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Effects of Vagus Nerve Stimulation on Arousal State and Cortical Excitation

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The vagus nerve is a major pathway by which the brain and the body communicate. Electrical stimulation of the vagus nerve (VNS) is widely used as a therapeutic intervention for epilepsy and there is compelling evidence that it can enhance recovery following stroke. Our work demonstrates that VNS exerts a robust excitatory effect on the brain. First, we establish that VNS triggers an increase in arousal state as measured by behavioral state change. This behavioral state change is linked to an increase in excitatory activity within the cortex. We also show that cholinergic and noradrenergic neuromodulatory pathways are activated by VNS, providing a potential mechanism by which VNS may trigger cortical activation. Importantly, the effect of VNS on neuromodulation and cortical excitation persists in anesthetized mice, demonstrating that VNS-induced cortical activation cannot be fully explained by associated behavioral changes.

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