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## Supplemental material

### Symptom-specific differential motor network modulation by deep brain stimulation in Parkinson's disease

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## **Supplemental Methods**

### **Functional Magnetic Resonance Imaging Procedure**

Average head specific absorption rate (SAR) values of  $<0.1$  W/kg were recorded during the fMRI study in all the patients, and a board-certified MRI physicist with expertise in MRI for patients with implanted electronic devices was present during all the sessions (Gorny et al., 2013). An anesthesia team was also present during all sessions and vital signs were continuously monitored. For all sequences, a manufacturer's standard transmit/receive RF head coil was used (1.5-T quadrature head coil, model 46-28211862; GE Healthcare). fMRI scans were then conducted using a block design as stated in the main text. Following fMRI, patients were returned to the operating room for pulse generator implantation.

### **Clinical Evaluation**

Tremor scores were calculated as the sum of contralateral upper extremity resting tremor, lower extremity resting tremor, and upper extremity action tremor scores (0-12). Rigidity scores were calculated as the sum of contralateral upper and lower extremity rigidity scores (0-8). Bradykinesia scores were calculated as the sum of contralateral rapid finger tapping, hand movement (opening/closing fist), upper extremity rapid alternating movement, and rapid heel tapping (0-16). Any patient-reported adverse effects prior to reaching 3V were recorded for each setting, and a short 3-5 minute washout period was allowed between settings. All four settings were interrogated in a single session to minimize inter-session error and patient discomfort.

Supplemental Table 1: Subjects and Therapeutic Responses to DBS

Case	Age/Gender	Handedness	Preoperative medication (LDE – mg)	DBS status	Off-medication contralateral UPDRS III subscores			
					Total	Tremor	Rigidity	Bradykinesia
1	64M	R	2760	Off	16	2	5	9
				*On: 0-; 1-; 2-; 3V	12; 9.5; 10.5; 11	2; 1.5; 0.5; 1	3; 3; 4; 3.5	7; 5; 6; 6
2	75F	R	1890	Off	17	3	2	12
				On: 0-; 1-; 2-; 3V	11; 8; 11; 10	4; 3; 1; 1	0; 0; 2; 2	7; 5; 8; 7
3	57F	R	935	Off	8	4	0	4
				On: 0-; 1-; 2-; 3V	2; 1; 1; 5	2; 0; 0; 4	0; 0; 0; 0	0; 1; 1; 1
4	37F	R	1200	Off	12	1	3	8
				On: 0-; 1-; 2-; 3V	9; 11; 3; 3	1; 1; 0; 0	3; 2; 1; 1	5; 8; 2; 2
5	60F	L	1100	Off	16	7	3	6
				On: 0-; 1-; 2-; 3V	16; 9; 15; 8	7; 3; 6; 2	3; 1; 3; 1	6; 5; 6; 5
6	72F	R	600	Off	12	5	3	4
				On: 0-; 1-; 2-; 3V	6; 3; 3; 3	0; 0; 0; 0	2; 2; 1; 2	4; 1; 2; 1

7	56M	R	1500	Off	7	4	1	2
				On: 0-; 1-; 2-; 3V	2; 3; 3; 2	2; 2; 1; 2	0; 0; 0; 0	0; 1; 2; 0
8	46F	R	2930	Off	4	1	1	2
				On: 0-; 1-; 2-; 3V	1; 2; 2; 6	0; 0; 1; 3	0; 0; 0; 1	1; 2; 1; 2
9	71M	R	0	Off	12	7	3	2
				On: 0-; 1-; 2-; 3V	7; 8; 5; 11	5; 2; 2; 6	2; 3; 2; 3	0; 3; 1; 2
10	67M	R	2300	Off	4	1	2	1
				On: 0-; 1-; 2-; 3V	1; 1; 0; 1	0; 0; 0; 0	1; 0; 0; 1	0; 1; 0; 0
11	83F	R	0	Off	10	0	3	7
				On: 0-; 1-; 2-; 3V	10; 6; 5; 5	0; 0; 0; 0	3; 2; 1; 1	7; 4; 4; 4
12	47M	R	1100	Off	10	1	4	5
				On: 0-; 1-; 2-; 3V	19; 5; 7; 6	1; 1; 1; 0	4; 1; 2; 2	14; 3; 4; 4
13	64F	R	1330	Off	10	5	0	5
				On: 0-; 1-; 2-; 3V	0; 2; 2; 9	0; 0; 1; 4	0; 0; 0; 0	0; 2; 1; 5
14	55M	R	0	Off	9	4	2	3
				On: 0-; 1-; 2-; 3V	9; 6; 2; 6	4; 1; 0; 3	2; 2; 0; 2	3; 3; 2; 1
15	74M	R	1400	Off	6	2	0	5

				On: 0-; 1-; 2-; 3V	5; 5; 5; 5	1; 1; 1; 1	0; 0; 0; 0	4; 4; 4; 4
16	71M	R	300	Off	/	/	/	/
				On: 0-; 1-; 2-; 3V	/	/	/	/
17	58F	R	800	Off	6	5	0	1
				On: 0-; 1-; 2-; 3V	/	/	/	/
18	55F	R	1400	Off	18	5	1	12
				On: 0-; 1-; 2-; 3V	/	/	/	/
19	75M	R	900	Off	16	6	4	6
				On: 0-; 1-; 2-; 3V	/	/	/	/
20	64F	R	1260	Off	12	2	1	9
				On: 0-; 1-; 2-; 3V	/	/	/	/

LDE = levodopa dosage equivalent (in mg); Contralateral mUPDRS subscores given for unilateral DBS on at 3V (or maximum side effect-free voltage), 90  $\mu$ s, 130 Hz, monopolar stimulation with the following active contacts: 0-; 1-; 2-; 3V (four DBS “on” evaluations per patient)

**Supplemental Table 2: Regions of Interest from group activation map**

Region	x*	y*	z*	Peak t	Volume (voxels)
Cerebellum (C)	8	65	-19	9.68	10616
Precentral gyrus (lateral – I)	-40	23	56	6.71	6163
Thalamus (I)	-14	15	10	11.04	2263
Midbrain (I)	-7	26	-4	8.65	1949
Insula/striatum (I)	-41	-9	3	-5.76	1847
Occipital/posterior cingulate (I/C)	-5	78	4	5.10	1717
Cerebellum (I)	-14	58	-24	5.26	1528
Precentral gyrus (medial – I)	9	34	63	-13.15	729
Pons	-3	34	-32	720	356

\*Peak voxel – Talairach coordinates

**Supplemental Table 3: Regions of Interest from side effect maps**

Contrast	Region	x*	y*	z*	Peak t	Volume (voxels)
Dystonia > no S.E.	Striatum (I)	-17	18	23	3.86	736
Paresthesia > no S.E.	Precentral gyrus (I)	-44	9	22	5.72	1949
	Prefrontal (C)	26	-39	44	5.28	831
	Cerebellum (C)	15	60	-23	4.26	897
	Cerebellum (I)	-12	60	-20	4.60	695
Nausea + lightheadedness > no S.E.	Cerebellum (C)	5	66	-17	7.39	5028
	Precentral gyrus (I)	-47	12	26	5.06	720