Neuroinformatics Quiz-1

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Total Marks : 14 / 20

(Q1)

For the experiment I would like to specify: (5/5)

- No. of electrodes = 64
- Sampling Rate = 512Hz
- A good Response device
- Eye Tracker.

From the question we need high temporal resolution, we need to also maintain the minimum spatial resolution – think about additional aspects even though not explicitly mentioned (32 and 64 are ok) – 128 will not be feasible due to cost effectiveness.(mentioned this already)

Choosing 64 electrodes is generally considered optimal for any kind of analysis, because choosing more electrodes = more time for setup, more preprocessing (applying gel for all electrodes) and expensive. So choosing 64 EEG channels would be cost effective.

Minimum = 14 Hz (bare minimum)
128Hz would work – thought of this but wrote the correct reasoning. 512 Hz and 1000 Hz would be fine as an expert advisor(with correct justification).

According to Nyquist rate, we have to sample at the rate twice the highest frequency component to avoid aliasing and perfect reconstruction(bare minimum). We can always downsample the rate so choosing high won't be a loss (should be at least 20-40x).

(for recording environment – just think of room conditions - electronic sounding,sound proofing and light proofing, eye tracker, nice experimental setup)
The other two requirements are also useful, a good response device will make the subject easier to handle and increase the accuracy and interest in the experiment instead of figuring out where the button might be.

Eye trackers can also be used for several purposes. It will facilitate the processing and cleaning dataset, It can also be used to measure changes in pupil dilation and there are methods that improve the temporal precision of pupil response.

Pay attention to the key words in the question - predictability => before time

(Q2) (2/4)

Rule of Thumb = 50 trails

(1) More trials leads to more accurate results. So it is recommended to plan for at least 20-30 trails per condition.

Rule of thumb = 30 subjects/design, effect size = difference between groups of different conditions (may be mean) (learnt in BRSM 🙂).. Expect more give yourself a bonus if you think broadly because during data analysis => cleaning and processing some irrelevant trails would be removed so 50 would be nice

(2) It is ideally recommended to have the same number of subjects for both conditions to avoid bias. I would recommend having at least 20-30 subjects.

Apart from buffers we need to add some time zones before and after the task periods.

(3) We can epoch the data around the task periods preceding the baseline and we have to include buffer zones before and after task periods for time frequency analysis to avoid any edge artifacts.

(Read as a stages of experiment supposed to be ** preprocessing stages**) but partially correct may be

(4) At early - raw eeg data, plots after preprocessing, spectral power density plots.
At mid stages - ERPs, butterfly plots, global field power,time frequency analysis etc..
At late stages - Topographical maps,images,plots of statistical comparisons between 2 conditions. Etc..

(Q3) (3/3)

All seems to be fine as discussed in class.

- The major sources of artifacts here are Eye blinks - they are easy to identify, they do not destroy the brain generated signal but rather linearly sum on top of brain generated EEG. We can remove them using ICA, regression

techniques. One of the problems is that the subject can sometimes miss the stimulus.

- Jaw movements and muscle activity - they can create a high frequency and high amplitude signals which can also be removed by Independent component analysis,
- Electrical noise from device - can be filtered with notch filter (if line noise) but sometimes it might filter the actual neural recording.

(Q4) (3/ 4)

In the question it is supposed to be decrease (instead of increase) makes more sense in this way, but fine both ways
Need to discuss temporal leakage ?
and edge artifacts– wrote nicely makes sense I think
Given ,

EEG Dataset – epoched trials of 1 sec baseline + task activity of 2 seconds (stimulus)
Initial : Analyze the alpha activity (8-12) Hz
Later : Need of exploring the deltaband(2-4)Hz

When we apply filter for already epoched data it can cause the artificial oscillations or ripples also called ringing artifacts results from poorly designed filters.These artifacts can disrupt the baseline and task periods especially for lower frequencies (if we use a high pass filter).Hence the robust increase in delta power during the task might be chance.

We have to apply filter for continuous non epoched data to avoid these artifacts and we can also use buffer zones / reflections. In this way we can fix or validate our analysis.

(Q5) (1/4)

We need to think and analyze data in a broad sense. We have to make sure if the given plot is trail level or averaged over trails.Identify and think about it before jumping in to the conclusions.-- from what i wrote only (a) is correct

(a) X axis - time (in seconds) 0-4 sec
Y axis - frequency (in Hz) 4-14 Hz

My initial observation is there is a strong band with red color of elevated power around 8-12 Hz and it fades out slowly at Read out period.

(b) From the plot given,
I would support the theory of working memory because power appears relatively stable and consistent across the delay period and the slight change near the read out phase also suggests that WM is updated or released.

Hence I support the WM theory.;

Feedback for myself:

- Read the question properly, understand it in a broad sense.
- Don’t just jump into conclusions directly just by looking at it, think in multiple possible ways and try to understand the underlying phenomena.
- Do more better next time !