Task-induced high-gamma suppression shows lateralized relationships with reaction time in the retrosplenial cortex.

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Introduction
Task-induced default mode network (DMN) deactivation is a well-established phenomenon with numerous imaging studies noting strong negative associations between the degree of deactivation and variable behavioral performance parameters such as reaction time (RT - Anticevic et al., 2012). The electrophysiological dynamics, however underlying this effect have received significantly less attention (Dastjerdi et al., 2011; Ossandon et al., 2011). We used electrocorticography (ECoG) to record electrical responses directly from the cortical surface while subjects completed a standardized language paradigm, requiring abstract-concrete discrimination.

Methods
We acquired ECoG signals from 7 epilepsy patients undergoing long-term monitoring for seizure focus localization. Experimental recordings were performed at the patient’s bedside with g USBamps (GugerTec, Graz, Austria) sampled at 1200 Hz and recorded with respect to an epidurally placed reference and ground electrodes. ECoG signals were first manually inspected for artifacts and/or significant noise. All signals were then re-referenced with respect to the common average of the remaining montage and notch filtered for 60, 120, and 180 Hz to eliminate line noise, using a fourth-order Butterworth filter.

Two spectral decomposition approaches were utilized.
1) Time-varying spectral (Time-Frequency) estimates were calculated using a continuous wavelet decomposition in MATLAB, utilizing complex Morlet wavelets. Each analysis was conducted on time-X-trial event matrices based event boundaries for both rest epochs and language discriminations. Time-frequency estimates were calculated on broadband signals from 1-199 Hz with wavelet center frequencies stepped every 3 Hz. The magnitude of the complex wavelet coefficients for each time and frequency combination represented the spectral power estimate at that point. To account for the exponential shape of the spectra, spectral estimates were normalized on a per-frequency basis by subtracting the mean of all samples within the rest epoch and dividing by the standard deviation of those samples. The wavelet analysis was used to illustrate temporospatial distribution of responses across electrodes over the posterior-medial DMN sites.
2) To delineate task-based suppression, we concentrated on high gamma (HG; 70-200 Hz) power, a correlative marker of local cortical activity. Signals were band-pass filtered for the HG band. Instantaneous amplitude of the filtered signal across channels was estimated by taking the absolute value of the Hilbert transform. Data were squared to calculate continuous HG power and then log transformed to approximate a normal distribution (henceforth referred to as HG power) for the full time series.

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Conclusions
1) These results potentially suggest that insufficient suppression of neural responses within the left localized medial parietal DMN sites relative to the right has a greater impact on normal linguistic functions.
2) The combination of the ECoG and an abstract-concrete discrimination induces significant spatiotemporal variation, and may provide a reliable spatiotemporal platform to investigate functional variability across low-frequency responses (Miller et al., 2013).

References