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## Recording Electroencephalography (EEG) Data: Questions and Answers

EEG For Psychophysiology Research Webinars: [Part I](#) [Part II](#) [Part III](#) [Part IV](#)

We recommend reviewing this [BIOPAC Knowledge Base](#) entry on preparing electrode sites and this document on [fundamentals of electrode use](#). We also recommend viewing this [video](#) on the EL-CHECK electrode checker, as it provides a good video review of participant preparation and impedance verification.

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## EEG Recording

1. Q: How do you ground the subject with simultaneous broadband recording of several psycho-physiological indicators (local EEG, EDA, EMG)?

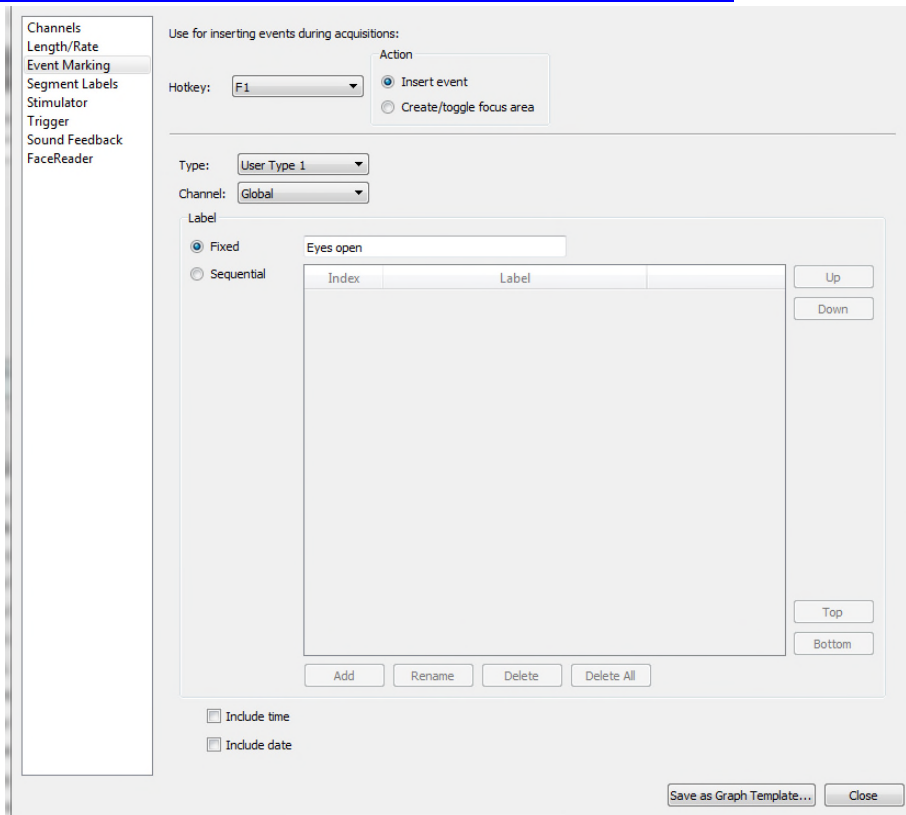
A: If grounded at one point, then all signals are mixed and, for example, a clean EEG is almost impossible to obtain.

If you are using EDA and biopotential signals, the subject is automatically grounded by one of the EDA leads. However, it can be helpful to apply a second ground lead the subject. The additional ground should be connected to a CBL205 AC Coupled Lead Adapter. The CBL205 will allow you to run a second ground lead on the subject without creating ground loop issues. [https://www.biopac.com/product/interface-cables-cbl200-series/?attribute\\_pa\\_size=cbl-ac-coupled-tp-lead-adapter-5-cm](https://www.biopac.com/product/interface-cables-cbl200-series/?attribute_pa_size=cbl-ac-coupled-tp-lead-adapter-5-cm)

2. Q: During spontaneous recording, how can I mark a response on the display?

A: *AcqKnowledge* has a sophisticated event marking system in place that allows you to enter marks in real-time. The following dialog shows the marker setup and this link will take you to a video that demonstrates the event marker system.

<https://www.youtube.com/watch?v=GUEv2GxTCKo&t=679s>



3. Q: What is the difference in signal quality between the different system demonstrated today?

A: The three systems that were demonstrated during the webinar all provide excellent signal quality, but they each have their own unique advantages. The MP160 system demonstration showed EEG from a tethered subject using shielded electrodes. The signal quality is very good, but the subject was tethered to the system by electrode leads and this may not be suitable for some applications. The B-ALERT and the Mobita systems both provide subject mobility and both offer good clean signals. The Mobita system provides a higher channel count, plus the ability to log the data and provide the participant with more freedom. The B-Alert system also has the cognitive states metrics software for real time evaluation of the participant. Each system will provide high quality data, but the application will dictate which system will provide the best solution.

4. Q: What is the difference between a channel and an electrode site?  
A: The electrode site is the location of one electrode, whereas a channel of EEG is the difference between two electrodes, or the difference between one electrode and an average reference.
5. Q: Can the Mobita system also utilize the cognitive metrics?  
A: See question 11.
6. Q: How reliable are the EEG signals recorded using Mobita for gait studies?  
A: The Mobita system is ideally suited to gait applications because the system can be used to telemeter the data back to the computer for real-time display of the signals and for data logging. If the participant is walking, the signal quality should be very good. However, if you want to monitor a participant while they are running, you will have problems with the artifact from the pounding of the feet.
7. Q: Where can I find background on details of the cognitive state metrics and how they were derived?  
A: The following link will provide you with additional information about the Cognitive States Metrics software. <https://www.biopac.com/product/b-alert-cognitive-state-software/>
8. Q: Can you modify the impedance threshold (it appears that it is set at 50, can we set it to under 25/15?)  
A: No, the impedance thresholds are set in the software, but the results are both color coded for the different impedance ranges and the actual impedance value is displayed for each electrode. It is very easy to set your own threshold and make sure that each electrode falls below the threshold.
9. Q: I assume the qEEG means quantitative EEG. Is that correct?  
A: Yes, that is correct, qEEG stands for quantitative EEG.
10. Q: Very interesting. What machine learning approach did you use and was it a multi-class classifier or 4 different classifiers?  
A: The classifier is a quadratic discriminant function with four classes. The model was empirically derived by having a group of 100 participants undergo a series of tasks designed to elicit both high and low levels of engagement as well as complete both partial and full sleep deprivation. We then selected EEG epochs most representative of each of the four states to implement the model.
11. Q: Would these cognitive workload metrics work in autism populations? Has that been tested in the past? If yes, is the workload same?  
A: The metrics have not been evaluated in an autistic population. Generally speaking, with any neurological or psychiatric disorders, we start by running our benchmark tasks and then examine the benchmark report to determine whether the EEG data can be modeled.

12. Q: What can we do to improve generalization (i.e. on low or moderate sample size)?

A: Assuming this question is targeted to creation of new classification models, there are many mathematical and statistical approaches (e.g. boosting, bootstrapping, etc.) that can improve machine learning models when working with small populations.

13. Q: What if we have patient a girl with long hair?

A: The subject that I used for the webinar was male, but he has a very thick head of hair. We have also used the system on females with long hair and there is no problem. It doesn't matter whether you are using a gelled or water electrode, you still must make sure that the electrode is properly contacting the scalp. The advantage of the water electrode is that you can move it around to help part the hair and ensure it makes good contact, which ensures good data.

## EEG System Questions

1. Q: Is EEG neurofeedback possible with BIOPAC, with audio and visual feedback?

A: *AcqKnowledge* is able to provide audio and visual feedback for neurofeedback applications. Please consult with our sales folks regarding the details of your application

2. Q: How does the B-Alert system classify the different states?

A: Each subject takes a standardized test that creates a definitions file. The definitions file is used when the cognitive states metrics are being used. The EEG data is referenced against the definitions file and then the state is updated to reflect the result. The following link will provide you with additional information about the Cognitive States Metrics software.

<https://www.biopac.com/product/b-alert-cognitive-state-software/>

3. Q: What eye tracking systems are highly compatible with the different recording systems offered by Biopac? I am interested in remote EEG/Eyetracking combo.

A: BIOPAC offers the SMI eye trackers for remote applications. The following link will provide you with additional information about the eye trackers and provide you with a webinar on interfacing the eye trackers with physiological data.

<https://www.biopac.com/product-category/research/eye-tracking/non-contact-tracking/>

<https://www.biopac.com/product-category/research/eye-tracking/mobile-tracking/>

<https://www.biopac.com/events/eye-tracking-webinar-biopac-smi/>

4. Q: Thanks, I'm also interested in the B-Alert. Do you have to buy that separate to use the gages or is that a software option that is just an add-on for a standard system?

A: The B-Alert cognitive states metrics software is only available for the B-Alert system.

They are not sold separately for use with other EEG systems. The following link will provide

you with additional information. <https://www.biopac.com/product/b-alert-wireless-eeg-with-acqknowledge-plus-cognitive-state-software/>

5. Q: Are BIOPAC systems able to reproduce an hypnogram?

A: *AcqKnowledge* software does not have a utility for sleep staging of human sleep data. However, we do interface with the Sleepsign software for small animal sleep studies.

6. Q: I am a researcher in convolutional neural networks on biosensing data. What efforts have been made to apply machine learning and especially Deep Learning to EEG data in general? What are techniques for getting more signal and less noise in EEG data? What efforts have been made for multi-modal sensor fusion?

A: BIOPAC offers a range of physiological measuring devices that can all be used in conjunction with EEG. In the first example, we showed EEG with EDA, but any number of signal combinations are possible. We can always provide specific information if you have an application in mind.

7. Q: Does the B-Alert work with the MP36?

A: Yes, the B-Alert system will work with the MP36 system.

8. Q: How do you link external system to Mobita. DC channels?

A: The Mobita system can be synchronized with the MP160 system using the trigger channel that is accessible from the Configap. The MP160 system can send a trigger at the start of acquisition. *AcqKnowledge* also has a Linked acquisition mode that will start both the MP160 and the Mobita from the push of a single button. The trigger is then sent from the MP160 to the Mobita and is used as the synchronization marker. A physical cable is used for sync pulse, but this can be disconnected, if the participant is mobile. The MP160 can be used to record many other signals, both AC and DC.

9. Q: B-Alert is extremely sensitive to subjects moving, is this the case with Mobita? Being wireless I expect subjects to move around quite a bit while wearing it. Would this be a problem?

A: The important thing in both instances is to make sure that the electrodes are not shifting on the scalp. This means that preventing the cables from tugging on the electrodes as the subject is moving around. Providing the subject isn't making strong head movements, jerking the head, the system is typically OK.

10. Q: How much data and time can the card record?

A: The system is battery limited and not storage space limited. In logging mode, the system will record for 17-19 hours. In Wi-Fi (telemetry) mode the system will record for 8-10 hours.

The following link will take you to the Product Sheet where you will find the full specifications. <https://www.biopac.com/wp-content/uploads/Mobita.pdf>

## EEG System Capabilities

1. Q: I have two questions. How good do you think the quality of the wireless EEG system as compared to the standard one? (referring to the signal to noise ratio for example). And second question: How good is the quality of the signals with the B-alert system in BCI experiments out of the lab. Because there could be additional artifacts caused by more movements of the channels, other electrical fields disturbances which can comprise the quality of the signal. Can we trust these signals and take the wireless system in outside of the lab scenarios? If not, can you think about some advancements regarding the hardware that can be done in the future, or some good signal processing methods that we can use in this sense to cancel a bit the external interferences

A: The signal quality of the wireless system is excellent, plus the software also includes artifact removal tools for identifying and removing contamination caused by EMG and eye blinks. The user always has access to both the raw and decontaminated data.

AcqKnowledge also includes a spectrum analyzer that displays the frequency components of the signal in real-time. This is a wonderful way to discover whether you have a lot of 50/60 Hz noise, or other signals potentially contaminating the data. The system can be used outside but you do need to pay attention to the Bluetooth connection. The device communicates with the computer via Bluetooth so the headset must be in range of the receiver to transmit the data.

2. Q: On average, how long does the gel last when on the participant?  
A: The gel will typically last for several hours and works well for sleep studies. If the subject is outside and performing a manual task, the gel will dry up faster.
3. Q: How durable is the Mobita wireless EEG? Will it maintain good impedance levels during a sport specific testing protocol?  
A: The system is designed for mobile applications but you must be a little careful about motion artifacts. If a subject is on an exercise bike, the level of motion artifact will be low, but if they are running on a treadmill, the pounding will create obvious problems.
4. Q: Can any of these be used overnight? for sleep studies?

A: The MP160 and the Mobita can both be used for overnight studies but the B-Alert system is not really designed for that. The headset is mounted at the back of the participant's head and this will make it difficult for sleep applications.

5. Q: Tactile sensitive participants such as autistic individuals have a lot of issues with things on their head or body touching them—suggestions?

A: That will always be a challenge when you are recording EEG because you must place the electrodes on the subject. The only thing you can really do is minimize the number of electrodes you are going to use for the recording. The water electrodes are also quite good because they are easy to setup and eliminate the need for gels, but you do still have to make contact with the subject. Unfortunately, there is no easy solution to this problem.

6. Q: What is the typical frequency range and impedance of the electrodes

A: The Mobita system will tolerate much higher impedance levels than a typical tethered system because of the design of the unit. The amplifier is built into Mobita and high-level signals are either stored on the unit or telemetered by Wi-Fi back to the computer.

7. Q: How long do the wet electrodes last before failure or need for replacement?

A: The paper electrode is a single use, consumable item, and is not intended to be used multiple times. Packs of replacement paper strips are available for purchase.

8. Q: How frequently do you have to re-fill the water electrodes?

A: The water electrodes should be good for several hours of recording but subject temperature and activity levels will dry the electrodes faster.

9. Q: Do you use just tap water, distilled, or saline for the water electrodes?

A: The electrodes should be soaked in regular tap water

10. Q: When you differenced the Cz was that just to account for the reference point?

A: Yes, that is correct. I used CZ as a physical reference to demonstrate the flexibility of the system.

## Finding Further Information

1. Q: I suggest you make more handy video tutorials about each product and how to analyze it. And the manual is not conductible. I would prefer some self-taught materials with steps. Thank you!

A: Thank you for the feedback regarding videos and the manual. We are always looking to improve so your feedback is appreciated. We are constantly adding videos to our YouTube

channel that cover both hardware and software functionality. The following link will provide you with further information. <https://www.youtube.com/user/BiopacSystems>

2. Q: I would like to know some specific articles that use some EEG products to make research and how they analyze and present data in articles.

A: The following link will provide you with further information about EEG with links to specific BIOPAC citations. <https://www.biopac.com/application/eeg-electroencephalography/>

3. Q: So, will there be a webinar on the Mobita?

A: Yes, we will have a webinar that focuses specifically on the Mobita system. We will make an announcement with dates and times.

4. Q: Can we apply newer GPU-based Deep Learning approaches like convolution neural networks or GANs to improve the signal interpretation?

A: These approaches are best used when you have a very large data set and a supervised learning problem. They are inherently computationally expensive and the amount of EEG data ABM has at our disposal (approximately 5000 sessions) is too small to apply deep learning methods.

5. Q: Is the workload signal driven by those EMG sensors?

A: The EMG signals were used to show other physiological signals being recorded with the EEG headset and were not used to calculate workload. The workload metric is coming from the EEG signals and is based on the definitions file that was created for the subject. Each subject takes a standardized test while they are wearing the B-Alert headset and the EEG signals are used to create a definitions file for the subject. The subject's definitions file must be used when the cognitive states metrics are running.