

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

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**Week - 02**

**Lecture – 07**

Hello and welcome to the course social behavior in the brain and introduction to social neuroscience. I am doctor Ark Varma an associate professor in the department of cognitive science at IIT Kanpur. This is week two and we are in the lecture seven of this week. Now we have so far seen this meta-analysis that you know the authors Zaki and Ochsner did wherein they were basically aggregating bunch of different kinds of studies in a two cross two sort of format. So they were looking at either direct processing or reflective processing and they are looking at either the self as a target or the other as a target. and they basically looked at a bunch of dependent variables in question where they were looking at emotions, traits, personality judgments, mental states, attributions and so on. Now on the basis of that we saw a bunch of things we saw that you know there is a certainly a large degree of overlap between areas of you know the brain involved when you are processing the affective states in self and in the others, but this you know this processing is moderated by the task demands, it is moderated by the mode of processing that is invoked and it is basically also regulated by this information that is spontaneously gained about the mental states and intentions of others.

Now from this lecture we are starting to you know evaluate another kind of stimulus, another kind of studies where we are going to be talking about how do we retrieve personal knowledge about others. So when you are looking at others let us say another person's picture or their you know their faces or say for example vignette about them, how do you retrieve information about them, how do you interact with familiar people versus people who you are not familiar to. For example, you are out there in the shopping mall, you are looking for something and you ran into a friend. How do you react then versus how do you react when you are seeing thousands of other faces who you do not really know about.

So, let us dive straight into it and let us try and understand how things are done with respect to retrieving personal knowledge, retrieving knowledge about familiar people as well as unfamiliar people. Now let us start with this the first piece of socially relevant information that we obtain about the other individuals is basically from viewing their faces when you are looking at somebody when you meet them first time you are trying to look at their faces trying to decipher oh whether this person is happy or not happy seeing me what is this person's intentions is are they you know. thinking to genuinely meet us,

genuinely congratulate us or they are you know have some other ulterior motivations behind their face. So, the face therefore becomes our entry point into the mental life of the other individual and that is why it is a very special stimulus, it is a very important stimulus and there is a very interesting you know observation by Leslie Brothers who says that the face is a special stimulus. It is a special stimulus because it is processed immediately and obligatorily converted into the representation of the person who the face belongs to even before reaching awareness.

So, it is not like you know sometimes you will hear people saying that oh you know I had I am getting good vibes from you, oh the energy around this person is great, oh the energy around this person is not great. I do not want to comment on you know the other aspects of what goes on in these kind of decisions, but certainly one very important aspect of these kind of decisions is how are you you know, what is the impression that you are forming of this other individual in question. Are you able to judge even before this has come to your awareness? Are you able to judge whether this particular individual bears good thoughts for you or negative thoughts for you? Whether this person is a kind individual at heart or is a mean person and the interaction is basically a manipulated interaction or not. So, these are some of the things that are automatically remembered. Ah face ah is is a very special stimulus socially relevant stimulus and evolutionarily also it carries a lot of weight you know we look at each other, we ah derive each other's ah intentions we decide to whether to work in cooperation or ah to not work in cooperation based on ah other than words just the face of the individual and their body language to basically estimate what they are feeling whether they are saying ah correct things true things or not.

So, this is a very interesting thing because just like words for example you do not have the choice to not read a word and you do not have the choice to not read a word if I show you a word you know you can see on the screen you cannot want to or you cannot you know voluntarily decide against reading a word if you know English and I have written here C A M E L camel you will immediately read it there is no it is not a voluntary process. Similarly, encoding or decoding information that is embedded in a face is a voluntary act is sorry is an involuntary act you do not need to decide oh let me process or not process this face you will automatically do it and you will have a sense of what the person is about even once you know having the first interaction with this individual. There is also very interesting you know point made by you know I think Marcel Proust in in one of these quotations. So, they have appreciated that viewing a person's face can be seen as akin to a very intellectual process you know it requires us to process ah the information that is embedded there in the face in great detail for example and there are there are so many attributes there is the physical outline of that individual our impression about that individual and our overall image of the individual you know whether you like the person or not you have you know ah many times might have heard of things like love

at first sight infatuation, attraction with certain people and sometimes you will have without even a fault of the other person a bit of a you know repelling feeling about the others may be you are not interpreting their intentions correctly, maybe you are misinterpreting their thoughts and so on. But it is again something of an intellectual act in the sense that you have to necessarily try and decode the information that is being provided to you in the face of the individual you are interacting with. And all of this sort of you know blends into the physical features of the face as well.

People who you think have good intentions for you or like you or have positive feelings and thoughts about you, you will automatically have more positive judgment about their face. For example, you might be inclined to say, oh, I think that this person is extremely beautiful. or I think that person's face is extremely likeable whereas people you don't like people you know that are let's say not good people or they have done something bad to you in the past. Sometimes you will even stop you know liking their face as well say oh when I see that face it sort of you know gives does not give me the correct vibes there is a lot of negative energy about this individual and so on those kind of metaphors are typically used based on your first you know phenomenal sort of judgment about an individual's face. So, again face seems to be a very very important stimulus that we process almost nonchalantly.

So, in this lecture we are going to try and study how faces or what you know in what way we process faces in some detail. So, yes face perception plays a very important and a multidimensional role in social communication. It seems to be mediated by a distributed neural system that includes a number of regions of the brain including face selective regions in the extra striate visual cortex which is designated as the core system and regions linked with other contingent functions such as emotions, action comprehension and person information. So, again when you are looking at a face there is the initial low level judgements that will be required, but then there are also cognitive judgements, intellectual judgements that you would be you will be making about the face and therefore, there will be other regions of the brain more cognitively you know relevant regions of the brain which will make these decisions for you. Now, in humans and other primates the neuroimaging of the brain in response to faces has been compared to other categories of objects and it has repeatedly implicated areas that show a stronger response to faces in comparison to let us say other kinds of stimuli like words or houses or other objects and so on.

So, it seems that the face being a very socially relevant and you know something that we have we must have evolutionarily learned since that it is a very important you know stimulus for us. There seem to be regions of the brain that are tuned to particularly respond to faces give a stronger response to face stimuli as compared to other kinds of stimuli. Now, what are these areas? Let us look at that. More specifically, in humans, the most important area implicated in face perception is the lateral fusiform gyrus, which was

also given the name the fusiform face area by Kanwisher in his 1997 paper. Now this fusiform face area has been deemed as a specialized module for perception of faces and that it is specialized or not is sort of you know has been debated widely.

So, there is again a large number of researchers which deem it the fusiform face area much like you know Fodor's module for face perception. But, there are also other you know arguments about the same which are for example, other accounts such as the distributed object form topography hypothesis. It states that faces and different categories of objects are represented by distributed and overlapping patterns of responses in the ventral temporal cortex. So, it seems so the distributed object form topography basically says that it is not only the fusiform face area, but a distributed bunch of regions which give overlapping pattern of responses and these regions are supposed to be found in the ventral temporal cortex. There is another hypothesis called the expert visual recognition hypothesis which also proposes that the stronger response in the fusiform face area might be driven by expertise you know over familiarity we have been seeing faces.

For you know millions and billions of years and it is this expertise that is coded encoded in you know our brain and it is not it is not you know it is not a special property of the face to be processed as such. It is because we have been processing faces for so long the brain has evolved into you know creating or dedicating these special regions for processing the face. Again whatever there might be let us let us get into seeing how phase processing is actually achieved because along with the fusiform phase area there are other regions also which have been implicated by the by neuro imaging studies wherein participants were looking at phases. For example, fMRI studies have demonstrated that other areas also respond selectively more to phases as compared to other objects. such as the inferior occipital gyrus the OFA and the posterior superior temporal sulcus which is the PSTS.

Also areas that are involved in cognitive functions such as other than face perception such as in emotion recognition or social cognition are also supposed to be involved in perception of faces. So, based on these observations, based on observation of a large number of regions implicated in phase processing, Haxby, Hoffman and Gobi proposed a model for phase perception which was inspired by a cognitive model earlier proposed by Bruce and Young in 1986. Let us look at this model. This is the model you can see this is this seems to be the core system as this seems to be the extended system. In the core system you can see that there is the inferior occipital gyrus the OFA which is involved in the early perception of facial features.

So, you know whether the face is symmetrical or not what is the you know complexion of the face and so many other things. On the other hand there is this superior temporal sulcus this region here it is involved in encoding face movement and changeable aspects of face. So, when I am talking to you my mouth is moving my eyes are moving I am sort

of you know also changing my expressions every now and then and these are supposed to be the dynamic features of face perception that seem to be mediated by the superior temporal sulcus. The third region which is actually your fusiform face area or the lateral fusiform gyrus, it seems to be encoding the invariant aspects of faces for perceptions of unique identity. Say for example, my face versus somebody else's face versus let us say your parents or your friends or your partner's face, those kind of invariant features of face say for example, there will be specific or unique markers on my face that will help you recognize me and differentiate or discriminate me from let us say another face that other ah face that you are just seeing.

So, that part seems to be mediated by the lateral fusiform gyrus or the fusiform face area. So, this here seems to be the core system. Then there is this other slightly extended system which basically might be getting recruited depending upon the task that we are asking our participants to do with as far as the phases are concerned. What are the regions here? The intraparietal sulcus, the precuneus, the superior temporal gyrus, the amygdala, the anterior temporal region, the superior temporal sulcus, the anterior parasyngulate and so on. And you can see here also that all of these faces are all of these regions of the brain are supposed to be recruited in specific functions.

For example, the IPS is recruited in spatial attention, the precuneus in retrieval of long term images. For example, if you are looking at a face you are recognizing oh this is my friend from school I have not met him from the past 5, 6 years and, but suddenly when you see them the all the memories and experiences with that person come back rushing to you. Then there is the superior temporal gyrus which basically links the face to the voice, the amygdala which helps you judge the emotion on somebody's face, the anterior temporal cortex which basically also has biographical knowledge related to the face of all person knowledge there, the superior temporal circus very important in judging the intentions of others whether I want to be friends with this person or just stay away and then there is the anterior parasyngelate cortex which is involved in the theory of mind and judging of the personal attributes of others. So, again this is a just a brief sort of overview let us dive in more detail and understand what these regions might be doing. So, a bit of a repetition I think the next few slides, but please pay attention.

So, it seems according to this model that phase perception is mediated by spatially distributed you know processes across different regions of the brain. The model divides the regions responding to the faces into two types of systems you just saw the core system which has three areas and the extended system which has a bunch of other regions. So, this core system seems to include the fusiform face area, the inferior occipital gyrus and the posterior superior temporal sulcus and this is supposed to encode the visual appearance of a face you know the first parts the first you know steps in processing a face. The FFA and the PSTS are proposed to mediate the encoding of two

broad classes of visual information about the appearance of the faces. So, the dynamic features and the invariant features and so that is that.

The screenshot shows a web browser window with a video player and subtitle list. The video player is titled "Lecture 07" and is powered by EkStep Foundation. The subtitle list contains the following text:

- 00 : 15 : 31 . 490
- 00 : 15 : 31 . 951 So, it seems according to this model that phase perception is mediated by spatially distributed processes across multiple regions. 24
- 00 : 15 : 40 . 938
- 00 : 15 : 41 . 676 The model divides the regions responding to the faces into two types of systems you just saw the core system which has three areas and the extended system which has a bunch of other regions. 35
- 00 : 15 : 52 . 065
- 00 : 15 : 52 . 765 So, this core system seems to include the fusiform face area, the inferior occipital gyrus and the posterior superior temporal sulcus and this is supposed to encode the visual appearance of a face you know the first parts the first you know steps in processing a 47
- 00 : 16 : 09 . 159
- 00 : 16 : 09 . 879 The FFA and the PSTS are proposed to mediate the encoding of two broad classes of visual information about the appearance of the faces. 24
- 00 : 16 : 18 . 002
- 00 : 16 : 18 . 262 So, the dynamic features and the invariant features and so that is that. 13

I just mentioned it. So, on the other hand there is this extended system. The extended system has been proposed to be recruited in concert with these other areas within the areas of the core system and to process information conveyed by a phase such as biographical information, direction of attention, emotion, intentions and so on and so forth. Again remember the recruitment of the areas in the extended system will basically be rather task dependent or context dependent. When you are just meeting and trying to recognize a person versus when you are trying to really get into a collaboration and you really need to sort of understand what is this person about and you are consciously reflecting on the person's identity. Now let's take this a little bit further I said in the beginning that there is supposedly a difference you know in two things when you are meeting familiar individuals when you are looking at familiar faces versus when you are meeting watching faces of people you have no idea about.

The screenshot shows a web browser window with a Chitrallekha video player. The video is titled "Lecture 07" and is paused. A transcript overlay is visible on the right side of the video player, showing the following text:

4 I just mentioned it. 00 : 16 : 25 : 539 I just mentioned it. 4

10 So, on the other hand there is this extended system. 00 : 16 : 26 : 379 So, on the other hand there is this extended system. 10

45 The extended system has been proposed to be recruited in concert with these other areas within the areas of the core system and to process information conveyed by a phase such as biographical information, direction of attention, emotion, intentions and so on and so forth. 00 : 16 : 29 : 161 00 : 16 : 44 : 308 39 The extended system has been proposed to be recruited in concert with these other areas within the areas of the core system and to process information conveyed by a phase such as biographical information, direction of attention, emotions, intentions, and so on.

20 Again remember the recruitment of the areas in the extended system will 00 : 16 : 44 : 528 00 : 16 : 51 : 912 19 Again, remember that the recruitment of the areas in the extended system will

At the bottom of the transcript, there is a "Jump to Page: 2" option and a page count of "51 - 100 of 171".

So, looking at familiar faces versus looking at unfamiliar faces they seem to be cognitive differences, neural differences and let us observe them going forward. So, meeting someone we know starts an interesting chain of events which involves activating and bringing into awareness all the information that we have about this individual, our past experiences and our overall impression of that person. FMRA research on familiar face recognition has focused mostly on the fusiform gyrus and the anterior temporal regions. Fusiform gyrus, anterior temporal region. However, the modulation of responses to the faces in fusiform gyrus has sort of you know at least based on familiarity has not yielded very consistent results.

So, different studies have come up with different kinds of insights about how the fusiform gyrus might be involved in looking at familiar faces. which seems a bit counter intuitive because it is a key area in the brain and so people have wondered as to why these inconsistent findings have been reported. So, let us look at this in some detail. So, the anterior temporal cortex has shown on the other hand we will talk about the ah inconsistent results in the FFA in a bit. Now, on the other hand the anterior temporal cortex has been shown to display stronger activation for a variety of familiar as compared to unfamiliar stimuli such as ah names, familiar landscapes and familiar faces.

It implies that this area the anterior temporal cortex may be playing a very important role in the retrieval of biographical or autobiographical information about the faces that you are seeing. Now, coming back to this point of inconsistent findings with the fusiform gyrus, different explanations have been offered. Let us go through them one by one.

Now, for the first part it has been opined that different experiments have used different types of familiar faces. For example, some studies have used famous familiar faces.

So, for example, pictures of Bollywood personalities or cricketers or other kinds of sports that you might be involved in politicians for that matter, whereas some studies have used faces of acquaintances. So, for example, faces of relatives, friends from college and so on. And in other case people have sort of you know induced familiarity just in an experimental setup you get the participant, you give them some behavioral training that you know you look at these 5 people or 10 people, this person's name is this, he does this, the qualities are this and you sort of give them this behavioral training for a let us say half an hour, one hour and so on and then you get the participant into the scanner using a watching these faces verses another class of faces. So, what seems to be happening here? So, what seems to be the problem here is that these studies that are trying to study the you know perception of familiar faces seem to have used faces that could be characterized by different types of familiarity. Remember the type of familiarity that you will have with a Bollywood personality or a cricketer personality or a political personality will be very different than the kind of familiarity you will have with let us say your family members.

And it will also be different with the kind of you know familiarity you will have with your friends. It will also be different with the kind of familiarity that you know with faces that you have just seen while walking into the experimental lab. So, obviously remember what we have been repeating through and through is that the human brain is extremely sensitive to context, the human the way the brain sort of acts, the way the brain recruits specific regions you know across the brain for specific task it is a) very sensitive to context, it is b) very sensitive to task demands, it is c) very sensitive to the exact dimensions in which the stimuli in question are differing from one another. So, you might be giving faces as you know target for perception, but if the faces are differing from each other in critical dimensions then obviously the way the fusiform gyrus for example will react will be different and that is probably one of the important reasons for the inconsistency that is being reported in literature with respect to watching familiar faces. There are other you know possible reasons as well.

For example, different experiments have been found to utilize tasks that have placed different demands on attentional resources. For example, recognition of a familiar individual goes beyond the visual representation of that persons face and it is therefore, possible that the fusiform face area may be influenced by top down modulation from the areas of the extended system. Now, remember the areas of the extended system are involved in paying attention, in inferring emotion, inferring mental you know states, inferring intentions and so many other things. Now, if you are watching the face of a familiar individual, suppose you are watching the face of a close family member who you have had a really bad fight with in the last week or so. When you are watching that face what are the emotions that are going to come when you are watching say for example

when you are watching that face it is not only the you know the peripheral or the you know superficial visual analysis that will take place it will basically bring to you as I said earlier a huge amount of data it will bring to you the intention of the person how the person is behaving in the past your impression of the person which is also rather dynamic I must say so again as I have been saying different kinds of experiments if they are placing different kinds of demands on the individual person then obviously the kind of activity that will be observed in the regions of the brain can be expected to be different which probably is causing some confusion amongst researchers.

Also, social psychological researchers you know have provided evidence for the automatic activation of traits and attitudes associated with perceived individuals. So, you know when you are perceiving the attitudes amongst individuals. So, the representation of significant others is found to be richer in terms of their thoughts, their feelings, emotions as compared to the representation of non-significant others. For example, you are watching the picture of your parent, you know, your mother or your father, of your sibling, your brother, your sister, of, you know, your partner, for example, or when you are watching at, you know, looking at the pictures of people who do not matter that much to you or people who you are not intimately familiar with. When you are watching pictures of people who you are intimately familiar with who you exactly know as family members and so on will bring you know an activation of the thoughts related to that person, the feelings related to that person, the emotions that these people evoke versus if you are just watching a picture of a random stranger obviously all of that rich information is not there since that rich information and since that you know over learned context is not there, obviously the regions of the brain will respond differently and which is what we see happening.

Gradually as people become more familiar with these other individuals, the inferences made about these individuals will gradually get more related to psychologically mediated variables such as you know goals and beliefs, oh I know this is my teacher, this is my student, this is my friend and so on. And to a lesser extent to broad uncontextualized traits such as oh it seems this guy seems aggressive or this guy seems friendly. You will see a lot of times people look at somebody's face and they say oh this guy has a mean face, seems to be very competitive, seem to be very rude. Oh if you do not know that person, if you do not have actual knowledge about that person's ambitions, mental states and so on, it is probably you know not correct to make judgments about how they you know what they might be feeling. So, once you know the person better you say oh I used to think that this person is a very rude guy, but it is just that he is slightly introverted or she is slightly introverted and does not you know open up very easily.

So, the degree of familiarity one has with the face in question, the type of familiarity one has with the face in question will evoke different kinds of knowledge about this individual that you will bring into play and accordingly your judgments about the person,

your overall impression about the person, your evaluation about the person and the neural regions involved in watching these other people's face will change accordingly. Now, the authors actually you know to basically investigate or to distinguish between these type of familiar faces they designed three fMRI experiments. And obviously, there were different participants in these three experiments and everybody just had to do this one back repetition detection task based on face identity. So, series of faces will come they have to remember the face which came just before the face in question. So, one back repetition you basically have to judge the identity, you know the consecutive images first face and so this is F1 and this another trial F1 is coming.

So, you consecutive pictures of the same person would come, but they there will be different images of this person. So, that you are just focusing on the face and not the visual characteristics of the stimulus in question ok. So, the task was based on the perceptual characteristics of these faces and it not really require the participant to pay attention to the person knowledge about these target faces to begin with. One of the aims of the task that I just described which is the same in three experiments was to induce equal attention to all stimuli without the explicit retrieval of information about the person. Hence, any effect of familiarity that you would now see would depend you know basically will signal the spontaneous retrieval of person knowledge when you see a face you remember everything about the person.

Spontaneously it is nothing in the picture itself that is asking you to do that. So, let us dive into this little bit more detail these three experiments I will discuss in this lecture to relatively you know lesser depth, but in the next lecture I will talk in much more detail about these three experiments as well. So, the three experiments just mentioned sought to explore different aspects of phase familiarity. For example, in the first two studies the authors investigated familiarity that accrues naturally with years of exposure in social interactions whereas the third experiment was designed as a control study for the first two studies to isolate the role of visual familiarity versus actual abstract familiarity from the role of person knowledge during face recognition. So, what is happening? In the first two experiment there are two kinds of familiarity that are being seen in one they are actually seeing ah pictures of ah you know ah family members I will describe this in more detail when we go ahead, but at this point just remember the first two experiment had naturally accruing familiarity.

So, people that you know from a long time either through intimate personal contact, pictures of family members or through a lot of mention in news and so on say for example, famous people you know Bollywood, politics, cricket, anybody who is more famous and you see their pictures virally trending on your social media those kind of pictures. And in the third study the familiarity is experimentally introduced by you know behavioral training that the participants received just before the main experiment began. So, you know you were shown a specific number of pictures you have said. this picture is

Rajesh, this is Ramesh, this is Ria, these are the characteristics of these individuals and so on, but this is something that is been just done hours ago probably minutes ago in the experiment. All three are familiar faces, but their degrees of familiarity and the kinds of familiarity you can see are actually very different.

So, in the first two experiments, the authors contrasted the hemodynamic or the bold response to different groups of familiar faces characterized by different social and emotional attachments as I was saying. So, in the first experiment, the authors compared the neural responses to personally familiar faces, faces of relatives and friends versus the neural responses to faces that are familiar because of media. So, politicians, actors, singers, athletes and so on. versus and they compared these two responses to faces of strangers. In the second fMRI experiment the authors actually recruited mothers and they measured the neural responses while they viewed pictures of their own children, familiar but unrelated children and totally unfamiliar children.

Here you can see there is a very interesting contrast that will come up. Finally, in the third fMRI experiment visual familiarity as I was saying was experimentally induced via behavioral training for a set of phases and then the neural responses were recorded for visually familiar phases versus novel a new list of phases or novel phases. Now, the results of these experiments actually demonstrated the modulation of activity by familiarity in a distributed set of areas including regions that have been associated with theory of mind task with retrieval of episodic memory and emotional response as well as in the you know features in the visual extracellular cortex in the fusiform gyrus. So, what did they set out to do? They set out to actually you know evaluate whether these different kinds of familiarity that are being observed you know induce the neural activity differentially and yes they found the fact that if you just look at the three experiments . How would mothers respond to their own children versus familiar but not their own children and totally unfamiliar faces? How would you involve, how would you respond to say for example pictures of Bollywood or media people versus pictures of you know your relatives and your family members? and lastly how do you respond to faces that you just become familiar with versus new set of faces.

So, these are the three kinds of familiarity that were manipulated and indeed these three kinds of familiarity affected the way the brain responded to these pictures. So, I will talk to you in much more detail about these experiments in the next talk till then good bye.