

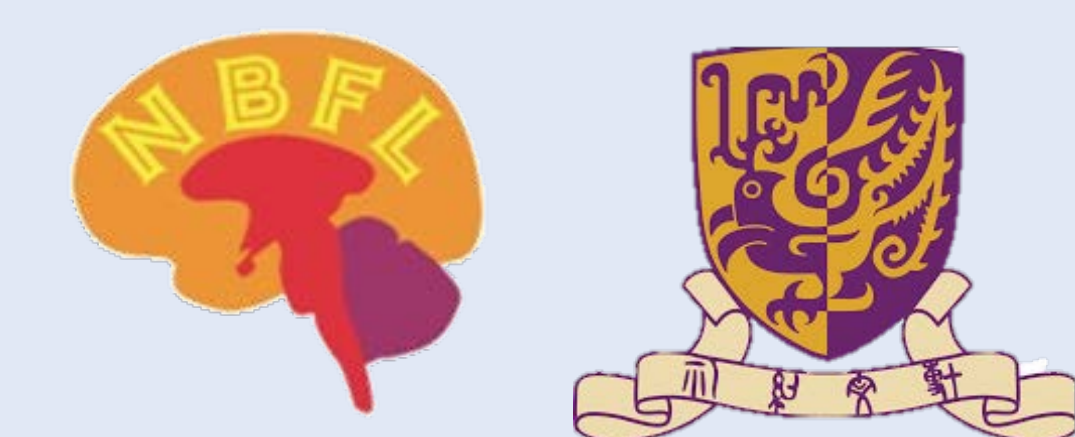
Timing Matters! – The Benefit of Temporal Fine Structure For Binaural Hearing with Cochlear Implants

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FENS Forum 2026
6-10 July 2026 | Barcelona, Spain

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Background Information:

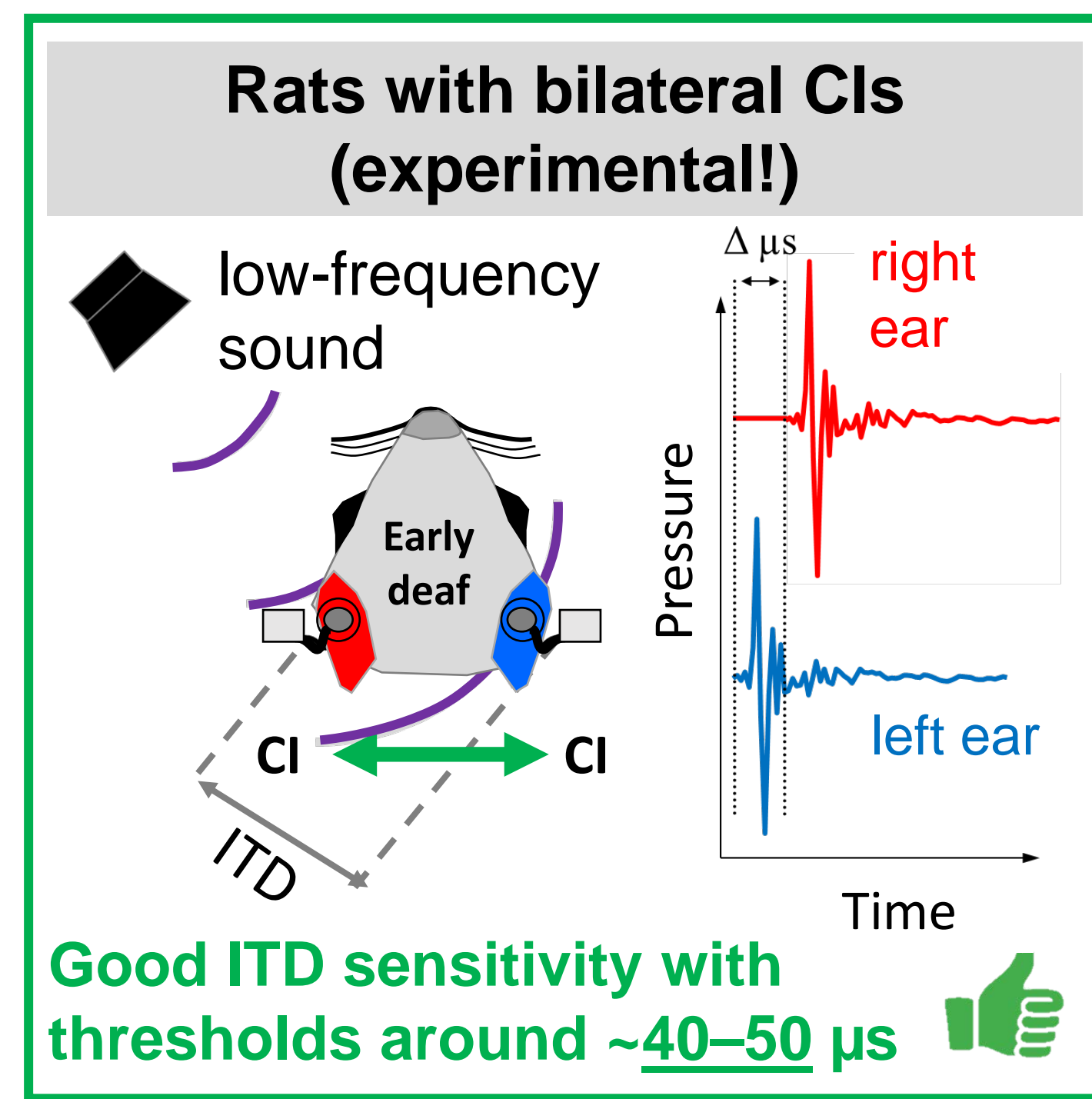
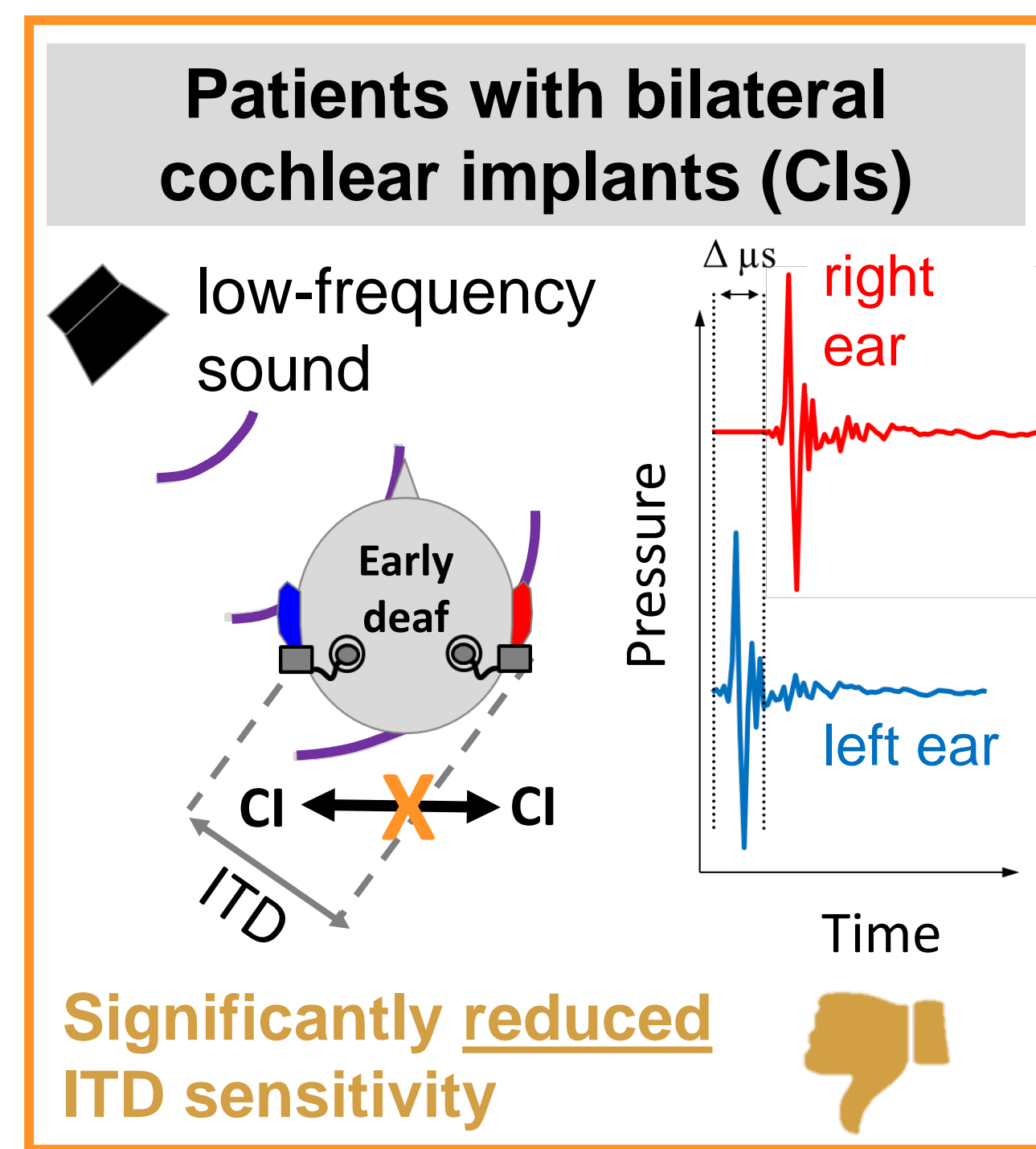
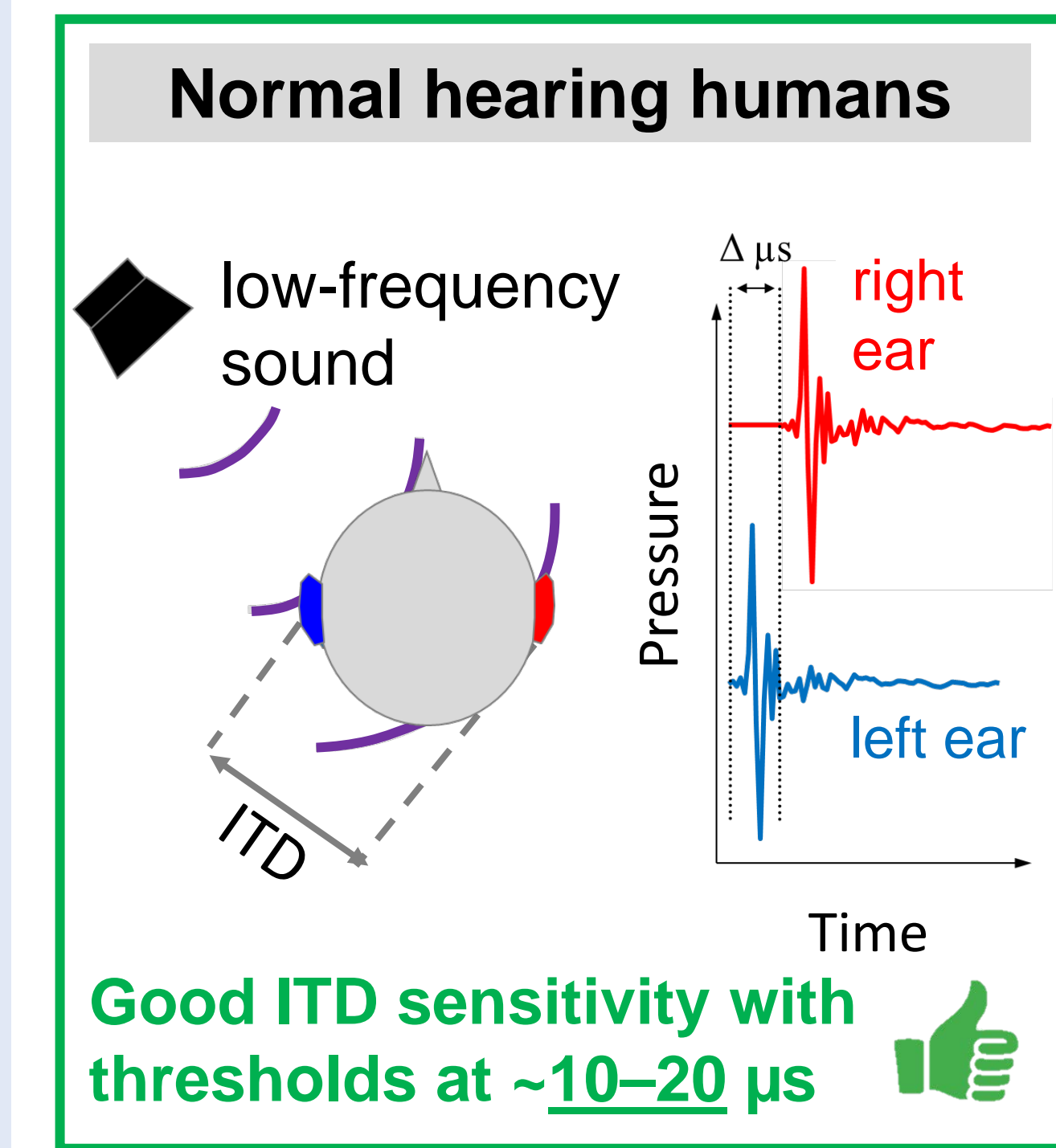
How does the brain compute the position of sound sources?

→ For example, by comparing μ s timing differences between the ears (ITDs)

Problem: Most cochlear implants (CIs) do not transmit timing cues

Research Question:

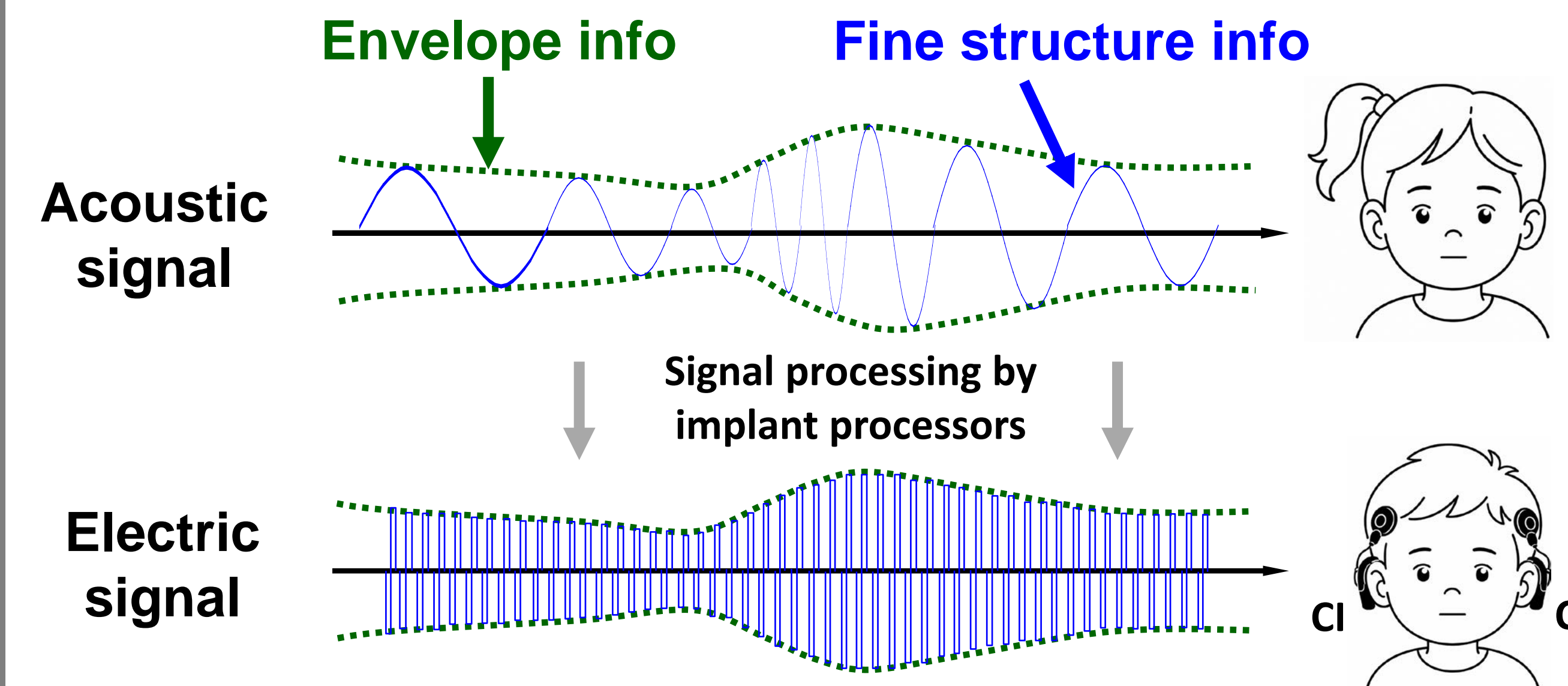
Does preserving **fine structure** information improve spatial hearing with CIs?



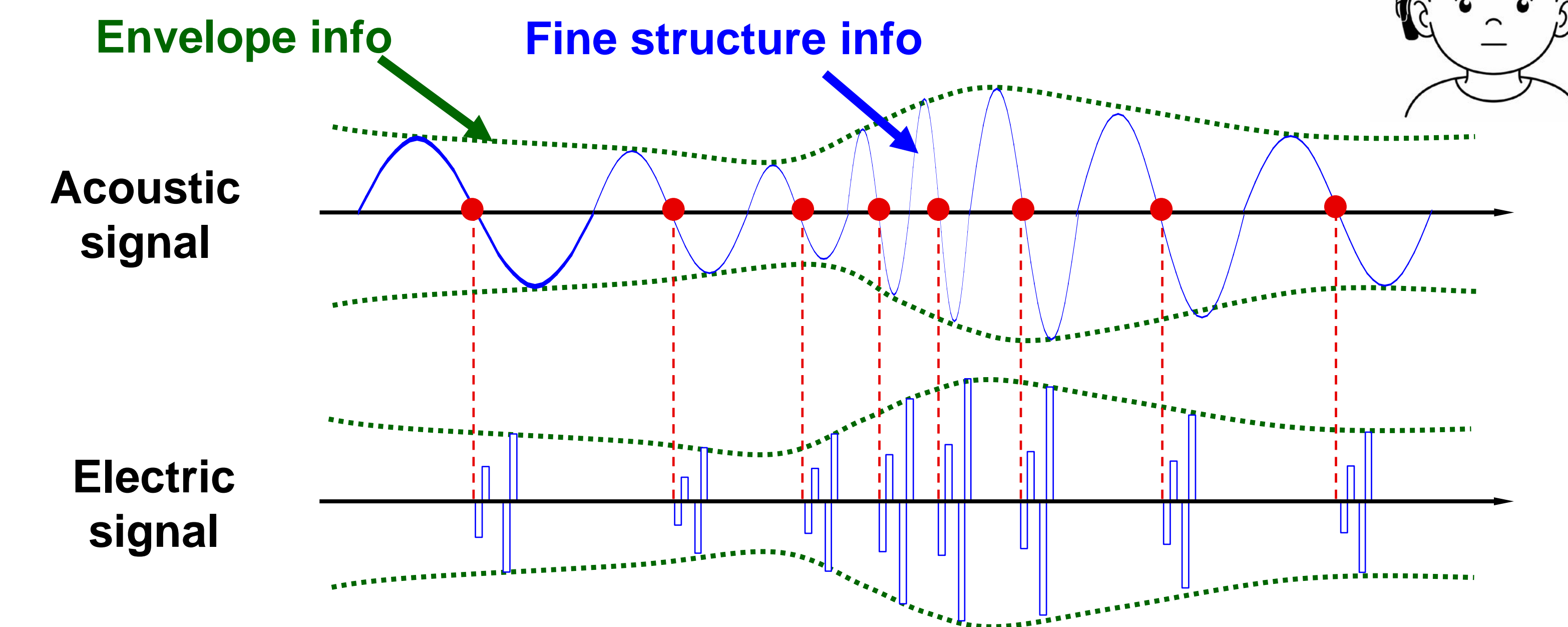
Zwislocki and Feldman (1956)

Ehlers et al. (2017)

Rosskoth-Kuhl et al. (2021);
Buck, Rosskoth-Kuhl et al. (2023)



- Envelope coding in all CI stimulation channels
- No coding of the temporal **fine structure**!
- CI patients do not experience **pulse timing ITDs**!



First clinical fine structure stimulation strategy:

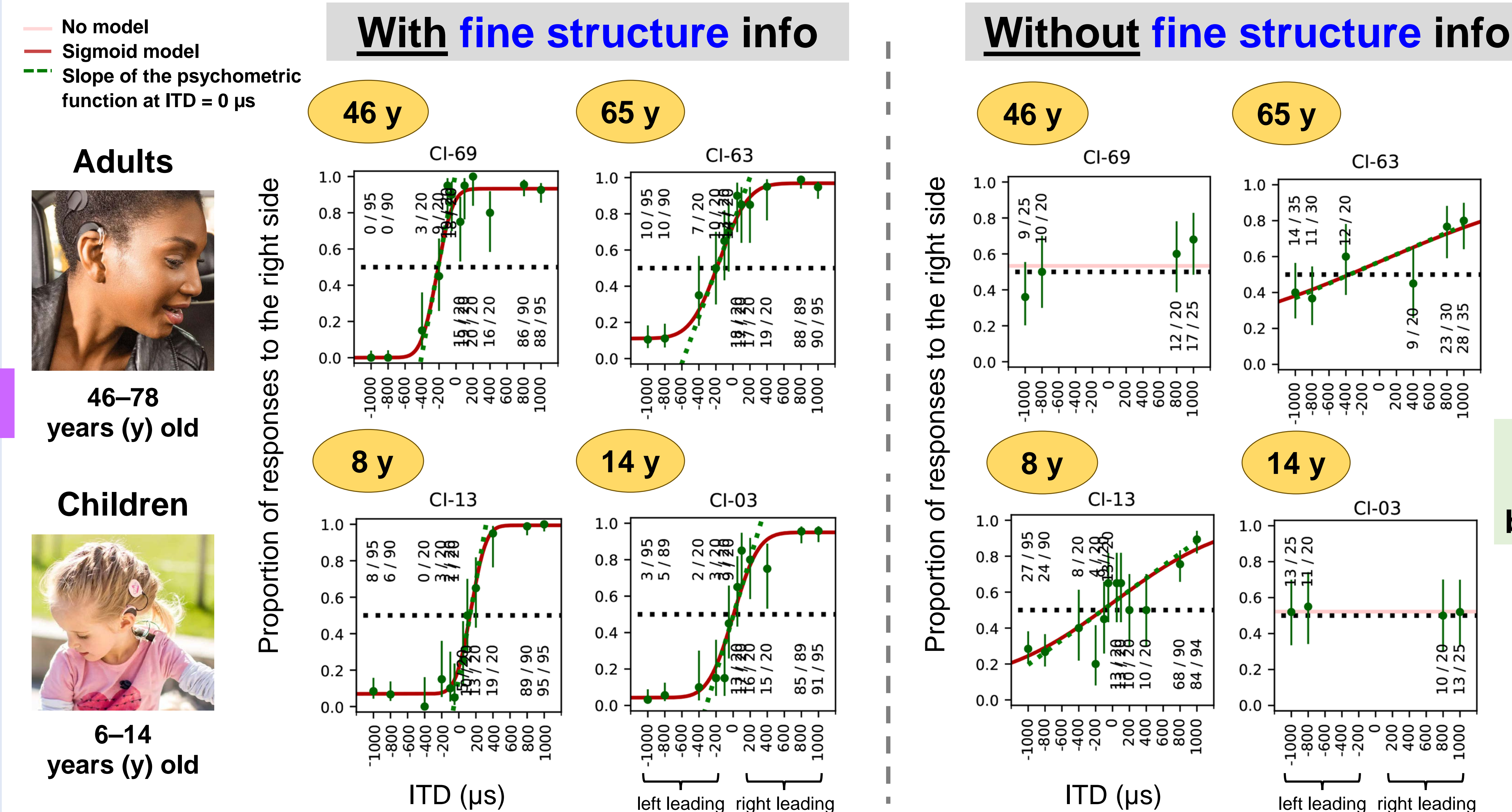
- Envelope coding in all stimulation channels
- **Fine structure coding in pulse timing** of some channels!
- CI patients experience **pulse timing ITDs**!

Take Home Messages:

- Spatial hearing is based on the integration of interaural timing cues within the microsecond range.
- A deaf auditory system is still capable of processing these timing cues independent of its early hearing experience.
- Preserving natural timing cues is critical for accurate binaural hearing with cochlear implants.



Results: Preserving temporal fine structure improves ITD sensitivity (= steep slope) in CI patients



Methods: Behavioral test of 21 bilateral CI patients for ITD sensitivity

10 adults, late deaf + CIs

➤ Left/right lateralization task
➤ ITDs of +/- 1000 μ s
➤ 250 Hz tone burst via audio-in port of CI processor
➤ stimulation strategies: with and without fine structure info

Psychometric analysis of behavioral data

Feedback from CI patients was provided via tablet

11 children, early deaf + CIs