Recording auditory brainstem responses with randomized stimulation level

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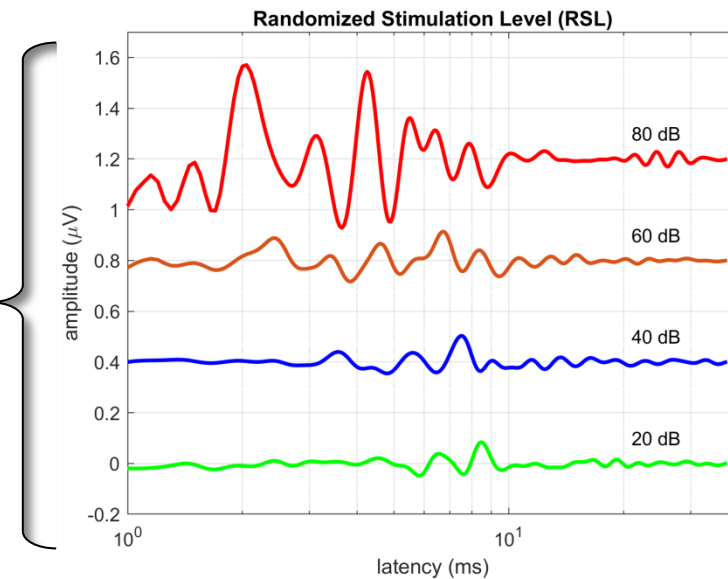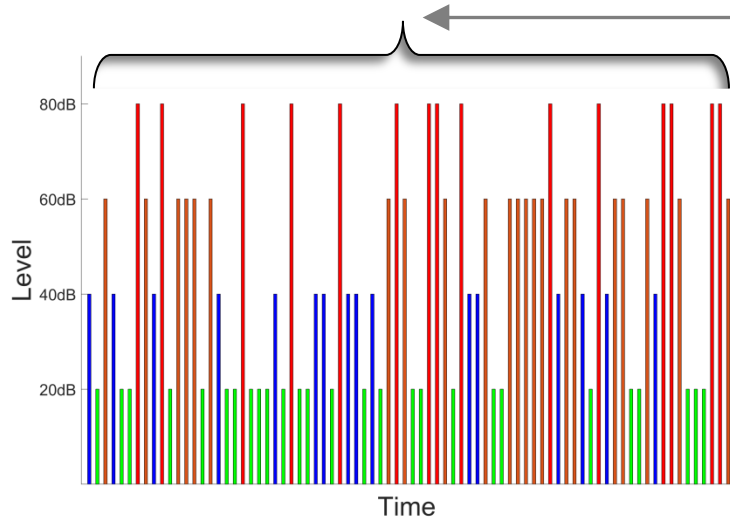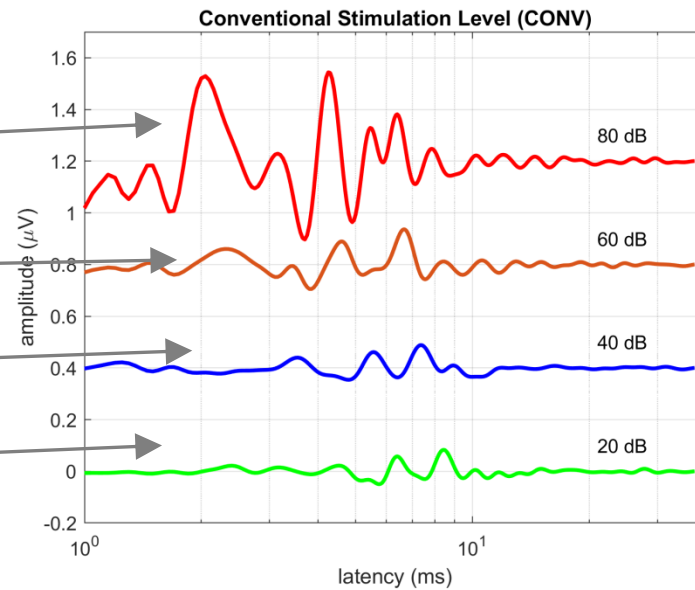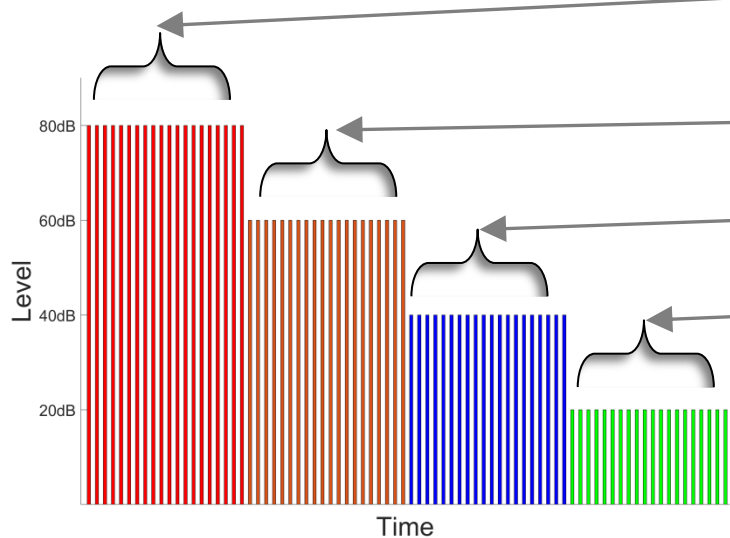
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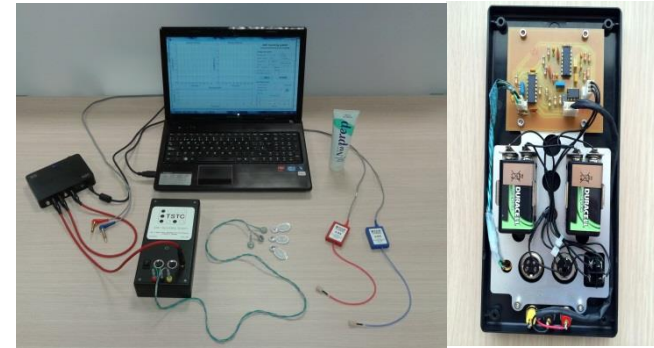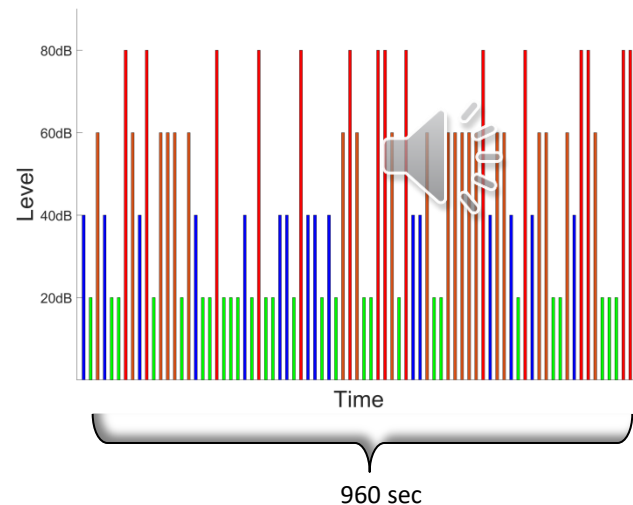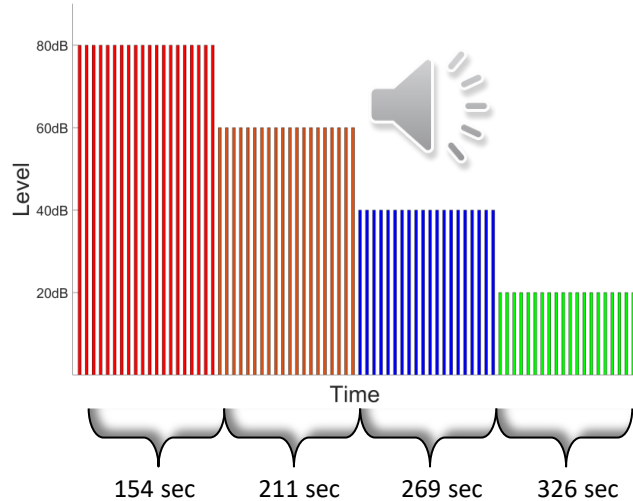
Motivation of RSL

Hypothesis

Hypothesis: $ABR_{CONV} \neq ABR_{RSL}$

Null hypothesis: $ABR_{CONV} = ABR_{RSL}$

Methods

ABR recording

- 6 subjects
- ISI: [38-48] ms
- 100 µs rarefaction clicks
- Stimulation levels: 80, 60, 40, 20 dB
- Amplifier*

* Valderrama et al. «A flexible and inexpensive high performance auditory evoked response recording system…» Biomedizinische Technik, 2014 Oct; 59(5):447-59.   DOI: 10.1515/bmt-2014-0034.

Signal processing
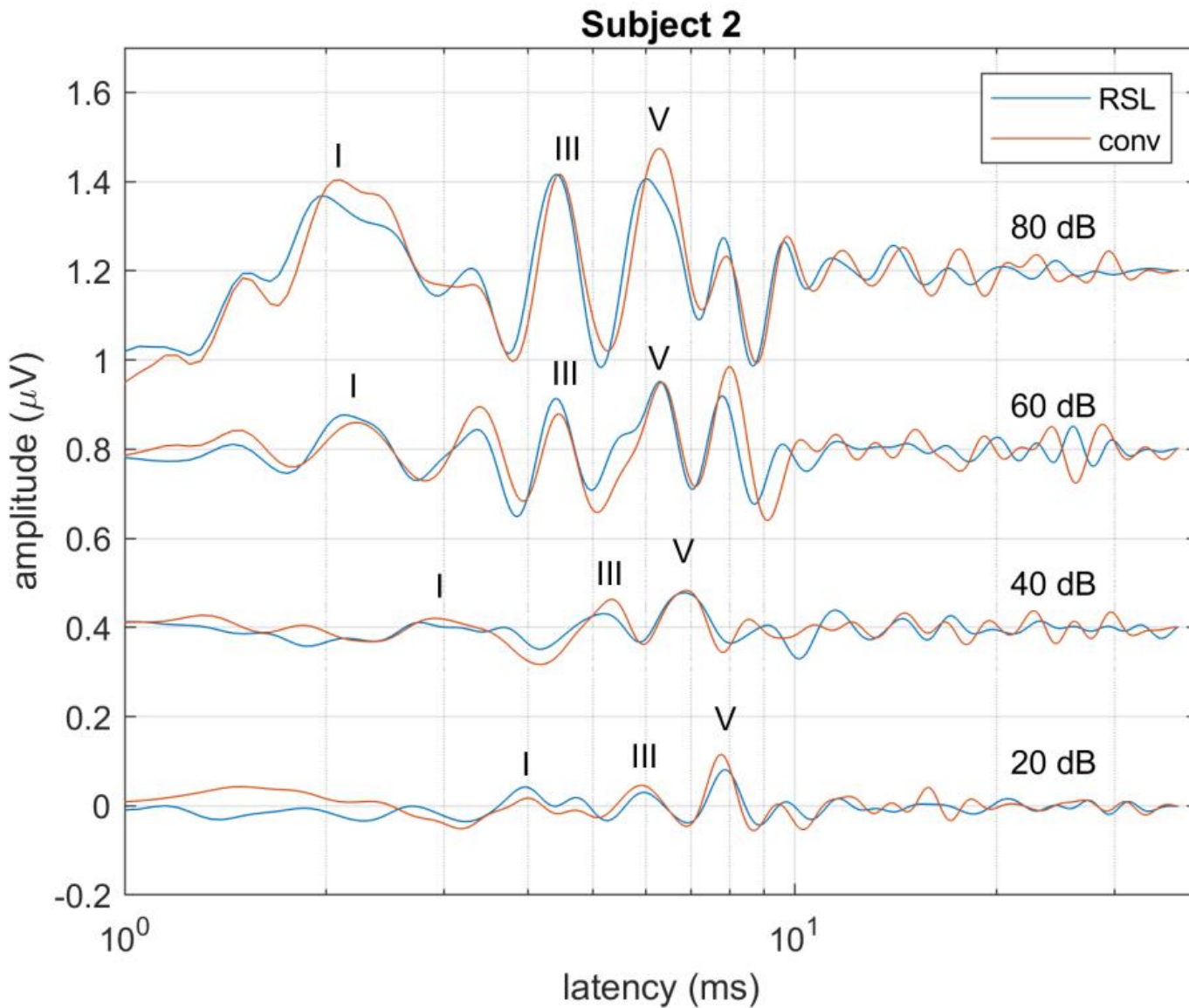
- Ensemble averaging
- Latency dependent filtering*

* De la Torre et al. «Latency-dependent filtering and compact representation of…» . JASA, 2020, 148(2): 599-613.   DOI: 10.1121/10.0001673.
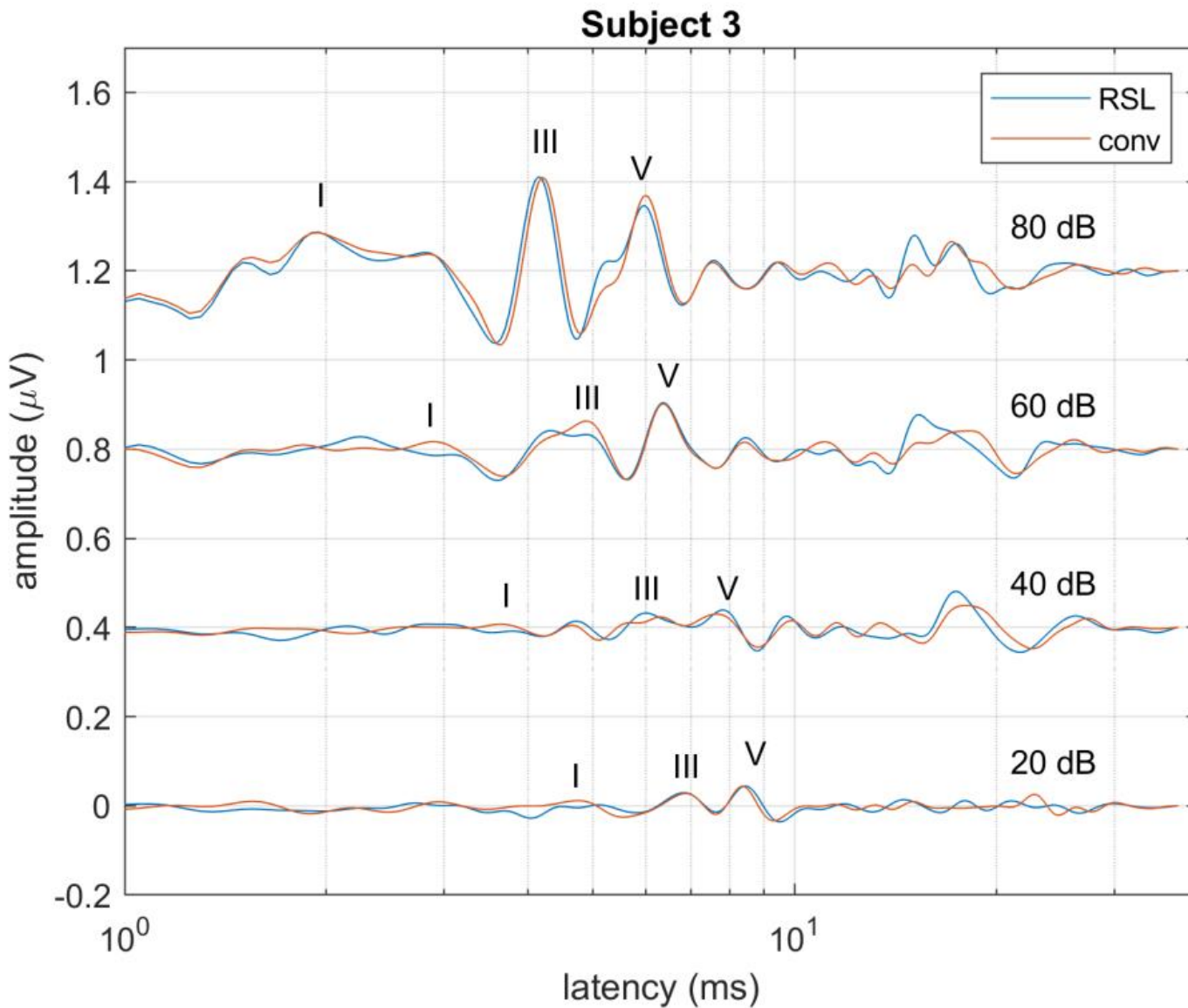
Results – ABR responses
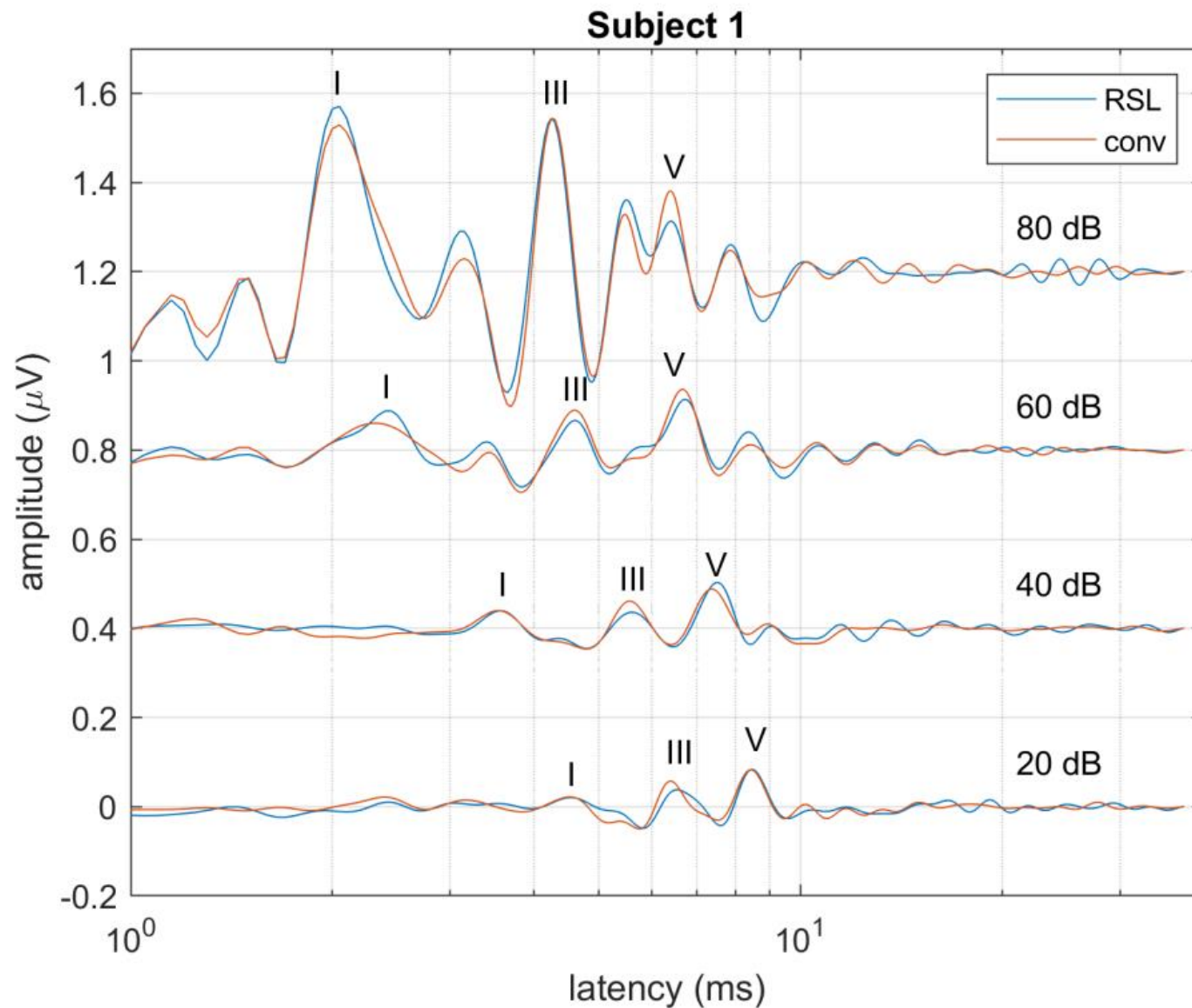
Subject 1

Results – ABR responses

Results – ABR responses

Results – ABR responses

Results – ABR responses

Subject 5

Results – ABR responses

Subject 6

Results – ABR responses

Subject 6

$$ABR_{CONV} = ABR_{RSL}$$

Differences in PAM

Differences for MLR or CAEP ?
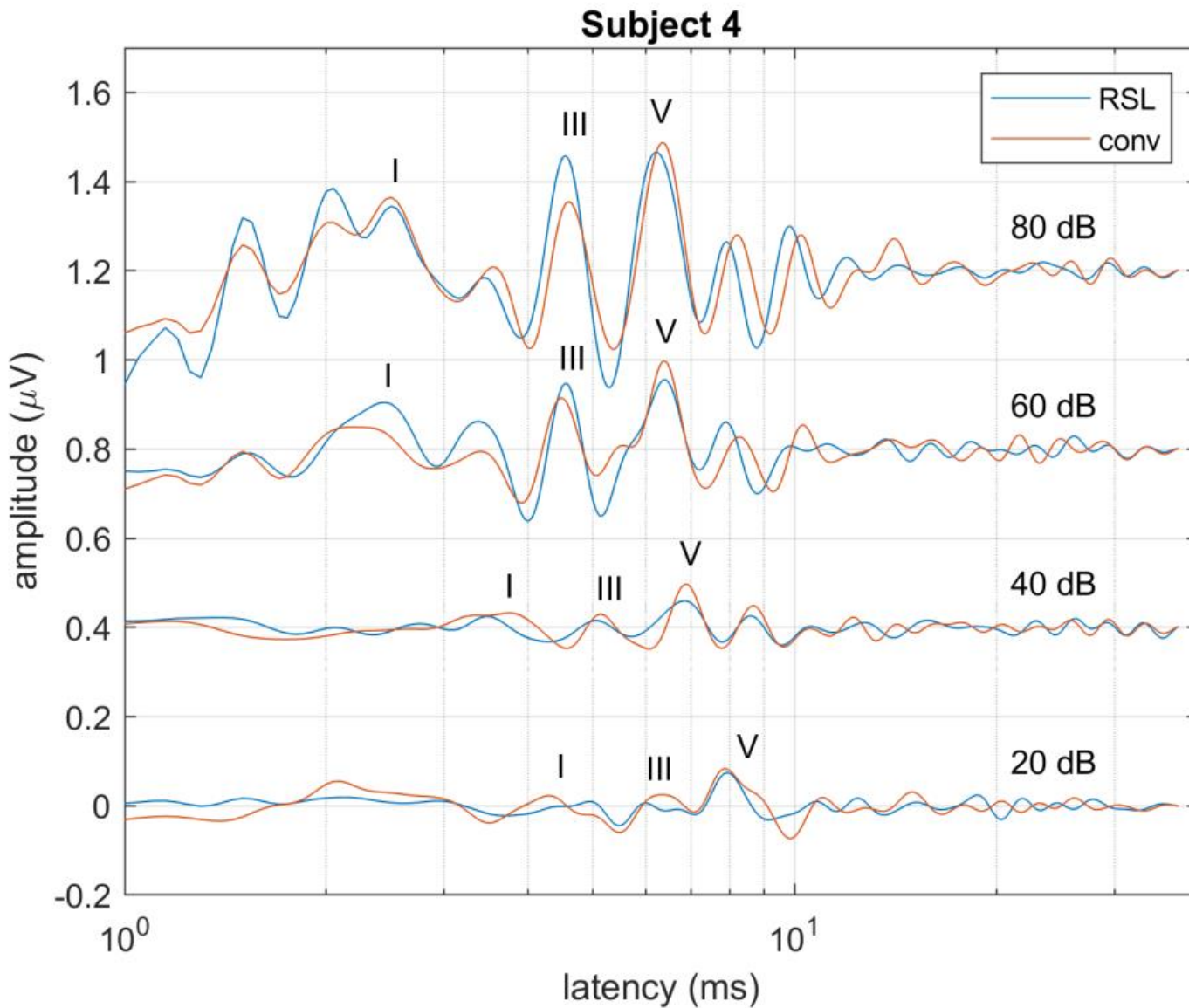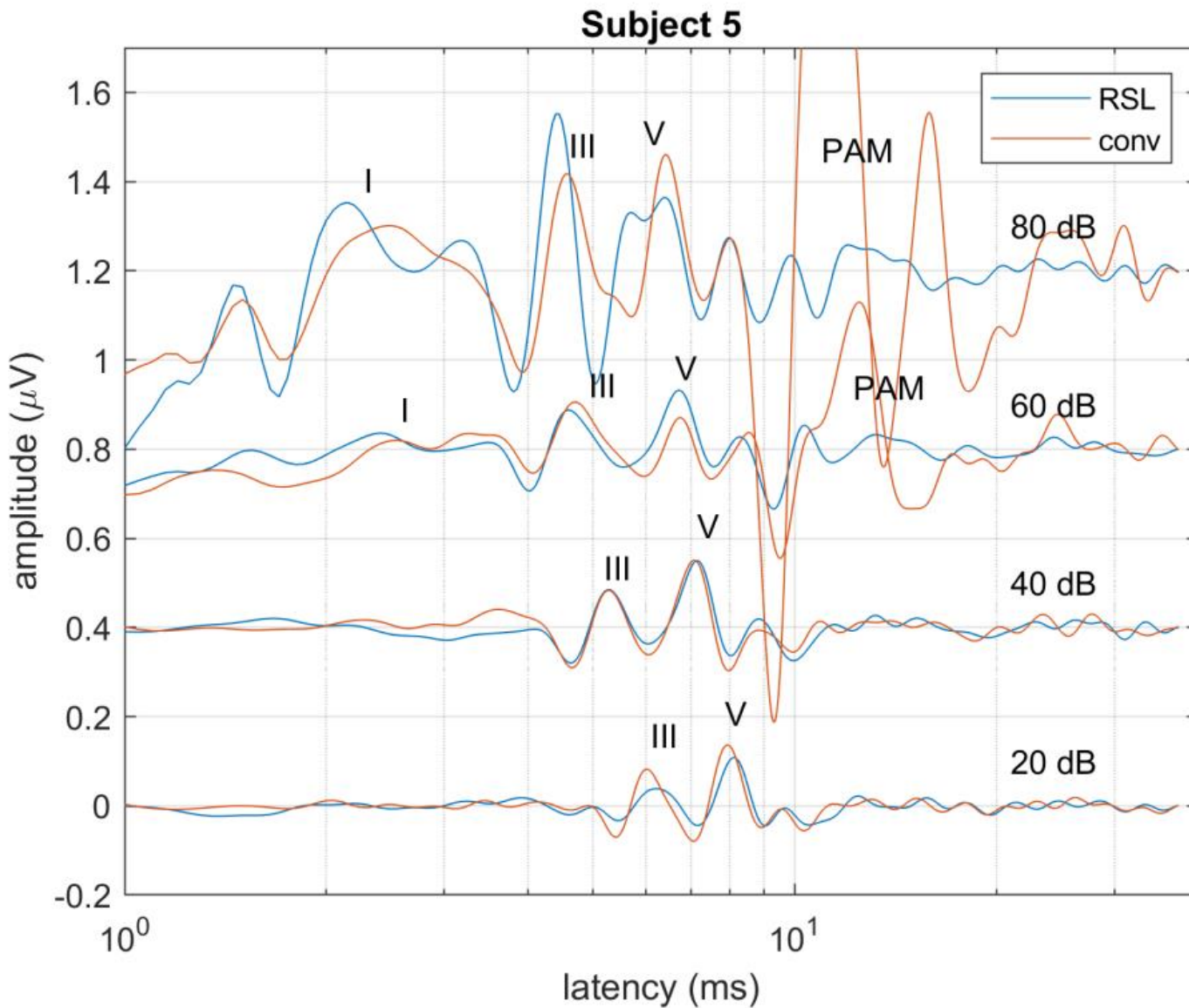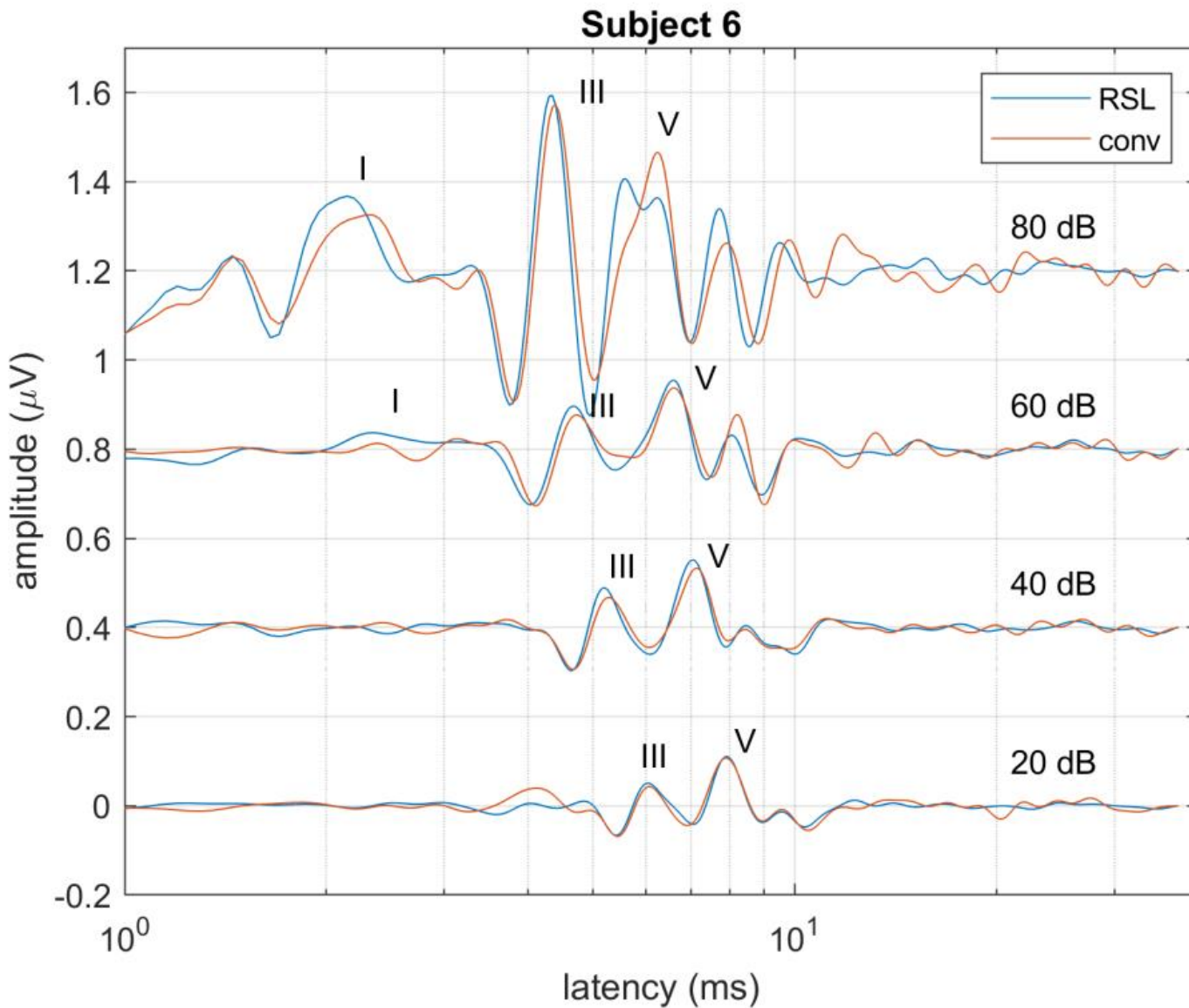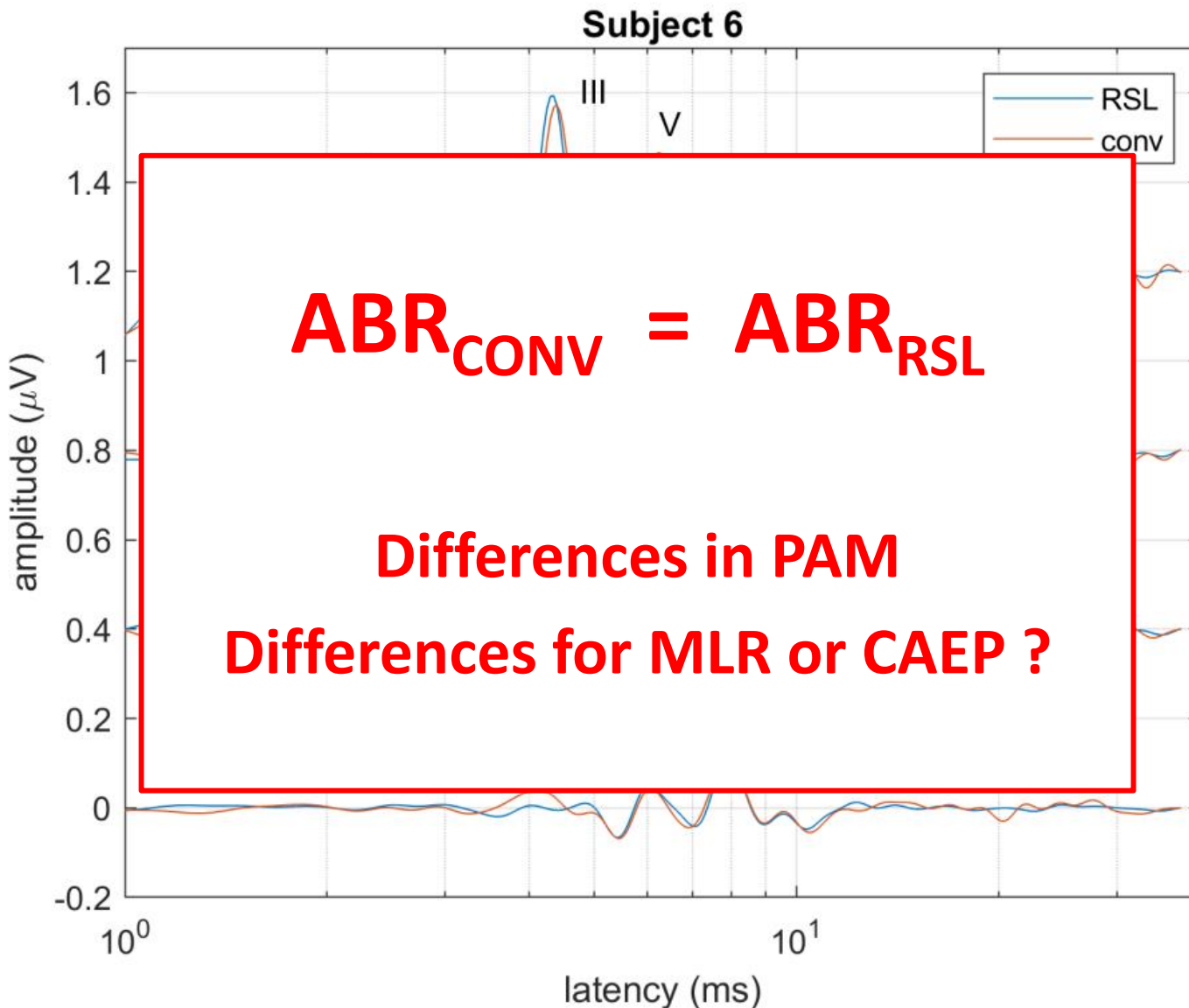
Potential utility of RSL: comfort

PAM → discomfort

Hypothesis: $Comfort_{CONV} \neq Comfort_{RSL}$

Null hypothesis: $Comfort_{CONV} = Comfort_{RSL}$

Survey: comfort comparison

- Available at this link:
  http://sl.ugr.es/subjective_evaluation_sound_stimulus

- Comfort$_{CONV}$ vs Comfort$_{RSL}$

- 102 volunteers

- Google Forms

Designing an audiological test

At the University of Granada we are designing an audiological test in which, in a real situation, the subject under study will have to listen to a sound stimulus for 20 minutes, remaining as relaxed and static as possible.

But we don't want to bore you with the 20 minutes that the real test lasts!

We would only like to have your opinion so that you could tell us with which sound you would be more comfortable if you had to listen to it during the 20 minutes that the real test lasts and remaining still.

We have three different sounds that we want to test:
- ASCENDING SEQUENTIAL
- DESCENDING SEQUENTIAL
- RANDOMIZED

Necessary material: mobile phone, personal computer or tablet and possibly an earphones. Time: less than 5 minutes.
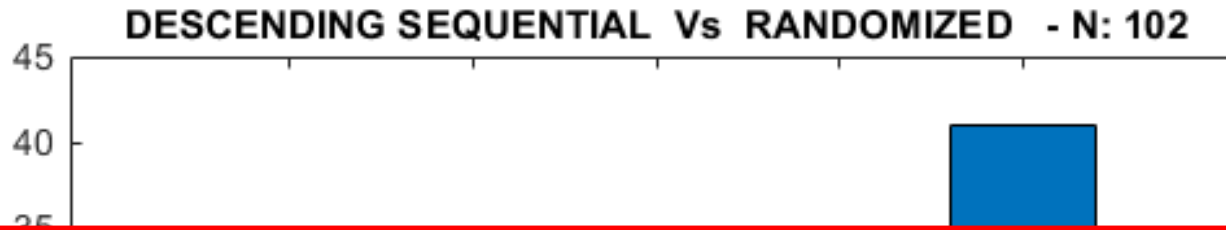
Thank you very much for your participation!

(If you found it interesting, you can forward this questionnaire to all the people you want. It is totally anonymous)

Survey about comfort: results

DESCENDING SEQUENTIAL Vs RANDOMIZED - N: 102

Survey about comfort: results

DESCENDING SEQUENTIAL Vs RANDOMIZED - N: 102
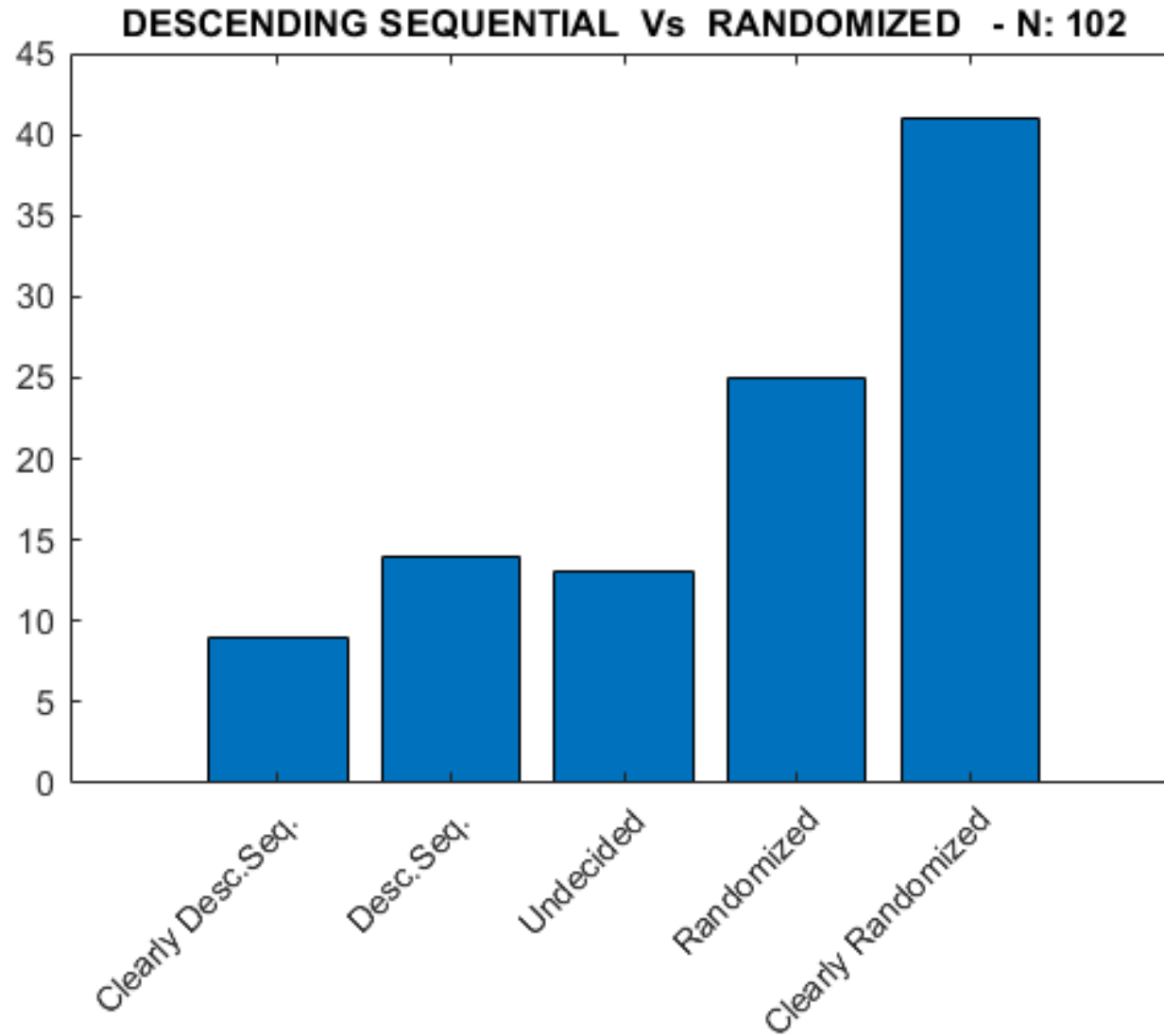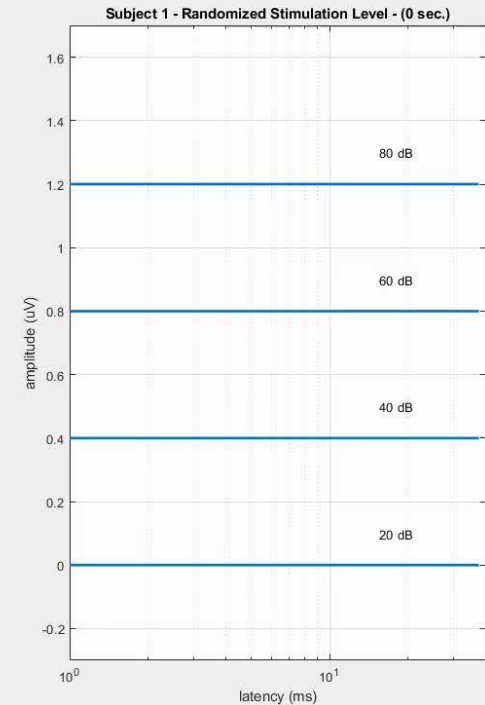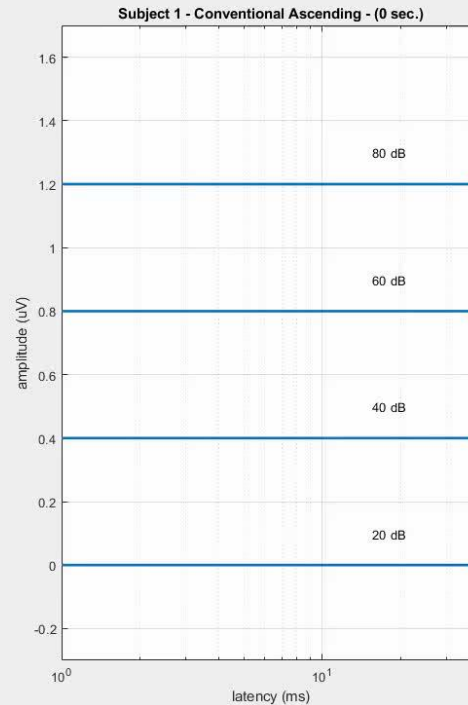
$$Comfort_{CONV} < Comfort_{RSL}$$
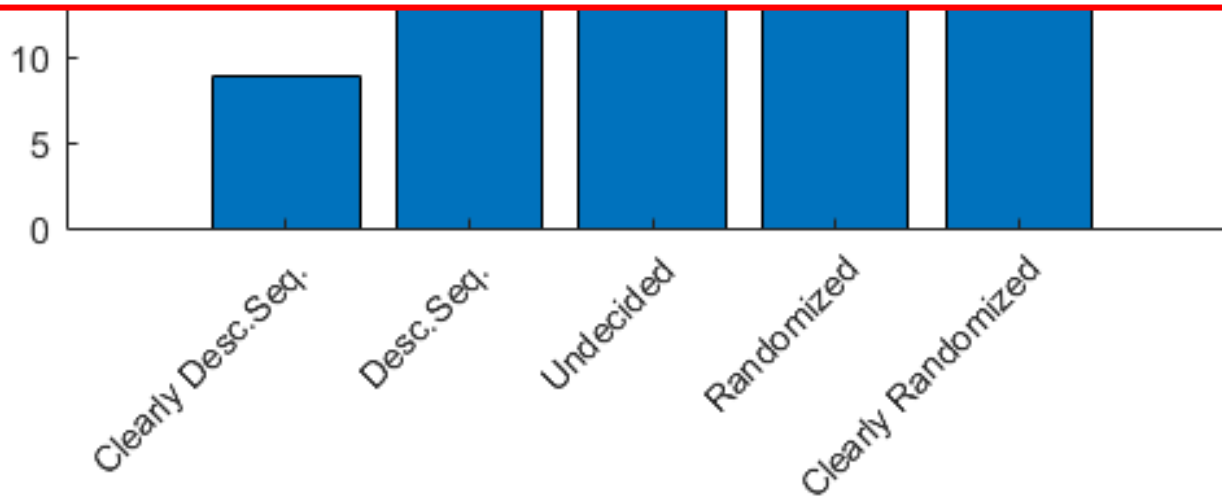
Potential utility of RSL: decision making

- ABR exploration
- Identification of waves I, III and V
- 6 subjects → video recreation

Hypothesis: $Decision_{CONV} \neq Decision_{RSL}$

Null hypothesis: $Decision_{CONV} = Decision_{RSL}$

Survey: decision making

- Available at this link:
  http://sl.ugr.es/comparing_ABR_recording_techniques

- $Decision_{CONV}$ vs $Decision_{RSL}$

- 10 volunteers (audiologists)

- Google Forms

Comparing ABR recording techniques

At the University of Granada we are analyzing two different tecniques, named RSL and SSL, for recording Auditory Evoked Potentials and in particular Auditory Brainstem Responses (ABR).
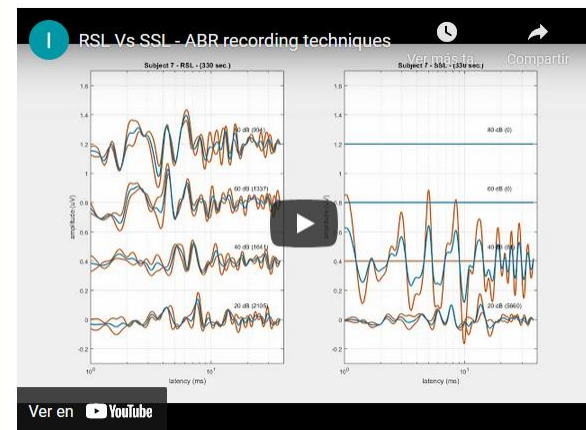
As an audiologist or expert in the field we would like to have your opinion.

The following video represents the ABR recording of 11 subjects at 4 stimulation levels (i.e. 20-40-60-80 dB) using RSL (left panel) and SSL (right panel). The duration of each recording session was 16 minutes (960 seconds).
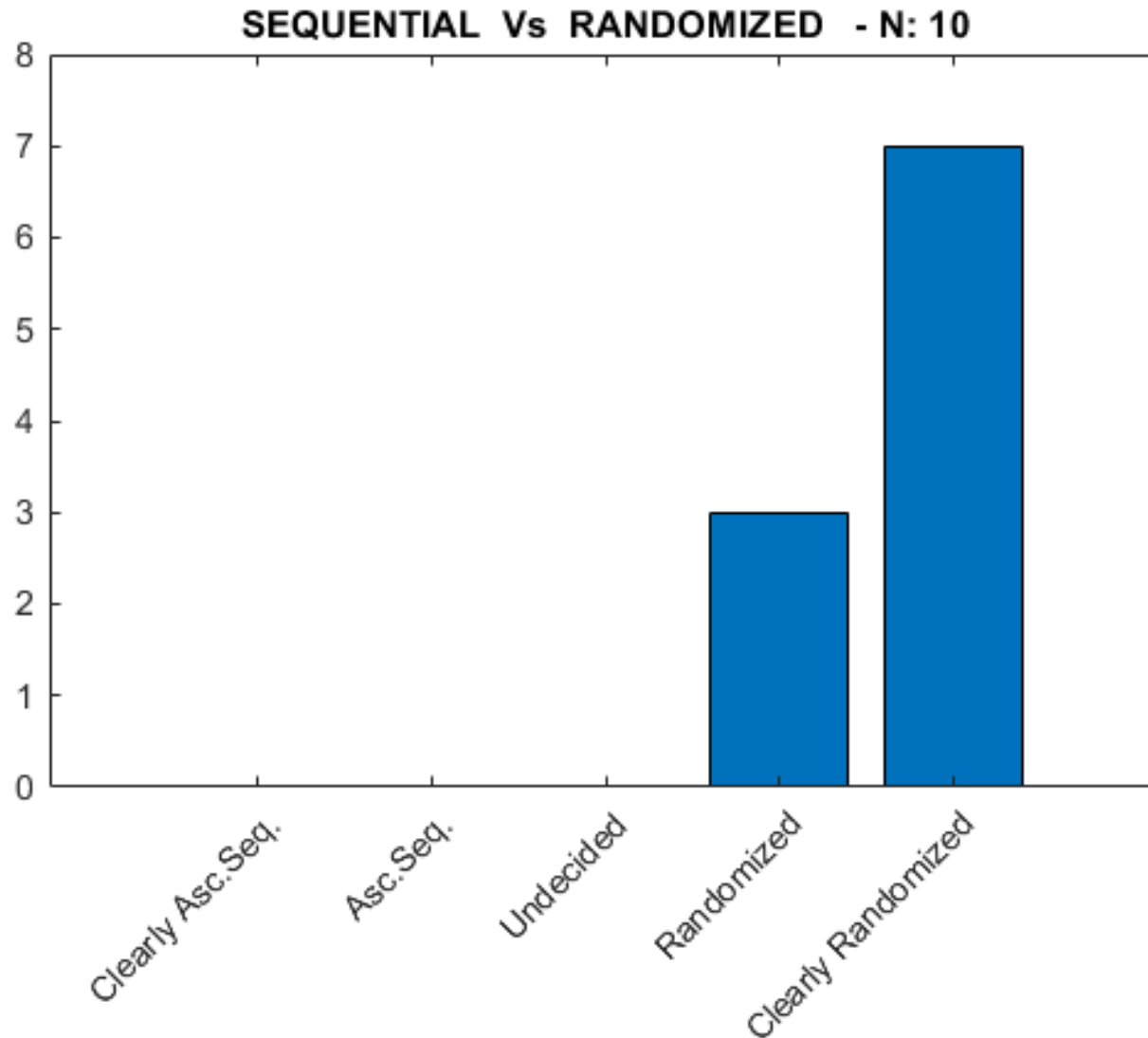
Observe in the video the ABRs as they are provided by both techniques. Consider which of these techniques provides more consistent results, or provides consistent results sooner.
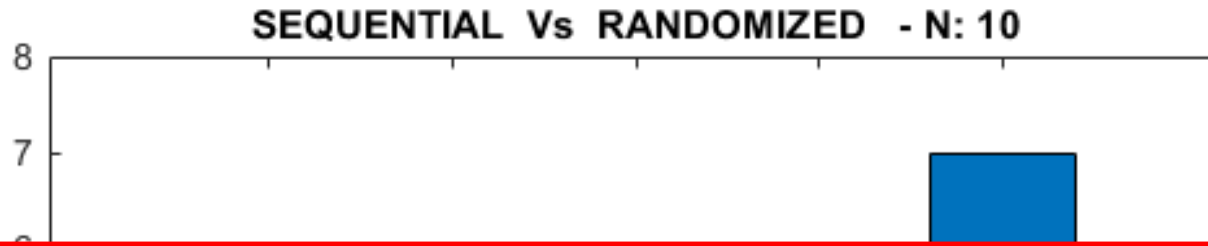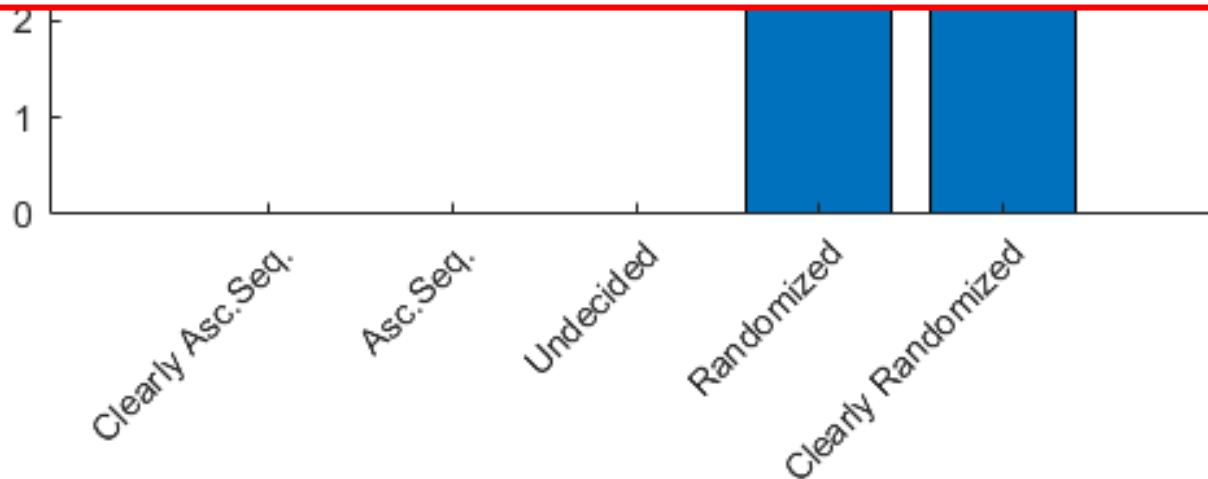
*Obligatorio

RSL Vs SSL - ABR recording techniques

Survey about decision: results

SEQUENTIAL Vs RANDOMIZED - N: 10

Survey about decision: results

SEQUENTIAL Vs RANDOMIZED - N: 10

$$\text{Decision}_{CONV} < \text{Decision}_{RSL}$$

Conclusions

- Randomized Stimulation Level (RSL)

- $\text{ABR}_{\text{CONV}} = \text{ABR}_{\text{RSL}}$

- $\text{MLR}_{\text{CONV}} = \text{MLR}_{\text{RSL}}$? $\qquad \text{CAEP}_{\text{CONV}} = \text{CAEP}_{\text{RSL}}$?

- $\text{Comfort}_{\text{CONV}} < \text{Comfort}_{\text{RSL}}$

- $\text{Decision}_{\text{CONV}} < \text{Decision}_{\text{RSL}}$

- RSL procedure interesting for clinical applications

- Absence of PAM in some subjects with RSL

Thanks for your attention!

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