Time-resolved recruitment of posterior parietal cortex during inhibition control.

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During complex behaviors we need to monitor sensory information and adjust behavior to best interact with a changing environment. Inhibition control reflects the ability to stop ongoing actions based on external demands. Some of the brain regions subtending inhibition control, like ventral prefrontal cortex and basal ganglia, have been extensively studied with high-temporal resolution techniques. However, parietal cortex has been largely overlooked notwithstanding being reliably active during inhibitory control. Recent evidence is sparking new interest on the role played by posterior parietal cortex during inhibition control [1, 2].
To determine the timing of activation of posterior parietal cortex with respect to the fast events occurring during response inhibition, the current work leverages direct intracranial recordings in human participants performing a stop-signal task.
The task is a classic stop-signal paradigm, where participants are required to deliver a fast and appropriate response to a go-cue and to withhold the response when a rare stop sign is presented. This procedure allows to estimate the time needed to inhibit a response (stop-signal reaction time, SSRT).
The intracranial signals are recorded using stereotactic depth electrodes (sEEG, 0.8mm diameter). The continuous voltage time-series is spectrally decomposed and power changes in the broadband gamma range (BBG, 70-150 Hz) are analyzed. A subset of recordings employs hybrid electrodes with a bundle of microwires (~50microm) allowing to isolate single-unit activity (SUA) surrounding the electrode tip. Extracellular spikes are detected based on a signal-dependent voltage threshold and automatically sorted into units based on waveform features.
Preliminary results from two participants in the current study demonstrate a very early BBG response in the intraparietal sulcus during successful stopping, occurring immediately after the onset of the stop-signal and sustained until the SSRT. This early response, occurring before the SSRT, supports a key role for posterior parietal cortex in monitoring and detecting relevant information for selective movement inhibition [1]. SUA in medial posterior parietal cortex revealed a unit sensitive to inhibition failure. The firing rate of the unit decreased after the stop signal presentation specifically for error trials, not for successful inhibition. This pattern of response is once again in line with a role in monitoring: the decrease firing rates tracks a failure of monitoring, and results in an inhibition error.
Overall, the current results offer new insights into the functional role played by posterior parietal cortex during inhibition control, demonstrating its early recruitment and its association with successful behavioral adjustments.

References:

[1] Osada, T., S. Ohta, A. Ogawa, M. Tanaka, A. Suda, K. Kamagata, M. Hori, S. Aoki, Y. Shimo, N. Hattori, T. Shimizu, H. Enomoto, R. Hanajima, Y. Ugawa, and S. Konishi, An Essential Role of the Intraparietal Sulcus in Response Inhibition Predicted by Parcellation-Based Network. J Neurosci, 2019. 39(13): p. 2509-2521.
[2] Hannah, R. and S. Jana, Disentangling the role of posterior parietal cortex in response inhibition. J Neurosci, 2019. 39(35): p. 6814-6816.

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