Introduction to Brain & Behaviour
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Lecture 29
Emotions and Other cognitive Processes

Hello and welcome to the course, Introduction to Brain and Behaviour. I'm Dr. Ark Verma from IIT, Kanpur. We are in the sixth week of the course and we will talk about emotion and its influence on the other cognitive processes.

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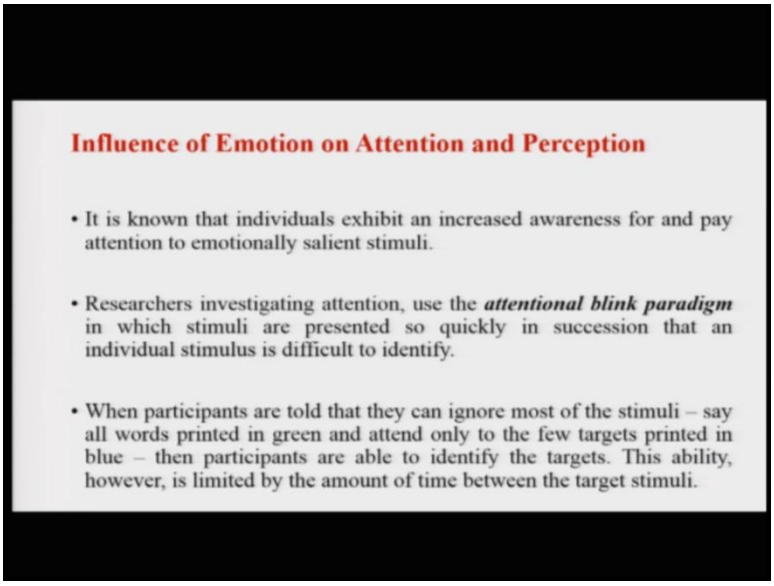

In today's lecture we will talk about the influence of emotion on attention and perception. Now it is known that individuals exhibit an increased awareness for and pay attention to emotionally salient stimuli. If, if a stimulus is having some kind of emotional significance, your attention will go towards it more rapidly than as compared to a stimulus that has no emotional value.

Now, researchers investigating attention typically use the attentional blink paradigm in which the stimuli are presented so quickly in succession with each other that an individual stimulus is very difficult to identify. Typically, the inter stimulus interval in attentional blink studies is around 75 milliseconds which makes it very hard for participants to actually be able to see the individual stimulus.

Individual stimulus are typically, are usually very simple stimuli like alphabets or letters, like alphabets, alphabets that are letters or digits and idea is that the participants are typically asked to detect couple of targets, the first target and the second target, during this RSVP or rapid serial visual presentation of stimuli. So, when participants are told that and sometimes what happens is that, the participants are told that they can ignore most of the stimuli, say, let us say, all words printed in green and attend to only a few targets printed in blue, so in a RSVP stream of green words, there will be two blue words that you have to track. The participants are in this case typically able to identify targets. However, because the time is so limited between these different stimuli, it is a very difficult task to do.

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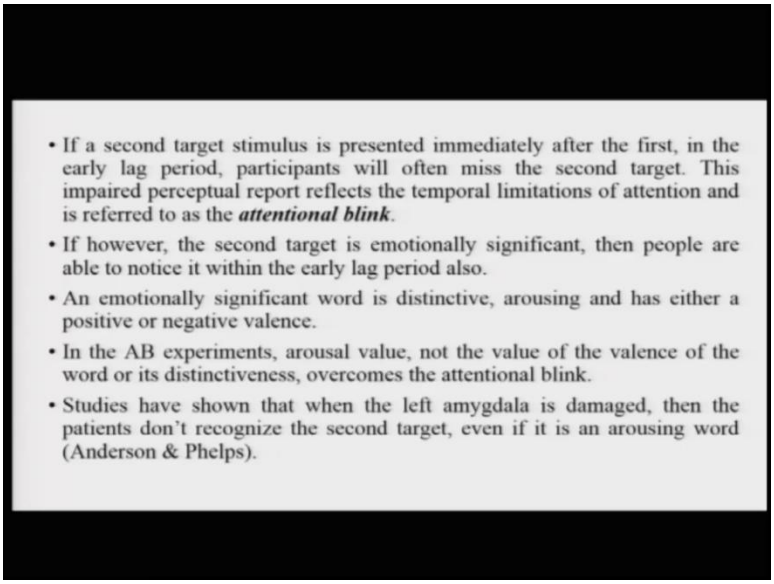

Now if a second target is, target stimulus is presented immediately after the first in the early lag period, in the early period of the RSVP stream, then the, the gap between one stimulus and the other one is very, very small. If a second target is, you know, if this second target stimulus is presented immediately after the first stimulus, participants will often miss the second target. They will not be able to see or report the second target.

This impaired perceptual report reflects the temporal limitations of attention and is referred to as the attentional blink effect. If, however the second target is emotionally significant, then people have been found to be able to report it even in the case of early lag period. Now an emotionally

significant word, you know, is distinctive, and then, and basically people are able to notice it even if it has a, say, for example, positive or a negative valence.

In the attention blink experiments, arousal value, not the valence of the word or its distinctiveness is capable of overcoming the attentional blink effect. So, somebody might ask why are participants able to report these, you know, emotional words in the RSVP stream where they are not, whereas they are not able to report other kinds of stimuli. The arousal that is generated by these words typically governs these process.

So, if a word is high arousal, it is highly likely that it is going to get noticed. Now studies have shown that when the left amygdala is damaged however, the patients don't recognize the second target, even if it is in arousing word. Okay? We were having this discussion about arousal and the role of amygdala in retention of arousal related information in the end of the last lecture. It is sort of continuing on the same line.

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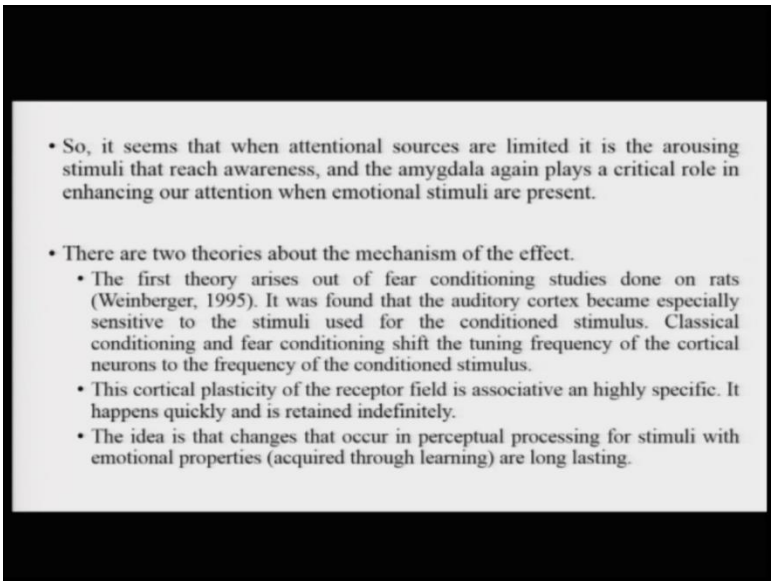

So, it seems that when the attentional resources are, when the attentional sources are limited, it is the arousing stimuli that reach awareness and that the amygdala plays a critical role in enhancing our attention to these arousing or the emotional stimulus.

There are two theories about the mechanism of this effect. The first theory arises out of fear conditioning studies that are done on rats that it was found that the auditory cortex would become especially sensitive to the stimuli that is used for the conditioned stimulus. So what, if a

sound stimuli is used with the, you know, as a conditioned stimulus with the fear and using, you know, unconditioned stimulus then the auditory cortex of these rats becomes extremely sensitive to detect this sound stimulus or to analyse this sound stimulus.

Classical conditioning and fear conditioning shift the tuning frequency of the cortical neurons to the frequency of this conditioned stimulus. So, the participant will be able to appreciate this sound in it all its detail. Now this cortical plasticity of the receptor field, of this auditory cortex neurons is very associative and it is highly specific. Associative in the manner because its pairing the, the aversive event with the, this conditioned stimulus. But it is highly specific as well. It does not, you know, it is not general across the entire auditory cortex. It happens very quickly and it is also retained rather indefinitely. It is retained for large amounts of time. Now the idea here is that changes that occur in perceptual processing for stimuli with emotional properties are long lasting.

Once you have encountered with the stimulus that has some, that has some emotional significance, something that is very, very pleasant or more in the case of something when there is completely unpleasant or negative or aversive, then this association between that stimulus and this stimulus will and this emotional property negative, more specifically, is learned and retained for much longer times.

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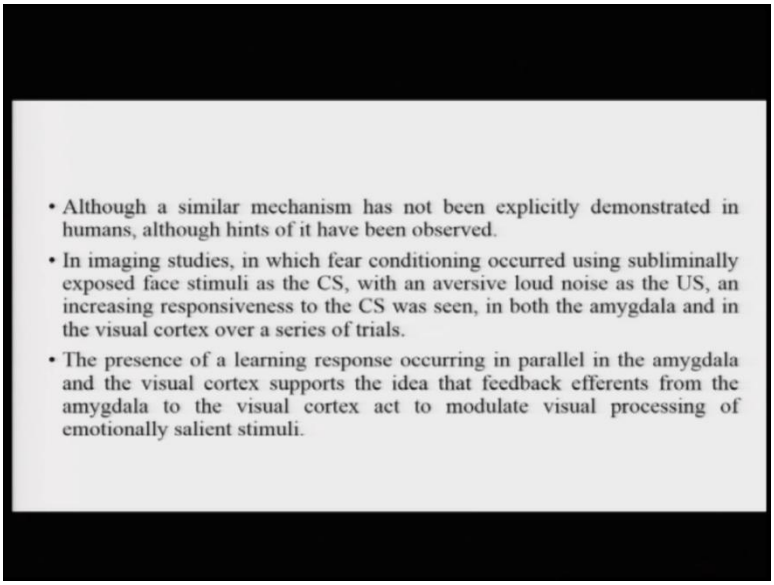

Although a similar mechanism has not been explicitly, explicitly demonstrated in humans, hints of it have been observed. In imaging studies, in which fear conditioning occurred using subliminally exposed face stimuli as the conditioned stimulus, with an aversive loud noise as the unconditioned stimulus and increased responsiveness to the conditioned stimulus or these face stimuli was seen in both the amygdala and in the visual cortex over a series of trials. So when a loud noise is presented and a face is paired with it, after a few trials there is higher activity both in the visual cortex and the amygdala for these face stimuli.

Now the presence of a learning response occurring in parallel in the amygdala and the visual cortex, supports this idea that the feedback efferents that go from the amygdala to the visual cortex can actually modulate the visual processing of emotionally salient stimuli. So, we are learning a lot of things about the amygdala. One of them is that it can actually not only modulate the activity of the hippocampus but it can also activate the initial visual processing of this emotionally salient stimuli.

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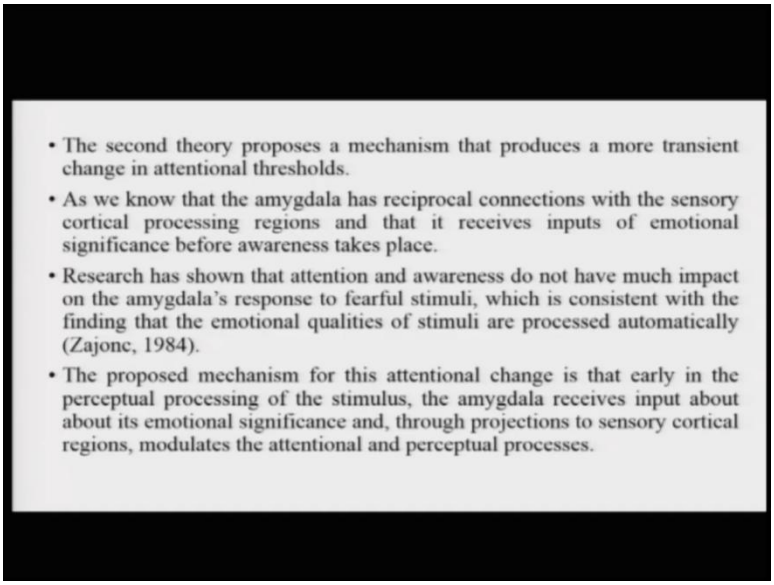

The second theory proposes a mechanism that produces a more transient change in attentional thresholds. Okay? So, as we know that the amygdala has reciprocal connections with the sensory cortical processing regions and that it receives the inputs from the emotional, of emotional significance before even awareness takes place, research has shown that attention and awareness do not have much impact on the amygdala's response to fearful stimuli.

If you remember the high road, low road thing of LeDoux, it, it is understandable. Okay? It is intuitive almost that attention and awareness do not really impact amygdala's response to fearful stimuli because information is coming through the faster lower road. Which is consistence with the findings of the, that the emotional qualities of stimuli are processed automatically. Okay?

Now the proposed mechanism for this attentional change to emotionally salient stimuli is that, early in the perceptual processing of the stimulus, the amygdala would receive the input about its emotional significance already prior to the emotional, prior to the perceptual processing or visual processing has completed and through projections to the sensory cortical regions, it automatically starts modulating the attentional and perceptual processing.

So, for example, if you are seeing something let us say some negative aversive stimuli, let us say a snake or a spider, even before you can, you know, the sensory regions can make out that this is a snake and kind of get you detailed information about this, amygdala has got this information and it has sort of now what it is trying to do, it is trying to modulate the initial processing of those emotionally salient stimuli. That is probably what is happening.

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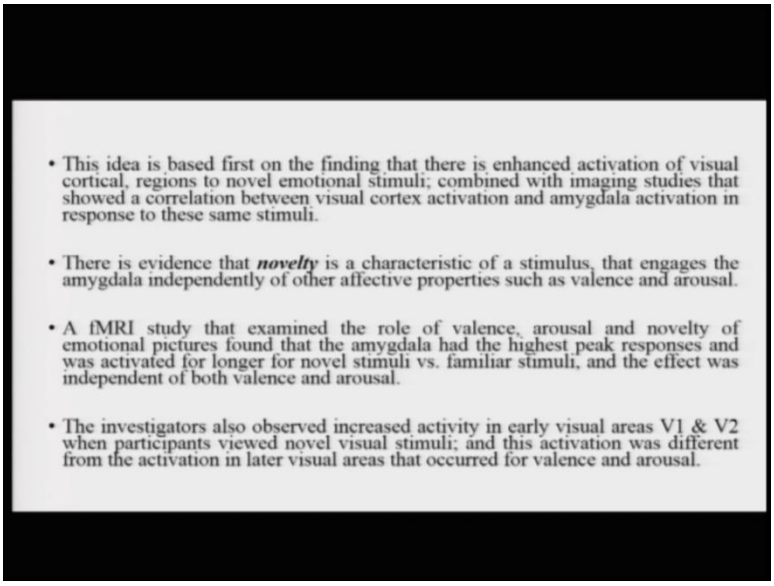

This idea is based first on the finding that there is actually enhanced activation of visual cortical regions to novel emotional stimuli, combined with also imaging studies that actually show a correlation between the visual cortex activation and amygdala activation in response to these same stimuli. So, if a emotional stimuli is presented, typically what is observed is that the firing

rate of amygdala and of the sensory cortical regions are sort of correlated with each other which probably means that the amygdala has some way of modulating the visual cortical activity. Okay?

There is evidence also, let us move to the different characteristic. There is evidence also that novelty is a characteristic of a stimulus that also engages the amygdala even independently of other effective properties such as valence and arousal. So, novelty is something that excites the amygdala. It is not just the valence, pleasantness, unpleasantness. It is not just the arousal that is, you know, high intensity, low intensity, highly excited, lowly excited kind of thing, but if something is novel, it is almost curious and it kind of engages the amygdala.

So, an fMRI study that examined the role of valence, arousal and novelty of emotional pictures found that the amygdala had the highest peak responses and was activated for the longest time for novel stimuli versus familiar stimuli. And this effect was independent of both the valence and arousal of the stimuli.

Also, investigators have observed that increased activity in early visual areas V1 and V2 was found, when participants were viewing novel visual stimuli. And this activation was different from the activation that was later reported in the, in the slightly higher visual areas which was for valence and arousal. So, novelty is probably a different characteristic than valence and arousal and novelty is also in that sense a characteristic that the amygdala seems to be interested in.

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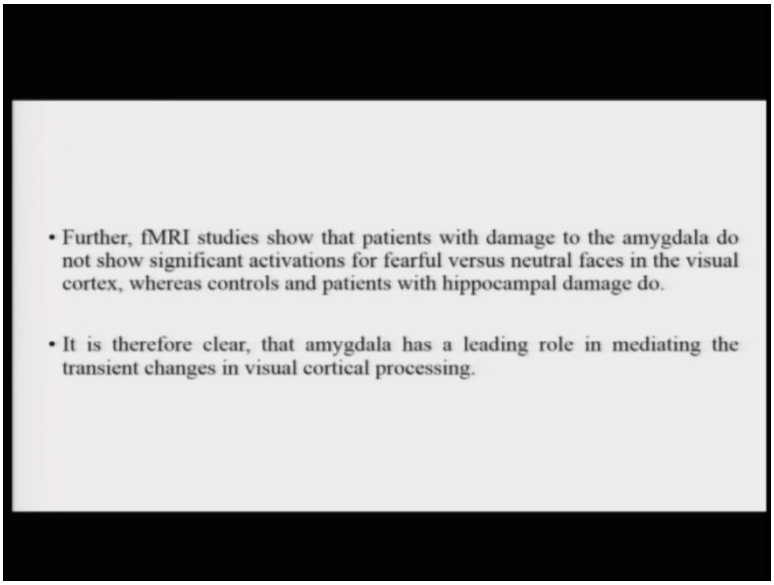

Further, fMRI studies have shown that patients with damage to the amygdala do not really show a significant activations for fearful versus neutral faces in the visual cortex. Okay? Whereas controls and patients with hippocampal damage actually do. So, when the amygdala is damaged patients do not really, you know, show a high activation for fearful versus neutral faces in the visual cortex.

So basically, if that information that this face is very fearful etc. does not really go to the visual cortex. It does not really, you know, it cannot modulate that activity. Whereas control patients and even patients with hippocampal damage actually show significantly higher activations for fearful faces versus neutral faces. It is, if you kind of combine all of this together, it is therefore clear, that the amygdala had a leading role in mediating the transient changes in visual cortical processing, let us say especially for emotionally salient stimuli.

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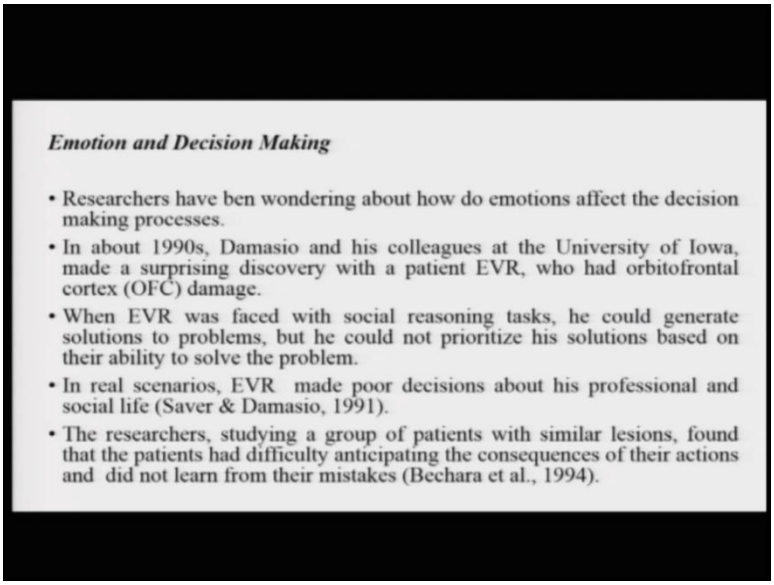

Moving further, let us talk a little bit about emotions and decision making. Now researchers have been wondering about how do emotions affect the decision-making process. In 1999, in the 1990s, Damasio and colleagues, Damasio and colleagues at the university of Iowa, made a surprising discovery with a patient called EVR, who had orbitofrontal cortex damage. When EVR was faced with social reasoning tasks, he could generate solutions to problems but he could not prioritize his solutions based on the ability to solve the problem.

So, for example, if there is a problem, you give me three options, so options this person can generate but he cannot tell me which of the three options are better or should be used first and second and third. In real life scenarios, you know, EVR made poorer decisions about his professional and social life. So, some, in some way the decision making or emotional decision making is affected.

The researchers, studying a group of patients with similar lesions actually found that the patients had difficulty anticipating the consequences of their actions and they did not learn from their mistake. So, here we are looking at a probable region that is kind of involved in, in decision-making but it is involved in decision-making of a special kind. The decision-making is about emotional decisions. The decision-making is amount, is about decisions that may have emotional consequences for these individuals.

You need to anticipate some of this. Okay? Unless you anticipate what the consequences will be of making these choices, you will not be able to make the correct decisions. What is happening with patients of orbitofrontal cortex damage is that they are not being able to anticipate this.

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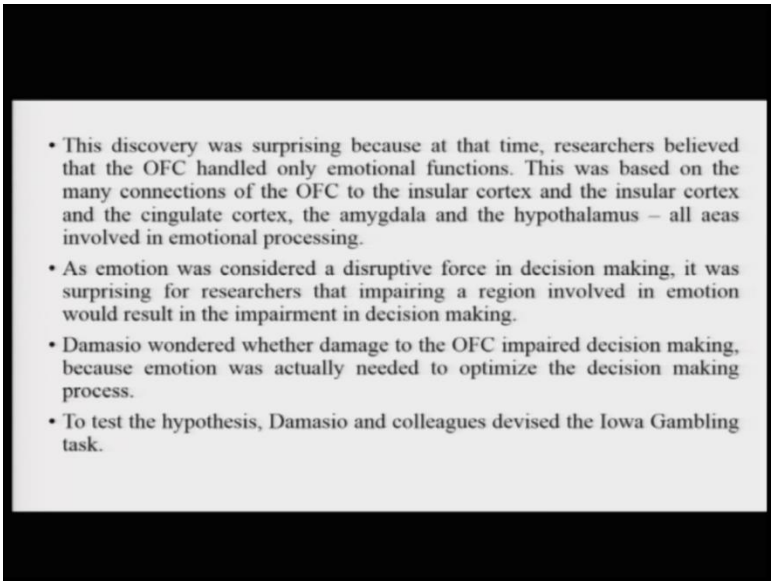

This discovery was surprising because at that time, researchers believed that the OFC handled only emotional functions and would not really interfere or would not really participate in actual decision-making. Okay?

This was basically based on the, on the knowledge that many connections of the OFC are there with the insular cortex and the cingulate cortex, the amygdala, the hypothalamus – all of which are involved in emotional processing. So, OFC and emotional processing linkage was alright, but people thought that probably emotions are not really involved in decision making. So, what can happen is that, say, for example, a, if the OFC is damaged, it should actually enhance the decision-making process rather than cloud it or something. Okay?

So, Damasio wondered whether the damage to the OFC actually impaired decision-making because emotions was actually a very important aspect needed to optimise these kind of decision-making processes. Okay? And Damasio wanted to test this hypothesis, so they devised what is called the Iowa Gambling task.

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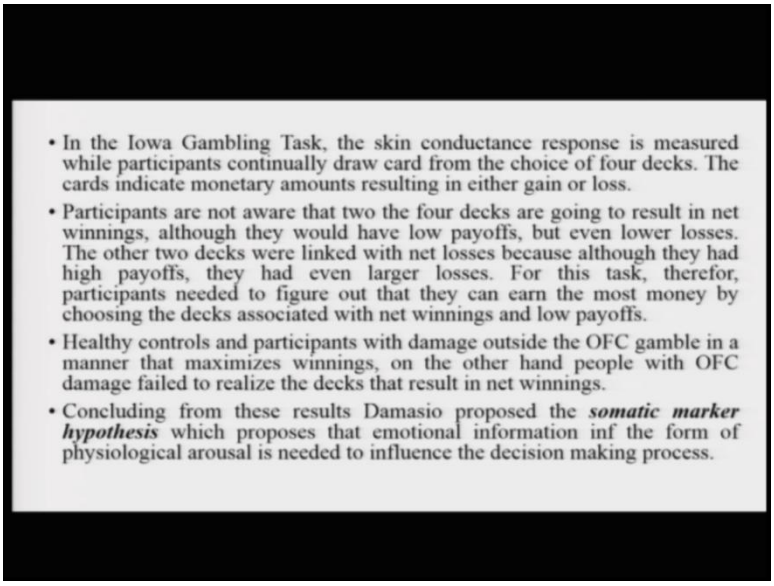

This task is rather simple. There are decks of cards. There are 4 decks. 2 of these decks basically are going to result in net loss and net winnings, even though they are, they have very low pay offs. Say, for example, I keep four decks of cards and these decks of card, I have to pick up each card and then each card will basically involve some kind of monetary gain or loss. So, I pick up this one, it gives me 10 rupees. I pick up this one, it gives me 50 rupees. I pick up this one, it gives me 1000 rupees and this one gives me 2000 rupees.

Now what typically happens is these 2 cards, these 2 decks which basically are giving me lower pay offs, actually, eventually end up in positive score side at the end. So, they end up in net

winnings. These 2 decks which are giving me higher pay offs actually also going ahead have higher losses. And what happens is eventually it, this kind of leads us to net losses. So, 2 decks for net winnings, 2 decks for net losses. These 2 decks although have higher payoffs, these 2 decks although have lower payoffs.

So, this is the Iowa Gambling task. Now let us see what happens. Participants, as I said, were not aware that 2 of the 4 decks are going to result in net winnings, although they had lower payoffs but and also lower losses. The other 2 decks, as I was telling you, was linked with the net, with net losses, although they had higher payoffs. So healthy controls for this task, therefore, what participants actually needed to do was to figure out how they can earn the most money by choosing the decks associated with overall net winning and low payoff. Okay?

Now, heathy controls and participants with damage outside this orbitofrontal cortex region gambled in a manner that maximise their winning. So, they could figure out which decks are leading to net winnings and they stuck to those decks. Okay? On the other hand, people with orbitofrontal cortex damage actually failed to realise the decks that would result in net winnings.

Concluding from these results, Damasio proposed what is called the somatic marker hypothesis and the somatic marker hypothesis is one that proposes that emotional information in the form of physiological arousal is needed to influence the decision-making process. So, the idea is that the decision-making process does take some kind of feedback from this emotional information or from some degree of physiological arousal.

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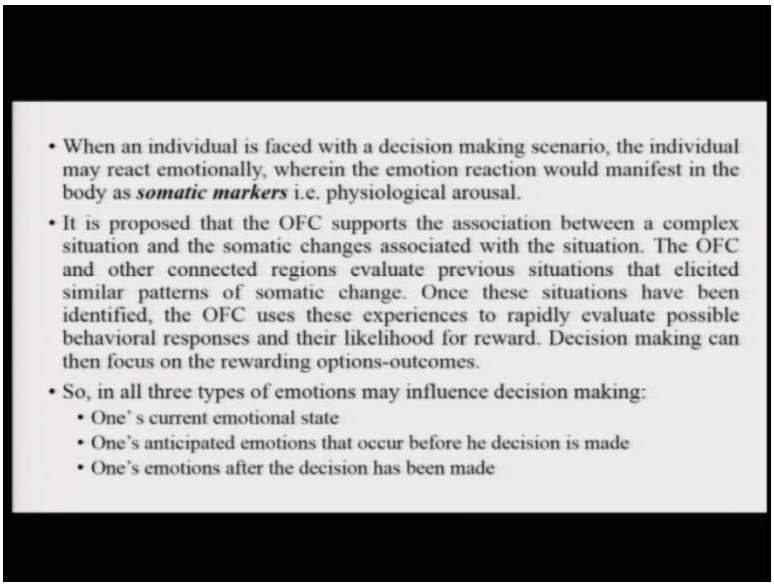

Now when an individual is faced with the decision-making scenario, the individual may react, react emotionally, wherein the emotional reaction would manifest itself in bodily, you know, arousal or in physiological arousal which are referred to as the somatic markers. It is proposed that the OFC supports the association between a complex situation and the somatic markers associated with the situation.

Suppose every time you are going for an interview, there is some kind of physiological reaction, something that is making you over excited, nervous, sad, angry, I don't know what, but say, for example, if a particular situation has a typical emotional reaction associated to it and there are some kind of physiological, you know, markers associated to it, so the OFC basically what it does is, it links these two things. It maps up these two things. Okay?

The OFC and the other connected regions, what they do is they evaluate previous situations that elicited similar patterns of somatic change. Once these situations have been identified, the OFC uses the experience to rapidly evaluate possible behavioural responses and the likelihood for reward. So, for example, if you go to a particular shop, suppose you have a vice and that vice is let us say, you know, gambling because we talked about the Iowa gambling task, let us talk about that vice.

So what happens is that every time you go to gamble, you lose. Now what will happen is the, if you have been doing this for, for a few times and you had that, you know, this physiological

response to okay I am going to gamble today, I might lose and I am a bit nervous but I, you know, for whatever reason I want to continue gambling, what will happen is that, the previous instances of this you are going to gambling will be compared with the current instance, what are you feeling, the same feelings will get aroused and also evaluation of the likelihood for, likelihood reward, is going to be made.

Decision-making can then focus on the reward options outcomes. So, for example, what do I do so that I get a reward. If I play, I'm going to lose. If I, you know, don't play, I am probably going to save a lot of money. So typically, normal individuals would act in a way that they would take this the better option and say, okay, I'm losing these days, I should not gamble and I should go away from here. Something like that. But people who will have orbitofrontal cortex damage, will probably not be able to do this. Okay?

So, it is now established in some which, in some manner that emotions do influence decision-making in some manner. Okay? How do they influence decision-making? Probably through three factors.

One is they, they influence the decision, the person's current emotional state. They also help anticipate the emotions that will occur after the emotion is made, suppose after the decision is made. What will happen after you have lost more money by gambling? And one's emotions after, no, so two things, one's current emotional state, one's anticipated emotions that occur before the decision is made. What will I feel? And you can tell yourself I will win this time and I will be very happy. Or you can tell yourself that, you know, I might lose and I'll be sad. So, the anticipated emotional state and then one's emotions after the decision has been made. Now how are you feeling? Now you are, you know, you have stepped in the gambling house, now how are you feeling. So, these three things will basically, you know, affect your decision-making process.

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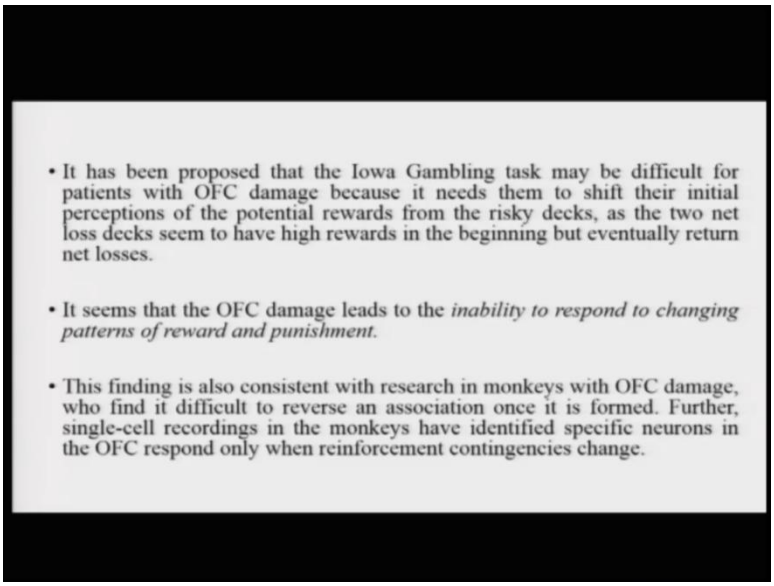

Now it has been proposed that the Iowa Gambling task may be difficult for patients with OFC damage because it will need to, it basically needs them to shift their initial perceptions of potential rewards from the risky decks as the 2 net loss decks seems to have high rewards in the beginning but eventually net losses. So, once you start picking up from these decks, you picked up these decks, you found 1000 rupees, you found 2000 rupees. But you have to figure out as the game goes by, that you have to stop picking up from these decks because these are leading you, leading you to losses as well.

A normal individual without OFC damage will be able to make this switch from this initial profitable situation to a loss-making situation. But, so the OFC damaged person will not be able to do it but a normal individual will be able to make this shift and quickly shift to these 2 decks which are even though they are giving you less money, they are giving you, but they are going to result in overall net winning. Okay?

Now it seems that the OFC damage leads to the inability to respond to changing patterns of rewards and punishments. So, if they, if a particular stimulus as is life, is involved with different patterns of rewards and punishments, the OFC sort of, or people with OFC damage cannot do that. They cannot keep up with the changing patterns of rewards and punishment.

This finding is also consistent with research in monkeys with OFC damage, who actually find it difficult to reverse an association once it is formed. Single cell recordings in the monkeys have

also identified specific neurons in the OFC region that respond only when reinforcement contingencies change. Okay? If the conditions of how they were getting, getting the food palate is changed, then these specific neurons respond.

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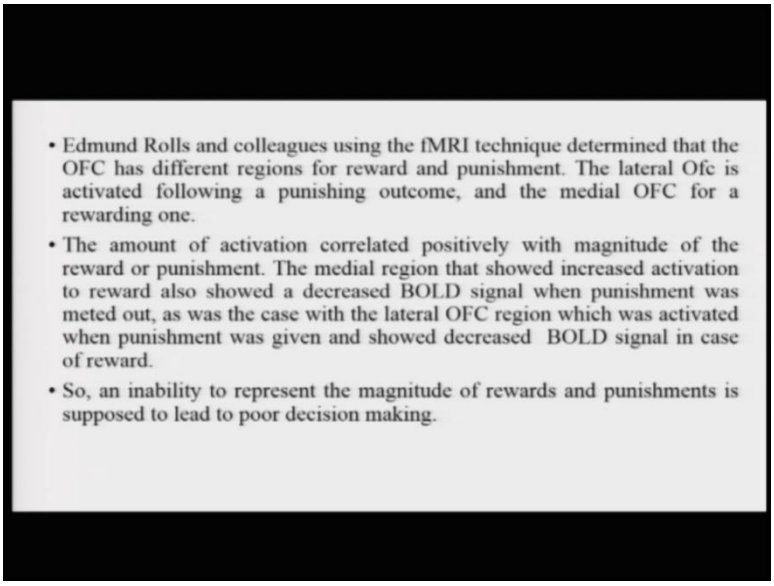

Now, Edmund Rolls and his colleagues using the fMRI technique determined that the OFC has different regions for reward and punishment. The lateral OFC is activated following a punishing outcome and the medial OFC is activated for a rewarding outcome. Okay?

Now the amount of activation correlated positively with the magnitude of reward or punishment. So, the higher the reward, the higher the activation of the medial OFC, the higher the punishment, so basically, ya, the lateral OFC is activated for a punishing outcome. So if there is more punishment, the more activity will be seen in lateral OFC. The medial OFC is linked with the reward outcomes. The more the reward, the more activity in the medial OFC.

Now the medial region, so again just, ya, so that's what I was trying to say. The medial region showed increased activation when, to reward and also showed a decreased bold signal when punishment was meted as with the case of the lateral OFC which was activated when punishment was given but less activated when reward was meted out. So, an inability to represent the magnitude of rewards and punishments is supposed to lead to poor decision-making.

If this OFC is not there, if, you will not be able to determine the amount or the magnitude of a positives and negatives, rewards and punishments and that will basically lead you to making

poorer decisions because you cannot estimate the magnitude of or the consequences of your decision-making.

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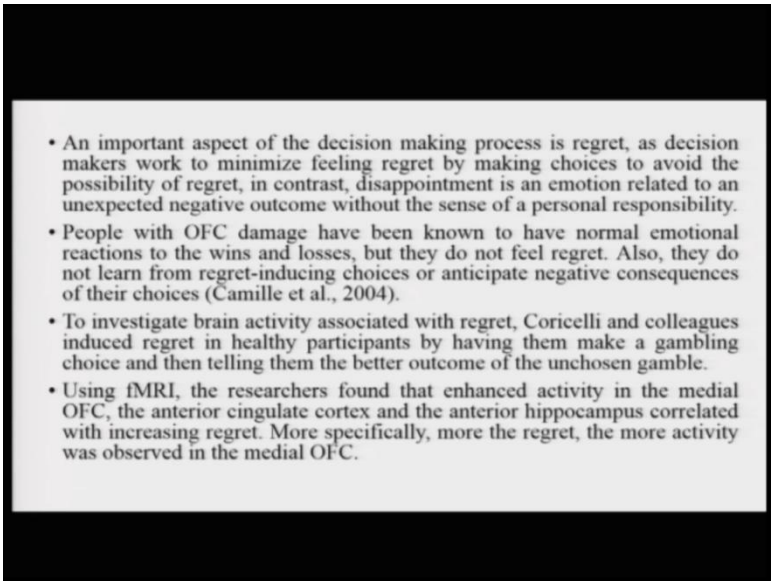

Now, a important aspect of this decision-making process is regret. Regret is also a very, very important aspect. Now as decision-makers typically work to minimise the feeling of regret by making choices that, such that they will not have to regret at the end. Okay? In contrast, disappointment is a, is an emotion that is related to an unexpected negative outcome without the sense of a personal responsibility. So, regret is slightly more personal than mere disappointment.

Now people with OFC damage have been known to have normal emotional reactions to wins and losses but they do not feel regret at all. Also, they do not learn from regret-inducing choices. So, this is also probably a clue to how they make more poorer decisions. Okay? And they are not able to anticipate negative consequences of their choices, of their choices. So here you can see why the OFC might be so necessary for good proper decision making.

To investigate brain activity associated with regret, Coricelli and colleagues induced regret in healthy participants by having them make a gambling choice and then later telling them that the choice they had not made was the better choice. Okay?

Using fMRI, these researchers found that the enhanced activity in the medial OFC, the anterior cingulate cortex and the anterior hippocampus is actually correlated with increasing regret. So,

these are probably the regions which are responsible for this feeling of regret. More specifically, the more the regret, the more activity was observed in the medial OFC.

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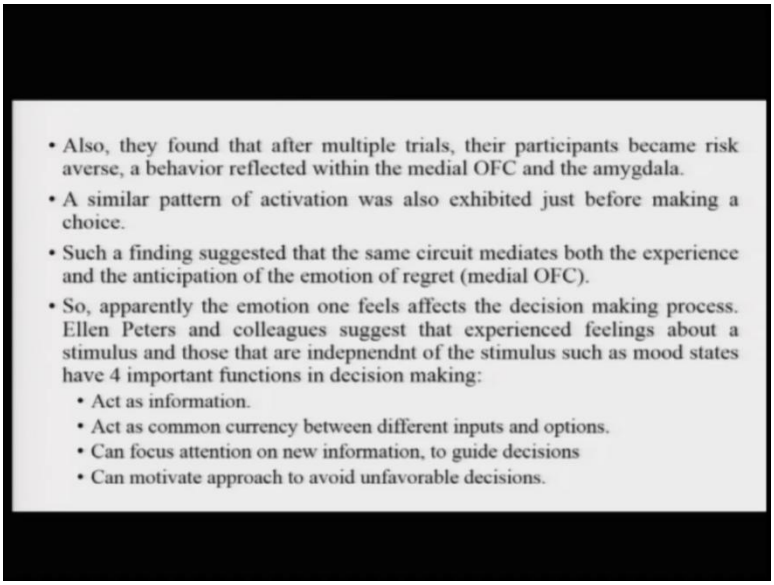

Also, they found that after multiple trials, their participants became risk averse, a behaviour that, that was reflected within the medial OFC and the amygdala. So, these are the reasons that are learning, you know, to become risk averse to sort of avoid making choices that will lead to regret in the later part. A similar pattern of activation was also exhibited just before making a choice.

So, now they are basically also decisions probably is linked with anticipation as well. Both of these findings and the others that we talked about, suggest that the same circuit mediates both the experience and anticipation of the emotion of regret. Okay? So, apparently, now we can kind of try and sum this up. Apparently, the emotion one feels affects the decision-making process.

And Ellen Peters and colleagues actually have suggested that experienced, experiencing feelings about a stimulus and those that are independent to the stimulus such as mood states have 4 important functions in decision-making. They act as information. They act as common currency between different inputs and choices. They can focus attention to new information so as to guide your decisions. And they can motivate the approach to avoid unfavourable decisions. So basically, they can motivate you to avoid regret making choices. Things like that.

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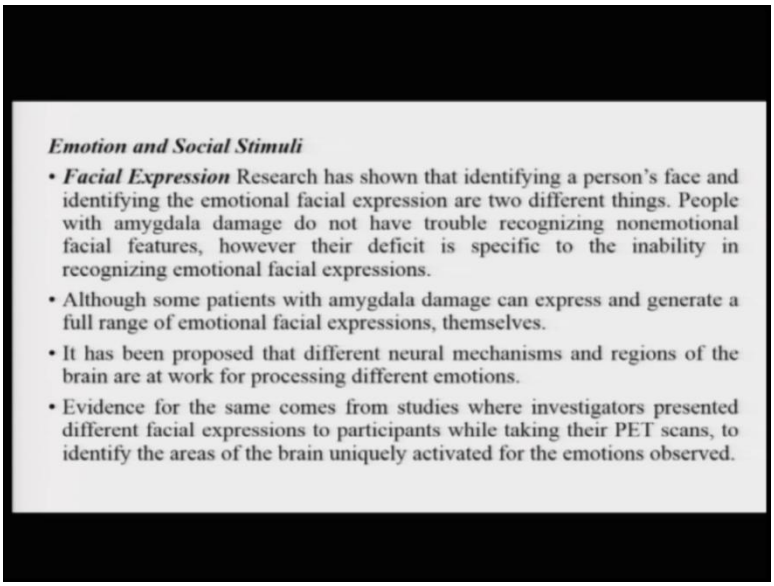

Now let us talk a little bit about emotions and social stimuli. Now, facial expressions is a very, very important aspect of emotions. Okay? Research has shown that identifying a person's face and identifying the emotional expression on the person's, the person's face are two different things and they must be associated with two different neural circuits.

People who have amygdala damage do not really have trouble recognizing the person's non-emotional facial features and their faces, but their deficit is specific to their inability of recognizing facial, emotional facial expressions. Okay? Although some patients with amygdala damage can express and generate a full range of emotional expressions themselves, the damage is in recognising these facial expressions.

It has been proposed that the different neural mechanisms and the regions of the brain are at work for processing different emotions. Okay? Evidence for the same comes from the studies where investigators presented different facial expressions to participants while taking their PET scans, to identify the brain areas uniquely activated for the emotions observed.

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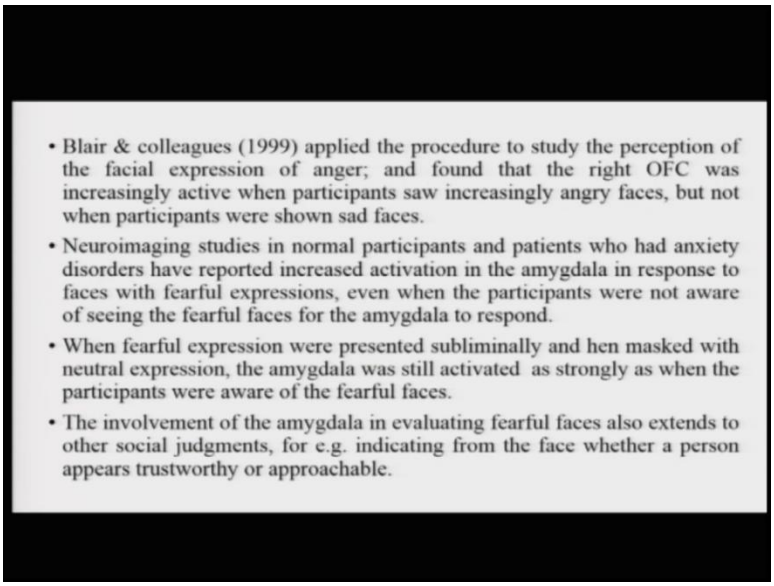

Blair and colleagues, 1999, applied the procedure to study the perception of the facial expression of anger and they found that the right orbitofrontal cortex was increasingly active when participants were seeing angry faces but not when they were seeing sad faces. So, you can kind of link that region to perception of anger.

Neuroimaging studies in normal participants and patients who had anxiety disorders have reported increased activation in the amygdala in response to faces with fearful expressions, even when the participants were not even aware of seeing the fearful faces. Okay? So, subliminally presented. Going further, when fearful expressions was presented subliminally and then masked with a neutral expression, amygdala was still found as strongly activated as if participants were actually seeing fearful faces.

So, in some ways, even at the subliminal level, the fear expression is being, is being gauged and recognised by the amygdala. So, the involvement of the amygdala in evaluating fearful faces also extend to other kinds of social judgment. For example, indicating from the face whether a person is trustworthy, you can go to this person for help or approachable.

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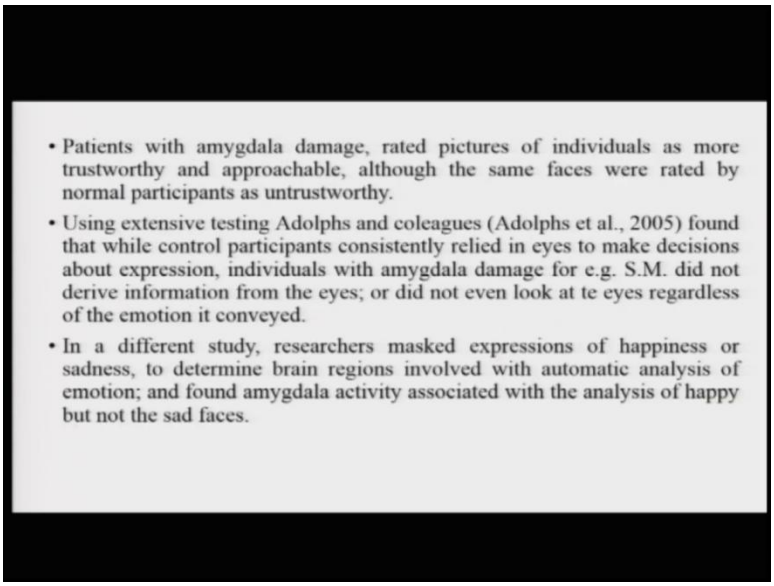

Patients with amygdala damage, rated pictures of individuals as more trustworthy and approachable, although the same faces were rated by normal participants as untrustworthy. So, you can see that if, if the person has amygdala damage, they will not be able to judge whether the person is trustworthy person or is an approachable person because this is a social decision which needs to be made on the basis of fear rating of a person.

Using extensive testing, Adolphs and colleagues, found that while control participants consistently relied on, so why is this or how is this amygdala kind of, you know, judging the, that the person's face is trustworthy or not. Using extensive testing, Adolphs and colleagues have found that while control participants consistently relied on their eyes to make, on the region of the eyes to make decisions about expressions, individuals with amygdala damage, like S.M. who had, you know, Urbach-Wiethe disease did not derive information from the eyes and did not even look in the eyes of the faces to derive emotional information. So, what is probably happening is that in some ways, in, in, because of something they are not focusing at the eyes. Okay?

In a different study, researchers masked the expressions of happiness and sadness to determine the brain regions involved with the automatic analysis of emotion and then they found that the amygdala activity was associated with the analysis of happy but not the sad faces. So, happiness, fear, both are sort of linked to amygdala.

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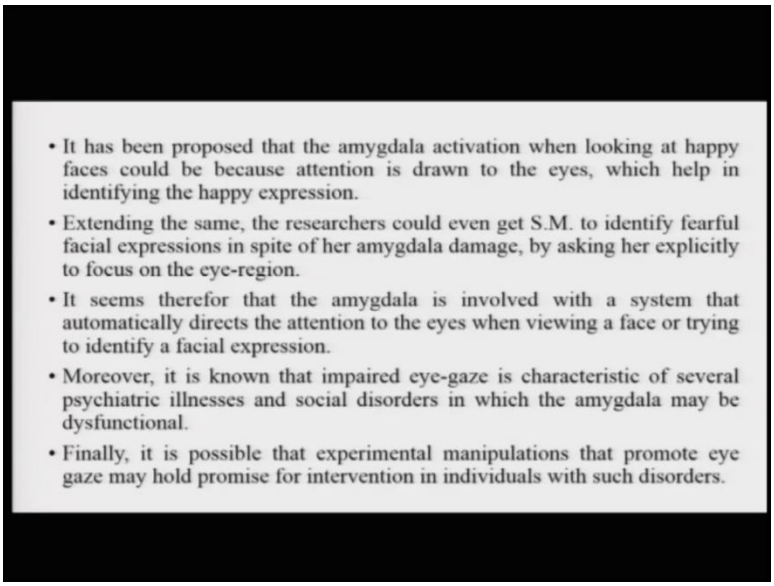

Now it has been proposed that the amygdala activation when looking at happy faces could also be because attention is drawn to the eyes, when you want to kind of decipher whether a person is happy or not and basically what is happening is that people are being able to derive whether some face is happy or sad by paying attention to the eye region. Okay?

Putting this, pushing this finding a little bit further, researchers actually showed that they, they could even get S.M. who has bilateral amygdala damage to identify both fearful and happy faces by just explicitly telling her that you have to focus on the eyes. When she focused on the eyes, she could actually identify fearful expressions and happy expression. Okay?

So it seems therefore what the amygdala was doing was, that it is involved in a system that automatically draws the participant's attention towards the eyes, then the information about the expression can be deciphered from the eyes and then basically a successful recognition of a fearful face or a happy face might be made. So, it is known that impaired eye-gaze is the characteristic of several psychiatric illnesses and social disorders in which the amygdala may be dysfunctional. Okay?

So basically, it seems that if amygdala is damaged, attention will not automatically be grabbed towards the eyes and people will not be able to, you know, a, read emotional expressions at least like that of happiness and fear and they will not be able to form emotional bonds. You know much like what happens in autism.

So, people have said, people like Adolphs and their research have actually shown that it is possible through experimental manipulations to train people to start looking at eyes a little bit more to start deriving that information more and in that sense once they have, they are able to derive that information independently of the amygdala, they will be able to make these recognitions and make these, you know, changes. So, this could sort of help as intervention with, you know, individuals which have such kind of disorders.

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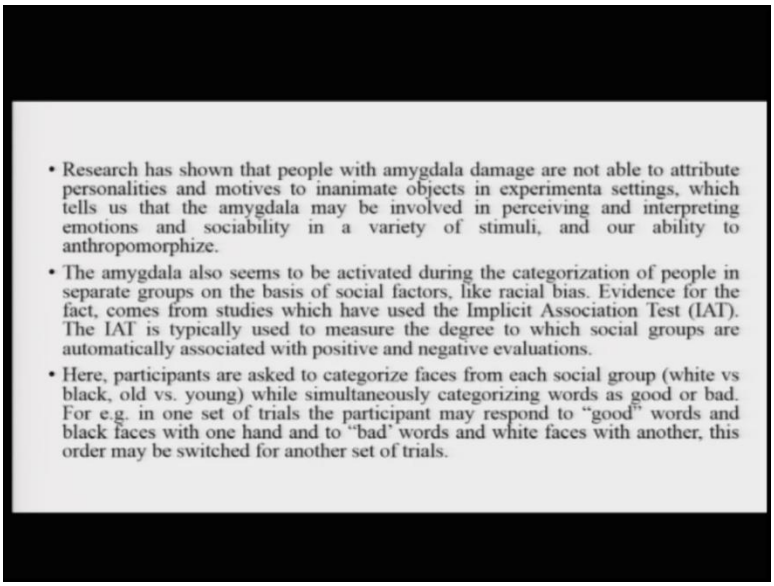

Research has also shown that the amygdala damage are not attributable, amygdala, people with amygdala damage are not able to attribute personalities and motives to inanimate objects in experimental settings. Say, for example, in, sometimes in experimental settings what happens is that you are shown, you know, these geometrical shapes and you are asked that, you know, imagine that these shapes are actual individuals and they are moving to gain something. They are moving to maximise their profit or, you know, something, something like that. So, people with amygdala damage cannot do that. They cannot just anthropomorphize, anthropomorphize. They are not able to attribute humanly features to inanimate objects. This is also something that the amygdala sort of mediates.

The amygdala also seems to be activated during the categorization of people in separate groups on the basis of social factors, things like racial bias. You know, there is, there is an evidence of some kinds of racial biases existing between people of different races sometimes, let us say the

whites and the blacks, the whites and the browns, the browns and the blacks and so on. So, all of these things are there. It seems that the amygdala probably is involved in some manner in these kind of judgements. Evidence for this fact, actually comes from studies that have used the implicit association test and this implicit association test is typically used to measure the degree to which the social groups are automatically associated with positive or negative evaluations.

So, whether, say, for example, all whites are good people or all blacks are good people or all whites are bad people or all blacks are bad people, these kind of associations, you know, basically this IAT measures. And basically, what it does is it tries to measure this bias. Okay?

So, what happens here is that participants are asked to categorize faces from each social groups, white versus black, old versus young, while simultaneously categorizing words, good words and bad words. Okay?

For example, it could happen that in one set of trails participants may be asked to respond to good words and black faces with one hand and bad words and white faces with the other. And in other set of trials they can actually, you know, react to good words and whites faces and bad words and black faces and they can kind of can do that.

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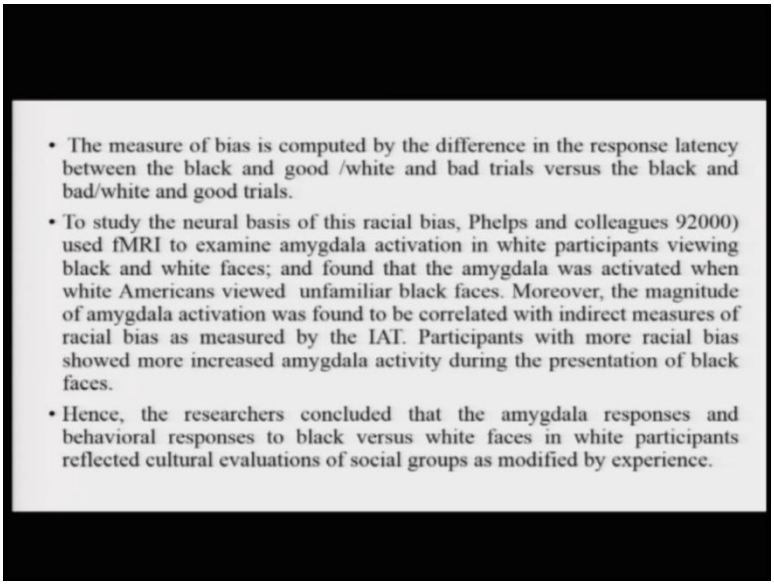

Basically, what this task is doing is that it is measuring the bias and the bias is basically being computed by the difference in the response latencies between the black and good and white and bad kind of trials. Okay? Now to study the neural basis of a possible racial bias, Phelps and

colleagues, in the year 2000 used fMRI to examine the amygdala activation in white participants while viewing black and white faces. And they found that the amygdala was activated when white Americans viewed unfamiliar black faces. Okay?

Moreover, the magnitude of the amygdala activation was found to be correlated with indirect measures of bias as was shown by the IAT task. Participants who had more racial bias as measured by the IAT task actually showed increased amygdala activity. So, the researchers concluded that probably the amygdala responses and the behavioural responses to these black versus white faces in white participants reflected some sort of cultural evaluation of these social groups as has been modified by experience.

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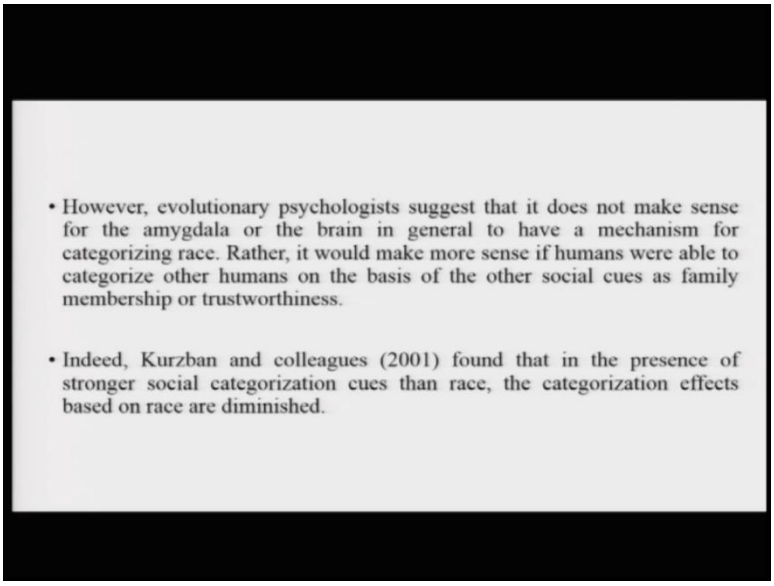

So, you can sort of make this assumption but say, but evolutionary psychologists do not agree with this. They say that it does not really make a lot of sense for the amygdala or any neural circuit in the brain for that matter to have a mechanism for categorizing race. Because that is not really useful at all. Rather, it would make more sense if humans were able to categorize the other humans on the basis of whether they are in group or out group, whether they are family members or not family members or whether they are trustworthy or not trustworthy.

Indeed, Kurzban and colleagues actually found that in the presence of stronger social categorization cues other than race, the categorization effects based on race diminished. So, although, you know, the amygdala might be, might be mediating some of these racial biases, it is

not the only thing. It is not something that the amygdala is, is basically tuned for. It is just that, it kind of evaluates the cues for categorization and if better cues are available, it will sort of help you categorize the faces socially on the basis of those other cues.

I think that was all for today's lecture. I will meet you in the next lecture to wrap up this chapter on emotion.