

# The HEARLab System

## Cortical Evoked Potential Analyzer

### What are Cortical Measurements?

Cortical Auditory Evoked Potential (CAEP) measurements are used to estimate whether sounds are easily detectable by the patient. HEARLab provides the audiologist with an easy to use method of performing this measurement.

A transducer such as an insert earphone, bone vibrator, or sound field speaker is used to deliver test signal to the patient. Electrodes placed on the patient's head measure the cortical response. A statistical analysis of each response (a "p-value") is automatically calculated to determine the likelihood that the patient detected the test signal. The audiologist can verify this analysis with a visual examination of the measured cortical response.

CAEP can be tested on patients who are unable or unwilling to communicate to the clinician about whether they can hear a signal. This could include infants who have not yet developed language skills, and adults who are disabled or uncooperative. The relationship between the presence of cortical responses and the audibility of sounds has so far been established only for infants aged 8 to 30 months and for adults aged 43 to 89 years. Cortical measurements are performed when the patient is alert and awake. Adults can be entertained during the test with reading material or a silent DVD. Infants can be entertained with quiet toys.

Previous to HEARLab, cortical measurements have only been available to audiologists with access to expensive research laboratory equipment. HEARLab has been developed over the last several years by the staff at the Australian National Acoustics Laboratory (NAL) with the idea that advanced auditory testing needs to be available at the clinical level at an affordable price. HEARLab is also designed to allow the addition of significant additional measurements in the future as advances are made in the field.

### Applications of HEARLab in Pediatric Audiology

The widespread use of infant hearing screening has identified hearing loss in children at much younger ages than ever before. While greatly improving the hearing health care of these children, this practice has also brought new challenges to pediatric audiologists providing amplification for patients who do not have the ability to respond to the question, "How does that sound?"

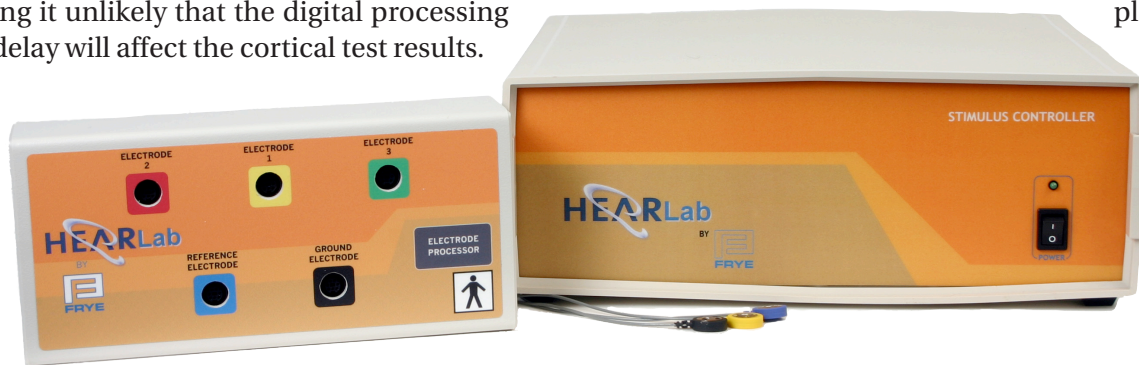
After a child has been diagnosed with a hearing loss using otoacoustic auditory emissions (OAE) and auditory brainstem response (ABR) tests, the child may be fitted with hearing aids. This creates a challenge for pediatric audiologists: real-ear (and simulated real-ear) measurements can be used to measure the amplification provided by the hearing aid, but it is difficult to determine if that



amplification is providing a benefit to the patient. One possible solution would be to perform an aided ABR test on the child. However, ABR testing has some fundamental drawbacks when performed with hearing aids.

Most digital hearing aids have a digital processing delay of at least 3 milliseconds (ms), and some digital hearing aids have a delay of more than 10 ms. Since the neural signal in the ABR test is received a few milliseconds after the reception of the auditory test stimulus, the delay of the digital hearing aid can interfere with the certainty of the ABR result. The ABR test also uses a short impulse stimulus type that is not speech-like and may not be processed properly with a hearing aid. In fact, the energy of the ABR impulse signal can actually momentarily saturate the hearing aid circuitry. Together, these issues mean that ABR cannot always accurately determine whether a patient is able to hear the amplification provided by the hearing aid.

Cortical testing, however, is a suitable solution in determining the neural response of the patient to aided auditory signals. The primary cortical waveforms arise around 100 to 300 ms after a signal is presented to the patient. This is several orders of magnitude greater than the timing in an ABR test. This much longer timeframe gives even the slowest digital hearing aid plenty of time to process the signal, making it unlikely that the digital processing delay will affect the cortical test results.



And unlike ABR, cortical testing can use a variety of test stimuli, including speech-like signals that are easily processed by hearing aids and should not saturate their circuitry.

## Aided Cortical Assessment Module

The Aided Cortical Assessment (ACA) module is used to evaluate whether speech is audible to the wearer of a hearing aid. Three speech stimuli with low (/m/),

medium (/g/), and high (/t/) frequency emphasis are presented to the patient in the free-field at input levels ranging from 55 to 75 dB SPL. These signals have a presentation time long enough to activate the compression circuits of a hearing aid, making it an effective tool for determining whether the amplification produced by the hearing aid provides a signal that is actually detectable at the cortical level of the patient. The unaided response of the patient can also be measured, allowing the clinician to compare the unaided and the aided cortical responses.

## Cortical Tone Evaluation Module

The Cortical Tone Evaluation (CTE) module provides audiologists with a tool to evaluate the audibility of highly frequency-specific tones in adults who are unable or unwilling to participate in regular pure tone audiometry assessments. Air and bone audiometric test tones are presented to the patient from 500 to 4000 Hz, 0-110 dB HL (air), and 0-70 dB HL (bone). Masking may be applied to the non-test ear as appropriate.

The CTE Module will not replace standard audiometric tests produced by a clinical audiometer, but it will provide a great tool that can be used when the standard testing methods are not possible or practical.

## Important Note

Several studies have shown that a small proportion of people do not exhibit a strong CAEP even when the stimulus is audible. Clinical studies done with HEARLab ACA on children and with CTE on adults have also shown results in line with these studies. The HEARLab system is intended as an adjunct to the assessment of hearing, not as a replacement for other methods of hearing assessment.



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