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To Your Health

A hearing test may be able to identify a concussion

By [Amy Ellis Nutt](#) December 22, 2016 [✉Email the author](#)

Call it the Telltale Brain. The first objective measurement for concussion may have been identified, according to a study published Thursday in the journal [Nature, Scientific Reports](#).

By measuring the brain's electrical reactions to speech sounds, researchers at Northwestern University were able to identify children who had suffered a recent concussion with 90 percent accuracy and those who hadn't with 95 percent accuracy.

[Heading a soccer ball causes instant brain changes, study finds]

The study was small, with just 40 subjects, ages 8-15, recruited from the Institute for Sports Medicine at Ann & Robert H. Lurie Children's Hospital of Chicago. But the children who had been diagnosed with a concussion showed a distinct neural signature, compared with a control group of children with no concussion history.

Three sensors attached to the scalp measured the "frequency following response," electrical signals in the brain evoked by listening to speech. The brains of the concussed children registered smaller and slower responses to the pitch of a speaker's voice than the control group. The scientists also found that for 11 of the 20 concussed children who came for follow-up visits, auditory processing improved with recovery from the brain injury.

"This is a unique and altogether new biomarker," said [Nina Kraus](#), the lead researcher and a professor in the hospital's communication sciences, neurobiology and otolaryngology departments.

Auditory processing, she said, is 10 times faster than visual processing and involves multiple brain systems, and that is what makes it a sensitive marker of neurological damage.

"It is the most precise, most complicated computational work the brain has to do. So it's not surprising that auditory processing can be used as a measure of brain health. ... Sometimes the power of sound is understated. But we know the brain has to do extremely fast, precise processing of sound that's just not required of us when we process other information."

Currently, the clinical criteria for a diagnosis of concussion are largely subjective, involving myriad neurological and cognitive tests.

[Texas launches largest concussion study of youth athletes]

For this study, children in the concussion group were evaluated an average of 27 days after injury. All had met the clinical diagnostic criteria for concussion after suffering injuries, primarily in sports (basketball, football, hockey, soccer, softball, volleyball and cheerleading). Eleven were evaluated during a follow-up visit to the clinic, where they were retested. Although only one subject was fully recovered at that time, all reported a reduction in their symptoms, which was accompanied by a 30 percent increase in the frequency following response.

“This is very exciting research,” said Daniel Corwin, a pediatric emergency physician at Children's Hospital in Philadelphia who was not involved in the study. “One of the challenges in pediatric concussion management today is identifying objective criteria to both diagnose and follow the progress of a concussion, and the authors present a potentially very useful objective marker of injury.”

“I would be very interested in seeing patients evaluated for auditory processing deficits within 24-48 hours following injury,” said Corwin, who is also an associate fellow at the Center for Injury Research and Prevention at Children's Hospital.

“Ultimately, this line of research shows incredible potential in helping to improve our care of concussed children.”

[What many football players have in common with Henry VIII: Brain damage]

Sound processing has been used to look at other disorders and social situations, including linguistic deficits and poverty, but Kraus's team is the first to look at brain response to complex sounds with “such granularity,” she said.

“Our life in sound shapes the response our brain will give to sound,” said the neurobiologist. “If part of that experience is having a head impact, that's going to affect this delicate processing.”

Sound shapes our lives and the meaning we extract from our experiences, Kraus said. The science of sound is a passion she comes by naturally. She grew up with a mother who spoke Italian in the home and played the piano. Today, she is multilingual and plays three instruments. Not surprisingly, her favorite way of “reading” books is audio. As she said, “We say, ‘I love the sound of your voice for a reason.’ ”

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Amy Ellis Nutt



Amy Ellis Nutt covers neuroscience and mental health for The Washington Post. She won the Pulitzer Prize in feature writing in 2011 and previously worked at the Star-Ledger in Newark, NJ and Sports Illustrated. Follow 

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