

# The Frequency-Following Response

ONE TYPE OF AEP

# FFR

- The Frequency Following Response has been studied for many years.
- It is one of the Auditory Evoked Potentials
- It is usually evoked by tones
- It has not been used diagnostically until recently

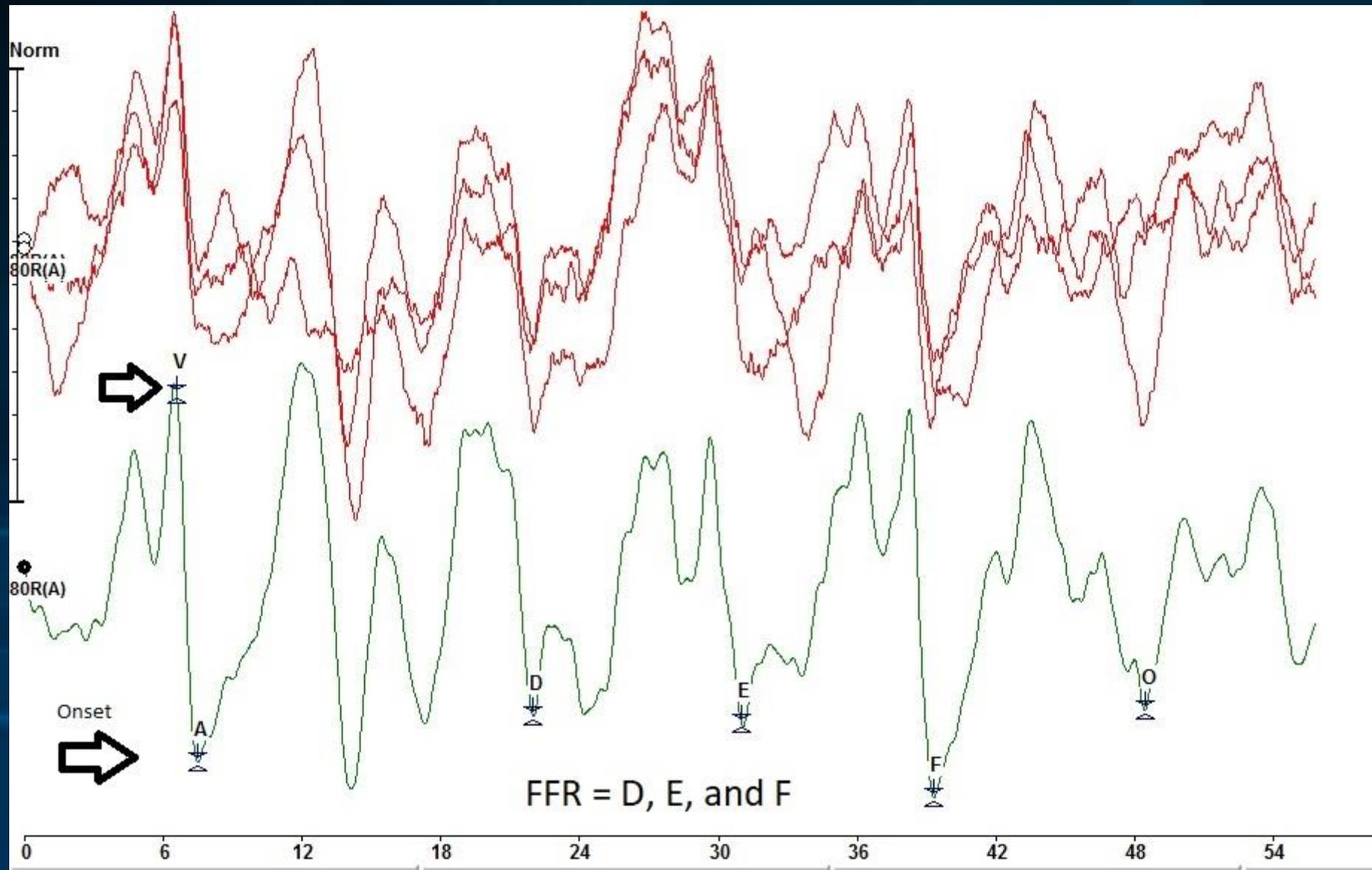
# Benefits of FFR as a diagnostic tool

(Kraus & Anderson 2016)

- Waveforms generated with FFR to speech syllables **reproduce** the fundamental frequency of a stimulus (as well as other information)
- The waveforms can be recorded from vertex (**not invasive**)
- The waveforms are highly **reliable**.
- The waveforms are **easily elicited** using standard clinical equipment already available
- The waveforms are **modified by experience** and can be used to track changes
- The waveforms are sensitive to **individual** differences

## FFR/cABR

- The ABR is defined as an “onset” neural activity. Because the syllables used as stimuli are all plosives, the FFR/cABR has an abrupt (transient) onset (plosive burst) like the traditional ABR response.
- However, because the syllable also has a sustained (vowel) portion, it resembles the Frequency-Following Response.
- Use of syllables allows examination through AEPs of brain’s response to both transients and tonic stimuli at same time.



# FFR: Represents Sustained Neural Activity

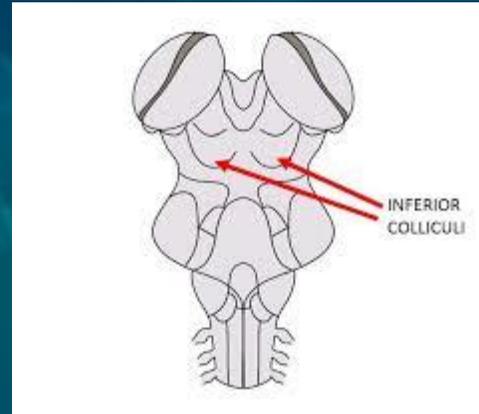
- The FFR reflects sustained brain activity integrated over a population of neural elements). It is generated at the brainstem.
  - The FFR is **phase-locked** to the individual cycles of the stimulus waveform, and/or the envelope of the periodic stimuli.
  - The FFR is characterized by **periodic peaks** whose intervals correspond to the period of the stimulus frequency (hence the name FFR).
  - The FFR can encode vocal pitch.
- The FFR is also small in amplitude (like the ABR) and can be recorded in the same way that the ABR is recorded

# FFR Spectrum and Amplitude

- The FFR spectrum includes significant energy at the harmonics of the fundamental frequency.
  - The scalp-recorded FFR can be evoked by tones or frequencies below 2000 Hz.
- The FFR increases in amplitude with increasing signal level up to about 65-75 dB SPL, and then asymptotes.

# FFR Generators

- The 6 ms latency between stimulation and onset of response of scalp-recorded FFR corresponds closely to the latency of Wave V, and suggests upper brainstem/inferior colliculus generator.



# Encoding Vowels

- Encoding of the first two formants of most vowels is sufficient for their identification, and the first two formants occur within the FFR frequency range.
- Information about certain acoustic features of speech sounds is preserved in the phase-locked activity among the population of brainstem neurons that contribute to the generation of the FFR.