Observing Brain Activity Using Near Infrared Spectroscopy

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Abstract

We are using a NIRS device to test the response of the user during a gambling activity. In this activity the subject is shown 2 choices which consist of different quantities of a specific shape. Each shape has a different probability of being chosen and the larger the amount of shapes, the more possible points you can receive. After the subject chooses, the program will let them know if they won or lost and continue to the next round. 20 trials are run and 3 runs are made. The data is then processed and analyzed in NIRS SPM, a toolkit for MATLAB.

Objectives

The goal of the project is to investigate the neural correlates associated with a value based decision making task using different brain imaging technologies. While previous studies have looked into such topics, the typical imaging modalities are EEG and FMRI. By adding FNIRS(functional near infrared spectroscopy) into the mix, we are hoping to discover additional information from this experiment. We would eventually want to run our testing while using a combination of FNIRS and EEG at the same time.

Methods

Figure1 – This is the cap the subject wears in order to attach the NIRS optodes.

The NIRS cap is placed on the subject and then the optodes are connected to the cap. An initial calibration is run which lets you know how good the placement of the optodes are. In order to improve the placement, the subjects hair may need to be moved out of the way of the optodes. The better the placement, the better the data. The Subject is presented with two choices of different amounts of shapes and asked to choose which one they think will win. They are then given feedback based on the results. If they win they get points based on the quantity displayed of the shape they chose. The subjects did this 20 times per run and each subject did 2 runs. We then removed the optodes and collected the position of the optodes using the polhemus device starting with the 5 main corners of the head: inion, nasion, origin, preauricular left and preauricular right. From there the rest of the positions are collected. Data is then processed and analyzed in NIRS SPM, a toolkit for Matlab.

Figure 2 – The polhemus device

Results

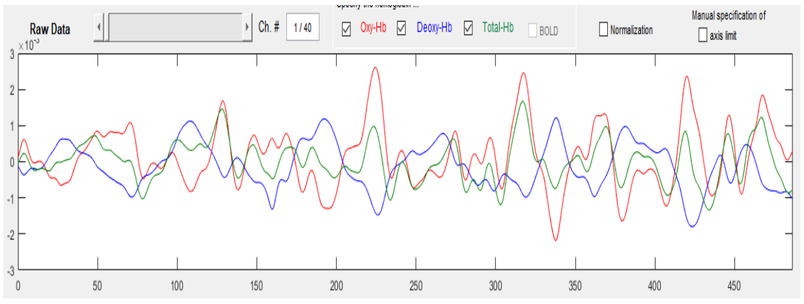

Figure 3 – This is the data for subject 1, run 1 after being processed with a baseline correction of 5 seconds, low pass filter, and wavelet detrending.

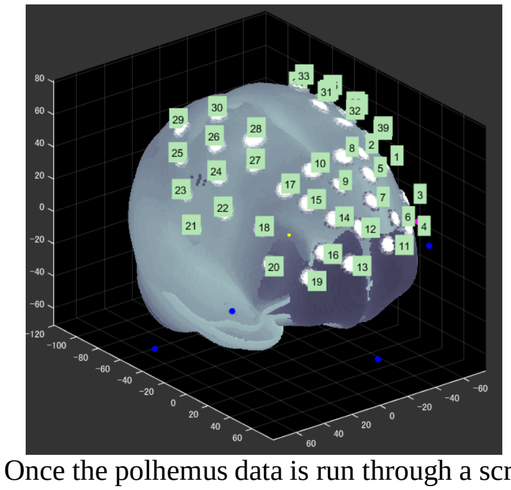

Figure 4 – Once the polhemus data is run through a script which converts the coordinates into MNI coordinates, the optode positions are displayed on a 3d model of a brain.

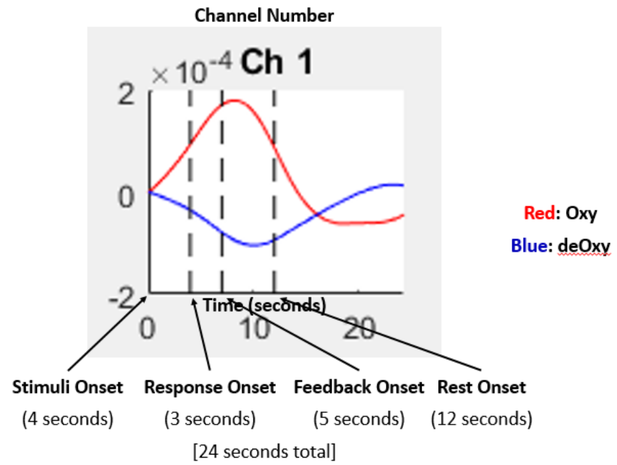

Figure 5 – A trial from channel 1. We would usually compare trials such as this one throughout the different runs and subjects to try to observe a pattern or trend.

Conclusion

Evident activity in the parietal cortex as well as in the frontal cortex telling us that our data is in fact good. As the data is further broken down, and looked at during the onset itself an increase in oxygenated hemoglobin - and in response a decrease in deoxygenated hemoglobin is seen signaling that this area of the brain is indeed being activated. As something in your body carries out a function, it requires more oxygen. Eventually, we would like to compare the winning and losing onsets and see if we can see a different response between the two conditions. We found with this paradigm that the 3 subjects won about 60% of the time. A further modification would be to increase the difficulty by adding more options to choose from. This will also help make the paradigm more engaging for subjects when done over a long period of time.

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