

SUPPLEMENTARY MATERIAL

Deconstructing empathy: Neuroanatomical dissociations between affect sharing and prosocial motivation using a patient lesion model.

Supplementary Table 1: Neural correlates of RSMS-EX and Affect Sharing

Anatomic Region and Structure	Right Lateralized				Left Lateralized			
	x	y	z	maxT	x	y	z	maxT
<i>Subcortical/striatal</i>								
Hippocampus	28	-8	-19	8.91	-25	-10	-18	6.52
Amygdala	28	-5	-21	8.87	-27	-2	-19	6.63
Putamen	30	-10	-10	8.19	-15	9	-13	6.69
Pallidum	24	-8	-7	8.18	-13	6	-6	5.85
Caudate	12	12	-6	6.73	-10	9	-6	6.44
Thalamus Proper	25	-31	-3	5.70	-10	-35	1	5.09
Brain Stem	10	-26	-3	4.52	10	-26	-3	4.52
<i>Temporal</i>								
Temporal pole (TMP)	21	10	-34	9.41	-27	9	-28	7.05
Middle temporal gyrus (MTG)	55	4	-24	8.76	-48	1	-39	5.79
Entorhinal area (Ent)	21	4	-21	8.76	-27	3	-21	7.14
Inferior temporal gyrus (ITG)	52	-7	-34	8.62	-43	0	-42	6.05
Posterior insula (Pins)	40	-8	-9	8.58	-40	-7	-10	6.31
Planum polare (PP)	42	-8	-9	8.57	-40	-8	-12	6.41
Anterior insula (Ains)	37	7	0	8.37	-30	9	-19	6.74
Superior temporal gyrus (STG)	52	3	-21	8.21	-52	3	-22	4.97
Fusiform gyrus (FuG)	27	-1	-42	8.09	-24	-4	-42	5.67
Parahippocampal gyrus (PHG)	27	-31	-19	7.58	-25	-7	-39	5.49
Transverse temporal gyrus (TTG)	43	-14	0	6.46	-42	-16	7	4.64
<i>Frontal</i>								
Posterior orbital gyrus (POrG)	22	9	-22	8.71	-25	9	-25	7.38
Basal Forebrain	19	7	-19	8.68	-15	6	-21	7.61
Medial orbital gyrus (MOrG)	18	7	-21	8.66	-13	18	-19	8.10
Subcallosal area (SCA)	10	15	-18	7.91	-12	16	-19	8.06
Gyrus rectus (Gre)	10	21	-16	7.66	-12	19	-19	7.96
Orbital part of the inferior frontal gyrus (OrIFG)	36	22	-9	7.25	-31	25	-6	5.69
Frontal operculum (FO)	39	10	4	7.21	-36	12	4	5.34
Anterior cingulate gyrus (ACgG)	0	21	-13	7.13	-1	24	-13	7.02
Medial frontal cortex (MFC)	0	21	-15	7.10	-9	22	-16	7.21
Central operculum (CO)	39	7	5	7.10	-39	1	7	4.95
Lateral orbital gyrus (LOrG)	34	24	-9	7.01	-34	36	-16	5.88
Superior frontal gyrus medial segment (MSFG)	12	45	10	7.00	-3	48	-6	6.11
Anterior orbital gyrus (AOrG)	33	37	-16	6.80	-31	36	-16	5.87
Triangular part of the inferior frontal gyrus (TrIFG)	51	25	-7	6.09	-43	43	-6	4.35
Middle frontal gyrus (MFG)	28	37	40	6.01	-45	45	-7	4.53
Superior frontal gyrus (SFG)	27	37	40	6.01	-10	45	43	4.60

Lingual gyrus (LiG)	25	-37	-13	5.99				NS
Frontal pole (FRP)	12	64	-3	5.84	-15	61	-12	4.43
Middle cingulate gyrus (MCgG)	4	-11	35	5.73	0	-10	32	5.33
Opercular part of the inferior frontal gyrus (OpIFG)	52	21	2	5.49				NS
Supplementary motor cortex (SMC)	7	24	32	5.30	-6	24	32	5.30
Posterior cingulate gyrus (PCgG)	15	-35	-1	4.89	-12	-37	0	4.68
Cerebellum								
Cerebellum Exterior	34	-34	-31	6.44	-27	-31	-27	5.77

RSMS-EX main effects: regions where RSMS-EX correlated with gray matter volumes, adjusting for age, gender, MMSE, total intracranial volume, and magnet strength. All effects shown in this table are corrected for family-wise error [FWE] across the whole brain at a significance level of $p < 0.05$). *Affect sharing analysis:* bold text indicates regions where RSMS-EX correlated with gray matter volumes, adjusting for IRI-EC score, age, gender, MMSE, total intracranial volume, and magnet strength (FWE corrected at a significance level of $P < 0.05$). Locations of peak coordinates are reported in MNI reference space. NS = Not significant at $pFWE < 0.05$.

Supplementary Table 2. Neural correlates of IRI-EC and Prosocial Motivation

Anatomic Region and Structure	Right Lateralized				Left Lateralized			
	X	y	z	maxT	x	y	z	maxT
<i>Subcortical/striatal</i>								
Caudate	10	12	-6	7.51	-6	9	-1	6.92
Putamen	31	-8	-6	7.51	-15	9	-4	6.27
Accumbens Area (NaCC)	10	10	-6	7.50	-6	12	-3	6.71
Pallidum	13	6	-6	7.28	-13	6	-4	6.32
Amygdala	30	-5	-22	6.59	-28	-8	-19	5.10
Hippocampus	28	-7	-22	6.53	-34	-19	-12	5.13
Thalamus Proper	4	-5	-4	5.48				NS
<i>Temporal</i>								
Anterior insula (Ains)	28	18	-16	8.77	-34	19	-10	6.53
Posterior insula (Pins)	37	3	-7	7.71	-37	-7	-9	6.05
Middle temporal gyrus (MTG)	49	-4	-34	7.67	-48	1	-39	5.01
Inferior temporal gyrus (ITG)	49	-6	-34	7.65	-24	1	-43	5.08
Temporal pole (TMP)	25	9	-27	7.58	-24	7	-31	5.84
Planum polare (PP)	45	3	-10	7.17	-39	-8	-12	5.75
Entorhinal area (Ent)	24	6	-24	7.15	-31	3	-27	5.70
Superior temporal gyrus (STG)	52	3	-21	6.96				NS
Fusiform gyrus (FuG)	30	-5	-45	6.50	-24	-4	-40	4.83
Parahippocampal gyrus (PHG)	15	-5	-24	5.73	-22	-7	-39	4.72
Transverse temporal gyrus (TTG)	43	-14	0	5.47				NS
<i>Frontal</i>								
Posterior orbital gyrus (POrG)	28	19	-16	8.81	-24	19	-22	6.61
Medial orbital gyrus (MOrG)	18	19	-21	8.22	-15	21	-21	7.23
Lateral orbital gyrus (LOrG)	36	24	-12	7.80	-33	24	-7	5.99
Subcallosal area (SCA)	6	9	-16	7.77	-12	18	-21	7.02
Orbital part of the inferior frontal gyrus (OrIFG)	37	22	-10	7.74	-37	22	-9	6.09
Basal Forebrain	19	7	-19	7.54	-15	6	-21	6.08
Gyrus rectus (Gre)	7	19	-21	7.50	-12	21	-21	7.07
Anterior orbital gyrus (AOrg)	33	37	-16	7.31	-33	37	-16	5.61
Medial frontal cortex (MFC)	3	21	-21	7.04	-7	22	-19	6.85
Anterior cingulate gyrus (ACgG)	10	45	8	6.80	-3	24	-16	6.66
Superior frontal gyrus medial segment (MSFG)	12	46	8	6.79	-3	34	31	6.24
Frontal operculum (FO)	40	12	1	6.64	-36	24	-1	5.11
Central operculum (CO)	39	7	5	6.26	-37	7	7	4.86
Triangular part of the inferior frontal gyrus (TriFG)	51	27	2	5.95	-52	28	17	4.87
Superior frontal gyrus (SFG)	16	42	37	5.90	-12	45	41	5.31
Supplementary motor cortex (SMC)	4	24	34	5.51	-4	24	35	5.47

Opercular part of the inferior frontal gyrus (OpIFG)	51	24	5	5.49				NS
Middle cingulate gyrus (MCgG)	7	24	29	5.40	-1	24	34	5.31
Frontal pole (FRP)	7	61	-16	5.30	-15	63	-12	5.25
Middle frontal gyrus (MFG)	25	37	37	5.13	-51	27	19	4.49

IRI-EC main effects: regions where empathic concern correlated with gray matter volumes, adjusting for age, gender, MMSE, total intracranial volume, and magnet strength All effects shown in this table (corrected for family-wise error [FWE] across the whole brain at a significance level of $p < 0.05$). *Prosocial motivation analysis:* bold text indicates regions where empathic concern correlated with gray matter volumes, adjusting for RSMS-EX score, age, gender, MMSE, total intracranial volume, and magnet strength (FWE corrected across the whole brain at a significance level of $p < 0.05$). Locations of peak coordinates are reported in MNI reference space. NS = Not significant at $p_{FWE} < 0.05$

Supplementary Table 3. Group Differences in mean IRI-EC and RSMS-EX score

	NC <i>(n = 44)</i>	bvFTD <i>(n = 58)</i>	nvPPA <i>(n = 28)</i>	svPPA <i>(n = 42)</i>	AD <i>(n = 75)</i>	PSP <i>(n = 28)</i>	
NC	-	12.82 (9.0, 16.6)	-	10.46 (6.4, 14.6)	5.55 (1.8, 9.2)	7.77 (3.2, 12.4)	RSMS-EX
bvFTD	-9.19 (-12.5, -5.8)	-	-8.97 (-13.3, -4.6)	-	-7.26 (-10.7, -3.9)	-5.04 (-9.4, -0.7)	
nvPPA	-	6.47 (2.6, 10.4)	-	6.61 (2.0, 11.2)	-	-	
svPPA	-6.41 (-10.0, -2.9)	-	-	-	-4.91 (-8.6, -1.2)	-	
AD	-	8.92 (5.9, 11.9)	-	6.15 (2.9, 9.4)	-	-	
PSP	-	6.57 (2.7, 10.4)	-	-	-	-	
	IRI-EC						

RSMS-EX is represented in the top half of the table (light gray) and IRI-EC in the bottom half of the table (dark gray). The least-squares mean differences, adjusted for age, gender, and MMSE are reported with 95% confidence intervals for all patient groups that had significantly different scores on each measure ($p < 0.05$). Positive t-values indicate that the score of the patient group in the left column is greater than the corresponding patient group in the top row. Negative t-values indicate that the score of the patient group in the left column is lower than the patient group on the top row. - =not significant