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Evaluation of an EEG Task for Detecting Latent Infections

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Introduction

Ultimately our goal is to develop methods for diagnosing neuropsychiatric illnesses through measurement and analysis of the electrophysiological stream of consciousness. In this project we test how well EEG adaptations of the Sternberg (1966) memory search task and the n-back cognitive task can discriminate between individuals who are positive for Herpes-simplex-1 and healthy controls.

Perhaps the greatest advance in the electrophysiological measurement of cognitive processes was the development in the 1960s of the event-related potential (ERP) method (Luck, 2005), in which EEG measurements are time-locked with stimulus presentation. This enables the combining of multiple trials to average out the “noise” (ongoing brain activity not related to the stimulus), and amplify the signal. ERP contours effectively capture the precise patterns of the temporal structure of cognitive processes.

Our Quantitative EEG Lab (qEEG) has developed a method (Brown, et al., 2014) for decomposing ERP contours into individual cognitive spectral bands, such as “memory load” or “presence vs. absence responding.” Like fingerprints, these cognitive spectral bands are ideographically unique to each person. However, unlike fingerprints, these spectral bands have been found to have diagnostic utility. We have used them to identify depression, obsessive-compulsive disorder, phases of the menstrual cycle, academic performance, and gender differences. In a recent study (Brown, et al., 2016) this method was able to distinguish significantly between 75 participants with mild cognitive impairment and 95 healthy controls (Wilk’s lambda=.4297, p<.0001, R2=.570). In another study by members of our research group, using large samples from an NHANES database, it was found that Herpes-1 was associated with decreased levels of cognitive functioning (Gale, et al., 2016). This study tests this finding neurologically using the increased precision of spectral band EEG measurements.

Methodology

Subjects will be 56 female and 56 male BYU subjects. Each will be tested with computerized versions of the Sternberg memory search task and the n-back task while having 14 channels of EEG measurements taken using the Emotiv recording device. Each subject will have blood drawn and tested for Herpes-1.

Two weeks later, the same 112 subjects will return to the lab and once again take the same cognitive tests. Once data collection is completed, we will use logistic discriminant analysis and signal detection theory ROC methods to identify Herpes-1 positive subjects on the basis of the EEG neurological recordings, and use the ROC curves to compare the sensitivity of the three cognitive measures.

Results

During the course of this study we were able to design the program for running the Sternberg memory search task and the n-back task, purchase the equipment necessary to conduct the experiment and begin testing subjects. Due to graduation we were unable to finish the project so with the help of Dr. Bruce Brown new researchers were trained and have continued on collecting and analyzing the data.
Conclusion

Since the study is ongoing we are not able to draw any strong conclusions at this time, but the initial results suggest that the measurement and analysis of the electrophysiological stream of consciousness can eventually be used as a method for diagnosing neuropsychiatric illnesses.

Scholarly Sources


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