

Prefrontal Control of Low Frequency Oscillations in Motor Cortex

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It has been proposed that low-frequency oscillations in motor cortex are signatures of preparation in anticipation of responding [1]. According to this idea, low-frequency oscillations in motor cortex should be controlled by regions such as prefrontal cortex that exert top-down control over response initiation. We tested this idea by recording local field potentials from both rodent prefrontal and motor cortex while animals performed a lever-release version of a delayed response task [2]. We found strong low-frequency power (1-20 Hz, peak 8-11 Hz) in the prefrontal and motor cortices. This band was selectively modulated while rats pressed, held, and released the lever. There was also low-frequency coherence between the prefrontal and motor cortices, which was maximal at 8-11 Hz during the delay period and during the collection of rewards. To establish that such low-frequency oscillations are controlled by prefrontal cortex, we studied field potentials from motor cortex in three animals in which prefrontal cortex was reversibly inactivated. Power in the 8-11 Hz range was specifically increased during the delay period when prefrontal cortex was inactivated.

These results provide evidence that low-frequency oscillations in motor cortex are controlled by prefrontal cortex, and support the idea that theta oscillations in motor cortex are related to preparatory activity. Based on previous studies from our lab [2], we suggest that this functional interaction between the prefrontal and motor cortices exerts top-down control over action that inhibits responding until the right time or the right stimulus has occurred.

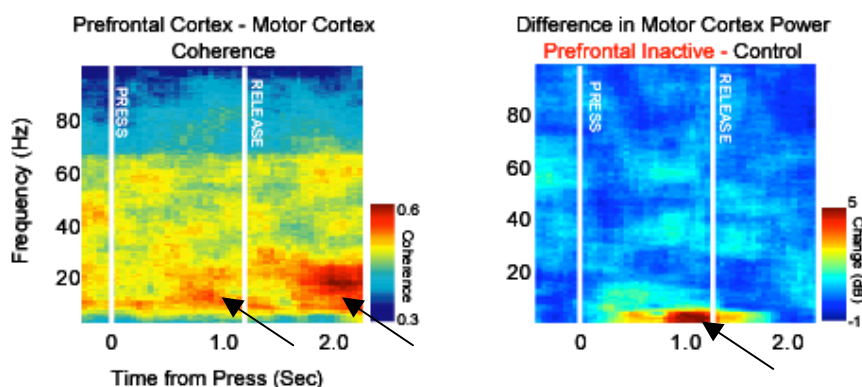


Fig 1: Left panel - Coherence between simultaneously recorded field potentials from prefrontal and motor cortex; Right panel - Difference in power of motor cortex field potentials with prefrontal cortex inactive vs. prefrontal cortex functioning. Arrows indicate regions of significant power.

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References

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