

Social Behavior and the Brain: An Introduction to Social Neuroscience

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Week - 03

Lecture – 13

Hello and welcome to the course Social Behaviour and the Brain, an Introduction to Social Neuroscience. I am Dr. Ark Verma, an Associate Professor at the Department of Cognitive Science, IIT Kanpur. This is the third week where we are trying to understand and represent social groups. This is the lecture 13 where we will talk about the representation of social category information through face perception. Now in the previous lectures we have seen that this human ability to perceive faces is absolutely impressive in the context of many different social inferences that humans need to perform.

Remember we have been talking about judgment of valence from faces, we have been talking about trade judgments from faces, so attractiveness, trustworthiness, you know responsibility, we have been talking about a bunch of these traits. We have been talking about enduring traits, we have been talking about you know dynamic traits. We have been talking you know a bunch about the information that the faces provide us. We have also been talking about how you know the first glance at a face can actually lead you know to degree of impression formation for a person.

Now something else is also important the information that the face provides is not only tied to the individual, but it is also tied to the group that the face represents or the group that the individual whose face it is comes from and this social category information is also a very important is also a very pertinent calculation that we are being able to do by just having a look at the faces. So, in this lecture we will talk in some detail about this idea and we will also talk in detail about how does this translate into or how quickly or how late or which areas of the brain are involved in making these judgments. So, just to sort of recap a very small glimpse at a person's face may allow us to gain information relevant to determining not only his or her emotional state, personality characteristics, but also identity and as we will see going forward their social category. So, face perception has been recognized as supporting inferences about social category membership also with information about an individual's race, their gender or their age usually very easily determined from their face in the first glance. all of these inferences as you may understand are integral to social perception but the computation of this social category information is also very critical aspect in determining our social behavior now just pay attention to this when you are talking about an individuals race when you are talking

about their gender when you are talking about their age remember that these are some of the factors that we you know consider while deciding how we are going to behave with that particular individual These decisions are not always explicit and strategized, but automatically for example, if you are interacting with a person, a person raises their voice or maybe some commits a mistake or maybe is nice to you, the way you will react to this person sometimes depends on their gender as well.

Sometimes say for example, if it is a female you know you might sort of go easy on the person and you probably ignore the first few times and then try and be you know chivalrous and kind about it. But if it is a guy, if it is a male who is misbehaving to you raising their voice then your reaction might be completely different. Cut to, for example, if it is a person from the same race, you know, it happens mostly in the context of, let us say, if you are an immigrant to a European country or the Americas, the way, you know, you will behave to people of your own race versus people of the other race might actually be very different. You know, people are much more informal and they are much more close or comfortable when they are interacting to members of their own racial group versus when they are interacting with members of another racial group. Also, age plays a very important part in determining our behavior.

The way you will behave with children versus with adults versus with the elderly also changes. Now, all of this information which is very critical for determining our social behavior is available to us in an instant through the first glance of the face. So, how does this happen? Let us try and understand this. Now, if you want to understand for example, how are we calculating all of this information from the individual spaces, a methodology is required that has a very good temporal resolution that allows us to compute that allows us to understand how quickly these decisions are being made. See from the last lecture and earlier also we have been saying oh this happens very quickly, this happens very quickly, but so far we have not or you know talked about the exact timeline, we have not talked about the exact temporal resolution of these decisions.

So, if you have to estimate the temporal resolution you have to use a particular tool called the event related potentials the EG or the ERP which will actually tell us in real time how these decisions are being made. So, the methodology that we are going to follow for this set of lectures is the ERP methodology. What is an ERP? I have talked about this in much more detail in the course on you know introduction to the brain, but let us just revise this for all of us and just to you know describe this to people who have not done that course. Now, ERPs are changes in the electrical activity of the brain that occur in response to discrete events such as presentation of a stimulus or execution of a behavioral response. You know, for example, if you are showing the person picture of a face, face, face, then a house or house, house, house, then a face, there will be a particular ERP response which is basically the summation of activity, electrical activity of the brain and you can interpret it against the stimulus event.

For example, if I were to give you a sentence Rajesh was spreading warm you know butter on the socks. Now as soon as I read on the socks there will be a negative ERP component at around 400 milliseconds which will tell you that the sentence that I have just said is semantically problematic. you know we know that bread is spread warm butter is spread on the bread, but not really on the socks. So, we know this we understand this anomaly we understand this incongruency and that leads us to giving a particular kind of response. So, ERPs are changes in this electrical activity of the brain they are basically coming out from these different regions of the brain summation of how these different regions of the brain are responding.

And, these a good thing about ERPs is that they can be recorded non-invasively from the surface of the scalp and they are thought to you know reflect as I said summated post synaptic potentials from large sets of neurons from a particular regions of the brain and these neurons which are firing synchronously in the different regions of the cerebral cortex. now this recorded electrical waveform is a time by voltage function composed of a series of positive and negative fluctuations and these time logged deflections in this waveform are known as components. So, if I was telling you that if you come across this you know semantically problematic sentence Ram was spreading warm butter to my socks it will lead to a particular negative component and in the ERP scale negative is on the top positive is on the bottom and basically this x axis has time as a factor. So, it will peak around 400 milliseconds and this negative peak can be identifiable every time this kind of semantic anomaly emerges and this particular peak is referred to as a component there is a waveform waveform waveform, but if a particular waveform peaks or you know decreases in response to a particular stimulus event then that is called a component. Now, you should have understood that ERPs are a very interesting tool to study cognitive functions and their importance in studying the psychological processes mainly derived from the association of these individual ERP components with distinct type of information processing operations.

This N 400 happens in response to when you detect a semantic anomaly. Similarly, a positive 600 you know peak happens in response to when you detect a grammatic or syntactic anomaly. And similarly, there can be any number of components that respond to specific type of information processing mechanisms or information processing decisions that your brain is taking in response to the stimulus that is it is being presented with. So, the component amplitude is thought to reflect the extent to which the associated psychological operation has been engaged. So, the amplitude basically gives you the strength, the timing on the x axis, the latency gives you the time at which the particular process has been engaged.

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See social cognition happens at a very dynamic at a very rapid scale and in that sense if you want to understand how these functions are happening and how these functions are happening on top of the ah typical non social aspect of cognition you will need to be careful with understanding the chronology of these things the temporality of these things and there is where the ERP is actually serve as a very important tool. 77

So, ERPs have been examined in response to a wide range of psychological operations providing a large corpus of research from which to draw in linking observed electrical activity to its assumed underlying psychological meaning. 35

Why this particular component is erupting? 6

How is this particular component indicating the actions that are going on in the brain? 15

Also, the tradition of using ERPs to study cognitive processing has resulted in the 34

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So much about the ERPs there are also advantages of using ERPs to study the phenomena in social cognition. See social cognition happens at a very dynamic at a very rapid scale and in that sense if you want to understand how these functions are happening and how these functions are happening on top of the ah typical non social aspect of cognition you will need to be careful with understanding the chronology of these things the temporality of these things and there is where the ERP is actually serve as a very important tool. So, ERPs have been examined in response to a wide range of psychological operations providing a large corpus of research from which to draw in linking observed electrical activity to its assumed underlying psychological meaning.

Why this particular component is erupting? How is this particular component indicating the actions that are going on in the brain? Also, the tradition of using ERPs to study cognitive processing has resulted in the association of you know functions like attention and memory which are also useful to understand the aspects of social behavior. Again, remember social behavior does not happen in isolation, it happens in context, social cognition cannot operate in isolation also, it happens with the help of know these abilities such as attention perception and memory and if you are using ERP we know that which components sort of you know erupt with different kinds of moderations of attention or different kinds of processes in memory say for example encoding and retrieval and so on and when you put them together in the context of a social event taking place then you can actually connect this whole thing and make sense of ok this particular social cognitive operation was carried out with respect of attentional orientation or encoding in memory or retrieval from memory and so on.

Let us take an example of this. For example, the components that are sensitive to covert orienting processes such as N100, P200 and N200 can be utilized to assess attention to social cues. How are we paying attention to social cues? For example, faces, how are we paying attention to the change of expression on somebody's face? How are we orienting to that? Does that recruit our N100 or P200 component does it tell us that oh our face is orienting attention towards that aspect of the face. Also several components have been associated with processes for behavioral control. For example the N200 and N400 that I was just describing and they can also be used to examine how social behavior is regulated and the components associated with attitudes and affective processes.

The screenshot shows the Chitralekha application interface. At the top, it displays the time (5:56 Fri, Apr 11) and the user's name (Irfan Ahma). The main content area is divided into two sections: a video player on the left and a list of notes on the right. The video player shows a man speaking, with the title "Lecture 13" and a play button. The notes are organized into a list with timestamps and a search bar. The notes include:

- For example the P300 it can be used to understand attitudes and affective responses towards other people.
- So, all of this sort of again remember these components are indications of how the brain is performing a particular operation, and it is not that these operations are happening only in an exclusive context.
- You may observe these components contingent to aspects of social information processing as well and you
- Now, there are also by the way components that are uniquely associated with social processes and these also have
- For example, the structural encoding of conspecifics of let us say about a person have been associated with this N 170 component.
- So, while there are components that are

For example the P300 it can be used to understand attitudes and affective responses towards other people. So, all of this sort of again remember these components are indications of how the brain is performing a particular operation and it is not that these operations are happening only in a exclusive context. You may observe these components contingent to aspects of social information processing as well and you may use the prior knowledge about oh where does this component typically appear to interpret why this component has appeared in face of this particular social decision that your brain is trying to make. Now, there are also by the way components that are uniquely associated with social processes and these also have been identified. For example, the structural encoding of conspecifics of let us say about a person have been associated with this N 170 component.

So, while there are components that are common to both social and non-social cognition, there are also components that are unique to social cognition which we will talk about as we go ahead. And as I have already said the high temporal resolution offered by ERPs allows the researchers to access processes that occur very quickly after stimulus presentation and facilitate the inferences about the time course and ordering of mental operations or the chronology of mental operations as I am saying. Now, given this high temporal resolution ERPs can also provide access to complex mental phenomena about which participants may themselves be unaware. A lot of decisions you know a lot of say for example, you are talking about you know amnesic patients, Korsakoff patients who will have the effective impression of somebody's face even though they will not have an explicit memory of whether they know the person or they do not. So, sometimes these things happen even outside a person's awareness and ERPs are a very interesting, a very important tool to give us access to that kind of information.

For instance, while we are perceiving persons, it is not necessary that we are explicitly aware of all aspects of this person's identity, all aspects of person perception, we might be also operating upon subliminally shows ideas or impressions of this person. ERPs also do not need to be explicitly tapping into processes under awareness and that sense just extending the previous point they are a useful tool to measure socially sensitive topics such as processes related to stereotyping and prejudice. Now, this is a bit of a touchy topic, but let us say for example, you know you as a person are prejudiced against a certain group. And all of us know that you know being prejudiced against others or stereotyping others is a bad, is a negative phenomenon. So, if I just come with my pen and paper to you and ask you questions about oh do you like these group of people or you not like these group of people, it is highly likely that you will say yes, yes I like this person, but inside this idea of prejudice and you know in some cases discrimination, hate etcetera might still be present.

So, if you really want to study what are the inherent attitudes or effective attitudes of people, you might want to use something like an ERP which will basically give a response that is subliminal under your awareness, but is still going to moderate your behavior towards stereotypes or prejudice individuals. and that ways ERPs you know are a breakthrough sort of component which must be used which allow you to sometimes go beyond these questionnaires and study how people are having these attitudes towards other groups. Now, ERPs they have a low spatial resolution, they do not tell us exactly which regions in the brain are involved in these activities and therefore, ERPs have been used in combination with for example, fMRI and PET and in combination of these they are also able to tell us a little bit about the neuro anatomical location from where these activities or where these components are actually emerging. So, again enough about the ERP and enough about the merits of ERP in social cognition. So, total or together these

factors make ERP is an excellent candidate for studying several aspects of social cognition as we are going to see in the next few slides.

Now let's talk about social categorization as I said competition of race, gender, you know age are some of the factors that are very critical in determining our social behaviors towards others and this is something that people have said is processed automatically for all of these dimensions. However, interestingly researchers have not been able to examine this computation of social category information directly or even while using more implicit kind of task or implicit you know aspects of stimuli. Why has that happened? One reason might have been that these previous studies have typically relied on indirect information using the fact that a stereotype and has been activated or that prejudice has been displayed as evidence for social categorization. So, you can do an approach avoidance task, you can do a task where you are asking people to fill some questionnaire or reacting to something. And, that aspect you can use to infer that oh because of these kind of reaction time patterns, these kind of responses in the survey, prejudice must have been activated or social categorization must have taken place.

A more direct, a more concerned way of doing this could be to imagine to is to basically examine the activity in the brain contingent to the stereotyped stimulus and that is what ERPs will allow us to do. and these measures provide information about aspects of social categorization as well, but assessments of these explicit categorization they sometimes have this possibility of leaving out several under addressed or unaddressed aspects of category perception. Remember category perception or how you react to specific groups is all a not under your awareness and b a lot of times people actively try to control and suppress a bunch of these information. If you are using these indirect methods we might be leaving out significant chunks of how to understand or significant chunks of the mechanisms that are recruited here. So, the ERPs therefore, and again repeating what I have already said are well suited to examining the issues related to social categorization even at the indirect implicit levels and this is what we are going to talk about today.

So, let us take the first very important study Ito and Erlin 2003, here in primarily white participants were presented with faces of black and white males and females, all participants were explicitly instructed to attend to social category information although they were randomly categorized into making judgments about gender or race. So, one group did male versus female, one group did white versus black those kind of judgments. Now, when they did this task they discovered four very interesting waveforms that responding to distinct deflections. the first component was the n one hundred component it is a negative going component with a mean latency of around hundred and twenty two milliseconds after phase onset the p two hundred component is a positive component with a mean latency about hundred and seventy six milliseconds the n two hundred component with a mean latency of around two hundred fifty six milliseconds and the p three hundred component which is a positive component having a mean latency of about four hundred

eighty five to five hundred milliseconds Now, these are the four very interesting components that have emerged. Let us try and understand in response to what these things come out.

Now, in line with the assumption that social category information is processed automatically, RACE quickly modulated attention and it showed its effects in the N 100 component which were found to be higher for blacks rather than whites. Remember these are all white participants when they are looking at these black faces this N100 component is being seen and it probably reflects the computation of you know same race or different race. Similarly, in the P200 component more attention was paid as manifested in the larger P200 to blacks than whites. So, again a race sensitive component is the P200 component. Interestingly, gender computation does not affect the N100, but it modulated the P200 component wherein the responses were slightly larger to males than to females.

The third component that they found was the N200 component, which actually manifested in both race effects and gender effects. So, but interestingly the direction here was reversed. So, the N200 was larger to whites and females as opposed to opposite categories respectively. So, here you can see while the first two components are responding to differences and discriminations, this particular component is responding to sameness. Now, as all of these early components are associated with attentional selection, these results indicate initial greater attention to the blacks and males was given and later greater attention to whites and females seem to have been given.

Why is that happening? Let us wonder at the reasons. Greater attention to blacks initially from the white participants may actually reflect a vigilance effect with participants initially orienting to stimuli that are novel or different and or associated with slightly relatively more negativity from either personal or cultural beliefs. Now, this is something that I will request you to take with a pinch of salt, but also try and understand more deeply. What we are seeing here is that the brain is responding to the people from the other race, here white participants are responding to black participants and it is this response is coming very quickly it is happening in the first 100 milliseconds or so. Why is this coming? The authors say it could probably be reflecting a vigilance effect.

Where does vigilance come from? It comes into play with stimuli that we consider as emanating some sort of threat, some sort of discomfort, some sort of difference. And again this is the brain which is doing it without people actively or voluntarily or strategically responding. This is something that is just happening. So, you can see here this is probably an outcome of either individual or personal bad experiences or also the stories that are carried in the society that you know and it is sad, but certain racial groups, certain ethnic groups have been linked with either positive or negative narratives. and you can see here that if these negative narratives are there and if they are bearing on your

mind they can actually affect how your brain response to individual instances from these groups ok.

Again as I said take this with a pinch of salt and we will talk about this later as well. In the same way males may be more strongly linked with power and agency and initially therefore, they trigger greater vigilance than female faces. See the male agent is typically seen as agent of force, agent of physical strength and the physical strength unless explicitly stated can be treated both as a friend or a foe. So, therefore, even the males are exhibiting slightly a male faces are exhibiting a slightly heightened vigilant response that is being seen in the P 200 component as opposed to the female faces. Also, the time course of these effects is in line with several other ERP studies that show that effective modulation happens as early as around 100 milliseconds.

Now, remember we are talk we constantly talk about stimulus processing, we talk about the chronology of stimulus processing, but here you are seeing that social narratives, social aspects of stimuli actually are involved at the earliest stages of stimulus processing. they are not waiting that oh you first understand that this is a phase that this is a phase of a black person or a male or a female and after that you bring in your social knowledge and after that that will modulate your brains activity, no the brains activity starts modulating how you are perceiving the phase in the initial first 100 milliseconds of stimulus presentation itself. So, again this is where and I have been saying and I will keep saying in this course that understanding and interpreting of cognitive functions must happen or must be entertained or understood in the context of these social factors. Now as the faces in this study were viewed in a mainly passive viewing context, initial visual processing would not reveal any continued threat. However, as processing continues attention may begin to orient to other categories of individuals typically associated with deeper processing.

Now these are the initial impressions, these are initial automatic impressions that are manifesting in the form of these components. After a while you understand oh I am in an experiment and then sort of a kind of a moderation appears that oh this person is not actually threatening or this physical you know the male face is not actually implying physical force and so on. And therefore, once you give time to the system it settles down and it engages in more deeper processing. For instance for race, in-group members are processed more deeply than out-group members. So, see this is the other kind of studies that come through.

In-group members are processed more deeply than out-group members and that is why they moderate the larger N200s to the whites as opposed to the blacks. In the same way when there are differences in the depth of processing for male versus female targets, they are more often in the direction of greater attention to females than males. Remember a bunch of these participants were white females. Now, the idea that the N200 reflects

greater depth of processing is in line with the extent research that demonstrates larger N200s to familiar as compared to unfamiliar faces and to one's own face as compared to faces of strangers. Not that these results, I mean these results are not entirely out of line, they are actually confirming a bunch of findings that have already been reported.

Now in addition to components sensitive to attention, Ito and Erland also examined this P300 component which is thought to be reflecting updates to working memory that serve to maintain an accurate model of the external environment. Now remember all of these stimulus processing does not happen in isolation, it basically needs to be updated to the memory, the memory tells you how do you strategize or how do you regulate your behavior and in that perspective the P300 is a very important component that continuously wants to update the status of the external environment, so that it modulates your attention, your intentions, the way you are going planning to interact with this world. So, this P300 amplitude is found to typically increase as a function of the discrepancy between a given stimulus and the preceding stimulus, how is the environment changing. So, if a preceding stimulus is a black male versus the next stimulus is a white female then obviously the P300 component will be slightly higher and it will signal to you that the environment has changed now and the strategies needed to be you know to be operational may now be different than in the previous section. Again remember however these things are happening at a very rapid time scale.

5:47 Fri, Apr 11

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Lecture 13

00 : 27 : 17 . 445 Again remember however these things are happening at a very rapid time scale. 13

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00 : 27 : 22 . 670 Now, to allow an examination of how social category affects working memory, stimuli were systematically varied, they sort of mix them well, so that the responses could be analyzed not only terms of race and gender of the target picture, but also in terms of race and gender of the face that comes before it. 55

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00 : 27 : 42 . 954 In line with the past research for example, Donchin's 1981 paper, P300s were found to be larger when a target individual social category membership differed from the preceding individual social category on this task relevant dimension. 36

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analyzed not only terms of race and gender of the target picture, but also in terms of race and gender of the face that comes before it. And what did they find? In line with the past research for example, Donchin's 1981 paper, P300s were found to be larger when a target individual social category membership differed from the preceding individual social category on this task relevant dimension. What is task element? Remember, half of these people were making gender decisions, half of these people were making race decisions. So, if the current stimulus in consideration is male and previous one was female, is black and previous one was white, in these situations you will see a heightened P300 response. Comparable effects occurred for participants when they were categorizing faces in terms of face.

This result confirms past findings that this P300 component involved in working memory processes that are sensitive to social category dimension along which explicit categorization was also happening. So, it is a component that is implicitly sensitive to social category decisions that are being made. Also, as expected based on the implicit attentional effects seen in the earlier components, the implicit working memory effects were also observed. The P300 amplitude increased when a target's picture differed from the individual's picture in the preceding trials along the task irrelevant dimension as well. For instance, for participants categorizing faces in terms of gender, P300s were larger to a black face presented after a racially incongruent white face related to when it was presented after a race-congruent black face.

It is sensitive to the congruency information not only on task relevant, but also task irrelevant dimensions. So, this is what I wanted to say and I hope you sort of made sense of how social category information is being factored in and how it is factored in almost automatically at very early stages of stimulus processing and how it may you know moderate our social behavior going forward. Thank you, I will see you in the next class.