Supplementary material

Functional PET for mapping metabolic dynamics in Parkinson's disease

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Variable	HC (n = 13)	PD (n=14)	Test Statistics	Statistics	p-value
Age	59.54±5.13	63.43±8.92	t	-1.40	0.18
Sex (m/f) (n)	7/6	11/3	Odds ratio	0.33	0.237
PANDA Sum	24.92±4.54	23.43±6.16	w	100.50	0.66
MoCa Sum	28.00±1.91	25.86±4.70	w	118.50	0.19
BIS11 Sum	56.31±6.76	59.71±10.37	w	73.50	0.41
UPDRS-III	-	35.64±17.54	-	-	-
LEDD (mg)	-	668.88±358.25	-	-	-

Supplementary Table 1: Demographic, clinical and behavioral data of subjects who underwent fPET scanning. Abbreviations BIS-11 = Barret Impulsiveness Scale-11, HC = Healthy control, LEDD = Levodopa equivalent daily dose, MDS-UPDRS-III – Movement Disorder Society Unified Parkinson's disease Rating scale, part III, MoCA = Montreal Cognitive Assessment, OR = Odds ratio, PD = Parkinson's disease, PANDA = Parkinson Neuropsychometric Dementia Assessment

contrast	region	MNI-coordinates (x y z)	t-value	cluster size	p_{FWE}
HC>PD	Temporal pole sup l, OFC post l	-36 +24 -28	13.41	386	<0.0001
	Angular left, Supramarginal l, Postcentral l, Temporal mid l, Temporal sup l, Parietal inf l Precuneus l, Precuneus r	-52 -58 +24	12.39	4865	<0.0001
	Frontal mid l, Frontal sup l,	-34 +48 +2	12.17	3135	<0.0001

	Frontal inf tri l, Frontal inf oper l, Insula l, caudate l				
	Angular r, Temporal mid r, Occipital mid r	+46 -62 +36	11.81	1764	<0.0001
	Calcarine l, Occipital mid l, Lingual l, Occipital inf l, Cereb Crus 1	-14 -98 -4	10.67	2017	<0.0001
	Lingual r, Occipital inf r, Calcarine r	+14 -96 -16	10.63	1124	<0.0001
	Occipital sup l, Cuneus l	-14 -98 +26	9.32	65	<0.0001
	Precentral l, Frontal mid l	-40 +4 +60	8.63	70	<0.0001
	Frontal mid r, Frontal sup r,	+46 +50 +8	8.26	276	<0.0001
	Cereb 9 r, Cereb 9 l	+2 -58 -54	8.22	232	<0.0001
	Frontal mid r, Frontal inf tri r	+38 +36 +20	8.21	159	<0.0001
	Precentral l	-40 -4 +40	8.21	136	<0.0001
	Cereb Crus 1 r, Cereb 6 r	+40 -74 -26	8.13	448	<0.0001
	Putamen r, Pallidum r	+22 +2 +10	8.05	112	<0.0001
	Temporal pole sup r, OFCpost r	+32 +22 -28	7.96	87	<0.0001
	Frontal sup medial l	-12 +68 +18	7.69	31	<0.0001
	Frontal sup l,	-16 +24 +56	7.06	109	<0.0001
	Temporal inf l	-64 -18 -32	7.04	25	0.001
	Tempoal inf r	+66 -10 -32	6.99	56	<0.0001
	Frontal med Orb l, Frontal med Orb r, Rectus l	0 +66 -16	6.98	233	<0.0001
	Postcentral r, Temporal sup r, Supramarginal r, Rolandic Oper r	+62 -16 +18	6.91	245	<0.0001
	Cereb 8 l	-26 -46 -60	6.69	23	0.001
	Frontal inf Orb r, Temporal pole sup r	+54 +22 -12	6.51	43	<0.0001
	Frontal sup R	+22 +10 +70	6.43	22	0.001
	SNc l, SNr l	-10 -16 -16	6.33	27	<0.0001
	Amygdala r	+24 +2 -14	6.25	28	<0.0001
	Frontal sup r	+20 +36 +42	6.16	26	<0.0001
	Putamen l, Thal VA l	-16 -2 +12	6.00	49	<0.0001
	SNc r, SNr r	+10 -16 -16	5.99	29	<0.0001
	Frontal inf tri r, Frontal inf oper r, Frontal mid r	+52 +22 +30	5.98	50	<0.0001

	Frontal sup l	-16 +44 +30	5.82	27	<0.0001
	Lingual r	+30 -66 +2	5.75	24	0.001
	Cereb 7 l, Cereb Crus 2 l, Cereb 8	-20 -76 -48	5.69	52	<0.0001
	Frontal sup medial l	-10 +58 +10	5.39	30	<0.0001
HC<PD	Precuneous l, Precuneous r, Paracentral Lobule l,SMA l, SMA r,Paracentral lobe r, Cingulate mid r, Cingulate mid l, Precentral r, Precentral l, Postcentral l, Postcentral r, Frontal mid r	0 -48 +56	18.13	13172	<0.0001
	Frontal mid l	-24 +36 +22	9.42	114	<0.0001
	Occipital mid l,	-20 -88 +16	9.23	284	<0.0001
	Lingual l	-4 -96 -20	8.95	47	<0.0001
	OFCant r	+22 +60 -20	8.58	96	<0.0001
	OFCmed l	-18 +58 -20	7.74	32	<0.0001
	NAcc r, Olfactory r	+8 +14 -8	7.69	193	<0.0001
	Frontal Sup r	+24 +44 +18	7.63	67	<0.0001
	Putamen r, Insula r	+36 -10 +2	7.61	258	<0.0001
	Fusiform l, Temporal inferior l	-38 -26 -30	7.57	338	<0.0001
	Frontal Sup medial l	0 +48 +46	7.38	42	<0.0001
	Frontal Sup l	-18 +60 +30	7.36	28	<0.0001
	Vermis 3	-2 -38 -10	7.09	99	<0.0001
	Putamen l	-32 -8 4	6.68	70	<0.0001
	Parietal sup l, Parietal inf l	-38 -62 58	6.66	72	<0.0001
	OFCant l	-26 +34 -18	6.64	93	<0.0001
	Temporal sup r	+60 -24 +6	6.52	47	<0.0001
	Cereb 4,5 l	-10 -50 -18	6.38	113	<0.0001
	Occipital sup r	+28 -88 +30	6.33	34	<0.0001
	Angular r	+26 -60 +40	6.27	34	<0.0001
	OFCmed r	+22 +22 -18	5.84	23	0.001
	Lingual l	-8 -64 -4	5.71	54	<0.0001
	Fusiform r	+38 -6 -42	5.55	23	0.001

Supplementary Table 2: Hypometabolic and hypermetabolic clusters in PwPD relative to healthy controls based on metabolic time series comparison using a subject x Time Design in SPM12. Threshold: $p<0.05$ after Cluster-level FWE correction.

Abbreviations (AALv3):

Abbreviation	Full Name
Amygdala r	Amygdala right
Angular left	Angular gyrus left

Angular r	Angular gyrus right
Calcarine l	Calcarine cortex left
Calcarine r	Calcarine cortex right
Cereb 8 l	Cerebellum Lobule VIII left
Cereb 9 l	Cerebellum Lobule IX left
Cereb 9 r	Cerebellum Lobule IX right
Cereb Crus 1 r	Cerebellum Crus I right
Cereb Crus2 l	Cerebellum Crus 2 left
Cereb 7 l	Cerebellum Lobule VII left
Cerebellum 8	Cerebellum Lobule VIII
Cereb Crus 1	Cerebellum Crus I
Cereb 4	Cerebellum Lobule IX
Cereb 6	Cerebellum Lobule XI
Cingulate mid l	Middle cingulate cortex left
Cingulate mid r	Middle cingulate cortex right
Cuneus l	Cuneus left
Frontal Sup l	Superior frontal gyrus left
Frontal Sup medial l	Medial superior frontal gyrus left
Frontal Sup r	Superior frontal gyrus right
Frontal inf Orb r	Inferior frontal gyrus (orbital part) right
Frontal inf oper l	Inferior frontal gyrus (opercular part) left
Frontal inf oper r	Inferior frontal gyrus (opercular part) right
Frontal inf tri l	Inferior frontal gyrus (triangular part) left
Frontal inf tri r	Inferior frontal gyrus (triangular part) right
Frontal med Orb l	Medial orbitofrontal cortex left
Frontal med Orb r	Medial orbitofrontal cortex
Frontal mid l	Middle frontal gyrus left
Frontal mid r	Middle frontal gyrus right
Frontal sup r	Superior frontal gyrus right
Frontal sup l	Superior frontal gyrus left
Frontal sup medial l	Medial superior frontal gyrus left
Fusiform l	Fusiform gyrus left
Fusiform r	Fusiform gyrus right
Insula l	Insula left
Insula r	Insula right
Lingual l	Lingual gyrus left
Lingual r	Lingual gyrus right
NAcc r	Nucleus accumbens right
OFC post l	Orbitofrontal cortex posterior part left
OFCant l	Orbitofrontal cortex anterior part left
OFCant r	Orbitofrontal cortex anterior part right

OFCmed l	Orbitofrontal cortex medial part left
OFCmed r	Orbitofrontal cortex medial part right
OFCpost r	Orbitofrontal cortex posterior part right
Occipital inf l	Inferior occipital gyrus left
Occipital inf r	Inferior occipital gyrus right
Occipital mid l	Middle occipital gyrus left
Occipital mid r	Middle occipital gyrus right
Occipital sup l	Superior occipital gyrus left
Occipital sup r	Superior occipital gyrus right
Olfactory r	Olfactory cortex right
Pallidum r	Pallidum right
Paracentral lobule r	Paracentral lobule right
Paracentral lobule	Paracentral lobule left
Parietal inf l	Inferior parietal lobule left
Parietal sup l	Superior parietal lobule left
Postcentral l	Postcentral gyrus left
Postcentral r	Postcentral gyrus right
Precentral l	Precentral gyrus left
Precentral r	Precentral gyrus right
Precuneous R	Precuneus right
Precuneous l	Precuneus left
Putamen l	Putamen left
Putamen r	Putamen right
Rectus l	Gyrus rectus left
Rolandic Oper r	Rolandic operculum right
SMA l	Supplementary motor area left
SMA r	Supplementary motor area right
SNc l	Substantia nigra pars compacta left
SNc r	Substantia nigra pars compacta right
SNr l	Substantia nigra pars reticulata left
SNr r	Substantia nigra pars reticulata right
SupraMarginal l	Supramarginal gyrus left
SupraMarginal r	Supramarginal gyrus right
Temporal inf r	Inferior temporal gyrus right
Temporal inf l	Inferior temporal gyrus left
Temporal inferior l	Inferior temporal gyrus left
Temporal pole sup l	Superior temporal pole left
Temporal pole sup r	Superior temporal pole right
Temporal mid l	Middle temporal gyrus left
Temporal mid r	Middle temporal gyrus right
Temporal sup r	Superior temporal gyrus right

Vermis 3	Cerebellar vermis lobule III

Group	Seed	MNI-coordinates	t-value	cluster size	P_{FWE}
HC	SN left	-8 -16 -14	116.66	731	0.0000
PD	SN left	-10 -16 -16	80.95	910	0.0000
HC	SN right	10 -16 -16	103.15	731	0.0000
PD	SN right	10 -16 -16	103.58	741	0.0000

Supplementary Table 3: Group-level seed-to-voxel results using the data-driven obtained hypometabolic cluster as seed. Threshold: $p_{FWE}<0.05$ at peak level. Abbreviations: SN = Substantia nigra left, SN right = Substantia nigra right

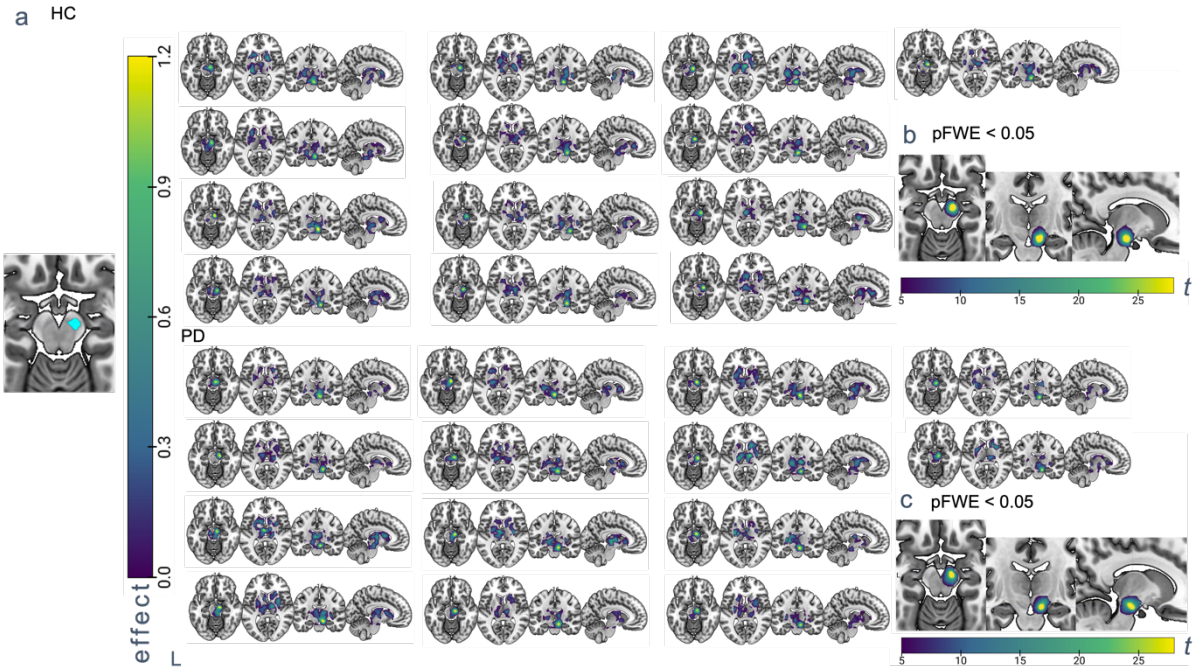

Fig. S1: Seed-based nigral networks in PwPD and healthy controls on subject- and group-level. SPM result of first-level single-subject regression analysis using the right substantia nigra as seed visualised on MNI standard template. Sagittal, coronal and axial view of regions of (a) subject-level contrast images or (b) group-level *t*-maps obtained by voxel-wise analysis of [^{18}F]-FDG PET scans from 13 healthy controls and 14 PD patients (P < 0.05 after FWE cluster level correction). Color bar represents subject-level effect in contrast images (a) or *t*-values of a voxel wise one-sample *t*-test of contrast images (b). All images are shown in neurological display.

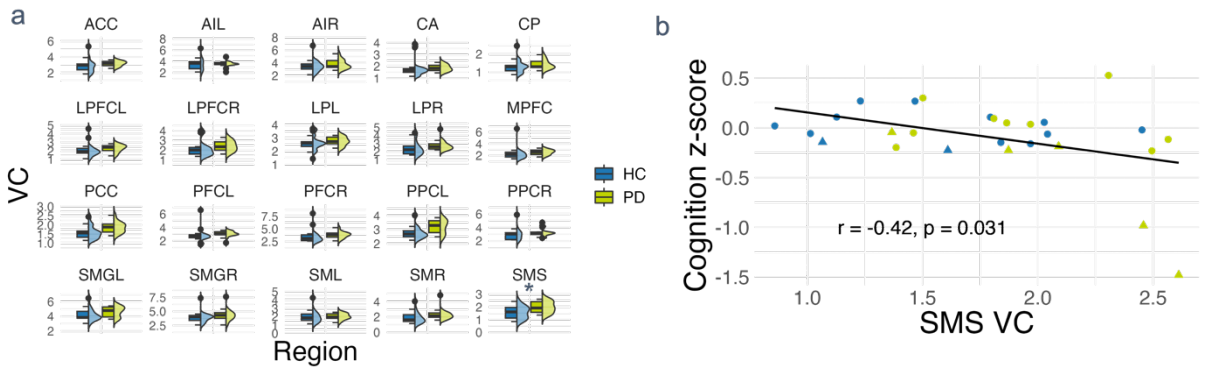

Fig. S2: Metabolic time series variation in PwPD relative to healthy controls. Subject-level variation coefficients from extracted metabolic time series in canconical resting-state network nodes. Marked dots represent outliers with values > 1.5 times the inter-quartile distance. b showes a scatterplot relating regional variation coefficients to cognitive performance measured by cognition z-scores. The subjects marked in rectanglular shape represent the subjects classified as MCI. Abbreviations: VC = variation coefficient

Network name	*Seed*	*x*	*y*	*z*
Default mode network (DMN)	Medial prefrontal cortex	1	55	-3
	Latral parietal cortex (L)	-39	-77	33
	Lateral parietal cortex (R)	47	-67	29
	Posterior cingulate cortex	1	-61	38
Frontoparietal network (FPN)	Lateral prefrontal cortex (L)	-43	33	28
	Posterior parietal coretx (L)	-46	-58	49
	Lateral prefrontal cortex (R)	41	38	30
	Posterior parietal cortex (R)	52	-52	45
Salience network (SN)	Anterior cingulate cortex	0	22	35
	Anterior insula (L)	-44	13	1
	Anterior insula (R)	47	14	0
	Rostral prefrontal cortex (L)	-35	45	27
	Rostral prefrontal cortex (R)	32	46	27
	Supramarginal gyrus (L)	-60	-39	31
	Supramarginal gyrus (R)	62	-35	32

Supplementary Table 4. CONN toolbox network region of interest (ROI) definitions.

Test	HC (n=11)	PD-MCI(n=5)	PD-NC(n=9)	statistic	p-value
z_RWT_SKW_sport_fruits	0.05 ± 0.99	-1.40 ± 1.60	0.17 ± 1.05	4.02	0.134
z_PANDA_WFL_t	-0.01 ± 1.03	-0.95 ± 1.38	0.16 ± 1.22	3.05	0.217
z_WMSR_ds_f_raw	-0.09 ± 0.98	-0.89 ± 0.99	0.73 ± 1.05	6.04	**0.049**
z_WMSR_ds_b_raw	0.22 ± 0.91	-1.17 ± 0.92	-0.02 ± 1.09	5.72	0.057
z_WMSR_ss_b_raw	0.16[c] ± 0.86	-1.89 ± 2.54	0.32 ± 1.34	4.08	0.130
z_WMSR_ss_f_raw	0.16 ± 0.93	-0.96 ± 2.47	-0.23 ± 1.83	0.70	0.704
z_PANDA_relayed recall	0.09 ± 1.01	-1.30 ± 1.58	0.11 ± 0.95	5.59	0.061
z_MoCa_language	-0.12 ± 1.05	-1.02 ± 0.93	-0.52 ±1.10	2.59	0.274
z_RWT_SK_animals	0.17 ± 0.93	-0.77 ± 1.43	-0.16 ± 1.08	2.18	0.337
z_PANDA_spatial	0.32 ± 0.67	0.06 ± 0.89	0.38 ± 0.96	1.40	0.496
Cog_z	0.08 ± 0.36[c]	-1.44 ± 1.52[a]	0.11 ± 0.60	7.10	**0.029**

Supplementary Table 5: Neuropsychological test results of patients undergoing fPET scanning and neuropsychological testing. Domain-specific tests were compared between all groups using Kruskal-Wallis test and pair-wise Wilcoxon tests were used to evaluate individual between-group differences.

a fMRI					
Group	Seed	Regions	MNI-coordinates (x,y,z)	size	p-FWE Cluster-level
HC	PCC	Precuneous Cortex, sLOC l, PC, sLOC r, AG r, LG l , Cuneal r, Thalamus l, pPaHC l, pPaHC r, Hippocampus l, Hippocampus r, Thalamus r, Cuneal l, pTFusC l, AC, Ver45, SCC r, Cereb45 l, SPL l, PostCG l, pTFusC r, PreCG l, pSMG l	+06 -69 +51	6092	0.000000
		FP r, PreCG r, PostCG r, CO r,IC r, FO r, aSMG r, IFG oper r, FOrb r	+48 +42 -12	1192	0.001000
		SMA r, PreCG r,PreCG l, SMA L, SFG l, SFG r	+18 +60 +06	665	0.004000
		SMA r, PreCG r, PreCG l, SMA L, SFG l, SFG r, PaCiG r, PostCG l, MidFG l, PostCG r, PaCiG l	+03 -12 +60	595	0.005000
		PreCG l IC l, IFG oper l, CO l	-39 -06 +36	518	0.009000
		Cereb9 r, Cereb9 l, Cereb8 r, Cereb7 r,Brain-Stem, Cereb2 r	+09 -57 -48	245	0.049000
PD-NC	PCC	Precuneous Cortex, PC, sLOC r, AG r, ICC r, LG l, ICC l,pPaHC l, LG r, Hippocampus l, sLOC l, toMTG r, Cuneal l, pTFusC l, aPaHC l, SCC l, TOFusC l	+00 -54 +57	3112	0.000000
		sLOC l,AG l, toMTG l	-51 -66 +42	546	0.010000
		TP r, pMTG r, pITG r, aSTG r	+45 +06 -33	221	0.047000
PD-MCI	PCC	Precuneous Cortex, OP l, PC, OP r, LG r, sLOC l, Cuneal l, Cuneal r, ICC r,Cereb1 r	15 -93 21	1825	0.000000

		CO r, IC r, TP r, HG r, IFG tri r,PT r,PreCG r, PP r, PO r, aSMG r, FO r, FOrb r	+42 -24 +12	505	0.0000
		PostCG l, CO l, IC l, HG l, FO l	-39 +03 +12	241	0.046000
HC	SMS	PostCG l,PostCG r PreCG l, PreCG r SPL r,SPL l, IC r,CO l,IC l, CO r SFG l, AC,SFG r, SMA r, aSMG r, Precuneous,PO r,SMA L,PT l,PO l,PT r, HG l,aSMG l, PP r,HG r, PP l,PC,aSTG r,aSTG l,TP r,pSTG l, MidFG l,TP l	-27 -42 +66	9058	0.000000
		Cereb2 l,Cereb1 l,Cereb8 l,Cereb7 l,Cereb6 l,Cereb9 l	-24 -72 -27	803	0.000000
		Cereb1 r,Cereb2 r,Cereb6 r,Cereb8 r,Cereb7 r	+27 -54 -33	484	0.004000
		LG l,Precuneous, ICC l,Hippocampus l, Cuneal l	-18 -57 +03	350	0.012000
		sLOC l, AG l, pSMG l	-45 -48 +36	317	0.016000
		LG r, Precuneous ICC r, Cereb45 r	+15 -54 +03	264	0.034000
		AG r,sLOC r,pSMG r	+42 -66 +51	225	0.047000
PD-NC	SMS	PreCG l,PostCG l, PreCG r,PostCG r, AC, SMA r,SPL r, SMA L, IC r, SPL l, IC l, aSMG l, SFG l, Precuneous, SFG r, aSMG r, PO r, CO l,PO l,PC, Putamen l, PT l (Planum,HG l,sLOC r,sLOC l,PaCiG r,PT r,Putamen r, CO r,PP l	-06 -42 +69	5582	0.000000
		Cereb2 r, Cereb2 l, Cereb1 r, Cereb1 l, Cereb7 r, Cereb8 r, LG r	+30 -81 -39	813	0.007000

PD-MCI	SMS	PostCG r,PostCG l PreCG r, PreCG l,SPL l, SPL r,Precuneous, SFG r,SFG l,SMA r SMA L,sLOC r,sLOC l MidFG r	+09 -36 +66	2495	0.000000
		Precuneous,ICC r,LG r,ICC l,PC,LG l	+12 -57 +12	413	0.023000
HC	ACC	AC, FP r,SFG r, FP l,PaCiG r, PaCiG l,SFG l, MidFG r,PreCG r, MidFG l,SMA r,SMA L, PC,PreCG l	+03 +24 +30	3550	0.000000
		IC r, Putamen r, TP r, FO r, Thalamus r, IFG oper r,FOrb r, CO r, Pallidum r, PreCG r	+42 +15 +12	1025	0.006000
		IC l, Putamen l, CO l, Thalamus l, FO l, TP l, FOrb l,PO l,PP l,Pallidum l, Caudate l, HG l, PT l, IFG oper l	-33 +09 -12	983	0.006000
		Thalamus l	+21 -39 +30	687	0.013000
		Cereb2, Cereb1 r, Cereb7 r, Cereb2 l, Cereb8 r	+42 -75 -45	437	0.024000
PD-NC	ACC	IC r,IC l,Thalamus r, CO l,PreCG r,CO r,Putamen r, TP l,PO l, PO r,HG r,Putamen l, aSMG l, Thalamus l, PP r,PT r,PostCG r,PP l,aSMG r, TP r, FO r, HG l, FO l pSMG l, Caudate, Pallidum r, PreCG l PT l, IFG oper l, PostCG l, FOrb r, Pallidum l	-60 -33 +27	2177	0.000000
		AC, PaCiG r SFG r SMA r, PaCiG l SMA L, SFG l, PC, PreCG r	+03 -15 +45	1715	0.000000
PD-MCI	ACC	AC, PaCiG r, PaCiG l FP l, SFG l, SFG r MidFG l, SMA L, SMA r, PC, PreCG l, PreCG r	-03 +18 +51	1762	0.000000

HC	LPFC-R	FP r, MidFG r, SFG r, PaCiC r	+30 +48 +03	1819	0.000000
		AG r, sLOC r, pSMG r, SPL r	+42 -54 +48	528	0.000000
		FP l, IFT tri l	-42 +51 -06	362	0.000000
		Cereb 2 l, cereb 1 l, Cereb 7 l, cereb 8 l	-42 -60 -45	236	0.000000
		pSMG l, sLOC l, AG l	-57 -54 +42	232	0.000000
		pMTG r, toMTG r, pITG r	+60 -33 -12	129	0.000000
		MidFG l	-30 +15 +54	32	0.001131
		MidFG l	-36 +21 +33	30	0.001790
PD-NC	LPFC-R	MidFGr FPr	+42 +42 +30	148	0.000000
		FPr	+33 +54 -06	74	0.000000
		AGr, LOCr	+45 -54 +45	73	0.000000
		MIdFGr	+30 +06 +51	70	0.000000
		Cereb l	-21 -78 -51	55	0.000000
		PaCiGr, SFGr	+06 +30 +45	37	0.000002
		FPr	+39 +39 -12	32	0.000010
		pITGr	60 -33 -21	21	0.000548
		FPl	-36 +57 -06	17	0.002717
		toMTGr	+66 -48 -06	14	0.009802
		pSMG l	-42 -54 +57	12	0.024155
		Cereb 1 l	-27 -57 -36	11	0.038495
PD-MCI	LPFC-R	FPr	+36 +54 -06	26	0.000000
		MidFG r	+36 +21 +57	17	0.000011
		MidFG r	+39 +33 +36	14	0.000085
		pSMG l, AG l	-57 -54 +36	14	0.000085
		Cereb 45 r	+09 -33 -09	11	0.000759
		MidFGr	+48 +33 +36	7	0.019649
b fPET					
HC	SMS	Frontal Sup Medial L, SMA L, Fromtal Supp L,	-04 +34 +54	868	0.000
		Paracentral Lobule R, Paracentral Lobule L, Precentral L, Postcentral L, SMA R, Cingulate Mid R	0 -26 +66	2138	0.000
		SupraMarginal L, Parietal inferior L, Temporal Sup L	-56 -44 +32	626	0.000
		Cingulate Mid R, SMA R	+10 +16 +44	254	0.000
		Precentral L, Postcentral L,	-50 -4 3+2	256	0.000
		Frontal Sup R	+20 +20 +58	249	0.000
		Frontal Mid R	+36 +52 -12	137	0.005
		Precuneus R	+08 -54 +26	478	0.000
		Putamen L	-22 +06 +04	547	0.000
		Rolandic Operculum R	+62 +02 +12	156	0.002

		Precentral R, Postcentral R	+20 -24 +76	237	0.000
		Temporal Mid L	-58 -58 +08	87	0.048
		Frontal Mid R, Frontal Sup R	+30 +42 +16	101	0.025
		Frontal Sup L, Frontal Sup Medial L	-12 +56 22	213	0.000
		Frontal Sup R, Frontal Sup Medial R			
PD-NC	SMS	Frontal Mid R, Precentral R	+40 +08 +44	137	0.000
		Postcentral R, Parietal sup R, Paracentral Lobule R, SMA R, Paracentral Lobule L, SMA L, Cingulate Mid R	+14 -38 +72	2023	0.000
		Precuneus R, Cuneus R	+16 -64 +28	250	0.000
		Frontal Inf Tri L, Frontal Mid L	-46 +32 +10	473	0.000
		Occipital Mid R, Occipital sup R	+32 -68 +34	236	0.000
		Frontal Inf Tri R, Frontal Inf Oper R	+54 +20 +24	112	0.002
		Precuneus L	-06 -62 +48	119	0.001
		Cingulate post R, Cingulate Mid R	+10 -40 +28	243	0.000
		Frontal sup R, Frontal Mid R	+22 +44 +38	450	0.000
		Frontal Inf Tri R, Frontal Inf oper R	+50 +22 +02	101	0.004
		Frontal sup R	+26 +54 +20	73	0.025
		Temporal Mid L	-58 -60 +18	140	0.000
		Frontal Mid R, Frontal sup R	+40 +52 +10	152	0.000
		Temporal sup L, Postcentral L, SupraMarginal L	-60 -32 +22	114	0.002
		Angular L, Temporal Mid L	-48 -64 +34	156	0.000
		Paracentral Lobule L, Postcentral L	-18 -24 +72	244	0.000
		SupraMarginal R	+62 -38 +28	151	0.000
		SupraMarginal R, Postcentral R	+56 -26 +40	235	0.000
		Putamen L, Pallidum L	-24 +06 -04	117	0.002
		Fronta Mid L, Frontal Inf Oper L, Precentral L	-32 +20 +44	113	0.002
		Occipital sup L, Cuneus L	-22 -74 +34	106	0.003
		OFCpost R, OFCant R	+36 +34 -14	121	0.001

		Postcentral L, Parietal sup L	-28 -44 +68	79	0.017
		Precentral R	+32 -14 +54	84	0.012
PD-MCI	SMS	Paracentral Lobule L, SMA L	-08 -22 62	53	0.003
		Putamen R	+26 +06 -04	35	0.037
		Parietal Inf R, SupraMarginal R	+44 -44 +44	53	0.003
		Cuneus R, Precuneus R	+10 -74 +36	60	0.001
		Precentral R	+20 -16 +76	46	0.008
		Temporal sup R	+60 -08 +02	39	0.021
		Fontal Mid R,	+28 +36 +36	41	0.015
		Parietal sup L	-24 -60 +56	47	0.007
HC	ACC	Cingulate Mid R, SMA L, ACC sup R, ACC sup L, Frontal sup Medial L, Cingulate Mid L, ACC sup R	+06 +14 +40	1308	0.000
		Thal VL R, Thal VPL R	+12 -16 +06	89	0.039
		Calcarine R	+20 -70 +08	105	0.018
		Frontal Inf Tri L, Frontal Inf Oper L	-52 +14 +24	104	0.019
		Frontal Sup L, Frontal Mid L	-20 +30 +44	98	0.025
		Occipital Mid L, Angular L, Temporal Mid L	-44 -72 +24	94	0.030
PD-NC	ACC	Frontal sup Medial L, Cingulate Mid R, ACC sup R, SMA L, SMA R, ACC sup L, Cingulate Mid L	+04 +12 +42	1175	0.000
		Putamen R	+22 +14 -02	77	0.016
		Precunus R, Precuneus L	+10 -52 +30	105	0.002
		OFCpost L, Frontal Inf Orb L	-18 +32 -12	71	0.024
		Frontal Mid L	-36 +06 +36	66	0.034
PD-MCI	ACC	Cingulate Mid R, SMA R, Cingulate Mid L, SMA L	+06 +22 +36	363	0.000
		Fusiform R	+36 -38 -16	42	0.044
HC	PCC	Precuneus L, Calcarine L, Precuneus R, Cuneus L,	-12 -68 +56	2852	0.000
		Thalamus PuA L, Thalamus VPL L, Thalamus PuM L, Thalamus IL L	-12 -24 +06	103	0.024
		Temporal Mid L, Angular L	-56 -56 +10	486	0.000

		Postcentral L, Precentral L,	-22 -32 64	273	0.000
		SupraMarginal R, Angular R,Parietal Inf R	+64 -44 +32	224	0.000
		Angular R, Occipital Mid R	+42 -74 +44	99	0.029
		Precentral R, Frontal Mid R, Frontal Sup R	+38 -08 +56	93	0.039
PD-NC	PCC	Precuneus L, Precuneus R, Cingulate Mid R, Cingulate Mid R, Cuneus L, Cuneus R	-02 -46 +40	2831	0.000
		Frontal Inf Tri R, Frontal Inf Oper R, Insula R	+50 +22 +02	305	0.000
		SupraMarginal R, Postcentral R	+58 -24 +36	281	0.000
		Frontal Inf Tri L, Frontal Mid L	-36 +34 +26	120	0.001
		ACCpre R, Frontal sup Medial R	+10 +50 +12	86	0.011
		Thal VL R, Thal VPL R	+14 -16 -04	72	0.027
		Parietal Inf R, Angular R	+46 -56 +48	116	0.002
		Occipital Inf L, Fusiform L	-46 -72 -12	71	0.029
		Calcarine R, Lingual R	+28 -64 +16	93	0.007
		Frontal sup Medial R, Frontal sup R, Frontal Mid R	+10 +30 +40	137	0.000
		Temporal sup L	-44 -12 -08	88	0.009
		OFCant R, OFC lat R	+28 +40 -14	70	0.031
		Precentral R	+36 -12 +54	77	0.019
		Temporal Mid L	-56 -60 +26	160	0.000
		Frontal sup R	+30 +56 +10	109	0.002
		SMA R, Frontal sup R, SMA L	+14 +08 +62	119	0.001
		Temporal Mid R, Temporal sup R	+64 -46 +06	68	0.036
PD-MCI	PCC	SMA R, Frontal sup R	+14 +06 +52	85	0.000
		Precuneus L, Precuneus R	0 -60 +42	399	0.000
		Calcarine R	+10 -66 +14	83	0.000
		Precentral R	+46 -08 +50	38	0.013
		Postcentral R	+24 -44 +68	31	0.041
		SupraMarginal R, Temporal sup R	+54 -48 +24	55	0.001
HC	LPFC-R	Frontal Mid R, Frontal Inf Orb R, Frontal Inf Tri R, Frontal sup R	+42 +56 +12	824	0.000
		Frontal Mid R, Frontal Inf Tri R	+42 +16 +52	942	0.000

		Putamen L, Pallidum L, Insula L	-24 -02 +02	411	0.000
		Precuneus R, Cuneus L, Precuneus L, Cuneus R	+06 -72 +36	233	0.000
		Frontal sup L	-22 +08 +58	145	0.004
		SMA R, Frontal Sup R, Precentral R, Paracentral Lobule R	+16 -14 +66	102	0.024
		Temporal Mid L	-56 -44 -08	163	0.002
		Postcentral L, SupraMarginal L, Temporal sup L	-58 -20 +24	207	0.000
		Frontal Mid L	-36 +38 +36	372	0.000
		Temporal Mid R, Temporal sup R	+56 -38 -02	100	0.027
		Paracentral Lobule L, Precentral L	-14 -26 +68	172	0.001
		Frontal Mid L, Frontal sup L	-22 +50 +28	114	0.014
		Frontal Inf Oper L, Frontal Inf Tri L	-58 +06 +12	178	0.001
PD-NC	LPFC-R	Frontal Mid R, Frontal sup R, Frontal Inf Tri R	+46 +26 +44	653	0.000
		Frontal Mid L, OFCant L	-32 +50 -12	84	0.012
		Caudate L	-12 +08 +14	77	0.019
		Frontal sup R, Frontal Mid R	+32 +56 +06	489	0.000
		Frontal Inf Oper R, Insula R	+48 +16 +06	70	0.031
		Frontal Mid L, Frontal sup L	-32 +36 +22	170	0.000
		SupraMarginal R	+60 -34 +30	134	0.001
		Angular R, Parietal sup R	+30 -60 +50	82	0.014
		Temporal sup R	+66 -38 +20	75	0.022
PD-MCI	LPFC-R	Frontal Mid R	+40 +34 +34	222	0.000
		Frontal Mid R, Frontal sup R	+42 +54 +06	64	0.000

Supplementary Table 6: Cluster wise statistical results per group revealed by seed-to-voxel connectivity analysis in a) CONN, b) SPM12. Threshold: $p<0.05$ after Cluster-level FWE correction.

Abbreviation (HO Atlas):

AC	Anterior Cingulate Cortex
AG l	Angular Gyrus Left
AG r	Angular Gyrus Right
Brain-Stem	Brainstem

CO l	Central Opercular Cortex Left
CO r	Central Opercular Cortex Right
Caudate	Caudate nucleus
Caudate l	Caudate Left
Cereb1 l	Cerebellum Lobule I Left
Cereb1 r	Cerebellum Lobule I Right
Cereb2 r	Cerebellum Lobule II Right
Cereb2 l	Cerebellum Lobule II Left
Cereb2 r	Cerebellum Lobule II Right
Cereb45 l	Cerebellum 4,5 left
Cereb45 r	NCerebellum 4,5 right
Cereb6 l	Cerebellum Lobule VI Left
Cereb6 r	Cerebellum Lobule VI Right
Cereb7 l	Cerebellum Lobule VII Left
Cereb7 r	Cerebellum Lobule VII Right
Cereb8 l	Cerebellum Lobule VIII Left
Cereb8 r	Cerebellum Lobule VIII Right
Cereb9 l	Cerebellum Lobule IX Left
Cereb9 r	Cerebellum Lobule IX Right
Cuneal l	Cuneal Cortex Left
Cuneal r	Cuneal Cortex Right
FO l	Frontal Operculum Cortex Left
FO r	Frontal Operculum Cortex Right
FOrb l	Frontal Orbital Cortex Left
FOrb r	Frontal Orbital Cortex Right
FP l	Frontal Pole Left
FP r	Frontal Pole Right
HG l	Heschl’s Gyrus Left
HG r	Heschl’s Gyrus Right
Hippocampus l	Hippocampus left
Hippocampus r	Hippocampus right
IC l	Insular Cortex Left
IC r	Insular Cortex Right
ICC l	Intracalcarine Cortex Left
ICC r	Intracalcarine Cortex Right
IFG oper l	Inferior Frontal Gyrus (Opercular Part) Left
IFG oper r	Inferior Frontal Gyrus (Opercular Part) Right
IFG tri r	Inferior Frontal Gyrus (Triangular Part) Right
LG l	Lateral Occipital Cortex Left
LG r	Lateral Occipital Cortex Right
MidFG l	Middle Frontal Gyrus Left
MidFG r	Middle Frontal Gyrus Right
OP l	Occipital Pole Left
OP r	Occipital Pole Right
PC	Posterior Cingulate Cortex
PO l	Parietal Operculum Cortex Left

PO r	Parietal Operculum Cortex Right
PP l	Planum Polare Left
PP r	Planum Polare Right
PT l	Planum Temporale Left
PT r	Planum Temporale Right
PaCiG l	Posterior Cingulate Cortex Left
PaCiG r	Posterior Cingulate Cortex Right
Pallidum l	Pallidum Left
Pallidum r	Pallidum Right
PostCG l	Postcentral Gyrus Left
PostCG r	Postcentral Gyrus Right
PreCG l	Precentral Gyrus Left
PreCG r	Precentral Gyrus Right
Precuneous	Precuneous Cortex
Precuneous Cortex	Precuneous Cortex
Putamen l	Putamen Left
Putamen r	Putamen Right
SCC l	Subcallosal Cortex Left
SCC r	Subcallosal Cortex Right
SFG l	Superior Frontal Gyrus Left
SFG r	Superior Frontal Gyrus Right
SMA L	Supplementary Motor Cortex Left
SMA r	Supplementary Motor Cortex Right
SPL l	Superior Parietal Lobule Left
SPL r	Superior Parietal Lobule Right
TP l	Temporal Pole Left
TP r	Temporal Pole Right
Thalamus l	Thalamus Left
Thalamus r	Thalamus Right
Ver45	Vermis IV–V
aPaHC l	Anterior Parahippocampal cortex left
aSMG l	Anterior supramarginal gyrus left
aSMG r	Anterior supramarginal gyrus right
aSTG l	Anterior superior temporal gyrus left
aSTG r	Anterior superior temporal gyrus right
pITG r	Posterior inferior temporal gyrus right
pMTG r	Posterior middle temporal gyrus right
pPaHC l	Posterior Parahippocampal cortex left
pPaHC r	Posterior Parahippocampal cortex right
pSMG l	Posterior supramarginal gyrus left
pSMG r	Posterior supramarginal gyrus right
pSTG l	Posterior temporal gyrus left
pTFusC l	Temporal Occipital Fusiform Cortex left
pTFusC r	Temporal Occipital Fusiform Cortex right
sLOC l	Superior lateral occipital cortex left

sLOC r	Superior lateral occipital cortex right
toMTG l	Temporo-occipital Middle temporal gyrus left
toMTG r	Temporo-occipital Middle temporal gyrus right