and this is the most interesting vowel in the central set, which is called schwa. So why is the schwa important? Because a lot of languages have this as a very common sound.

In English it is very important because when a vowel is unstressed, it may reduce to a schwa and we will find plenty of examples of schwa. For instance, we say alone, so the initial vowel here is a and similarly many other words in the language will make use of the schwa and then along this central line that we have, we have like a, this is in English, it exists as a longer version of the a and then we have also a central ah ah in some languages.

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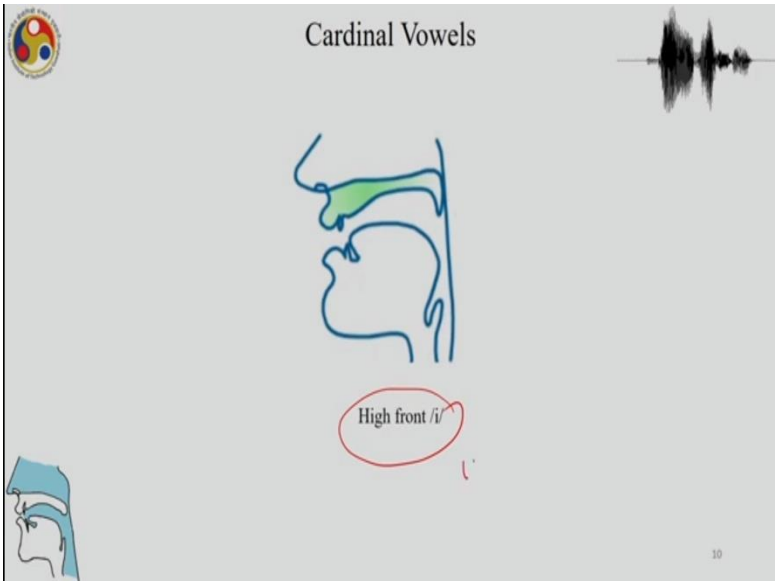

So here we see a bit of how the tongue moves to produce the cardinal vowel, among the primary the cardinal, the 4 cardinal vowels. So what is the tongue height and narrowness position will be shown in these movements that you will see here. So we have for instance a high front i and what do you see in this movement here? You see that the tongue moves up close and that narrowness is happening in the front part. So it is not just the tongue moves up but the narrowness is happening in the front. So as a result, we have high front vowel. Also along with being high front, it is also an unrounded vowel. Now, let us see the other cardinal vowels.

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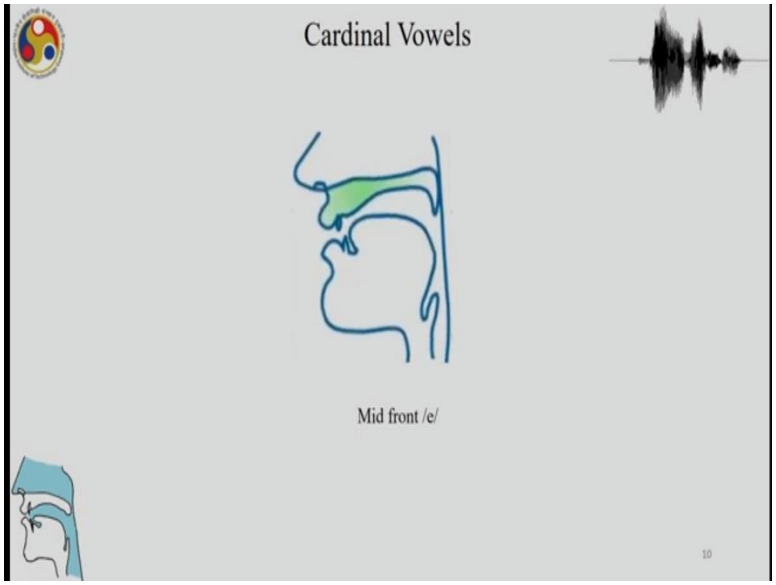

So this is the mid-back o. Again, you see the tongue moves up but it is the back cavity. It is where it is moving up and it is not as high as e. So as you can see the i goes very close towards the front of the mouth and that is why it is a very high vowel because the movement of the tongue towards a very high position.

Unlike that, if we take the mid front e, as you can see that it is not as high as i so that is why it is a mid vowel. The position of the tongue is not as high i, it is somewhat a bit lower. So that is why a is different from e and that is shown with the movement of the tongue here.

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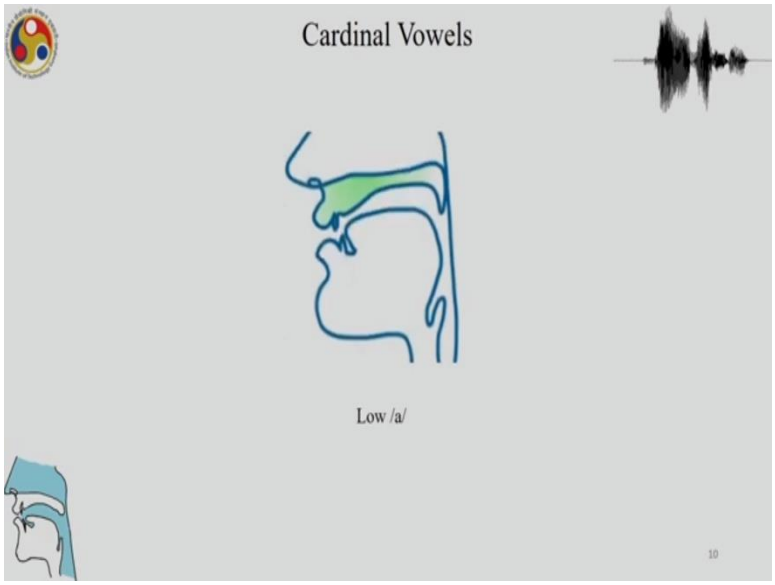

Now as unlike e a, let us look at a. a as if you when you produce it, you will see that your jaw goes down considerably and it gives a its quality as a low vowel and then compare that with the production of o.

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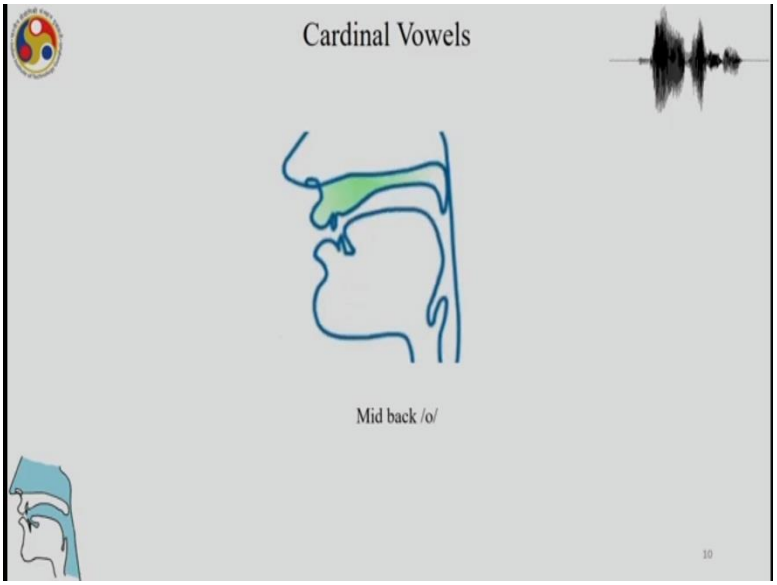

Again with the production of o, the tongue, the back of the tongue goes a bit high and makes the narrowness happen towards the back of the mouth, the back of the vowel space. However, it is going towards higher position, but not exactly the highest position and that is why o is a mid-vowel. Compare that to production of o and that of u where for the production of u, this will again go all the way back even more higher than that of o.

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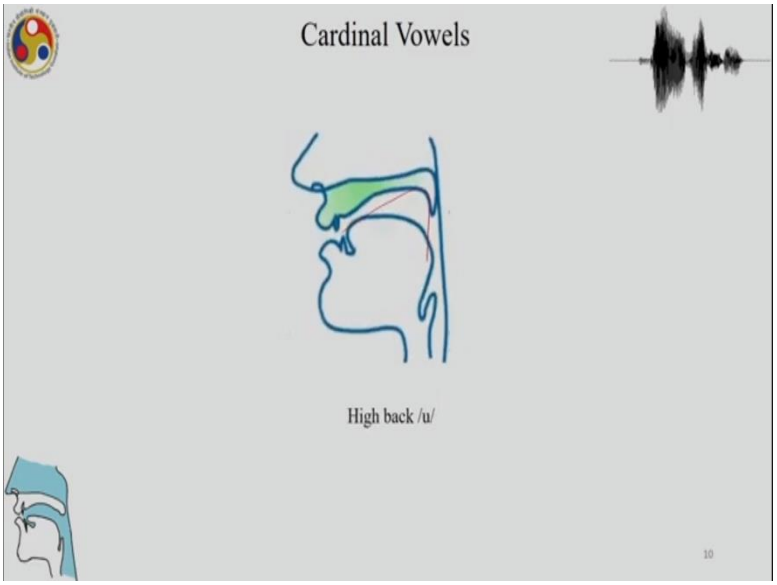

So that will be your position of the u which is going to be highest. Let us have a look at different vowel inventories in say, American English vowels and another English vowel inventory, British

English vowels. So the vowel chart that we have been talking about till now is here right in front of you.

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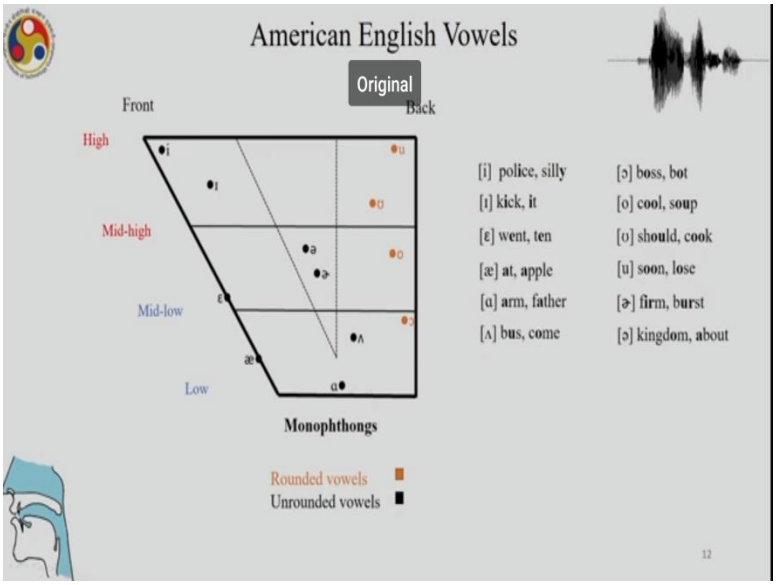

And you can see the front, back, high and all these positions in between the high and low position. So you have one mid which moves more closer to the higher place of articulation and then you have something which is low towards the lower place of articulation and then you have front and back. So if you have these then you can see i there and then the lax e and then we have a and then we have ae and then we have the American English um, ah and then ah and au, oh, u and ooh. So these are the monophthongs as we call them because they are only 1 units, each of them constitute only 1 unit.

So when you have a movement from one place in the vowel space to another place that is called diphthong. So these are the monophthongs and you see that you can form all these words here like police, like kick and went and at and arm and bus. So we will play these sounds to you spoken by a native speaker, but at the moment these are the standard so called we had talked about issues concerning standardness, but generally these are the most commonly occurring vowels and apart from that, 2 central vowels a and ah. So these 12 vowels are more or less the general American English vowels.

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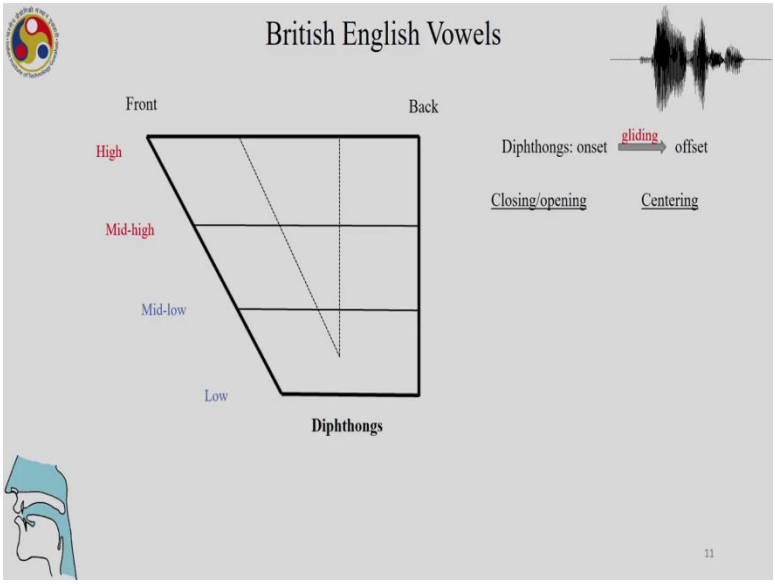

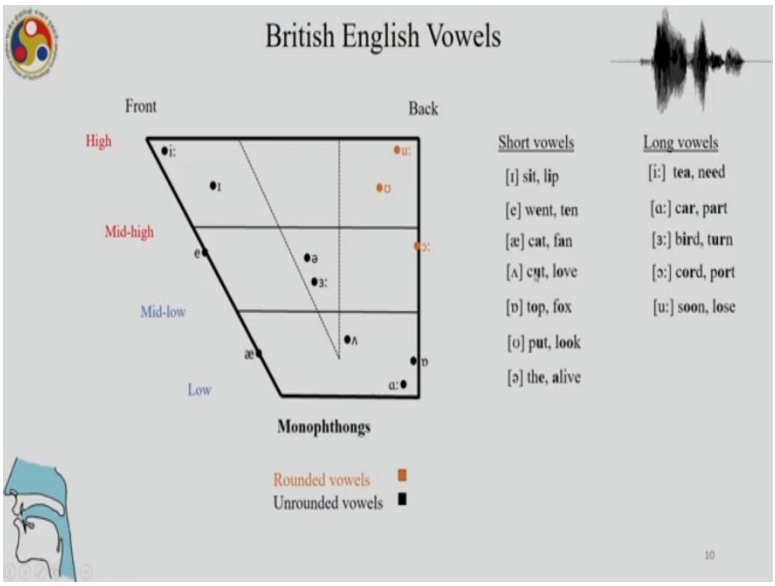

So now let us look at the British English vowels. So when you talk about the British English vowels again, we will lead the vowel space that we have talked about before. So as you can see the British English vowel inventory has a few more vowels than you have in the American English vowel system. So there is a reason why this happens because this is what is called the standard inventory or the BBC British English vowel inventory but depending on the variety where it is spoken in the British Isles, depending on that the vowel inventory will be very different but generally these are the most recognized vowels and we have the high vowels and we see that we have many longer vowels in the British English system.

These longer vowels in the case of aa like car and bird are the result of the loss of the rhotic there which is deleted and you have a long vowel and also called cord and unlike that we have tea or soon, etc. which are long vowels. So you have a and e which is a long vowel and u and oh and its counterpart the high vowels, one is a high tense long vowel, the front and one is a high back long tense vowels and then we have the counterparts sure that lax counterparts which are shorter, i for instance is a high vowel which is front as well as unrounded just like e but it is not long and it is a lax vowel.

Similarly, also u is a lax vowel, it is high and back and rounded just like oh but it is lax and it is short. Similarly, we have the e and ae vowels and although we saw that the American English has a slightly lower vowel than e, ae but the British English vowel here is longer, there are differences depending on where this is spoken and then we have the central vowels, which is we have a and ah and then ah and then these round vowels ooh, oh and then the back low vowels which are the ones put down here as top and this one as in car.

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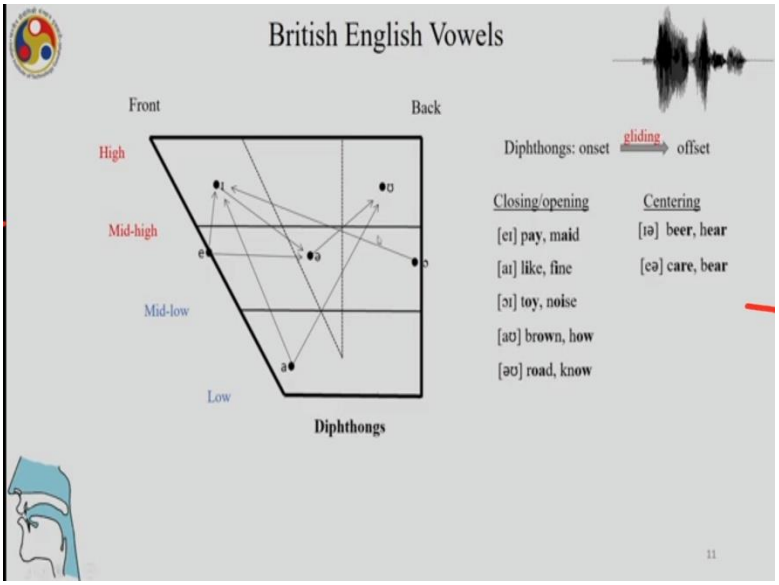

So let us have a look at the diphthongs. So what are diphthongs? Diphthongs are nothing but movements from one place towards another place in the vowel space. So as a result, we have all these diphthongs in the British, so let us look at them again. So we have the first one here as you can see a moving towards e, this is a closing diphthong. We have closing, opening diphthongs

and then centering diphthongs, depending on where the movement is happening towards. If it is towards the closing position, it is a closing diphthong.

Similarly, we have a and then we have i like we have a as in pay, maid, etc. And then we have oi as in toy, we have another closing diphthong a as in brown and how and now etc and then we have another one like road, etc, o and then we have the centering diphthongs which are er and ear like hear, bear. Sometimes in some varieties there are also another diphthong oor as in poor.

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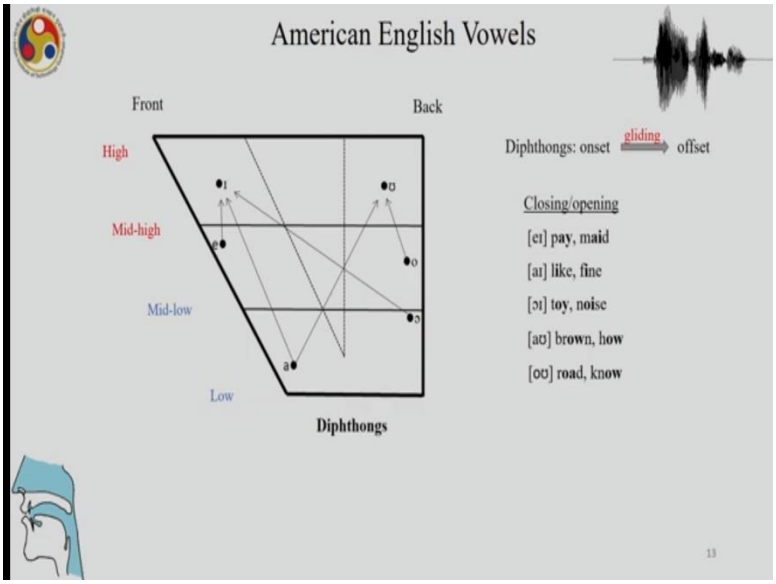

So we have seen the American English vowels and here are the American English diphthongs, which are gliding also called glides, movement from one position towards another in the vowel space. So we have a as in the British English diphthong you had seen before and again, i as in like fine etc, oy as in toy, noise and ow as in brown, how, now, etc and o as in road and these are as you can see fewer American English diphthongs unlike the British English diphthongs, which were more, which are around 8 diphthongs, here we have 5 diphthongs. So again, we are not talking about varieties, the wide variety of vowels that we find in all these varieties of the language.

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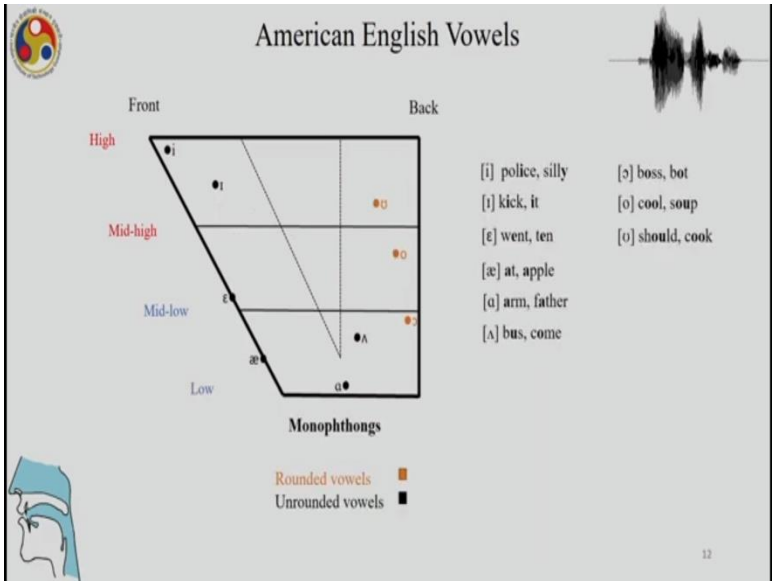

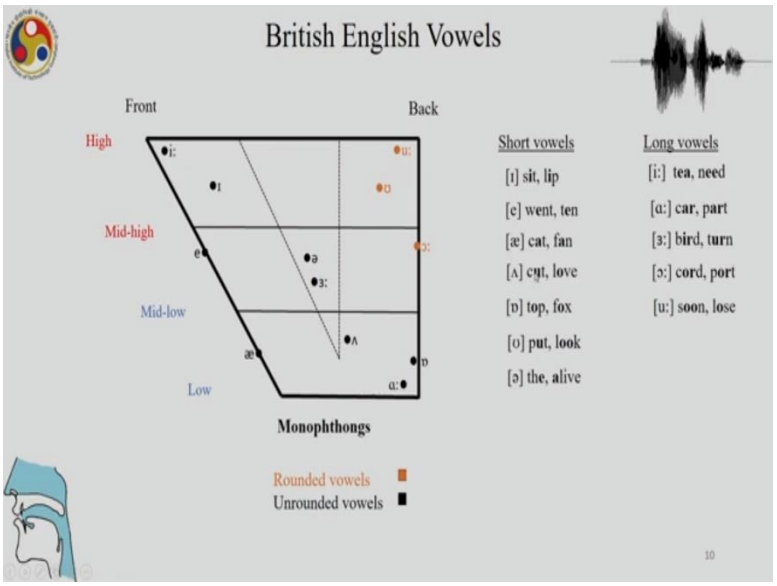

So when we talk about for instance American English, so very often there is a loss of links for instance in boss or as in English, so where you make a distinction between cot and caught in the British English vowels, in the American English vowels, so here, like o and oh, so that distinction may be neutralized in American English vowels.

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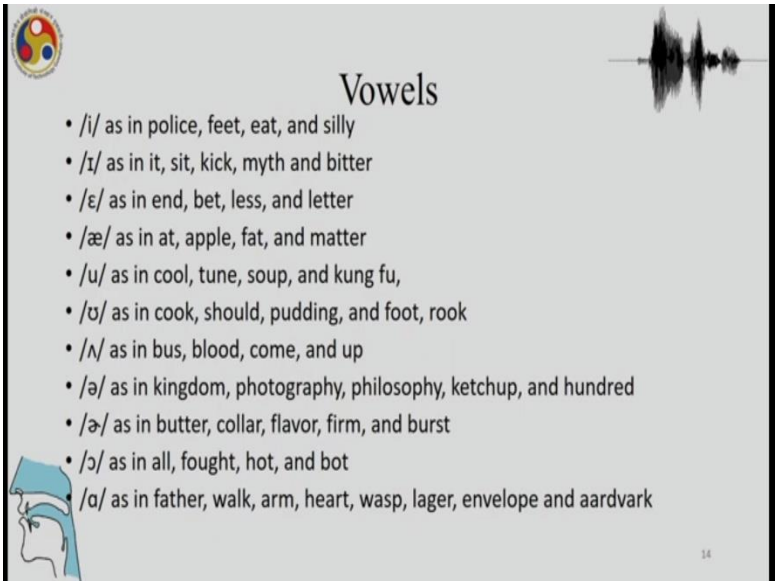

So again summarizing the vowels that we have seen, the most common English vowels as in e, u, eh, a, ooh, o, aah, aa, ah and auh.

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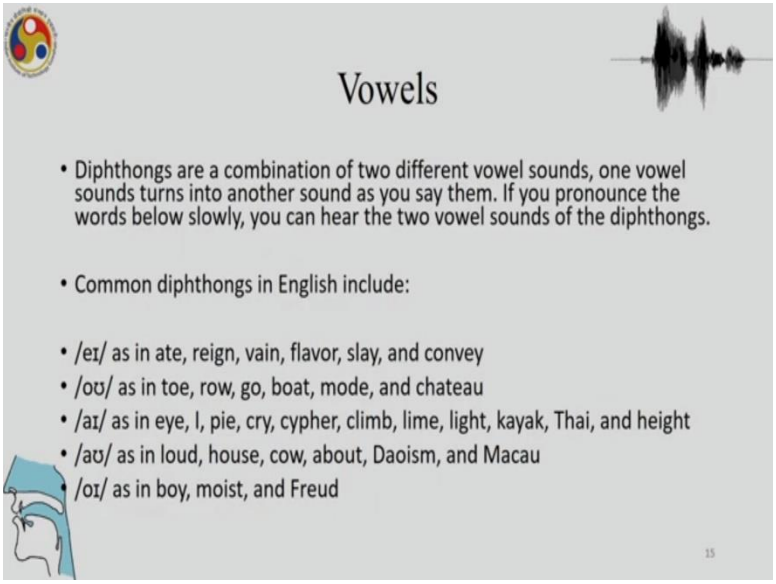

Then you have diphthongs which are these other ones that you have just seen, the American English ones that you have just seen and also the British ones which are more in number than the American.

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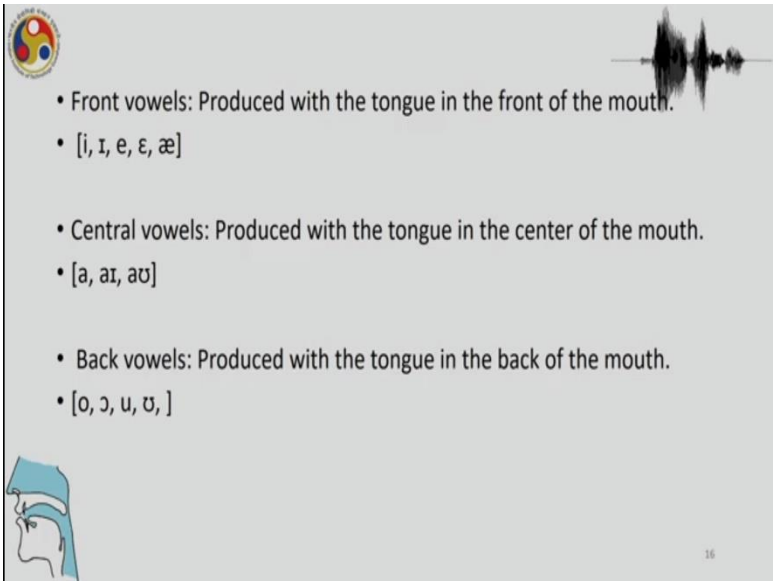

Now the reason that we are going through these vowels is that so that we understand what are the characteristics that we use to describe the articulation of vowels. So when we try to do that, one of the important things is to remember that what we had initially talked about when we talked about cardinal vowels, that there are 2 things involving vowels, that one is the narrowness in the cavity and the other is the height of the tongue.

So depending on the cavity, we have generally a back cavity and front cavity and also something in between which you use to produce central vowels and similarly, we have tongue height so such that even if you have a constriction, not exactly a constriction, a narrowness created in the back cavity and a narrowness created in the front cavity, those will be the two different things distinguishing 2 vowels. So, let us see what we are talking about here. So in vowels, when you have narrowness in the front cavity, then you have the front vowels.

So you have i, eh, e, ah and ae and then you have a central vowels which will produce because of the narrowness in the center of the vocal tract and then you have the back vowels which is because of the narrowness of the back cavity. So essentially these vowels then are distinguish between because of the narrowness that they create in the different cavities. Now, of course as we have studied, this is not the only characteristic of vowels, there are other vowels as well.

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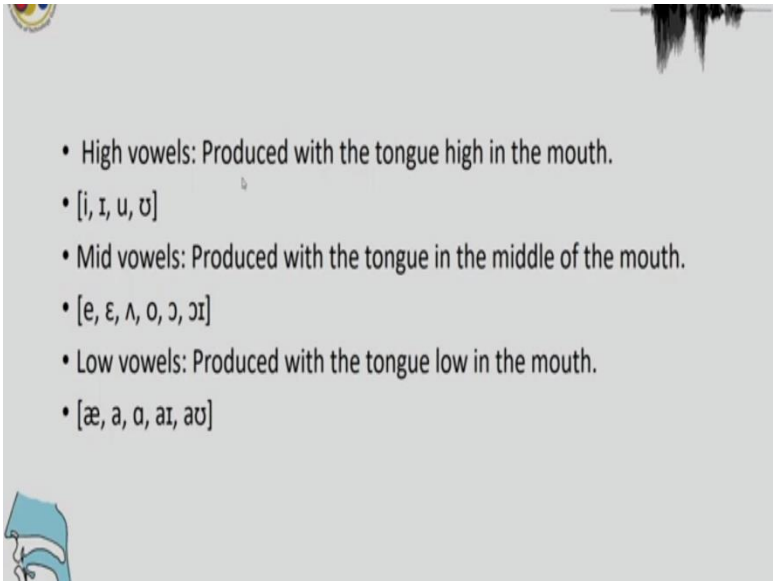

So you have the tongue height. This is another property of vowels and so some vowels are high vowels, some are mid vowels and some are low vowels. So what are the high vowels? Some high vowels are i, e, u, oh as we saw from English as we have talked about before when we talked the Cardinal vowels and how this primary set and the secondary sets are formed, we saw that high front vowel could also have a high front rounded counterpart.

As you can see we do not have those vowels here because the vowels you are talking about here are the English vowels. Their languages which use these distinctions, I will talk about those languages in another class. And you have mid vowels and then you have the low vowels produced with the tongue which is in a place which is lower than the high position and the mid position. So this is a lowest position of tongue and with that you produce sounds like ae, a, ah, auh, ai and au.

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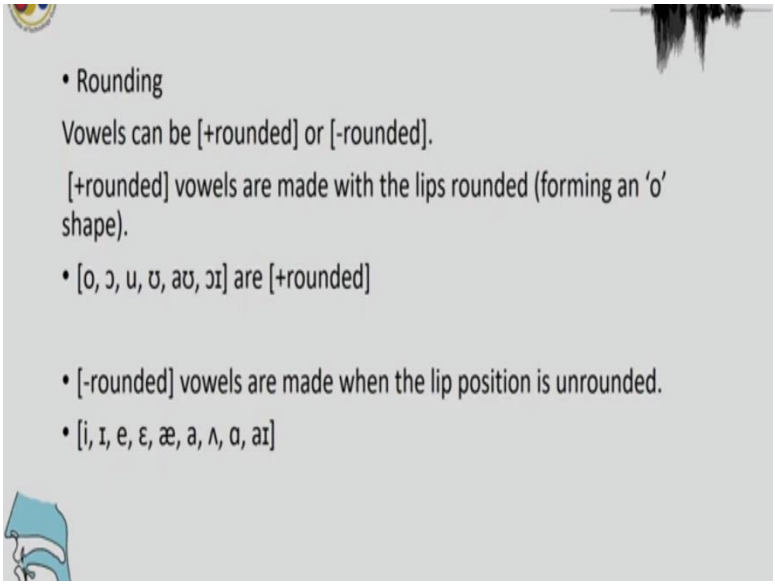

So apart from that, the third property of sounds is that of vowel sounds of rounding. So what is rounding? Lips are rounded in a rounded position when some vowels are produced, lips are in unrounded position when some vowels are produced. So when we see here, we see the rounded vowels o, oh, ooh, u, au and oy and then we have the unrounded vowel which are i, ee, e, eh, ae, aah, auh, ai.

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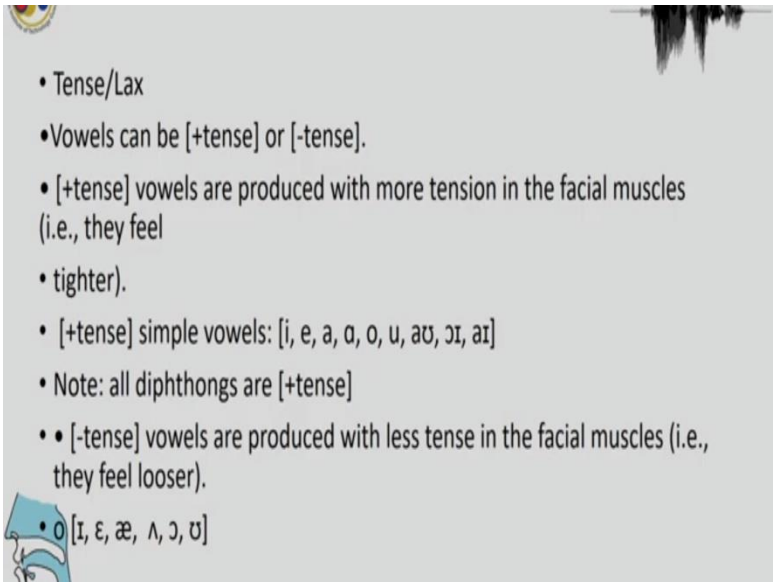

Another constriction or property that we just talked about is tense versus laxness. Tense vowels are produced with more tension in the facial muscles and lax vowels are produced with lesser tension in the facial muscles.

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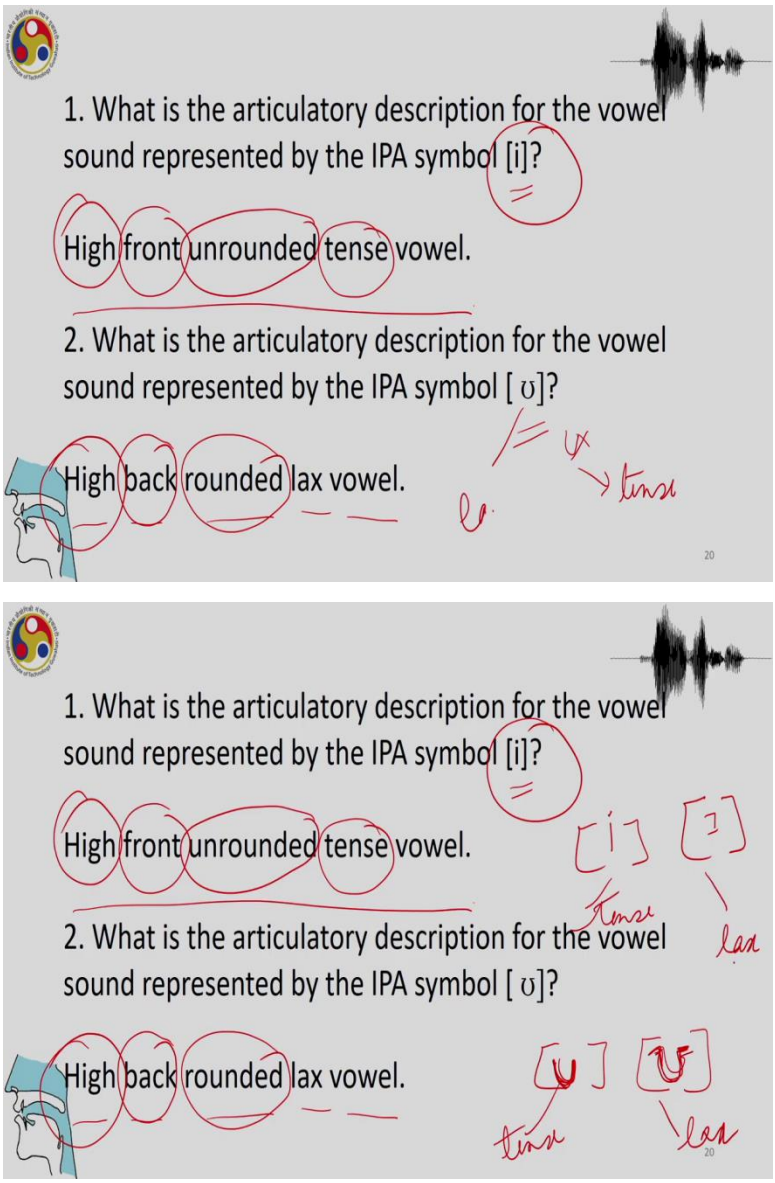

Now, so when we are asked to describe vowels, how are we going to describe them? We are going to use the characteristics that we just mentioned. So what are these? Suppose the question is, what is the articulatory description of the vowel sound represented by the IPA symbol i. So what happens in the production of i there is a narrowness in the front cavity it so it is a front

vowel. The tongue position is high. It is a high vowel. It is unrounded and it is also tense because it uses a certain amount of tension in the muscles of the tongue.

So when you talk about the IPA symbol i, these are the 4 properties which will distinguish this vowel and this is how we describe or we give a label towards of these symbols. So what is the articulatory description of the vowels sound represented by the IPA symbol u, for instance. So then you just high back rounded lax vowel. So again high because the tongue is in a higher position, back because the narrowness is in the back cavity, rounded as you can feel when you are pronouncing this sound.

It is rounded almost like ooh but it is not ooh because ooh is tense whereas u is lax. That is the difference between these 2 sounds. So we should talk about u versus ooh, what is the difference? Difference is that in the production of this one, this is tense and this is lax. That is the only difference.

Apart from that, they are both high back rounded vowels. Again, similarly when we are talking about i versus eh, the lax vowel, then, what is the difference? They are both high front unrounded. However, this is the tense vowel and this is the lax vowel and these properties should be reflected if you are talking about vowel sounds.

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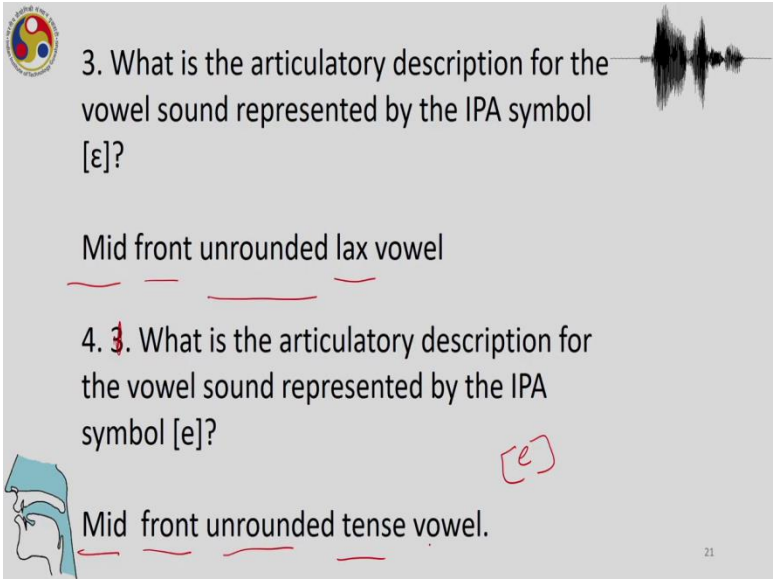

So similarly mid front unrounded lax vowels and then what is the articulatory description for the IPA? So similarly when we talk about these vowels in the mid vowels, also, we have to talk

about whether it is mid, whether it is front, whether it is rounded, unrounded, whether it is lax or whether it is tense. So concluding discussion is that vowels are mostly represented with their 4 labels.

Among those 3 are the most important. You have to describe whether the tongue position is high, mid or low, whether the narrowness is in the back cavity or in the front cavity or whether the lips are rounded or unrounded, apart from that the sets of vowels which are different depending on whether the tongue is in a state of tension or is it tense or is it lax.

So the sets of vowels which differ solely on that criteria and these are the ones that you see right here u versus a and ooh versus o and there may be other properties which we have not discussed in this lecture on vowels because those involve other properties such as nasality. So some vowels are nasal. So languages may have nasal versus non nasal vowel sets. Normally those languages always have nasal harmony which means or nasal vowel or nasal consonant can make the surrounding vowels nasal.

So that is a process of harmony or assimilation that we will not talk about here. So vowels can be nasal, vowels can also be voiceless, but there is no known language where vowels are distinctively voiceless. Vowels can be voiceless because of an environment in which they are produced and there are many languages which produce those voiceless vowels, but they are almost always determined by the environment and not distinctive vowels. So with that we come to the end of this lecture on the articulation of vowel sounds.

We will have another discussion, a longer discussion on vowels when we are talking about the acoustics of vowels, when we talk about vowel formants and what are the acoustic properties of vowels and in that discussion, you will see what happens to these properties such as place of articulation for instance, the place where the narrowness happens or how the tongue height, how these properties are reflected in acoustic properties such as vowel formants. So when we discuss those issues you will learn a lot more about vowels. Thank you.