SUPPLEMENTARY DATA
Predicting and characterizing neurodegenerative subtypes with multimodal neurocognitive signatures of social and cognitive processes

S1. Acquisition parameters for each center

Center 1 (Argentina): Using a 3-T Phillips scanner with a standard head coil, we acquired whole-brain T1-rapid anatomical 3D gradient echo volumes, parallel to the plane connecting the anterior and posterior commissures, with the following parameters: repetition time (TR) = 8300 ms; echo time (TE) = 3800 ms; flip angle = 8º; 160 slices, matrix dimension = 224 x 224 x 160; voxel size = 1 mm x 1 mm x 1 mm. Also, functional spin echo volumes, parallel to the anterior-posterior commissures, covering the whole brain, were sequentially and ascendingly acquired with the following parameters: TR = 2640 ms; TE = 30 ms; flip angle = 90º; 49 slices, matrix dimension = 80 x 80 x 49; voxel size in plane = 3 mm x 3 mm x 3 mm; slice thickness = 3 mm; sequence duration = 10 minutes; number of volumes = 220.

Center 2 (Chile): Using a 3-T Siemens Skyra scanner with a standard head coil, we acquired whole-brain T1-rapid gradient echo volumes, parallel to the plane connecting the anterior and posterior commissures, with the following parameters: repetition time (TR) = 1700 ms; echo time (TE) = 2000 ms; flip angle = 8º; 208 slices, matrix dimension = 224 x 224 x 208; voxel size = 1 mm x 1 mm x 1 mm. Finally, functional EP2D-BOLD pulse sequences, parallel to the anterior-posterior commissures, covering the whole brain, were acquired sequentially intercalating pair-ascending first with the following parameters: TR = 2660 ms; TE = 30 ms; flip angle = 90º; 46 slices, matrix dimension = 76 x 76 x 46; voxel size in plane = 3 mm x 3 mm x 3 mm; slice thickness = 3 mm; sequence duration = 13.3 minutes; number of volumes = 300.

Center 3 (Colombia): Using a 3-T Philips Achieva scanner with a standard head coil, we acquired whole-brain T1-weighted Turbo Field Echo (TFE) volumes, parallel to the plane connecting the anterior and posterior commissures, with the following parameters: repetition time (TR) = 7000 ms; echo time (TE) = 3000 ms; flip angle = 8º; 350 slices, matrix dimension = 480 x 480 x 350; voxel size = 0.48 mm x 0.48 mm x 0.5 mm. Additionally, functional field echo planar imaging (FE-EPI) volumes, parallel to the anterior-posterior commissures, covering the whole brain, were sequentially and ascendingly acquired with the following parameters: TR = 2000 ms; TE = 30 ms; flip angle = 90º; 40 slices, matrix dimension = 80 x 80 x 40; voxel size in plane = 2.88 mm x 2.88 mm x 3 mm; slice thickness = 3 mm; sequence duration = 10 minutes; number of volumes = 150.

SUPPLEMENTARY TABLES

Supplementary Table 1. Selected works of emotion recognition and/or theory of mind tasks (other than SEA/MiniSEA) in behavioral variant frontotemporal dementia, Alzheimer's disease, and/or Parkinson's disease.

Source	Groups: *N*	Tasks	Behavioral performance	Brain structure associations	Brain function associations
Bek et al., 2020 [1]	PD: 18 HC: 10	Emotion recognition in dynamic and static facial expressions (Amsterdam Dynamic Facial Expression Set)	PD = HC on FER, but motion increased performance only in HC	NA	NA
Del Prete et al., 2020 [2]	PD: 16 HC: 11	Faux-Pas test Picture Sequencing Task Capture Story Emotion Attribution Task Happe test Strange Stories Karolinska Directed Emotional Faces	PD-early stages < HC in cognitive components of ToM (preserved affective ToM) Significant effect of dopaminergic therapy on ToM	NA	NA
Mattavelli et al., 2020 [3]	PD: 70 HC: 46	Ekman-60	PD < HC, especially in fear recognition Performance correlated with perceptual, executive and general cognitive abilities, but deficits still present in cognitively unimpaired patients	NA	NA
Takenoshita et al., 2020 [4]	AD: 63	Sally-Anne false belief test	29 AD patients: successful performance 34 AD patients: unsuccessful performance (Both groups matched in cognitive ability)	NA	Regional cerebral blood flow (SPECT) result: Lower uptake in the bilateral posterior cingulate gyrus in the ToM unsuccessful group compared to the successful group

Yildirim et al., 2020 [5]	AD: 18 MCI: 31 Subjective cognitive impairment: 32	Faux-Pas test RMET	AD < MCI = subjective cognitive impairment on Faux-Pas test AD, MCI < subjective cognitive impairment on RMET Deficits related to episodic memory and verbal fluency in the overall sample	NA	NA
Chainay and Gaubert, 2020 [6]	AD: 28 HC: 33	FER (pictures from Montreal Set of Facial Displays of Emotion) Facial expression attribution Faux-Pas test	AD < HC on affective and cognitive ToM Deficit partially explained by working memory	NA	NA
Giovagnoli et al., 2019 [7]	bvFTD: 14 HC: 14	Faux-Pas test	bvFTD < HC	Atrophy correlates (bvFTD): Misinterpretation of mental states and concrete thinking related to disease severity and PFC atrophy	NA
Multani et al., 2019 [8]	AD: 18 FTD: 10 (bvFTD: 4) PD: 19 HC: 10	TASIT-EET Behavioral Inhibition System/Behavioral Activation System scale Revised Self-Monitoring Scale IRI SNQ	FTD = AL = PD < HC in IRI-Perspective taking scale A trend towards significance was found for TASIT-EET and SNQ (patients < HC)	NA	BOLD co-activation (resting-state fMRI) between left inferior temporal gyrus-anterior division with bilateral frontal pole and paracingulate gyrus was correlated to IRI-Perspective taking, SNQ total and TASIT-EET
Fabbri et al., 2018 [9]	PD: 60 HC: 60	Advanced test of ToM Emotion Attribution Task	PD < HC on both tasks	NA	NA
Kumfor et al., 2018 [10]	bvFTD: 19 LSD: 12 HC: 20	FAST Emotion recognition in bodies Contextual effects (emotion recognition in faces embedded in body posture context)	bvFTD = LSD < HC on emotion recognition in faces and bodies alone bvFTD = LSD = HC on FER in congruent context (i.e., same emotion displayed by the body) bvFTD < LSD = HC on FER in incongruent context (i.e., different emotion displayed by the body) bvFTD more likely to label the facial emotion as that portrayed by the body (contextual influence)	GM volume (VBM) correlations for bvFTD: - FER in context: bilateral fusiform cortex, medial and superior frontal gyrus, right insula - Contextual influence: bilateral	NA

				temporal fusiform cortex, parahippocampal gyrus, amygdala, OFC	
Kumfor et al., 2017 [11]	AD: 23 bvFTD: 25 HC: 33	TASIT (short version) -EET -SI	bvFTD < HC AD = HC on emotion recognition (TASIT-EET) and sarcasm recognition (TASIT-SI)	GM volume (VBM) correlations for all groups combined: - TASIT-EET: amygdala, insula, fusiform - TASIT-SI: precuneus, temporal pole	NA
Nobis et al., 2017 [12]	PD: 44 (left dominant motor symptoms: 24; right dominant motor symptoms: 20	Faux-Pas test RMET	ToM performance not associated with right hemispheric dysfunction Faux-Pas test (cognitive ToM) associated with verbal fluency and overall cognition RMET (affective ToM) associated with motor symptom severity	NA	NA
Park et al., 2017 [13]	AD: 32 FTD: 13 (bvFTD: 8) MCI: 32 HC: 33	FER test (pictures)	FTD = AD < HC on FER total score Negative emotion recognition (not positive) distinguished FTD from the other groups	GM volume (VBM) correlations for all groups combined: - Negative emotions: anterior temporal regions - Positive emotions: fronto-parietal regions (pre- and postcentral gyrus)	NA
Pohl et al., 2017 [14]	PD: 13 HC: 13	Video clips depicting emotional, non-emotional, and neutral facial expressions (fMRI active task) Emotion Hexagon test	PD < HC on FER (only on highly ambiguous expressions)	NA	BOLD (active fMRI) correlates: - Both groups during observation and execution of the emotional facial expressions: activation of inferior frontal and

					anterior inferior parietal (mirror neuron system) - PD during observation of emotional expressions: decreased activation in pars opercularis of the right inferior frontal gyrus, bilateral inferior parietal lobule, bilateral supplementary motor cortex In PD, activation of the right anterior inferior parietal lobule was positively related to accuracy in the FER task
Albuquerque et al., 2016 [15]	PD-advanced: 42 HC: 43	CATS	PD = HC on FER PD < HC on emotion recognition in prosody	NA	NA
Bologna et al., 2016 [16]	PD: 18 HC: 16	Ekman-60	PD < HC	NA	NA
Ille et al., 2016 [17]	PD: 25 HC: 25	FER (pictures from Karolinska set)	PD = HC (fear, disgust, anger)	NA	NA
Brioschi Guevara et al., 2015 [18]	bvFTD: 18 Caregivers = 20 HC = 32	Faux-Pas test	bvFTD < HC	GM volume (VBM) correlations of Faux-Pas in bvFTD: right dorsolateral PFC, right OFC, left lateral PMC, left medial PMC, left superior temporal cortex	NA
Díez-Cirarda et al., 2015 [19]	PD: 37 HC: 15	Happe test Strange Stories	PD < HC, related to executive functions	Correlations of ToM in PD: GM volume (VBM): precentral and postcentral gyrus, ACC, middle and inferior frontal gyrus	NA

				-but the results disappeared when controlling for executive functions WM: superior longitudinal fasciculus (adjacent to the parietal lobe) and WM adjacent to the frontal lobe	
Kamminga et al., 2015 [20]	bvFTD: 19 RSD: 12 HC. 20	Emotion-matching Emotion-selection Ekman-60	bvFTD < HC on all tasks	GM volume (VBM) correlations of FER in bvFTD: left temporal, inferior frontal and OFC, right frontal gyrus	NA
Sapey-Triomphe et al., 2015 [21]	AD: 39 HC: 39	FER test (pictures)	AD < HC on FER	Brain regional volume negative correlations: - Fear: amygdala - Disgust: pallidum - Happiness: fusiform gyrus	NA
Torralva et al., 2015 [22]	bvFTD: 40 HC: 18	Faux-Pas test RMET	bvFTD-moderate < bvFTD-mild < HC on cognitive ToM (Faux-Pas) bvFTD-moderate = bvFTD-mild < HC on affective ToM (RMET) Cognitive ToM related to executive functions	NA	NA
Wabnegger et al., 2015 [23]	PD: 17 HC: 22	Pictures of facial expressions (Karolinska set) depicting disgust, fear, sadness, and anger during fMRI	PD = HC on intensity and classification accuracy ratings (post-scan)	NA	BOLD (active fMRI) results across all emotions: Similar activation in both groups but stronger recruitment of somatosensory regions in PD
Aiello et al., 2014 [24]	PD: 12 HC:13	FER (pictures from NimStim set) Emotion recognition in prosody	PD-on-med < HC on FER (total score and disgust) PD-on-med = HC on emotion recognition in prosody PD-off-med = HC on FER and emotion recognition in prosody (total score), but more errors in identifying disgust	NA	NA

Alonso-Recio et al., 2014 [25]	PD: 53 HC: 53	FER (pictures from FACES Database)	PD < HC on emotion identification	NA	NA
Kumfor et al., 2014 [26]	AD: 18 CBS: 16 HC: 22	Emotion-matching Emotion-selection Ekman-60 TASIT-EET	AD = CBS < HC on Ekman-60 and TASIT	Cortical thinning/volume (FreeSurfer) correlations for AD: - Ekman-60: bilateral insula, right hippocampus, - TASIT: right insula, right anterior cingulate, bilateral hippocampus, right amygdala, bilateral accumbens, bilateral putamen	NA
Couto et al., 2013 [27]	bvFTD: 12 nfvPPA: 10 HC: 18	FER in cartoons RMET	bvFTD < HC on both tasks	GM volume (VBM) correlations for bvFTD: - FER: bilateral OFC, right gyrus rectus, right insula - RMET: fronto-insular areas	NA
Kumfor et al., 2013 [28]	bvFTD: 18 SD: 12 nfvPPA: 11 HC: 27	Ekman-60 Ekman Caricatures	bvFTD < HC on Ekman-60 (negative emotions) Deficits persisted when increasing stimuli salience (Ekman Caricatures)	GM volume (VBM) correlations for all groups combined: - Fear: right amygdala, hippocampus, ACC - Disgust: left insula, left temporal pole - Anger: left middle and superior temporal gyrus - Sadness: left subcallosal cingulate	NA
Narme et al., 2013 [29]	PD: 23 HC: 46	Ekman-60 Faux-Pas test	PD < HC on: - FER (fear and sadness)	NA	NA

		Yoni task	- Faux-Pas, attributable to impaired understanding - Yoni task (second-order inference), not attributable to cognitive status		
Virani et al., 2013 [30]	bvFTD: 20 HC: 18	Implicit emotional facial expression task during fMRI	bvFTD < HC in sex discrimination	NA	BOLD (active fMRI) results in bvFTD vs HC: Emotion-specific functional abnormalities in frontal and limbic regions Decreased activity in posterior ventral visual regions Increased activity in posterior regions, including the inferior parietal cortex
Baggio et al., 2012 [31]	PD: 39 HC: 23	Ekman-60	PD < HC	Correlations of FER in PD: GM volume (VBM): - Sadness: right OFC, amygdala, postcentral gyrus - Anger: right occipital fusiform gyrus, ventral striatum, subgenual cortex - Disgust: ACC WM (FA-DTI) correlates of sadness recognition: frontal portion of the right inferior fronto-occipital fasciculus	NA
Hsieh et al., 2012 [32]	SD: 11 AD: 12 HC: 20	Emotion recognition in unfamiliar musical tunes Ekman-60	SD < AD = HC in Ekman-60	Correlations of labeling emotions (both modalities) for all groups combined: right anterior	NA

				temporal pole, amygdala, insula	
Le Bouc et al., 2012 [33]	AD: 12 bvFTD: 11 HC: 20	False belief task (animated scenes)	AD < HC in inferring someone else's belief bvFTD < HC in inhibiting their own mental perspective	NA	Hypometabolism (PET) correlations (patient groups combined) - Deficits in inferring someone else's beliefs: left temporoparietal junction - Deficits in self-perspective inhibition: right lateral PFC
Miller et al., 2012 [34]	bvFTD: 17 LSD: 12 AD: 20 HC: 36	Ekman-60 Emotion matching Emotion selection	bvFTD = LSD = AD < HC on all tasks Deficits survived when controlling for perceptual and language impairments	NA	NA
Yu et al., 2012 [35]	PD: 39 HC: 40	Faux-Pas test Implication Stories test Cartoon ToM task	PD < HC on Cartoon ToM task PD = HC on Faux-Pas test and Implication Stories test PD performance in ToM tasks related to executive functions	NA	NA
Kumfor et al., 2011 [36]	bvFTD: 16 SD: 12 nfvPPA: 13 HC: 37	Ekman-60 Ekman Caricatures	bvFTD < HC (negative emotions) Performance improved with increased emotion intensity	NA	NA
Omar et al., 2011 [37]	fvFTD: 19 tvFDT: 13 HC: 22	Ekman-24	fvFTD = tvFDT < HC	GM volume (VBM) correlation of anger recognition in the combined FTLD group: posterior bilateral insula	NA
Roca et al., 2010 [38]	PD-early: 36 HC: 36	Faux-Pas test RMET	PD = HC on RMET (affective ToM) PD < HC on Faux-Pas test (cognitive ToM) Deficit not associated with executive functioning, depression, or medication	NA	NA
Bediou et al., 2009 [39]	AD: 10 FTD: 10 MCI-amnesic: 10 HC: 10	FER in pictures	FTD < AD < HC = MCI	NA	NA

Fernandez-Duque et al., 2009 [40]	AD: 17 bvFTD: 11 HC: 12	First- and second-order false-belief tasks	AD = bvFTD < HC on second-order false-belief Ceiling performance on first-order false-belief	NA	NA
Ibarretxe-Bilbao et al., 2009 [41]	PD: 24 HC: 24	Ekman-60 Iowa Gambling Task	PD < HC on both tasks	GM volume (VBM) correlations for PD: - Ekman-60: bilateral OFC - Iowa Gambling Task: left lateral OFC	NA
Kipps et al., 2009 [42]	bvFTD: 26 AD: 9 HC: 16	TASIT-EET-SI-M	bvFTD with pathological MRI = AD < bvFTD with normal MRI and HC on negative emotion recognition (TASIT-EET) bvFTD-pathological-MRI < bvFTD-normal-MRI, AD and HC on sarcasm comprehension (TASIT-SI-M)	GM volume (VBM) correlations of negative emotions and sarcasm recognition: right amygdala, lateral OFC, insula, amygdala and temporal pole (>right)	NA
Péron et al., 2009 [43]	PD-early: 17 PD-advanced: 27 HC: 26	Faux-Pas test RMET	PD-early = HC in ToM (with no differences between medicated and unmedicated PD) PD-advanced < HC in cognitive ToM (intention attribution question of the Faux-Pas test) -Preserved affective ToM (RMET)	NA	NA
Wright et al., 2007 [44]	AD: 12 HC: 24	Ekman faces during fMRI	No significant between-group differences on successful face recognition, arousal or valence ratings	NA	BOLD (active fMRI) results in AD vs. HC: greater amygdala responses to both neutral and emotional faces
Ariatti et al., 2008 [45]	PD: 27 HC: 68	Ekman pictures Emotional Prosody Recognition Battery	PD < HC on FER (especially sadness and fear) and in processing emotional and propositional prosody	NA	NA
Kohler et al., 2005 [46]	AD: 22 HC-caretakers: 22	FER in pictures PEAT	AD < HC on FER AD < HC on PEAT Only PEAT results survived when adjusting for overall cognition Not related to cognitive deficits or depression	NA	NA

Rosen et al., 2004 [47]	fvFTD: 13 tvFTD: 15 HC:16	Florida Affect Battery	fvFTD, tvFTD < HC in recognizing negative emotions and neutral expressions fvFTD < HC in happy faces	NA	NA
Gregory et al., 2002 [48]	AD: 12 fvFTD: 19 HC: 16	First-order false belief test Second-order false belief task Faux-Pas test RMET	fvFTD < AD = HC on first order false belief, Faux-Pas test and RMET fvFTD = AD < HC on second order false belief	Atrophy correlates: ToM deficits in fvFTD related to their degree of ventromedial frontal damage	NA
Adolphs et al., 1998 [49]	PD: 18 HC: 13	Ekman-39	PD = HC	NA	NA
Albert et al., 1991 [50]	AD: 19 HC: 19	Emotion recognition in faces (pictures) and emotional situations	AD < HC on all tasks, but the majority of effects disappeared when adjusting for cognitive abilities	NA	NA

ACC: anterior cingulate cortex; AD: Alzheimer's disease; BOLD: blood oxygen level dependent; bvFTD: behavioral variant frontotemporal dementia; CATS: Comprehensive Affect Testing System; CBS: corticobasal syndrome; DTI: diffusion tensor imaging; FA: fractional anisotropy; FAST: Facial Affect Selection Test; FER: facial emotion recognition; FTD: frontotemporal dementia; fvFTD: frontal variant frontotemporal dementia; GM: gray matter; HC: healthy controls; IRI: Interpersonal Reactivity Index; LSD: left-hemisphere predominant temporal atrophy - semantic dementia; MCI: mild cognitive impairment; (f)MRI: (functional) magnetic resonance imaging; NA: not assessed; nfvPPA: non-fluent variant primary progressive aphasia; OFC: orbitofrontal cortex; PEAT: Penn Emotion Acuity Test; PET: positron emission tomography; PD: Parkinson's disease; PFC: prefrontal cortex; PMC: premotor cortex; RMET: Reading the Mind in the Eyes Test; RSD: right-hemisphere predominant temporal atrophy - semantic dementia; SD: semantic dementia; SNQ: Social Norms Questionnaire; SPECT: single photon emission computed tomography; TASIT: The Awareness of Social Inference Test; TASIT-EET: The Awareness of Social Inference Test - Emotion Evaluation Test; TASIT-SI-M: The Awareness of Social Inference Test - Social Inference-Minimal Test; ToM: theory of mind; tvFTD: temporal variant frontotemporal dementia; VBM: Voxel-Based Morphometry; WM: white matter.

Supplementary Table 2. Regions of significant atrophy in behavioral variant frontotemporal dementia patients compared with controls.

Cluster size	Regions	Coordinates			Peak T	Peak Z
		x	y	z		
737	Superior temporal gyrus R	52	-9	-6	6.37	5
	Temporal pole: superior temporal gyrus R	57	3	-2	5.6	4.58
	Superior temporal gyrus R	51	-20	-4	4.55	3.92
239	Middle frontal gyrus L	-22	10	48	4.71	4.02
108	Superior frontal gyrus. dorsolateral R	21	-9	58	4.19	3.67
243	Superior temporal gyrus L	-45	-2	-10	4.18	3.67
461	Gyrus rectus R	2	36	-18	4.01	3.54
	Superior frontal gyrus, medial orbital R	8	52	-14	3.92	3.48
	Gyrus rectus R	3	45	-16	3.65	3.29
118	Fusiform gyrus L	-21	-33	-21	3.87	3.44
34	Fusiform gyrus L	-21	-68	-40	3.71	3.33
40	Fusiform gyrus R	26	-30	-24	3.66	3.29
36	Inferior frontal gyrus. triangular part L	-33	20	10	3.64	3.27

L: left; R: right.

$p < 0.001$, uncorrected; extent threshold = 30 voxels.

Supplementary Table 3. Regions of significant atrophy in Alzheimer's disease patients compared with controls.

Cluster size	Regions	Coordinates			Peak T	Peak Z
		x	y	z		
18936	Hippocampus L	-16	-6	-16	6.4	5.52
	Hippocampus R	18	-4	-15	5.86	5.16
	Hippocampus R	26	-4	-28	5.25	4.71
402	Thalamus R	4	-10	8	5.52	4.91
	Thalamus L	-4	-12	8	5.29	4.75
1054	Middle frontal gyrus L	-36	38	20	4.7	4.3
42	Inferior frontal gyrus. triangular part L	-38	14	27	3.72	3.5
75	Middle frontal gyrus R	30	34	28	3.61	3.41
	Middle frontal gyrus R	30	45	27	3.38	3.21
188	Superior temporal gyrus R	51	-46	12	3.59	3.39
	Supramarginal gyrus R	52	-44	26	3.28	3.13
121	Inferior frontal gyrus. triangular part L	-36	38	-12	3.59	3.39
67	Superior frontal gyrus. medial R	8	60	9	3.48	3.3
34	Middle frontal gyrus L	-20	39	30	3.45	3.27
54	Anterior cingulate and paracingulate gyri R	9	38	24	3.44	3.27
70	Superior frontal gyrus. orbital part R	20	60	-4	3.42	3.24
56	Superior frontal gyrus. orbital part	-15	60	-10	3.37	3.2

L: left; R: right.

$p < 0.001$, uncorrected; extent threshold = 30 voxels.

Supplementary Table 4. Demographic data of participants with MRI scanning and motion parameters of resting-state functional images.

Demographic data	**CN-bvFTD**	**bvFTD**	**Stats**
Age *Mean* (*SD*)	64.71 (4.22)	66.50 (9.03)	t = -0.73; p = 0.46
Education *Mean* (*SD*)	13.59 (4.30)	15.38 (4.37)	t = -1.13; p = 0.26
Sex *(F:M)*	(1:16)	(4:13)	X^2 = 2.34; p = 0.12
	CN-AD	**AD**	**Stats**
Age *Mean* (*SD*)	73.47 (4.84)	75.33 (6.43)	t = -1.26; p = 0.20
Education *Mean* (*SD*)	11.60 (5.04)	11.17 (4.53)	t = 0.35; p = 0.72
Sex *(F:M)*	(18:12)	(16:14)	X^2 = 0.27; p = 0.60
	CN-PD	**PD**	**Stats**
Age *Mean* (*SD*)	68.28 (6.66)	68.77 (8.23)	t = -0.29; p = 0.76
Education *Mean* (*SD*)	12.47 (3.32)	11.23 (5.32)	t = 1.26; p = 0.21
Sex *(F:M)*	(20:20)	(18:25)	X^2 = 0.55; p = 0.45
Motion parameters	**CN-bvFTD**	**bvFTD**	**Stats**
Average Translation *Mean* (*SD*)	0.07 (0.05)	0.07 (0.03)	t = -0.27; p = 0.78
Average rotation *Mean* (*SD*)	0.03 (0.02)	0.05 (0.02)	t = -1.59; p = 0.12
	CN-AD	**AD**	**Stats**
Average Translation *Mean* (*SD*)	0.09 (0.06)	0.08 (0.03)	t = 1.07; p = 0.28
Average rotation *Mean* (*SD*)	0.04 (0.03)	0.06 (0.03)	t = -1.86; p = 0.07
	CN-PD	**PD**	**Stats**
Average Translation *Mean* (*SD*)	0.08 (0.05)	0.06 (0.03)	t = 1.42; p = 0.15
Average rotation *Mean* (*SD*)	0.04 (0.03)	0.05 (0.04)	t = -1.26; p = 0.20

AD: Alzheimer's disease; bvFTD: behavioral variant frontotemporal dementia; CN-AD: Controls matched with the AD patients; CN-bvFTD: Controls matched with the bvFTD patients; CN-PD: Controls matched with the PD patients; PD: Parkinson's disease.

Supplementary Table 5. Discriminant functions and classification statistics between patients and controls of models with less classification accuracy.

Predictor variable	Standardized coefficient	Discriminant function	Classification accuracy (%) (patients : controls)
bvDFT patients and controls			
MiniSEA total score	1.00	Wilkis's λ = .748 $X^2(1) = 13.532$ $p < .0001$	75.5 (50.0 : 93.1)
MoCA total score	1.00	Wilkis's λ = .541 $X^2(1) = 28.588$ $p < .0001$	81.6 (70.0 : 89.7)
IFS total score	1.00	Wilkis's λ = .841 $X^2(1) = 8.030$ $p = .005$	63.3 (50.0 : 72.4)
MiniSEA and IFS total scores		Wilkis's λ = .741 $X^2(2) = 13.780$ $p = .001$	73.5 (50.0 : 89.7)
MiniSEA	.84		
IFS	.22		
AD patients and controls			
MiniSEA total score	1.000	Wilkis's λ = .658 $X^2(1) = 27.388$ $p < .0001$	75.0 (69.7 : 80.0)
IFS total score	1.00	Wilkis's λ = .599 $X^2(1) = 33.75$ $p < .0001$	79.4 (78.8 : 80.0)
MiniSEA and IFS total scores		Wilkis's λ = .536 $X^2(2) = 40.516$ $p < .0001$	82.4 (81.8 : 82.9)
MiniSEA	.51		
IFS	.68		
PD patients and controls			
MoCA total score	1.000	Wilkis's λ = .861 $X^2(1) = 15.464$ $p < .0001$	65.1 (60.8 : 69.1)
IFS total score	1.00	Wilkis's λ = .879 $X^2(1) = 13.339$ $p < .0001$	63.2 (58.8 : 67.3)
MoCA and MiniSEA total scores		Wilkis's λ = .733 $X^2(2) = 31.982$ $p < .0001$	69.8 (62.7 : 76.4)
MoCA	.43		
MiniSEA	.78		
MoCA, IFS and MiniSEA total scores		Wilkis's λ = .733 $X^2(3) = 31.827$ $p < .0001$	68.9 (60.8 : 76.4)
MoCA	.43		
IFS	.003		
MiniSEA	.77		

AD: Alzheimer's disease; bvFTD: behavioral variant frontotemporal dementia; IFS: INECO Frontal Screening battery; MiniSEA: Mini Social Cognition and Emotional Assessment; MoCA: Montreal Cognitive Assessment; PD: Parkinson's disease.

Supplementary Table 6. Discriminant functions and classification statistics between groups of patients with less classification accuracy.

Predictor variable	Standardized coefficient	Discriminant function	Classification accuracy (%)
bvDFT and AD patients			
MiniSEA total score	1.00	Wilkis's λ = .984 $X^2(1) = .720$ $p = .396$	54.3 (50 : 56.7)
IFS total score	1.00	Wilkis's λ = .806 $X^2(1) = 9.393$ $p = .002$	68.7 (62.5 : 75)
MiniSEA and IFS total scores		Wilkis's λ = .790 $X^2(2) = 10.138$ $p = .006$	69.6 (68.8 : 70)
MiniSEA	-.362		
IFS	1.145		
MoCA, IFS and MiniSEA total scores		Wilkis's λ = .665 $X^2(3) = 17.307$ $p = .001$	69.6 (75 : 66.7)
MiniSEA	-.278		
MoCA	.91		
IFS	.242		
bvFTD and PD patients			
MoCA total score	1.000	Wilkis's λ = .955 $X^2(1) = 2.589$ $p = .108$	62.7 (50 : 67.4)
IFS total score	1.00	Wilkis's λ = .998 $X^2(1) = .110$ $p = .741$	40.7 (50 : 37.2)
AD and PD patients			
MiniSEA total score	1.00	Wilkis's λ = .224 $X^2(1) = 105.608$ $p < .0001$	94.5 (86.7 : 100)
MoCA total score	1.000	Wilkis's λ = .553 $X^2(1) = 41.751$ $p < .0001$	78.1 (76.7 : 79.1)
IFS total score	1.00	Wilkis's λ = .853 $X^2(1) = 11.236$ $p = .001$	71.2 (76.7 : 67.4)
MiniSEA and IFS total scores		Wilkis's λ = .167 $X^2(2) = 135.279$ $p < .0001$	95.9 (90 : 100)
MiniSEA	1.065		
IFS	-.597		

AD: Alzheimer's disease; bvFTD: behavioral variant frontotemporal dementia; IFS: INECO Frontal Screening battery; MiniSEA: Mini Social Cognition and Emotional Assessment; MoCA: Montreal Cognitive Assessment; PD: Parkinson's disease.

Supplementary Table 7. Brain regions related to discriminant scores in behavioral variant frontotemporal dementia patients and controls.

Cluster size	Regions	Coordinates			Peak T	Peak Z
		x	y	z		
MoCA and MiniSEA						
3296	Hippocampus L	-16	-14	-15	5.61	4.60
	Parahippocampal gyrus L	-18	3	-26	3.92	3.50
	Fusiform gyrus L	-21	-33	-20	3.75	3.37
928	Cerebellum L	-22	-72	-42	5.01	4.24
3207	Caudate nucleus R	8	12	6	4.92	4.18
	Caudate nucleus L	-6	10	4	4.43	3.86
	Gyrus rectus L	0	36	-18	4.16	3.67
1752	Parahippocampal gyrus R	18	-14	-28	4.92	4.18
	Hippocampus R	15	-9	-14	4.23	3.72
	Hippocampus R	28	-8	-21	3.69	3.32
178	Middle temporal gyrus L	-46	-51	2	4.75	4.07
699	Postcentral gyrus R	26	-38	45	4.64	4.00
746	Cerebellum R	26	-74	-42	4.35	3.80
70	Hippocampus R	40	-20	-16	4.25	3.73
943	Middle temporal gyrus R	45	-2	-30	4.02	3.57
	Middle temporal gyrus R	64	-27	-2	3.80	3.40
	Middle temporal gyrus R	52	-12	-12	3.78	3.39
69	Temporal pole: superior temporal gyrus R	56	3	0	4.01	3.56
62	Superior frontal gyrus. medial L	-2	51	21	4.01	3.56
105	Inferior temporal gyrus L	-39	6	-38	3.93	3.50
842	Insula R	34	24	8	3.93	3.50
342	Insula L	-34	14	8	3.91	3.49
155	Insula R	46	-4	4	3.85	3.45
98	Middle temporal gyrus L	-46	-12	-22	3.84	3.44
91	Middle temporal gyrus L	-52	-30	2	3.79	3.40
63	Lenticular nucleus. putamen R	24	-6	2	3.72	3.35
126	Temporal pole: superior temporal gyrus R	42	3	-15	3.62	3.27
MoCA, IFS and MiniSEA						
3633	Hippocampus L	-16	-15	-16	5.44	4.50
	Parahippocampal gyrus L	-21	-18	-28	5.10	4.29
	Hippocampus L	-28	-12	-14	4.37	3.81
1357	Parahippocampal gyrus R	18	-14	-30	5.17	4.33
	Hippocampus R	14	-8	-14	3.78	3.39
	Parahippocampal gyrus R	12	3	-24	3.53	3.20
2883	Caudate nucleus R	8	12	6	4.97	4.21
	Caudate nucleus L	-6	9	4	4.63	3.99

	Caudate nucleus L	-9	8	14	4.08	3.61
878	Cerebellum L	-22	-74	-40	4.93	4.18
533	Postcentral gyrus L	26	-38	46	4.70	4.04
154	Middle temporal gyrus L	-46	-51	2	4.42	3.85
671	Cerebellum R	26	-74	-42	4.26	3.74
51	Hippocampus R	40	-20	-16	4.03	3.58
880	Inferior frontal gyrus. triangular part R	38	22	9	3.98	3.54
	Insula R	38	14	6	3.80	3.41
	Insula R	38	30	6	3.63	3.28
57	Temporal pole: superior temporal gyrus R	56	4	-2	3.92	3.50
315	Insula L	-36	12	8	3.86	3.45
93	Lenticular nucleus. pallidum R	24	-4	2	3.85	3.44
549	Superior temporal gyrus R	56	-24	-3	3.81	3.41
	Middle temporal gyrus R	64	-27	-2	3.79	3.40
	Superior temporal gyrus R	52	-12	-10	3.70	3.33
64	Middle temporal gyrus R	-39	6	-38	3.73	3.35
62	Insula R	46	-6	4	3.64	3.29
82	Temporal pole: superior temporal gyrus R	42	4	-15	3.56	3.23

IFS: INECO Frontal Screening battery; L: left; MiniSEA: Mini Social Cognition and Emotional Assessment; MoCA: Montreal Cognitive Assessment; R: right.
$p < 0.001$, uncorrected; extent threshold = 30 voxels.

Supplementary Table 8. Brain regions related to discriminant scores in Alzheimer's disease patients and controls.

Cluster size	Regions	Coordinates			Peak T	Peak Z
		x	y	z		
MoCA						
1517	Temporal pole: superior temporal gyrus L	-18	3	-33	4.57	4.20
129	Postcentral gyrus R	32	-32	40	3.97	3.72
78	Caudate nucleus R	10	2	4	3.76	3.54
96	Cerebellum L	-33	-81	-24	3.69	3.48
69	Precentral gyrus L	-54	4	18	3.58	3.39
186	Fusiform gyrus R	44	-46	-22	3.57	3.38
139	Fusiform gyrus R	18	0	-39	3.51	3.33
89	Thalamus R	4	-24	0	3.41	3.24
	Thalamus L	-3	-16	-6	3.31	3.15
MoCA, IFS and MiniSEA						
1703	Temporal pole: superior temporal gyrus L	-18	3	-33	4.56	4.19
	Fusiform gyrus L	-18	-4	-38	4.53	4.17
	Parahippocampal gyrus L	-18	-10	-32	4.22	3.92
176	Postcentral gyrus R	32	-32	40	4.22	3.92
104	Inferior frontal gyrus, opercular part L	-56	6	18	3.88	3.64
109	Cerebellum R	2	-78	-18	3.82	3.59
95	Lenticular nucleus, pallidum R	10	2	4	3.79	3.57
157	Cerebellum L	-33	-82	-26	3.78	3.56
	Cerebellum L	-34	-70	-24	3.30	3.14
262	Fusiform gyrus R	40	-50	-22	3.56	3.37
55	Inferior temporal gyrus R	44	-52	-8	3.56	3.37
273	Thalamus R	4	-24	2	3.51	3.32
	Thalamus L	-2	-21	-3	3.39	3.22
	Thalamus L	-3	-18	9	3.31	3.15
84	Fusiform gyrus R	18	0	-39	3.43	3.26
65	Parahippocampal gyrus R	15	-12	-26	3.37	3.21
	Parahippocampal gyrus R	14	-4	-22	3.27	3.12
MoCA and MiniSEA						
1790	Temporal pole: superior temporal gyrus L	-18	3	-33	4.61	4.24
	Fusiform gyrus L	-18	-4	-38	4.60	4.22
	Parahippocampal gyrus L	-18	-10	-32	4.26	3.95
183	Postcentral gyrus R	32	-32	40	4.22	3.92
116	Inferior frontal gyrus. opercular part L	-56	6	18	3.92	3.67

106	Caudate nucleus R	10	2	4	3.81	3.58
105	Cerebellum R	2	-78	-18	3.80	3.57
150	Cerebellum L	-33	-82	-26	3.78	3.56
52	Inferior temporal gyrus R	44	-52	-8	3.55	3.36
361	Thalamus R	4	-24	2	3.55	3.36
	Thalamus L	-2	-21	-3	3.43	3.26
	Thalamus L	-3	-18	9	3.37	3.20
237	Fusiform gyrus R	42	-48	-22	3.54	3.35
75	Fusiform gyrus R	18	0	-39	3.42	3.25
87	Parahippocampal gyrus R	15	-12	-26	3.39	3.22
	Parahippocampal gyrus R	14	-4	-22	3.30	3.15

IFS: INECO Frontal Screening battery; L: left; MiniSEA: Mini Social Cognition and Emotional Assessment; MoCA: Montreal Cognitive Assessment; R: right.
$p < 0.001$, uncorrected; extent threshold = 30 voxels.

Supplementary Table 9. Brain regions related to discriminant scores in Parkinson's disease patients and controls.

Cluster size	Regions	Coordinates			Peak T	Peak Z
		x	y	z		
	MiniSEA					
852	Precuneus L	-2	-72	50	4.81	4.50
	Precuneus L	-3	-72	40	4.56	4.29
593	Inferior parietal R	28	-54	54	4.24	4.02
223	Inferior parietal L	-32	-38	36	4.12	3.91
198	Inferior occipital gyrus R	36	-87	-9	4.07	3.87
151	Fusiform gyrus R	38	-42	-15	3.90	3.72
95	Superior temporal gyrus L	-40	-45	20	3.74	3.58
125	Middle frontal gyrus L	-20	32	22	3.52	3.39
132	Fusiform gyrus R	42	-15	-28	3.35	3.23
	Fusiform gyrus R	38	-27	-22	3.34	3.23

L: left; MiniSEA: Mini Social Cognition and Emotional Assessment; R: right.
$p < 0.001$, uncorrected; extent threshold = 30 voxels.

Supplementary Table 10. Associations between functional connectivity and discriminant scores in Alzheimer's disease patients and controls.

Brain regions	Spearman's rho	*p*-value
MOCA and MiniSEA		
Superior frontal gyrus L - Angular gyrus L	-0.45	0.000445
Superior frontal gyrus R - Inferior parietal lobule R	-0.464	0.000281
Middle frontal gyrus L - Inferior parietal lobule L	-0.433	0.000762
Middle frontal gyrus R - Inferior parietal lobule L	-0.43	0.000845
Middle frontal gyrus R - Inferior parietal lobule R	-0.526	2.6E-05
Middle frontal gyrus R – Supramarginal gyrus L	-0.44	0.000625
Middle frontal gyrus R - Supramarginal gyrus R	-0.493	9.65E-05
Middle frontal gyrus, orbital R - Inferior parietal lobule R	-0.474	0.000195
Inferior frontal gyrus, triangular L - Superior parietal lobule L	-0.455	0.000376
Inferior frontal gyrus, triangular L - Inferior parietal lobule L	-0.477	0.000173
Inferior frontal gyrus, triangular R - Superior parietal lobule L	-0.514	4.38E-05
Inferior frontal gyrus, triangular R - Superior parietal lobule R	-0.489	0.000113
Inferior frontal gyrus, triangular R - Inferior parietal lobule R	-0.485	0.000131
Inferior frontal gyrus, triangular R - Temporal Mid R	-0.443	0.000557
Inferior frontal gyrus, orbital L - Inferior parietal lobule L	-0.485	0.000132
Inferior frontal gyrus, orbital R - Superior parietal lobule R	-0.428	0.000885
Frontal, medial orbital R - Precuneus L	-0.48	0.00016
Cingulum anterior R - Cingulum mid L	-0.426	0.000951
Cingulum anterior R - Cingulum mid R	-0.436	0.000709
Postcentral gyrus L - Putamen R	-0.425	0.000994
Postcentral gyrus R - Putamen R	-0.425	0.000979
Superior parietal lobule L - Putamen R	-0.472	0.000208
Superior parietal lobule L - Pallidum R	-0.446	0.000499
Superior parietal lobule R - Putamen R	-0.498	7.98E-05
Inferior parietal lobule L - Putamen L	-0.459	0.000332
Inferior parietal lobule L - Pallidum L	-0.499	7.75E-05
Inferior parietal lobule L - Pallidum R	-0.518	3.69E-05
Inferior parietal lobule R - Putamen L	-0.557	6.88E-06
Inferior parietal lobule R - Putamen R	-0.573	3.18E-06
Inferior parietal lobule R - Pallidum L	-0.581	2.18E-06
Inferior parietal lobule R - Pallidum R	-0.63	1.54E-07
SupraMarginal R - Putamen L	-0.467	0.000252
SupraMarginal R - Putamen R	-0.504	6.51E-05
SupraMarginal R - Pallidum L	-0.542	1.35E-05
SupraMarginal R - Pallidum R	-0.511	4.86E-05
MOCA, IFS and MiniSEA		
Superior frontal gyrus L - Angular L	-0.456	0.000368
Superior frontal gyrus R - Inferior parietal lobule R	-0.46	0.000317

Middle frontal gyrus L - Inferior parietal lobule L	-0.436	0.000698
Middle frontal gyrus R - Inferior parietal lobule L	-0.432	0.000783
Middle frontal gyrus R - Inferior parietal lobule R	-0.526	2.59E-05
Middle frontal gyrus R - Supramarginal gyrus L	-0.443	0.000566
Middle frontal gyrus R - Supramarginal gyrus R	-0.492	0.0001
Middle frontal gyrus, orbital R - Inferior parietal lobule R	-0.479	0.000166
Inferior frontal gyrus, triangular L - Superior parietal lobule L	-0.452	0.000421
Inferior frontal gyrus, triangular L - Inferior parietal lobule L	-0.473	0.000204
Inferior frontal gyrus, triangular R - Superior parietal lobule L	-0.519	3.6E-05
Inferior frontal gyrus, triangular R - Superior parietal lobule R	-0.49	0.000109
Inferior frontal gyrus, triangular R - Inferior parietal lobule R	-0.481	0.00015
Inferior frontal gyrus, triangular R - Temporal Mid R	-0.441	0.000589
Inferior frontal gyrus, orbital L - Inferior parietal lobule L	-0.483	0.000141
Inferior frontal gyrus, orbital R - Superior parietal lobule R	-0.432	0.000797
Supplementary motor area L - Vermis	0.476	0.000184
Frontal, medial orbital R - Precuneus L	-0.477	0.000173
Cingulum anterior R - Cingulum mid R	-0.427	0.000937
Cingulum anterior R - Supramarginal gyrus L	-0.426	0.000947
Postcentral gyrus L - Putamen R	-0.427	0.000919
Superior parietal lobule L - Putamen R	-0.476	0.000183
Superior parietal lobule L - Pallidum R	-0.445	0.000524
Superior parietal lobule R - Putamen R	-0.503	6.67E-05
Inferior parietal lobule L - Putamen L	-0.457	0.000351
Inferior parietal lobule L - Pallidum L	-0.497	8.52E-05
Inferior parietal lobule L - Pallidum R	-0.515	4.13E-05
Inferior parietal lobule R - Putamen L	-0.559	6.07E-06
Inferior parietal lobule R - Putamen R	-0.573	3.15E-06
Inferior parietal lobule R - Pallidum L	-0.581	2.14E-06
Inferior parietal lobule R - Pallidum R	-0.626	1.88E-07
Supramarginal gyrus R - Putamen L	-0.473	0.000204
Supramarginal gyrus R - Putamen R	-0.511	4.95E-05
Supramarginal gyrus R - Pallidum L	-0.546	1.13E-05
Supramarginal gyrus R - Pallidum R	-0.514	4.31E-05

IFS: INECO Frontal Screening battery; L: left; MiniSEA: Mini Social Cognition and Emotional Assessment; MoCA: Montreal Cognitive Assessment; R: right.
$p < 0.001$, uncorrected.

Supplementary Table 11. Associations between functional connectivity and discriminant scores in Parkinson's disease patients and controls.

Brain regions	Spearman's rho	*p*-value
MiniSEA and IFS		
Precentral gyrus L - Middle frontal gyrus R	-0,371	0,000697
Superior frontal gyrus L - Superior parietal lobule R	-0,398	0,00026
Superior frontal gyrus R - Superior parietal lobule R	-0,364	0,000892
Superior frontal gyrus, orbital R - Inferior frontal gyrus, orbital R	-0,409	0,000166
Middle frontal gyrus L - Superior parietal lobule R	-0,426	8,16E-05
Middle frontal gyrus R - Superior parietal lobule R	-0,39	0,000343
Inferior frontal gyrus, orbital L - Rectus gyrus L	-0,378	0,000547
Supplementary motor area L - Paracentral lobule L	-0,37	0,000717
Supplementary motor area L - Cerebelum R	-0,367	0,000815
Olfactory cortex R - Thalamus L	-0,399	0,000248
Olfactory cortex R - Thalamus R	-0,362	0,000981
Paracentral lobule L - Cerebelum L	-0,371	0,000705
Paracentral lobule L - Cerebelum R	-0,394	0,000296
Paracentral lobule L - Cerebelum R	-0,405	0,000193
Paracentral lobule L - Vermis	-0,386	0,000405

IFS: INECO Frontal Screening battery; L: left; MiniSEA: Mini Social Cognition and Emotional Assessment; R: right. $p < 0.001$, uncorrected.

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