

Frequency specific objective AEP-based assessment of hearing perception in noise

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Proyecto P21.00152



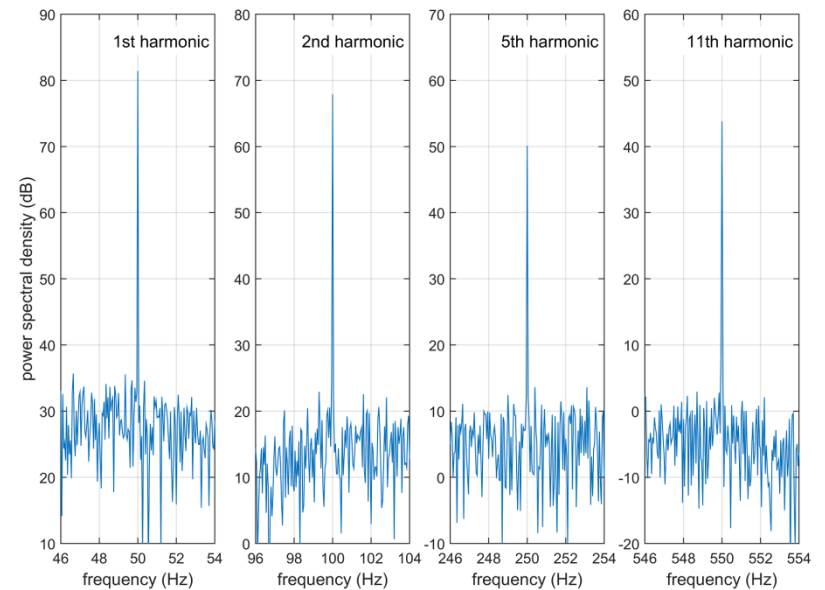
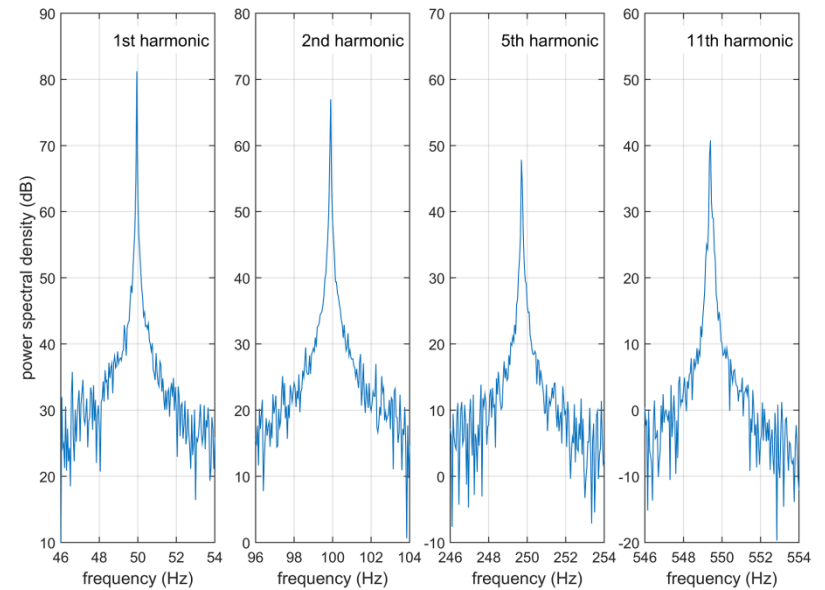
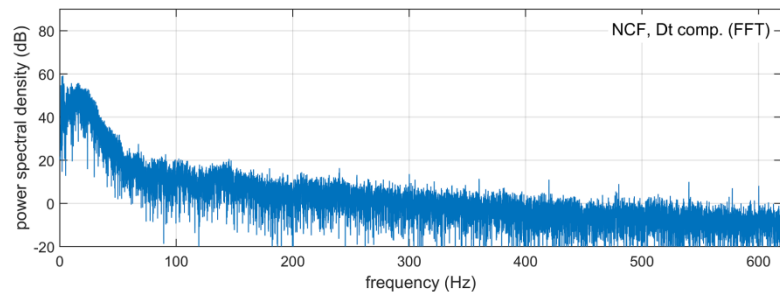
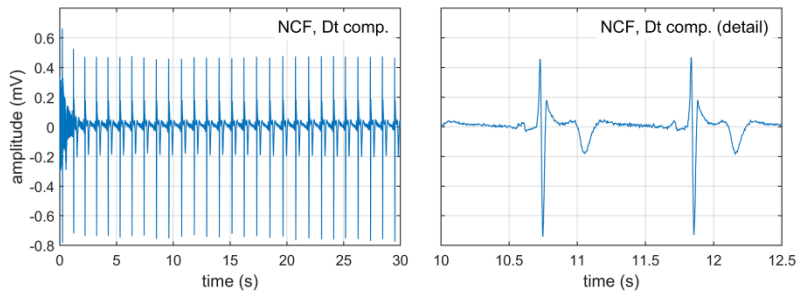
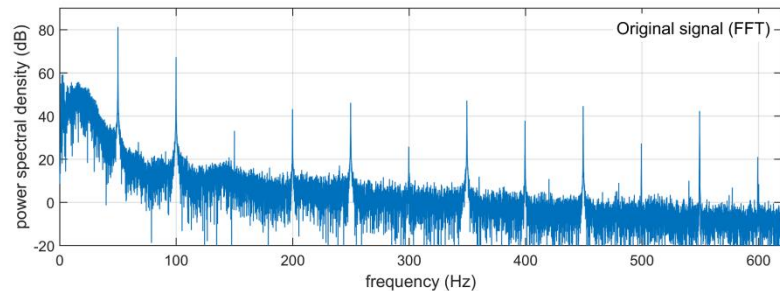
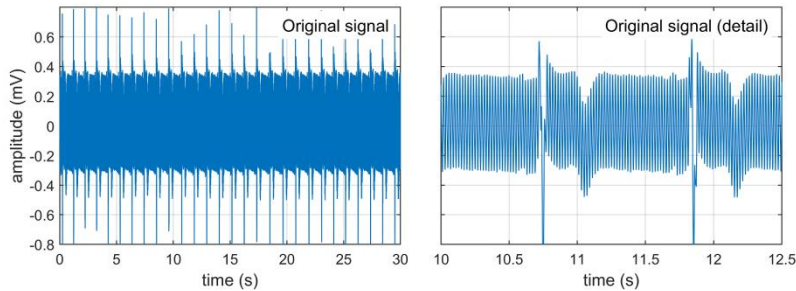
Motivation

- **Advanced procedures for AEP recording**
 - PLI reduction & flexible recording system
 - Simultaneous recording of early-late response
 - Multi-response deconvolution
- **Application to new experiments:**
 - Responses to tone burst of different levels
 - ABR+MLR
 - Noise conditions
 - Effect of noise? Age related differences?
- **Hearing perception in noise**

Overview of the presentation

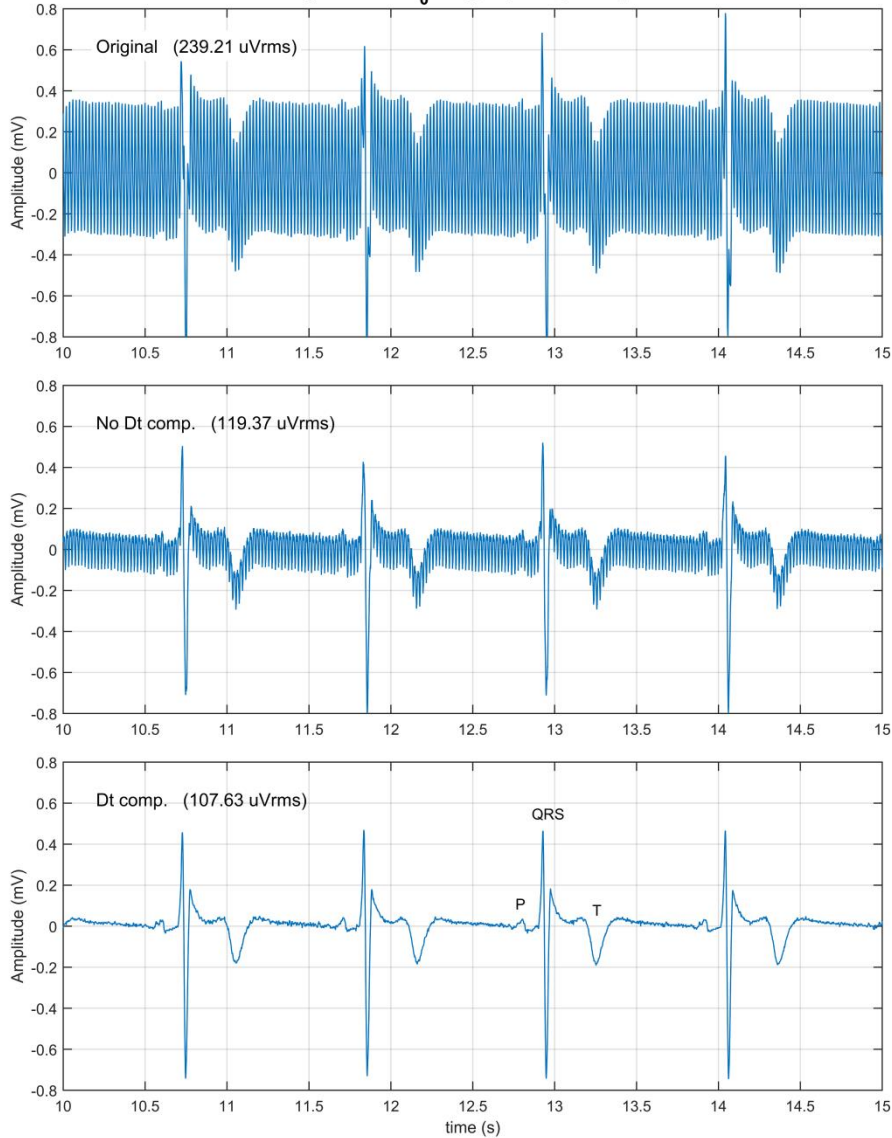
- **Recording procedure:**
 - Signal conditioning (PLI reduction)
 - Hardware
 - Latency range: ABR+MLR
 - Multi-response deconvolution
- **Stimulation pattern:**
 - Tone bursts 2 kHz (clean, noise, filtered noise)
- **Experiments:**
 - 10 subjects (age: 18 – 55)

AEP recording: PLI reduction (patent p.)

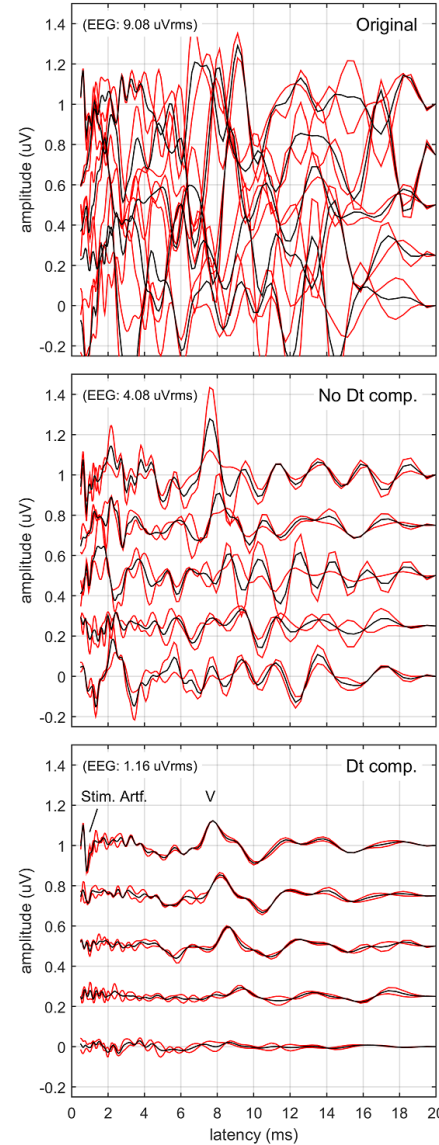


AEP recording: PLI reduction (article r.)

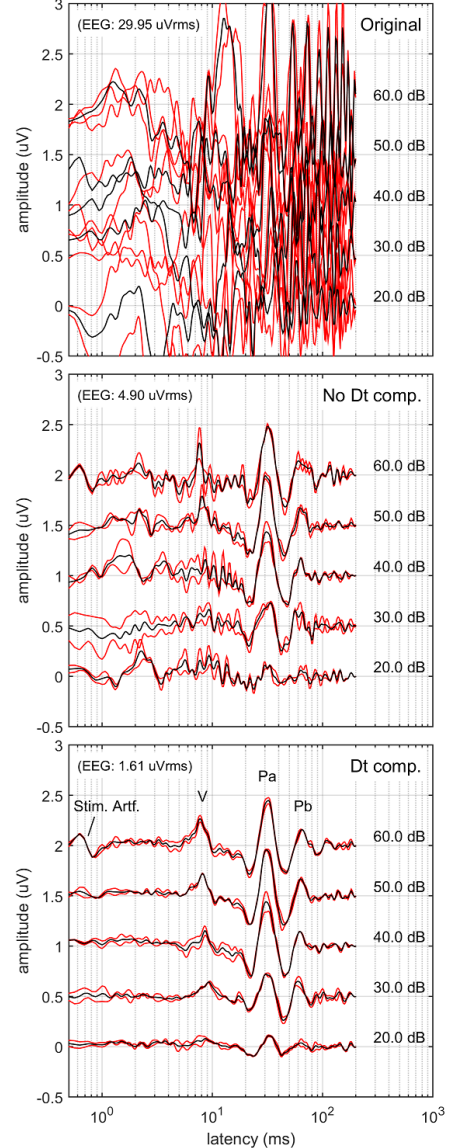
Subject 1 Df_0 range: [-70.3, -46.1] mHz



Subject 1 ABRs (150-3500 Hz)



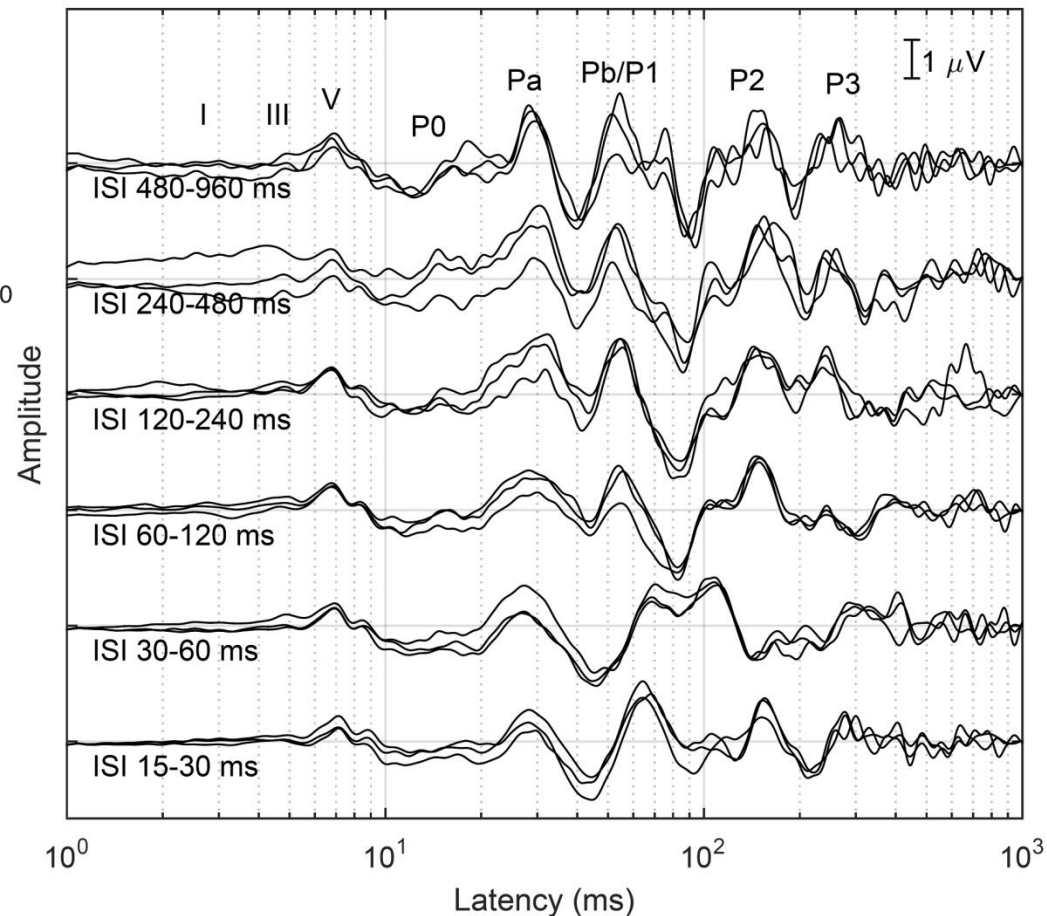
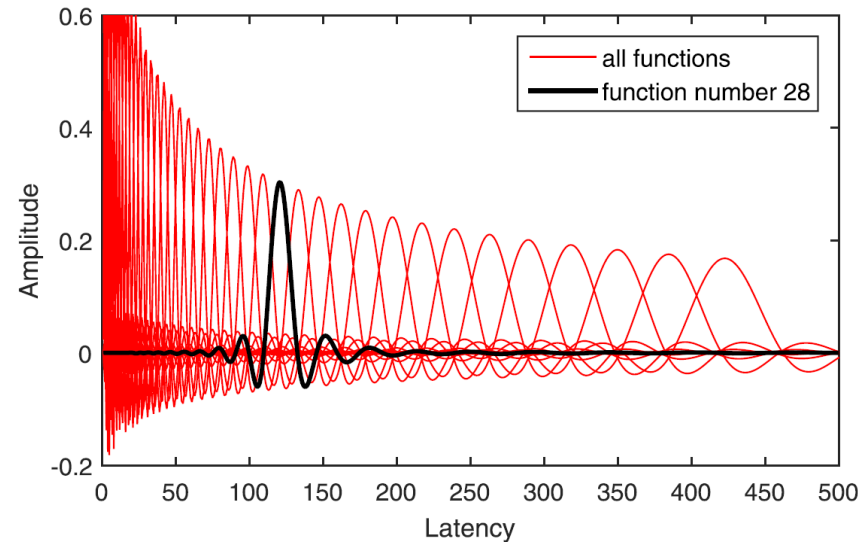
AEPs (25-3500 Hz)



AEP recording system (article prep.)

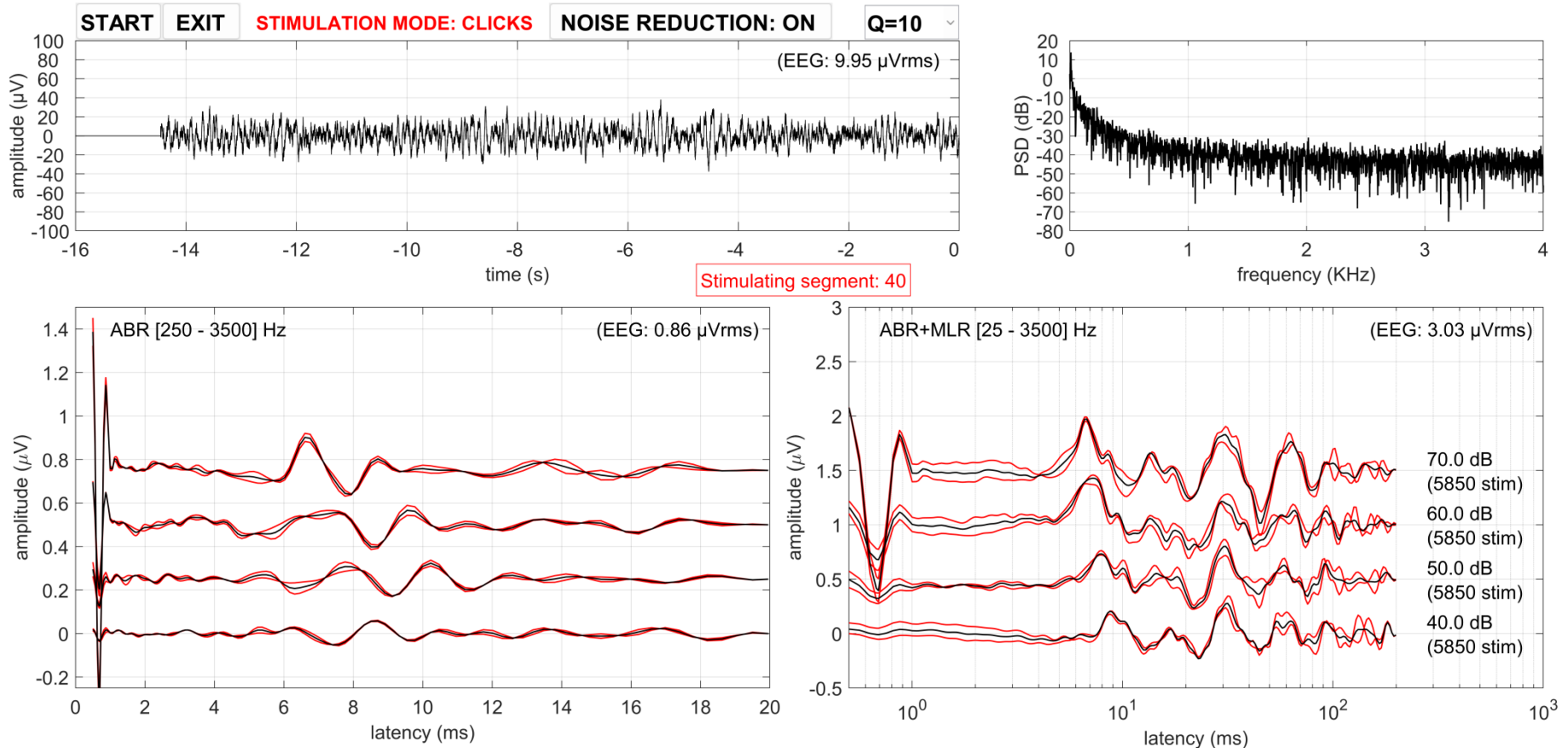


ABR+MLR responses: LDF



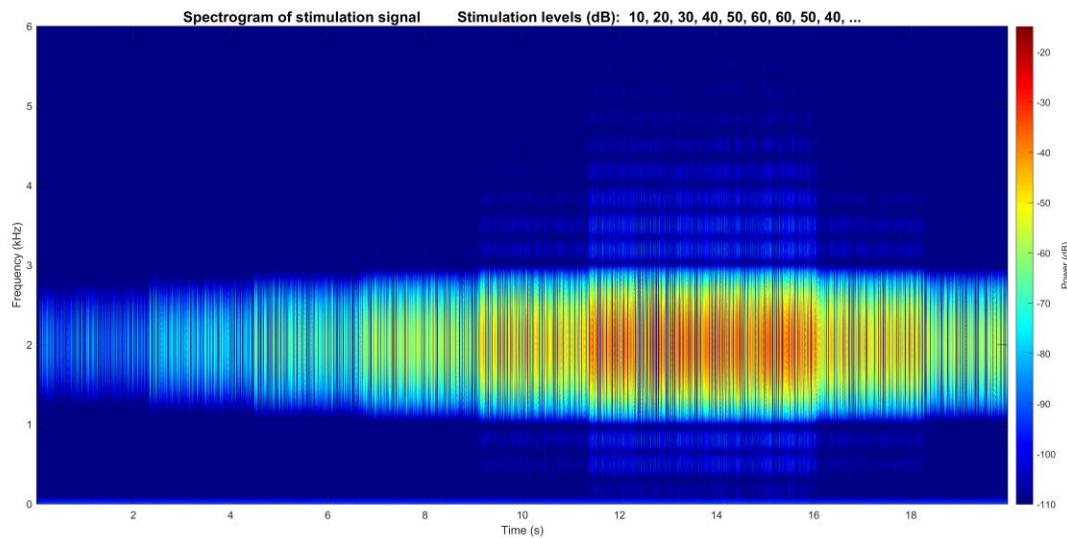
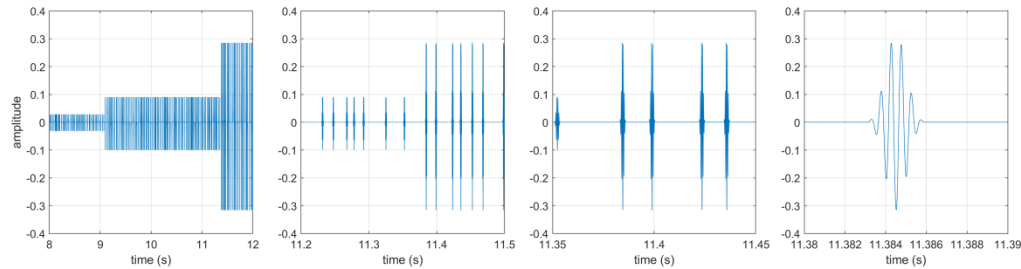
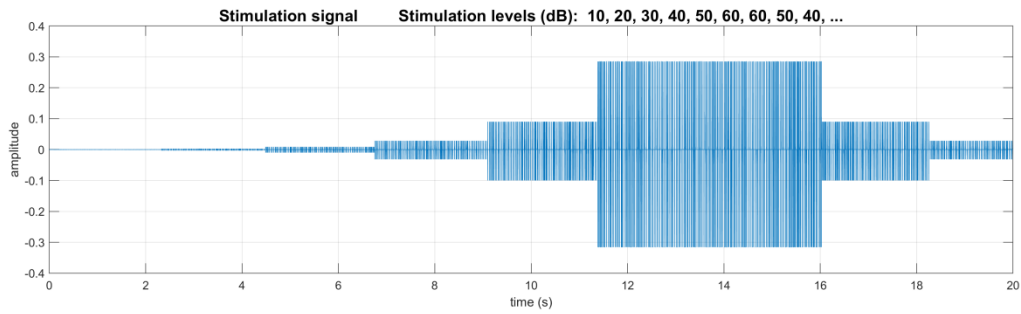
- De la Torre et al. (2020), “Latency dependent filtering...” JASA 148, 599–613.
- De la Torre et al. (2022), “Subspace - constrained deconvolution of...” JASA 151, 3745–3757.

Multi-response deconvolution

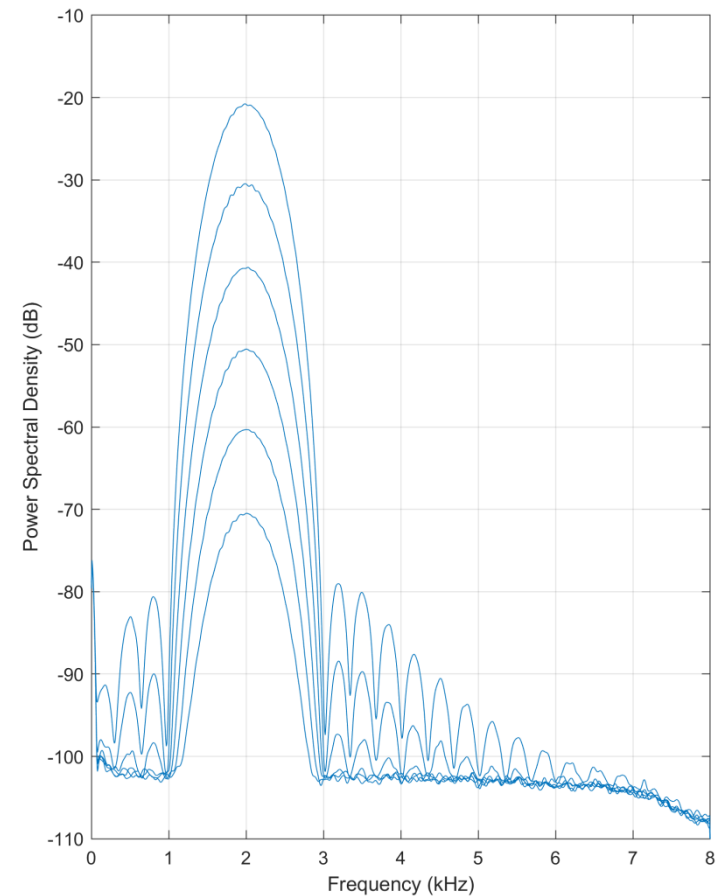


- Demonstration presented at IERASG-2023
- De la Torre et al. (2024), "Multi-response deconvolution of AEPs in a reduced..." JASA 155, 3639–3653.

Stimulation pattern - clean

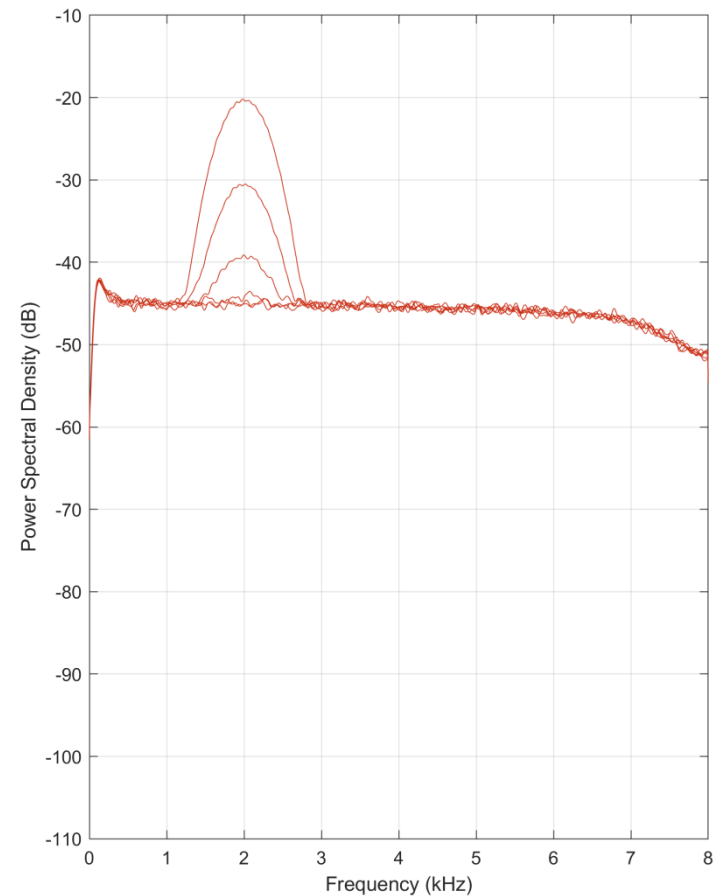
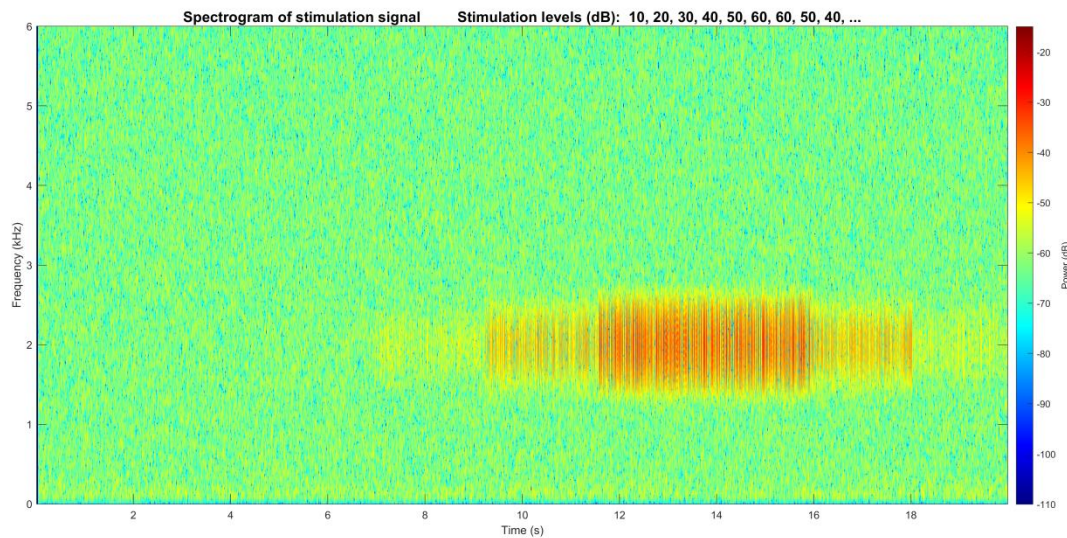
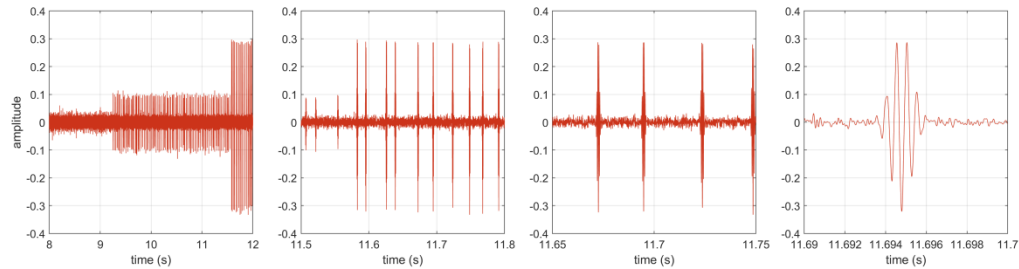
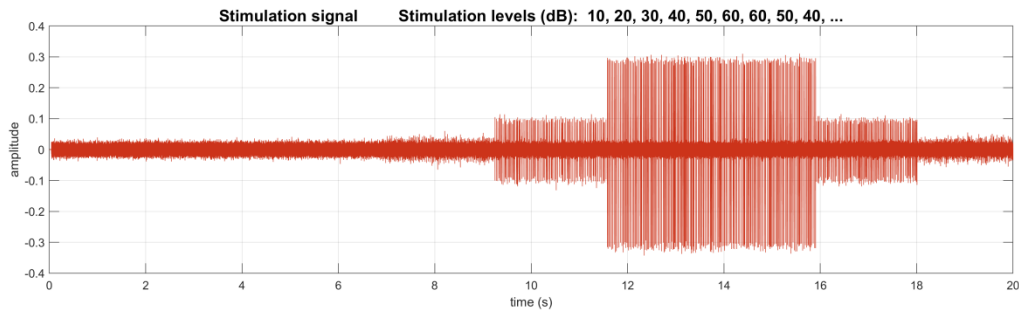


- Short tone bursts 2 kHz
- Level 10 dB to 60 dB



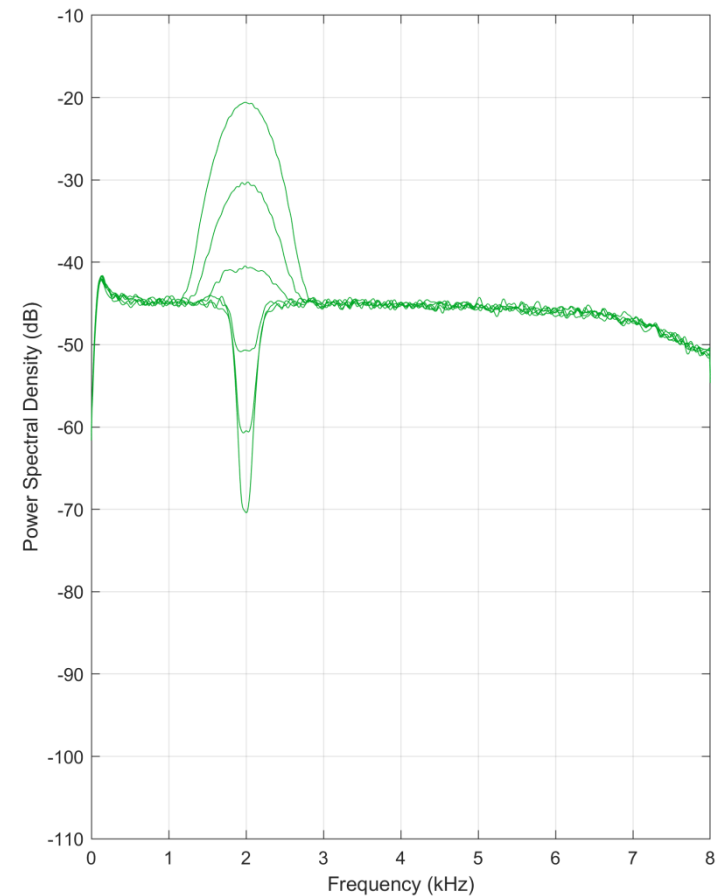
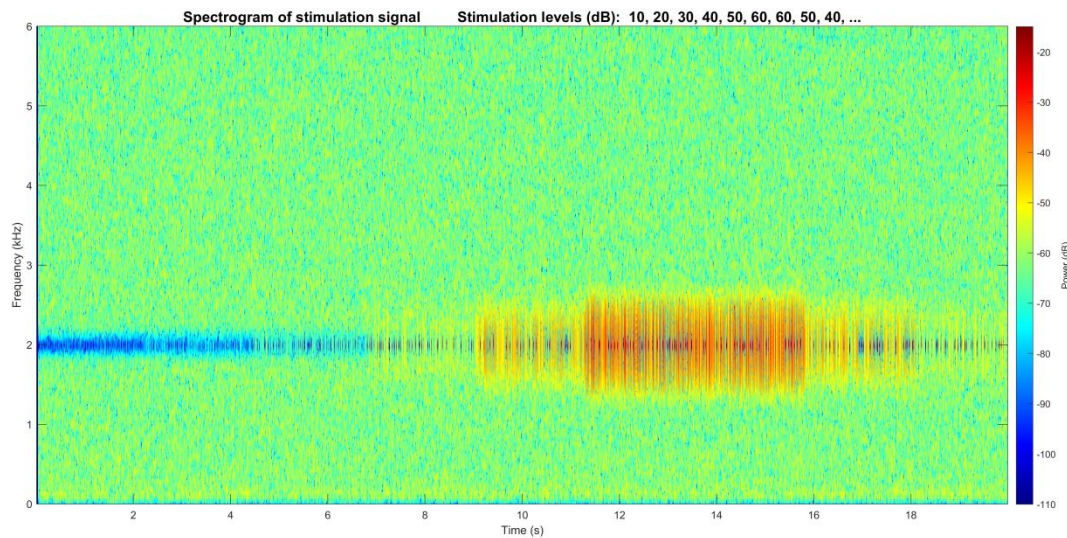
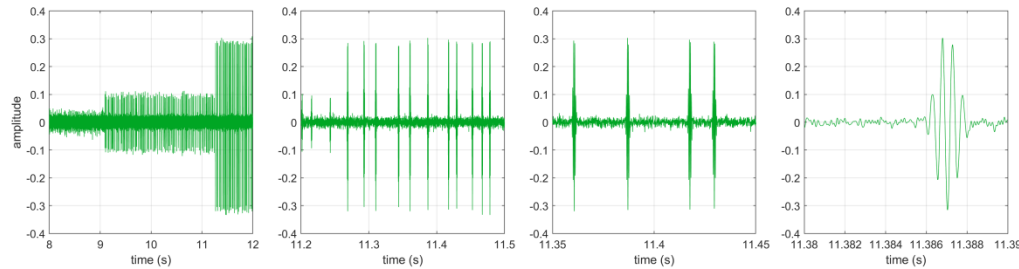
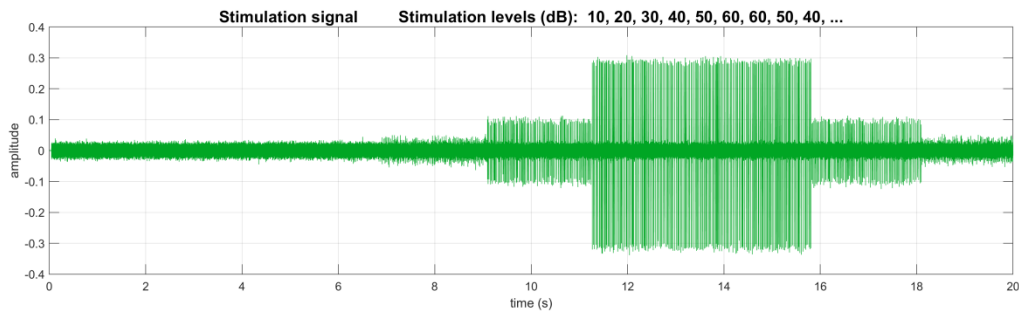
Stimulation pattern – white noise

- Short tone bursts 2 kHz
- Level 10 dB to 60 dB
- Noise at 30 dB



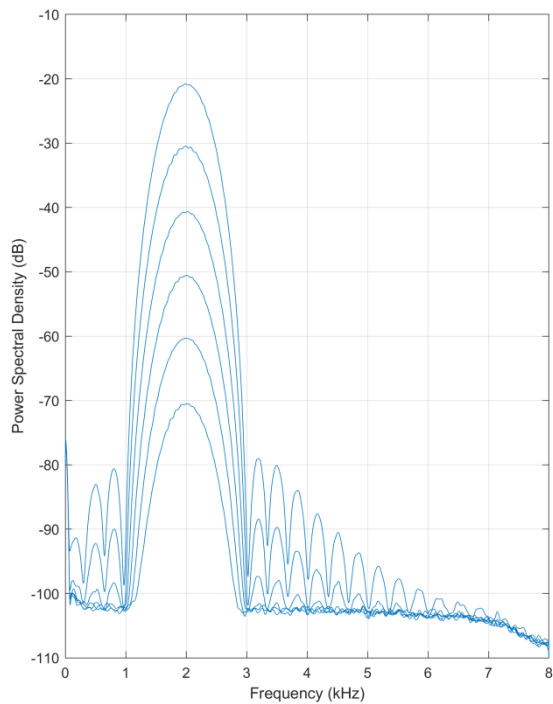
Stimulation pattern – WN stop band

- Short tone bursts 2 kHz
- Level 10 dB to 60 dB
- Noise at 30 dB

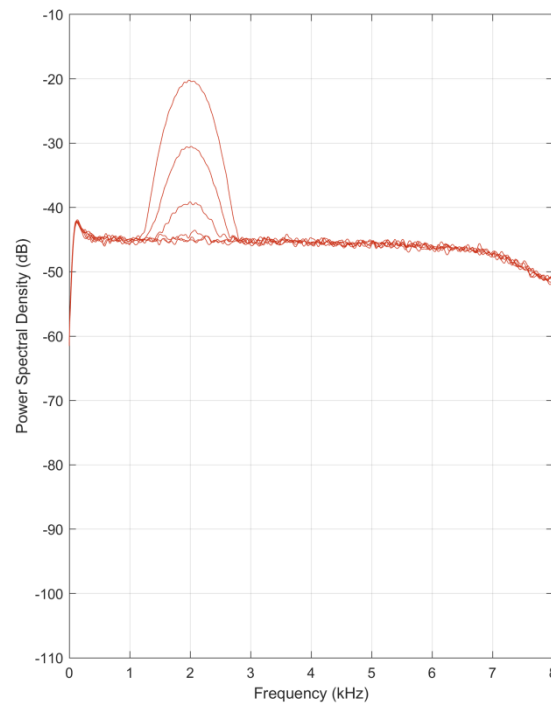


Stimulation pattern – 3 conditions

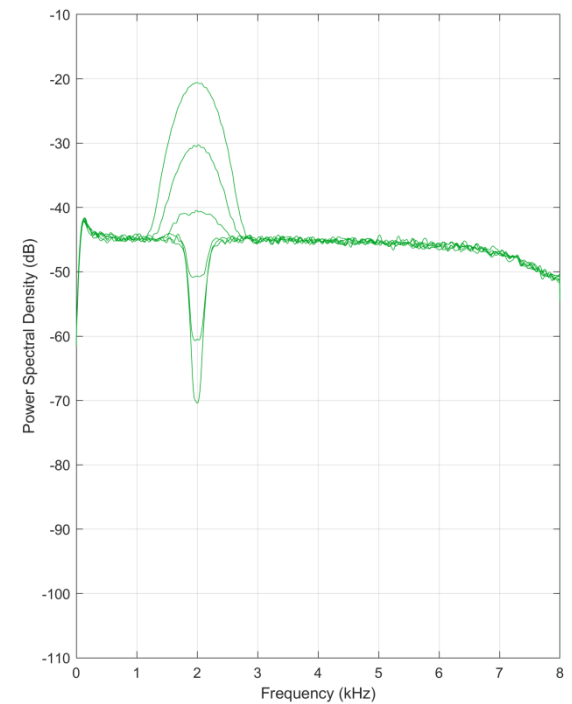
Clean



White noise



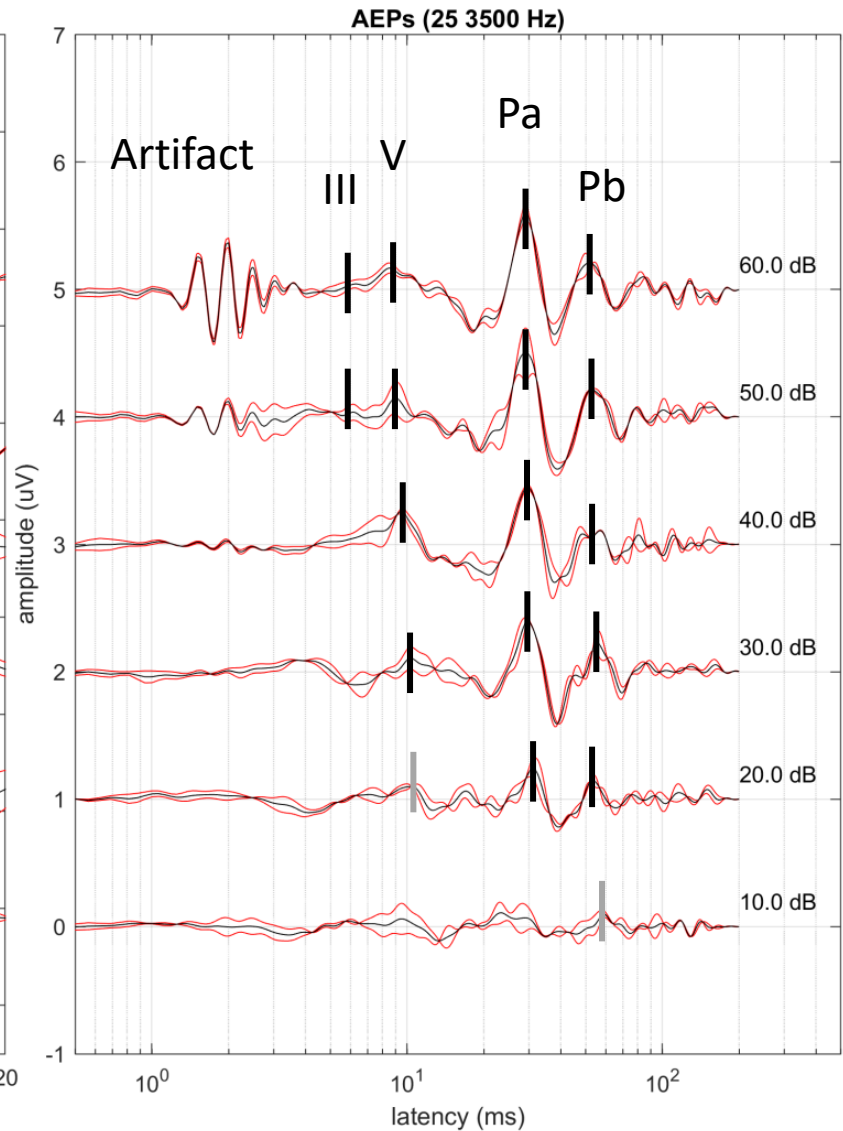
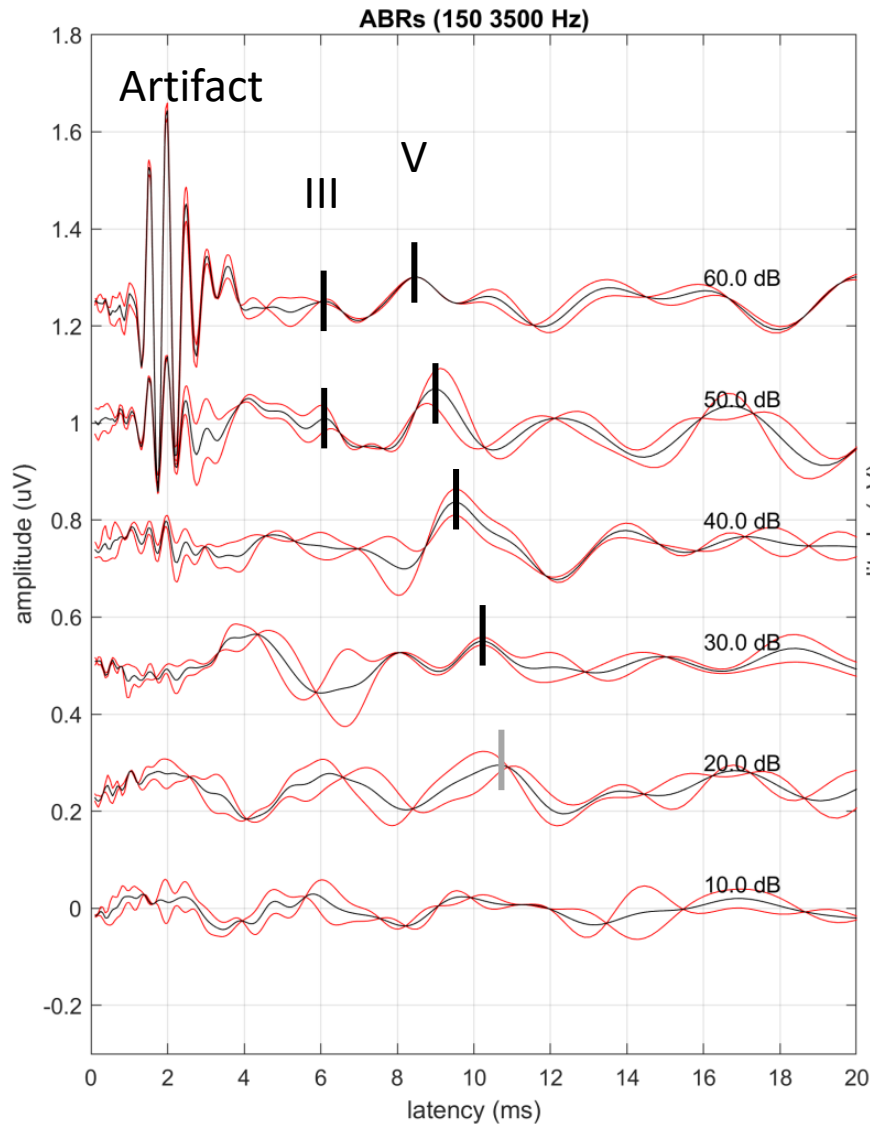
White noise
stop-band filt.



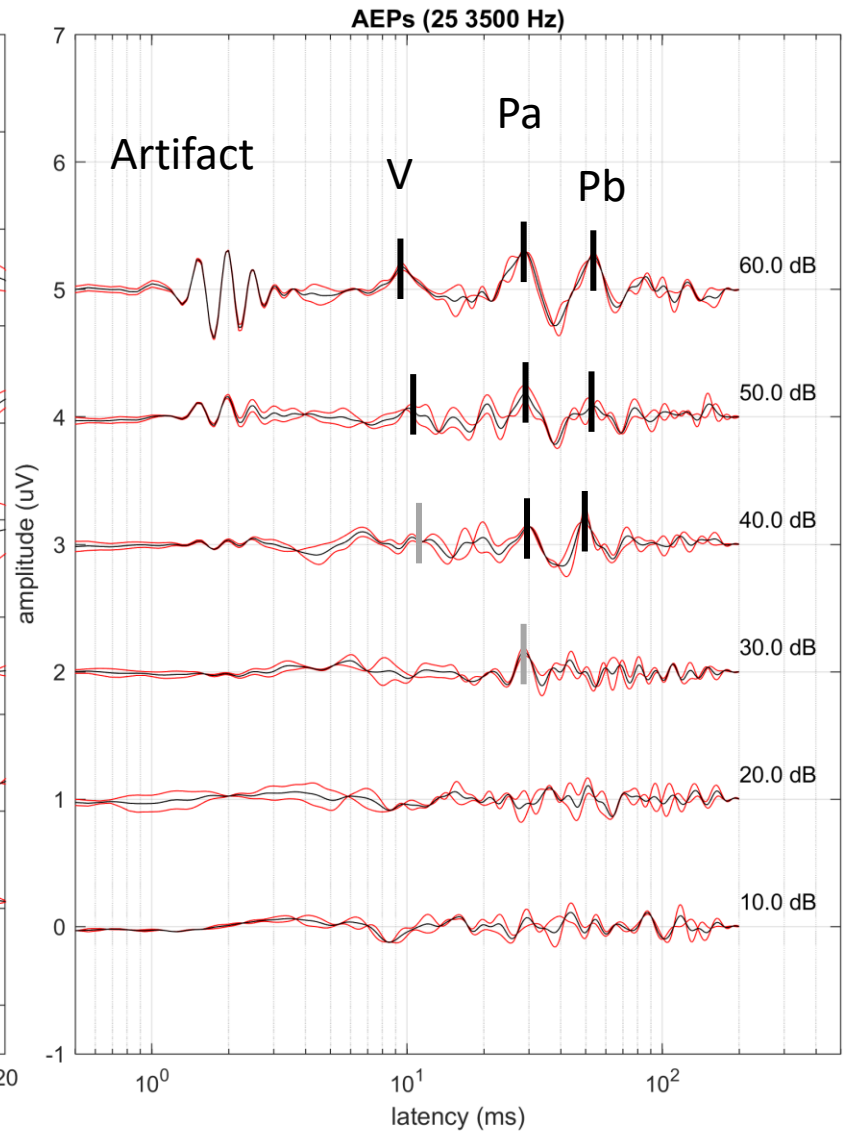
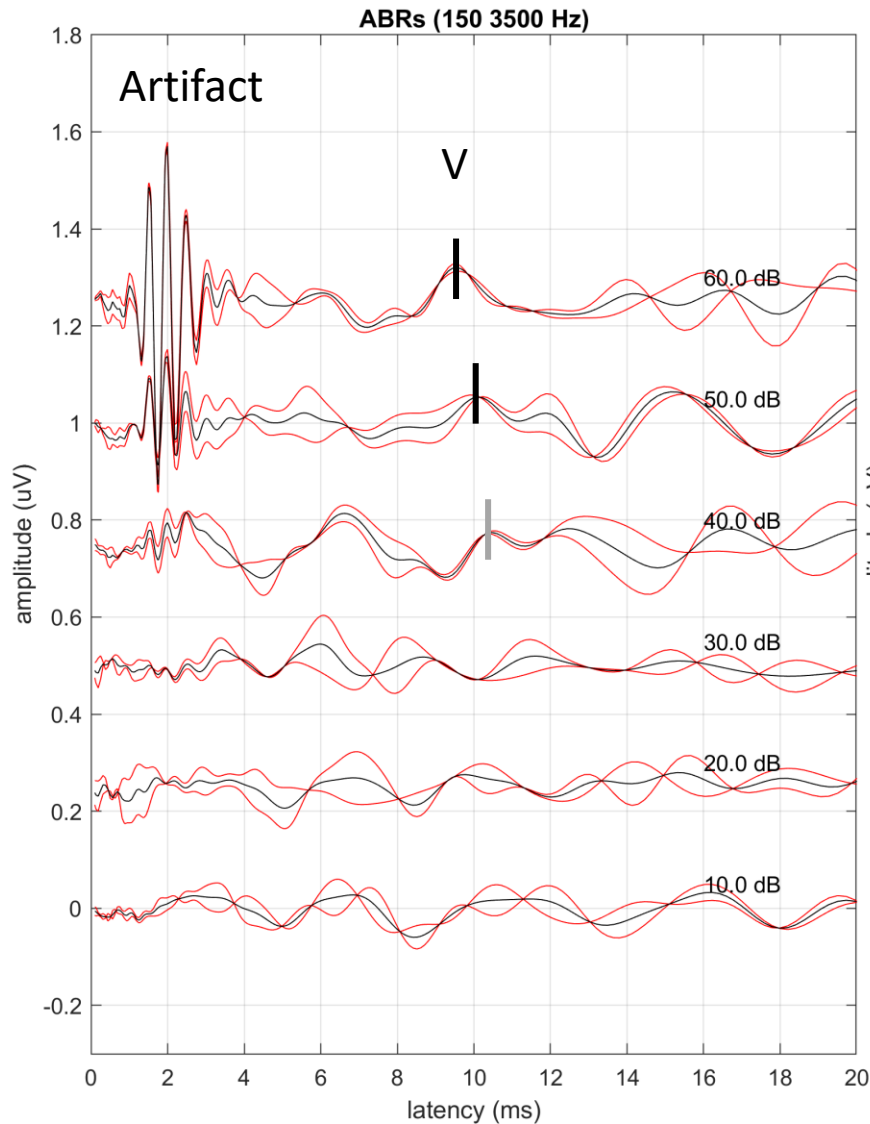
Experiments

- 10 participants
- Aged between 18 and 55 years
- 10 to 20 minutes for each condition (30' – 60')
- Latency range 0.2 ms to 200 ms
- ABR plots and ABR+MLR plots

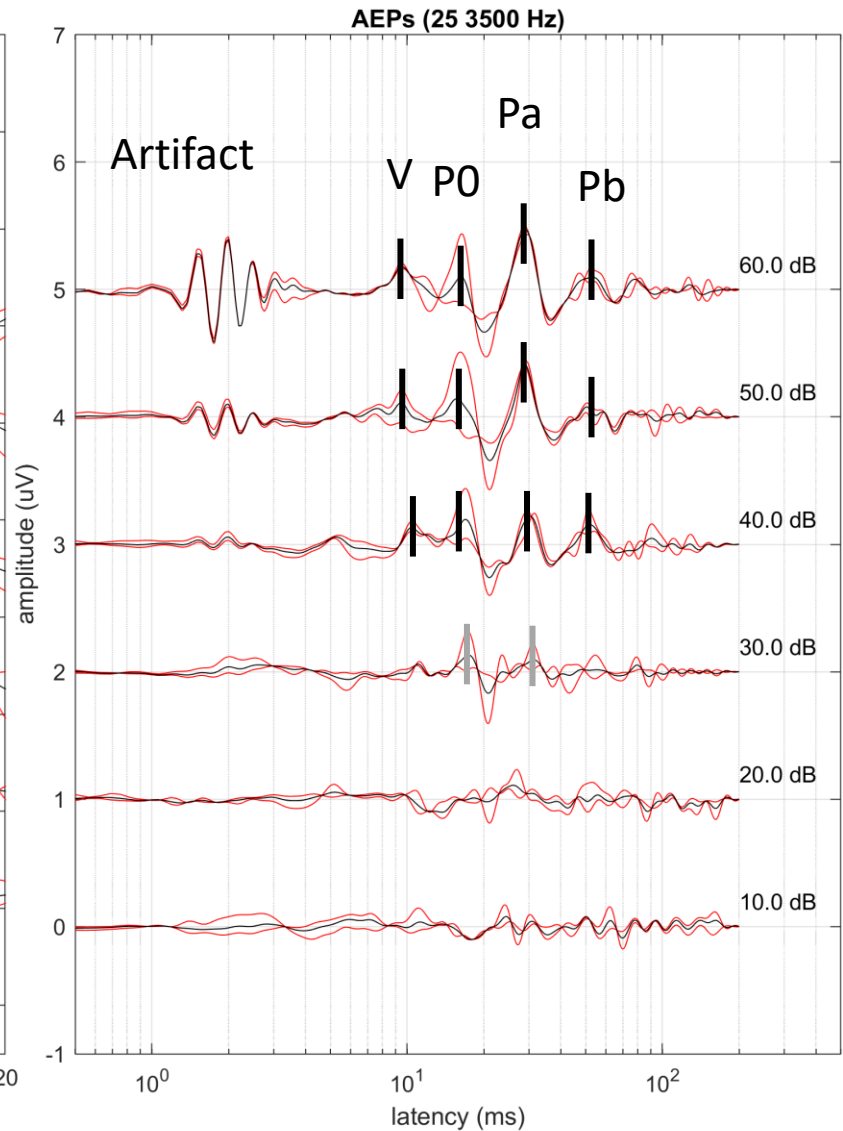
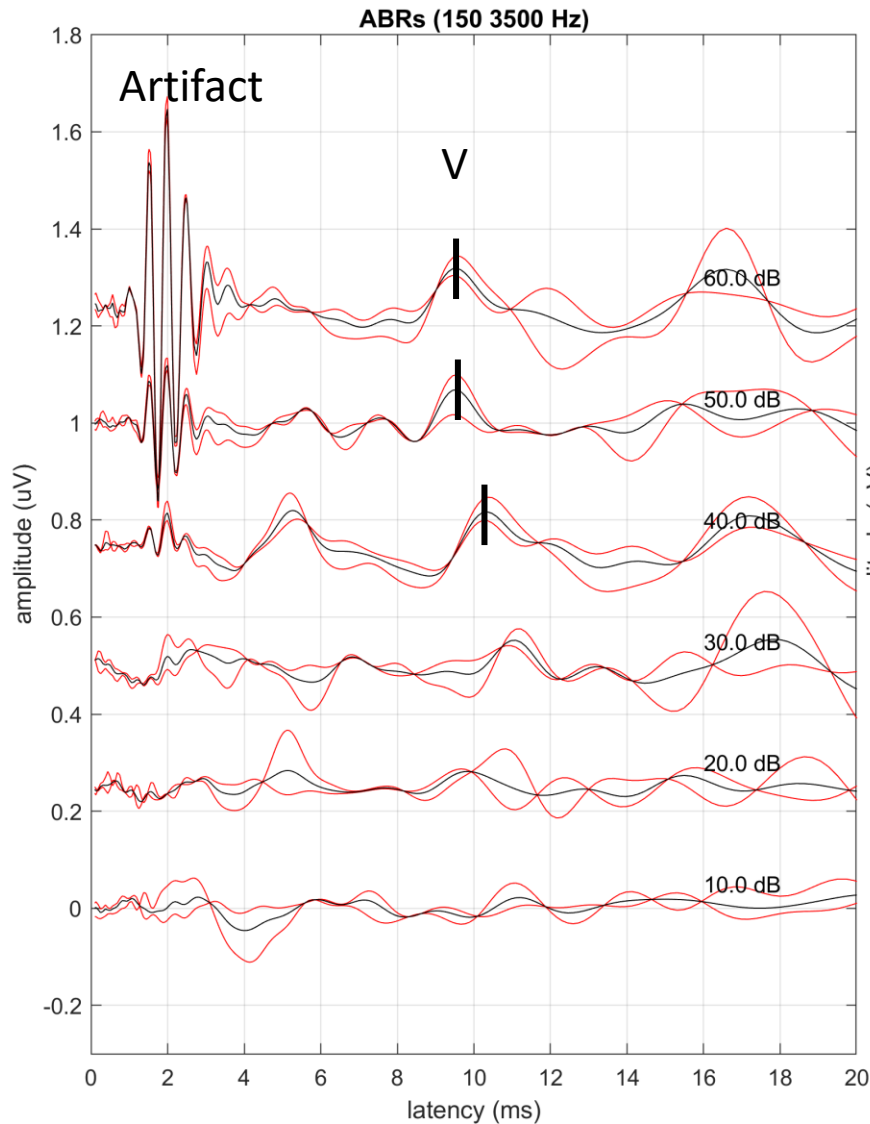
Results: subject A (54), clean



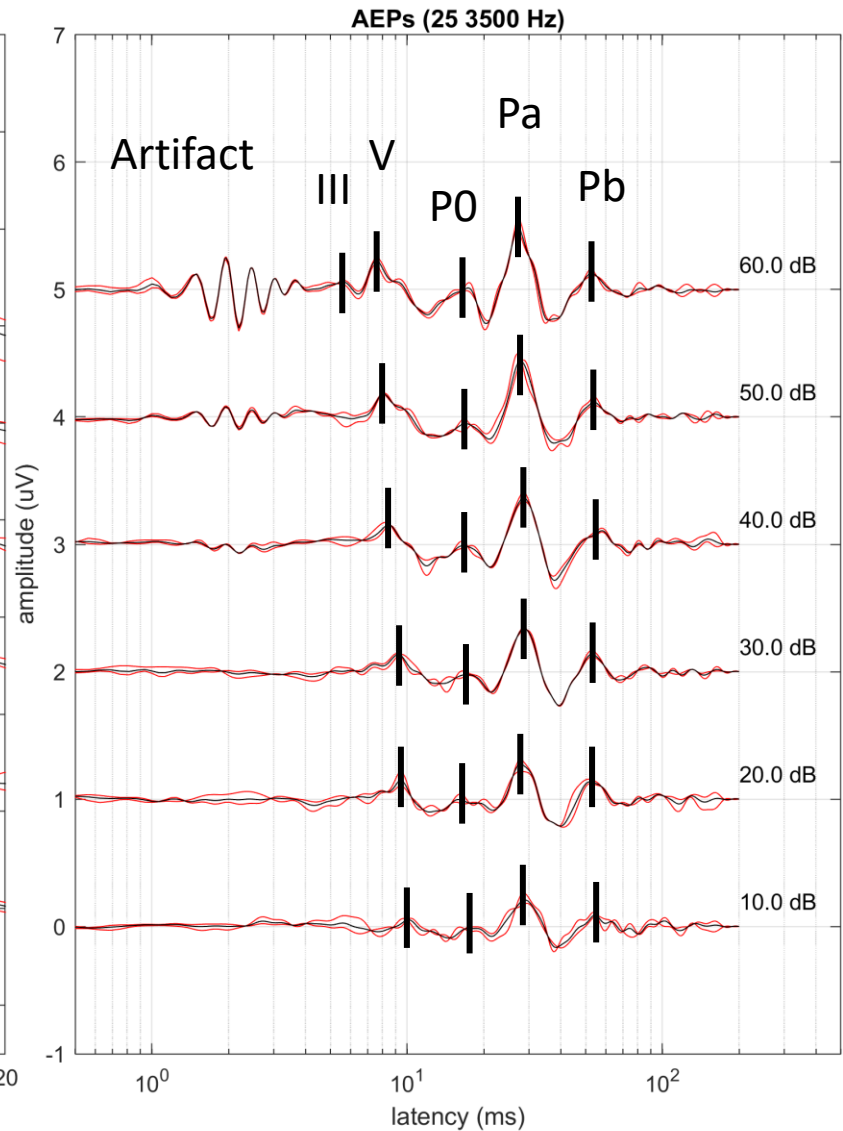
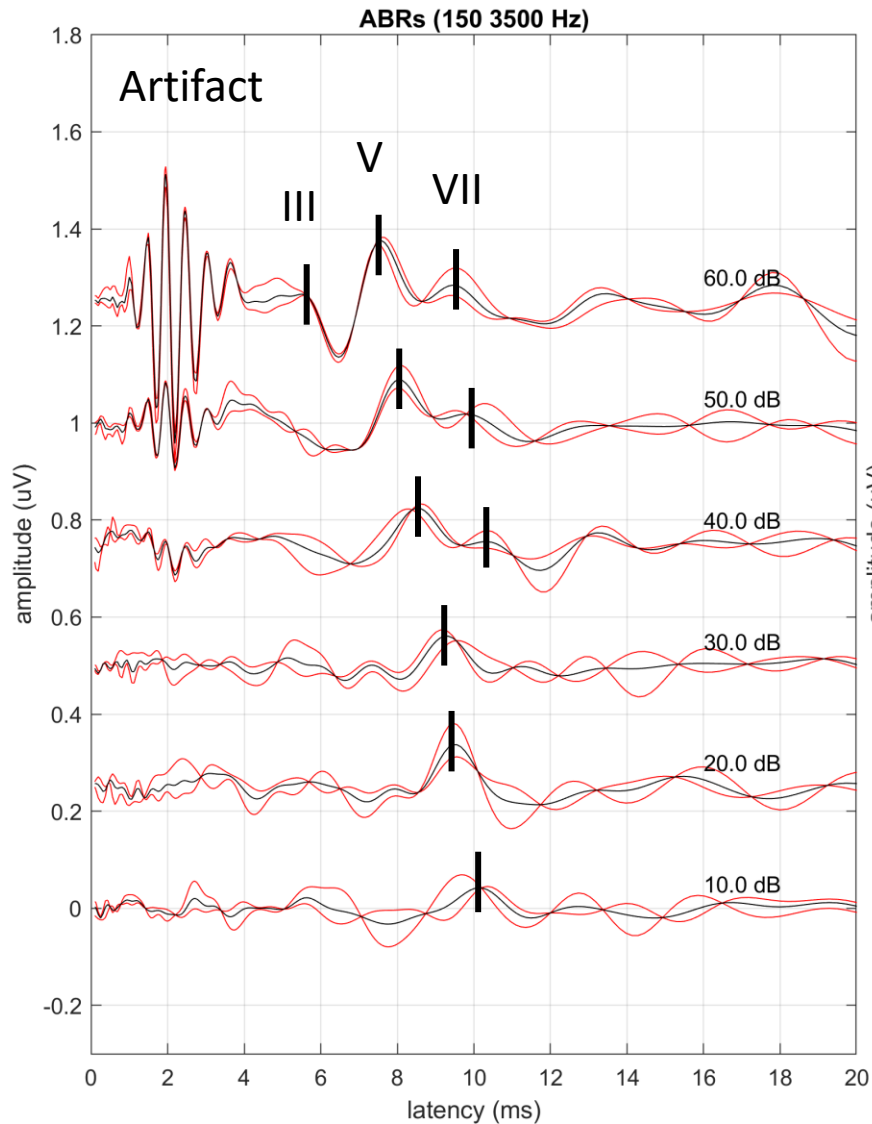
Results: subject A (54), WN



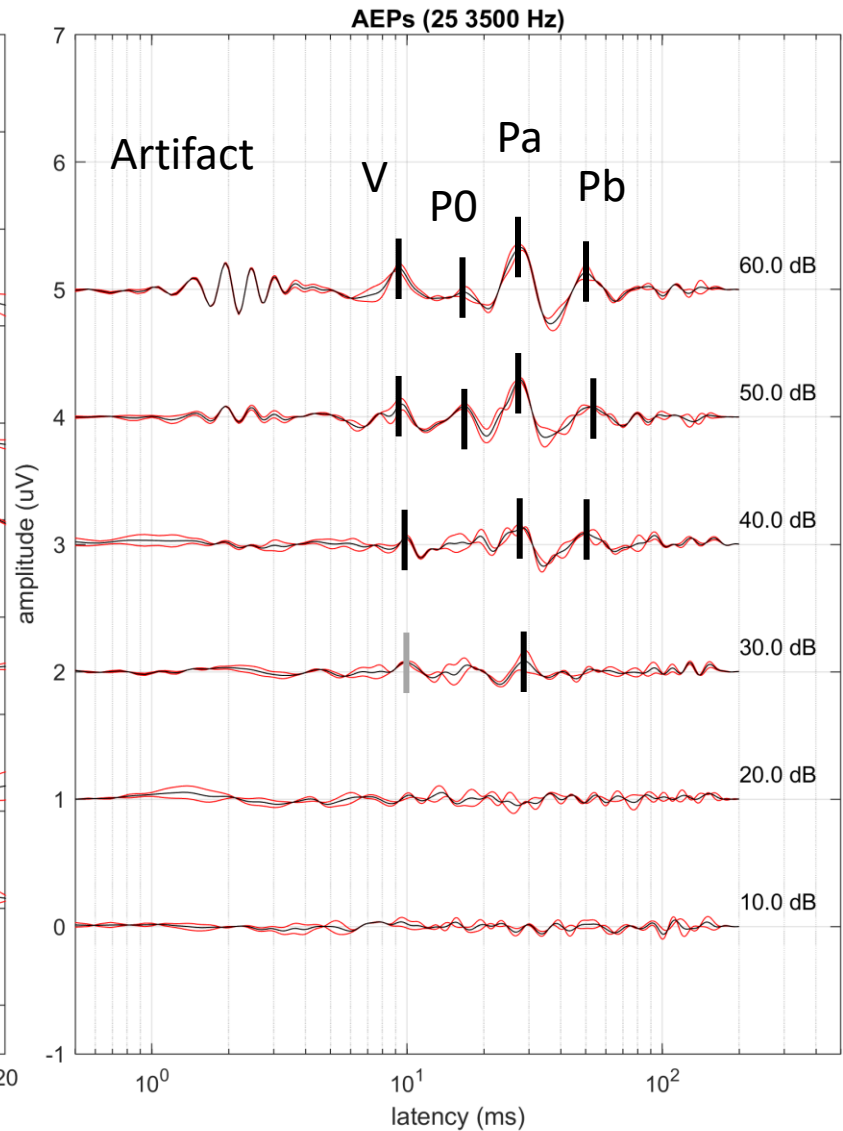
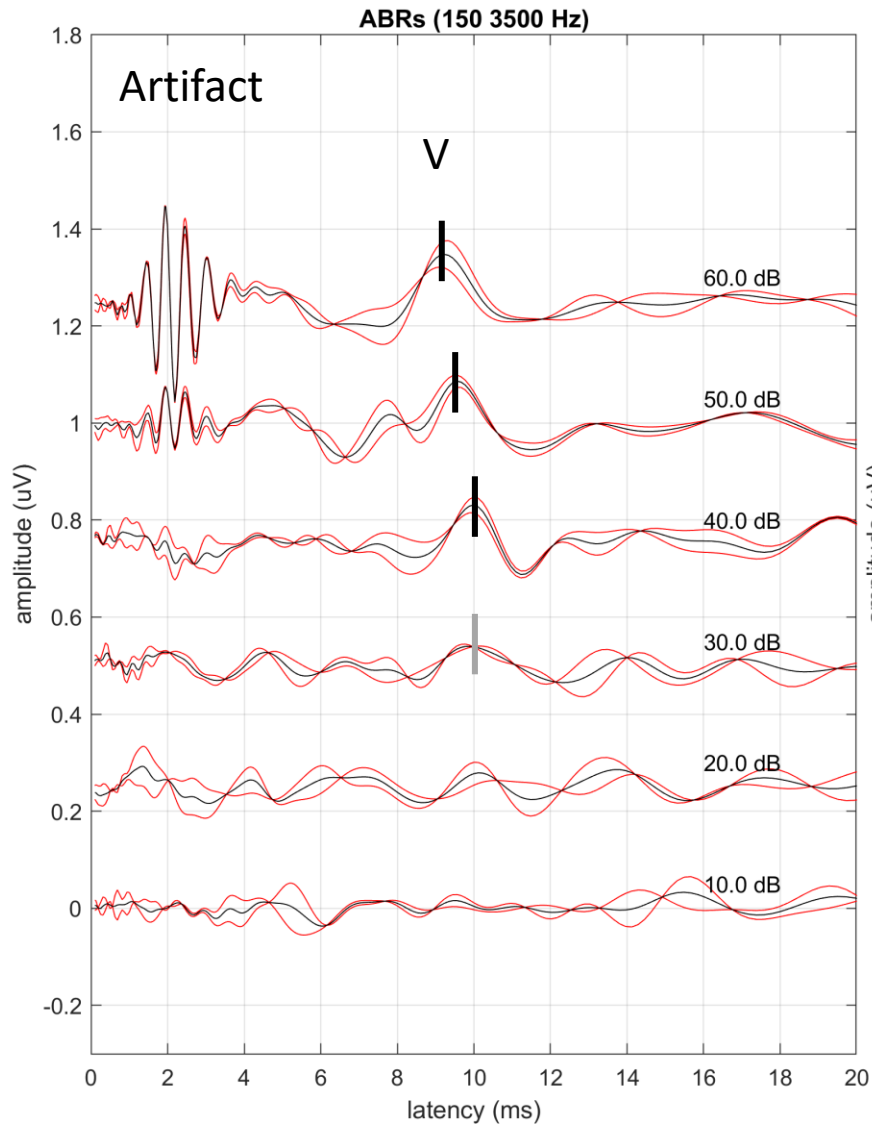
Results: subject A (54), WN-SB



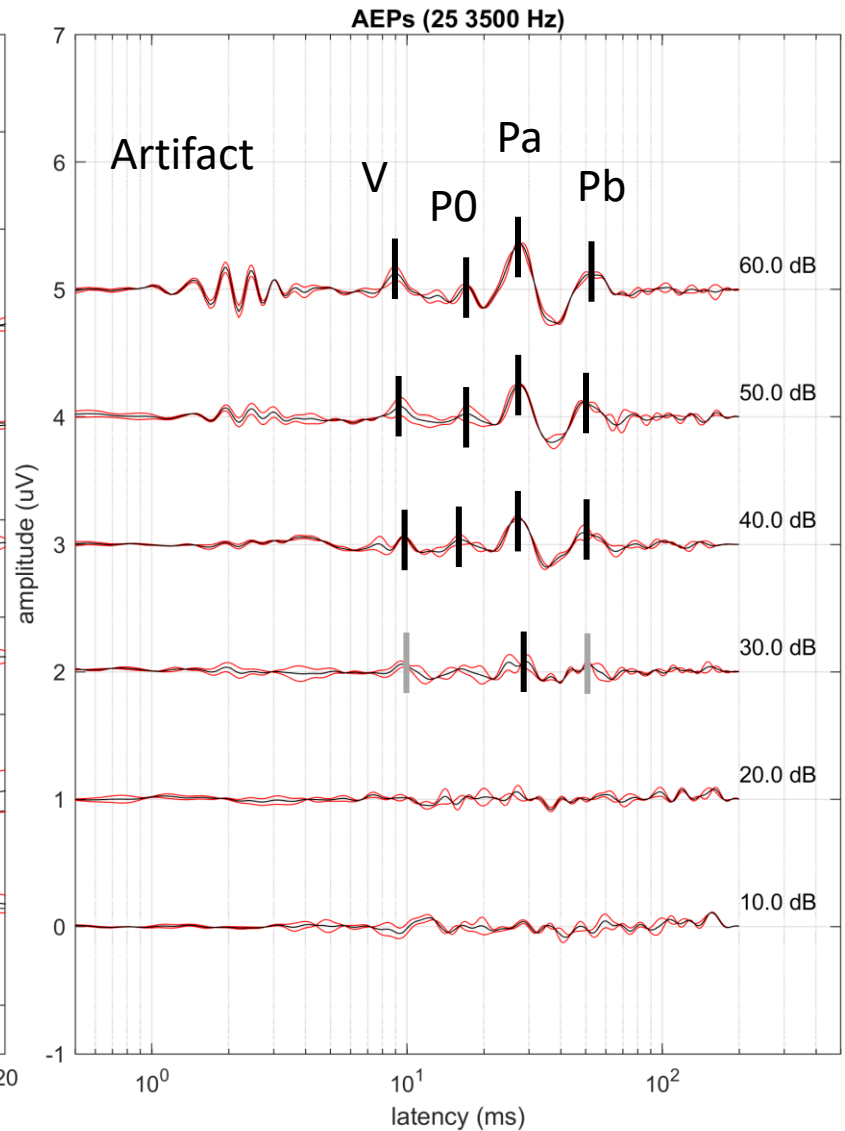
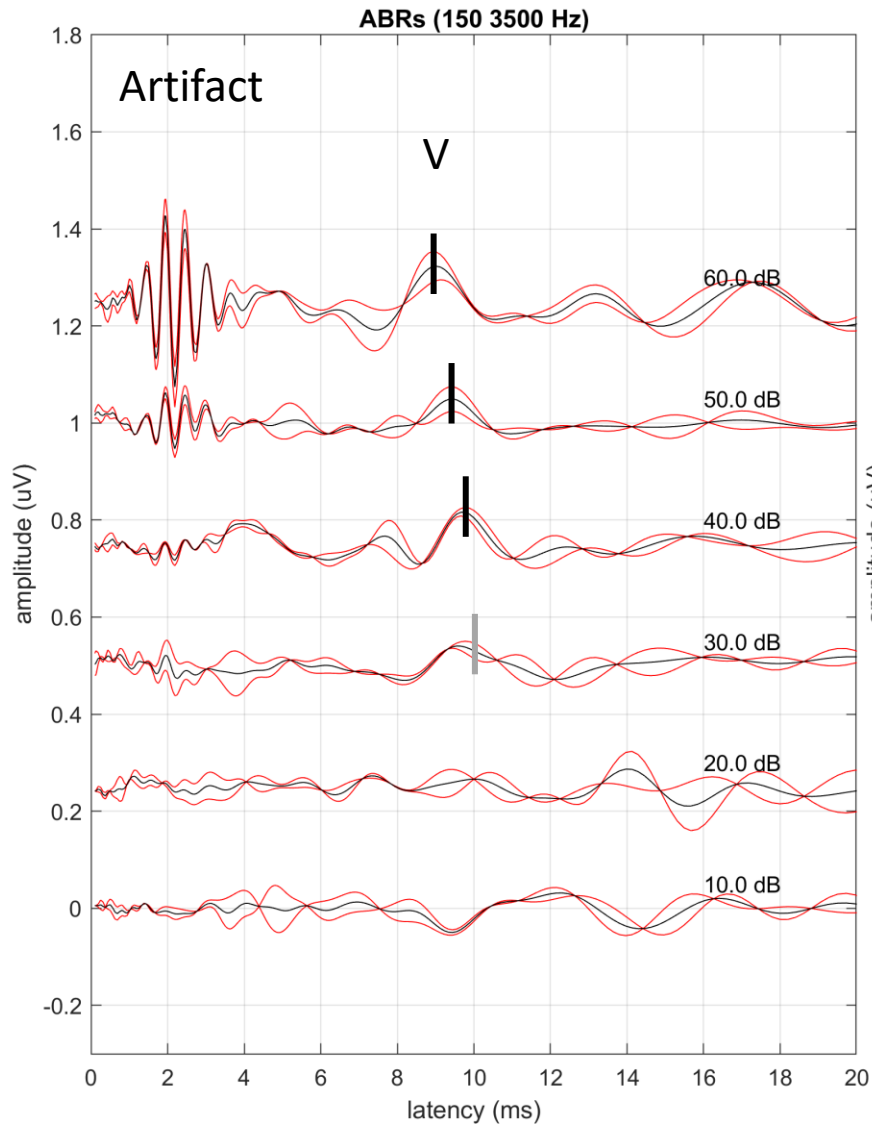
Results: subject I (18), clean



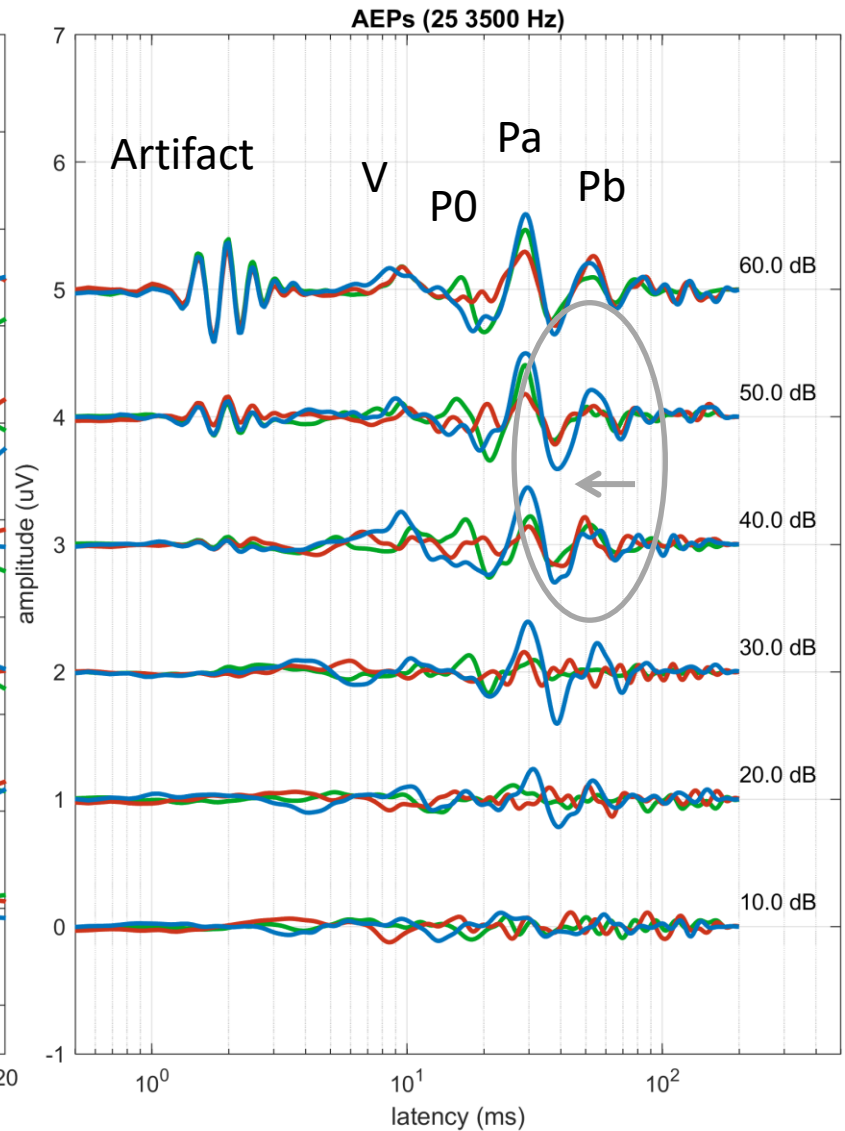
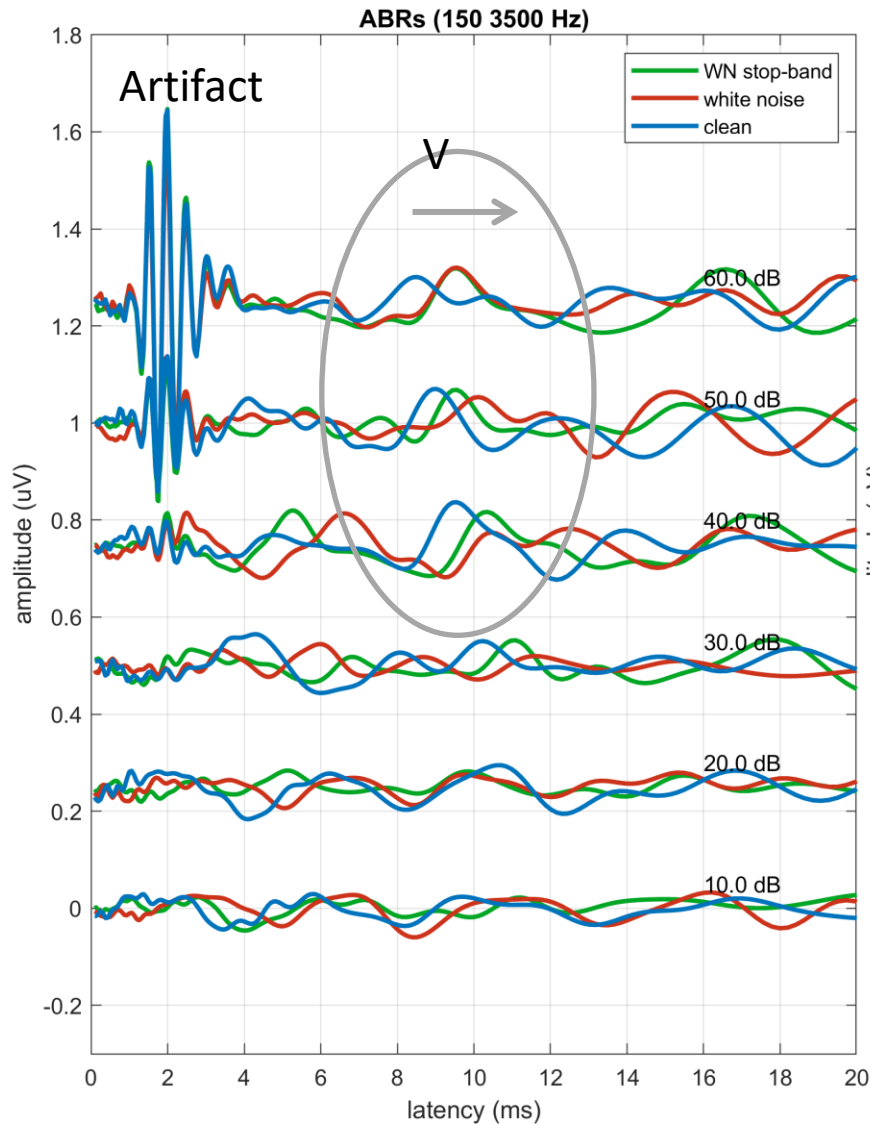
Results: subject I (18), WN



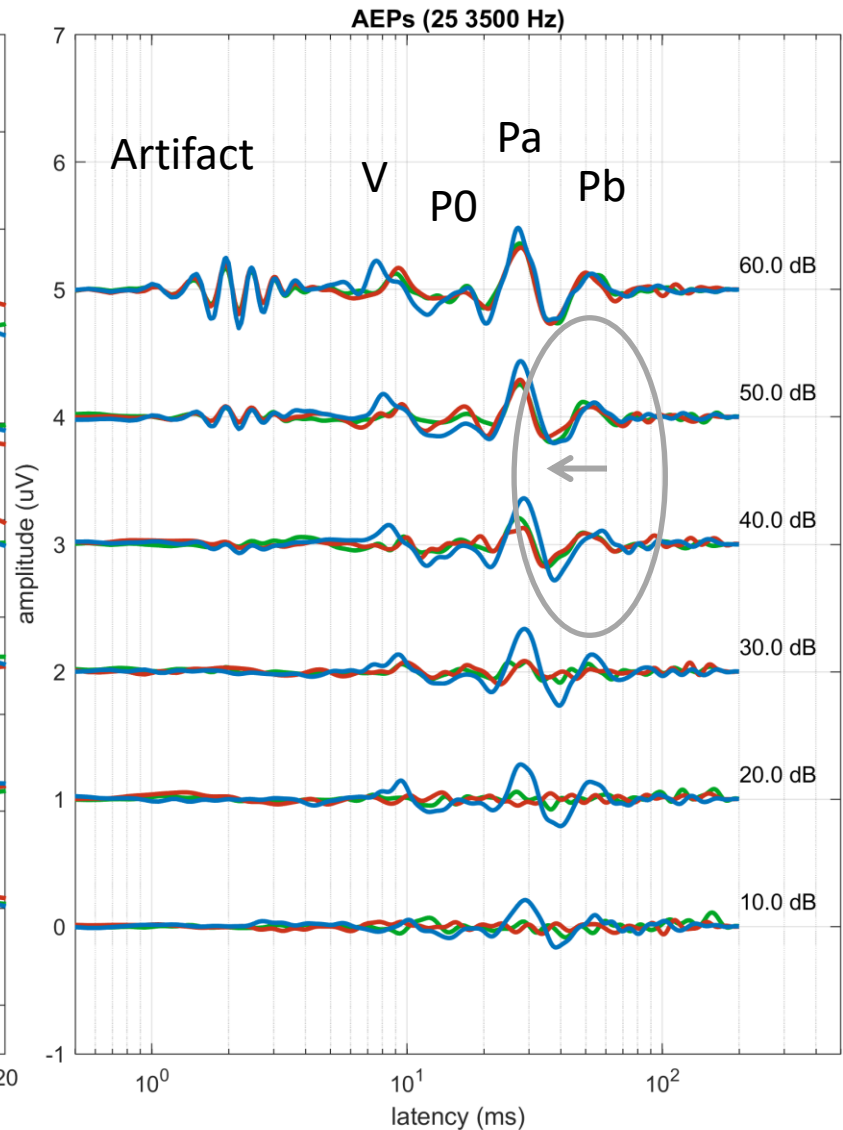
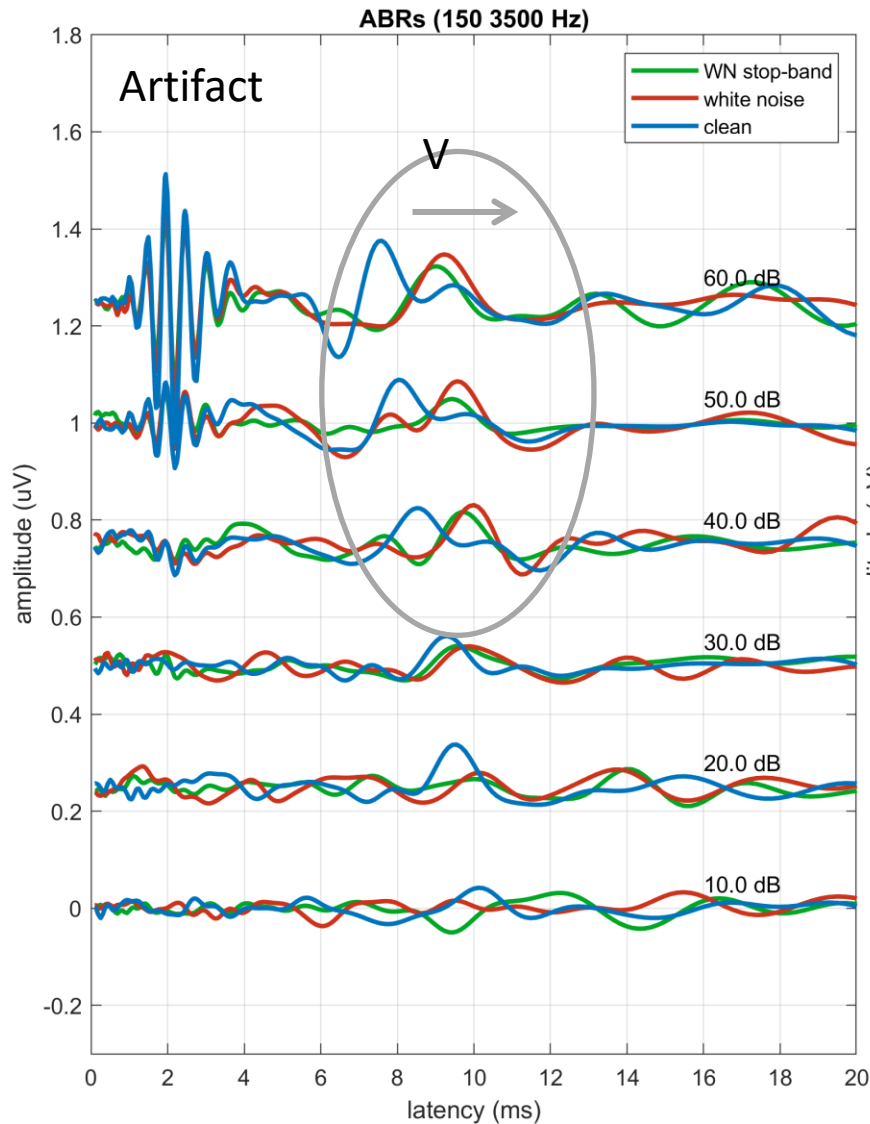
Results: subject I (18), WN-SB



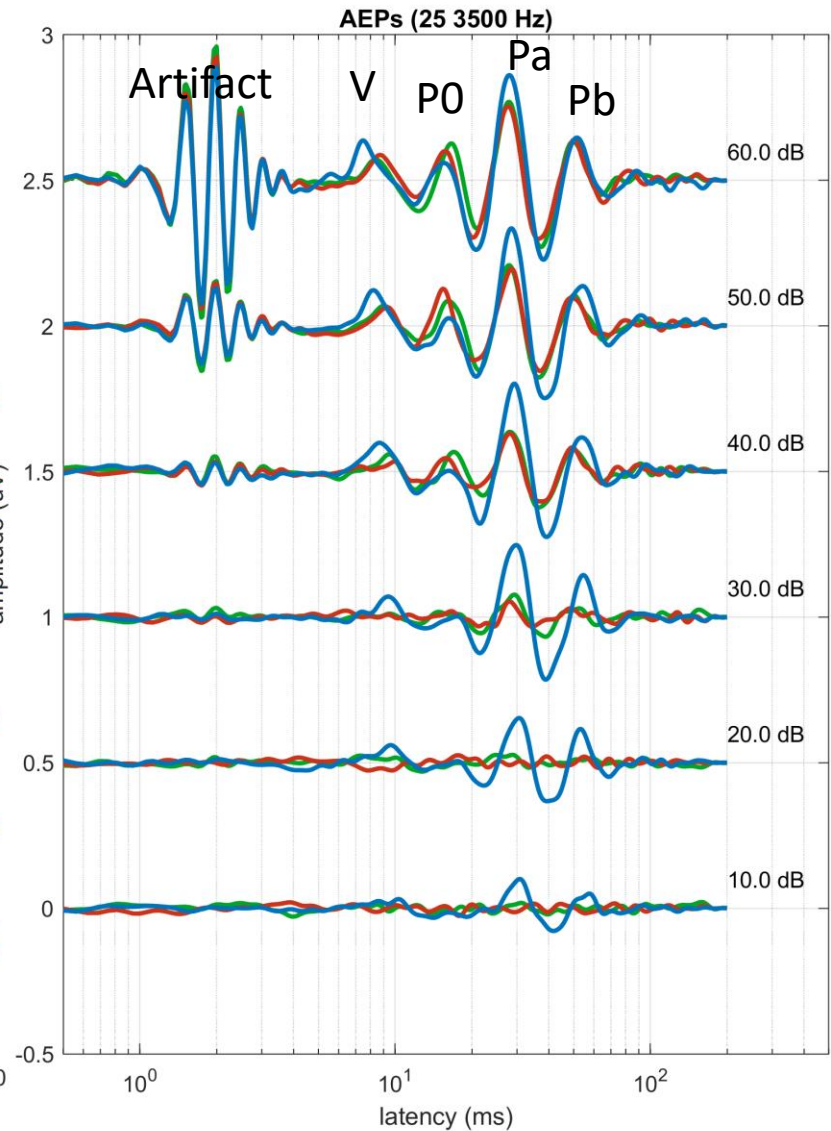
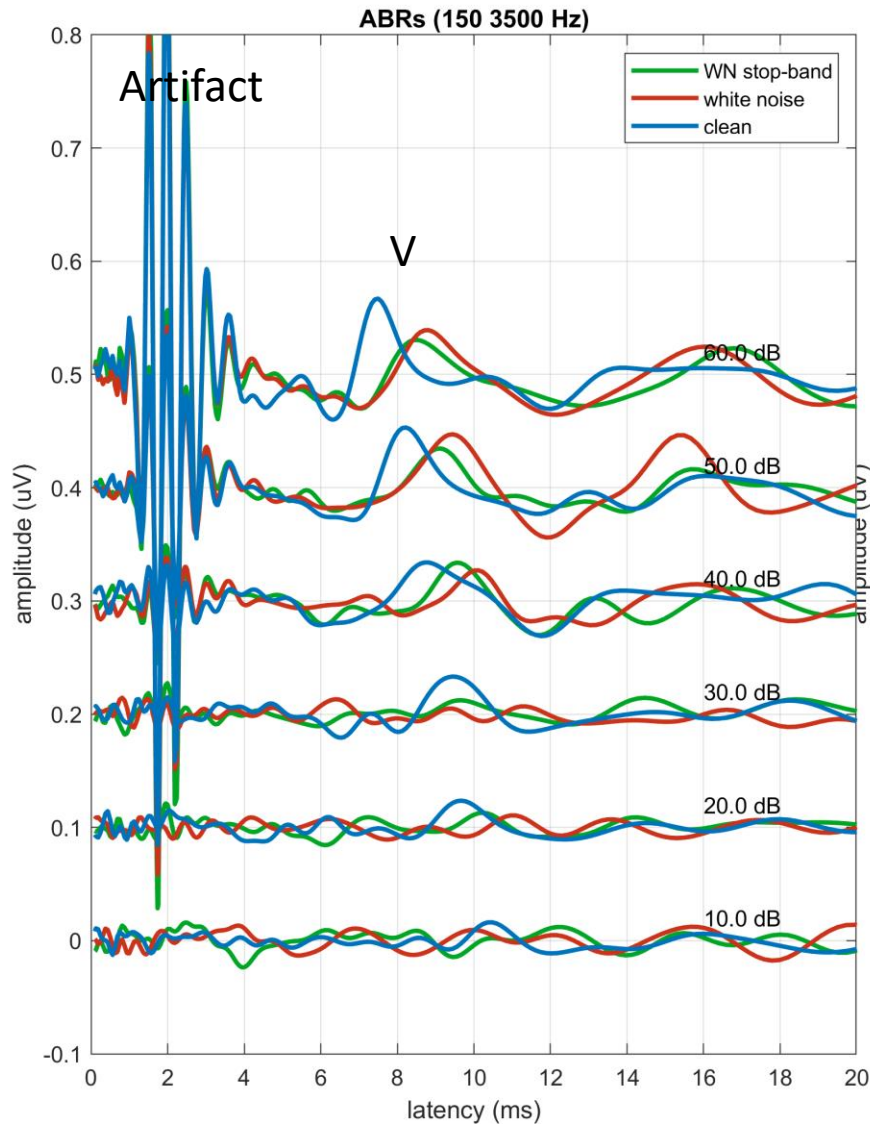
Results: subject A (54) all cond.



Results: subject I (18) all cond.



Results: Grand Average

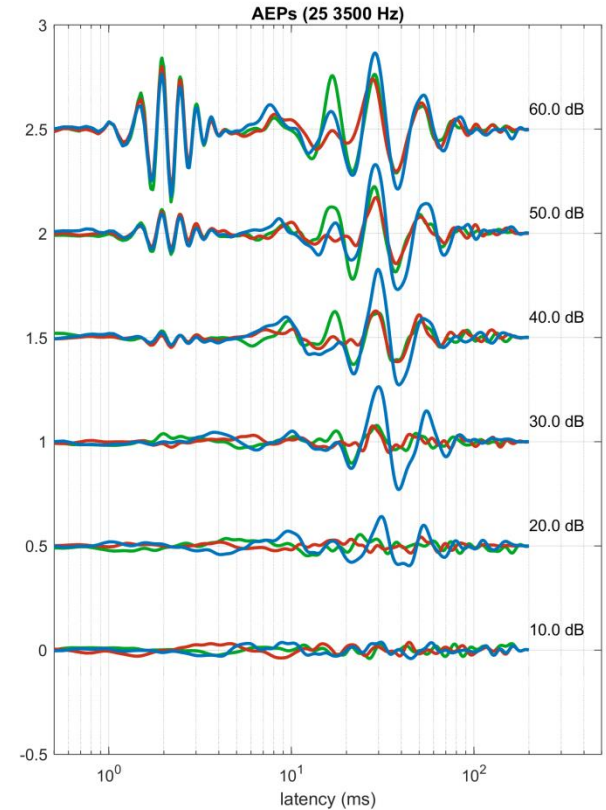
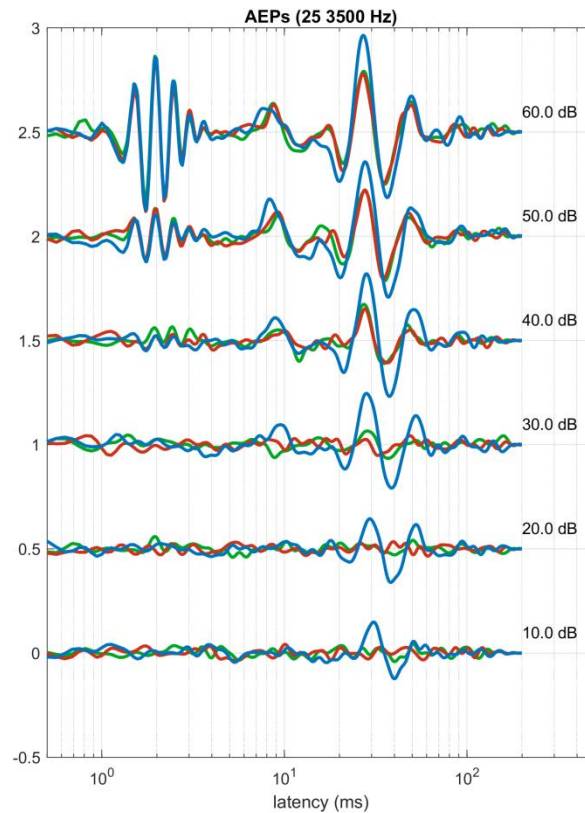
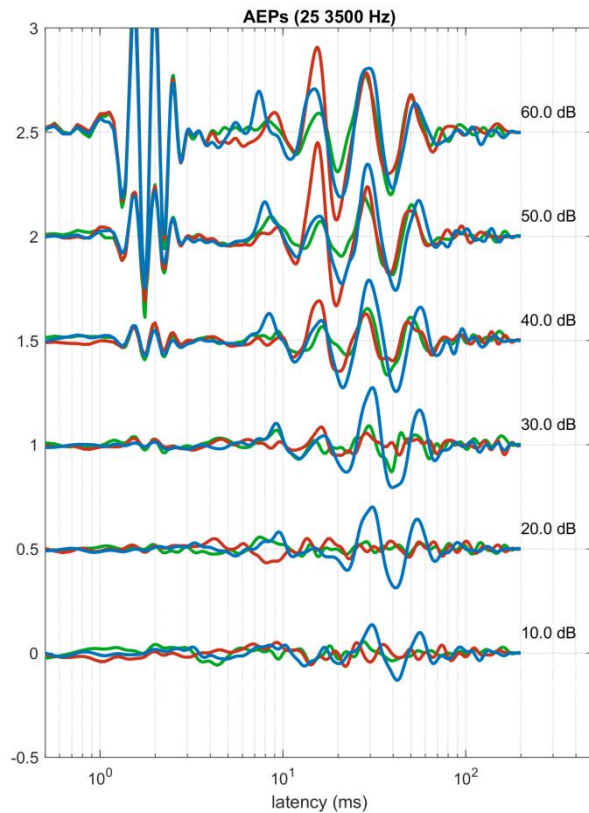


Comparison of age groups

Group A N=3
Younger than 25

Group B N=3
25 - 35

Group C N=4
Older than 25



CONCLUSIONS

- The presence of noise causes changes in the amplitude and latency of the waves
- Changes related to age:
 - Differences in thresholds
 - No differences in changes related to noise
- Interesting results
- Experimental design could be improved
- Utility of ABR+MLR (difficulty of PAM)

Thank you for your attention!

- The authors gratefully acknowledge all the volunteers who participated in the AEP recording sessions
- This work was supported by the Spanish Government – Ministry of Science and Innovation [Project “Speech-AEPs” PID2020-119073GB-I00] and by Junta de Andalucía - Consejería de Universidad, Investigación e Innovación [Project “Early-HHL-D” P21.00152]
- Visit our web: <https://wpd.ugr.es/~sig.proc.audiology/>
- E-mail us to: atv@ugr.es / isamaru@ugr.es

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