Novel, Non-Invasive Approach to Driving Rhythmic Neural Activity to Control Brain Inflammation (#7773, 7832)

Reaches deep brain regions quickly and precisely to potentially treat brain injuries and diseases, inflammation, and more

This device precisely and non-invasively controls brain inflammation to induce a rapid immune response with the potential to radically transform the ability to treat brain diseases, injuries, and mood disorders; study inflammation in brain function; and promote healthy aging.

Developed by researchers at Georgia Tech, this novel approach delivers visual and/or auditory stimuli with millisecond precision to induce electrical activity by driving cells to fire together on short timescales. Driving the electrical activity in this manner increases functional connectivity in brain networks involved in memory, disorders, and disease (in humans) and increases expression of synaptic markers, that indicate connections between neurons (in mice).

The use of patterns of light and sound turning on and off with precise timing reaches deep brain regions beyond what standard non-invasive neural stimulation can access. This new method to non-invasively drive brain rhythms may enable new therapies to treat a wide variety of mental and neurological conditions in significantly less time than current interventions.

Benefits/Advantages

- **Reaches deep brain regions**: Drives rhythmic neural activity in deep brain regions that are unreachable by most non-invasive stimulation technology
- **Non-invasive**: Uses only lights and sound with precise timing and control
- **Fast response**: Effects are seen in 5 to 30 minutes rather than hours
- **Simple**: Provides light and audio sensory flickering that is simple and fast to implement, potentially even in at-home settings
- **Flexible**: Stimulation increases or decreases immune responses depending on the frequency of stimulation

Potential Commercial Applications

This novel approach has the potential to treat:

- Brain diseases, injury, and infection

- Cognitive loss and the effects of normal brain aging
- Depression and anxiety disorders
- Other disorders that involve inflammatory signaling, the brain's immune response, and neural activity
- Neurodegenerative diseases

Background/Context for This Invention

Brain inflammation is thought to play a critical role in multiple diseases, including neurodegenerative disease, traumatic brain injury (TBI), normal aging, and development disorders like schizophrenia and autism, among others. Methods to precisely and non-invasively modulate brain inflammation and gene/protein expression will radically transform the ability to treat diseases and promote healthy aging as well as to produce model systems to study inflammation and immune signaling in brain function. This Georgia Tech innovation is designed to provide this capability.

How It Works
The sensory stimulus triggers a rapid change (<15 minutes) in a subset of inflammatory pathways, followed within an hour by an increase or decrease in production of inflammatory cytokines known to regulate microglia (immune cells), with the direction of change dependent on the frequency of stimulation (in mice). Driving neural activity, therefore, may enable manipulation of molecular signaling in the brain to control inflammation.

Annabelle Singer
Assistant Professor – Georgia Tech School of Biomedical Engineering

Abigail L. Paulson
Graduate Student - Georgia Tech Singer Lab

Levi Wood
Assistant Professor – Georgia Tech School of Mechanical Engineering

More Information

International Application Filed - PCT/US2019/021701

U.S. Number: 62/640,736

Publications

Gamma Visual Stimulation Induces a Neuroimmune Signaling Profile Distinct from Acute Neuroinflammation, Journal of Neuroscience, February 5, 2020

A feasibility trial of gamma sensory flicker for patients with prodromal Alzheimer's disease, Alzheimer's & Dementia: Translational Research & Clinical Interventions, May 13, 2021

Prof. Annabelle Singer on Gamma Sensory Flicker Therapy Tackling Alzheimer’s – Our Longevity Futures, with Chris Curwen | Ep. 9, Our Longevity Futures, Gowing Life, June 24, 2021

Researcher Annabelle Singer models an experimental visor and earphones that play 40 Hertz light and sound. Photo credit: Georgia Tech/Allison Carter

,

A flickering light strip used to expose mice to 40 Hertz light stimuli in Annabelle Singer's lab. The exposure triggered very strong releases of signaling chemicals in the brain. Photo credit: Georgia Tech/Allison Carter

For more information about this technology, please visit:
https://licensing.research.gatech.edu/technology/novel-non-invasive-approach-driving-rhythmic-neural-activity-control-brain-inflammation