

## **Social Behavior and the Brain: An Introduction to Social Neuroscience**

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**Week - 04**

**Lecture – 17**

Hello and welcome to the course social behavior and the brain and introduction to social neuroscience i am doctor Ark Verma from the department of cognitive science at iit kanpur. This is the fourth week of the course and we are trying to understand how we represent and interact with social relations and other groups and this lecture specifically i am going to talk to you about the social neuroscience approach to investigating racial bias in the context of maintaining intergroup relations. Now, as we have seen so far, social neuroscience broadly refers to an integrated study of the brain and social processes which involves combining methods from both social psychology as well as neuroscience. If you take this perspective, neuroscientific models of brain organization and function are actually utilized to clarify and refine models of social cognition and an appreciation of the social structures, goals, motivations and relationships may be used to better understand the functioning of the brain. So, it is basically a two way street where understanding and interacting with these complex social stimuli should help us understand the functioning of the brain better in the sense for example, remember I have done this differentiation between cognitive neuroscience and social cognitive neuroscience a bunch of times where you are in cognitive neuroscience thinking of and you may correct me if I am wrong thinking of mental processes as operating in isolation and the stimuli being considered in isolation away from all the social baggage that they carry. But in social cognitive neuroscience or social neuroscience basically what we are trying to do is we are trying to understand the context of these stimuli, we are trying to understand the structure of the society, the goals, the motivations and the relationships between these various players and we are trying to put all of this together with understanding the functioning of the brain.

So, in that sense it may help us with get you know it may help us get better theories, it may help us understand some of these things relatively better. Now, one of the first questions that people have asked about intergroup processes has been addressed and that has been addressed from a social neuroscience perspective has been the idea to understand the mechanisms underlying implicit bias. Now, see that implicit biases exist is not new that implicit biases influence and you know moderate our behavior is also not new. And this is an old question that has been answered from cognitive psychology perspective from social psychology perspective a lot of times, but in social neuroscience again this question has been repeatedly asked and we will have try to answer this.

For example, initial inquiries basically concerned the role of the amygdala in implicit prejudice. So, people propose that amygdala is the region that is involved in this implicit evaluation and thereby prejudice against certain kinds of groups or certain kinds of stimuli for that matter. And what is this amygdala just to sort of remind you amygdala is this you know small collection of nuclei located bilaterally in the medial temporal lobes that has been implicated in classical fear conditioning also emotional learning and more generally in the processes of arousal and vigilance. Remember we have seen some of these studies where we see that looking at a face of a black individual or a male individual brings across effect of vigilance and that vigilance effect recruits the amygdala. So, we have talked about that in the previous lectures in much detail.

Amygdala also is a part of the brain's rapid response system that is activated and expressed within milliseconds of a potentially threatening you know event. So, if you come across a potentially threatening stimulus or a phase or an event is happening the amygdala is recruited rapidly and it is one of the first responders so to speak to any of these kinds of events. This mode of rapid response is made possible by the short distance that the incoming sensory information has to travel to the amygdala, because it is in the you know the medial temporal lobes it basically is you know very easily accessible through the thalamus which receives all the sensory information. For example, just to describe this in more detail, visual and auditory information is relayed by the thalamus via a single synapse to the amygdala for the initial processing, whereas slower and more elaborative processing continues in the background throughout the cortex. So, because it is so close to the thalamic structure which is basically a relay center for all the sensory information and you see it is just requires a single synapse, it basically requests and you can basically know that you know the time period for a synapse is very very low up to you know just a few milliseconds.

So, within a few milliseconds the amygdala gets the first you know news about this kind of stimuli so to speak and it can react and potentially moderate your behavior in that way at that kind of speed. So, this quick and dirty detection of you know any of these potentially threatening stimuli basically creates a very important mechanism for survival and why would we need this to happen quickly because yes these are things that we have you know inherited through millions of years of evolution and millions of years of evolution must have made us very good at detecting and avoiding threat, detecting and avoiding possible danger and this is where the amygdala is you know playing a very important role. So, this quick and dirty detection quality of the amygdala provides a very important mechanism for survival and at the same time the amygdalas response to particular stimuli sometimes is very resistant to change and it is prone to generalization as well. So, sometimes what you can do is remember if you seen you know Pavlovian experiments of conditioning where an individual is conditioned with let us say a shock when every time a white stimulus comes and then this response can be generalized to all

kinds of white stimuli. So, we have seen that in a first year psychology and it seems that the amygdala might be responsible for that kind of generalization.

Also note that the amygdala and the associated subcortical structures orchestrate and adapt, behave or orchestrate adaptive behavioral responses as well. So, while on the one hand they are allowing us to you know detect and respond to this they are also allowing us to adapt our responses. Such as inhibition, approach or withdrawal through multiple connections to the brain stem structures such as the thalamus, the hypothalamus, the basal ganglia and the medial prefrontal cortex. Remember these are the parts of the brain that are involved in regulation, response selection, response inhibition and so on. So, while at the same time while at one hand the amygdala is allowing us this quick and dirty detection and response mechanism, rapid response mechanism to threatening stimuli, it is also allowing us to choose the right kind of behavior to regulate or adapt our behavioral responses to these kinds of stimulations.

Initial fMRI studies provide a preliminary evidence for the link between prejudice and amygdala. So, some fMRI studies have actually also shown that there is some kind of link between prejudice and amygdala. For example, Phelps in the year 2000 found that the difference in amygdala activity you know in viewing black versus white faces was actually related to two other implicit measures of bias. So, on one hand you are seeing that this activity is getting moderate is you know in the amygdala is getting moderated by when a person is viewing a black face versus white face the degree to which this activity is getting moderated is linked to implicit measures of bias. Which were measured through the implicit associations test or the startle eye blink response.

What are these two tests? Very quickly let us look at them. So, the implicit association test is by the way a very common, a very widely used test. It is a behavioral task that assesses evaluative associations with any kind of stimuli black and white faces. For example, whether you have at the first positive impression or a negative impression of certain kinds of stimuli. Also, there is this another very interesting paradigm we will talk about this in more detail going forward the startle eye blink response.

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Lecture 17

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It is basically the response of how you know how much an individual is startled and gets this you know and generates this blink response when they are viewing certain kinds of stimuli.

And the degree to which they are startled the degree to which the blink response is there can be correlated to how deeply they were involved in processing certain kinds of stimuli or how positively or how negatively we will talk about that as we go ahead

Interestingly, just coming back to Phelps' study, they did not find a main effect difference in amygdala response to black and white and also Hart and colleagues also did not observe any race effect on the amygdala activity during the first block of trials, but found that gradually the amygdala responses to black faces habituated relatively more slowly.

So, the vigilance component sort of sustains for a longer period of time for stimuli that can be considered potentially threatening.

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So, the idea is it basically provides a physiological index of amygdala activity. So, for example, I will talk about this in more detail going forward, but just for the moment. It is basically the response of how you know how much an individual is startled and gets this you know and generates this blink response when they are viewing certain kinds of stimuli. And the degree to which they are startled the degree to which the blink response is there can be correlated to how deeply they were involved in processing certain kinds of stimuli or how positively or how negatively we will talk about that as we go ahead. Interestingly, just coming back to Phelps' study, they did not find a main effect difference in amygdala response to black and white and also Hart and colleagues also did not observe any race effect on the amygdala activity during the first block of trials, but found that gradually the amygdala responses to black faces habituated relatively more slowly.

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So, the vigilance component sort of sustains for a longer period of time for stimuli that can be considered potentially threatening. Now, these discoveries if you look at these bunch of studies encourage new and more research in the neural underpinnings of implicit and explicit racial biases and social psychologists have actually utilized models not only from human cognition, but also from animal cognition to ask some of these very fundamental questions about how these racial biases operate. For example, is implicit prejudice and emotional process that is fundamentally different from other types of associative learning. For example, semantic associations, fountain pen those kind of things you know when you associate two things and you learn them together. Or, can individual differences in amygdala responses to race explain why some self-avowed egalitarians show more implicit evaluative bias than others on behavioral measures? So, is there a difference in amygdala activity between different individuals? Is that what you know controls the individual differences in how people express or manifest their biases? Now, Amodio and colleagues in 2003 tried to address some of these questions by comparing the participants startle eye blink responses to black versus white faces.

More specifically, the authors identified participants who responded without prejudice for either personal or for normative reasons or for combination of these two reasons. So, for example, they were just looking for people who are responding without prejudice this could be because of personal reasons, this could be because they wanted to look good or this could be because of a combination of these two. Consistent with the previous studies that had demonstrated that although people motivated to respond without prejudice for personal reasons report explicit attitudes towards black people, those who also tend to worry about social pressures also showed higher levels of implicit evaluative bias than those who do not. So, interestingly what their studies had shown that people who are

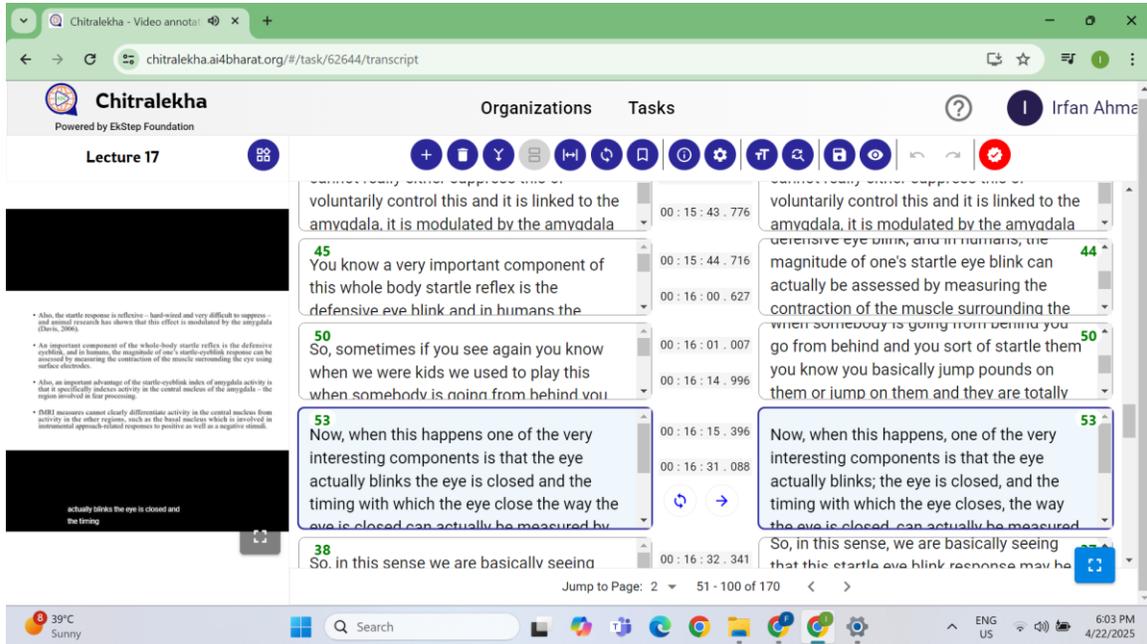
people are you know all the people who are motivated to respond without prejudice for either personal reasons they sometimes support explicit attitude toward black people. Also people who want to look very good people who want to project themselves as you know liberals and egalitarians sometimes also show the same degree of implicit evaluative bias as people who do not sort of you know carry on this kind of projection.

So, individuals with a combination of motivations you know who basically want to respond in one way, but they have an implicit attitude or implicit bias that is pulling them another way tend to get conflicted and you know tend to get sort of confused and they while they are can be you know explicitly egalitarian or liberal, but sometimes they are implicitly biased and some of these studies actually show that. Now, these authors they wanted to investigate whether this kind of conflict pattern could be explained by amygdala based processes related to the bias. So, does the amygdala activity predict somehow how conflicted will I be when I am looking at the faces or other similarly related to an out group as opposed to you know whether there will be no conflict and I will go along with whatever the implicit or the explicit attitude is saying. So, to assess the same they examined amygdala responses to black and white faces among participants who were motivated to respond without prejudice. So, they said that oh we do not want we do not want to be prejudice towards these black faces for any reason for that matter they chose to use the startle eye blink response as an index of amygdala activity, because it is capable of making temporally precise measurements compared with the relatively slow measurements the hemodynamic measurements that come from fMRI.

Now, we will just pay a little bit more attention to the startle eye blink response, because this will come again in future studies also. So, just we will talk a little bit about what this kind of response is about. So, first is that it allows a more precise measurement. It is something that happens quickly and it allows a very precise measurement of when a particular bias let us say is triggered. Also, since the automatic activation of raised bias operates within the first few hundred milliseconds, we have seen in previous studies, the Ito and Erlen studies following exposure of a target of bias, precise timing of measurement was extremely important for this particular study.

Also to elaborate just to describe this to you again the startle eye blink response works on the principle that people are more easily startled to a loud noise when they are in an aversive state and less easily startled when they are in an appetitive state compared with baseline. So, how do I explain this to you? For example, imagine that you are watching a horror movie and it is extremely dark and you know suddenly somebody may be a member of your family, may be a sibling, may be a friend has creepily put some kind of you know rope on your shoulders or some kind of a hand rests on your shoulder, if you are deeply engrossed in a movie and also it is a horror movie. So, you are in a slightly hyper vigilant state, you are in a in a terrified afraid state. In that state what happens is the eye blink response that will happen will be much larger, you the person will be startled to

a much larger extent. As opposed to if you are in a very happy state, if you are in a relatively a relatively happy state then if an unpleasant event happens or then if a event out of the blue happens then the degree of startle that you will experience that the degree of novelty that you will experience will be relatively lower.



So, the idea is that the eye blink response in negative states is much more than in positive states and we use this the experimenters use this particular property of the eye blink response to check for the presence of prejudice versus no prejudice. Also, some more things, the startle response is reflexive, it is hardwired, you cannot really either suppress this or voluntarily control this and it is linked to the amygdala, it is modulated by the amygdala which is what previous research tells us. You know a very important component of this whole body startle reflex is the defensive eye blink and in humans the magnitude of one's startle eye blink can be actually assessed by measuring the contraction of the muscle surrounding the eye using surface electrodes. So, sometimes if you see again you know when we were kids we used to play this when somebody is going from behind you go from behind and you sort of startle them you know you basically jump pounds on them or jump on them and they are totally shaken. Now, when this happens one of the very interesting components is that the eye actually blinks the eye is closed and the timing with which the eye close the way the eye is closed can actually be measured by placing surface electrodes on these muscles that are controlling the movement of the eyelids.

So, in this sense we are basically seeing that this startle eye blink response may be a very useful response to judge when people are in a negative state or versus where people are in a positive state. If they are in a negative state due to prejudice or due to some kinds of

implicit bias, you can basically expect more magnified eye blink responses versus when they are in you know relatively positive, relatively pleasant states because there is no bias involved. So, an important advantage of this startled eye blink index of amygdala activity is that it specifically indexes activity in the central nucleus of the amygdala, the region that is involved in processing of fear, the region that is involved in indicating how afraid a person is or vigilant a person is at that point in time. fMRI cannot really do this. So, fMRI measures have not been able to clearly differentiate the activity in the central nuclei from the activity in other regions.

So, all in all just based on the things that we just discussed, the startle eye blink method seems to be best suited for assessing amygdala activity associated with fear related processing. All right, coming back to the study now. In this study done by Amodio and colleagues in 2003, participants were made to view faces of black, white and Asian males and they occasionally hear a startle probe which is a very loud noise 96 decibels and a short blast of white noise which is just 50 milliseconds delivered through headphones. So, they are wearing headphones and they are seeing these faces the underlying idea as I just discussed was that if seeing a picture of a black persons face elicited negative effect the probe should elicit a stronger blink. So, whenever this sound comes the person will be startled you know in a much more stronger way when it occurs during the viewing of a black person's face versus if you compare this by when they are viewing a white person's face.

As expected the conflicted participants actually showed larger startle eye blink responses to black faces versus white faces than those who responded without prejudice for purely personal reasons. So, when you are conflicted when you are having this negative implicit bias remember these are all people who are responding without prejudice. Only what this you know startle eye blink response allows us is to basically uncover or detect the implicit biases. All of these people are motivated to respond without prejudice. This bunch of people who are giving this heightened startle response are actually people who are conflicted because implicitly they are being pulled on another direction and explicitly they want to go in a different direction.

And such a pattern emerged in eye blink responses occurring as early as 400 milliseconds following the onset of a face picture and was very strongly pronounced in responses that are happening after 4000 milliseconds, which is around 4 seconds of picture viewing. So, the authors could conclude that an important source of this conflict in these individuals was the automatic activation of the amygdala based effective associations with the black people. So, inherently due to baggage, due to learned association, due to repeated exposure, due to kinds of conditioning that you may call it. The amygdala is getting engaged when people are when these white Americans are watching faces of black Americans and this is just a paradigm example of how bias operates. You can extrapolate it to all other kinds of biases as well, but maybe not to that same strong degree as it is

happening in race because race seems to be a much more culturally and you know otherwise embedded form of bias.

Finally, the current study was became the first ones to demonstrate a significant increase in an index of amygdala activity in response to black faces compared with white faces across participant groups. So, remember we were saying that while there is these you know dual process applications while they say that yes there is this implicit biases that there are these implicit biases that affect people's behavior. We were saying in the previous lecture or probably earlier in this lecture that there is no hard evidence to support that you know the amygdala gets engaged or there is no hard evidence to say how does an implicit bias perform, but here is a very interesting paradigm that allows you to check for implicit biases. Further research has also sort of converged or provided very similar findings using a different methodology using the fMRI methodology.

Let us look at that. Cunningham and colleagues they circumvented the issue of slow timing in fMRI by presenting pictures of black and white faces to participants for only around 30 milliseconds immediately followed by a color shape. So, that the participants were not even aware of that they have seen such a face see you want to do it in an implicit manner you want you do not want the probes to be explicitly you know deliberated upon. So, you want to do it for a very short time you do it for a very short time just present it as a prime and then you present it a color shape. Participants task was basically to classify the shape as either appearing on the left or the right side of the monitor. So, it could be a lateralized kind of presentation.

The observers the authors observed greater amygdala activity associated with the presentation of black faces than white faces. So, even without awareness even without these faces entering awareness even without them entering the explicit set of knowledge they you can see that the black faces are moderating or you know modulating the amygdala activity. Also whereas, Amodio and colleagues established the automaticity of the effect by measuring the amygdala activity within few milliseconds of its activation even before deliberative control could be engaged. Cunningham and colleagues this study established automaticity by using rapid presentations of faces that they were you know that were actually intended to preclude control. So, this happens and only then control would get engaged, but you can see that there is a lot of activity happening here itself.

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00 : 22 : 42 . 050 Now, we initially said in the previous lecture that there are two types of implicit bias, implicit stereotyping and implicit evaluation of prejudice. 23

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*Are there different mechanisms for implicit stereotyping vs. implicit prejudice?*

- So far, we have reviewed studies investigating the neural basis of implicit evaluative biases, but few studies have examined implicit stereotypes.
- To elaborate, in social psychological literature, stereotypes refer to the cognitive component of racial biases and typically correspond to sets of trait attributes ascribed to a social group (Fiske, 1998).
- While, the notion of independent affective and semantic components of person perception has a long history in social psychology, previous work has highlighted that this distinction may be represented in implicit processes.

Now, this is so far talking about that there is an implicit bias and the implicit bias gets kicked in and to a certain degree we can say with some confidence that the implicit bias is probably you know under pinned by the activity in the amygdala. Now, we initially said in the previous lecture that there are two types of implicit bias, implicit stereotyping and implicit evaluation of prejudice. Are these two also different? Are there different mechanisms operating for these two? Let us look at that. In social psychology literature, stereotypes refer to the cognitive component of racial biases and they typically correspond to sets of trait attributes ascribed to a social group. So, typically this is something that you know, this is very much part of your explicit knowledge and it affects your behavior in likewise manner.

So, for example, biases against or stereotypes linked with black American faces like for example, gun violence, drug use, being good at sports for that matter positive biases as well all of them are you know parts of the cognitive component of this people know and reason and deliberate upon these things and this is how these things start affecting their behavior. Now, while the notion of the independent effective and semantic components of person perception has a really long history in social psychology, previous work has actually highlighted that this distinction may be represented in implicit processes as well. Research however, has not been able to advance a very important you know a very detailed theoretical framework to describe how do implicit prejudice and implicit stereotyping actually work and what is the nature of their relationship. Just to elaborate, several social neuroscience studies have suggested that implicit prejudice involves basic

neural systems for detecting threat and initiating rapid behavioral responses. On the other hand, implicit stereotypes work differently.

They involve relations between symbolic representations of abstract concepts and may actually function to bias judgments and to organize our behavior. Things like for example, we remember things that are confirming our stereotypes. A lot of studies in social psychology have shown that people remember things confirming to their stereotypes better. They process a stimuli confirming to their stereotypes better. So, there are two different things implicit stereotyping and implicit prejudice seems to work in slightly different ways.

Now, also note that this ability to form conceptual representations that is utilized by stereotypes is actually a higher order cognitive capacity and neuroscience research and conceptual priming also suggest that this type of processing is associated with the regions of the neocortex in the temporal lobe and the posterior left prefrontal cortex. Whereas, implicit affective associations actually rely on subcortical structures like the amygdala and the thalamus etcetera. Now based on literature from neuroscience it has been argued that implicit prejudice and implicit stereotypes do reflect distinct underlying memory systems that are expressed through different sets of response channels. So, it seems or it has been argued in you know bunch of social neuroscience literature that implicit prejudice and implicit stereotype also work differently and they are expressed through different kinds of response channels. For example, Amodio and Devine 2006, they demonstrate that IAT the implicit association test measures of evaluative racial associations.

You know when you ask people to deliberate and basically say what is this, you know how do you feel about persons of this other group in the absence of any stereotype content and they have shown stereotype associations in the absence of evaluative content. So, remember this is a very interesting example of what we call double dissociation. If you can observe one without the other and the other without the first one, then there seems to be a dissociation, there seems to be enough ground to assume that yes these two are different processes and have different underlying mechanisms. Also, the authors have shown you know of this study that the levels of implicit prejudice are able to uniquely predict participants effective judgments of black people as well as the distance for example, they decided to sit from a black students belonging in a row of chairs while waiting to interact with them. In the previous lecture I was basically trying to tell you how you know do these biases, how implicitly and even unintentionally in an unaware way they affect our behavior.

So, this is a very interesting example. The degree of implicit prejudice that you possess and if there is a way to measure it through the startle I blink response or through any other responses, they can actually be used to predict how you are going to interact or

react to people from the other group. For example, in the study this implicit prejudice the level of implicit prejudice was used to predict how far somebody will sit from a member of the other group. So, how far a white individual will sit from a black individual while they are still waiting to interact with each other. On the contrary, the participants level of implicit stereotyping actually predicted the extent to which they form stereotype consistent impressions of a black student as well as their expectations that a black activity partner how will they perform in you know in a test of academic skill in sports trivia and so on. So, again this is more part of your I would say explicit knowledge you know the whole idea of that I carry this stereotype about black people and that sort of starts collating my impression of how the black person would behave if I interact with them or how will they behave in my classroom or how will they behave when I am engaged in play with them and so on.

So, these findings are actually in confirmation with the idea that at implicit level of processing, prejudice and stereotype do actually reflect slightly different mechanisms. Now moving on, despite the attention that you know the neural mechanism of implicit prejudice has got, there is really you know little evidence for a neural substrate for racial stereotypes. So, implicit prejudice there is some literature there is some evidence, but for racial stereotypes there is relatively less data, less research. For instance, remember in the last week we were talking about ERP studies that Ito and Erlen did, we found that the ERP measures of attentional processes were contingent to stereotyping and categorization were activated as early as 200 milliseconds after the presentation of a face or even earlier actually. However, more research is needed, so we know that it happens quickly, but we do not know that what are the neural substrates that are specific to this kind of stereotyping such as for example, neural substrates you know implicit semantic memory have been described in some detail by Amodio and Devine.

These kind of studies actually they have this potential or they actually elucidate they actually demonstrate the potentially dissociable mechanisms that underlie implicit race bias and therefore, these studies can be used to refine the dual process theories account for how implicit prejudice and how stereotyping are acquired by a different modes of operation. See the way implicit biases are sort of acquired versus the way stereotypes are gained or inherited probably happens through different mechanisms and some of these experiments the studies that we are discussing or we will discuss later should actually be used to fine tune these theories and you know get a better understanding of how this really works. And a very important idea in, you know, implicit social cognition that has not really been investigated a lot concerns how do people acquire motor skills or procedural memory, you know, the process through which repeated motor associations also become automatized independently of explicit knowledge. So, here we can see that there is a bit of a, you know, analog, there is a bit of an analogy between learning and automatization of motor skills, you know, just like operating your keyboard, moving your

hands and so on, as opposed to how these biases are also internalized. So, neural mechanisms for procedural memory have been dissociated from those of explicit knowledge such that procedural memory is associated with activity in the basal ganglia whereas, explicit knowledge is associated with the activation of hippocampus.

So, given that we have this dissociation established, given that we have this dissociation of implicit memory and explicit memory established. And you may refer to the course on introduction to basic cognitive process where we have done memory in detail, you may go to the introduction to brain and behavior, we have done the neural underpinnings of memory again. And you will see that there are you know loads of studies that established that implicit memory is subserved by different regions, explicit memory is subserved by different regions and they play different roles, they manifest differently in different kinds of mental functions. So, given that we have established these two things, it also makes sense to establish how implicit biases and how implicit stereotypes manifest and are acquired and moderate our behavior. So, I will talk a little bit more about this in the next class. I am stopping here and we will try and understand how racial biases operate and ways to handle them in the next lecture. Thank you.