Reliability of resting state power with MEG at the sensor and source space

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Question

Several findings reported disturbed oscillatory activity in developmental, psychiatric disorders and neurodegenerative diseases. Similarly, drug-related changes were assessed in MEG pharmacological trials. Brain rhythms might be used as clinical biomarkers or in longitudinal studies. But

How reliable is MEG power in resting state?

Background

- This is the first reliability assessment of resting state power with MEG.
- Only functional connectivity (graphs metrics) with MEG has been addressed.
- Evidence for reliability of the power in the classical frequency bands with EEG has been accumulating:

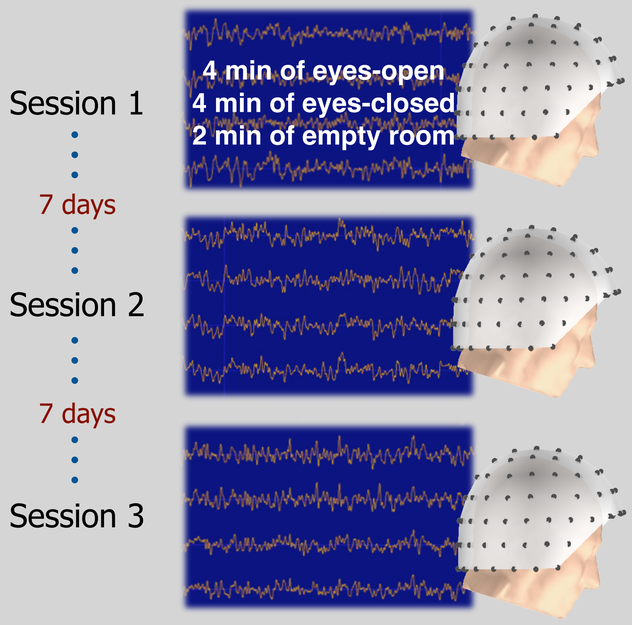
1. Reliability values were lower in resting state than during a cognitive task.
2. Resting state power was higher in the eyes-closed condition.
3. Reliability varied across the frequency bands: alpha, beta and theta bands were the most reliable in different test-retest intervals, while gamma and delta showed the least reliability.
4. Reliability distribution remains unclear: some studies found that the occipital sensors were the most reliable while others found different patterns.

Conclusions

- Reliability in the sensor-space ranged from 0.54 to 0.95. Our results are in line with previous EEG studies
- Theta, alpha and low beta were more reliable than delta and gamma. Also, occipito-parietal sensors were the most reliable across the frequency bands.
- Frontal-beta, medial temporal lobe theta and fronto-posterior alpha were the most reliable profiles in the source space.
- Signal-to-noise ratio may be partially responsible for the variability across brain regions and frequency bands. This was especially evident in the gamma band.
- Gamma band is associated with high level processing then could be expected to be more reliable under task condition than resting-state.

Method

Vectorview system, Elekta Neuromag® (Helsinki, Finlandia)



25 subjects (mean age 28.9 years, 14 females)

T1-weighted MRI

16/25 subjects

- Source locations: each 6mm over individual cortical surface (Freesurfer and MNE softwares)
- Forward model solved with a 3-shell boundary element method (BEM): inner skull, outer skull and skin (NFT software). Leadfields were computed (MNE software).

Power spectra were obtained with a multi-taper method using discrete spheroidal sequences taper and 1 Hz smoothing.

Absolute power for each source location and frequency band was computed with a frequency-domain beamformer (DICS)
- 5% regularization
- Unconstrained source orientation

Delta (2-4Hz)	Low beta (12-20Hz)
Theta (4-8Hz)	High beta (20-30Hz)
Alpha (8-12Hz)	Gamma (30-45Hz)

Test-retest reliability: Intraclass correlation coefficient (ICC) (range: 0-no reliability to 1-perfect reliability)

Results: sensor-space

		Delta	Theta	Alpha	Low beta	High beta	Gamma
Eyes-open	occipital	0.52	0.79	0.86	0.86	0.75	0.64
	left temporal	0.72	0.75	0.92	0.85	0.85	0.59
	right temporal	0.79	0.76	0.83	0.82	0.79	0.59
	parietal	0.76	0.85	0.86	0.86	0.85	0.77
	frontal	0.78	0.82	0.85	0.76	0.74	0.48
Eyes-closed	occipital	0.78	0.86	0.94	0.91	0.89	0.59
	left temporal	0.69	0.74	0.92	0.87	0.75	0.50
	right temporal	0.55	0.83	0.95	0.83	0.75	0.49
	parietal	0.66	0.82	0.93	0.85	0.79	0.63
	frontal	0.90	0.54	0.84	0.74	0.70	0.53
Empty room	occipital	0.02	0.19	0.38	0.42	0.17	0.34
	left temporal	0.06	0.01	0.03	0.07	-0.0	0.08
	right temporal	-0.01	-0.01	0.05	0.14	0.02	0.17
	parietal	-0.07	-0.07	-0.02	-0.01	0.01	-0.00
	frontal	-0.09	-0.11	-0.05	-0.01	-0.0	-0.03

Table 1. ICC of the average power over five MEG sensor regions, for each frequency band and condition.

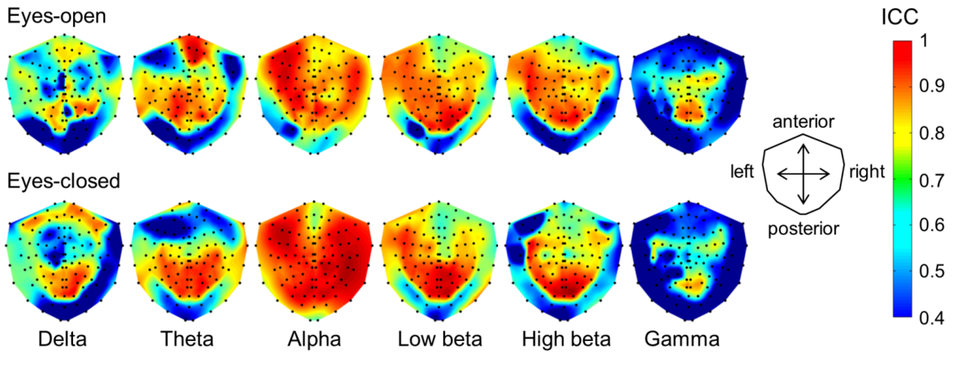


Figure 1. Topography map of the intraclass correlation coefficient (ICC) of sensor-space power for each resting state condition, frequency band, sensor.

Results: source-space

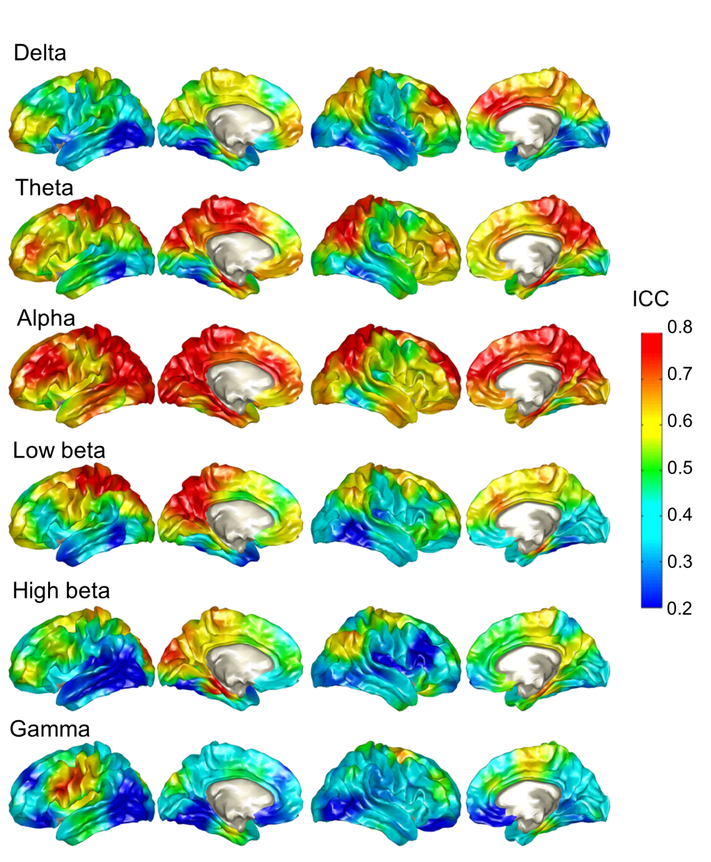


Figure 2. ICC of source space power for the resting state eyes-open condition. ICC values were computed for each source location and frequency band separately.