Introductory Neuroscience and Neuro-Instrumentation
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Lecture No. 42
P300 Demonstration with EEGLab/ERPLab (1)

Hello everyone. So as a part of this Introductory Neuroscience and the Neuro-Instrumentation course, I will be giving the next demonstration about P300 using the EEGLab and ERPLab analysis. So the previous tutorials, I have been giving based on the MMN and the auditory evoked potentials.

Now, I will just give you an overview on background about what is this P300 about and how does the waveform look. And then, I will be giving a small detail about how does the demonstration being carried out. So it is a bit different from the MMN and AEP again in the event list how it is being created and some operations and all that is being done, how to visualise it and everything.

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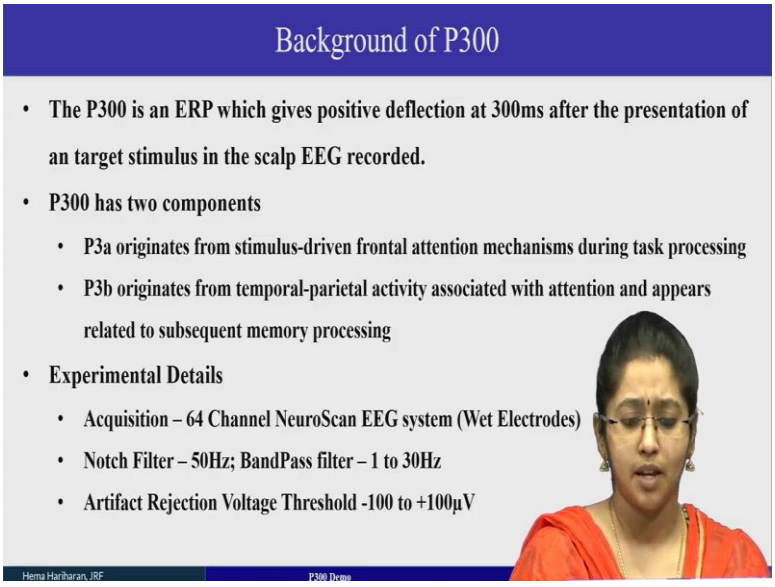

So, what is this P300? So, the P over here, it represents the positive peak that has been obtained and 300 means, it is like the positive response that has been obtained in the 300 millisecond that range. So, it will be obtained always in that 300, the 300 to 600 in that range it should be obtained.

So, this is about the P300. So always, as I told you, there will be Wet Electrode. We have to keep -- it has been need to be put in the head and then there should be a contact between the electrode and the system, so that we can obtain the scalp potentials. So how is it, how the experiment has been conducted is that, there are basically three stimulus in this.

So first is the standard stimulus that has been over there -- that has usually been given. And here we are, and P300 is about the visual, how it looks, how do we perceive whatever we see? That is how it is being recorded. So, there are two components that will be there in this P300. One is this P3a and the P3b. There are two components that is being obtained. So, one is the brain, it should be able to check how the brain is able to attend -- how it is being able to give attention to what we see.

Like for example, now, if we have, there is a difference in the two, if we have a 4-centimetre ball and a 6-centimetre ball, we -- our brain should work in such a manner that it should able, it should be able to differentiate the 4-centimetre and the 6-centimetre. So, that is what is done by the attention. That is, it is done using the attention how it would be, how we perceive it. So based on that, it is the -- how that is how the P3a works.

And P3b is something that is based on the, how the memory is working. So, even if we have to differentiate between these two, we have to -- there will be another one stimulus also like this checkerboard or something like a distractor will be presented in P300. So, what will happen is, when this distractor has been given, we have to still remember that okay this 6-centimetre ball is the difference and 4-centimetre ball is also different.

So, that difference also you should remember and we have to pay attention also and we have to keep it in the memory also. So, those two parts of the brain is being studied in detail using this P300 analysis. So, both the working memory as well as the attention-seeking memory of the cognitive brain, how it works, that has been explained or that can be studied in detail using the P300 analysis.

So, here, as I told you there will be three stimulus basically. One is the standard, the standard it can be the normal and maybe in this experiment which we have conducted over here, we have used a 4-centimetre blue coloured ball as a standard. So, and then, we will be giving a distractor as well as a target. So, these three are the stimulus that has been given.

And about the experimental details, as I told, as I have mentioned, it is all the same, the neuroscan EEG system, where we have the 64 electrode channel. And then, we use -- we have, before acquiring the data itself, we have to have the BandPass filter, the Notch Filter and all the artifact rejections and all to be done has been performed. And the P300 mainly, it has been obtained from the frontal as well as in the temporal-parietal areas of the brain.

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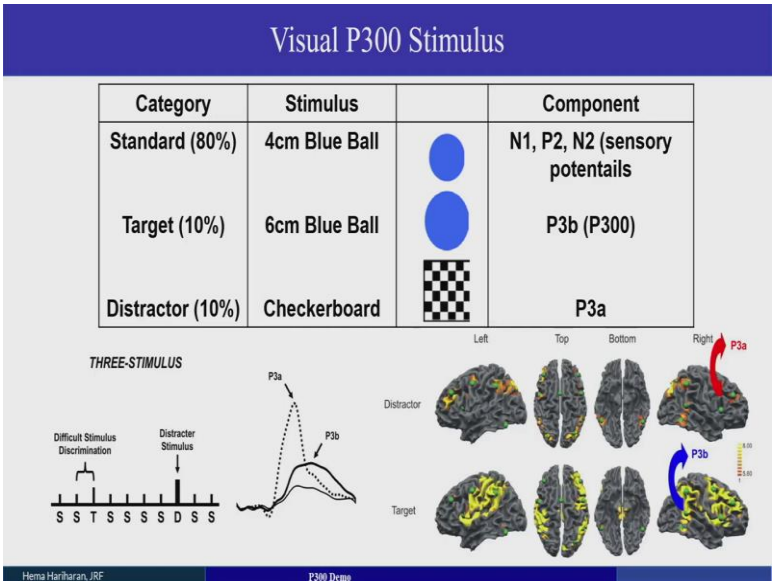

So, in the next figure, I will just give you a brief about what are the different test stimulus and how does the, where does the, where do we get the brain, in which part of the brain we are actually obtaining these P300 responses I will be saying. So, here, this stimulus here, in P300 also there are various different types. Now, what we had performed is the visual P300, even there is an audio P300 also wherein, we have a target and its standard.

So, and there we do not have a distracter, but we will just have a standard target. So in visual, we have, a three stimuli, one is the standard which, like for example, if we have a 1000, totally we want 1000 stimulus mean over that the 800 stimuli will be over 1000, 800 stimuli will be of this 4-centimetre blue ball, the small sized ball.

So that will be just like the responses which will give the N1, P2, P1, P2, N1 complex that particular thing it will give. It is just to sense; it is to just check whether our visual cortex are all working properly and all. So, that is for this standard. Next is this target. Target is actually a 6-centimetre blue ball. So here in this experiment, what we have to do is that we have to instruct the subject in order to give a response to the target.

So, whenever there is a, this particular experiment is being running in that place, we will have a response pad been given to the subject. And whenever there is a target, that is the 6-centimetre blue ball whenever we are, whenever we encounter this ball, the 6-centimetre ball, we have to allow, ask them to give a response. So, that is about the experiment.

And this, it will say that okay, the brain will differentiate the 4-centimetre ball and there is a 6-centimetre ball. And when there is a 6-centimetre ball, we have to give a response. So all of

this, the brain will know and it will do it. So, that is why we say that the attention memory of the brain is being working and the attention as well as the working memory, both of them is being working in this condition.

And there is a 10 percent of a Checkerboard also been given, like it is just a chess-board kind of thing with, this is how it has been given. So this will just, it is like acting as a distracter. Whenever, there is this Checkerboard comes again, we have to -- our brain will have to come to the normalcy that there is a standard and this target and now we have to differentiate again the 6-centimetre ball.

So, all of these, working memory and the attention, everything together, it works and then this is how we get the P300 response and in P300 itself, there are two responses, one is P3a and P3b. So P3a, it is like the earlier component and the P3b is a bit later component. Over here, if I show you and another one important thing about this is, it is all randomised. It is not like this MMN, always there should be three that beep beep beep boop, or beep beep beep boop like that, that is not the case in P300, it is always randomised.

We have to give a percentage, like 80 percent I want the standards to be coming, 10 percent the targets and 10 percent distractor. So, whenever, it is like Artificial Intelligence or it is some program that is being done by the stimulus system, and it will give -- it gives in a randomised manner. So, in this condition for example, there are two, first two standards, then a target, then again three standards, then a deviant comes.

So, it is all randomised. We want out of 1000 responses, out of 1000 stimuli, 800 will be for standards, 100 will be for the target and 100 will be for the distractor and it will be randomised. It is not that always, first five will be standard, then a target, then a distractor, not like that. It can be all randomised. That is the main important step stimulus thing that you have to remember about the visual P300.

And if you see the image over here, the P3a, it comes in the frontal part of the brain and the P3b it is in the parietal part of the brain. So, frontal and parietal and mostly the central parietal, all these areas are the most commonly activated during the -- and the visual P300 stimuli or the ERPs are being obtained in these parts of the brain.

So when we are doing the ERP analysis, also we should concentrate more on those parietal regions or the central parietal, temporal regions and all. So in that areas only the P300 response will be maximum. So, there is a positive. As I told you, at 300-milliseconds, in that

time, we will have this P3a, it starts the P300 response, it was obtained from that particular thing.

And here we have a response being, as I told you, there is a response that should be given for the -- whenever there is a target being seen. So, these are the different stimuli and this is how it is actually being done and the experiment, I mean the brain, how it looks and how, from where it has been obtained.

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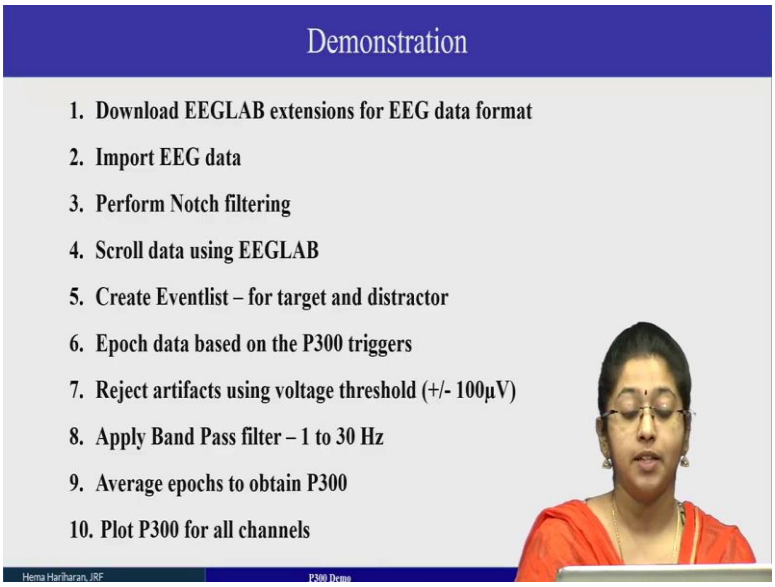

And then, the demonstration part is the similar as that. I only think that here, in this, we have to concentrate on the target and the distractor and then the P300 triggers based on that and even the epoching also will differ, because we wanted to be from minus 50 to like 600 or 650 like that, because our response in this case, it starts from 300 only.

So, that is why we take minus 50 like a baseline and then to the next level like till 600 or 700 like that. We will be epoching in this condition. Similarly, all other steps are similar only, only the difference is in the event list and the epoching. And the plotting also, we can just give a difference or just give, how our, like for both the bin values we can directly do or we can do even for the separate analysis also.

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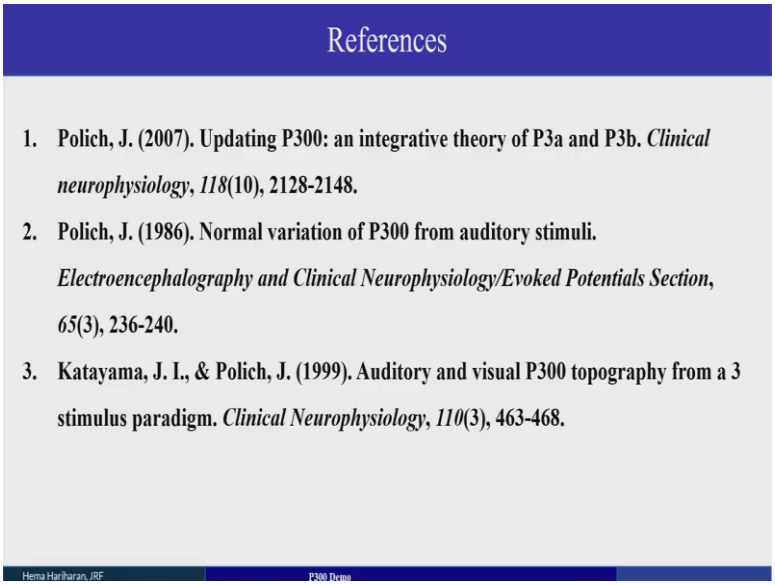

And the P300, if you have to say about the papers that they have used, this Polich's paper is the best paper for P300 because they are the ones, he is the one who actually started all the works about P300. So, he is the -- it is like a base paper for P300. So, as I told you, along with this visual, there are auditory stimulus also been given for P300. So, there are topographic analysis, everything can be studied with these papers. Next, I will be speaking about the demonstration using the Matlab using EEGLab and ERP Analysis. Thank you.