

Electroencephalography: Machine assembly & diagnostic testing



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Abstract:

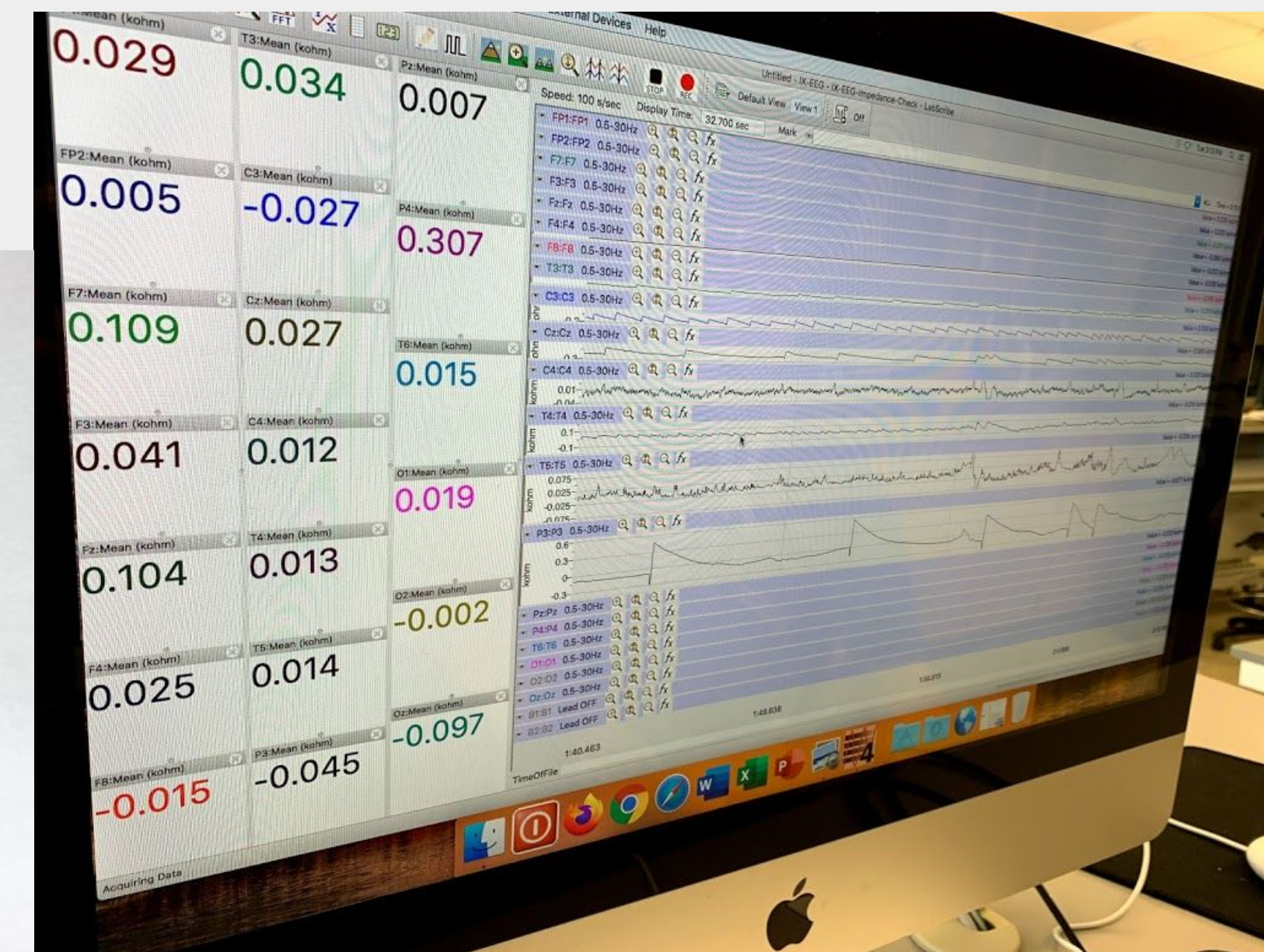
Electroencephalography (EEG) is a tool widely used by medical professionals to examine the function of the brain. The EEG can analyze the emission of brain waves from precise parts of the brain to ascertain a structure-function relationship of alertness and the response to a variety of stimuli. With the use of a 24 lead research grade EEG supplied by iWORX we began to gain an understanding of the intricacies and functionalities of this technology. Our EEG consists of 20 scalp electrodes, 2 galvanic skin receptors (used to measure sympathetic arousal), and 2 biological potential electrodes. After thorough research of protocol, tests were administered on volunteers to allow the student to practice calibrating, recording, and analysing EEG data to better understand the tool for future use in research trials. In research to come we plan on studying the effects of binaural beats on brain wave emissions

Methods:

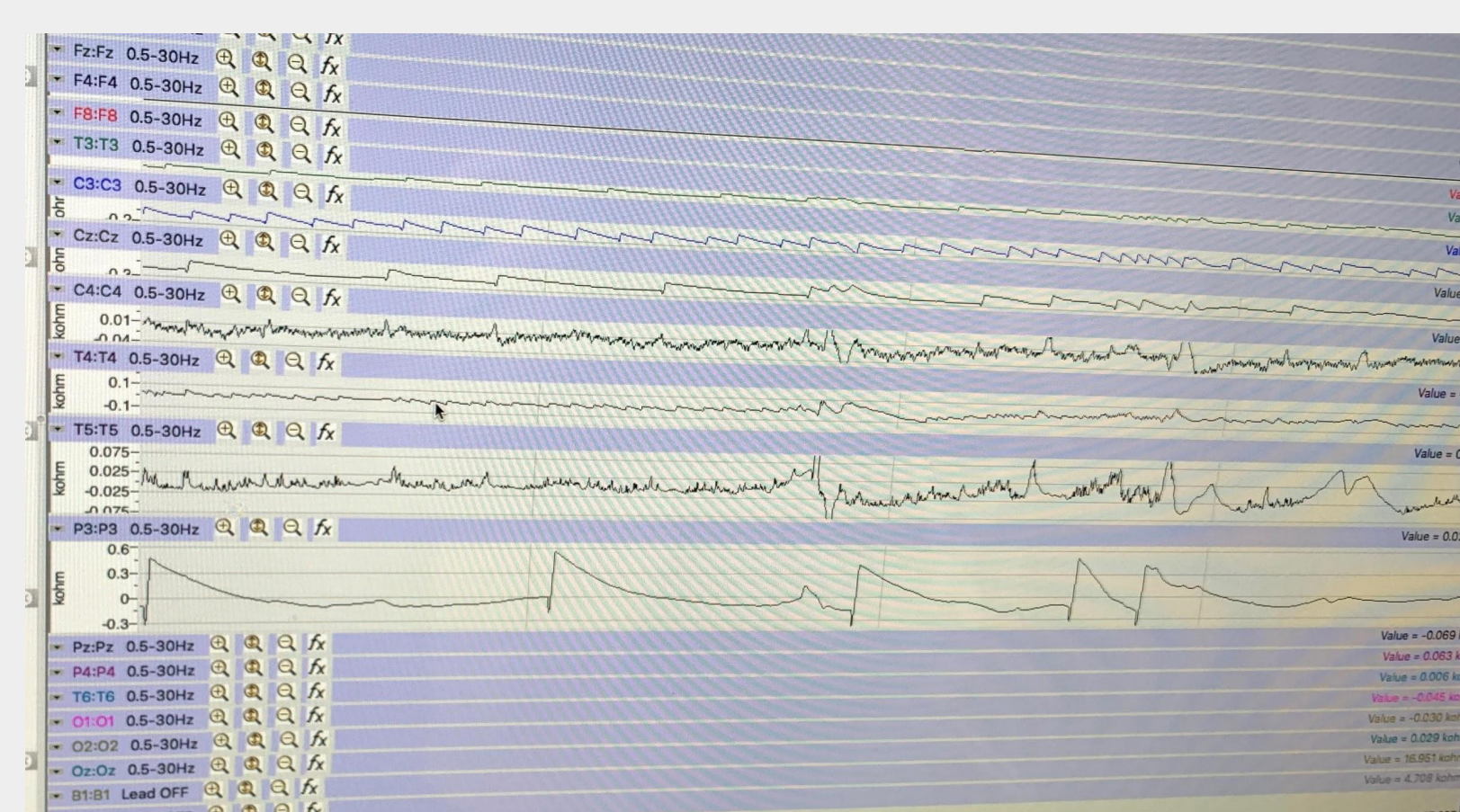
The 24 lead iWORX EEG system was set up for preliminary pre-research trials in which optimal settings would be determined to be utilised in experiments on the effects of binaural beats on brain waves. Researchers utilised volunteers to determine the optimal settings for the EEG system and become familiar and confident on using the research grade equipment for clinical research.



Findings:



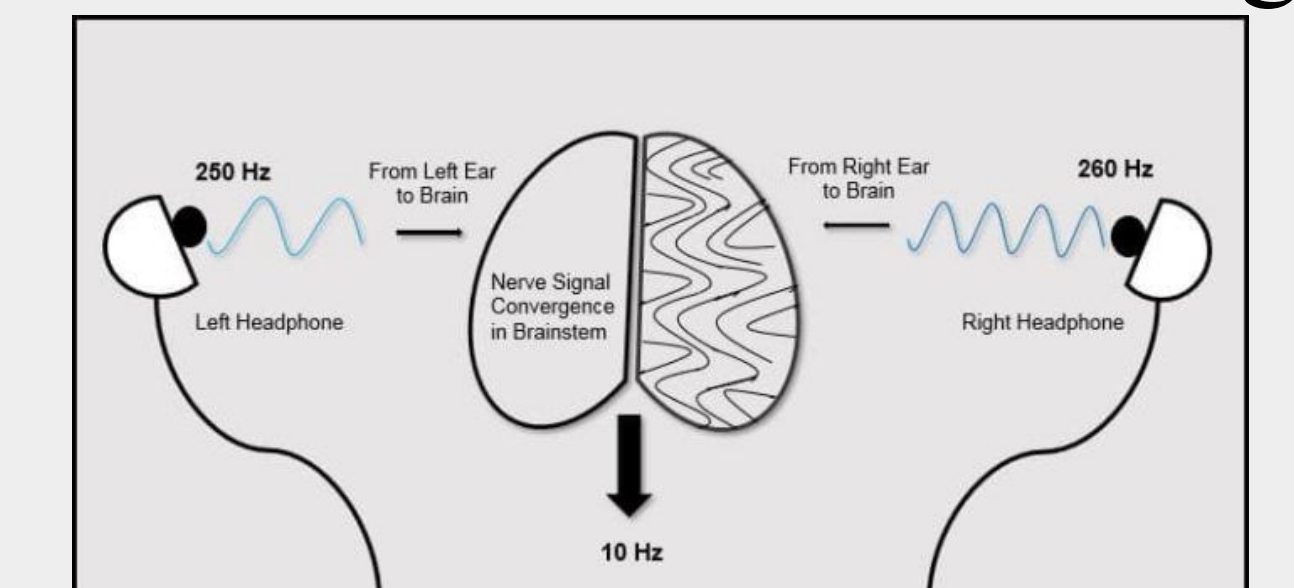
Initial set up and troubleshooting of the 24 lead EEG system provided by iWORX revealed key information regarding proper and efficient use of the system in future trials. Familiarization of the researchers with the Labscribe EEG program was used to determine optimal conditions under which to use the equipment in future research. Volunteers were utilized for hands on testing once the equipment was prepared and a variety of settings were manipulated and measured including filters, impedance values, hardware optimization, and sensitivity.



It was determined that filters would be used to eliminate background artifacts. A 1 Hz low pass filter was paired with a 40 Hz high pass filter and provided steady and consistent readings lacking significant artifacts. Impedance values were measured and reduced in all electrodes to sufficient levels through the gradual acclimation of proper electrode gel application techniques. Sensitivity was adjusted to 7 $\mu\text{V}/\text{mm}$ to provide optimal sampling.

Future Goals:

It is hypothesized that using binaural beats (the application of tones in conflicting frequency to each ear) can be used to alter brain waves. We will run a control on each of our future participants to gain a baseline EEG reading. Then a negative control will be run on each subject to eliminate the confounding variable of a placebo effect by using equal frequencies in each ear. Finally, in the experimental test we will administer binaural beats at various conflicting frequencies and analyze the EEG reading for a change in brain waves as a result of conflicting frequencies in each ear. Whether the brain emits unique waves when exposed to binaural beats will be explored. This could result from a reaction to conflicting simultaneous frequencies which causes the brain to synthesize a frequency pulse equal to the difference in the frequencies applied to each ear. The location of origin will also be investigated.



Discussion/Conclusion:

It was found that the iWORX 24 lead EEG system produced accurate and consistent readings with the use of a 1Hz low pass filter, 40Hz high pass filter, 7 $\mu\text{V}/\text{mm}$ sensitivity and precise administration of the test through meticulous assembly of the scalp to cap connection with conductive gel. The parameters derived in these preliminary experiments will be implemented in future research on the effects of binaural beats on brain waves and will allow the researchers to begin the research effectively and without artifacts.

References:

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- (4) BioSemi. Is skin preparation necessary when using BioSemi active electrodes? (Image of gel application to scalp with syringe); [cited 2020 Apr 05]. https://www.biosemi.com/faq/skin_preparation.htm

