

A Neurophysiological Marker of Auditory Working Memory Load

BACKGROUND

- Working Memory (WM) is a limited-capacity short-term memory system that allows us to temporarily hold several representations accessible in service of other mental tasks¹.
- WM is theorized to consist of multiple components: Two amodal regulatory components, one visual store and one auditory store².
- Neurophysiology can be used to index individual WM capacity and in effect shed light on WM organization^{3,4}.
- Aim: Isolate a neurophysiological marker that reflects encoding and maintenance of auditory WM load in conditions where specific sounds have to be filtered out for retention.

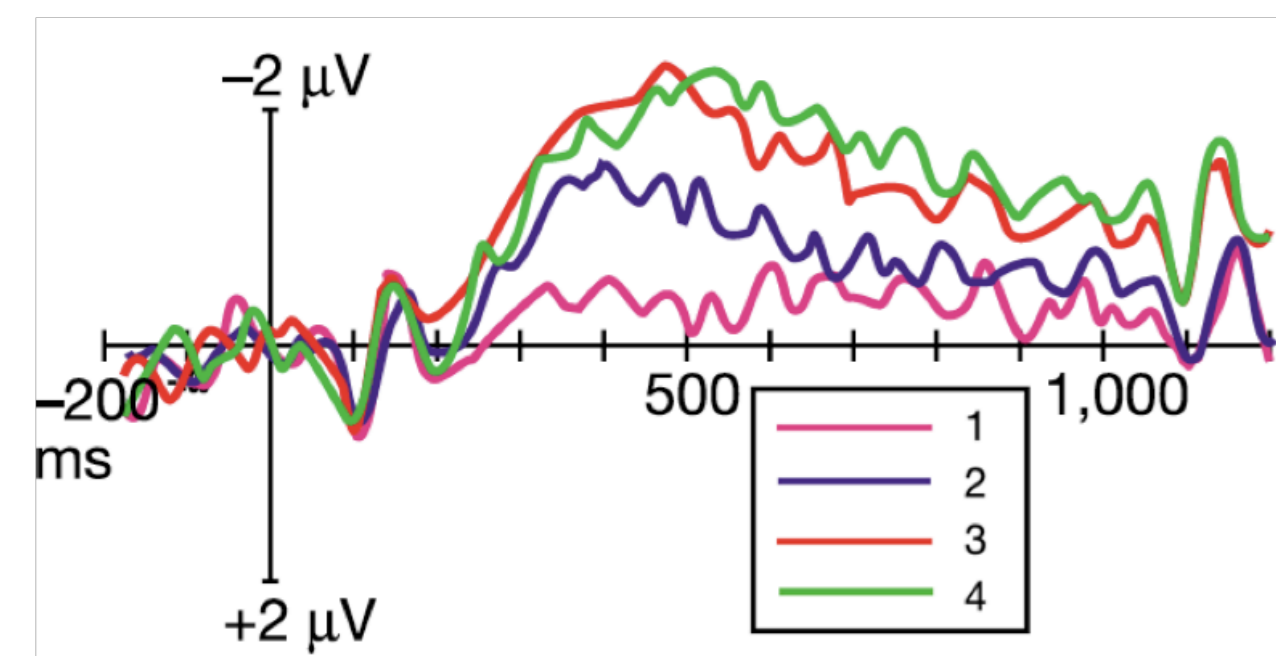


Fig 1. ERP contra-ipsi difference waves at lateral occipital and posterior parietal electrodes during the retention interval of a bilateral visual change-detection task³.

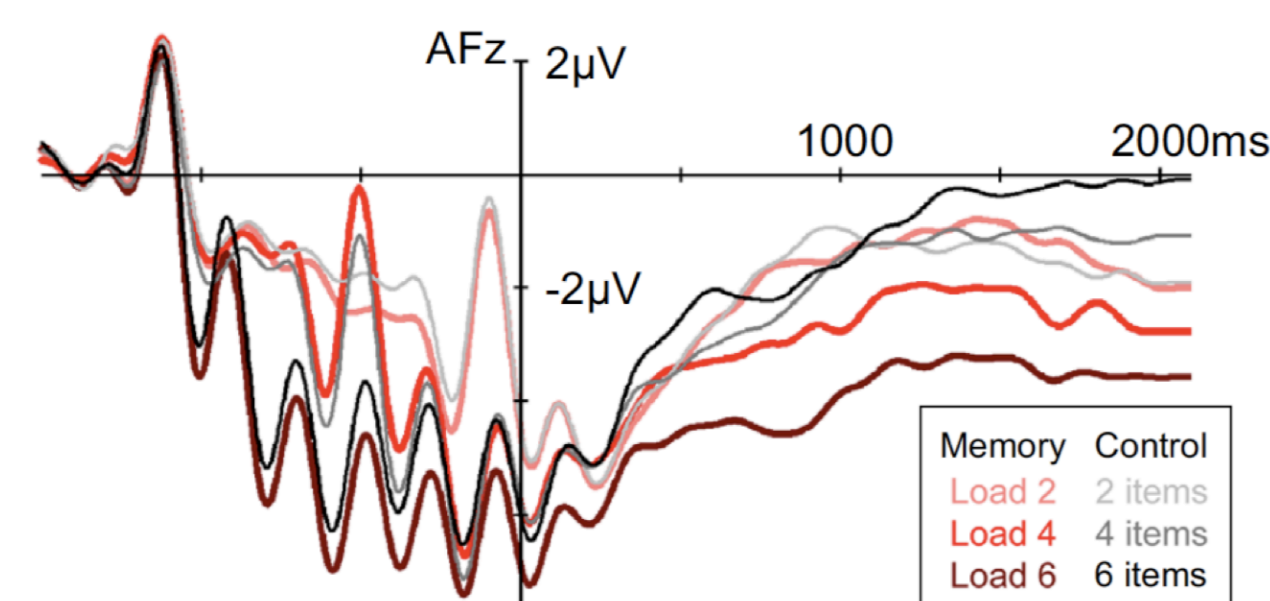


Fig 2. ERP comparison between memory and control conditions at the central frontal electrode during the retention interval of an auditory change-detection task⁴.

METHODS

N = 18 (320 trials).

Stimuli

125-8,128 Hz pure tones,
200-2,300 ms auditory arrays.

Apparatus

3M™ E-A-RTONE™ Insert Earphone 3A (10 Ohm),
32 EEG standard electrode sites (international 10-20 system).

Pre-measurements

- Audiogram (Audiometer Oscilla USB-330),
- Tone-distinction task.

Task procedure

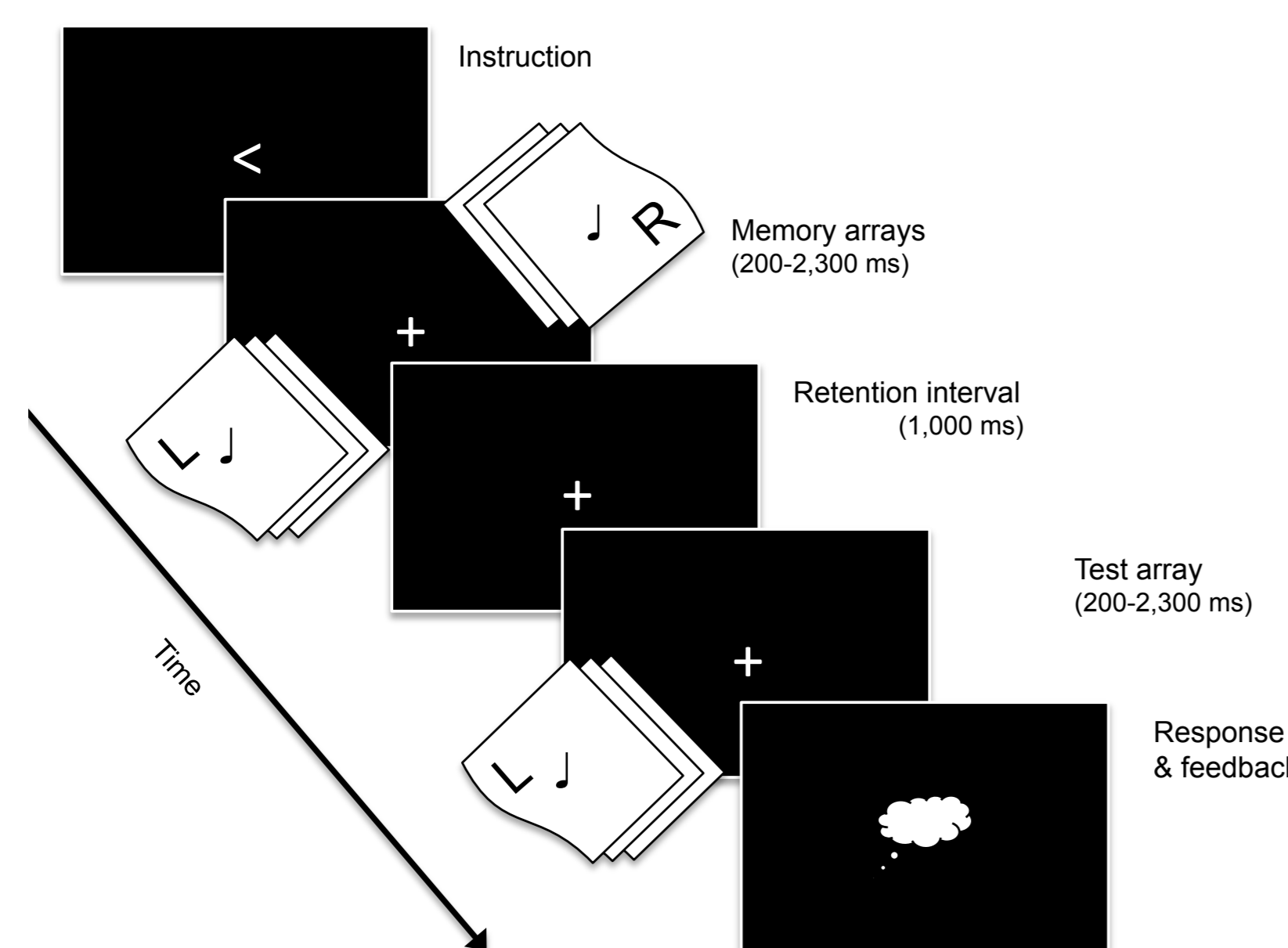
Auditory change-detection
x dichotic listening task.

Factors

Set-size (1 to 4 tones),
Side of presentation (L/R).

Clusters

Hemisphere (L/R),
6 clusters across frontal,
temporal, & parietal regions.



RESULTS: Behavior

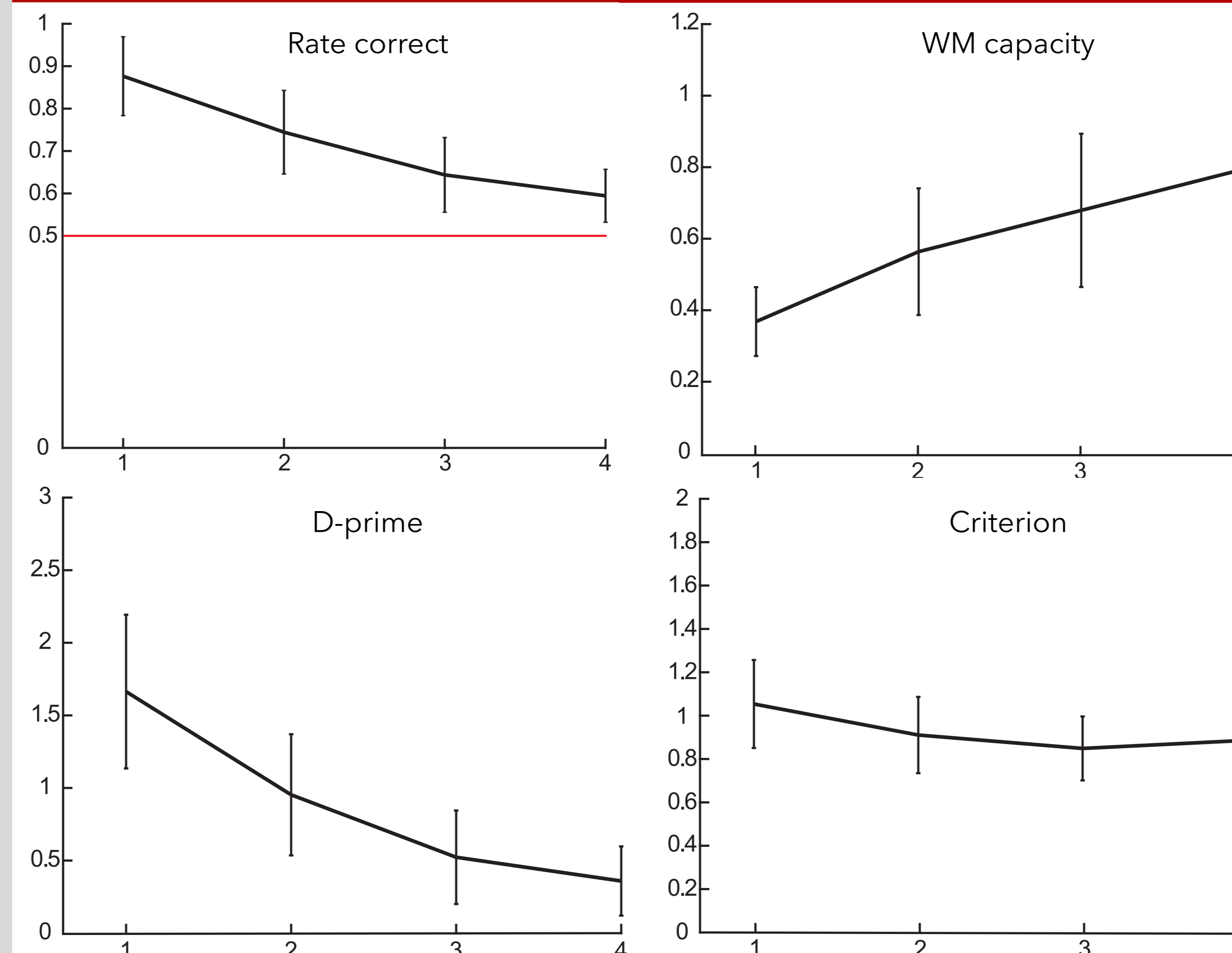


Fig 3. Behavioral results for set-sizes 1 - 4, averaged for side of presentation conditions, errorbars show SD.

RESULTS: Event-related potentials

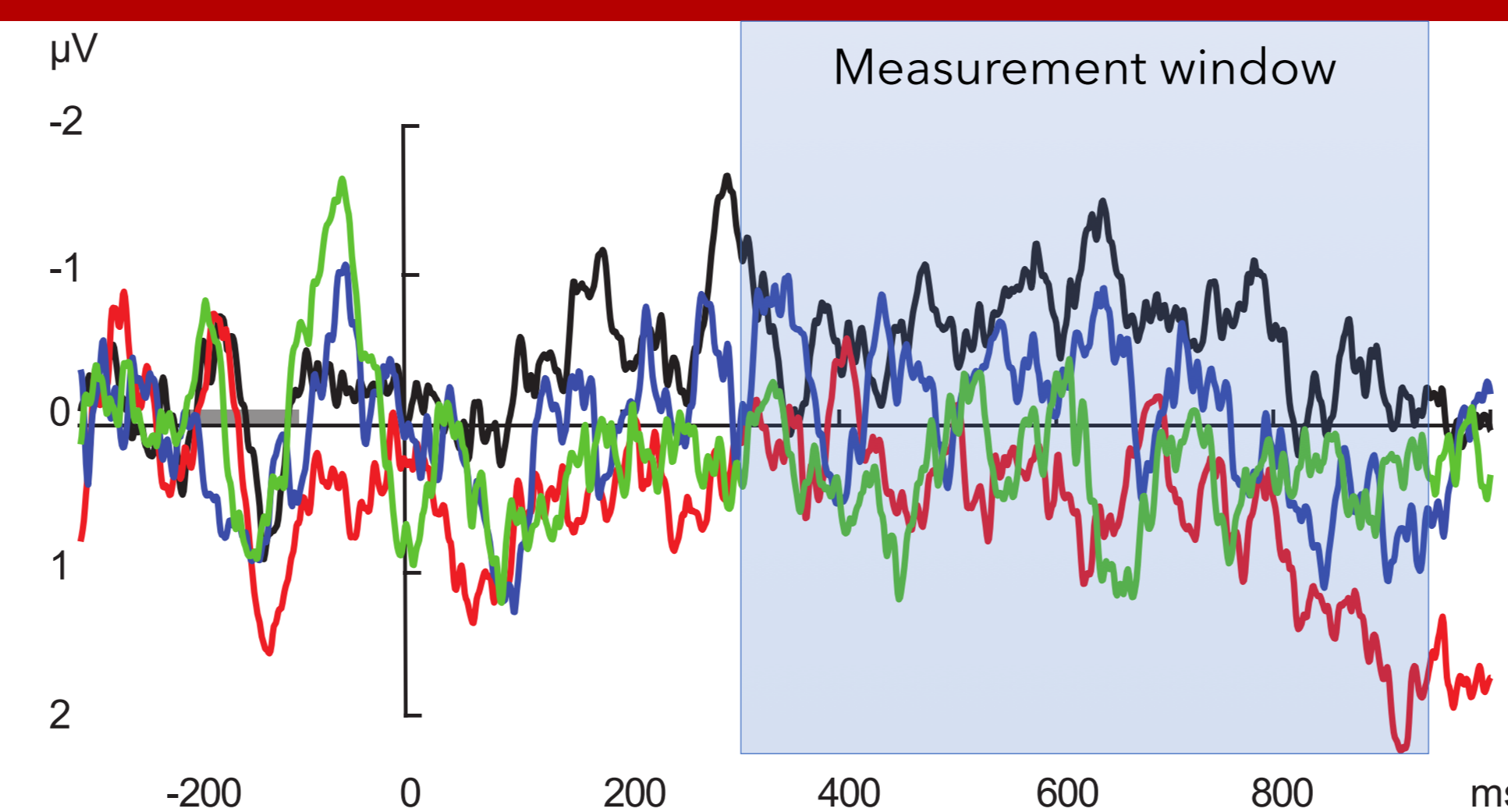


Fig 4. Temporal contra-ipsi difference ERP for set-sizes 1 - 4, Side of presentation Left.

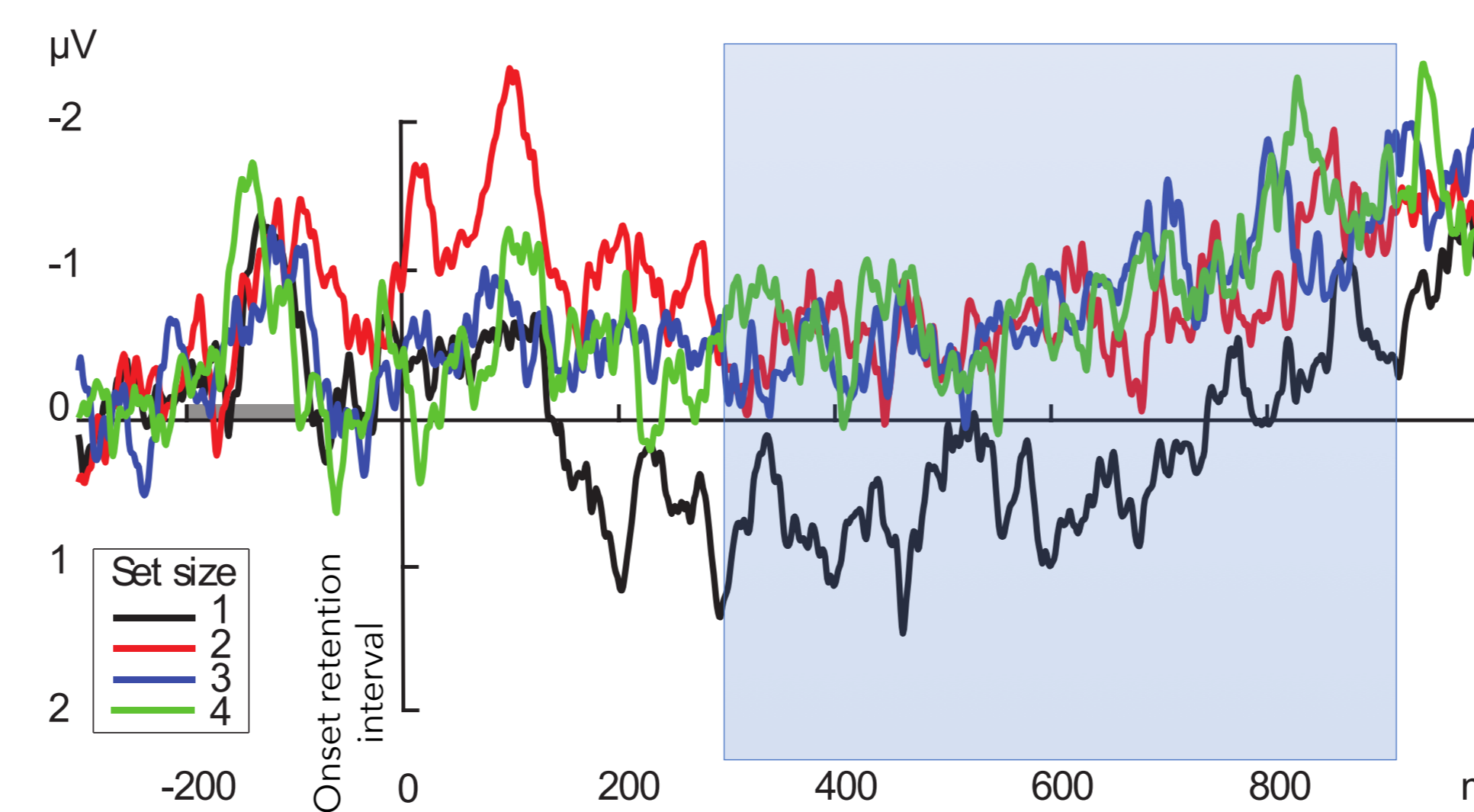


Fig 5. Temporal contra-ipsi difference ERP for set-sizes 1 - 4, Side of presentation Right.

RESULTS: Mean amplitude ERP

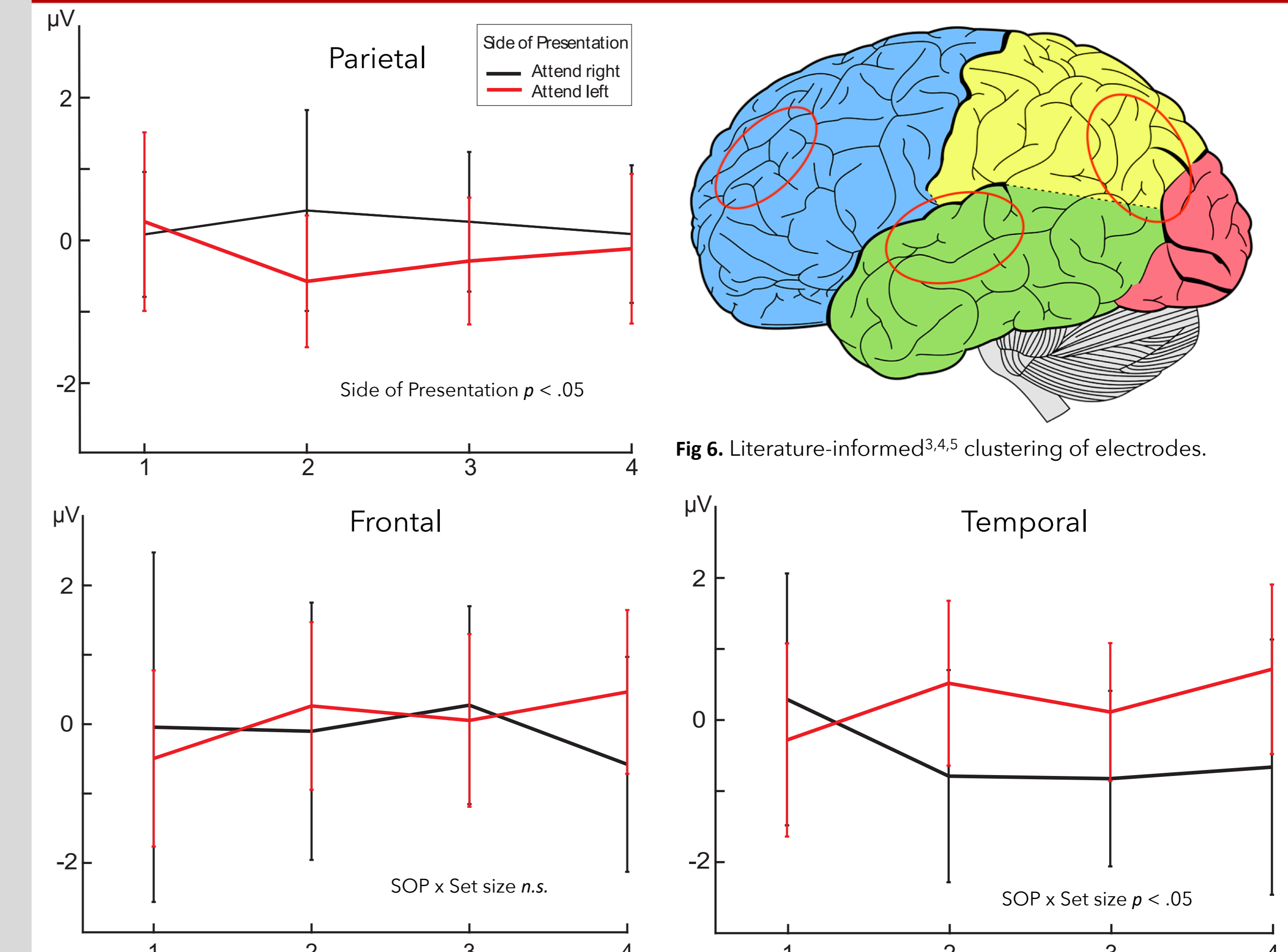


Fig 6. Literature-informed^{3,4,5} clustering of electrodes.

Fig 7. Mean amplitude of contra-ipsi difference ERP during 300 - 900 ms of retention interval, errorbars show SD.

CONCLUSION

Behavior:

- The auditory WM task became increasingly difficult with set-size.
- WM capacity estimates were small, generally below 1, possibly due to expenditure of resources during dichotic listening.

Neurophysiology:

- Interhemispheric activity differences in the whole hemisphere and a region in the temporal lobe seem to scale with auditory WM load when the side of presentation is accounted for.
- Results indicate lateralisation of auditory WM processing.

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