Transcranial Direct Current Stimulation Raises Glutamate Levels in Humans

Reports new study in Biological Psychiatry

Philadelphia, PA, September 19, 2016 – The notion that low levels of electrical stimulation applied to the scalp, barely enough to create a mild tingling sensation, could activate the brain is a relatively new and somewhat controversial idea. The technique, called transcranial direct current stimulation (tDCS) has been reported to modify mood, emotion, and cognition, yet researchers lack any evidence for how – or even if – it directly modulates brain activity. Still, some researchers see its potential for a new strategy to treat psychiatric disorders.

A new study in Biological Psychiatry is the first to measures changes in brain metabolism during tDCS. Led by senior author Shirley Fecteau of the Université Laval in Quebec, Canada, the study reports that tDCS increases levels of the neurotransmitters glutamate + glutamine—glutamate is the main activating chemical messenger in the brain—and N-acetylaspartate (NAA), an indicator of neuronal health. Both of these neurotransmitters support learning and adaptation in the brain.

“These interesting data provide chemical evidence suggesting that tDCS may activate the human cerebral cortex,” said John Krystal, Editor of Biological Psychiatry. “This type of change would seem to be critical for producing behavioral and perhaps therapeutic effects.”

In the study, the researchers applied a single tDCS session to 15 healthy participants for 30 minutes at a current intensity of 1 mA, considered a mild dose. They stimulated the prefrontal cortex, a brain region involved in behavior and cognition. During stimulation, the researchers acquired magnetic resonance spectroscopy scans to measure changes in neurotransmitter levels in the prefrontal cortex and in the striatum, an important region involved in many functions including reward and learning.

In participants who received tDCS, first author Antoine Hone-Blanchet measured a rapid increase in prefrontal NAA, within 15 minutes of stimulation, and in striatal glutamate + glutamine within 30 minutes. The levels returned to normal immediately at the end of the session. According to Fecteau, these results suggest that tDCS has a rapid but short-lived excitatory effect at and downstream from the stimulation site.

“These findings need to be replicated with greater sample size, but also compel for investigation on the neural effects of tDCS,” said Fecteau, noting that the scientific community and general population have been increasingly using tDCS over the prefrontal cortex in recent years.

Researchers still do not know the effects of repeated or longer-lasting stimulation on neurochemical activity, which may be beneficial or detrimental, depending on the user, said Fecteau. Understanding the potential impact of the tool, positive and negative, will help harness its utility for effective and safe use in healthy and clinical populations.

---
Notes for editors

Copies of this paper are available to credentialed journalists upon request; please contact Rhiannon Bugno at +1 214 648 0880 or biol.psych@utsouthwestern.edu. Journalists wishing to interview the authors may contact Shirley Fecteau at shirley.fecteau@fmed.ulaval.ca.

The authors’ affiliations, and disclosures of financial and conflicts of interests are available in the article.

John H. Krystal, M.D., is Chairman of the Department of Psychiatry at the Yale University School of Medicine, Chief of Psychiatry at Yale-New Haven Hospital, and a research psychiatrist at the VA Connecticut Healthcare System. His disclosures of financial and conflicts of interests are available here.

About Biological Psychiatry
Biological Psychiatry is the official journal of the Society of Biological Psychiatry, whose purpose is to promote excellence in scientific research and education in fields that investigate the nature, causes, mechanisms and treatments of disorders of thought, emotion, or behavior. In accord with this mission, this peer-reviewed, rapid-publication, international journal publishes both basic and clinical contributions from all disciplines and research areas relevant to the pathophysiology and treatment of major psychiatric disorders.

The journal publishes novel results of original research which represent an important new lead or significant impact on the field, particularly those addressing genetic and environmental risk factors, neural circuitry and neurochemistry, and important new therapeutic approaches. Reviews and commentaries that focus on topics of current research and interest are also encouraged.

Biological Psychiatry is one of the most selective and highly cited journals in the field of psychiatric neuroscience. It is ranked 5th out of 140 Psychiatry titles and 11th out of 256 Neurosciences titles in the Journal Citations Reports® published by Thomson Reuters. The 2015 Impact Factor score for Biological Psychiatry is 11.212.

About Elsevier
Elsevier is a world-leading provider of information solutions that enhance the performance of science, health, and technology professionals, empowering them to make better decisions, deliver better care, and sometimes make groundbreaking discoveries that advance the boundaries of knowledge and human progress. Elsevier provides web-based, digital solutions — among them ScienceDirect, Scopus, Research Intelligence and ClinicalKey — and publishes over 2,500 journals, including The Lancet and Cell, and more than 35,000 book titles, including a number of iconic reference works. Elsevier is part of RELX Group, a world-leading provider of information and analytics for professional and business customers across industries. www.elsevier.com

Media contact
Rhiannon Bugno
Editorial Office, Biological Psychiatry
+1 214 648 0880