Basics of Mental Health and Clinical Psychiatry
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Lecture 09
Physiology of Emotions

Hello everyone. So, today we will move on to our next topic, that is Physiology of Emotions.

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So, the concepts we will cover in this physiology of emotions, that is components of, what are the components of emotions, the basics emotions which we deal with, the various theories of emotions and what are the biological basis of emotions.

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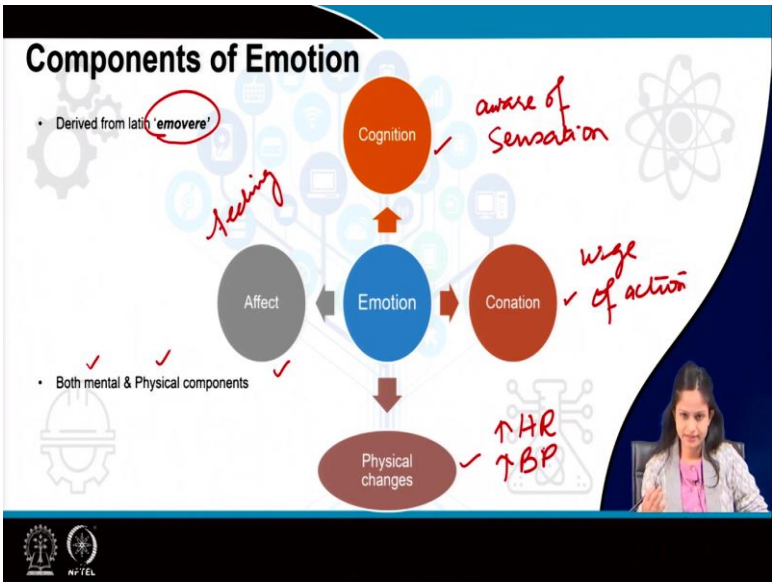

Now, emotion is the word which is derived from a latent word that is emovere. Emovere means to become agitated or to become excited. Definition of emotions, I am not going to deal with that because there are various definitions of emotions. So, what emotion consists of is mainly two components, it consists of both the mental component and the physical component. Mental component means whatever it is happening inside our brain; physical component means because of the mental component what actions we are doing.

Now, it mainly consists of four parts cognition, affect, physical changes and conation. Now, affect means feeling. Affect means feeling. Cognition means you are aware of the sensation. Whatever sensation is there, you are aware of that. Conation means what is the urge of taking action, urge of action. Now, suppose I am feeling very much angry and I want to slap a person. So, that slapping a person is the urge of action, that is conation.

And the physical changes, these physical changes mainly we talk about the involuntary changes and which happens because of the autonomic arousal, that is suppose whenever we get angry, there is increase in the sympathetic nervous system or whenever there is fear in our body or whenever there is some tension what happens? Our heart rate increases, our BP increases, we get sweating. So, these are the physical changes. That is why I told you, the emotion has got both, the mental component and the physical component.

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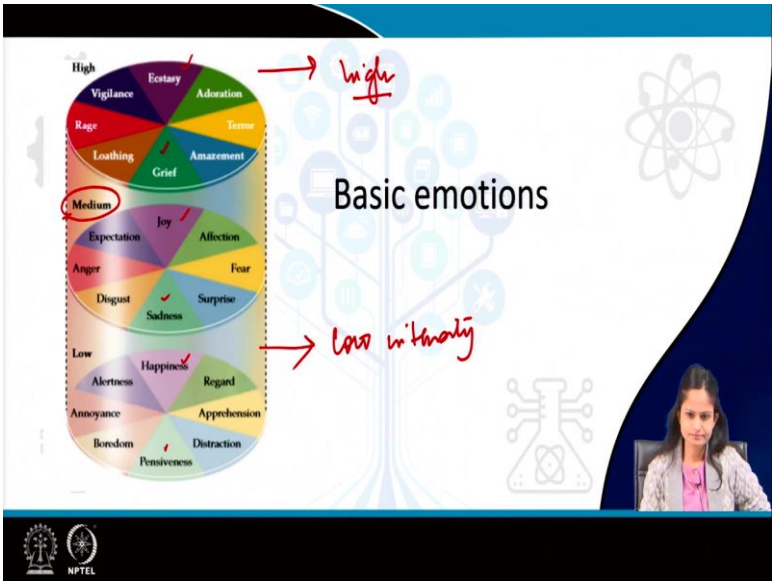

So, moving on to the basic emotions, initially in the 90s Plutchik, a scientist has discovered various emotions, the 8 emotions which he has paired in force oppositely and he has divided based on the level of intensity. Now, this is the low intensity. This structure is given based on

the intensity. This is the low intensity. This is the medium intensity and here, this is the extreme that is the high intensity; how high or how low is your intensity of the emotions?

So, the basic emotions he has told like for example happiness and pensiveness. It is arranged in orders and that too the opposite emotions are arranged. In the low intensity, happiness and pensiveness. Then in the medium intensity we call it as joy and sadness. Then in high intensity, it is ecstasy and grief. In this way we have several other emotions also. But later on, this theory has been not regarded, disregarded.

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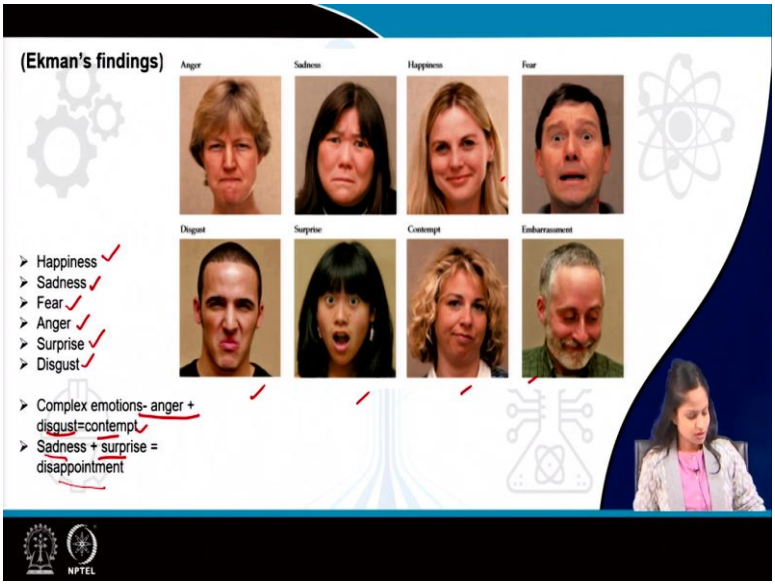

And Ekman came out with the 8 basic emotions. So, according to the Ekman's findings we have the 8 basic emotions, that is happiness. You can see from the various faces of the person - happiness, sadness, fear, anger, surprise and disgust. Now, with these emotions we have a complex 2 emotions, that is anger and disgust, if it is combined. Suppose a person is angry and as well as the person is feeling disgusted.

So, that will give rise to contempt. Now, the person is sad as well as surprised. So, that gives rise to disappointment. So, these are the 2 complex emotions which are formed from the simpler emotions. So, the simpler emotions are happiness, sadness, fear, anger, surprise and disgust. So, these are the various facial expressions of various emotions - anger, sadness, happiness, fear, disgust, surprise, contempt and embarrassment.

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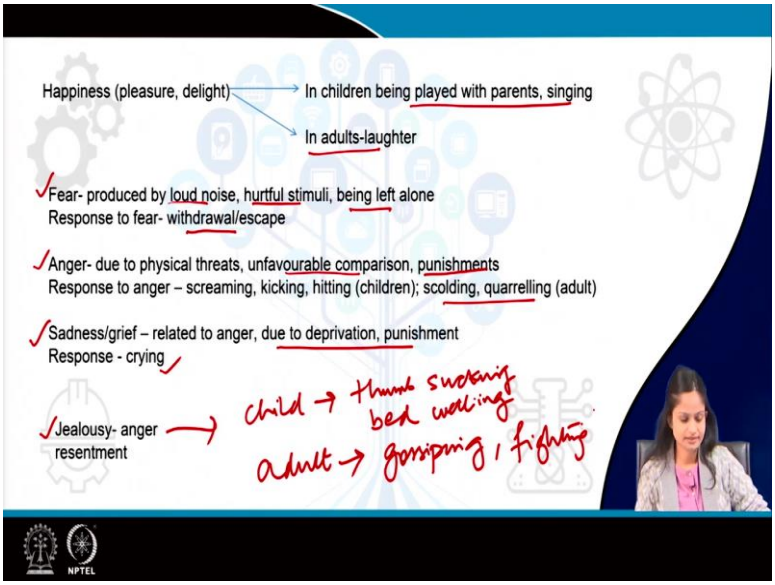

So, based on these findings we will discuss more about these each emotions. So, first and foremost happiness. So, what do mean by happiness? Happiness is a pleasure, delight or joy. Now, each expressions of each emotions are demonstrated in individuals differently. For example, in case of a child, the happiness is being demonstrated with the help of playing with the parents. Whenever they play with the parents they are happy; whenever they sing, singing that means they are happy.

But in case of adults the smile or a laughter is a sign or is an expression of the happiness. Then again when we come to fear, fear is when there is a production of loud noise or heart full stimuli or whenever there is a sense of deprivation or when a person is left alone. So, then a fear develops. Now, how there is a reaction to this response? There is a response to this fear is mainly withdrawal or escape mechanism. So, suppose I am fearful of a particular place, obviously I will not be staying in that place. I will move away, I will try to escape from that place.

So, in that way fear is produced by loud noise, heart full stimuli, deprivation, being left alone and whenever there is lack of confidence. Like for example, also suppose one person is fearful of giving exams. So, that person will try various mechanisms to escape from that exam. So, that usually occurs in case of children. Now, the next emotion is anger. Anger is due to physical threats, unfavorable comparison amongst others whenever punishment is given. So, anger is due to the physical threats, punishments, use of irrational words, unfavorable comparison.

The response to anger again differs in case of children and in case of adults. In case of children the child will scream, kick, hit. In case of adult usually they will scold or they will fight, that is quarrelsomeness. Sadness or grief, that is more or less related to anger, in close association with anger, that mainly occurs due to deprivation or punishment. The person is sad and the most common response to sadness is crying. Whether it is a child or adult the person weeps or crying.

Another important emotion is jealousy. Jealousy occurs because it is a type of anger resentment. Now, this anger resentment occurs whenever a person is often neglected. So, that's why this emotion comes and mainly the response in case of jealousy, in case of child occurs, thumb sucking or bed wetting. Then the bed wetting and thumb sucking, these are the normal phenomenon but if the person is doing it more and there is something which is associated with the child, then in case of adult the feeling, the emotions of jealousy is mainly represented in form of gossiping and of course fighting or quarrelling. So, these are the basic emotions and their responses we see in case of individuals, that is happiness, fear, anger, sadness and jealousy.

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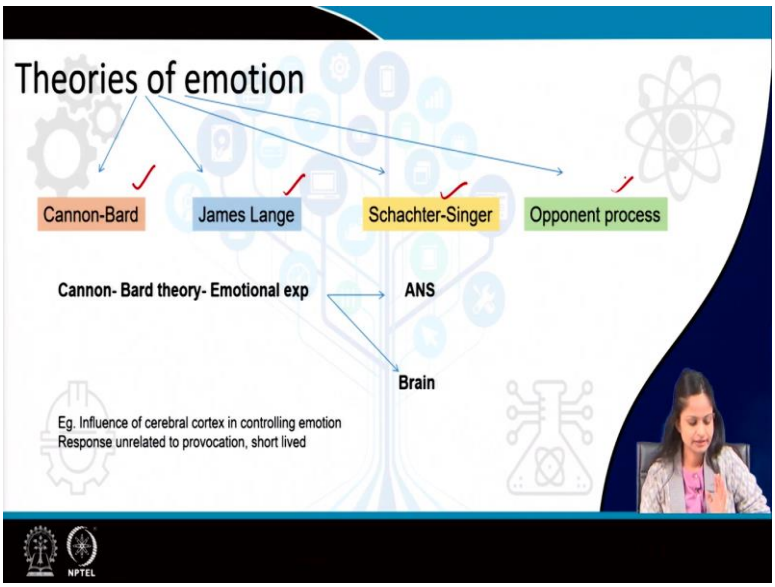

Now, what are the theories of emotions? Various theories of emotions have been come forward but we have accumulated the main four important theories that is Cannon Bird Theory, James Lange Theory, Schachter and Singer's Theory and Opponent Process Theory. Now, Cannon Bird Theory says, we will go through each theory one by one. Cannon Bird Theory says the emotional experience whatever is formed that gives rise to autonomic arousal as well as the arousal of the brain or the central nervous system simultaneously. It is not that

initially or firstly autonomic arousal will be there; that will be followed by brain stimulation, No. Simultaneously, two pathways occur where autonomic system also gets aroused and brain also gets aroused. So, this is the theory of Cannon Bird.

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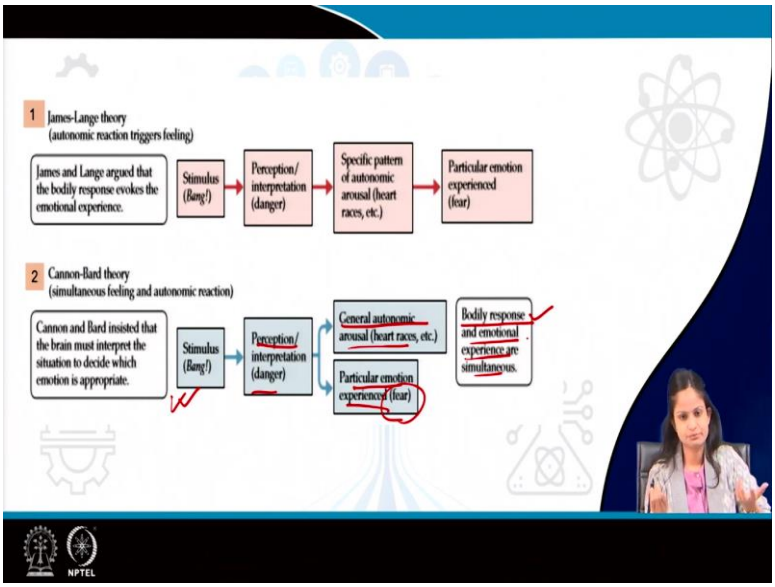

Now, as you can see in this diagram, Cannon Bird insisted that brain must interpret the situation to decide which emotion is appropriate. So, there is a stimulus, suppose a bang, there is a perception or interpretations whatever that loud noise is there, danger. So, automatically there is a general autonomic arousal, there is an increase in the heart rate and there is a particular emotion which is experienced with the help of central nervous system. Central nervous system emotional experience mainly prefrontal cortex, amygdala hippocampus.

So, they causes this emotional processing fear and the bodily response and emotional experience are simultaneous and that way the response occurs to that emotion. So, bodily response and emotional experience occur simultaneously, not after one by one, it occurs simultaneously. The autonomic arousal and the seenness arousal will occur at the same point of time.

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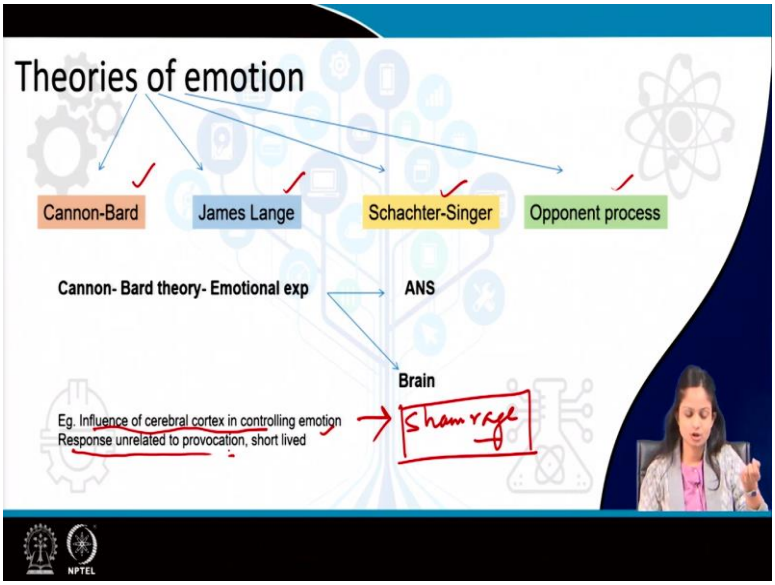

Now, the examples of this Cannon Bird theory is very common example is seen whenever there is an influence in the cerebral cortex in controlling emotion. This is seen in case of sham rage. Now, rage means anger. Now, normally the anger center or punishment center, anger is what? Whenever we get punishment, we get angry. So, the punishment center or anger center is present in the periventricular region of the hypothalamus or the periaqueductal gray region of the hypothalamus.

It has already been discussed in hypothalamus chapter. Now, whenever there is stimulation, if I constantly stimulate this periaqueductal gray region, so what will happen? The person will get automatically angry. Now, we do not get angry easily. Now, even if you ask my name, what is your name? I do not say that why are you asking these questions and like that. So, because I am not angry, if you ask my name, I will tell my name.

So, this happens because our cerebral cortex keeps an inhibition over this region, the anger center or the punishment center that is periaqueductal gray region and the periventricular region of the hypothalamus. The cerebral cortex keeps an inhibition over the hypothalamus. So, we don't get angry easily. Now, what will happen whenever the cerebral cortex is cut off or if we just remove the cerebral cortex or in any decortication is done or any accident has occurred.

So, there has to be removal of the cerebral cortex. So, the inhibition of the cerebral cortex over the hypothalamus will go. Now, when this inhibition will go, what will happen? The punishment center or anger center of the hypothalamus will become active. There is no one to

control. So, that will become active. At that time, if you ask my name, obviously, I will get angry. If you say me hello, I will get angry. So, every single moment I will get angry. So, this is known as sham rage, excessive rage irrespective of the kind of stimulus or provocation you give. So, influence of cerebral cortex in controlling emotion, which is the response, which is unrelated to provocation and it is short-lived, this is an example of canon bird emotional experience or canon bird theory.

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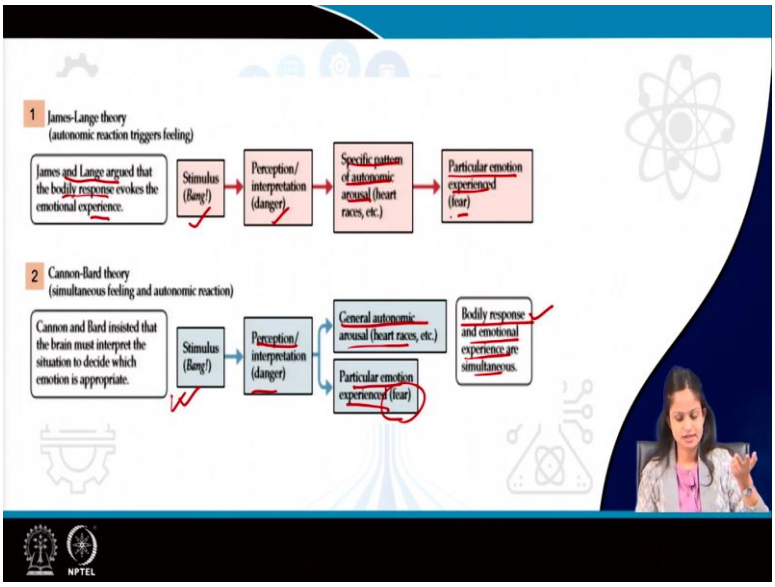

Now, coming to the next theory, that is James and Lange theory. James and Lange theory said that the body responses evoke an emotional experience. Now, there is a stimulus. There will be a perception of that stimulus. Now, there will be an autonomic arousal. This autonomic arousal is experienced as a particular emotion. In canon bird theory, autonomic arousal and brain arousal occur simultaneously. But in James Lange theory, autonomic reaction triggers the CNS reactions. So, it does not occur simultaneously. It will occur one after the another. First, the autonomic arousal will be there. Then, that will cause the particular emotion to get experienced.

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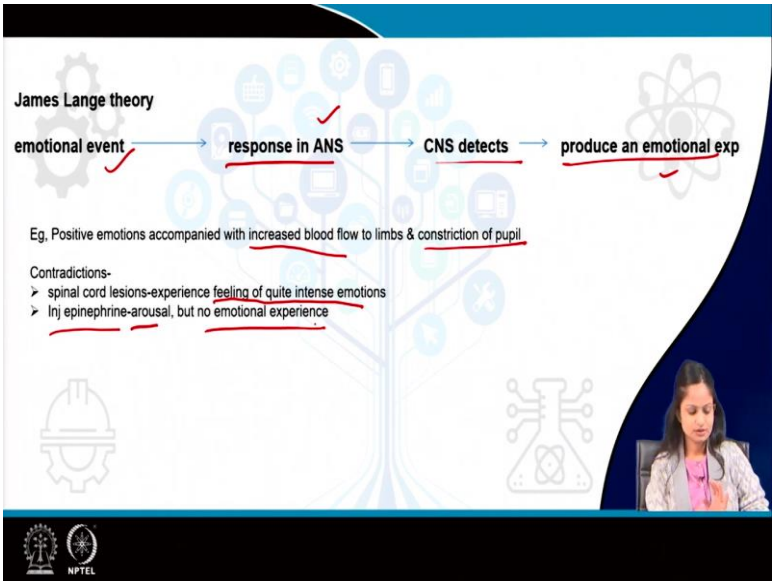

So, emotional event response in the autonomic nervous system. CNS will detect that response and produce an emotional experience. So, that is James Lange theory. The example which is in favor of this James Lange theory are whenever positive emotions are there, that is usually accompanied with increased blood flow to the limbs with positive emotions. Whenever there is an emotion, there will be increase in the autonomic arousal. And then, there will be an emotional experience which is felt.

So, whenever there is a positive emotions, it is seen that there is an increased blood flow in our limbs. Even if you do not remember this increased blood flow, this is very important and very basic thing. Whenever you get excited, whenever you are happy or positive emotions is there, the pupil gets constricted. There is constriction of the pupil. Or whenever there is a positive emotion, suppose the person is having some disease with positive emotions or with positive thought process, we say that the disease gets better, the person gets better day by day.

But if the person is having negative emotions, even if the person is having less severe disease, the person will not get well soon. So, if you want to say a person to get well soon, obviously, you will say positive things to that person, you will not be saying negative things to that person. So, that is about the James Lange theory, that positive emotions or the emotional event arouses a response in the autonomic system and that is detected by our brain and that produce an emotional experience.

But the contra-indications to this theory is, whenever the persons undergo spinal cord lesions, now the spinal cord lesions are already there, that means the spinal cord is not functioning, either they are functioning less or they are not at all functioning. So, that person should not get any emotional feeling. But it is seen that those persons also feel some intense emotions, why is it so? Or it is then contradictory to the James Lange theory because there is already a spinal cord lesion and I have, there is a lesion or destruction of a organ or the system, then how come there is feeling of intense emotions?

The second important contra-indication is when I inject epinephrine, there is arousal, but there is no emotional experience which is felt, which means epinephrine is a sympathomimetic drug, that means epinephrine or adrenaline whenever if I inject, even it is in our present endogenously in our body, whenever we are having fear or whenever you are having a tense situation, whenever you are anxious, at that time our sympathetic system gets activated and there is release of more and more adrenaline, what we call very common term is adrenaline rush.

So, at that time what happens? We feel the fear, we feel the anxiousness as well as there is there are the physical changes which occur, - there is increase in the heart rate, there is increase in the BP, there is increase in the sweating, but what happen if we give this injection exogenously means from outside, what will happen? There will be the physical changes which will occur, that means there will be increase in the blood pressure, there will be increase in the heart rate, but there won't be any expressions or any feelings or emotional experience in the person.

If I give the injection epinephrine to a person, his BP will increase, his heart rate will increase, probably he will be sweating, the sympathetic nervous system will get activated, but that does not mean the person will feel happy. So, these are the two contra-indications of James Lange theory.

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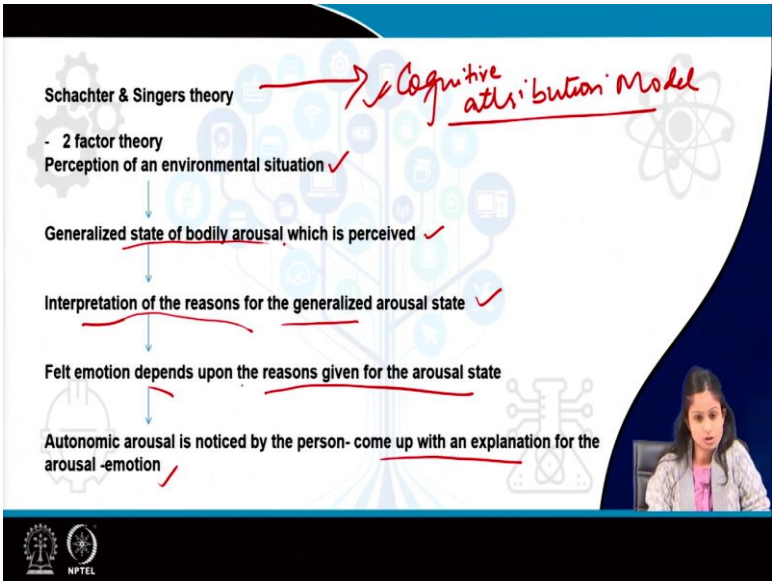

Next is the theory that is Schachter and Singer's theory. It's a two-factor theory. This theory is known as cognitive attribution model. This theory is known as cognitive attribution model. Cognitive attribution model means, based on the cognitive analysis of our surroundings, there is an emotional experience which is felt. Now, for example, there is a perception of an environmental situation. Then, there is a generalized state of bodily arousal which is perceived.

Then, there is an interpretation or analysis of the reasons for that generalized arousal state. Then, the emotion felt depends upon the reasons which are given for the arousal state. Autonomic arousal is noticed by the person and they come up with an explanation for that emotion. Now, even if you do not understand what are all the states, I will give you a simple example. Suppose, perception of an environmental situation means, suppose while walking, you are walking along a road and suddenly you hear a loud noise, now before coming into any conclusion, your emotion will depend on the analysis of that loud noise, what you will do.

So, the second step after hearing or after perceiving that loud noise, there will be generalized state of body arousal which is perceived. So, you heard that noise, you will feel a bit scared, a bit confused that from where that loud noise has come. Then, you will try to interpret the reasons for that generalized arousal state. What will happen? You will think, you will try to analyze from where this loud noise has come? If it has come from the door, suppose a dog is barking, so obviously that is fear, you will get fear, you will be very much anxious, you will get scared.

So, the emotion is of fear. If the loud noise has come from some children who are bursting crackers, suppose in Diwali, that time you will not feel fear, that time you will feel happy or joy because they are bursting crackers. If the loud noise has come from very loud music which is being played and that is very irritating to your ears, so that time you will feel disgust. What is this loud noise?

So, based on the analysis which you do from your generalized arousal state, that is the cognitive analysis of the surrounding. So, that is why it is known as cognitive attribution model. Based on that, the failed emotion depends upon the reasons for the or cognitive analysis of the arousal state.

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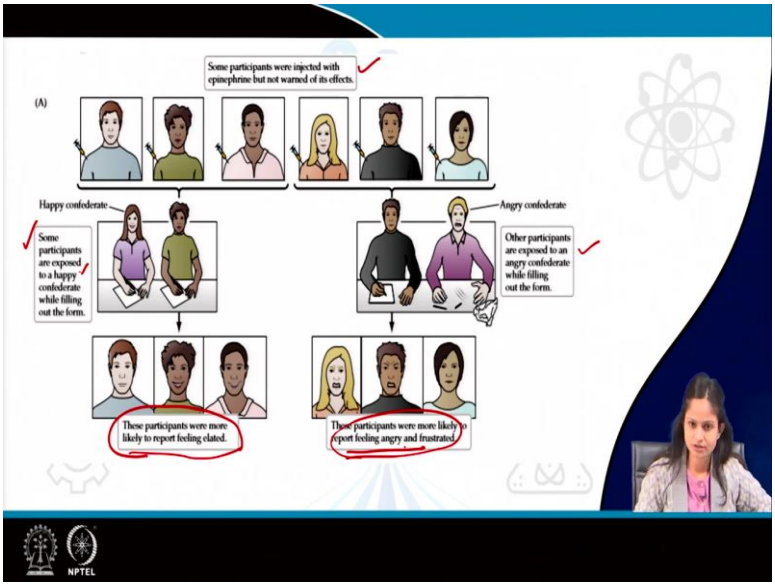

The similar experiment being done by Schachter and Singer's, there are three groups of participants. Some participants were injected epinephrine, but they were not told about the effects. They know that they have been injected epinephrine, but they do not know what are the effects of epinephrine. The other participants were exposed to an angry confederate while filling out the form. The environment was very much not favorable.

I mean the environment was not at all in favorable to the participants. There were environment of angerness. Supposedly, they were not in terms with the investigators. They did not want to fill the form, but somehow, they were forced to fill the form. So, the environment was not at all in favour of the participants. The third participant, the third group of participants were exposed to a happy environment while filling the form.

So, few participants, the three group of participants, one, they were kept in a happy environment and they were injected and they filled the form. The next participants were given injection of epinephrine and they were not told about the effects. And the third group of participants, they filled the form, but the environment in which they filled the form was not adequate for them or not appropriate for them.

So, what it has been observed, the participants were more likely to repeat elated who were in the happy environment and who were in the environment where they were neutral, I mean they did not know anything, but the participants who were more likely to report angry, they felt more angry and frustrated whenever they were kept in an environment which is not favorable to them. So, the environmental analysis which is done by our cognitive system has affected the arousal state or the felt emotion.

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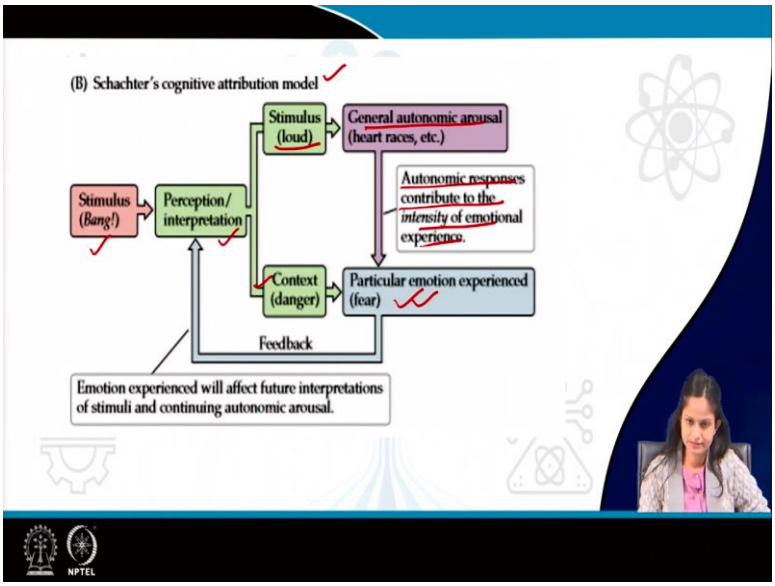

So, this attribution model, cognitive attribution model, you see the stimulus, it is banged, the perception is done, the stimulus that is loud sound, the context, if it is danger; simultaneously there is arousal of the autonomic nervous system, there is increase in the heart rate, beating of the heart rate. Now, this autonomic response has contributed to the intensity of the emotional experience. Based on the analysis of this arousal, there is a fear emotion which has been again given feedback to this perception.

The emotion experience will affect the future interpretations of the stimuli also and this will continue the autonomic arousal. If I am fearful with some time, with something, obviously that fear emotions is again sent back, the feedback of that emotion is sent back to my

perception so that I get fearful again with time. So, this is the Schachter's cognitive attribution model. Basically, the cognitive analysis of the environment affects the arousal state.

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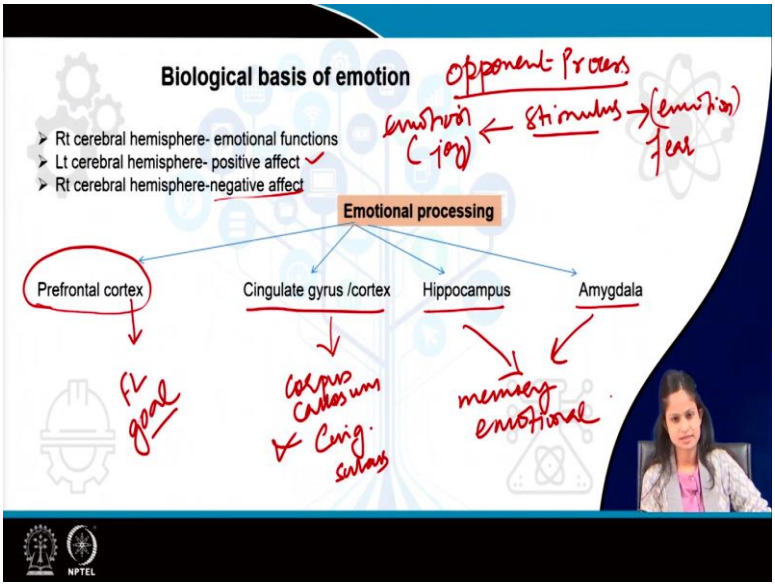

Now, before coming to the biological basis of emotions, there was another theory that is opponent process theory. Now, this opponent process theory says that whenever a stimulus is given for the first time to a person, there is a stimulus. The first time a person will experience an emotion, suppose this emotion is of fear, but with successive stimulus to that person, the person will experience an emotion opposite to that of the initial emotion which he has perceived.

So, suppose the initial emotion was fear, the other emotion was suppose not happy or joy or whatever. That means it is not fear, it is not fearful. So, why is it so? And this forms a very important basis of exposure theory. Suppose I am fearful to something, what happens? That happens in case of phobia. I am fearful to anything that is phobia. So, what is done in case of phobia? Exposure therapy. Whenever a person, as I told you, the response to fear in a normal person is withdrawal or escape.

So, instead of withdrawal or escape, I will ask the person or I will make the person to get exposed to that stimulus more and more. So, with more or further exposure, that fear will be gone in that person. So, that person who was initially experiencing fear, he will not experience fear anymore with subsequent exposure. So, that is the opponent process which is mainly seen or which is mainly done in case of exposure therapy. Now, the biological basis of emotion.

Normally, the right cerebral hemisphere of our brain controls the emotional functions. As well as whenever the right cerebral hemisphere, it is said or it has been seen, it is stimulated, it causes negative affect, means negative feeling. But when our left cerebral hemisphere is stimulated, it causes positive feeling. The emotional processing, how it is done or what are the structures which play an important role in the emotional processing? Now, these are the structures which you all have been acquainted to, because it has already been discussed in previous various lectures.

Prefrontal cortex, cingulate gyrus or cortex, hippocampus, amygdala. Now, prefrontal cortex, it is present in the interior portion of the frontal lobe. So, it is present in the interior portion of the frontal lobe. And it is associated with various other structures in our brain. And this is the main site for goal. That means, the planning of any actions is set or it is started in the prefrontal cortex. Then we come to cingulate gyrus or cingulate cortex. Cingulate gyrus or cortex is a very important part in our limbic system.

It is mainly present in between the corpus callosum and cingulate sulcus. So, this is a very important portion, cingulate gyrus and cortex, which is very important in case of our social cognition or cognitive behavior or affective behavior. And hippocampus and amygdala as we all know, this plays a very important role in our memory formations and emotional behavior. So, here these are the main important structures which play a very important role in emotional processing amygdala, hippocampus, cingulate cortex and prefrontal cortex. And hippocampus and amygdala in turn gives various associations to other cortices.

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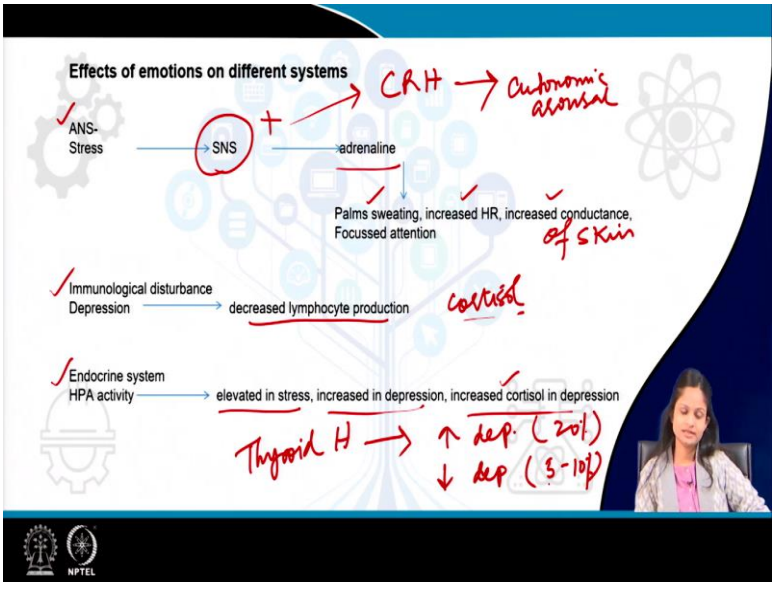

Now, effects of the emotions on different systems. What will happen whenever we get agitated or excited? Now, first and foremost is autonomic nervous system. So, whenever we are agitated or whenever we suffer from any stress, the sympathetic nervous system gets excited. There is a stimulation of sympathetic nervous system.

Now, this sympathetic nervous system also causes corticotropin-releasing hormone. This has been described in the limbic system. And this corticotropin-releasing hormone causes the autonomic arousal and other endocrine responses besides the adrenaline, which is also released from the various organs.

So, with the help of stimulation of sympathetic nervous system, which causes palm sweating, increased heart rate, increased skin conductance, increased conductance of skin and focused attention. So, this is the mainly response of the stress response to corticotropin-releasing hormone and adrenaline done by the autonomic nervous system. Second is the immunological disturbance. Now, whenever we are in stress, there is a release of hormone that is cortisol.

This cortisol actually causes decrease in our immunity. This will cause decreased lymphocyte production. Endocrine activity, the hypothalmo pituitary access activity gets elevated in stress. It is increased in depression and increased cortisol in depression. Whenever the person is depressed, the cortisol is increased. And obviously, when a person is depressed, the cortisol is increased. So obviously, the immunity will also get decreased because of the decrease in the lymphocyte secretions. Another important is the thyroid hormones.

Now, thyroid hormones, it is seen in few cases, in few articles, they have told there is increased with depression. And in few articles, it is seen, it is decreased with depressions. Around 20 percent cases, it is increased; around 5 to 10 percent cases, it is decreased with depression.

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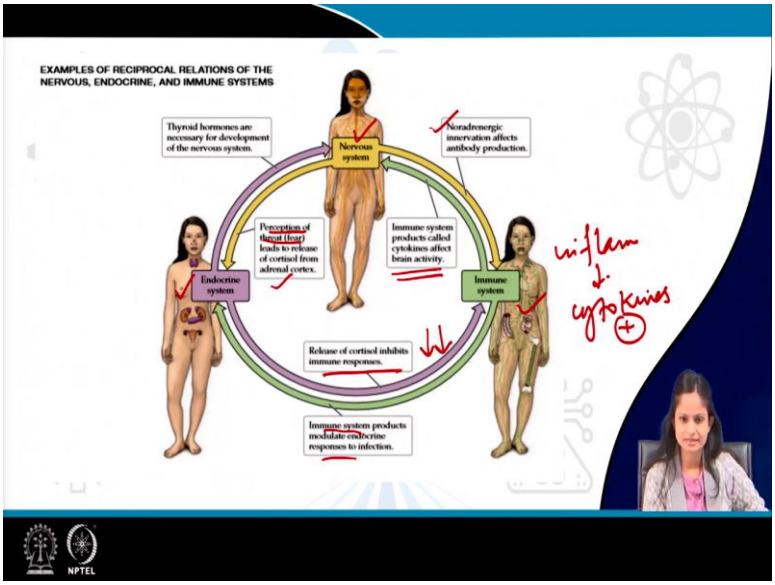

Here is a reciprocal relation of the nervous system, endocrine system and the immune system. Now, what we see, first we will see the outer circle. This is the endocrine system. This is the nervous system. This is the immune system in a person. What happened? Thyroid hormones are necessary for development of the nervous system.

Without thyroid hormones, the neural system would not be getting developed. So, thyroid hormones will obviously affect the nervous system. With proper thyroid hormones, there will be proper development of brain or the nervous system. Now, nervous system what it will do? It will further cause activation of the non-adrenergic innervation that will affect the antibody productions. Antibodies means we will talk about the immunity.

Now, with the proper antibody productions, there will be immune system, which will modulate various endocrine responses to infection. In this way, this innervation occurs. Suppose whenever a person is getting fearful or anxiousness, so the perception of threat or fear leads to cortisol secretion from adrenal cortex. This I told you in the endocrine system, the cortisol will get secreted because of the fear. Now, this cortisol will cause release of cortisol inhibit the immune system.

The person's immune system will get destroyed. Now, whenever this immune system gets destroyed, any destruction in the body leads to inflammation. Whenever there will be inflammation, there will be cytokines, which are released. So, these cytokines will finally affect the brain activity. I mean, the brain activity will not occur properly.

So, in this way, we can see this is a reciprocal relation of neural or nervous system, endocrine hormonal system and the immune system, which tells in brief that whenever the person is in stress or emotional disturbance, the neural system, the immune system, the endocrine system all gets disturbed.

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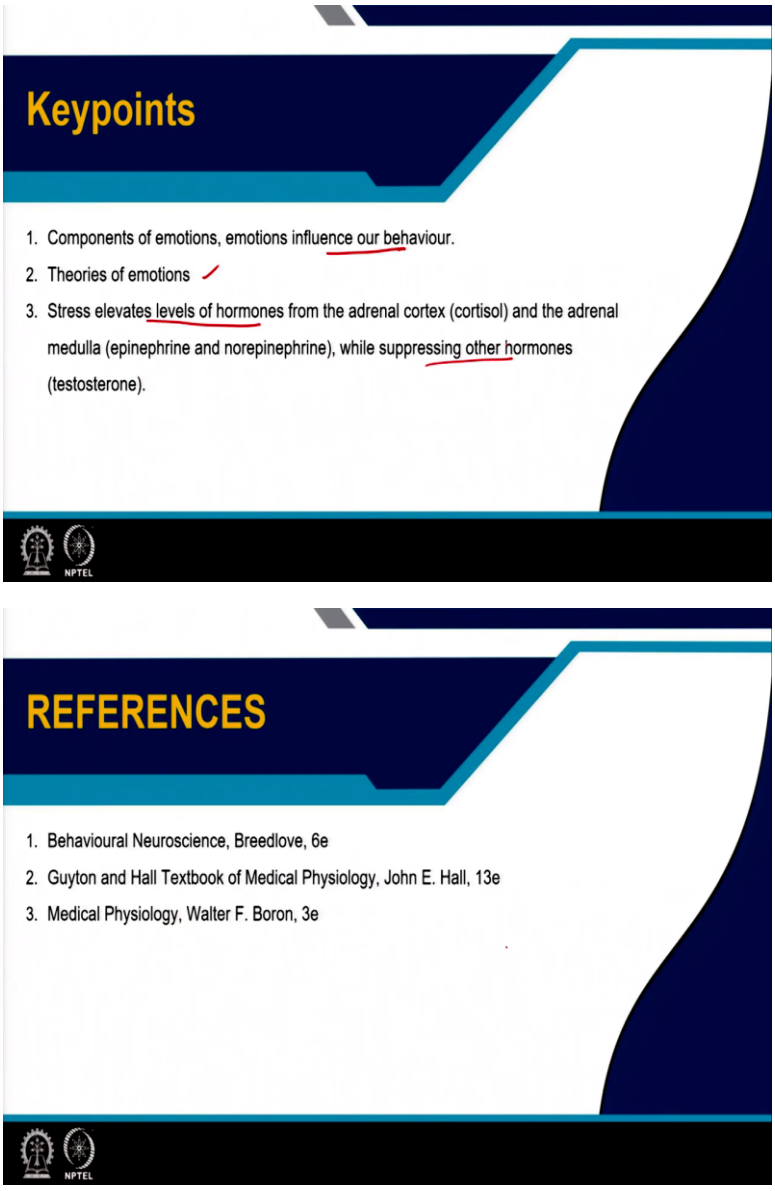

So, the key points what we have to remember in this physiology of emotions, emotions influence our behavior with the components of because we have seen the four components of emotions, the mental and physical. The various theories of emotions, stress elevates the level of hormones from the adrenal cortex and the adrenal medulla while suppressing other hormones and suppressing the immunity. So, this much you have to remember in physiology of emotions. Thank you.