Introduction to Brain & Behaviour
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Lecture 40
Social Knowledge in Social Cognition

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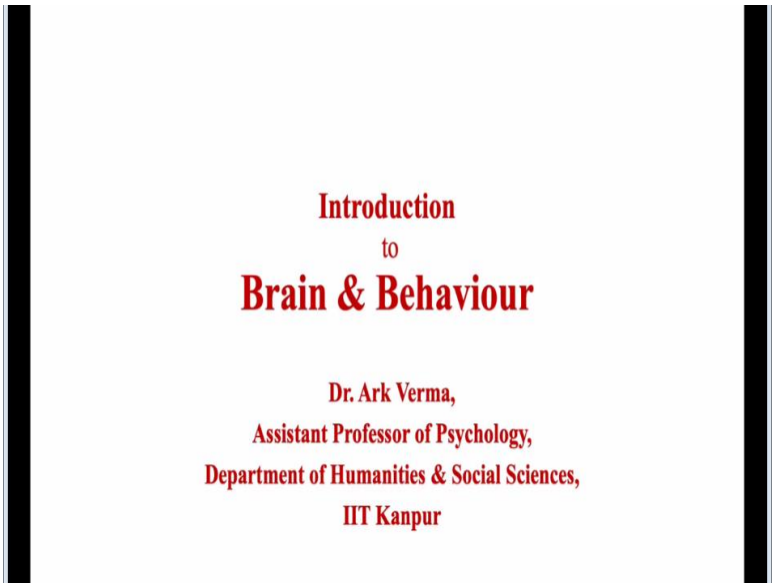

Hello and welcome to the course, Introduction to Brain and Behaviour I am Dr. Ark Verma from IIT Kanpur. This is the eighth week of the course and this is the last lecture in the course. Today we will talk about social knowledge and social cognition.

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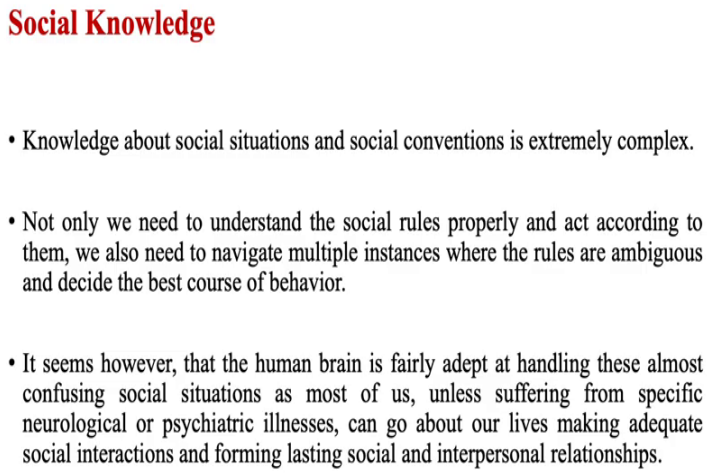

Now, social knowledge is something very interesting to think about it. Basically, it's knowledge about social situations and social conventions by which we have to live our lives. So, the idea is about how do you get out? How do you meet people? How do you greet people?

What is the basic courtesy when somebody says please or thank you or when do you have to say sorry, when do you have to pay respect, things like that. So, social situations and social conventions are in some extremely complex. Not only we need to understand the social rules properly, but we also need to act according to them, we also need to understand or navigate multiple instances where sometimes these rules are ambiguous and then we have to decide the best course of behaviour.

It seems, however, that the human brain is fairly adept at handling these almost confusing social situations as most of us unless suffering from specific neurological or psychiatric illnesses, can go about our lives making adequate social interactions and forming lasting social and interpersonal relationships.

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- However, the lack of straightforward social rules is never the less a concern and social neuroscientists have been interested in figuring out the neural systems that help us take appropriate decisions in situations where the social rules are of little help.
- According to some contemporary research the following areas of the brain have a role to play in navigating our social environments and driving our social behaviors.
- ***Orbitofrontal Cortex*** :- Patients with OFC damage have been found to have the most difficulty when they need to draw on their social knowledge and make sense of their social interactions.
- Valerie Stone et al. (1998) developed a social faux pas task that tries to estimate a person's ability to reason about the world. In this task, participants are presented with series of social scenarios in which one of the character omits a social faux pas by accidentally saying something impolite.

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cortex, patients with OFC damage have been found to have the most difficulty when they need to draw on their social knowledge and make sense of their social interactions. For example, Valerie Stone and colleagues developed a social faux pas task that tries to estimate a person's ability to reason about the world.

In this task, participants are presented with the series of social scenarios in which one of the characters commits a social faux pas by accidentally saying something impolite.

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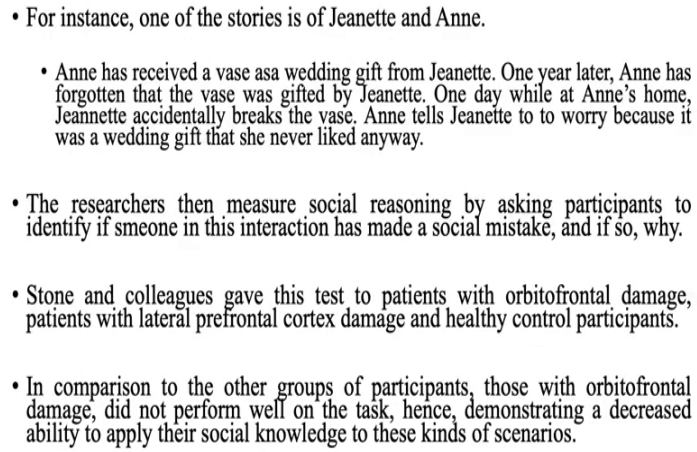

For instance, one of the stories is of Jeanette and Anne. Anne has received a vase as a wedding gift from Jeanette. One year later, Anne has forgotten that the vase was gifted by Jeanette. One day while at Anne's home, Jeannette accidentally breaks the vase. Anne tell not worry because it was a wedding gift that she never liked anyway.

The researcher then measured the social reasoning by asking participants to identify if someone in this interaction has committed a social mistake, and if so, why? Stone and colleagues gave this test to patients with orbitofrontal cortex damage, patients with lateral prefrontal cortex damage and healthy control participants. In comparison to the other group of participants those with orbitofrontal damage, could not perform well on the task, hence, they demonstrated a decreased ability to apply their social knowledge to these kinds of scenarios.

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- Patients with orbitofrontal damage understood that a character like Jeanette would feel bad about breaking a vase, but they could not understand that Anne's comment about not liking the vase was actually intended to reassure Jeanette and not insult her in any way.
- These patients were not as able to take the context into account when reasoning about the social mistakes.
- These pattern of results suggested that orbitofrontal cortex damage impairs the ability to use social knowledge to reason about social interactions.

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- Another set of experiments by Jennifer Beer (Beer et al., 2003) involved patients from three groups engaging in a structured conversation with a stranger, and included patients with orbitofrontal damage, with lateral frontal damage and healthy participants.
- It was found that patients with orbitofrontal damage were likely to introduce impolite conversation topics, even though they were talking to a complete stranger. These patients were apparently unaware that their actual social behavior violated the social rules for conversations with a stranger.
- Such alack of awareness can be especially problematic as it makes it difficult for patients with OFC damage to feel embarrassment that would have motivated them to behave differently in the future.

Now, another set of experiments by Jennifer Beer and colleagues as we have discussed earlier in the chapter involved three groups of participants engaging in a structured conversation

with a stranger, and included patients with orbitofrontal damage, with lateral frontal damage in healthy participants. It was found that patients with orbitofrontal damage were likely to introduce impolite conversation topics, even though they were talking to a complete stranger.

These patients were apparently unaware that their actual social behaviour violated the social rules for conversations with a stranger. Now, such a lack of awareness can be especially problematic as it makes it difficult for patients with OFC damage to feel embarrassment that would have motivated them to behave differently in the future. Sometimes, what happens is in certain situations, you commit a mistake but you immediately get the feedback. If you said something which is not nice, you will immediately get the feedback from those people around you.

That will cause you to feel embarrassed and next time you will not say something that is improper or impolite to that particular context.

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- IN a separate study, Beer et al. 92003) patients with OFC damage participated in a task that required them to make up nicknames for an experimenter that they were not familiar with.
- While healthy control participants were careful to come up with flattering nicknames and apologized for having to tease someone that they did not know so well, patients with OFC damage actually offered unflattering nicknames and announced them often in a singsong like voice used for teasing people you know well.
- Moreover, these patients were not embarrassed by this inappropriate behavior and reported feeling especially proud of their social behavior.
- It seems therefore that this lack of knowledge about their social mistakes, the patients with OFC damage never generate the emotional feedback that would allow them to change their behavior in future instances.

Now, in a separate study, Beer and colleagues, they patients with OFC damage and participated in a task that required them to make up nicknames for an experimenter that they were not familiar with. Now, it a a very awkward situation when you have to do something like this.

So, while healthy control participants were careful to come up with flattering nicknames and apologized for having to tease someone that they did not know so well, patients with OFC

damage actually offered unflattering nicknames and announced them in a singsong like voice typically used for teasing people and people you know well.

Moreover, patients with OFC damage were not really embarrassed by this inappropriate behaviour and reported feeling especially proud of their social behaviour. It seems therefore that this lack of knowledge about their social mistakes, the patients with OFC damage can never generate the emotional feedback that would allow them to change their behaviour for future instances.

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- It seems therefore that even in cases when they do have the knowledge about social appropriateness conventions, they cannot apply this knowledge to their own social interactions.
- Further, they are less likely to be able to recognize that their behavior is inappropriate, generate any emotional feedback that they would need to check their behavior and change it for the future.
- Adult patients who have sustained ofc damage later in life, do retain their social knowledge prior to the accident, but are deficient in learning new social conventions.
- Patients with OFC damage on the whole, display socially inappropriate behavior and cannot apply the social knowledge to specific social interactions.

It seems therefore that even in cases when they do not have the knowledge about social appropriateness and conventions, they cannot apply this knowledge to their social interactions. Further, these people are less likely to be able to recognize that their behaviour is inappropriate, generate any emotional feedback that they would need to check their behaviour and change it for better in the future.

Adult patients who have sustained OFC damage later in life, do retain their social knowledge which they have gain prior to the accident, but are deficient in learning or taking up any knowledge about social conventions. Also, patients with OFC damage, on the whole, display socially inappropriate behaviour and cannot apply social knowledge to specific social interactions.

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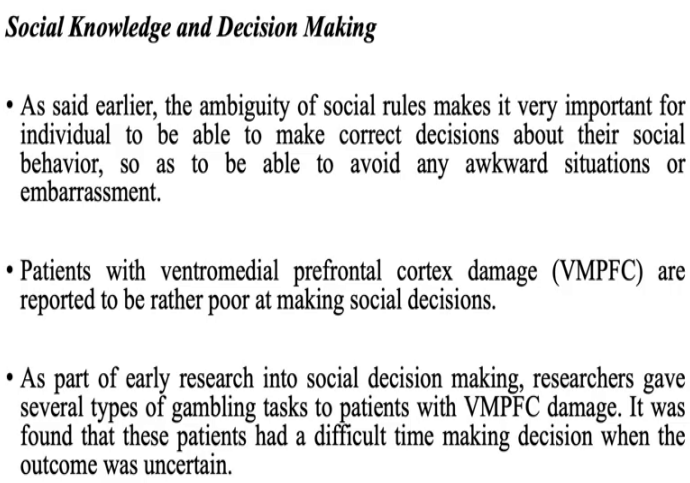

Let us talk about social knowledge and decision making, as said earlier, the ambiguity of social rules makes it very important for individuals to be able to make correct decisions about their social behaviour, so as to be able to avoid any awkward situations or embarrassment. Patients with ventromedial prefrontal cortex damage VMPFC are reported to be rather poor at making social decisions.

As part of early research into social decision-making, researchers gave several types of gambling tasks to patients with VMPFC damage. It was found that these patients had a difficult time making this decision when the outcome was uncertain.

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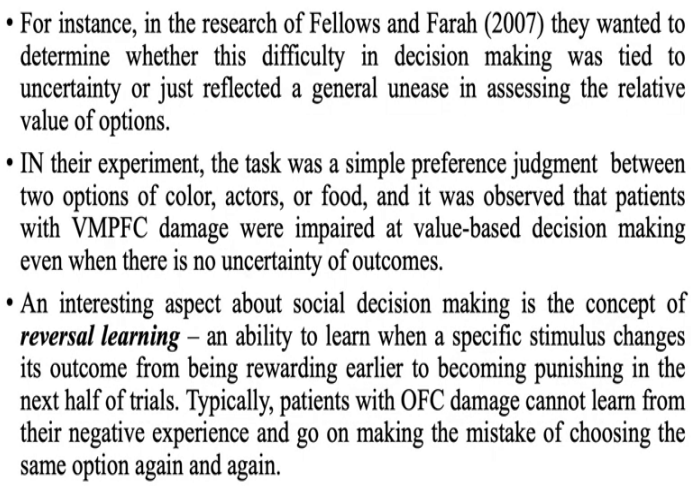

For instance, in the research of Fellows and Farah in 2007, they wanted to determine whether this difficulty in decision making was tied to uncertainty or just reflected a general unease in assessing the relative value of options.

Now, in their experiment, the task was a simple preference judgment task between two options of colours, actors, or food, and it was observed that patients with VMPFC damage were impaired at value-based decisions. Even though there is no uncertainty of outcomes. Another interesting aspect about social decision making is the concept of reversal learning, reversal learning basically is an ability to learn when a specific stimulus changes its outcome from being rewarding earlier to becoming punishing in the next half of trials.

Typically, patients with OFC damage cannot learn from their negative experiences and they go on making the mistake of choosing the same option again and again.

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- The idea of reversal learning is also fairly important in social decision making as it can sometimes happen that the same behavior that was once rewarding can turn into unrewarding or even punishing.
  - For example, sometimes one can hug someone and not get the same response back or ends up creating an awkward situation, as the hug was neither expected nor appreciated.
- Individuals need to take note of the negative feedback and be able to change their future social behavior accordingly.
- It has been suggested that the VMPFC is involved in coding stimulus value, but it seems odd that patients with VMPFC lesions can selectively learn a stimulus value initially but is unable to learn when the value of a given stimulus is reversed.

So, the idea of reversal learning is also fairly important in social decision making as it can sometimes happen that the same behaviour that was once rewarding can turn into unrewarding or even punishing. For example, sometimes one can hug someone and not get the same response back or ends up creating an awkward situation, as the hug was neither expected nor appreciated.

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lesions can selectively learn a stimulus value initially but is unable to learn when the value of a given stimulus is reversed.

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- Wheeler and fellows 92008) investigated whether positive and negative feedback of stimulus value expectation would influence behavior through separate and distinct neural mechanisms.
- In their study, participants were patients with damage to the ventromedial frontal lobe, healthy controls and patients with dorsolateral frontal damage.
- The participants were asked to perform in a probabilistic learning task with positive and negative feedback, while undergoing fMRI scanning.
- It was observed that VMF damage selectively disrupted the ability to learn from negative feedback, but not from positive feedback. The controls and DLP damage patients however, performed equally well, and could learn from both positive and negative feedback.
- This finding therefore suggest two distinct neural mechanism for learning from the two kinds of feedback.

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This finding, therefore, suggests two distinct neural mechanisms for learning from the two kinds of feedback.

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- Further, these findings were also consistent with literature that implicates the VMF in reversal learning, extinction, fear conditioning, regret and envy.
- However, the findings are inconsistent with an earlier study by Fellows, that suggested that this region represents relative reward value and preferences.
- It could be therefore possible that the VMF may carry representations of the expected reward value not to guide choice, but to serve as a benchmark to compare the outcomes against.
  - More specifically, when the outcomes are negative and unexpectedly fail to match the expectations, the VMF enables avoidance learning.
- It also is plausible that this process does not take place directly, but indirectly by signaling to the amygdala and other regions to form new associative representations that may flexibly change their behavior.

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It could be therefore possible that the VMF may carry representations of the expected reward value not to guide choice, but to serve as a benchmark to compare the outcomes against. More specifically when the outcomes are negative and unexpectedly fail to match the expectations, the VMF enables avoidance learning. Also it is plausible that this process does not really take place directly, but indirectly by signalling to the amygdala and other regions to form a new associative representation that may flexibly change their behaviour.

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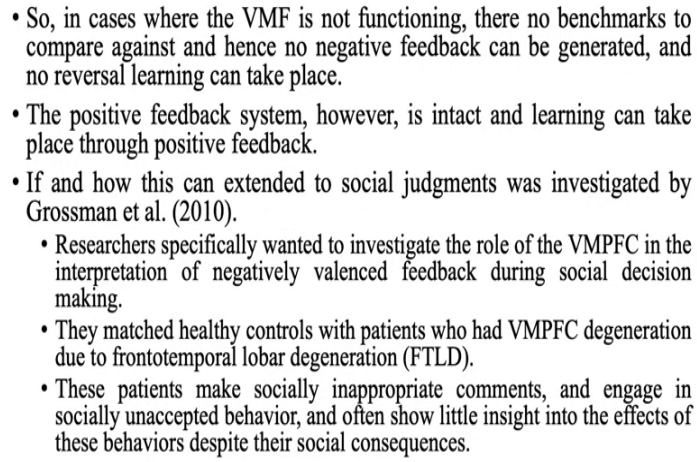

So, in cases where the VMF is not functioning, there are no benchmarks to compare against and hence no negative feedback to be generated, and therefore no reversal learning can take place. The positive feedback system, however, is intact and because things are moving as per expectations, learning can take place through positive feedback If and how this can be extended to social judgments was investigated by Grossman and colleagues in 2010.

These researchers specifically wanted to investigate the role of the VMPFC in the interpretation of negatively valencd feedback during social decision-making. They matched healthy controls with patients who had VMPFC degeneration due to frontotemporal degeneration FTLD. These patients make socially inappropriate comments and engage in socially unaccepted behaviour, and often snow little insight into the effects of these behaviours despite their social consequences.

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- Participants were made to judge 20 social situations (for e.g. cutting into the ticket line at the movie theater) or minor infarctions of the law (rolling through a red light at 2 a.m.) on a scale of 1 – 5 for social acceptability.
- These scenarios were then given contingencies that were either negatively biased (e.g. rolling through a red light at 2 a.m., when a police car is at the intersection) or positively biased (e.g. rolling through a red light at 2 a.m., when rushing a sick child to the emergency room).
- This time participants were asked to judge accoding to two randomly presented instructions: "Should everyone do this all of the time?" (rule based condition) or "Is this generally okay?" (similarity – based condition).
- This manipulation was intended to ferret out differences that could be due to insensitivity to perceived legal and social rules.

Now, participants were made to judge twenty social situations, for example, cutting into the ticket tine at the movie theatre or minor infractions of the law rolling through a red light at 2 a.m. on a scale of one to five for social acceptability. These scenarios were then given contingencies that were either negatively biased. Let's say rolling through a red light at 2 a.m. when a police car is at the intersection or positively biased. Let's say rolling through a red light at 2 a.m. when rushing a sick child to the emergency room.

This time participants were asked to judge according to two randomly present their situations as should everyone do this all of the time? That is a rule-based judgement or is this generally okay? That is a similarity-based judgement. This manipulation was intended to ferret out differences that could be due to insensitivity to perceived legal and social rules.

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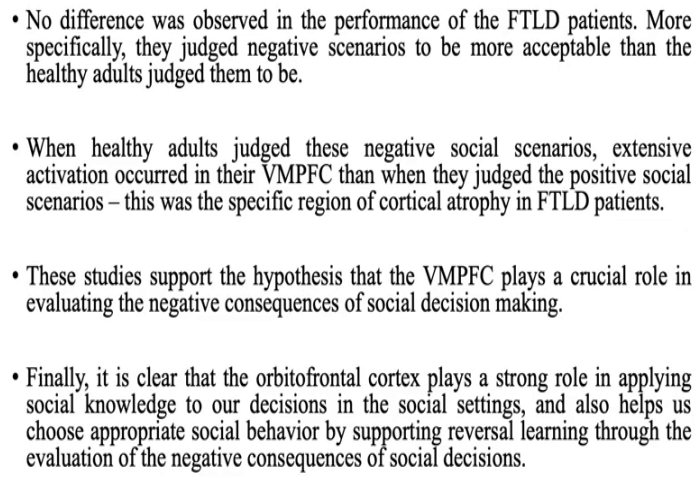

No difference was observed in the performance of FTLD patients. More specifically, they judged negative scenarios to be more acceptable than the healthy adults judged them to be. When healthy adults judged these negative social scenarios, extensive activation occurred in their VMPFC, then when they judged the positive social scenarios, this was the specific region of cortical atrophy in FTLD patients. So, this is the region which is basically helping them learn through these negative social scenarios.

These studies support the hypothesis that VMPFC plays a crucial role in evaluating the negative consequences of social decision making. Finally, it is also clear that the orbitofrontal cortex plays a strong role in applying social knowledge to our decisions in social settings. And also helps us choose appropriate behaviour by supporting reversal learning through the evaluation of the negative consequences of social decisions. So, this is about decision-making and social cognition.

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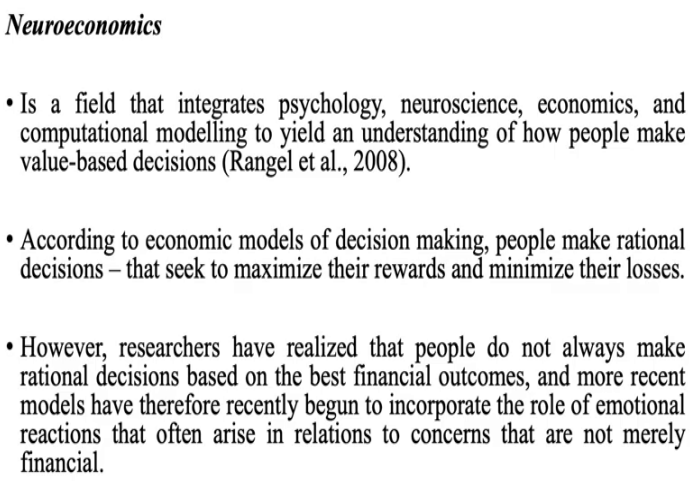

Now, let us talk a little bit about neuroeconomics. Neuroeconomics is an exciting upcoming field that integrates psychology, neuroscience, economics and computational modelling lo yield an understanding of how people make value-based decisions. According to economic models of decision-making, people should make rational decisions all the time that is they should seek to minimize their losses and maximize their gains.

However, researchers have begun realized that people do not always make rational decisions based on the best financial outcomes, and more recent models have therefore recently begun to incorporate the role of emotional reactions that often arise in relations to concerns that are not merely financial.

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- Some neuroeconomists have proposed have proposed that emotions may sometimes help people make optimal decisions by taking into account a wider range of consequences, and are trying to make models that include cognitive and emotional variables driven by valuation of gains, losses, risks, and uncertainties.
- Suppose individuals are given $50 and a chance to gamble with it.
  - If one has either a guarantee of keeping $20 or a chance to gamble it all, what could be the choice.
  - Alternatively, if one has a guarantee of losing $30 or a chance to gamble it all? Will the choice be different from the earlier one.
- Most individuals prefer to gamble when faced with a guaranteed loss, even when the monetary consequences of the guaranteed options are the same, as in the two bets outlined here.

Now, some neuroeconomists have proposed that emotions may sometimes help people make optimal decisions by taking into account a wider range of consequences. And they are trying to make models that include cognitive and emotional variables driven by valuation of gains, losses, risks, and uncertainties. Let me give you an example, suppose individuals are given dollar 50 and a chance to gamble with it.

Now, if one has either a guarantee of keeping dollar 20 or a chance to gamble it all, what could be the choice. On the contrary, alternatively, if one has a guarantee of losing a dollar 30. A chance to gamble it all, will the choice be different from the earlier one. Most individuals prefer to gamble when faced with a guaranteed loss, even when the monetary consequences of the guaranteed options are the same, as in the two bets outlined here.

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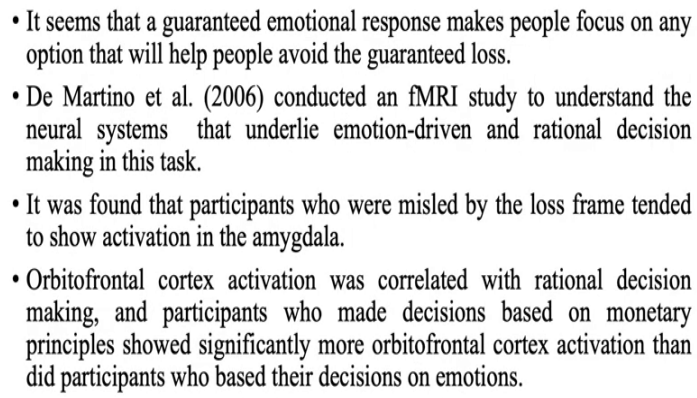

Now, it seems that a guaranteed emotional response makes people focus on any option that will help people avoid the guaranteed loss. People just want to avoid the guaranteed lose and take some other decision that sort of helps to gain another outcome.

De Martino and colleagues in 2006 conducted an fMRI study to understand the neural systems that underlie emotion-driven and rational decision making in this task. It was found that participants who were misled by the loss frame tended to show activation in the amygdala. Orbitofrontal cortex activation was correlated with rational decision making, and participants who made decisions based on monetary principles showed significantly more orbitofrontal cortex activation than did participants who based their decisions on emotions.

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- How are financial decisions made in the context of interaction with another person?
- Some research suggests that emotions may lead to decision making that is financially irrational, but beneficial for overall social reputation.
- One study observed decision making using the ***Ultimatum Game***. Here one player (P1) must split a sum of money with another player (P2). Now P1 has to offer a portion of the um to P2 and P2 must decide whether to accept or reject the offer. The offers may be fair, i.e. close to 50% for both or unfair, i.e. 80-20 or 70-30 split. However, if P2 rejects the offer, neither player gets any money.

Now, how are financial decisions made in the context of interaction with another person? Let us see, some research suggests that emotions may lead to decision making that is financially irrational, but beneficial for overall social reputation. One study observed decision making using the Ultimatum Game. Here, one player must split a sum of money with another player, let us say P1 and P2.

Now PI has to offer a portion of the sum to P2 and P2 must decide whether to accept or reject the offer. The offers may be fair like fifty to fifty-two both or it could be slightly unfair, let us say eighty, twenty or seventy, thirty split. However, if P2 rejects the offer, neither player would gets any money.

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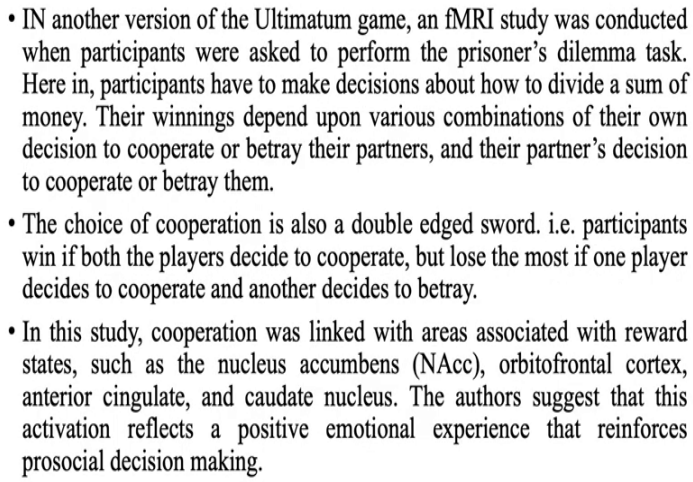

In another version of the Ultimatum game, an MRI study was conducted when participants were asked to perform the prisoner's dilemma task. Here in, participants have to make decisions about how to dividing a sum of money, Their winnings depended upon various combinations of their own decision to cooperate or betray their partners, and their partner's decision to cooperate or betray them.

The choice of cooperation is also a double-edged sword, participants win if both the players decide to cooperate, but lose if one player decides to cooperate and another decides to betray. So, in this study, cooperation was linked with areas associated with reward states, such as the nucleus accumbens. The orbitofrontal cortex, anterior cingulate, and caudate nucleus. The authors suggest that this activation reflects a positive emotional experience that reinforces prosocial decision-making. When you decide to cooperate, these areas as the brain would light up sort of and will basically make you feel better about the decision-making.

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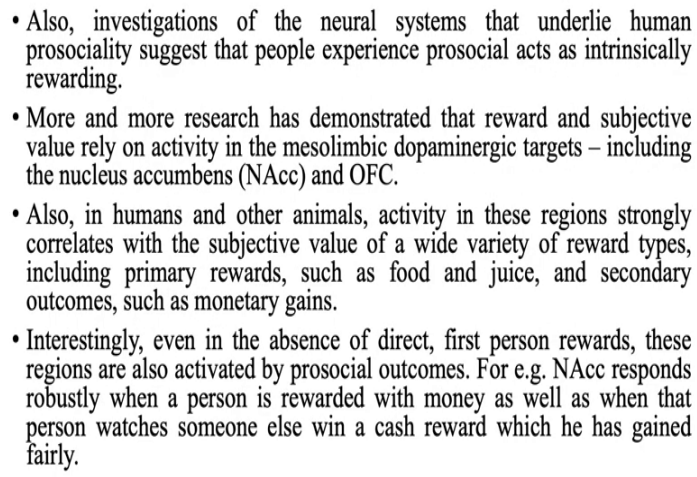

Also, investigations of the neural systems that underlie human prosociality suggest that people experience prosocial acts as intrinsically rewarding. More and more research has demonstrated that reward and subjective value rely on activity in the mesolimbic dopaminergic targets that is including the nucleus accumbens and OFC. Also, in humans and other animals, activity in these regions strongly correlates with the subjective value of a wide variety of reward types, including primary rewards, such as food and juice, and secondary outcomes, such as monetary gains.

Interestingly, even in the absence of direct, first-person rewards, these regions are also activated by prosocial outcomes. For example, NACC responds robustly when a person is rewarded with money as well as when that person watches somebody else win a cash reward which he has gained fairly.

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- Such evidence suggests that perceivers experience outcomes for another person to be rewarding in their own right.
- Also, similar patterns of neural response have been observed when one person agrees with others, suggesting that individuals experience interpersonal consensus as intrinsically rewarding.
- In both these activations were observed even though participants received no immediate reward other than the prosocial outcomes associated with positive social events.

Such evidence suggests that perceivers experience outcomes for another person to be rewarding in their own right. Also, similar patterns of neural response have been observed when one person agrees with others, suggesting that individuals experience interpersonal consensus as intrinsically rewarding. In both, these activations were observed even though participants received no immediate reward other than the prosocial outcomes associated with positive social events. So, this whole prosocial act already in itself seems to be rewarded.

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Moral Decision Making

- One of the interesting aspects in social behavior is the need to often make moral decisions.
- Several interesting questions can be raised in regards to moral decision making. For e.g. Which brain areas may be involved? Whether moral decisions are based on emotions or cognitive computations?
- Moral decision making is typically studied by posing moral/philosophical problems, and asking participants to make these decision, while their response times of brain activations may be measured.
- Let's look at couple of examples of such problems.

Now, let us talk about moral decision making, one of the interesting aspects in social behaviour is the need to often make moral decisions. Several interesting questions have been

raised in regards to how people make moral decisions. Say for example, what are the brain areas that are involved, whether moral decisions are based on emotions or cognitive computations and so on. Moral decision making is typically studied by posing moral or philosophical problems and asking participants to make a decision, while their response times of brain activations may be measured.

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Trolley Problem:

- In this problem, a conductor loses control of his trolley car, while you (the participant) are watching.
- As witness you can see that if nothing is done five people will be likely killed because they are directly in the path of the speeding trolley.
- But you have a choice, and you can pull a switch and divert the trolley on another track.
- This option however comes at a cost, one of ensuring the death of a single construction worker who is working on the alternate track.
- The dilemma is whether you pull the switch or not?

Let us look at a couple of such problems, first is the trolley problem. In this problem, a conductor loses control of his trolley car, while you as a participant is watching. As a witness, you can see that if nothing is done five people will be likely killed because they are directly in the path of the speeding trolley.

But you have a choice, and you can pull a switch and divert the trolley on another track. This option, however, comes at a cost, one of ensuring the death of a single construction worker who is working on the alternate track. So, the dilemma is whether you will pull the switch or not? Whether you want to kill one person or let five people die.

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- Another problem given is the ***Footbridge Dilemma.***
- Here you are standing next to a large stranger on afootbridge that crosses over the tracks. You see an out-of-control trolley speeding towards give people.
- This time, the only way to stop the trolley is to push the large stranger next to you off the footbridge onto the tracks to impede the movement of the trolley car.
- Would you push the stranger onto the tracks in order to save the other five people?

Another problem given is the Footbridge Dilemma. Here you are standing next to a large stranger on a footbridge that crosses over the tracks. You see an out-of-control trolley speeding towards five people This time, the only way to stop the trolley is to push this large stranger next to you off the footbridge onto the tracks to impede the movement of the trolley car. Would you push the stranger onto the tracks in order to save the other five people?

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- Most participants in such studies agree that while it is acceptable to pull the switch in the trolley dilemma, it is immoral to push over the stranger in the footbridge dilemma.
- Joshua Greene et al. (2004) suggests that we make different choices in the trolley and the footbridge dilemmas because the level of personal involvement in causing the single death differentially engages emotional decision making.
- More specifically, you still maintain a distance from the death of the construction worker in the trolley problem, but you are most closely involved in the death of an individual in the footbridge problem.

Most participants in such studies agree that while it is acceptable to pull the switch in the trolley dilemma, it is immoral to push over the stranger in the footbridge dilemma. Even though, if you see economically speaking the outcomes are very similar. Joshua Greene and

colleagues suggest that we make different choices in the trolley and the footbridge dilemmas because the level of personal involvement in causing the single death differentially engages emotional decision-making.

Say, for example, more specifically, you still maintain a distance from the death of the construction worker because you are just pulling a switch and the death is happening. In the footbridge problem, you have to yourself push the person down from the bridge to the tracks and it sort of your involvement is a little bit more. You will feel responsive causing the death.

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- Greene and colleagues conducted a series of fMRI studies that contrasted moral dilemmas involving high levels of personal engagement with dilemmas involving low levels of personal engagement.
- It was observed that personal and impersonal dilemmas were associated with distinct patterns of activation.
  - Impersonal dilemmas were linked with greater activation in the right lateral prefrontal cortex and bilateral parietal lobe, areas associated with working memory.
  - On the other hand, more personal dilemmas engaged regions such as the medial frontal cortex, the posterior cingulate gyrus, and the amygdala.
- These regions have previously been associated with emotional and social cognitive processes.
- It is therefore established that moral decisions are differentiated to the extend that we allow emotions to influence our decisions about what is morally acceptable.

References

- Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (2014) *Cognitive Neuroscience – The Biology of the Mind* .W W. – Norton & Company.

Now, Greene and colleagues conducted a series of fMRI studies that contrasted moral dilemmas involving high levels of personal engagement with dilemmas involving low levels of personal engagement.

It was observed that personal and impersonal dilemmas were associated with distinct patterns of activation. So, impersonal dilemmas were linked with greater activation in the right lateral prefrontal cortex and bilateral parietal lobe, areas associated with working memory. On the other hand more personal dilemmas engage regions such as the medial frontal cortex, the posterior cingulate gyrus, and the amygdala which are more about emotional processing.

So these regions have previously been associated with emotional and social-cognitive processes. We have seen about these regions in the earlier parts of the lecture. It is therefore established that moral decisions arc differentiated to the extent that we allow emotions to influence our decisions which is in more personal dilemmas, about what is morally acceptable. So, how closely or personally you take these moral decisions basically sort of decides how you will moral decisions.

So, I think we have come to the end of the course now. I think for the last two weeks of lectures, you have seen that I am given you a PowerPoint voiceover. We will if there is time to record these lectures in the normal format and update it on the website. At the moment you will just be able to access these PowerPoint voiceover lectures. I know that the exams have been postponed, so I still see that you can go through all of this material.

Send me questions if you have any and get the chance of participating in the test, whenever it is possible. Okay, thank you for attending the course. Thank you for paying attention to it hopefully and I hope everybody would have learnt something from this course. That’s all from me, that’s all from this course is end. Thank you so much and hopefully, everybody stays safe from this corona pandemic, thank you.