a place of mind

STEWARDSHIP REPORT

THE 256-CHANNEL ELECTROENCEPHALOGRAM SYSTEM FOR SCHIZOPHRENIA RESEARCH

2015-2016 PROGRESS REPORT

Prepared for the BC Schizophrenia Society Foundation
By the UBC Faculty of Medicine
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Your support makes a vast difference to the success of our research and the health of our community.

Thank you.

EEG TO ADVANCE SCHIZOPHRENIA RESEARCH AT UBC

Thanks to the support of the BC Schizophrenia Society Foundation, the UBC Faculty of Medicine's Department of Psychiatry has successfully completed the purchase and implementation of a 256-channel electroencephalogram (EEG) system to advance the Department's schizophrenia research program. The system was ordered on June 15th and arrived at UBC on July 23rd, 2015. Dr. Todd Woodward, Associate Professor of Psychiatry and Director of the Cognitive Neuroscience of Schizophrenia Laboratory, and Dr. Christine Tipper, Assistant Professor of Psychiatry and Scientific Director of the UBC Brain Dynamics Lab, are overseeing the setup and use of the EEG. This state-of-the-art equipment will enable UBC schizophrenia researchers and their colleagues in mind and brain health research to develop more nuanced models of the relationship between symptoms and brain function, increasing the speed with which new therapies can be developed and tested for the benefit of patients with schizophrenia and other brain disorders in British Columbia. The pages that follow present an overview of our activities and accomplishments since the EEG system arrived at UBC in July.

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FACULTY OF MEDICINE

Activities and Accomplishments

Dr. Todd Woodward

Dr. Christine Tipper wearing the EEG cap.

SETUP AND TRAINING

Starting on August 18th, the vendor Electrical Geodesics, Inc. (EGI) came to UBC for a required three-day site visit, during which the EEG system was assembled, installed, and quality tested. Prior to commencing data collection, Dr. Woodward purchased a high-performance computer with his existing research operating funds. This computer was optimized for visual stimulus presentation, including streaming video and 3D graphics, which provides researchers with precise experimental timing control, as well as digital communication with the EEG recording computer to enable time-stamping of task-related events into the EEG data. This technology allows the investigation of distinct brain processes that are engaged by specific task conditions that can be manipulated experimentally.

From August 24th to September 25th, Dr. Tipper completed the lab setup and conducted a three-session training seminar on equipment use and procedures for interested users. At the time, the interested users included three postdoctoral researchers, one medical resident, three graduate students, and four research assistants from seven research labs in the Departments of Psychiatry and Neurology. The principal investigators represented by this group of researchers included Dr. Woodward (schizophrenia), Dr. Evelyn Stewart (obsessive-compulsive disorder), Dr. Anthony Bailey (autism spectrum disorder), Dr. William Panenka (traumatic brain injury/concussion), Dr. Alex McGirr (mood disorders/PTSD), Dr. William Honer (schizophrenia), and Dr. Martin McKeown (Parkinson's disease).

Lab setup involved installing all required software for programming and presenting controlled experiments, setting up hardware for linking stimulus presentation and EEG data recording computers, and conducting extensive testing of timing precision between experimental events and timing codes embedded in recorded EEG data. Dr. Tipper also designed a user agreement that established a usage protocol and informed users of their opportunities and responsibilities. On October 20th, Dr. Tipper completed a software upgrade on the EEG computer system and performed extensive data quality assurance tests.

RESEARCH

Data collection for research started in September 2015. Four schizophrenia-related studies are currently underway, and one more will be initiated in 2016. In addition, three non-schizophrenia-related studies are planned for 2016. To date, 120 hours of research data collection on patients and healthy controls has been carried out.

CURRENT SCHIZOPHRENIA-RELATED STUDIES

Functional brain networks underlying non-pharmaceutical interventions for psychosis (Dr. Woodward)

Sarah Flann, Research Coordinator in the Woodward Lab.

This study aims to contribute to the body of evidence supporting methods for bringing strength and organization back to the brain networks affected in psychosis through the use of group-based education and training sessions. To measure changes that may occur in cognition as a result of these interventions, research participants undergo assessments before and after their participation in a randomly assigned treatment condition for delusions and cognitive deficits. The assessments involve functional Magnetic Resonance Imaging (fMRI) scans and EEG recording sessions occurring before and after participation in treatment.

Cognitive and brain mechanisms underlying disconfirmatory evidence integration in delusions in schizophrenia (Dr. Woodward)

Evidence integration is a fundamental aspect of belief revision and serves to update one's belief system, so that it corresponds to real-world experiences. This process allows individuals to develop an increasingly comprehensive perspective of the world around them through the gathering of novel and often contradictory information. Schizophrenia patients with delusions have difficulty integrating new evidence that contradicts current beliefs, and this may contribute to the maintenance of delusions. This study investigates whether these brain networks are impaired in schizophrenia patients with delusions, compared to patients without delusions and healthy controls.

Decision-making and in schizophrenia and the salience network (Dr. Woodward)

The amount of information gathered before making a firm decision is thought to be reduced in schizophrenia. Using a decision-making task involving matching and non-matching hypotheses, subdivisions of salience networks are to be estimated, focusing on anterior/posterior split. This study investigates whether these networks are impaired in schizophrenia, compared to healthy controls.

Activities and Accomplishments

Neurological networks underlying working memory in psychosis (Dr. Woodward)

A hallmark of schizophrenia is persistent cognitive impairments that are present throughout the course of illness, in a wide range of cognitive domains. The purpose of this study is to develop a better understanding of the brain networks underlying such impairments in working memory. Schizophrenia patients, bipolar disorder patients, and healthy individuals perform a working memory task while undergoing fMRI and EEG.

SCHIZOPHRENIA-RELATED STUDIES PLANNED FOR 2016

Neurological networks underlying attention in psychosis (Dr. Woodward)

Cognitive impairment is well-established in schizophrenia. In an fMRI study, we showed that an imbalance in two brain networks during task switching might reflect a general mechanism underlying multiple forms of cognitive impairment in schizophrenia, including global processing deficits such as cognitive inefficiency and impaired context processing. The purpose of this study is to extend this task-switching investigation to the more precise timing available with EEG.

Dr. Tipper explains the EEG.

NON-SCHIZOPHRENIA-RELATED STUDIES PLANNED FOR 2016

Canadian Traumatic Brain Injury Initiative/Dynamic Social Brain Networks (Dr. Tipper and Dr. Panenka)

These research projects will provide new insights on neurocognitive functional dynamics underlying complex cognition and behaviour that will also be applicable to schizophrenia research. The collegial research synergies between all of these labs will facilitate the sharing of neurocognitive testing procedures and emerging EEG analytical techniques. Importantly, these non-schizophrenia-related autism, brain injury, and social perception projects are investigating cognitive functions that are also impacted by schizophrenia, including working memory, attention, social cues, and body language. These projects will help maximize the research value of the EEG system and contribute new knowledge with direct relevance to schizophrenia research. These additional projects will in no way interfere with schizophrenia research, which will maintain scheduling priority and majority utilization.

Electrophysiological correlates of executive function before and after symptom provocation in pediatric obsessive-compulsive disorder (Dr. Stewart and Dr. Jaspers-Fayer)

EEG will be used to study cognitive and affective brain networks before and after obsessive-compulsive disorder (OCD) symptom provocation to determine if provocation is directly related to decreased dorsolateral prefrontal cortex activity and increased limbic (e.g., anterior cingulate cortex) activity in individuals with OCD and at genetic risk of developing OCD and in healthy controls. It is hypothesized that before symptom provocation all three groups will show normal behavioural and electrophysiological functioning on a stop signal task, but after symptom provocation the three groups will diverge, such that healthy controls will continue to show no impairment, the siblings will show some behavioural impairment and network changes, and individuals with OCD will show the greatest behavioural impairment and network changes. Eventually, as EEG is inexpensive and easily implemented in the clinic, results from this work may lead to useful markers of OCD genetic risk, helping us identify electrophysiological correlates that might predict OCD onset.

A neuroimaging study of language in autism (Dr. Bailey and Dr. McLarren)

Half of children with autism spectrum disorders (ASDs) experience language delay and 20-30% experience language loss. Various imaging studies have noted atypical language lateralization in some individuals with ASDs. Based on the results of a MEG study of language by our group, language delay or language loss is hypothesized to be associated with more atypical language lateralization in the autistic population. A combined fMRI/DTI approach will be used to investigate this, with an EEG component as a complementary measure of timing and response.

Thank You

The UBC Faculty of Medicine, the Department of Psychiatry, Dr. Woodward and Dr. Tipper, and all the investigators who are using the EEG for schizophrenia and brain research are sincerely grateful to the BC Schizophrenia Society Foundation for providing the matching funds to purchase the EEG. Thank you for enabling UBC to introduce state-of-the-art technology that measures brain network activity into our research program to accelerate the development of new therapies that improve the lives of people with schizophrenia and other brain disorders in British Columbia.