New study shows how tests of hearing can reveal HIV's effects on the brain

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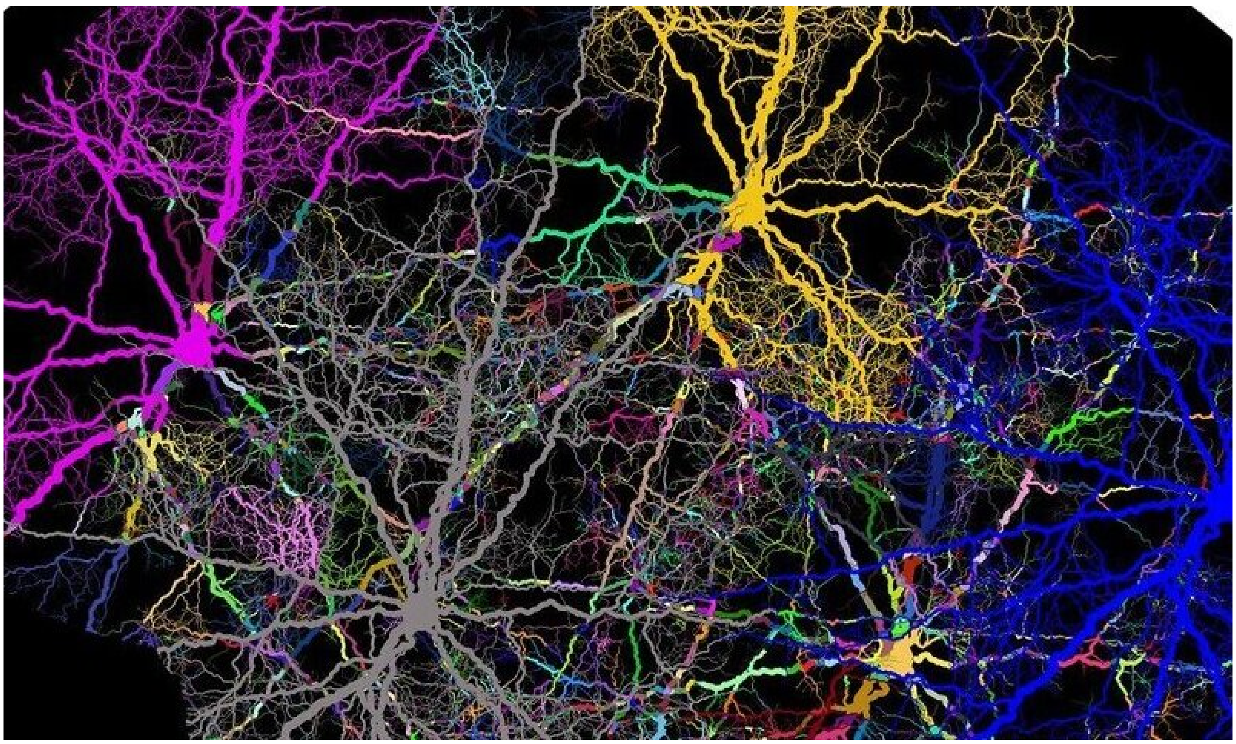

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Even with effective anti-retroviral therapy, patients infected with the Human Immunodeficiency Virus (HIV) sustain central nervous system damage. Whether these problems can be mainly attributed to the disease, its treatments, or the body's immune responses is still being debated, but detecting these changes early and reliably is difficult.

Findings from a new study published in *Clinical Neurophysiology*, involving a collaborative effort between Dartmouth's Geisel School of Medicine and the Auditory Neuroscience Laboratory at Northwestern University, are shedding further light on how the brain's auditory system may provide a window into how the brain is affected by HIV.

"We've been performing a variety of hearing tests on an established cohort of HIV-positive patients in Dar es Salaam, Tanzania," says Jay Buckey, Jr., MD, a professor of medicine at Geisel who co-led the study. "Initially, we thought we'd find that HIV affects the ear, but what seems to be affected is the brain's ability to process sound."

To test this hypothesis, the researchers used what's called a speech-evoked frequency-following response (FFR). In this test, brain waves are recorded from scalp electrodes (as in an electroencephalogram) while sounds common to everyday speech, like "ba," "da," or "ga," are played into the ear. This offers an objective, non-invasive way to record brain waves and assess the brain's auditory functions.

"There are many acoustic ingredients in speech, such as pitch, timing, harmonics, and phrase," says Nina Kraus, Ph.D., Hugh Knowles Professor of Communication Sciences and Neurobiology at Northwestern, who co-led the study with Buckey. "The FFR enables us to play speech sounds into the ear of study participants and figure out how good a job the brain is doing processing these different acoustic ingredients."

When comparing the FFR results of 68 HIV-positive adults to 59 HIV-negative adults, the investigators found that the auditory-neurophysiological responses to certain speech cues were disrupted in HIV-positive adults, even though they performed normally on hearing tests—confirming that these hearing difficulties are grounded in the central nervous system.

"When the brain processes sound, it's not like a volume knob where all of the acoustic ingredients are either processed well or poorly," Kraus explains. "With the FFR, we're able to see which aspects of auditory processing are affected or diminished and ask, 'Is there a specific neural signature that aligns itself with HIV?'"

That's why the researchers envision the FFR as a viable tool for further understanding not only the mechanisms of brain dysfunction associated with HIV, but also other disorders that affect the brain such as concussion, Alzheimer's disease, and the Zika virus infection.

"Typically, if you want to assess cognitive function, you're going to do things like have people do math problems, remember a list of words, work on some sort of puzzle or task, or do a drawing," says Buckey. "It requires people who are trained in doing this kind of testing, and the tests may be fairly specific to the language people speak and the culture they come from.

"What's significant about our results is that the test doesn't require any actions on the patient's part; it's recorded passively—subjects can even sleep or watch a movie," he says. "We think the FFR holds a lot of promise as a way to assess the brain easily and objectively."

More information: Travis White-Schwoch et al, Auditory neurophysiology reveals central nervous system dysfunction in HIV-infected individuals, *Clinical Neurophysiology* (2020). DOI: 10.1016/j.clinph.2020.04.165

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