Introduction to Brain & Behaviour

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Lecture 30

Cognitive Control of Emotions

Hello and welcome to the course introduction to Brain and Behaviour. I am Dr. Ark Verma from IIT, Kanpur. This is the sixth week of the course and today is the final lecture.

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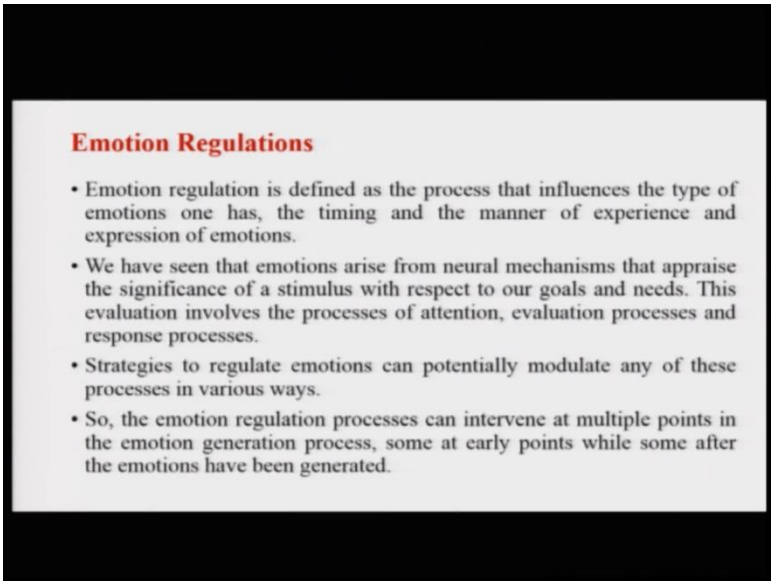

We will talk about, now emotion regulation is a very important aspect. Emotion regulation is, is a process that something that we typically do on a daily basis. In, in the, in the confines of the civil society that we live in, we, it will be considered uncivil, it will be considered improper that if we, you know, express our emotions as they come. Say, for example, sometimes you might feel extremely angry towards somebody but you have to kind of regulate that, lower down your anger and behave in a proper manner.

Sometimes you feel so happy that you want to, you know, jump with joy, move around, dance and all of that, but you have to kind of control your emotions and sort of, you know, behave in a proper manner. So, regulation of emotions is, is a very, very important skill that is needed to lead somebody's, you know, normal social life as well. On top of that, regulation of emotions is also

responsible, it is also important in aspects, say, for example, it can help you cope with more difficult situations slightly easily.

Suppose, say, for example, if you have encountered a loss, if you have suffered from a failure and obviously you are feeling bad about it, then you need to sort of, you know, regulate your emotions. You need to tell yourself that it is alright. You should not completely feel so bad about it so that you can, you bury yourself in grief. But you have to kind of derive some positive messages from there, sort of lift yourself up, motivate yourself and then move on to the next journey. Okay?

Also say, for example, you cannot be too excited about good outcomes in your life and so that you kind of, you know, lose the vision of the bigger picture and so on. So again, as I was saying emotional regulation is something that all of us do on a daily basis and it is something that is a very, very important skill and is a very, very important aspect of understanding and expressing emotions. Now, emotion regulation, more formally is defined as the process that influences the type of the emotions one is experiencing, the timing of these emotions and the manner of experiencing and expressing these emotions. This is what I was trying to explain to you.

Now, we have seen that emotions arise from neural mechanisms that are, that basically appraise or evaluate the significance of a stimulus with respect to your own goals and needs. This evaluation involves the processes of attention. It involves these evaluation processes and their response processes. So, three things, evaluation processes, how do you attend some information and how do you respond to it.

Strategies to regulate emotions can potentially modulate any of these processes in different ways. So, the emotion regulation process can actually intervene at multiple points in the emotion generation process, sometimes at early points, while sometimes at, you know, sometimes at later points. So, different strategies might basically, you know, affect this entire experience and expression of emotion at different points and in different ways.

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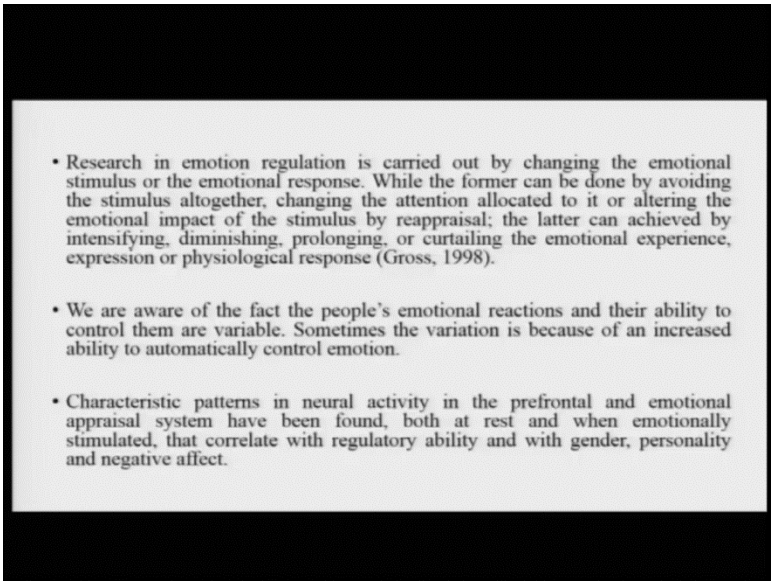

Now, research in emotion regulation is typically carried out by changing the emotional stimulus or the emotional response. So, what can happen is while the formal, while changing this emotional stimulus can be done by either avoiding this stimulus altogether, changing the attention that you are paying to it or altering the emotional impact of the stimulus.

Suppose, you know, you are excited by you know seeing, seeing, let us say there is a box of chocolates kept here. And while let us say, it is for me, a box of chocolate is kept over here and you are not able to, you know, you are not able to focus on the lecture because I have kept a box of chocolates over here. Now you can do three things. You can either just ignore the box of chocolates completely. Or you do not give attention to it, you just push it at the back of your attention. Or you can alter the emotional impact, you can tell yourself, okay I will get a bag of chocolates for myself after I have watched the lecture.

Now, the latter, this changing the response thing can actually be done by either intensifying the response, you can say, no, I want that box of chocolate. You kind of, you know, drool over it. You kind of want it. Diminishing this, oh, I don't want it. I am satiated. I have had enough sugar for the day or by prolonging or curtailing this emotional experience. Okay? Or the physiological response that is ensuing.

So, both is possible. Either you can sort of deal at the level of the stimulus or you can deal at the level of how you are going to respond about it. Now we are aware of the fact that people's

emotional reactions and their ability to control them are different. Different people can emotionally regulate to up to different extents. Sometimes this variation is because of an increased ability to automatically control emotion.

There are some people who are very good at it. There are some people who can automatically control or automatically modulate the extent or the intensity of the emotions that they are feeling. Characteristic patterns in neural activity in the prefrontal and emotional appraisal system have been found, both at rest and when emotionally stimulated, that correlate with regulatory ability and with gender, personality and negative effect.

So, neural activity basically has been found that is characteristic of how you kind of modulating these different emotions. They correlate with gender as well. They correlate with personality types as well and negative effect as well. So, there is something here.

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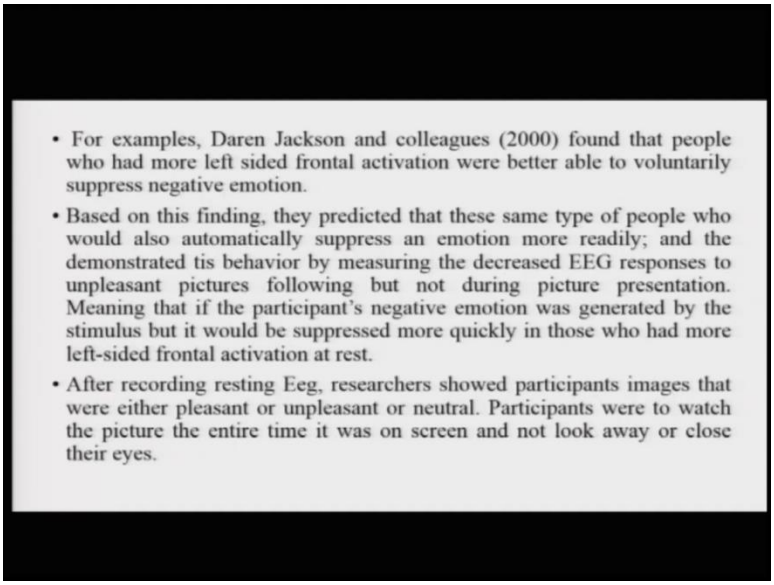

For example, let us look at it in a bit more detail. Daren Jackson and colleagues have found that people who had more left sided frontal activation were able to voluntarily suppress negative emotion. Suppose you are feeling very angry, very sad etc., if you have higher left sided, left sided frontal activation, you might be able to suppress this negative emotion better.

Based on this finding they predicted that the same type of people those who have left sided frontal activation would also find it, also find, are also be able to automatically suppress any emotion

more readily. And they demonstrated it by, you know, and then demonstrated it by measuring the decreased EEG responses to unpleasant pictures following but not during the picture presentation.

So, when these people were shown these negative pictures, you know, some kinds of pictures that were gory, that were not to be seen and then what basically was found was that these people could automatically were exhibiting decreased EEG responses. Okay? After the picture. So, during the presentation, whatever is happening is happening but then it seems that these people are regulating their emotional response and hence after the presentation of the picture, the emotional responses, the EEG responses are decreased. So, it means that if these participants' negative emotion was generated by the stimulus, it would be supressed very quickly by those who had this higher left sided frontal activation at even the resting state. Okay?

Now, after recording this resting EEG, researchers showed participants images that were either, so in, in a different study, participants that were either pleasant or unpleasant or neutral. And participants were basically told to watch these pictures the entire time they were on the screen and not look away or here and there and so on.

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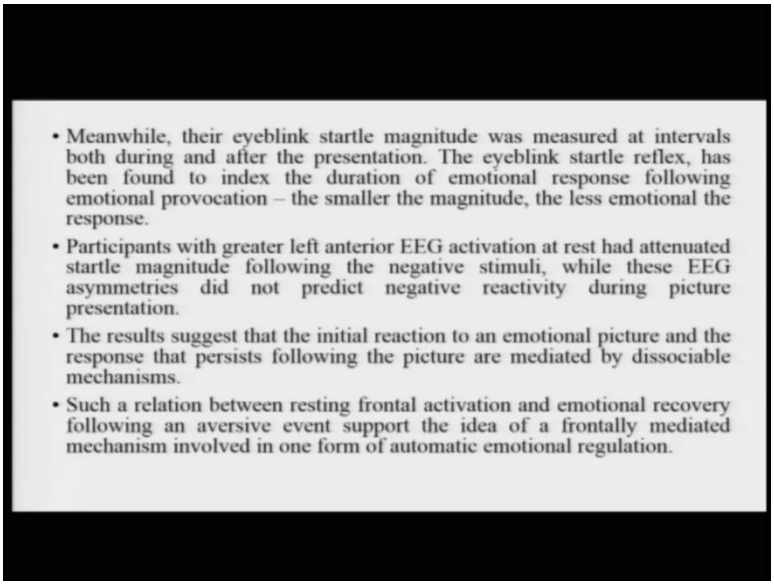

Meanwhile, their eyeblink startle magnitude was measured at intervals both during the presentation and after the presentation. Now this eyeblink startle reflex has actually been found to index the duration of the emotional response following emotional provocation. So, if you show somebody highly emotional stimuli, there is this eyeblink startle reflex and this eyeblink startle reflex

basically indicates the magnitude or the duration of this emotional response. The smaller the magnitude, the lesser the emotional response.

So, if the magnitude of this reflex is large, then it seems that the emotional response is going on for a larger time. Now, participants with the greater left anterior EEG activation at rest had attenuated startle magnitude following the negative stimuli while those with, while also that these EEG asymmetries did not predict negative reactivity during picture presentation.

So, during seeing the picture, nothing is really happening. Probably the response is the same but after this, they can very quickly regulate this and their eyeblink startle reflex is smaller. These results suggest that the initial reaction to an emotional picture and the response that persists following the picture are mediated by different mechanisms. They are mediated by dissociable mechanisms.

Such a relation between the resting frontal activation and emotional recovery following an aversive event, support the idea of a frontally mediated mechanism involved in one form of automatic emotional regulation. So, what is basically happening is that this mechanism is able to automatically regulate emotion. Okay? So, people who have this higher left frontal activity, even at the resting state when no stimuli is being presented, when nothing is there and when these people, the specific people are presented with emotional stimuli, they can automatically regulate this.

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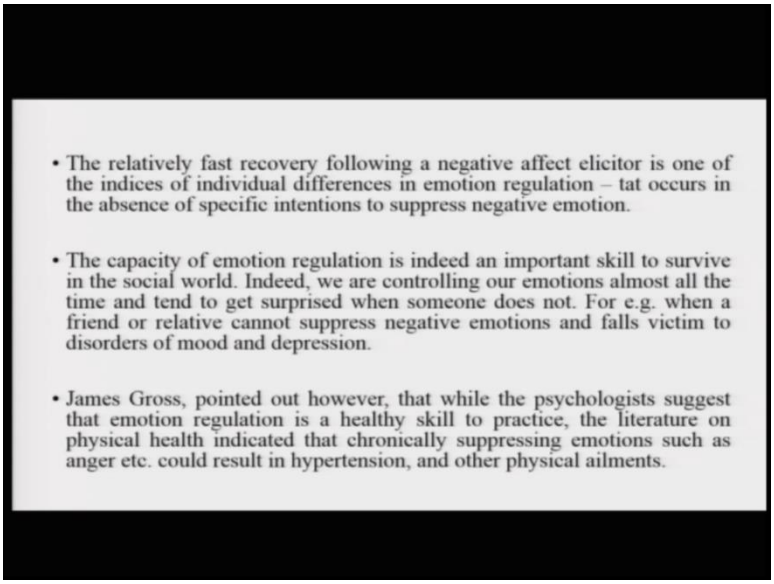

The relatively fast recovery following a negative effect elicitor is one of the indices of the individual differences in emotion regulation. Some people would be better at that. Some people would be worst at that. Definitely the people with higher frontal activity or left frontal activity are going to be better at emotional regulation. Okay?

Now, the capacity of emotion regulation is indeed as I have been saying an important skill to survive in the social world. Indeed, we are controlling our emotions almost all the time and we tend to get surprised when somebody is not able to do that. Suppose somebody gets too angry and starts fighting in the mall or somebody gets too depressed on, you know, let us say failing one exam and gets into this, you know, vicious cycle of depression and, you know, grief.

James Gross pointed out however that while psychologists keep suggesting that emotion regulation is a healthy skill and it should be practiced, literature about physical health says quite the opposite. It says that chronically suppressing emotions such as anger, you know, sadness etc., could result in hypertension and other kinds physical ailments. So, which of the two are right or which of the two must be, you know, heeded to?

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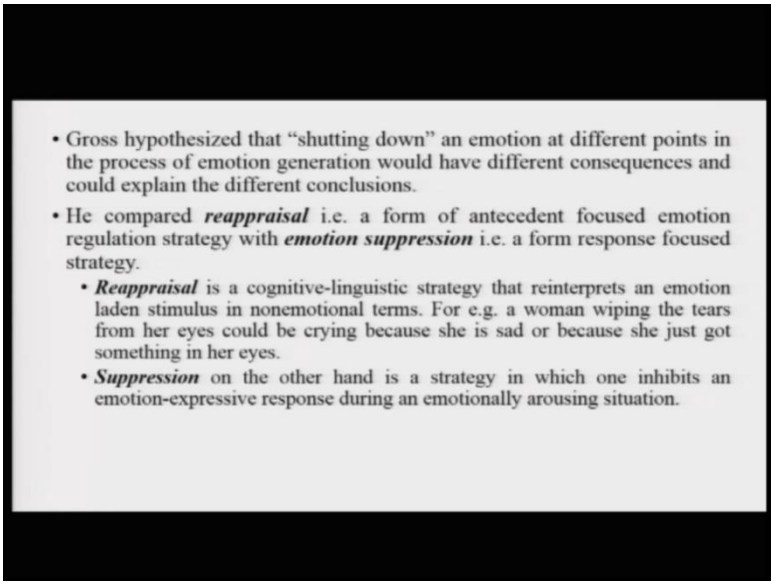

Let us look at this. So, Gross hypothesized that this shutting down an emotion at different points in the process of emotion generation would have different consequences and could explain different, these kind of different conclusions. So, at what point you are shutting down this emotional response, might be able to determine what consequences are going to come out of it.

So, he compared reappraisal with emotion suppression. What is reappraisal? It is a cognitive-linguistic strategy that reinterprets an emotion laden stimulus in a non-emotional terms. Say, for example, if a woman is, if you see a picture of a woman wiping tears, okay? You could say that, okay, the woman is sad and is crying and you yourself become sad or you can just say maybe she is, you know, cutting onions for that matter or there is something that has come in her eye.

So that is reappraisal. Re-evaluating the stimulus in a, in a sort of a unemotional manner. You know, just changing the interpretation of this event, so that it does not really make you emotionally aroused. Suppression on the other hand is a strategy wherein you simply have to inhibit the emotion-expressive response. Happiness, sadness, negative, any kind of thing, whatever the response is there, you just have to suppress it and do not and, you know, you do not have to show it, completely forget it in some manner.

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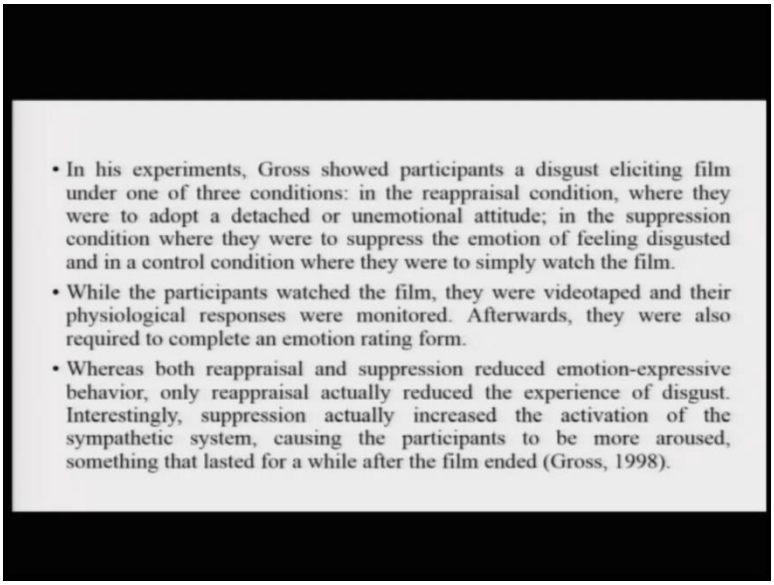

Now, in his experiments, Gross showed participants a disgust eliciting film under one of three conditions. In the reappraisal condition where they were to adopt a detached or unemotional attitude, in the suppression condition where they were to completely suppress the emotion of feeling disgusted and in control condition where they just had to watch the film. Okay?

Now, while the participants watched the film, they were videotaped and their physiological responses were also monitored. Afterwards, they were also required to, you know, complete a form that would rate the emotion of the film. Okay? How emotional did you feel? What were the

aspects? And so on. Now, whereas both reappraisal and suppression reduced the emotion-expressive behaviour, so, the expressions on their face, maybe even the physiological responses, only reappraisal actually reduced the experience of disgust.

So, your overall experience kind of reduced only on reappraisal. And it is intuitive, you know. You are kind of just giving a different spin to things. You are thinking from a very different angle that is what reappraisal is and, in that sense, you can see that it is changing or it is actually, you know, modifying the experience of that strong emotion that is disgust. So, it is something very important, you know. It is something very useful that you can probably exercise in your daily lives using, when you are, you know, confronted with highly emotional situations.

Now, interestingly, suppression actually increased the activation of the sympathetic system, causing the participants to actually to be more roused. And it also extended for a long time. So, it is actually true what the health, you know, experts were saying that it is actually going to make you sick because it is causing more arousal and that arousal is extending for a longer time and that is obviously going to take a toll on your body, make you unhealthy over periods of time.

So, this is probably the reason why the psychological literature and the health literature sort of diverge at this point. So, you have to sort of see what is the strategy that you are going to employ to sort of handle your emotional feelings or handle your emotional outburst.

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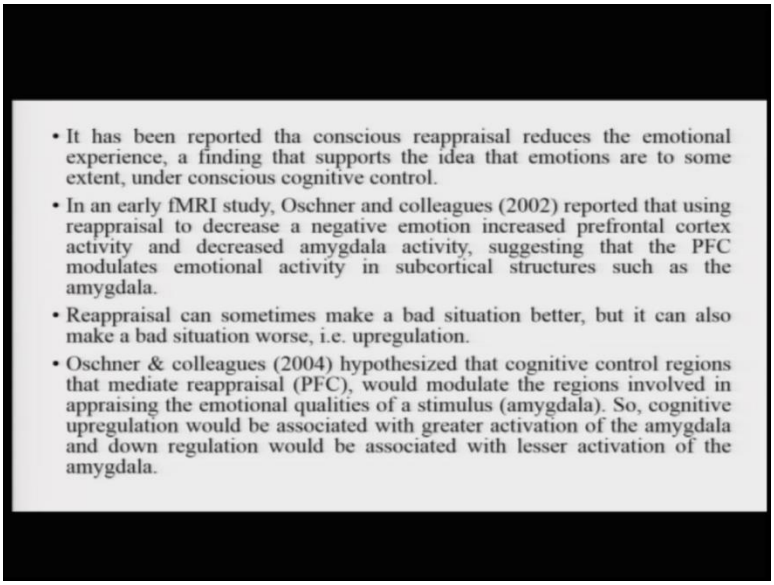

Now, it has been reported that conscious reappraisal actually reduces the emotional experience, a finding that supports the idea that emotions are to some extent, under conscious cognitive control. You can sort of govern how you are feeling about particular stimuli.

In an early study, in an early fMRI study, Oschner and colleagues actually reported that using reappraisal to decrease a negative emotion increased prefrontal cortex activity and decreased amygdala activity, suggesting that prefrontal cortex actually modulates emotional activity in the subcortical structures such as the amygdala. So, reappraisal, so, this is basically what is linking the prefrontal cortex activation and prefrontal cortex activation is seeming to modulate this activity in the lower parts.

Now, reappraisal can sometimes actually make a bad situation better. Okay? But it can also make a bad situation worse. You can basically do both, down regulation and up regulation. You can de-intensify what you are feeling. Suppose it is negative feelings, it will make situations better. You can over intensify also what you are feeling. Suppose, you know, you are kind of taking something too seriously, more seriously than it needs to be taken. So, what you are doing is you are making the situation worse. You are making yourself angry or sometimes sadder. Okay?

So, Ochsner and colleagues in 2004 hypothesized that cognitive control regions that mediate the reappraisal like the prefrontal cortex were in a position to modulate the regions involved in appraising the emotional qualities of a stimulus that is amygdala. So, this is probably how this is happening. So, cognitive upregulation should typically be associated with greater activation of the amygdala and down regulation should be associated with lesser activation of the amygdala.

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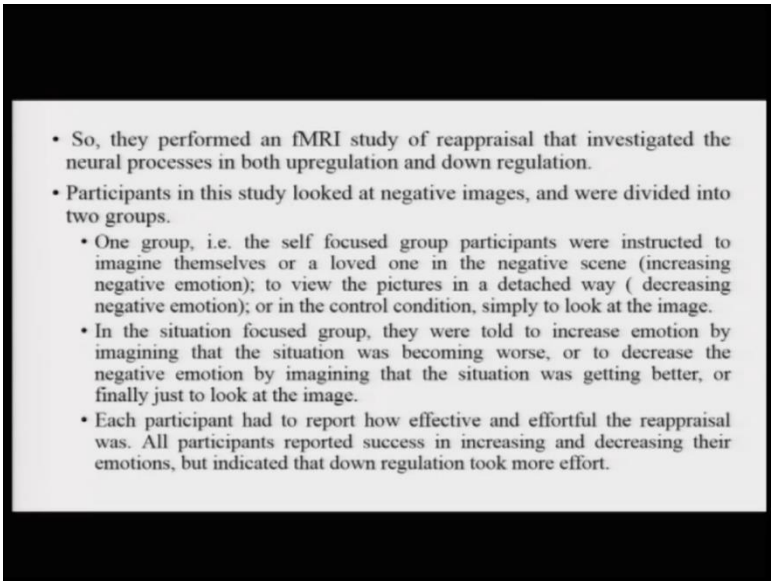

So, Ochsner and colleagues, they performed an fMRI study of reappraisal that investigated the neural processes in both upregulation and down regulation.

So, what happened? Participants in this study were made to look at negative images and they were divided into 2 groups. One was the self-focused groups, one was the, one as this situation focused group. Now, in one group, that is the self-focused group, participants were instructed to imagine themselves or something, somebody very close to them in the negative scene. So, what would this do? It will increase their negative impact. Or they were asked to just view the picture in a completely detached manner. Or they were just asked to look at the picture without using any strategy.

In the situation focused group, they were told to increase the emotion by imagining that the situation was becoming worse or to decrease this negative emotion by imagining that the situation was getting better or just looking at the image. Each participant had to report how effectively and effortful, how effective or effortful the process of reappraisal was and all of these participants eventually reported success in increasing or decreasing their emotions. But they indicated that down regulation of negative information, let us say, took slightly more effort.

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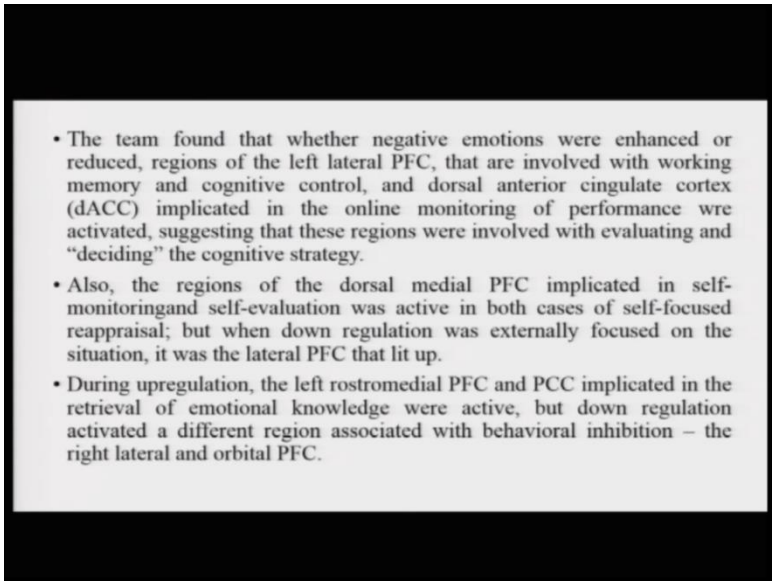

Now, the team found, let us go to the results. The team found that whether negative emotions were enhanced or reduced, the regions of the lateral prefrontal cortex, were actually involved, and these are the regions which are involved in working memory and cognitive control. And dorsal anterior cingulate cortex which is actually implicated in the online monitoring of performance, were activated. So, lateral PFC and dorsal ACC are activated irrespective of whether the, you know, upregulation or down regulation is being done.

Also, the regions of the dorsal medial prefrontal cortex which are, which is typically involved in self-monitoring and self-evaluation, was active in both cases of self-focused reappraisal and so self-focus upregulation and down regulation. But when down regulation was externally focused, let us say in a situation group, the lateral PFC actually was more important. So, dorsal medial PFC is there when self-related judgements are being made and lateral PFC is basically being lit up when situation-based judgements are being made.

Now, during the upregulation, the left rostromedial prefrontal cortex and the PCC implicated in the retrieval of emotional knowledge were found to be active. But down regulation, during down regulation, basically a different region was activated which is typically associated with behavioural inhibition, which is the right lateral and orbital prefrontal cortex. So, these are the regions which is involved in reappraisal of emotional information.

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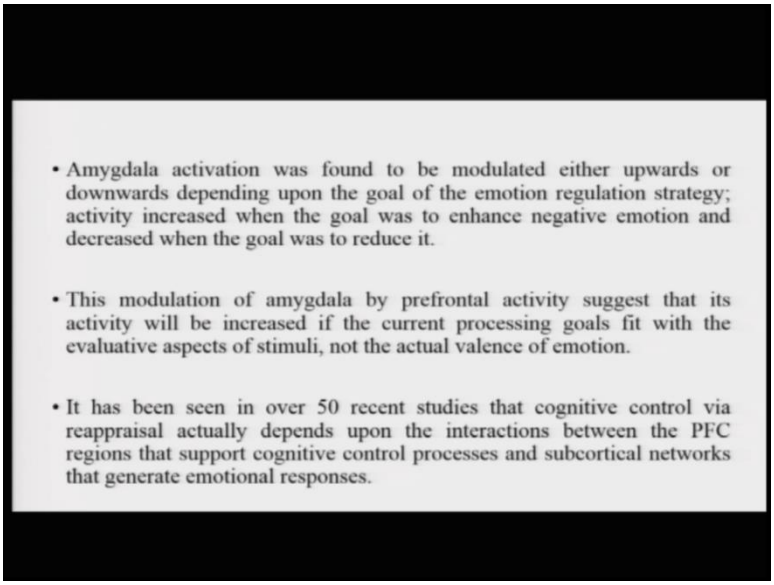

Now, amygdala information, amygdala activation was found to be, you know, modulated either upwards or downwards depending upon whether upwards regulation or downwards regulation was being done. When upward regulation was being done, the amygdala activity was increasing. When downward regulation was being done, the amygdala activity was decreasing.

This modulation of the amygdala by the prefrontal cortex activity suggests that this activity will be increased if the current processing goal fits with the evaluative aspects of the stimuli and not really the actual valence of the stimulus. So, what is the significance of the stimulus? So, appraisal seems to be very, very important in dealing with emotional stimuli. And how you evaluate the stimulus, this is where the amygdala will come in. Okay?

Now, it has been seen in over 50 recent studies of, that cognitive control via reappraisal actually depends upon the interaction between the prefrontal cortex regions that support cognitive control process and subcortical networks that actually generate emotional responses. So, you can basically conclude that the prefrontal cortex modulates these, the activity in the subcortical structures, basically, what helps you or what helps you achieve this reappraisal kind of things. Okay?

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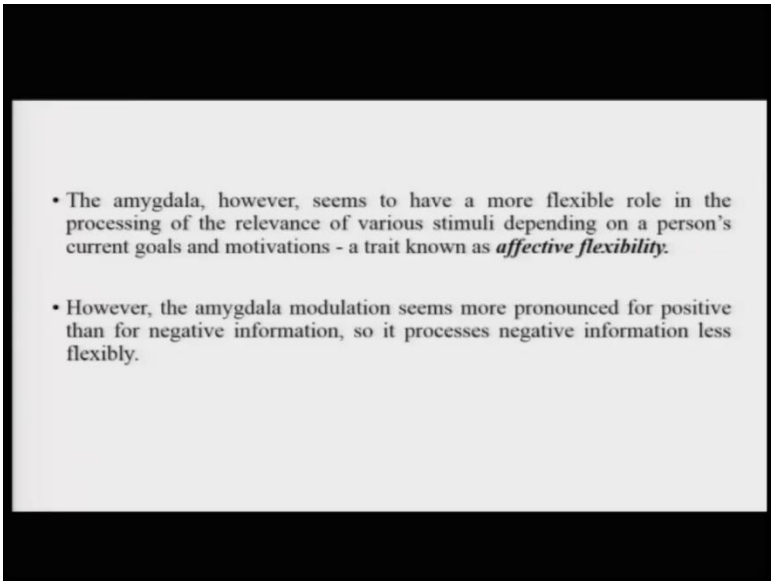

The amygdala, however, seems to be more flexible, play a more flexible role in processing of the emotional significance of stimuli and basically depending upon what the person sort of wants and this trait is known more as affective flexibility. I can feel very highly or excited or very less excited about the same stimulus because I'm affectively flexible.

However, the amygdala modulation seems more pronounced for positive information, so with respect to positive information the amygdala modulation is, is, is can happen in more ways but for the negative information, it is more difficult to sort of down regulate the negative information. Okay? Which basically was also something that we found in the earlier study. Okay? So, this is all about cognitive control.

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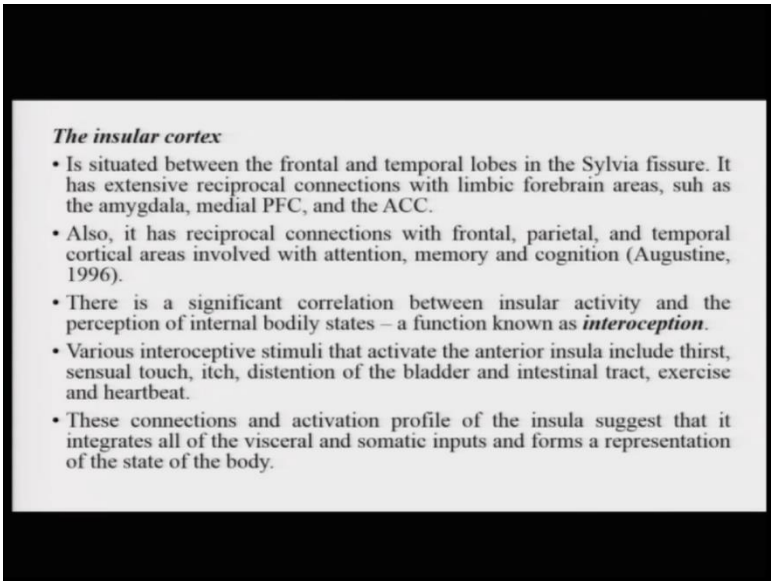

I am just doing a very small section on this insular cortex which is also very, very important region involved in emotional processes. Now this insular cortex is actually situated between the frontal and the temporal lobes in the Sylvian fissure. It has extensive reciprocal connections with the limbic forebrain areas such as the amygdala, the medial prefrontal cortex, and the ACC. Also, the insular has reciprocal connections between, with the frontal, parietal and temporal cortical areas which are involved in attention, memory and cognition in a more general sense.

There is a significant correlation between insular activity or the activity of the insular and the perception of internal bodily states. How is your body feeling at this point in time? Is there some pain? Are you, you know, is there some, you know, some problem or something? This is basically known as interoception.

Now, various interoceptive stimuli that activate the anterior insula include thirst, sensual touch, itching, distention of the bladder and intestinal tract, exercise and heartbeat. So, whatever changes your body goes through, whatever the changes that come in the bodily state, that is basically perceived probably, you know, directly through this anterior insula region.

Now, these connections and activation profile of this, of the insula suggest that it integrates all of the visceral and somatic inputs and it forms a overall representation of how your body is feeling at any point in time. Okay?

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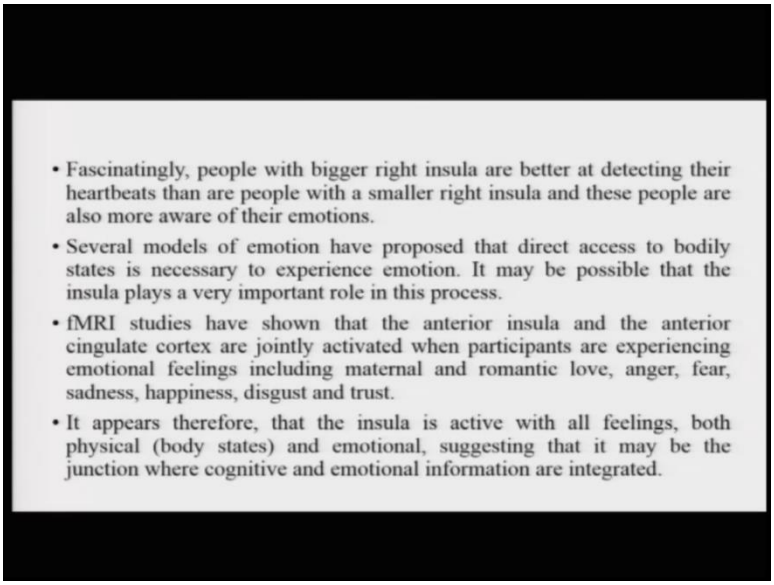

Fascinatingly, people with bigger right insula are actually better at detecting their own heartbeats than with people who have a smaller right insula. So, you can basically say that the insula is actually related to the degree of or to the resolution of how aware you are about your own body. Okay? These same people who have this bigger right insula are actually even more aware of their own emotions as well. So, it is not only just the bodily states but your emotional experience as well.

Now, several models of emotion have actually proposed that the direct access to bodily states is necessary to exercise emotion. So, in that sense, you can actually link that the insula must be very, you know, deeply involved with emotional, you know, experience as well. So, it may be, therefore, possible that the insula plays a very important role in this process.

fMRI studies have shown that the anterior insula and the anterior cingulate cortex are jointly activated when participants are experiencing emotional feeling, okay, including maternal or romantic love, anger, fear, sadness, happiness, disgust and trust. So, all of these emotional feelings, anterior cingulate cortex and the anterior insula are both involved and activated.

It appears therefore, that the insula is active with all feelings both physical and, you know, with all feelings and what it has is that both physical and emotional kind of experience suggesting that it may be the junction where cognitive and emotional information are integrated. So, in that sense, it plays a very, very important role in experience of information.

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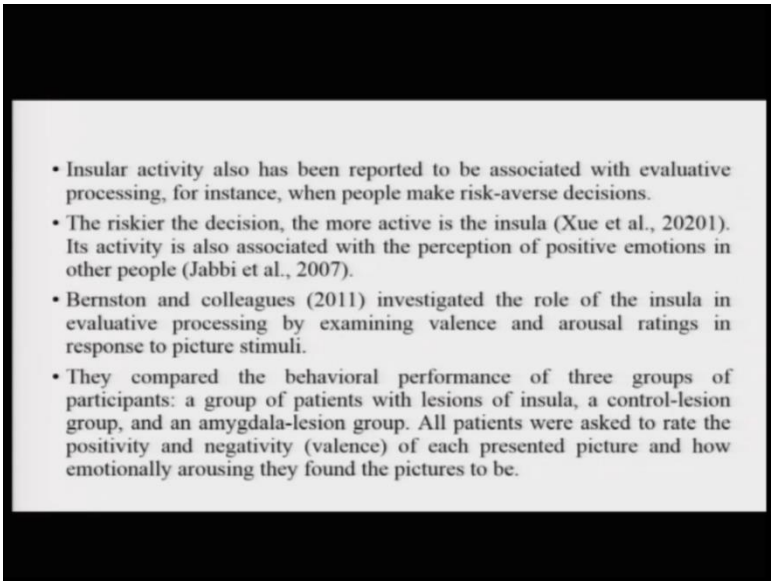

Now, insular activity has also been reported to be associated with evaluative processing. For example, when people are making risk-averse decisions, so judgement of risk is also a, probably in some sense involved with the insula. So, the riskier the decision somebody is going to make, the more active is the insula. Its activity is also associated with the perception of positive emotions in other people. So, experience, what kind of decision you are making and what kind of emotions people are, other people are experiencing.

Now, Bernston and colleagues in 2011 wanted to investigate in evaluative processing by examining the valence and arousal ratings in response to picture stimuli. So, the idea was that, you know, there were picture stimuli which had different valence in arousal rating and basically these people wanted to look at the role of the insula. And how they evaluate arousal and how they evaluate valence.

Now, they compared the behavioural performance of three groups of participants. One group of participants had lesions of the insula, a control-lesion group, and an amygdala-lesion group. Okay? All patients were asked to rate the positivity or negativity, that is, the valence of each picture and how emotionally arousing those pictures were.

The findings showed that people with insular lesions reported both reduced arousal and reduced valence rating. So, it seems that insula is linked with both arousal judgements and valence judgements. In contrast, arousal ratings of patients with amygdala lesions who are selectively

attenuated for unpleasant stimuli. So, amygdala damage patients could not really judge the arousal ratings of unpleasant stimuli but they were fine with other things.

These findings are actually in line with an earlier study that found that patients with amygdala damage showed a complete lack of an arousal gradient across negative stimuli, although they displayed a typical arousal gradient with other kinds of stimuli or the, you know, other kinds of emotions. If you combine these findings together, these results support the view that the insula may play a broader role in integrating the affective and cognitive processes, whereas the amygdala may play a more selective role in affective arousal, but especially for negative stimuli.

So, that is, basically I think, all about the insula that I wanted to talk about. The main crux of this lecture was in cognitive control. I think this would wrap up the chapter on emotion. I am basically announcing that because of this corona virus situation, we will upload the material for the next lectures in due course and probably the exams will anyways get postponed. So just keep updated and we will see how these other lecture materials of the remaining two chapters is going to get uploaded. Thank you.