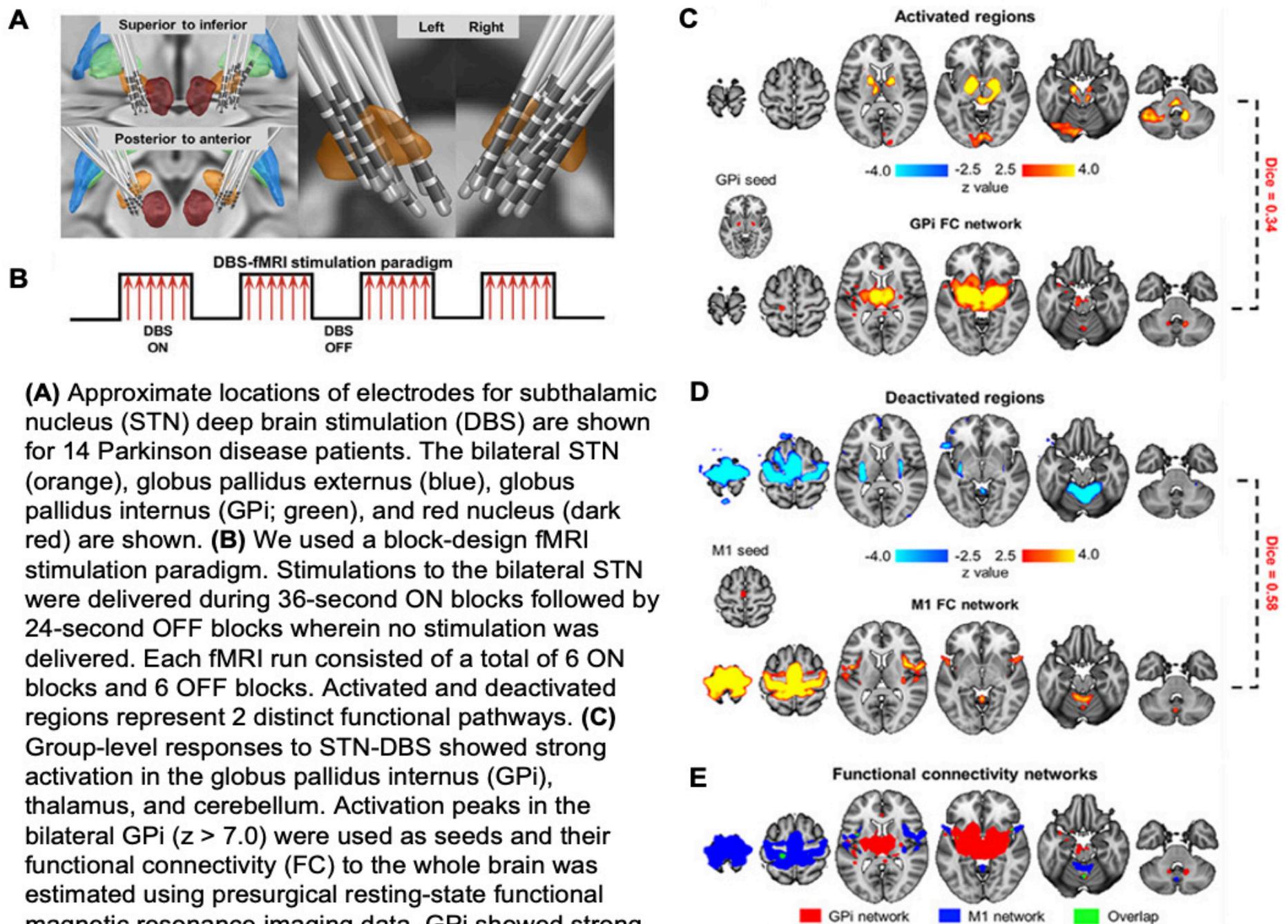


Subthalamic Nucleus Deep Brain Stimulation Modulates 2 Distinct Neurocircuits

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(A) Approximate locations of electrodes for subthalamic nucleus (STN) deep brain stimulation (DBS) are shown for 14 Parkinson disease patients. The bilateral STN (orange), globus pallidus externus (blue), globus pallidus internus (GPI; green), and red nucleus (dark red) are shown. **(B)** We used a block-design fMRI stimulation paradigm. Stimulations to the bilateral STN were delivered during 36-second ON blocks followed by 24-second OFF blocks wherein no stimulation was delivered. Each fMRI run consisted of a total of 6 ON blocks and 6 OFF blocks. Activated and deactivated regions represent 2 distinct functional pathways. **(C)** Group-level responses to STN-DBS showed strong activation in the globus pallidus internus (GPI), thalamus, and cerebellum. Activation peaks in the bilateral GPI ($z > 7.0$) were used as seeds and their functional connectivity (FC) to the whole brain was estimated using presurgical resting-state functional magnetic resonance imaging data. GPI showed strong connectivity to the thalamus and deep cerebellar nuclei. Regions functionally connected to the GPI and regions activated by STN-DBS showed a Dice overlap of 0.34. **(D)** Group-level response to STN-DBS showed strong deactivation in primary motor cortex (M1), putamen, and cerebellum. Deactivation peaks in M1 ($z < -7.0$) were used as a seed region and FC to the whole-brain was estimated. Regions functionally connected to M1 and regions deactivated by STN-DBS showed a Dice overlap of 0.58. **(E)** FC maps from C and D were overlaid onto a single map. Regions connected to the GPI (red) showed minimal overlap (green) with regions connected to M1 (blue), with Dice coefficient = 0.05.