

Biometric Audiology: Docking with the Brain

By Dennis A. Colucci, AuD, MA

Innovative ideas applying biosensing technology to audiology are offering a glimpse into the future of a new gold standard.

For example, at the 2015 Annual Hearing Conference of the National Hearing Conservation Association in New Orleans, Vishakha W. Rawool, PhD, from the Department of Communication Sciences and Disorders at West Virginia University, proposed combining recent advances in technologies such as the Biostamp and stimulus reconstruction to measure speech recognition skills objectively.

The Biostamp is a flexible sensing sticker with an electrode array. It is coupled to a processor via wireless telemetry and functions without a conventional power supply or battery.

Other investigators have developed techniques to record neural responses from the auditory cortex in response to speech stimuli, Dr. Rawool noted. In one example, electrode arrays were implanted on the superior and middle temporal gyrus, and words and nonwords were presented to the participants to evoke neural responses. The neural data was then reconstructed into spectrograms that could be used for correlation to the incoming signal without input from the patient (*PLoS Biol* 2012;10[1]:e1001251).

Improvements are needed before this technique becomes clinically feasible because the sound recordings of the reconstructed responses had poor speech intelligibility, Dr. Rawool noted. Stimulus reconstruction has also been reported by Nina Kraus, PhD, from recordings of the auditory brainstem response to complex sounds (cABR) of speech and music (bit.ly/cABR-Kraus).

NOW AVAILABLE: BIOSENSING

Biosensing technology has a variety of mainstream futuristic applications. In fact, the technology is already available to the public from companies like NeuroSky, which produces an EEG headset and app designed to help improve attention.

In gaming, new biometric technology will be able to control the experience and heighten the participant's interaction, reports the Computer Electronics Association's blog (CEABLOG; bit.ly/CEABLOG). In fact, Sony has a patent for a game controller that monitors biometrics such as heart rate, perspiration, and body movements.



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NeuroSky

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In a more clinical sense, the ADHD Society is combining forces with U.K.-based Myndplay in an effort to improve emotional intelligence in ADHD patients by integrating advanced EEG technology with video training (bit.ly/ADHD-Myndplay).

SEEING THE FUTURE

With the creation of the cABR and the collaborative work done by Dr. Kraus; Samira Anderson, PhD, now of the University of Maryland; and many others, the idea of using auditory evoked potential biomarkers to evaluate hearing aids objectively has already been elucidated (*Int J Otolaryngol* 2013;604729).

As the beginning of a new era in hearing devices unfolds, the use of auditory system biomarkers to adjust hearing device parameters, qualify performance, and verify marketing claims will become the gold standard.

The ability to translate the distinctive features of speech and environmental sounds into prescriptions that are sensitive to timing, spectral and spatial cues, harmonics, noise, etc., without damaging the signal envelope will make individual prescriptions so accurate and brain friendly that superior outcomes will be the norm.

Maybe within 50 years, miniaturization and technology advances will mean that hearing devices not only can provide biometric data to correlate environmental input and EEG measures, but also will be able to project signals directly into the brain, bypassing the dead zones in the cochlea and the effects of auditory neuropathy or even cortical damage. 