What is the CE-Chirp® and what are its benefits?

In all evoked potentials, synchronization of the nerve fiber firing is important to generate a large amplitude ABR waveform. However, using traditional click stimuli makes this task difficult due to the well-known cochlear travel delay whereby frequency areas of the cochlea are stimulated one after the other (Cebulla et al., 2007; Dau et al., 2000, Elberling et al., 2007). The CE-Chirp® is a family of stimuli designed to compensate for this cochlear travel delay and provide enhanced neural synchronicity. The stimuli family includes a broadband CE-Chirp® as well as narrow band CE-Chirp® stimuli for frequency specific testing.

The original proposed method for overcoming the cochlear travel delay was using output compensation, first described by Don et al., in 1994 and typically known as the Stacked ABR. While this method clearly demonstrates that compensation for the travel delay produces a significantly larger amplitude of the ABR than that of a click-ABR (Don, Elberling & Maloff, 2009, Elberling et al., 2007), the method is impractical in a clinical setting due to the time it takes to record the narrow bands, shift and summate them.

Recently, a much more clinically acceptable method using input compensation has been implemented into diagnostic equipment. Input compensation involves using a stimulus which delays the input of the higher frequency components of the click stimulus relative to the lower frequencies. This reshuffled click is known as a chirp and the input delay of the various frequency components of a chirp stimulus are based on a model of the travelling wave. The arrival of each frequency component at its place of maximum excitation along the cochlear partition is delayed so that all components arrive at approximately the same time. In turn, higher temporal synchronization of the elements that contribute to the evoked response is achieved and a larger amplitude ABR is produced (Don, Elberling & Maloff, 2009, Cebulla et al., 2007, Elberling et al., 2007).

But are all chirps alike? The short answer is no. While it is well reported that greater ABR amplitudes are achieved with various chirp stimuli compared to the 100us click (Dau et al., 2000, Cebulla et al., 2007, Elberling et al., 2007), differences in the performance of a chirp are primarily based on the delay model used (Elberling et al., 2008).

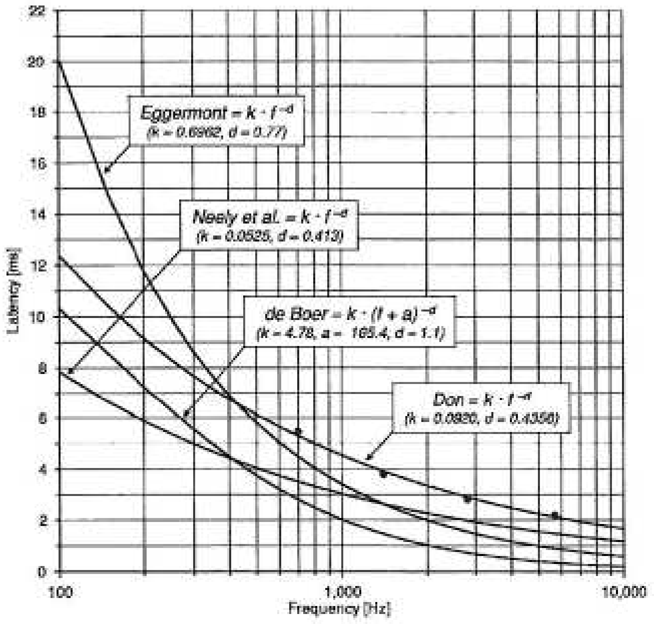

Figure 1: Latency-frequency functions/delay models – borrowed from Elberling et al., 2007.

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leading diagnostic solutions

The CE-Chirp® has been refined over the years based on extensive human studies by Claus Elberling, the man who the CE-Chirp® has been named in honor of. These studies show that the CE-Chirp® is based on a delay model that has the best match for the average human cochlea at intensities close to threshold. For the clinician, this means larger amplitudes waveforms are obtained allowing for easier threshold identification.

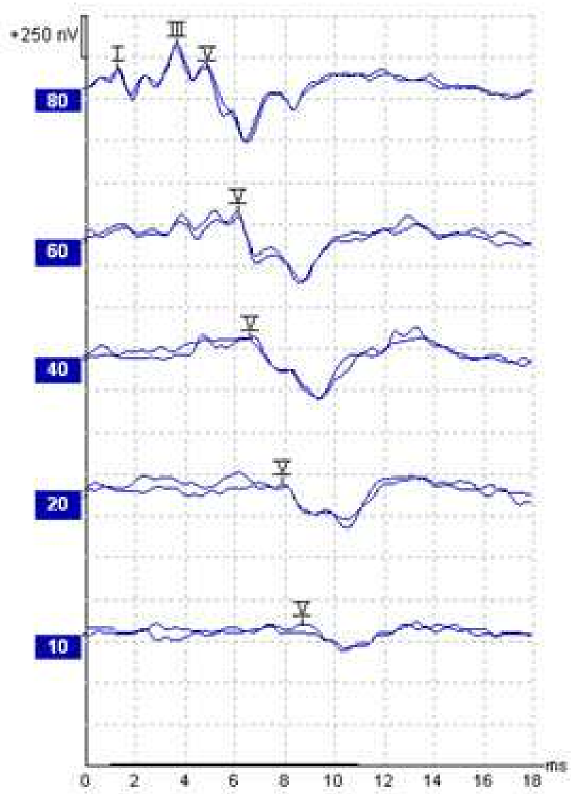
Interacoustics first implemented the CE-Chirp® in 2007 in the ASSR module of the Eclipse platform. Today, the broadband CE-Chirp® and the narrow band (NB) CE-Chirp® stimuli (alternatives to toneburst stimuli), have also been implemented in the Interacoustics Eclipse EP25 and the portable Titan ABR Infant Screening module.

So, what clinical benefits do the CE-Chirp® stimuli provide:

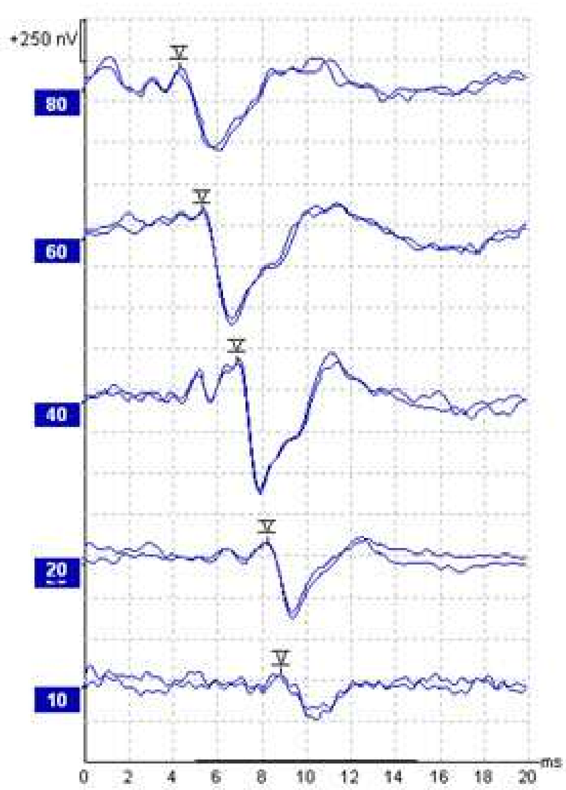
- Larger amplitude ABRs (typically double the response) making it faster and easier to detect thresholds at low intensity levels when performing screening or frequency specific testing (see Figure 2).
- Faster and more reliable detection during ASSR acquisition, especially close to threshold.
- Fast automated ABR detection for infant screening purposes – in-house testing indicates average detection times between 15 – 30 seconds during bilateral stimulation/recording.

The following illustrates the larger wave V response amplitudes achieved with the broadband CE-Chirp® compared to the traditional click stimulus.

Click waveforms



Broadband CE-Chirp® waveforms



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