Social Behavior and the Brain: An Introduction to Social Neuroscience
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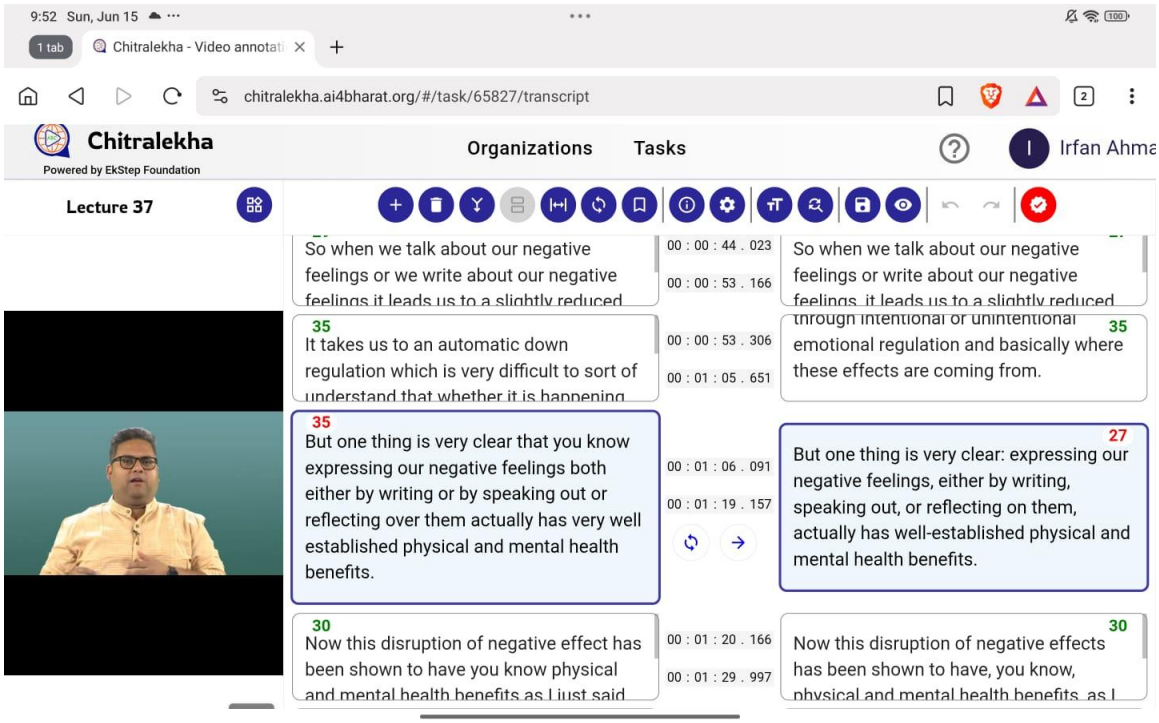
Week - 08
Lecture – 37

Hello and welcome to the course social behaviour in the brain an introduction to social neuroscience. I am Dr. Ark Verma an associate professor in the department of cognitive science at IIT Kanpur. This is the final week of the course we are talking about social affect processing and we are trying to understand the neural underpinnings of emotional regulation in this lecture. Now in the previous lecture we were discussing about the fact that verbalizing one's emotions and feelings especially negative ones actually may lead to a diminished experience of the same. So when we talk about our negative feelings or we write about our negative feelings it leads us to a slightly reduced you know intensity of that experience.



It takes us to an automatic down regulation which is very difficult to sort of understand that whether it is happening through intentional or unintentional emotional regulation and basically where these effects are coming from. But one thing is very clear that you know expressing our negative feelings both either by writing or by speaking out or reflecting over them actually has very well established physical and mental health benefits. Now

this disruption of negative effect has been shown to have you know physical and mental health benefits as I just said and has been utilized in several therapeutic approaches. In this lecture we will try and understand the possible neural mechanism for how this is happening.

Now Lieberman proposes the area of the brain called the right ventrolateral prefrontal cortex as playing a central role in this neurocognitive mechanism that governs a set disruption of negative effect through the process of verbalization. The RVL-PFC, that is how we will refer to this from now onwards, the RVL-PFC has long been associated with inhibitory processes and has also been identified in large number of studies examining the symbolic processing of effect. Now what is this symbolic processing effect? We will talk about this going forward also but the idea is when you are you know verbalizing something you are basically giving words you know in the process of speech production if you have done my course on psycholinguistics when we talk about the fact is when you conceptualize from the process of conceptualization to lexicalization When you are putting pre-verbal thoughts into words, you are basically looking for words, you are concretizing something that is amorphous, that is just at operating at a phenomenal level and once you are making that connection, it is reducing the intensity of those feelings. Remember what James said, what Benedict Spinoza said and so many others. So, the right ventrolateral prefrontal cortex has actually been associated with a large number of studies which have been involved in examining the symbolic processing of effect.

So, symbolically you know transforming or transforming into symbols what was just a physiological feeling or you know a cognitive feeling of sadness or anger or anything like that. Now, given the fact that the RVL-PFC is involved in both of these roles, inhibitory processes and regulation and symbolic processing of effect, according to Lieberman this makes RVL-PFC as a real candidate for you know driving these disruption effects. As these disruption effects appear to derive from the symbolic processing of effect which may be leading to the inhibition of effective processing. So, the idea that is being presented here is that it is you know the we were trying to see you know whether intentional or unintentional emotional regulation is happening, but the hypothesis that is put forward by Liberman is the fact that these negative effect or the disruption of this negative effect is happening due to the fact that we are symbolically processing effect and how or what is helping us symbolically process effect is this right ventrolateral prefrontal cortex. this is basically the area that we are talking about here.

So, you can see that there is a huge overlap between the areas for intentional regulation as well as the areas for affect labeling and this has been found in several studies. So, there is a large number of studies that you can basically see have actually found the same kind of you know findings. Now while there seems to be you know in ongoing discussion about the neural regions that are involved in inhibitory processes, if you you know look at them the the prefrontal cortex as a whole, the dorsolateral prefrontal cortex, anterior cingulate,

you know the RVL, PFC etc. There are so many of these you know areas of the frontal cortex that are involved in emotional regulation, all kinds of inhibitory processes. But typically the right ventrolateral prefrontal cortex is something that comes up in anybody's imagination of what the important areas for inhibitory control are.

So several neuroimaging studies using for example the go-no-go task or the flanker task or the stroop task have actually identified the right ventrolateral prefrontal cortex activations associated with trying to inhibit a prepotent motor response or trying to ignore task irrelevant information. That would lead to an incorrect response. So, the role of the RVL-PFC in inhibition is very well established across different kinds of you know studies using different kinds of experimental paradigms. Also, these tasks have found that the RVL-PFC activity is linked with faster reaction times on inhibition trials. So, when you are able to successfully inhibit you know irrelevant responses and for more successful inhibition trials than unsuccessful inhibition trials.

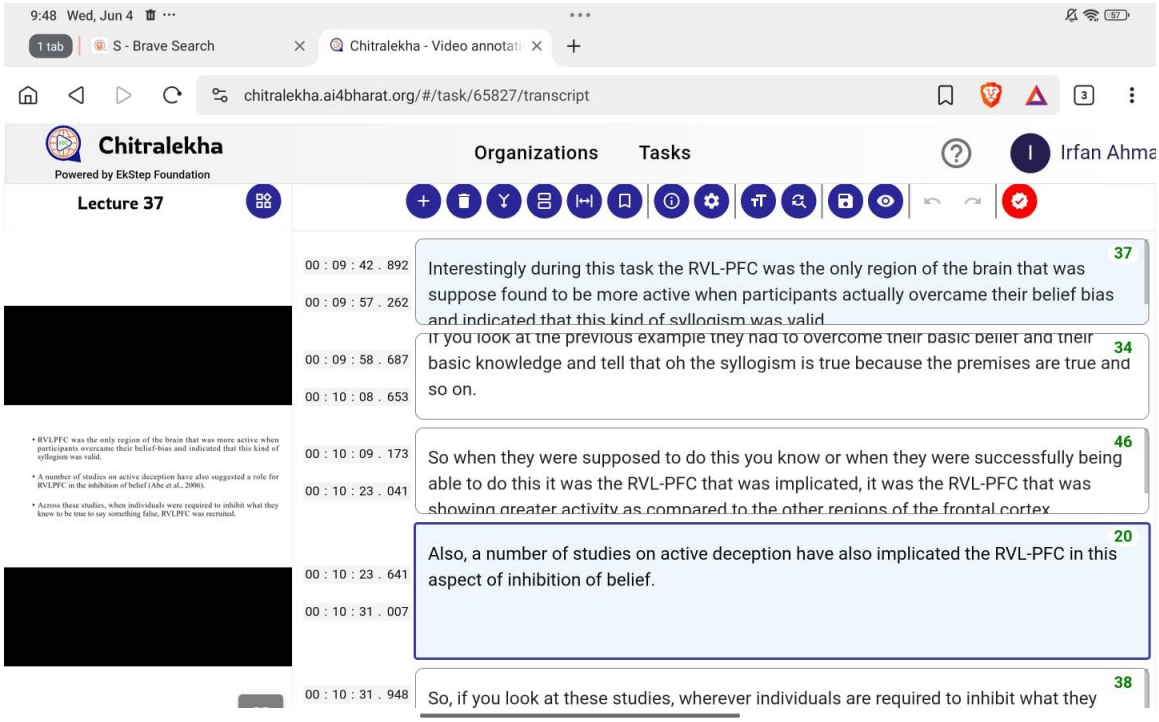
Also, RVL-PFC activity has been found to be greater for harder inhibition trials. It seems that the area is putting in that much more effort as compared to easy inhibition trials. So, if you look at these studies, it seems that this area is certainly involved in emotional regulation or inhibition of emotional or affective or task-irrelevant information. Also children with attentional deficit hyperactivity disorder typically show impaired behavioral performance on motor inhibition and also show right you know less RVLPFC activity during inhibition tasks than controls. So there is some you know data some of this data that is coming from patient studies as well.

For instance in one of the studies you know the experimenters observed better motor inhibition in an ADHD sample after neurofeedback training also correlated with increased RVL-PFC activity relative to a sample that did not receive such training and who did not receive you know who did not report higher RVL-PFC activity. Also, studies which are you know documenting effects of permanent lesions or temporary lesions through TMS in the RVL-PFC have also led to impaired motor inhibition. So, the specific type of inhibition that the RVL-PFC seems to be linked with is motor inhibition, but again this may have other consequences as well. Also, pharmacological studies, you know, when you use certain kinds of drugs, you know, so pharmacological studies wherein participants receive serotonergic agonists, you know, that, you know, disrupt the effects of the serotonin you know drugs associated with enhanced self-control and diminished impulsivity observed greater activity in RVLPFC during motor inhibition trials. So, even in drug trials basically when the drugs are affecting and they are increasing self-control or they are decreasing impulsivity.

They are linked with they are probably doing it through increasing the activity in the RVL-PFC. So, this is something which basically tells us that this area is is very critical for inhibiting prepotent motor responses for you know decreasing our impulsivity. Now,

an interesting study by Goel and Dolan has proposed that RVL-PFC may be involved in non-motoric forms of inhibition as well such as the inhibition of belief. Now, inhibition of belief is something more in the ballpark of emotions. Let us look at this study.

In their study, participants were asked to assess the validity of syllogisms. For example, does the conclusion logically follow from the given premises? And that were either sound, so either the syllogism was correct, deriving from true premises or they were incorrect, deriving from, you know, false premises. For example, participants had you know difficulty accurately identifying a valid syllogism as valid if it was unsound and therefore not true. So, this is interesting that for example, the premise is all addictive things are expensive, some cigarettes are inexpensive, it is valid to conclude that some cigarettes are not addictive although the first premise and the conclusion are both false. People were having this difficulty you know identifying a valid syllogism as valid if it was unsound and therefore not true.



So people were finding it difficult to do this task. Interestingly during this task the RVL-PFC was the only region of the brain that was suppose found to be more active when participants actually overcame their belief bias and indicated that this kind of syllogism was valid. If you look at the previous example they had to overcome their basic belief and their basic knowledge and tell that oh the syllogism is true because the premises are true and so on. So when they were supposed to do this you know or when they were successfully being able to do this it was the RVL-PFC that was implicated, it was the RVL-PFC that was showing greater activity as compared to the other regions of the

frontal cortex. Also, a number of studies on active deception have also implicated the RVL-PFC in this aspect of inhibition of belief.

So, if you look at these studies, wherever individuals are required to inhibit what they knew to be true and then to say something as well, say for example, I tell you, oh, sun rises in the west. I know that this is false, but I am overcoming that and I am saying this. In these kind of scenarios, the RVL-PFC was supposed to be recruited. Now the RVL-PFC has also been implicated therefore in the symbolic processing of effect you know in a large number of studies. So this symbolic processing of effect again remember I just talked about this very shortly.

Symbolic processing of effect is basically putting feelings to words that is basically idea that we will work with. So the SPA or the symbolic processing of effect refers to the explicit linguistic or propositional processing of one's own effect. I am feeling sad, I am feeling angry. You know when you say this, when you verbalize that, it sort of takes away the edge of how angry or how sad you are feeling because you have concretized all of that into a sentence and that sentence may be correct, incorrect, reasoned with, argued against, negotiated with and so on. The effect of others for example she looks frightened, evaluatively villains categories for example terrorists are bad or the value of response options say for example I will lose my money if the you know if I keep my money in the betamax stock or x stock or y stock and so on.

So this aspect of symbolically processing effect seems to be recruiting the right ventrolateral prefrontal cortex that we are referring to by the acronym RVLPFC. Now across a range of these studies across a variety of these studies RVLPFC tends to be more active during symbolic crossing of effect than the non-symbolic crossing of effect conditions particularly in the case of negatively valenced emotions or negatively valenced feelings. For example, Cunningham and colleagues presented participants with famous names like Bill Cosby and Adolf Hitler who are generally viewed either very positively or very negatively. So, they basically presented these kind of names and in this experiment what happened was that on some trials participants were asked to decide whether the target was alive or dead, but on some other trials they were asked to decide if the target was a good or a bad individual. So, on all trials implicit effective responses to the targets were anyways affected as soon as I take the name Adolf Hitler some kind of value judgment will anyways creep up even if you have to just say oh he is dead or he is alive or even if or even if you have to explicitly say he was good or bad ok.

But explicit SPA would be expected only on trials which I said when they were asking good or bad. Now Cunningham and colleagues actually observed that the RVL-PFC along with the medial prefrontal cortex were more active during good bad judgments than during alive dead judgments. Suggesting that these are the two regions which are involved in the symbolic processing of effect because you are propositionally in this case

you are propositionally processing you know these two individuals or you know any individuals in question. Now, a number of studies that are focused on explicit judgments about emotional aspects, oh I am feeling sad, happy, angry and so on and voices demonstrated greater alveol PFC activations to emotional than to non-emotional judgments. So, when you are making emotional judgments when you are doing this basically what it leads to is it leads to the recruitment of this particular region.

A study that specifically compared negative emotion judgments to neutral and positive judgments observed greater RVL-PFC activations to negative judgments similarly as was found in the Cunningham study. So, it seems that while the RVL-PFC is certainly getting recruited you know in cases where symbolic processing of effect is required, it is all the more you know critical for cases where negative you know emotions are being processed, where negative feelings are being symbolically or propositionally being you know addressed. Several studies have also observed the fact that reading negatively valence words, you know, just read a list of negatively valence words, you know, things like anger, sadness, cruelty, gory, all of those kind of things. Reading negatively valenced words is also associated with greater RVLPFC activity than reading neutral or positive words. So it seems that this region is certainly getting recruited every time you are encountering or coming across negatively valenced emotional information.

Nomaren colleagues for example compared difficult emotion judgements to easy emotion judgements. Presumably, in the task, the difficult emotion judgment requires relatively more top-down elaboration of the emotional qualities of the stimulus than the easy judgments and thus would involve more symbolic processing. In this study, participants were asked to judge the emotional expression or the gender of the target faces. So either you tell whether the face is happy or sad, or you tell whether it is a male or a female. For half of the trials, the critical dimension was ambiguous.

For example, half of the gender trials had faces that were ambiguous with respect to gender. So it would require more detailed processing. Noor and colleagues actually found that the RVL-PFC and the dorsal anterior cingulate cortex were the only regions of the brain that were more active during ambiguous trials than during unambiguous trials. So, it seems that some kind of you know critical processing is happening during you know in these regions. Importantly, however, the effect of the RVL-PFC was driven entirely by its response to ambiguous emotion trails whereas the dorsal anterior cingulate cortex was equally responsive to both kinds of ambiguity.

So, this is where is you know where the critical finding is that when you are not very sure that you know the emotion is happy or sad or positive or negative that is where the RVL-PFC is sort of getting recruited and it is get is being asked to work as compared to the docile anti-singlet cortex is basically when you know responding to both kinds of ambiguity, gender ambiguity as well as feeling ambiguity. So again, we cannot stress

enough the importance of the RVL-PFC here with respect to processing, symbolically processing negative effect or negatively balanced emotions. So a reasonable interpretation of these results could be that the RVL-PFC is getting recruited on an ambiguous emotional trial as participants engage in explicit hypothesis testing about the emotional expression. Oh, whether it is sad, whether it is a happy feeling, whether it is a positive feeling, whether it is a negative feeling, you are basically you know trying to process that and the processing is probably happening in this particular region of the brain known as the right ventrolateral prefrontal cortex. Which again is consistent with the putative role that is being proposed in of this region in symbolic processing of effect.

I have only this much in this lecture. I will see you in the next lecture where we will continue our discussion about symbolic processing of effect and the role of the RVL-PFC. Thank you.