**Appendix 1. Supplementary Methods**

**Participants**

 Participants were diagnosed in multidisciplinary clinical consensus conferences based upon the results of a comprehensive neurological evaluation, a 60-minute standard neuropsychological assessment, and a functional interview with an informant. Participants were excluded if they presented with a major psychiatric illness, another neurological condition affecting cognition, a history of substance abuse, or a major medical illness. A Clinical Dementia Rating score > 0 and a Geriatric Depression Scale >15 were exclusionary for controls.

**Neuroimaging Data Acquisition and Image Processing**

 Whole brain T1 images were acquired using Magnetization-prepared rapid gradient echo (MPRAGE) in the axial plane: TR=2300ms; TE=3.43ms; TI=900 ms; flip angle=9; slice thickness=1 mm; FOV=256\*224 mm; voxel size=1 mm\*1mm; matrix size=256\*224; and number of slices=176. Diffusion Weighted Images (DTI) were acquired using single-short spin-echo sequence with the following parameters: TR=5300 ms; TE=88 ms; TI=2500 ms; flip angle=90; FOV=256\*256 mm; two diffusion values of b=0 and 1000 s/mm; 12 diffusion directions; four repeats; 40 slices; matrix size=128\*128; voxel size=2 mm\*2 mm; slice thickness=3 mm; and GRAPPA=2.

For DTI images, we used FSL software to co-register the diffusion direction images with the b = 0 image, then applied a gradient direction eddy current and distortion correction. Diffusion tensors were calculated using a non-linear least-squares algorithm from Diffusion Imaging in Python (Dipy; Garyfalidis et al., 2014). After quality control, participants' tensors (four dimensional images) were registered linearly and non-linearly into a common space using DTI-TK (Zhang, Yshkevich, Alexander, & Gee, 2006). Tensors were moved into the group template. Once in the group space, diffusion tensor images were diagonalized to extract the diffusion metrics like FA using Dipy (Garyfalidis et al., 2014).

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**Supplementary Figure 1.** Scatter plot of Favorites memory performance and FA of the column and body of the fornix by diagnostic group.

**Note.** MCI= mild cognitive impairment; AD= Alzheimer’s disease; FTD= behavioral variant frontotemporal dementia; PPA= primary progressive aphasia; PSP= progressive supranuclear palsy syndrome

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**Supplementary Figure 2.** Scatter plot of Favorites memory performance and FA of the superior cerebellar peduncle by diagnostic group.

**Note.** MCI= mild cognitive impairment; AD= Alzheimer’s disease; FTD= behavioral variant frontotemporal dementia; PPA= primary progressive aphasia; PSP= progressive supranuclear palsy syndrome



**Supplementary Figure 3.** Scatter plot of Match executive function and speed performance and FA of the superior cerebellar peduncle by diagnostic group.

**Note.** MCI= mild cognitive impairment; AD= Alzheimer’s disease; FTD= behavioral variant frontotemporal dementia; PPA= primary progressive aphasia; PSP= progressive supranuclear palsy syndrome

**Supplementary Table 1.** Correlations of Memory and Executive Function/Speed Performance with white matter tracts.

|  |  |  |
| --- | --- | --- |
|  | Memory: Favorites | Executive/Speed: Match |
| *Frontal tracts* |  |  |
| Superior longitudinal fasciculus  | 0.40\* | 0.42\* |
| Cingulate gyrus | 0.30 | 0.40\* |
| Anterior corona radiata | 0.29 | 0.30 |
| Posterior corona radiata | 0.10 | 0.14 |
| Superior corona radiata  | 0.13 | 0.18 |
|  |  |  |
| *Callosal tracts* |  |  |
| Genu of corpus callosum | 0.33 | 0.46\* |
| Body of corpus callosum | 0.38\* | 0.54\* |
| Splenium of corpus callosum | 0.32 | 0.43\* |
| Tapetum | 0.14 | 0.11 |
|  |  |  |
| *Temporal tracts* |  |  |
| Column and body of fornix | 0.44\* | 0.33\* |
| Fornix stria terminalis | 0.46\* | 0.34\* |
| Cingulum hippocampus  | 0.34 | 0.28 |
| Uncinate fasciculus | 0.34 | 0.36\* |
|  |  |  |
| *Posterior tracts* |  |  |
| Sagittal stratum | 0.34 | 0.35\* |
| Superior fronto-occipital fasciculus | 0.14 | 0.23 |
|  |  |  |
| *Subcortical tracts* |  |  |
| Anterior limb of internal capsule  | 0.18 | 0.27\* |
| Posterior limb of internal capsule | 0.19 | 0.23 |
| Retrolenticular part of internal capsule | 0.25 | 0.23 |
| External capsule | 0.32 | 0.40\* |
| Posterior thalamic radiation | 0.20 | 0.32 |
| Pontine crossing tract | 0.24 | 0.08 |
| Cerebral peduncle | 0.33 | 0.29 |
| Superior cerebellar peduncle  | 0.40\* | 0.32 |
| Inferior cerebellar peduncle | 0.22 | 0.16 |
| Middle cerebellar peduncle | 0.28 | 0.14 |

 **Note.** All correlations control for age and sex.

\*Significant after multiple comparisons correction (*p* < 0.0024 for Favorites, *p* < 0.0033 for Match).

**Supplementary Table 2.** Correlations of visuospatial performance with white matter tracts.

|  |  |
| --- | --- |
|  | Visuospatial: Line Orientation |
| *Frontal tracts* |  |
| Superior longitudinal fasciculus (L) | -0.11 |
| Superior longitudinal fasciculus (R) | -0.15 |
| Cingulate gyrus (L) | -0.19 |
| Cingulate gyrus (R) | -0.09 |
| Anterior corona radiata (L) | -0.20 |
| Anterior corona radiata (R) | -0.23 |
| Posterior corona radiata (L) |  0.02 |
| Posterior corona radiata (R) |  0.02 |
| Superior corona radiata (L) | -0.01 |
| Superior corona radiata (R) |  0.07 |
|  |  |
| *Callosal tracts* |  |
| Genu of corpus callosum | -0.24 |
| Body of corpus callosum | -0.26 |
| Splenium of corpus callosum | -0.16 |
| Tapetum (L) | -0.04 |
| Tapetum (R) |  0.08 |
|  |  |  |
| *Temporal tracts* |  |
| Column and body of fornix | -0.04 |
| Fornix stria terminalis (L) | -0.20 |
| Fornix stria terminalis (R) | -0.18 |
| Cingulum hippocampus (L)  | -0.09 |
| Cingulum hippocampus (R) | -0.09 |
| Uncinate fasciculus (L) | -0.18 |
| Uncinate fasciculus (R) | -0.13 |
|  |  |
| *Posterior tracts* |  |
| Sagittal stratum (L) | -0.19 |
| Sagittal stratum (R) | -0.17 |
| Superior fronto-occipital fasciculus (L) | -0.03 |
| Superior fronto-occipital fasciculus (R) | -0.11 |
|  |  |
| *Subcortical tracts* |  |
| Anterior limb of internal capsule (L) | -0.16 |
| Anterior limb of internal capsule (R) | -0.15 |
| Posterior limb of internal capsule (L) | -0.03 |
| Posterior limb of internal capsule (R) |  0.01 |
| Retrolenticular part of internal capsule (L) |  0.03 |
| Retrolenticular part of internal capsule (R) |  0.15 |
| External capsule (L) | -0.23 |
| External capsule (R) | -0.19 |
| Posterior thalamic radiation (L) | -0.23 |
| Posterior thalamic radiation (R) | -0.14 |
| Pontine crossing tract |  0.06 |
| Cerebral peduncle (L) | -0.11 |
| Cerebral peduncle (R) | -0.03 |
| Superior cerebellar peduncle (L) |  0.03 |
| Superior cerebellar peduncle (R) |  0.01 |
| Inferior cerebellar peduncle (L) | -0.06 |
| Inferior cerebellar peduncle (R) | -0.06 |
| Middle cerebellar peduncle |  0.00 |

**Note.** All correlations control for age and sex.

\*Significant after multiple comparisons correction (*p* < 0.00114 for Line Orientation).

**Supplementary Table 3.** Summary of backward elimination regression models for regions predicting memory performance.

|  |  |  |  |
| --- | --- | --- | --- |
| Model/Order of region removed | B | 95% CI for B | *p* value |
| 1. Body of corpus callosum  | 0.51 | (-78.12, 79.14) | 0.99 |
| 2. Sagittal stratum | -12.30 | (-72.42, 47.82) | 0.68 |
| 3. Cingulum hippocampus | 15.07 | (-41.58, 71.71) | 0.60 |
| 4. External capsule | -19.74 | (-98.55, 59.06) | 0.62 |
| 5. Uncinate fasciculus | 15.86 | (-33.03, 64.75) | 0.52 |
| 6. Cingulate gyrus | -11.79 | (-61.21, 37.63) | 0.64 |
| 7. Cerebral peduncle | 12.68 | (-28.67, 54.02) | 0.54 |
| 8. Genu of corpus callosum | 14.99 | (-29.92, 59.90) | 0.51 |
| 9. Superior longitudinal fasciculus | 38.54 | (-15.13, 92.21) | 0.16 |
| 10. Splenium of corpus callosum | -34.16 | (-84.81, 16.50) | 0.18 |
| 11. Fornix stria terminalis | 40.67 | (-6.22, 87.56) | 0.09 |
| **12. Superior cerebellar peduncle** | **41.76** | **(12.02, 71.49)**  | **0.007\*** |
|  **Column and body of fornix** | **30.78** | **(12.44, 49.12)** | **0.001\*** |
| Age | 0.20 | (0.07, 0.34) | 0.004\* |
| Gender | 0.46 | (-1.97, 2.89) | 0.71 |

**Note**. \*p<.05

**Supplementary Table 4.** Summary of backward elimination for regions predicting executive and speed performance

**Note**. \*p<.05

|  |  |  |  |
| --- | --- | --- | --- |
| Model/Order of region removed | B | 95% CI for B | *p* value |
| 1. Cingulate gyrus | -1.47 | (-106.48, 103.55) | 0.98 |
| 2. Sagittal stratum | -4.51 | (-109.76, 100.75) | 0.93 |
| 3. Fornix stria terminalis | 5.88 | (-94.09, 105.85) | 0.91 |
| 4. Uncinate fasciculus | -11.88 | (-98.52, 74.75) | 0.79 |
| 5. External capsule | 39.65 | (-104.97, 184.28) | 0.59 |
| 6. Splenium of corpus callosum | -31.33 | (-155.04, 92.39) | 0.62 |
| 7. Column and body of fornix | 9.31 | (-29.46, 48.08) | 0.63 |
| 8. Superior cerebellar peduncle | 17.33 | (-41.24, 75.89) | 0.56 |
| 9. Cingulum hippocampus | -37.61 | (-122.37, 47.15) | 0.38 |
| 10. Genu of corpus callosum | 56.57 | (-45.51, 158.65) | 0.27 |
| 11. Superior longitudinal fasciculus | 72.41 | (-29.41, 174.23) | 0.16 |
| 12. Anterior corona radiata | -81.93 | (-181.93, 18.07) | .11 |
| **13. Body of corpus callosum** | **143.50** | **(91.95, 195.04)** | **<0.001\*** |
| Age | -0.09 | (-0.32, 0.15) | 0.45 |
| Gender | 0.98 | (-3.36, 5.31) | 0.66 |