Introductory Neuroscience and Neuro-Instrumentation
Professor Hema Hariharan
Lecture 37
MMN Demonstration with EEGLAB/ERPLAB

Hello everyone. So as a part of this Introductory Neuroscience and Neuro-Instrumentation course, I will be giving the next demonstration about MMN. I will just give you how to do the EEGLAB and ERPLAB analysis with an MMN data. So, I will be giving you a brief introduction about what is this MMN and how it looks and everything.

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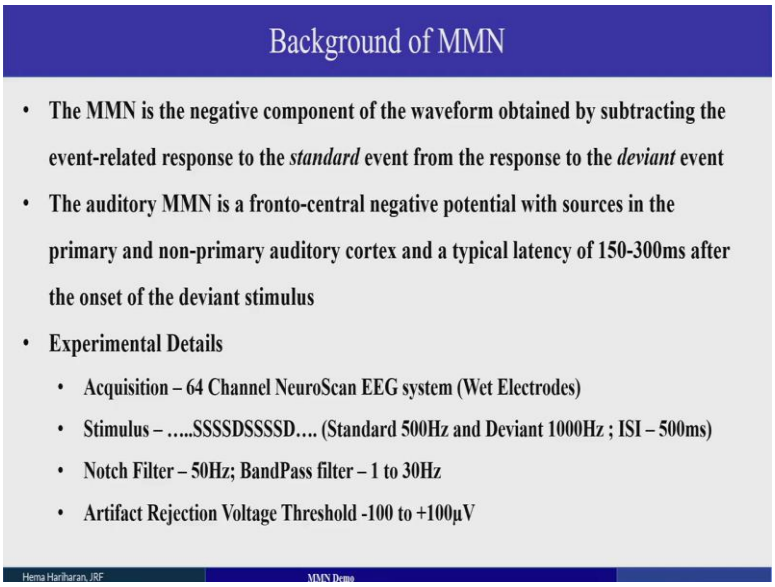

So, MMN it means it is called the mismatch negativity. It is actually a negative component that is being obtained were during the analysis, during the ERP analysis, EEG analysis. So, we in this we are giving two types of stimulus, two stimulus are given at the stretch like standard 500 hertz and a deviant of 1000 hertz and that too it is in it is repeated, it is repeated in a particular fashion. For example, it will be always in this fashion beep beep beep boop, like that it will be.

So, it almost every time it will be in this fashion because it should be in a repetitive form, that is when only then that is when we can find out when the deviant response is obtained. So, the brain what it does is it keeps the standard, the standard it will think that this is the how the sound will come and suddenly when there is a difference in this, in the tone that is when the deviant response is obtained, there is a different negative component that comes into part, that is called as this MMN, that mismatch negativity that is why it is known as mismatch negativity.

This is also similar to that of the auditory stimulus, auditory evoke potential itself because even in this also there is an auditory because it is an auditory stimulus, we are giving there is an auditory cortex is, it is involved in this particular MMN ERPs also. So, usually, this MMN if you see, if it will be always between a 150 to 300 millisecond, in this particular range the MMN should be seen every time. So, it starts with the deviant stimulus, it starts soon after there is a deviant stimulus obtained, there will be this MMN response being obtained.

Next, the so experimental details, it is again recorded from the neuro scan system, a wet electrode system. So, here we have it is a 64 channel again and then we have the stimulus as I told you, it should be this S it will be standards and for a deviant and followed by 4 standards and 1 deviant like that this will be repeated for about 100 loops or something like that. So, it we will get a huge and the time range of this MMN, it would maybe takes about 10 to 15 minutes like that. So, then only we will be able to average all the ERPs and everything and to obtain the particular MMN.

And even in this also we have all the filtering range, we have we will do all the filters, we will be incorporating the notch filter, the bandpass filter, and everything and the artifact rejection is again from minus 1000, 100 to plus 100 microvolts. So, even in this experiment what happens, we have a longer time range, we having more, mean it is taking 15 minutes of where we cannot steadily or stationary like that we cannot sit for long, so obviously there will a lot of artifacts been produced in this also. So, that is why we have to have the artefact rejection to be done in all the ERPs.

Then, and this mainly the MMN it is being obtained in the frontal, right frontal part of the brain it will be obtained. So, for example, I will just show you in the next pictures. So, here this blue part over here that is the place where the MMN response is maximum because here is the place where you have the primary and the non-primary auditory cortex and all are present in this part of the brain.

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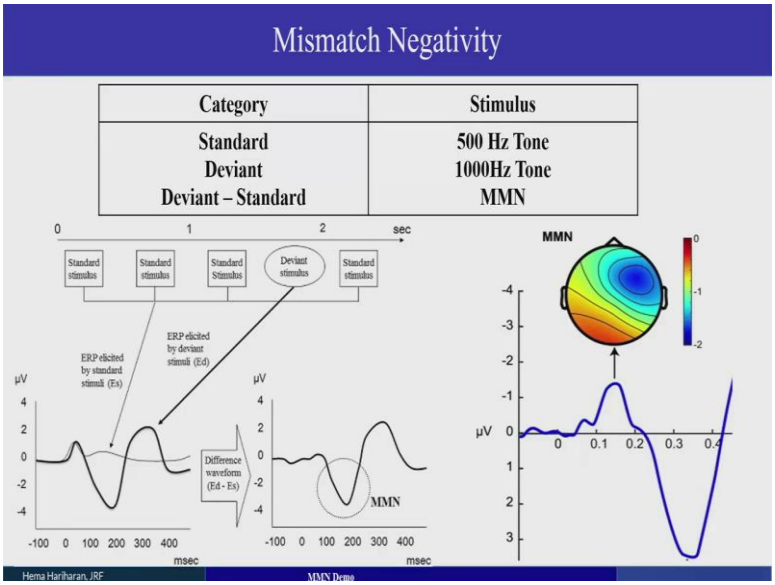

So, here in this place only, the MMN is being obtained. So, here in the first figure as I showed, here we have the there are 3 standards followed by the deviant stimulus, so what happens is, the all the standard we can together average it and obtain one form and all the deviants together we can average it and produce this waveform. The thin black line over here is the standard stimuluses waveform and the thick line over here that is the deviant stimulus. So, that is the waveform obtained for the deviant stimulus.

Now, what we have to do is, always when this MMN, it should be the difference between, there will be the MMN is not, it is not just the deviant stimulus or the standard stimulus, it is none of that, it is the difference between the deviant and the standard. So, when we so, when we have his ERP analysis being done, we have to separately being, we have to create two different bins for the standard as well as the deviant and then we have to subtract the, we have to do a bin operation so that there will be a subtraction taking place between the deviant and the standard, so then only we will get the proper MMN result.

So, here in this case, here it show in this figure it is shown and the left figure the it is shown as a negative down or a positive up as shown. So, here if you see it is a perfect peak at the 200 millisecond and here we can see that it is between 150 to 200, you will have 100-200, there is a peak. This is a two different pictures I have taken just to show which part of the brain is being activated in this case and what is the different stimuli, how does the stimuli looks, for that we are using this.

So, always the standard will be a 500 hertz tone and 1000 hertz tone. Now, there are a various types of MMN also like there can be duration MMN. For example, now from one deviant

from the standard to deviant if you have, we can change the timeframe. Now, usually sometime, mostly people take a 500-millisecond difference or a 2 hertz of frequency they will take, in that range they will experiment. So, sometimes they will take a different timeframe also.

So, there are different types of MMN also been there like this duration MMN and the delta MMN, like that there are various types of MMN as also there. We can modify the experimental protocols according to what we want to find out. So, different types of this one will have obviously will have different kinds of result also. So, this is about the MMN pictorial representation of how it looks.

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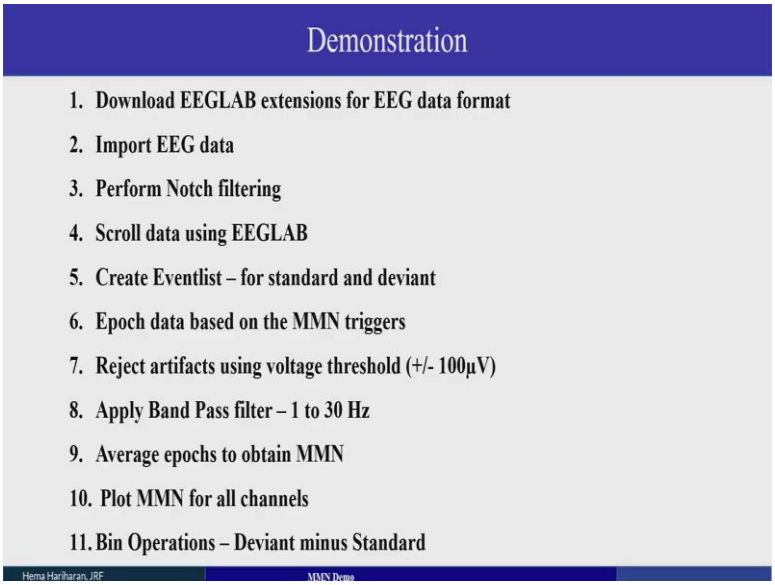

And so how does and I will just go brief about how to do this MMN demonstration in EEGLAB and ERPLAB. So, again as I told you, first we have to have the format according to the EEG thing, I mean how whichever EEG format we have, according to that we have get and then he will import the EEG data and then we do the notch filtering and followed by we just check what which trigger refers to the standard and which triggers refer to the deviant we have to check that before doing any analysis.

And then do the create the event list for the standard and deviant separately and then we have to do the artifact rejection, all the band passing filters and everything and then finally we have to epoch the MMN and we have to, another important step apart from the EEP is that we have to do the bin operation in this in this thing because we wanted the MMN is the difference between the deviant and the standard. So, we have to do that particular step in the ERPLAB analysis before doing any other.

Otherwise, we will just directly if you do not do the bin operation, we can just visualize the standard alone and the deviant alone but we would not be able to visualize how the MMN looks. Even the channel operations also can be done for this particular because as I told you only the right side frontal-central in that particular area only the brain is being activated. So, only those electrodes and all can be together averaged and channel operation can be done, averaged together in that part and then we can obtain a final MMN waveform.

So, this is about the, this is about the total, procedural of procedures of what we have to do in the EEGLAB.

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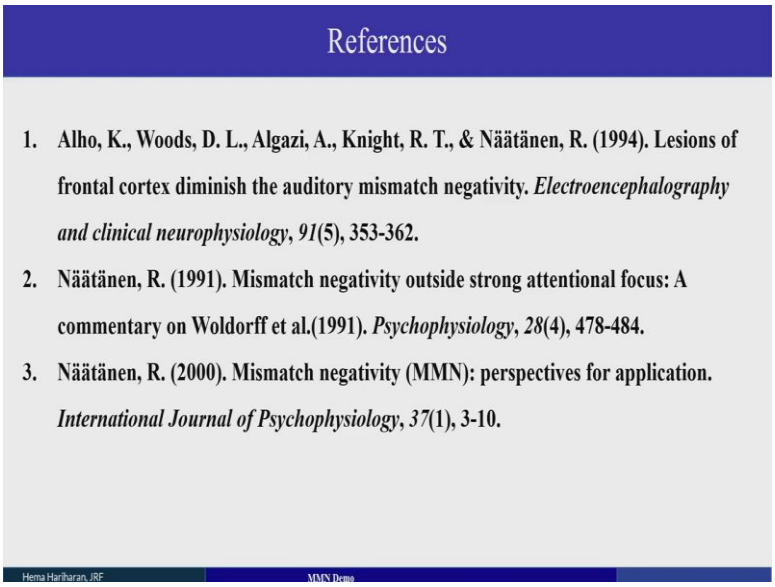

And the MMN if you have to say about, this is proper like this is Naatanen is the main person who done lot of research on this MMN, various other different types of MMN, auditory, visual or even this duration MMN as I told you, different types of MMN and analysis has been performed by this Naatanen and group. So, these are the best references you can give for MMN. You can have this as the base paper for doing any MMN analysis.

So, next I will just go about demonstrating how does the MMN EEGLAB, ERPLAB analysis we can do using the Matlab source, so thank you.