

Further information on Patient 1's case history and neuropsychological testing

Patient 1, a right-handed male in his mid-fifties with 11 years of education, was admitted to hospital in early 2015 following a one-week history of persistent coughing, dyspnoea and fever. Due to the emergence of sepsis and Acute Respiratory Distress Syndrome (ARDS), he was intubated and mechanically ventilated for two weeks. Upon regaining consciousness, Patient 1 complained of visual difficulties and problems with navigation which were initially attributed to side effects of the pharmacological treatment. Upon returning home, Patient 1 had difficulties navigating his home environment and confused cardinal directions. A clinical brain CT scan performed 7 weeks after the onset of the visual deficits revealed a bilateral occipital stroke congruous with a left hemianopia and right lower quadrantanopsia revealed by campimetry. Patient 1 had no previous significant medical or neuropsychiatric history except for an appendectomy at the age of 14 years. Based on these clinical symptoms and imaging findings, Patient 1 was identified as a patient of interest for this study in which he consented to participate. Patient 1 was deemed right-handed based on a score of +100 on the Edinburgh Handedness Inventory (Oldfield, 1971). Standard tests that were performed to assess Patient 1's general cognitive abilities are listed in the Table S1 of the supplementary material.

To test Patient 1's ability to navigate new environments in the chronic stage, he was accompanied by one of the authors (M.C.) to a town that he had not previously visited. Patient 1 was guided through the new walking route which covered a distance of about 1 Km. After completing the new route, Patient 1 was asked to identify photos of the landmarks he had just seen along the way. Other similar landmarks from a different town were included in this test to ensure that he had correctly learned the new landmarks and would not simply respond to any similar looking. For instance, one of the learned landmarks was a clock tower, so the series of presented photos included other similar clock towers and Patient 1 had to choose the one he had encountered on the new route. His performance on this landmark recognition task was 100% correct.

Patient 1 was also asked to point in the direction of multiple landmarks from several imagined positions along the route. This was in the form of: "Imagine that you are standing in front of the municipality building, with the building behind you. Point in the direction of the clock tower." Afterwards, he would be asked to mark these directions on a circle for multiple landmarks at once (akin to knowing cardinal directions and the relationships between landmarks). Error in direction estimate was calculated as deviation from the correct direction and was 14 ± 9.9 degrees. Patient 1 was able to correctly draw a map of the new route and

mark the locations and names of the relevant landmarks on it. Finally, he successfully navigated between different landmarks along the route without guidance.

Table S1. General cognitive assessment of Patient 1

GENERAL COGNITIVE FUNCTION				
	<i>Raw score</i>	<i>Corrected score</i>	<i>Cut-off</i>	<i>Range</i>
MMSE (Measso et al., 1993)	28/30	27.97	23.8	Normal
Addenbrooke's Cognitive Examination (ACE-R) (Siciliano et al., 2016)				
Attention and orientation	18/18	18.1		
Memory	21/26	21.99		
Verbal fluency	8/14	8.6		
Language	26/26	26.43		
Visuospatial	15/16	15.36		
Total score	88/100	90.5		Normal
REASONING				
	<i>Raw score</i>	<i>Corrected score</i>	<i>Cut-off</i>	<i>Range</i>
Coloured Progressive Matrices (Basso et al., 1987; Raven, 1965)	26/36	28.5	18	Normal
MEMORY				
	<i>Raw score</i>	<i>Corrected score</i>	<i>Cut-off</i>	<i>Range</i>
Verbal span (Spinnler and Tognoni, 1987)	4/10	3.75	3	Normal
Digit span (Orsini et al., 1987)	6/9	6	3.75	Normal
Spatial span (Spinnler and Tognoni, 1987)	6/10	5.75	3.75	Normal
Brooks matrix (Brooks, 1967; Poirier et al., 2019)	80.60%		77%	Normal
Rey Auditory Verbal Learning Test (Carlesimo et al., 1996)				
Immediate recall	46/75	46.7	28.53	Normal
Delayed recall	9/15	9.2	4.69	Normal
PLANNING, CONSTRUCTIONAL AND VISUOSPATIAL ABILITIES				
	<i>Raw score</i>	<i>Corrected score</i>	<i>Cut-off</i>	<i>Range</i>
Clock Drawing Test (Mondini et al., 2003)	9.5/10		5	Normal
Rey-Osterrieth Complex Figure (Caffarra et al., 2002)				
Direct copy	35/36	35.5		Normal
Delayed recall	21.5/36	20.75		Normal

ATTENTION				
	<i>Raw score</i>	<i>Corrected score</i>	<i>Cut-off</i>	<i>Range</i>
Test of Attentional Performance - Auditory Alertness Subtest (Zimmermann and Fimm, 2002)				
Tonic (median)	244			PR.31
Phasic (median)	234			PR.34
Attentional Matrices (Della Sala et al., 1992)				
Matrix a	10/10			
Matrix b	17/20			
Matrix c	11/30			
Total score	38/60	33.5	30	Normal limit
Trail Making Test (Giovagnoli et al., 1996)				
Score A	70	57		Normal
Score B	113	55		Normal
Score B-A	43	9		Normal
EXECUTIVE FUNCTION				
	<i>Raw score</i>	<i>Corrected score</i>	<i>Cut-off</i>	<i>Range</i>
Frontal Assessment Battery (FAB) (Appollonio et al., 2005)				
Similarities (Conceptualization)	3/3			
Lexical Fluency (Mental Flexibility)	2/3			
Motor Series (Programming)	3/3			
Conflicting Instructions (Sensitivity to Interference)	3/3			
Go-No Go (Inhibitory Control)	3/3			
Prehension Behavior (Environmental Autonomy)	3/3			
Total score	17/18	17.1	12.03	Normal
Verbal judgment (Spinnler and Tognoni, 1987)	50/60	48	32	Normal
Cognitive Estimation Test (Nichelli et al., 2002)				
Time	25/30		20	Normal
Weight	28/30		20	Normal
Total score	53/60		40	Normal

Figure S1. T1-weighted MRI sections showing Patient 1's lesion extent.

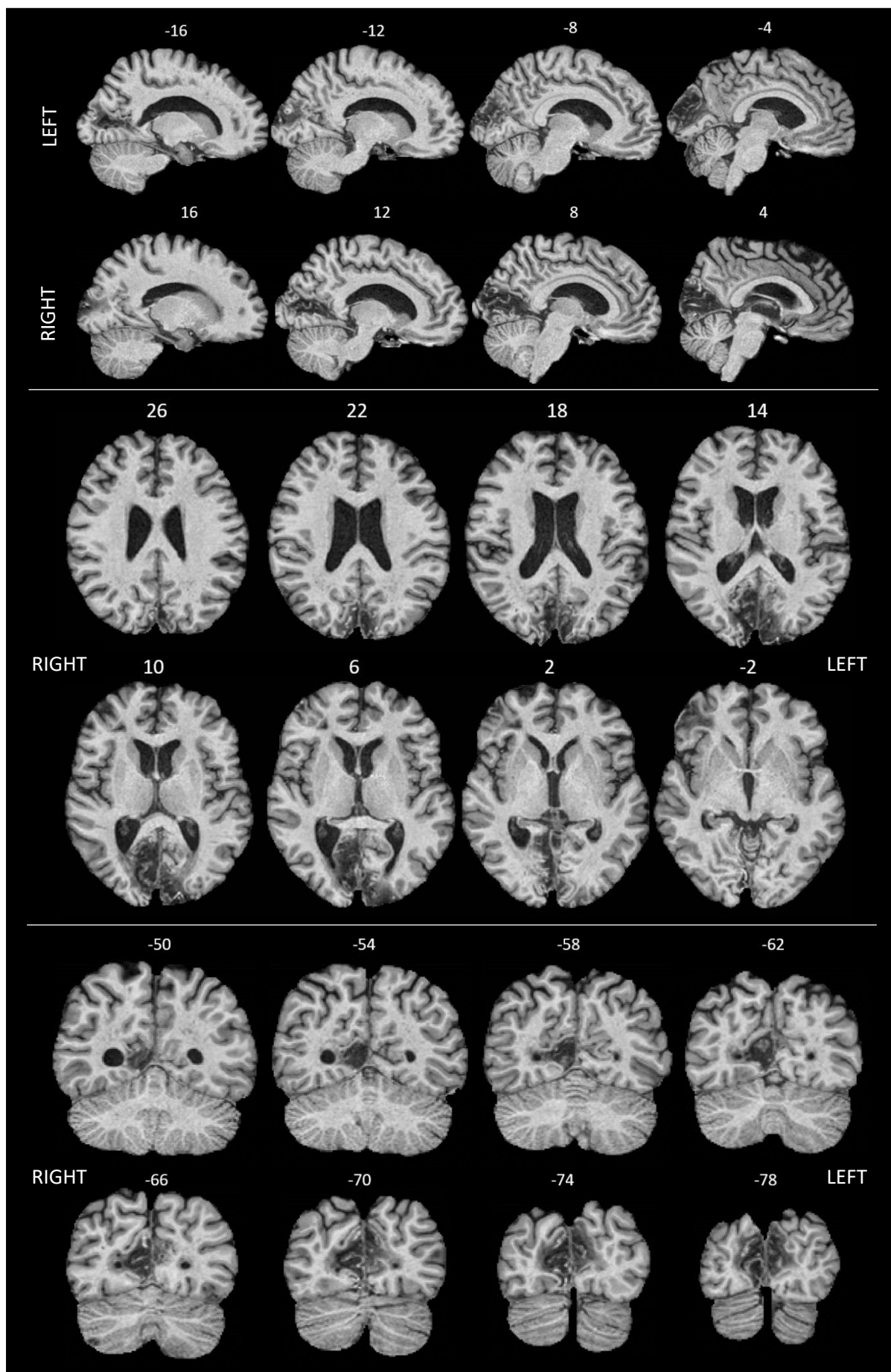


Table S2. Descriptive statistics of the medial occipital longitudinal tract (MOLT).

	Streamline count	Tract volume (mL)	Connected area (mm ²)	HMOA
MOLT Dorsal Left	126.84 ± 111.24	3.33 ± 1.76	1360.19 ± 544.86	0.0147 ± 0.0026
MOLT Ventral Left	265.28 ± 117.33	7.45 ± 2.20	2817.19 ± 546.70	0.0101 ± 0.0010
MOLT Dorsal Right	169.84 ± 125.70	3.74 ± 1.65	1681.94 ± 560.25	0.0149 ± 0.0024
MOLT Ventral Right	368.38 ± 176.45	9.24 ± 2.43	3048.01 ± 522.36	0.0106 ± 0.0011

Table S3. Statistical comparison of the left and right hemisphere MOLT components.*

	Mean	95% CI	<i>t</i>	df	<i>p</i>
MOLT Dorsal Count	0.15	0.05, 0.24	4.28	198	< .001
MOLT Dorsal Volume	0.07	0.01, 0.14	3.15	198	.002
MOLT Dorsal Area	0.11	0.06, 0.17	6.20	198	< .001
MOLT Ventral Count	0.15	0.10, 0.20	8.89	199	< .001
MOLT Ventral Volume	0.11	0.08, 0.14	10.98	199	< .001
MOLT Ventral Area	0.04	0.02, 0.06	6.68	199	< .001

* Positive values indicate a right hemisphere bias.

Table S4. Statistical comparison of the dorsal (cuneus) and ventral (lingual) MOLT components.*

	Mean	95% CI	<i>t</i>	df	<i>p</i>
MOLT Left Count	-0.41	-0.48, -0.34	-16.44	198	< .001
MOLT Left Volume	-0.41	-0.45, -0.36	-26.66	198	< .001
MOLT Left Area	-0.37	-0.40, -0.33	-29.70	198	< .001
MOLT Right Count	-0.38	-0.45, -0.31	-15.70	199	< .001
MOLT Right Volume	-0.43	-0.47, -0.39	-32.12	199	< .001
MOLT Right Area	-0.30	-0.33, -0.27	-28.24	199	< .001

* Negative values indicate a ventral bias.

References

- Appollonio, I., Leone, M., Isella, V., Piamarta, F., Consoli, T., Villa, M.L., Forapani, E., Russo, A., and Nichelli, P. (2005). The Frontal Assessment Battery (FAB): Normative values in an Italian population sample. *Neurol. Sci.* 26, 108–116.
- Basso, A., Capitani, E., and Laiacona, M. (1987). Raven's coloured progressive matrices: Normative values on 305 adult normal controls. *Funct. Neurol.* 2, 189–194.
- Brooks, L.R. (1967). The suppression of visualization by reading. *Q. J. Exp. Psychol.* 19, 289–299.
- Caffarra, P., Vezzadini, G., Dieci, F., Zonato, F., and Venneri, A. (2002). Rey-Osterrieth complex figure: Normative values in an Italian population sample. *Neurol. Sci.* 22, 443–447.
- Carlesimo, G.A., Caltagirone, C., Gainotti, G., Fadda, L., Gallassi, R., Lorusso, S., Marfia, G., Marra, C., Nocentini, U., and Parnetti, L. (1996). The Mental Deterioration Battery: Normative data, diagnostic reliability and qualitative analyses of cognitive impairment. *Eur. Neurol.* 36, 378–384.
- Giovagnoli, A.R., Del Pesce, M., Mascheroni, S., Simoncelli, M., Laiacona, M., and Capitani, E. (1996). Trail Making Test: Normative values from 287 normal adult controls. *Ital. J. Neurol. Sci.* 17, 305–309.
- Measso, G., Cavarzeran, F., Zappalà, G., Lebowitz, B.D., Crook, T.H., Pirozzolo, F.J., Amaducci, L.A., Massari, D., and Grigoletto, F. (1993). The mini-mental state examination: Normative study of an Italian random sample. *Dev. Neuropsychol.* 9, 77–85.
- Mondini, S., Mapelli, D., Vestri, A., and Bisiacchi, P.S. (2003). *Esame Neuropsicologico Breve* (Milan: Raffaello Cortina Editore).
- Nichelli, P., Leone, M., Caronna, A., Imbornone, E., Alberoni, M., Zuffi, M., and Venneri, A. (2002). Taratura di un test di stime cognitive di impiego diagnostico in clinica: Stime dei tempi e dei pesi (STEP). *Nuova Riv. Di Neurol.* 12, 37–42.
- Oldfield, R.C. (1971). The assessment and analysis of handedness: The Edinburgh Inventory. *Neuropsychologia* 9, 97–113.
- Orsini, A., Grossi, D., Capitani, E., Laiacona, M., Papagno, C., and Vallar, G. (1987). Verbal and spatial immediate memory span: Normative data from 1355 adults and 1112 children. *Ital. J. Neurol. Sci.* 8, 537–548.
- Poirier, M., Yearsley, J.M., Saint-Aubin, J., Fortin, C., Gallant, G., and Guitard, D. (2019). Dissociating visuo-spatial and verbal working memory: It's all in the features. *Mem. Cogn.* 47, 603–618.
- Raven, J.C. (1965). *Advanced Progressive Matrices: Sets I and II: Plan and use of the scale with a report of experimental work carried out by G. A. Foulds and A. R. Forbes* (London: H. K. Lewis).
- Della Sala, S., Laiacona, M., Spinnler, H., and Ubezio, C. (1992). A cancellation test: Its reliability in assessing attentional deficits in Alzheimer's disease. *Psychol. Med.* 22, 885–901.
- Siciliano, M., Raimo, S., Tufano, D., Basile, G., Grossi, D., Santangelo, F., Trojano, L., and Santangelo, G. (2016). The Addenbrooke's Cognitive Examination Revised (ACE-R) and its sub-scores: Normative values in an Italian population sample. *Neurol. Sci.* 37, 385–392.
- Spinnler, H., and Tognoni, G. (1987). Standardizzazione e taratura italiana di test neuropsicologici. *Ital. J. Neurol. Sci.* 8, 1–120.
- Zimmermann, P., and Fimm, B. (2002). A test battery for attentional performance. In *Applied Neuropsychology of Attention*, (Psychology Press), pp. 124–165.