Brian A. Coffman, PhD
Research Instructor
Department of Psychiatry
University of Pittsburgh School of Medicine
UPMC Western Psychiatric Hospital
Pittsburgh, PA

Dr. Brian Coffman is a Research Instructor of Psychiatry in the Clinical Neurophysiology Research Lab (CNRL). He earned his BS, MS, and Ph.D. in Psychology at the University of New Mexico, where his primary mentor was Dr. Vincent P. Clark. Dr. Coffman’s current research program focuses on the neurophysiology of sensory and cognitive dysfunction in clinical populations such as schizophrenia, and the therapeutic effects of brain stimulation on these deficits. He has pursued interests in functional magnetic resonance imaging (fMRI), electroencephalography (EEG), magnetoencephalography (MEG), transcranial direct current stimulation (tDCS), and mathematical/computational problems associated with neuroimaging data analysis. Dr. Coffman has published basic science research as well as research in various clinical populations, and he has applied multimodal neuroimaging data to complex problems in clinical diagnosis and treatment. He has published 27 research articles on these topics in peer-reviewed journals, as well as multiple chapters in edited volumes. Dr. Coffman was recently awarded a Young Investigator Award in September of 2018 for his outstanding contributions to the field as an early-career investigator.

Abstract: Schizophrenia Treatment with Non-Invasive Brain Stimulation: Using Positive and Negative Currents to Treat Positive and Negative Symptoms (Intermediate)

This talk will introduce the methods of transcranial magnetic stimulation and transcranial DC electric stimulation, review studies of the clinical effects of these noninvasive brain stimulation methods in schizophrenia, and present preliminary findings from Dr. Coffman’s lab showing improved cognition and reduced auditory hallucinations in schizophrenia patients following DC electric stimulation paired with cognitive training.

Learning Objectives

By the completion of this session, participants should be able to:
1. Recognize the difference between magnetic and electrical stimulation methods
2. Recognize positive and negative symptoms of schizophrenia, including auditory hallucinations
3. Discuss noninvasive brain stimulation research studies reported in the literature

References

Schizophrenia Treatment with Non-Invasive Brain Stimulation
Using Positive, Negative, and Induced Electric Fields to Treat Positive, Negative, and Cognitive Symptoms

Brian A. Coffman
Department of Psychiatry
University of Pittsburgh School of Medicine

Outline

What is brain stimulation?

How can brain stimulation be used therapeutically in schizophrenia?

Ongoing research at UPSOM

What is Brain Stimulation?

Early Torpedo Fish
Brain Stimulation
153 AD – 6th Century AD
What is Brain Stimulation?

Thompson, 1910
Barker, 1985
Nexstim, 2015

Therapeutic Brain Stimulation
A New Avenue for Clinical Translation of
Neuroimaging Research?

- Number and cost of funded proposals mentioning “fMRI” funded through NIH, 2005–2016 (from NIH RePORTER)
  - 14,233 projects and subprojects
  - Total = $6,152,143,137
Therapeutic Brain Stimulation
A New Avenue for Clinical Translation of Neuroimaging Research?

- Neuroimaging correlations can only be used to make inferences about causality
- Imaging has not provided many treatment benefits for community medicine, especially for mental health
- Stimulation provides new ways to apply information gained by neuroimaging

Therapeutic Brain Stimulation - TMS
Lasting effects of stimulus frequency
- TMS to motor cortex (single/ repeated pulses)
- EMG recording from muscle

Baseline

High frequency
rTMS increases excitability

Low frequency
rTMS reduces excitability

Choosing the right dose – the MEP
# Therapeutic Brain Stimulation - TMS

<table>
<thead>
<tr>
<th>ADHD</th>
<th>Fibromyalgia</th>
<th>Schizophrenia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addiction</td>
<td>Learning</td>
<td>Stroke</td>
</tr>
<tr>
<td>Alzheimer Disease</td>
<td>Migraine</td>
<td>Recovery</td>
</tr>
<tr>
<td>Autism</td>
<td>Multiple</td>
<td>TBI</td>
</tr>
<tr>
<td>Bipolar Disorder</td>
<td>Sclerosis</td>
<td>Tinnitus</td>
</tr>
<tr>
<td>Depression*</td>
<td>Parkinson's Disease</td>
<td>Tourette's Syndrome</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>PTSD</td>
<td></td>
</tr>
</tbody>
</table>

## Outline

What is brain stimulation?

How can brain stimulation be used therapeutically in schizophrenia?

Ongoing research at UPSOM
Schizophrenia

Prevalent
Lifetime prevalence: 1-5%

Debilitating
Positive Symptoms
Hallucinations
Suspiciousness
Delusions

Negative Symptoms
Diminished speech
Lack of motivation
Social impairment
Decreased emotional

Cognitive Impairments
Memory
Attention
Motor skills
Social cognition
Executive skills
Disorganized speech

Disease Burden

Top 10 Causes of Premature Mortality and/or Disability for Adults Age 15-44 years

<table>
<thead>
<tr>
<th>Cause</th>
<th>Both Sexes</th>
<th>% Total</th>
<th>Male</th>
<th>% Total</th>
<th>Female</th>
<th>% Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>13.8</td>
<td>12.1</td>
<td>HIV/AIDS</td>
<td>12.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depressive disorders</td>
<td>8.6</td>
<td>7.7</td>
<td>Depressive disorders</td>
<td>10.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road traffic accidents</td>
<td>4.9</td>
<td>6.7</td>
<td>Tuberculosis</td>
<td>2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol Use Disorders</td>
<td>3.0</td>
<td>5.1</td>
<td>Alcohol Use Disorders</td>
<td>3.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-inflicted injuries</td>
<td>2.7</td>
<td>3.7</td>
<td>Obstetric and midwifery</td>
<td>2.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron deficiency anemia</td>
<td>2.6</td>
<td>3.0</td>
<td>Maternal and neonatal</td>
<td>2.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>2.0</td>
<td>2.5</td>
<td>Suicidal behavior</td>
<td>2.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bipolar disorder</td>
<td>2.5</td>
<td>2.4</td>
<td>Self nflicted injuries</td>
<td>2.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Violence</td>
<td>2.3</td>
<td>2.1</td>
<td>Maternal and neonatal</td>
<td>2.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Economic Burden of Schizophrenia, 2013

- Direct Costs: $47 billion
- Health Care
- Non-Health Care

In 25–30% of cases auditory hallucinations are not treated by traditional antipsychotic drugs. - Shergill et al (1998)
Therapeutic Brain Stimulation – TMS for Auditory Hallucinations

- Low frequency (1 Hz, inhibitory) rTMS applied to left TPJ

rTMS and Clozapine are the only treatments with evidence of efficacy for treatment refractory psychotic symptoms

Brain Stimulation in Schizophrenia

Negative Symptoms:
- Reduced prefrontal cortex metabolism/volume

Sanfilippo et al. (2000) Arch Gen Psychiatry
Therapeutic Brain Stimulation – TMS for Negative Symptoms

- High frequency (10 Hz) rTMS applied to Prefrontal Cortex


Therapeutic Brain Stimulation – TMS for Negative Symptoms

Ngram