Matteo Pardini,^{1,2} Varun Sethi,^{1,3} Nils Muhlert,^{1,4} Özgür Yaldizli,^{1,5} Fulvia Palesi,⁶ Daniel Altmann,^{1,7} Maria Ron,¹ Claudia Wheeler-Kingshott,¹ David Miller,¹ Declan Chard^{1,8}. ¹*UCL Institute of Neurology*; ²*University of Genoa, Genoa, IT*; ³*NINDS, NIH, Bethesda, Maryland, USA*; ⁴*Cardiff University, Cardiff, UK*; ⁵*University Hospital Basel, Basel, Switzerland*; ⁶*University of Pavia, Pavia, Italy*; ⁷*London School of Hygiene and Tropical Medicine, London, UK*; ⁸*National Institute for Health Research (NIHR) University College London Hospitals (UCLH) Biomedical*

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Background Cognitive functions can be conceptualized as emergent properties (EP), as they depend on the synchronization of neural activity. However, EP are not currently included in physio-pathological models of cognitive deficits.

Design/Methods Seventy-two relapse-onset multiple sclerosis (MS) subjects underwent structural and diffusion MRI and completed the paced auditory serial addition test (PASAT). Fibre tractography was used to create study-specific templates of the PASAT network. Network structural damage was assessed with Network Efficiency (NE)—the prototypical EP—computed based on diffusion data as well as with grey matter mean diffusivity and regional volume, white matter radial and axial diffusivity and T2 lesion load.

Results We found a significant direct correlation between NE and PASAT performance as well as between NE and our metrics of focal and diffuse grey and white matter damage. Multivariate statistics revealed that NE better accounted for PASAT performance than the other MRI metrics combined.

Conclusions We found that NE can be used to capture in a single measure the relationship between different facets of structural damage and cognitive performance. This suggests that emergent properties may be a key bridge between structural tissue damage and cognitive deficits.

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