Affective Computing
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Week - 02
Lecture - 02
Emotion Theory and Emotional Design

Hi friends. So, welcome back and now let us start with the session 2 of this week. So, in the session 1 we already understood that there are different distinction, there are distinctions among the perceived and the induced emotions and both the type of the emotions can be represented or modelled by different categories, different ways. And, two most popular models are the categorical models and the disk and the dimensional models right. So, let us start with the categorical models.

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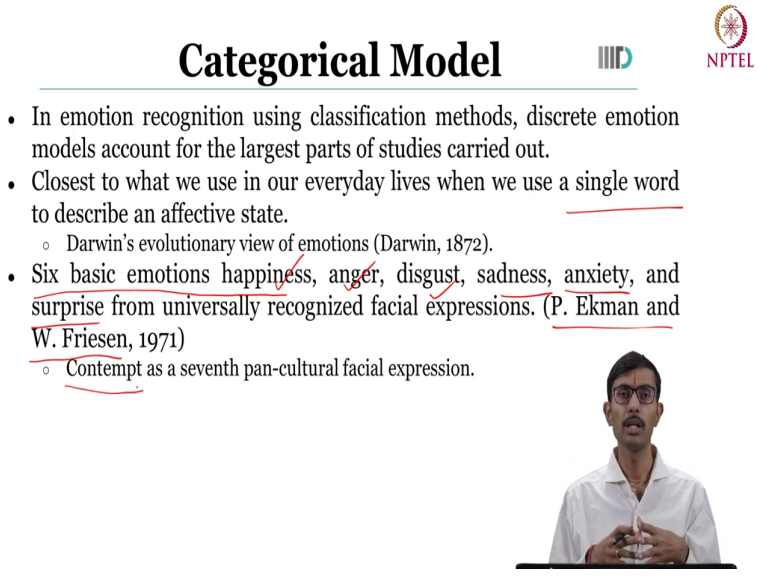

Now, in the categorical model what happens that discrete emotion models are discrete emotion emotional states are used and this categorical model is the most popular model or most commonly used by the affecting computing community as of now. And, for the reasons that will become very very obvious now. So, first thing that the categorical model of emotions they are very very easy to understand and hence they are very very easy to represent as well.

So, basically what this categorical model of emotion is that it describes exactly what we use it describes the emotion in exactly the same way in which we use it in our everyday lives that is using only a single word. So, what it does? It simply uses a single word to describe the emotions that are there.

So, that describes our affective states and this particular view of describing the emotions using the single word or using the words that are commonly used by in our everyday lives is has been used by this right starting from the Darwin's age which is when he gave this paper on the Darwin's evolutionary view of emotions, where he described this his evolutionary view of emotions.

Where he said that emotions are basically what can be used what can be described in by in the single word or what can be described by what the people are using in their day to day lives. Now, among this categorical model of emotions also then there are different ways in which the categorical models of emotion is also implemented.

And, the one that is again very very popular among this categorical models of emotion is the one that is given by the Paul Ekman and Friesen in 1971, where what they said that they recognized there are six basic emotions. And, these six basic or discrete emotions together constitute can be treated as a one categorical model right.

So, basically of course, Paul Ekman made it popular or popularized with respect to the facial expressions. But, nevertheless the idea was that these are the basic six emotions using which any more complex set of emotions can be represented. So, the basic six emotions that Paul

Ekman popularized or proposed were happiness, anger, disgust, sadness, anxiety and surprise right.

And, in his later papers he also recognized contempt as a seventh basic emotion. And, altogether the idea is that this six or seven basic emotions, they represent most of the emotions that we experience in our day to day lives. But, more importantly even if there are complex emotions they can be constituted with the help of these basic emotions right.

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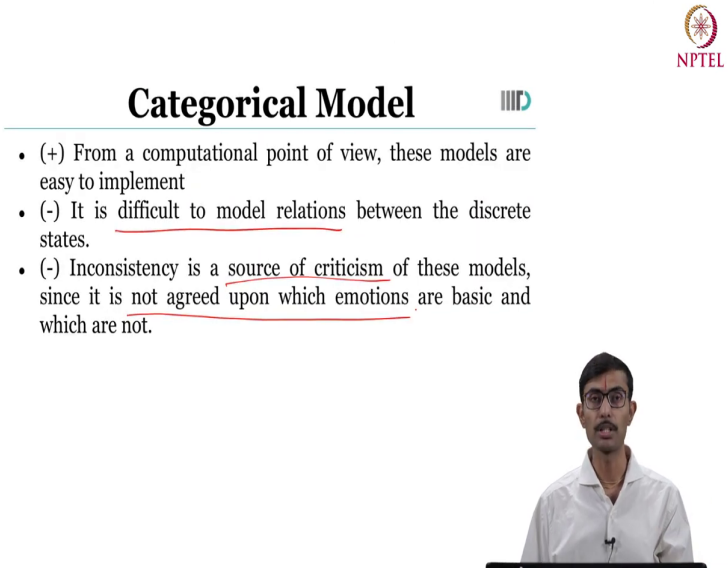

Now, the biggest advantage. The biggest advantage of these models or this representation of emotions is that from a computational perspective, these models are very very easy to implement. This becomes discrete classes from a machine learning perspective and hence there are different; if there are we are talking about six basic emotions, then we only will have to deal with the six classes of classification.

And, hence it becomes very very easy for a classifier or for a machine learning model to deal with these type of modelling. And, similarly not only for the machine learning models also even for when you want to collect the ground truth is it is very easy for the end users or the users to provide the ground truth in terms of these basic models.

Because, it is very easy for them to describe whether they are feeling happy, whether they are feeling sad, whether they are feeling scared or so on so forth right. So, hence it becomes computationally very very easy. But, one problem that is there in the model is that even though it talks about some basic emotions and even though Paul Ekman and other researchers they hypothesize, that the complex emotions such as shame, pride, guilt and all that they can be constituted with the help of these basic emotions. But, it remains unclear how the relations between these discrete states can be modelled right.

So, basically for example, it is not it is not very clear therefore, example in the case of the pride should there be what exactly will be the elements of the basic emotions; maybe there is a bit of happiness, maybe there is a bit of maybe there is a bit of happiness, maybe there is a bit of surprise, anxiety or whatever element you can think of right.

But, the problem is most importantly whatever you can think of, first it will be a bit harder to justify as you can as you rightly saw. And, the other thing in what quantity they will have to mixed up so, that you come up with the emotion of the pride right. So, it becomes really hard and difficult to model the relations between the discrete states.

Other problem that is there with the categorical models that there is a lot of inconsistency. And, when I say the inconsistency what it means that the basic emotions themselves are not agreed upon among the researchers. So, for example, while the Paul Ekman and the researchers they have hypothesized the six and later the seven basic emotions, in another paper Paul Ekman and his team also hypothesized about twelve and the fourteen basic emotions.

And, then there are different researchers those who talk about eight emotions, ten emotions and so on so forth. So, this is a very very big source of criticism that the basic set of emotions are not agreed upon. So, first thing that we do not agree, the researchers do not agree what exactly are the basic set of emotions. And, the other problem is that how these basic set of emotions are related to each other and can be used to model more complex emotions. So, I hope that the categorical model of the emotion is a bit clear.

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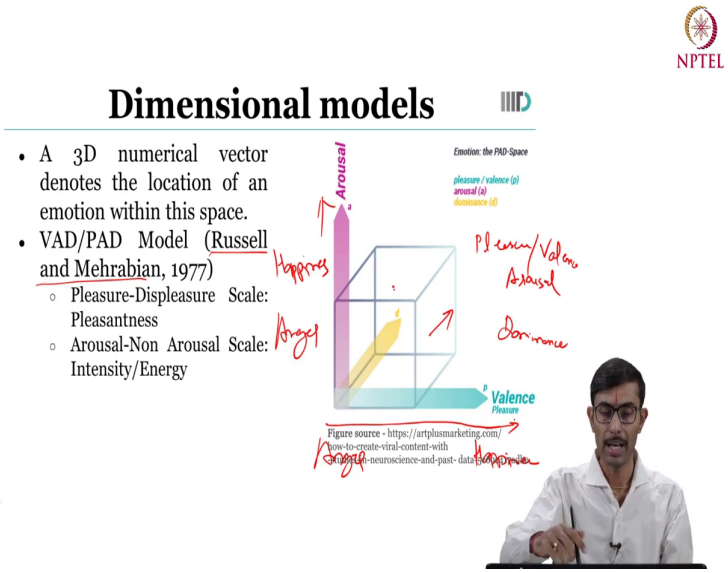

Now, the problem with the categorical model, the psychologists they have a lot of problem with the categorical model of the emotions. So, basically psychologist what they believe mostly that this using a single word to describe an affective experience is not correct. And, because the emotions themselves are very very complex and hence they have to be

represented in terms of some dimensions underlying dimensions that are enabling those particular emotions.

And, for the same reason based on the same hypothesis, this dimensional models was proposed. And, this in this dimensional model as you can see in the figure on the right that there is this there is a 3D numerical vector which denotes the location of any space which could be for example, you know there is an emotion here. So, then you can see that there is a dimension as valence, there is a dimension as arousal and then there is another dimension which is known as the dominance.

So, basically it is known as the pleasure arousal dominance. So, basically it is known as the pleasure arousal dominance or rather than the pleasure it is also known as the valence arousal or the dominance. And, hence this particular dimensional model is now known as either the PAD model or the VAD model, where the V stands for the Valence and the P stands for the Pleasure. And, this was popularized or proposed initially by the Russell and his and Mehrabian in 1977.

So, basically Russell and basically the whole idea of this dimensional model was that the a particular emotion cannot be described by using a single word, but it is described by the underlying dimensions which enables this particular emotions. So, for example, we have three-dimensions here in this three-dimensional model. So, first dimension is the pleasure or the displeasure scale.

So, basically this is what this is your the pleasure or the displeasure scale. Of course, on the right side you have the pleasure and on the left-hand side you have the displeasure. So, basically what it measures exactly on this pleasure or the displeasure pleasure and the displeasure scale?

It measures the pleasantness or the positivity of an emotion rather than saying that what exactly is the emotion, what you want to say, what is the positivity that is associated with the

particular emotion. So, for example, if you talk about a emotion of happiness right and then there is for example, an emotion of anger.

Of course, it is very easy to understand that more positivity is associated with the happiness unless positivity or maybe no positivity is associated with anger. And hence for example, when we talk about the pleasure or the displeasure scale, the happiness could be lying on the right hand side, while the anger could be lying on the left hand side on this particular pleasure valence scale right. So, this is with the first dimension of this model.

The second dimension is the arousal scale that you can see on the y axis. So, basically on the y axis, you can see that this is the arousal scale. Now, in the arousal scale you have to be careful and pay attention here. The arousal dimension commonly it represents the intensity or the energy that is associated with a particular emotion right. So, for example, the more the intensity is there, the more the arousal is there in the more the energy is there in a particular emotion, the more is the arousal of that particular emotion right.

So, for example, if I take two examples of the there is one emotion let us say we call it there is one anger emotion again we can take and then again there is a emotion that we can take as a let us say we can take as the happy happiness itself right. So, basically if we talk about the anger and the happiness also. So, again you can have angerness with low intensity as well we can you can have the angerness with the high intensity as well, right.

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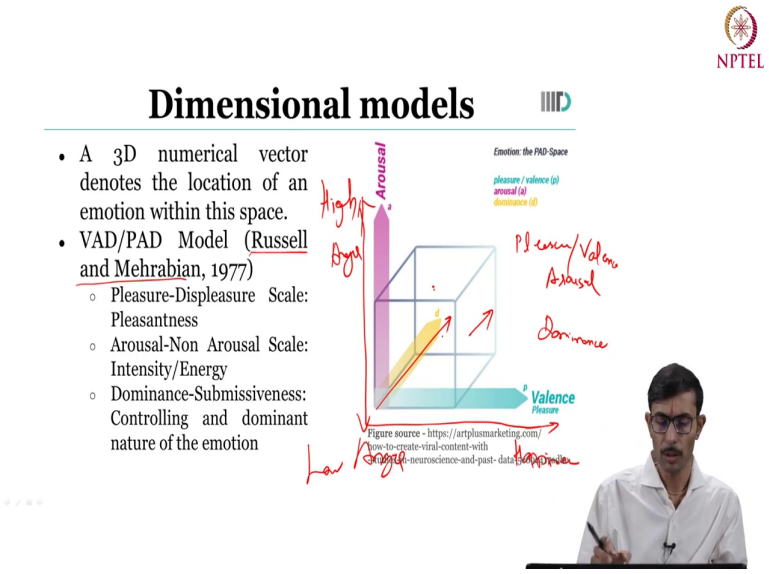

So, basically let us say you know while on the lower side bottom side let us say of this scale you will have the low anger. On the higher side, you will have the high anger right because there is going to be higher. Similarly, for the happiness also you can say that lower happiness can be there on the lower scale a lower side of this arousal dimension and then higher happiness can be on the higher side of the arousal dimension right. So, this is what is the arousal scale.

There is the oftenly used third-dimension which is known as the dominance. So, this particular dimension that we are seeing here, basically this is known as the dominance scale. And, this is also known as the dominance or the submissiveness scale. So, basically this dominance scale what it represents? It represents the nature of the emotion whether the nature

of the emotion is controlling or the nature whether the nature of the emotion is the dominant right.

So, basically or is submissive for example, whether the nature of the emotion is dominant or whether the nature of the emotion is submissive, contrary to each other. So, for example, again if you take the example of two emotions, we can take the example of let us say; let me just clean this a bit.

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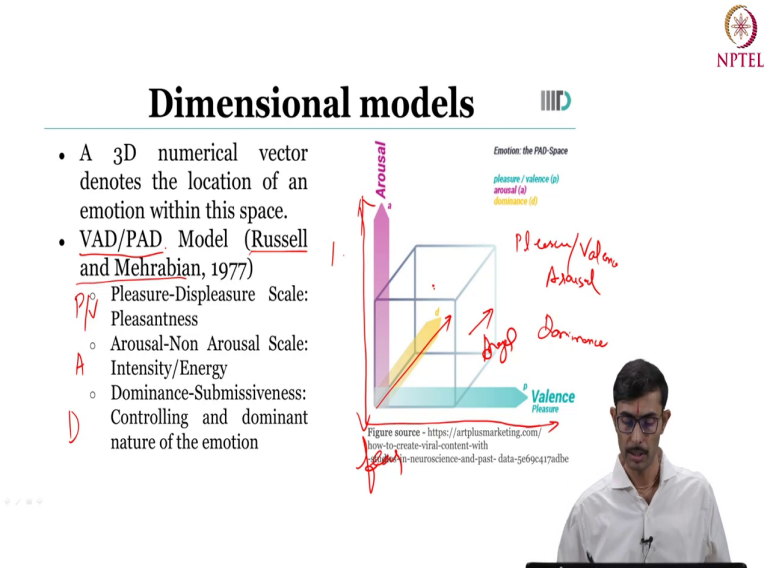

So, for example, if you take the example of fear right, an another example you can take of is of the anger. Now, what do you think that as an user you feel more dominant when you are scared or you feel more dominant when you are angry right? So, the answer is of course, you feel more dominant when you are angry; because when you are angry you have more intention

to take an action. You do not feel the submissiveness, you do not experience the submissiveness in that particular emotion.

For the same reason fear when it comes to the dominant, emotion it will lie on the left side of the scale; while the anger will lie on the right side of the scale. So, the more dominance is there in the emotion, the more the emotion can be represented on the right side of the scale right.

So, I hope that these three are clear. So, basically this is what is becomes your P or V, this becomes your A, this becomes your D. So, this is it how it becomes the pleasure arousal dominance or the valence arousal dominance. So, PAD or the VAD, these two are equally commonly used in the literature. So, do not get confused with PAD or the VAD model.

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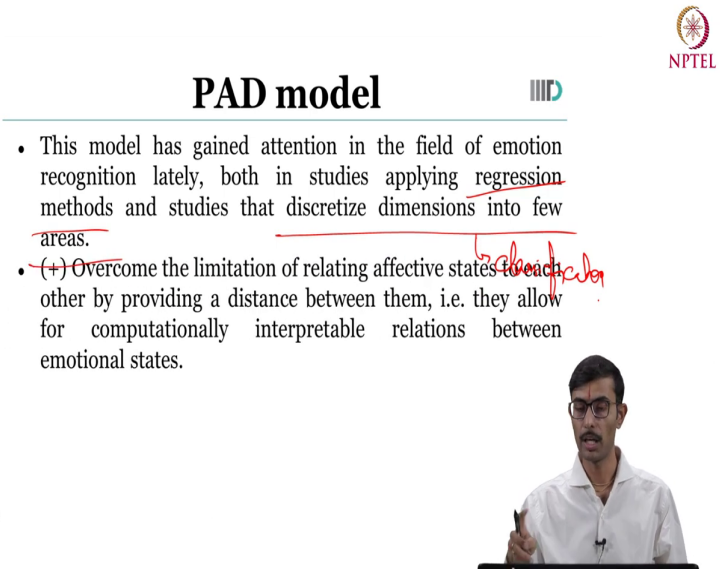

Now, having understood the PAD and the VAD model, one particular reason that it has gained a lot of attention is that it can very easily be used in the regression methods as well as it can used to discretized dimensions in the few areas right. So, when I say that regression methods, what it means?

That imagine rather than saying whether an individual is feeling happy or sad, we may want to say that for example, the emotion intensity was let us say 7, a 0.7 and the positivity that was there in the emotion was 0.4 right. So, you already know that when there are continuous values associated with a particular scale, then that particular problem can be easily modelled as a regression problem.

Then, you have a number associated with that rather than having a category right. So, that is one reason that it has become very very popular. Other interesting thing is of course, you can always discretize the emotions as well the dimensions as well. So, for example, you can always say that when the positivity is greater than 0.3, let us say if you are talking about a scale of 0 to 9, then when the positivity is let us say greater than 7, greater than 6, a 7, 8, 9 then that can be a let us say highly positive emotion.

Similarly, you can talk about low positive and you can talk about medium positive right. So, you can always discretize this continuous scale as well and hence once you discretized this continuous scales, this also becomes a what? This also becomes your classification problem.

So, you can treat the same you can use the same scale, same representation of the emotions to deal with the regression methods as well as the classification methods. So, that is one biggest advantage of this particular thing is, other thing other advantage of this particular model is that it really allows you to understand to have an interpretability between of the relations that is there between the different emotional states. So, for example, you can always say that let us take this particular example here.

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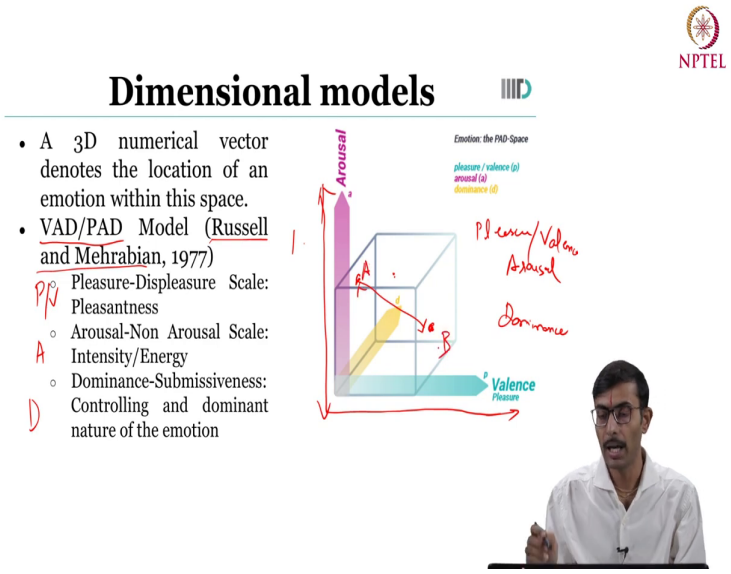

So, for example, you can always say that there is one particular emotion that is lying here and then there is one particular emotion that is lying here. So, you can always calculate a distance between these two emotions. Let us say emotion A and emotion B and that can give you the interpretability that is there between these two emotions and the relations that is there between these two emotions right.

So, you can always understand that on the scale of the positivity how they are related, on the scale of the intensity how are they related, on the scale of the dominance how are they related. So, basically this becomes computationally really really interpretable and really easy for us to do the modelling of the different emotions ok.

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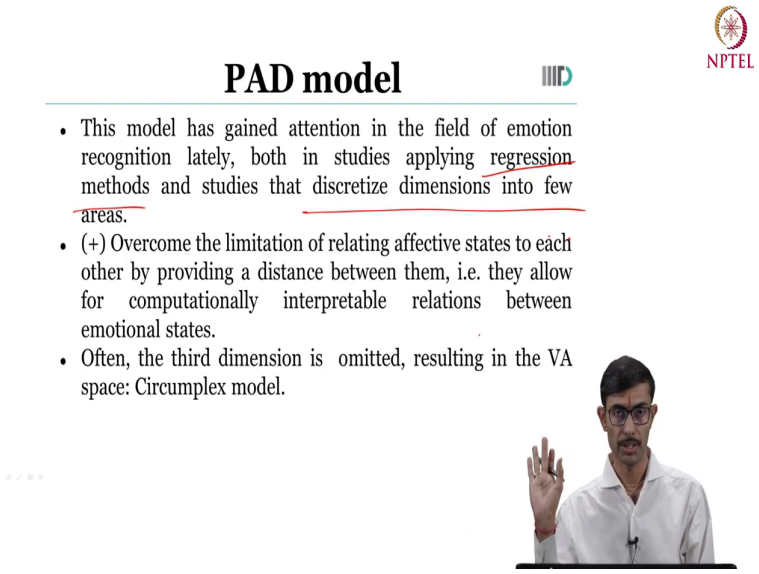

So, these are the two advantages of this particular thing. Of course, one disadvantage that can be seen that since there are three-dimensions. So, of course, earlier you were having only one value to represent one particular emotion, right now you are having need you need to have three values to represent one particular emotional state.

Now, an often may be for this reason only that often what happens the third dimension is omitted. So, once the when the third dimension is omitted, then it results in the VA space only which is also known as the circumplex model.

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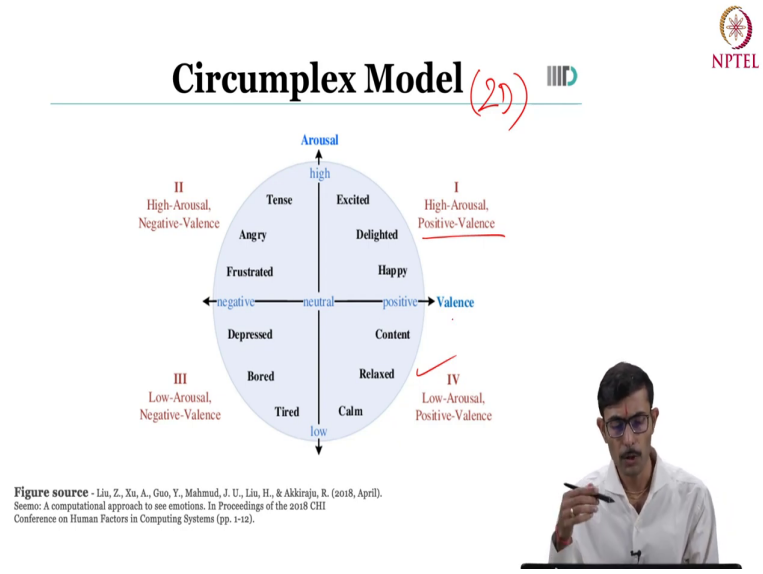

So, for example, if you look at the circumplex model this is what the circumplex model, a 2-dimensional circumplex model basically is the is a 2-dimensional model where you just have the valence and the arousal scale and the dominance scale is completely omitted. And basically so, you can see on this beautiful diagram that there are when you talk about the two emotions, two dimensions then the entire quadrant can be divided into four quadrants.

And, then you have the 1st quadrant which is of course, being represented by high arousal. So, basically you have the high arousal here and then the positive valence may be on this side right sorry. And, then in the 2nd quadrant you have the higher arousal and the negative valence.

Similarly, you have the low arousal and the negative valence in the 3rd quadrant and in the 4th quadrant for example, here you have the low arousal and you have the positive valence. And then of course, you can see for some of the representative emotions that are there.

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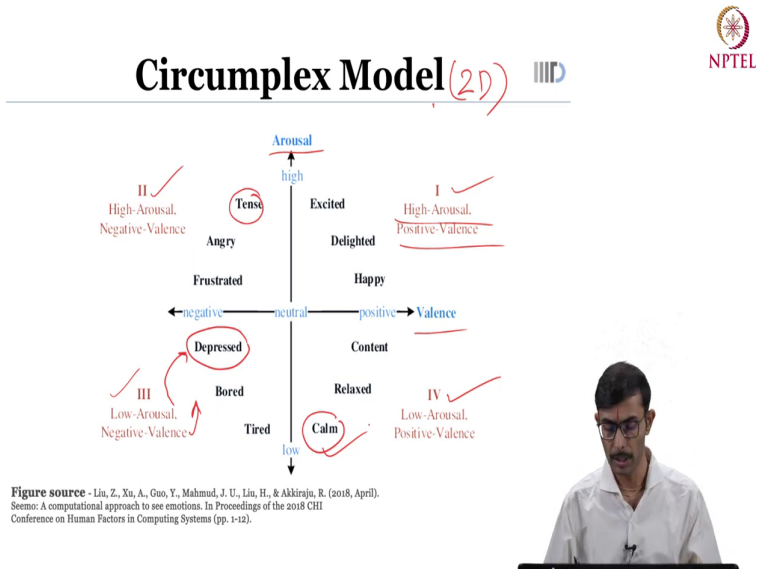

So, for example so, for this reason when we omit one particular dimension, it results into the 2-dimensional model and which is known as the circumplex model. So, circumplex model is only having 2-dimensions. And, these 2-dimensions are what? These are the arousal and valence dimensions. So, we are omitting the dominance dimension here right. And, as you can see in this beautiful diagram, we have different emotions that are represented in the four quadrants of these 2-dimensions.

So, for example, in the very first quadrant we have what we have the happy, delighted and excited emotions. Now, these emotions you can very easily understand that the positivity of

these emotions is high. So, they cannot be termed as the negative valence emotions right. So, they are what? They are positive valence emotions, for the same reason they are lying in this right side of this quadrant right side of the valence scale.

And, now if you look at the arousal so, usually when the when you talk about the happiness, when you talk about the delightness, when you talk about the excitement; all these emotions usually you have a there is a lot of energy, there is a lot of intensity right. So, for the same reason usually they are termed as the high arousal and hence they can occupy this entire space here right.

So, this is how you got we arrive to the high arousal and the positive valence in the first quadrant which is being represented by the happy, delighted and the excited emotions. Similarly, if we talk about the 2nd quadrant here which is this particular case here, if we take one representative emotions such as the angry emotion. Now, if you talk about the angry emotion of course, what would be the positivity of the angry emotion?

Of course, the positivity of this would be very very low or in other words that this particular emotion will have a negative valence. And, hence it is lying in the second quadrant that is on the left side of the valence scale. Similarly, if you talk about the arousal state of the angry angerness of course, usually the arousal is that what is the type of the energy or the intensity that is there. So, usually when you have the angerness, the energy can be high, energy can be low as well.

Nevertheless so, but when you put it somewhere here, it means what you are representing that there is a high arousal that is associated with the angerness. Of course, there is no less arousal here, of course, in the when we are representing anger here, it means what we are saying that anger is having high arousal.

Similar thing goes for the tense, maybe when tense is represented here for example, maybe what we are trying to say that the positivity of the tense emotion is a bit higher than the positive positivity of the anger emotion right. Similarly, when you talk about the frustration

maybe tense is more positive than the frustration right. But of course, nevertheless you can put it on the other side as well and accordingly the values may change.

These are just the representative emotion. So, we covered already the 1st quadrant, we covered the 2nd quadrant. Now, similarly let us look at the 3rd quadrant. So, let us just take one example of one representative emotion. So, for example, if we talk about the depressed emotion, now in the depressed emotion of course, it is not a very positive emotion. So, definitely it is going to have a negative valence right.

So, we are right in saying that this is having a negative valence as being represented by putting it in the 3rd quadrant. Similarly, if you talk about the arousal, when you have the depression of course, the intensity or the energy that is associated with the depression can be high as well. But, nevertheless usually what happens when you are depressed, there is low energy, there is low intensity that is associated with it right.

So, for the same reason, this arousal is low and hence it is being represented in the 3rd quadrant here right. Similarly, that is how we covered the third. Now, let us look at the 4th quadrant here. In the 4th quadrant, let us just take the example of the calm. Calm is a very beautiful emotion. Now, in the case of the calmness, if you look at the arousal of the calmness, the intensity is going to be low right. There is not going to be much energy in the calmness right.

So, basically what you will have? You will be in a very relaxed state of mind. So, there is not going to be much energy. But, definitely if you look at the valence or the positivity associated with this particular emotion, it is going to be it is definitely going to lie on the positive side and for the same reason it can very well occupy a space in the 4th quadrant here right.

So, that is how we have calm, relaxed and content, these kind of emotions in the 4th quadrant. So, that is how this circumplex model is used which is a two-dimensional model. And, it is very very fairly popular and commonly used model where we have omitted the dominance.

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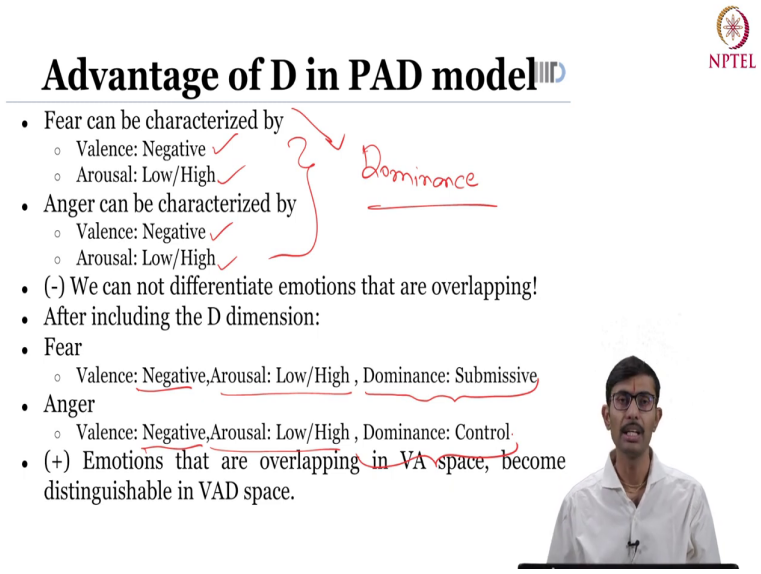

Now, having used only these seen this circumplex place model, now the question that may arise ok, this is fairly good model and for the same reason actually it is commonly used also. Now, but is there any advantage of using the D dimension, that is the Dominance dimension in this PAD or the VAD model. So, to answer that let us look at two different emotions.

Let us see how the fear is characterized for example. So, for example, the fear can be characterized definitely by having a negative valence. And, the arousal depending upon what is the amount of the energy that is associated in the fear; it can be low or high right. So, basically this is how the fear can be easily characterized. Now, let us look at the anger emotion.

If you look at the characterization of the anger emotion of course, the valence of the anger is also negative right, it cannot be positive. And, if you look at the energy that is associated with

the angerness or the intensity that is associated with the angerness can also be low or high right. So, basically you can be very angry or you can be less angry as well and for the same reason the arousal can be low or high.

So, what happens now if you look at these the characterization of the fear and the anger on this two-dimensional scale, then there is not much difference here and that is where it can be confusing. So, we are not able to differentiate the emotions that are overlapping in the two-dimensional space. So, for the same reason what we do? We let us now see what happens if we include the D, that is the dominance emotion. So, please remember here that the D stands for the dominance right.

Now, in the case of the fear what will happen? Of course, our valence will remain negative; our arousal can be low or high. But, when we look at the dominance of the fear emotion, in the fear emotion usually the individual who is experiencing the fear emotion is submissive right. So, for the same reason the dominance can on the dominance scale, it can be described as submissive.

Now, if you look at the anger of course, the valence is the negative, arousal is low or high. Now, but if you look at the dominance, the dominance is the individual who is experiencing the anger emotion usually is more dominant right is more wants to take the control of the situation, more action oriented. And, for the same reason the dominance on the dominance scale, it can be said that it is controlling right.

So, dominance is really high on the high side of the dominance scale. So, now, you can see that earlier the fear and the anger emotions were not getting classified or discriminating discriminated on the basis of the two-dimensional emotion. But, the moment we include the third dimension, now we are able to classify or characterize it in a bit better way right.

So, that is what is the advantage of including or having the D in the PAD model. But, for most for our common purposes most of the time what we do? We simply omit the D dimension and we simply operate in the two-dimensions of valence and arousal to represent

the emotions right. And, when say you say the emotions both the type of the emotions, the perceived emotions as well as the induced emotions right, perfect.

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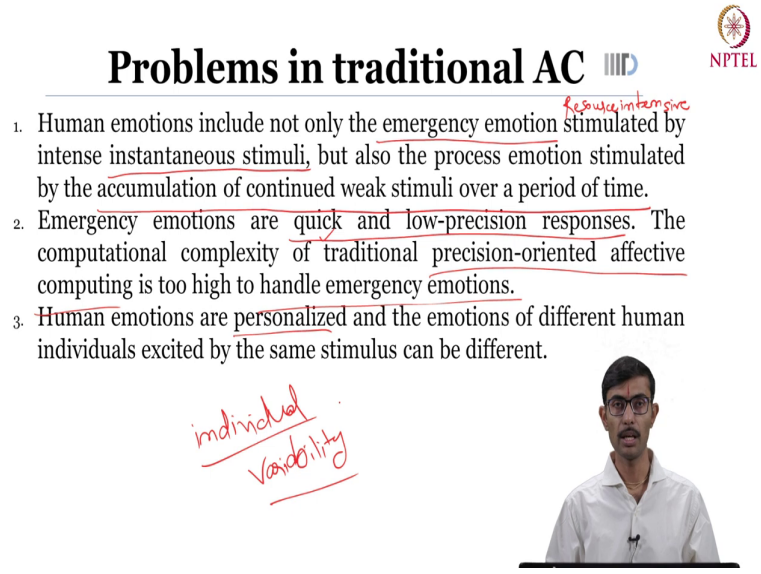

So, now we have already understood that how the emotions are represented and what are the categorical and the this dimensional models of the emotion right. Now, with that let us try to look that what are some of the problems associated with this because of this the way we represent the emotions, the way we understand the emotions in the traditional affective computing research or the domain.

So, first thing that we have to understand most of the time what happens when we talk about the human emotions, when the fatigue computing community talks about the human emotions; they talk about the emotions that are sort of emergency emotions and that are

stimulated by some intense or more importantly instantaneous, instantaneous stimuli right. But, the problem is that the that is not how the human emotions are exactly stimulated.

Of course, you may see some lion, you may see some bear for example, or you may see a very beautiful interface and you feel happy about that, you feel good about that. So, that is all fine, but many times what happens that this process of the emotion is stimulated by an accumulation of continued weak stimuli over a period of time. What it means? That it means for example, if you are feeling tense, then what happens that you are not just feeling tense because you just saw something at the moment.

It may have happened that you know over the period of time, you have been encountering several tense full situations. And, because of that now what is happening that your general baseline state has become kind of a more tense than normal. And, whenever you are encountering a particular stimuli that is kind of a acting as a trigger then you are feeling very tense about it.

So, that is one particular problem, that in the affective computing community and in the research that we have seen in the affective computing so far, most of the time when we talk about the human emotions, we are talking about the emotions which are emergency emotions and which are stimulated by the instantaneous stimuli. But, we fail to take into account the effect of weak stimuli over a longer period of time or how the emotions are accumulated over a longer period of time.

Of course, there are several reasons that we have not been able to do so. One simple reason can you think of? Any reason about it. For example, one simple thing reason could be which is of the resources as well. Definitely, in order to understand in individual's emotion over a longer period of time, you need to be able to monitor the emotional state over a longer period of time right. And, this is where you know it all becomes very very resource intensive.

So, it is rather easy to make you listen a music for example, and see what is your response to listening that music. But, let us say if you want to understand that how you have been responding to the different music's, that you have been listening over a period of 1 week, then

definitely you will need lots of resources, you will need lots of different ways in which you can monitor the this response. And, you can see that in what way at what points, what instances the individual is listening to the music and so on so forth.

So, that is what the one particular problem here is that here what happens that it becomes very very, it becomes very very resource intensive. So, that is what we have to remember and hence we have not been able to do the monitoring over a longer period of time sorry. Now, emergency emotions as we have already talked about, they are quick and they are low precision responses.

What it means that first thing that you experience a particular emotion and then they are gone, gone maybe in seconds, maybe in minutes, maybe in few minutes right. Definitely, most of the instantaneous emotions, emergency emotions or the emotions that you feel in response to a particular stimuli, they do not last longer than a few minutes, definitely not hours maybe right and days and weeks definitely not.

So, what happens that since they are quick in that sense their precision also is very very low right. What happens that it may be confusing at the at times or there may be a mix of different emotions that an individual is experiencing. So, what happens that the precision oriented effective computing that we have been using; its computational complexity becomes too high to handle these kind of emergency emotions.

What it means that if you want to understand accurately that what is the emotion that individual felt in response to a particular stimuli, then we will have to be very very precise. We will have to be seeing, we will we need to be able to see that ok at what particular time for example, the stimuli was presented, at what particular time for example, the music was presented or the listener started listening music.

And, within how many seconds for example, the emotion started getting manifested in the user's response and more importantly what exactly was that particular emotion. So, what happens here that you need to create a system that is computationally very very powerful. And, hence the computational complexity of the system should be very very high as well in

order to handle these kind of emergency emotions right. So, this is other problem that the computational complexity demand is very very high.

Now, 3rd and definitely not the very one of the most important problems as well which is what, that the human emotions are very very personalized right. What it means that when we say the human emotions are very very personalized that one thing that they are also not only influenced by the stimuli that the individual is experiencing, but each individual they have their own set of different beliefs, desires, intentions, background, context so on and so forth.

And, for the same reason the emotions of different individuals excited by the same stimulus can be different. Or in other words, as we talked about before as well if there is any happy music, one may feel or experience the happiness by listening to the happy music.

But, the other individual may or may not exactly feel the happiness associated with that particular music or even if there are two individuals who are experiencing the happiness by listening to a particular type of music, the amount with which they are feeling or experiencing the happiness may not be the same.

And, on the top of that maybe there could be a mix of different emotions that are playing a role while listening to the music, when we are talking about when we are checking the different individual's right. And so, this is where what we say that always there is a lot of individual variability. So, we call we say that there is a lot of individual variability that we need to take into account right.

And, individual variability not only in terms of the baseline response, but also in terms of the context that one particular individual may or may not have right perfect. So, now, this is what was the now we talked about briefly we talked about some of the problems that are there in the traditional affecting computing approach. And, nevertheless all these problems, they are not easy to tackle; they are not easy to address.

But, in order to tackle them, in order to understand them we definitely need better understanding of the emotions and better understanding of the individual variability. And of

course, computationally more powerful not only the hardware, but also more powerful the methods or the software's and the algorithms to help us achieve this in an efficient manner right.

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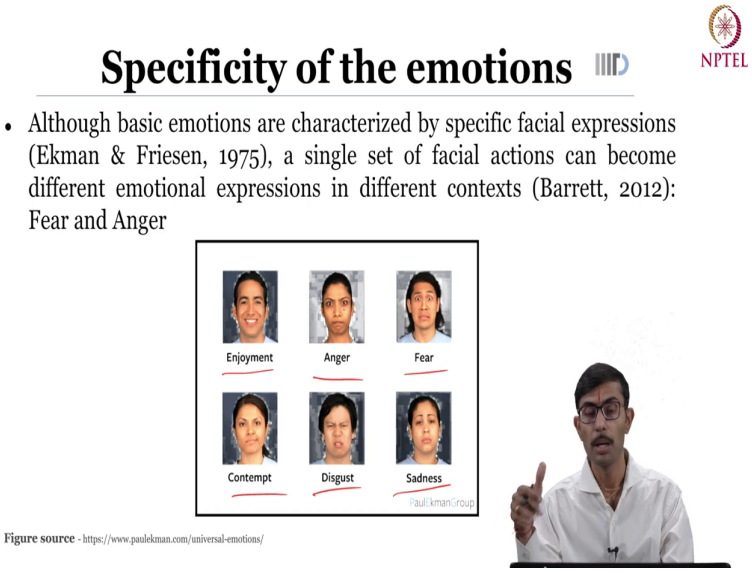

Now, having talked about the limitations, let us now move our focus to some a bit something a bit different; where we want to understand that how the different emotions are expressed right. So, we already talked about the different emotion, different individuals, they can experience different types of emotions when presented a same type of stimuli. Now, here we want to talk about something that is a bit related, but at the same time bit different.

So, what happens that there are different basic emotions and different basic emotions are characterized by different facial expressions or for that matter Ekman proved that Ekman showed that different basic emotions are characterized by different specific set of facial

expressions. But, nevertheless a single set of facial actions or a single set of behaviour facial behaviour of facial muscles can also become different emotional expressions in different context right.

So, for example, without getting confused too much, if you look at this beautiful diagram that Paul Ekman group has created. Now, we can see the facial expressions of individuals in case of enjoyment for example, in case of sadness for example, in case of fear, anger, disgust and contempt.

So, in general what you can see from the diagram that depending upon the type of the emotion for all these type of emotions, usually the response is differently definitely different right. The facial expressions that an individual is experiencing is or making is quite different.

But, at the same time there are certain emotions which have lot of things in common as well. For example, if you talk about the anger and the fear, sorry if you talk about the anger and the fear emotion; then what is happening here that if you look at that the for example, the eyes of this individual the anger and the fear emotions, while experiencing the anger and the fear emotions, the they both in both the cases we have very very open eyes right. We have very very set of open eyes.

In the same way for example, if we look at the disgust and the sadness maybe the eyes are quite closed right. Of course, the amount with which we are they are closed depends on so many different things, about the individual behaviour and all that as well. But, but nevertheless in general in anger and the fear we have open eyes, in the disgust and the sadness we have closed eyes.

So, this is what the Ekman first hypothesized and proved that different emotions are characterized by different facial expressions. But, then came Barrett and what Barrett said at the same time different emotional expressions in different contexts can have lot of similarity also between same.

And, then there could be a single set of facial actions that can represent both in different context right. So, for example, in this case the set of facial actions that we are talking about is the opening of the eyes or the closing of the eyes right.

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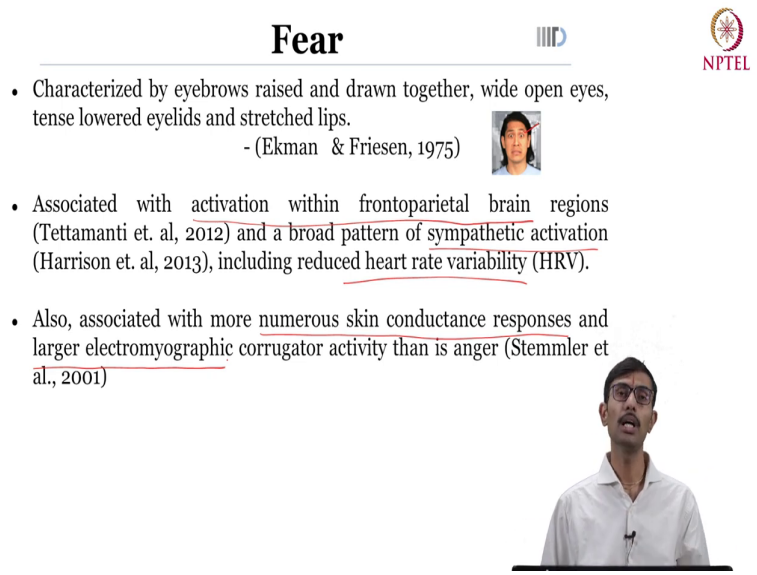

So, here we need to understand a bit more about what we mean by the specificity of the emotions. So, let us start with the fear emotion first. So, we already look at looked at this diagram of the fear emotion. Now, you can rightly see in the diagram that this fear emotion is characterized by the eyebrows of the individual is quite raised eyebrows and of course, they are drawn sort of together and it has wide open eyes. You can cleverly clearly see that the eyes are very very widely open, it has tense lowered eyelids.

So, basically if you look at the eyelids, eyelids are quite lowered and tense and then of course, if you look at the lips, then lips are stretched kind of you know the lips are stretched. So, in

general Paul Ekman made a lot of effort in characterizing the different facial expressions in terms of the different facial behaviours that individual shows. So, this is what is the behaviour of the fear and we saw that this has a lot of similarity with the anger as well.

Now, but if you look at only the facial expressions of course, there are certain ways in which this expression is being expressed, this emotion is being expressed. Now, the same emotion of fear can also be expressed in other physiological responses as well. So, for example, it has been found that there is there an activation has been found within the frontoparietal brain regions right.

So, what we mean by the frontoparietal? So, basically this is the front, this is the parietal. So, basically frontoparietal brain regions an activation has been found. At the same time a broad pattern of sympathetic activation has also been found. What do you mean by the sympathetic activation? It relates to the cardiovascular activities right. So, basically there is lot of cardiovascular activity that has been found in case of the fear emotion which includes for example, reduced heart rate variability.

Similarly, in the case of the fear emotion numerous or increased skin conductance responses has also been found. And, we have also seen larger EMG activity in case of the fear emotion than in comparison to the anger emotion. So, with that let us take a break and we will continue in the next session.

Thanks.