Inter- and intra-individual variation in brain structural-cognition relationships in aging

Raihaan Patel1 | Clare Mackay2 | Michelle G Jansen3 | Gabriel A. Devenyi4 | M Clare O’Donoghue2 | Mika Kivimaki5 | Archana Singh-Manoux6 | Enikő Zsoldos2 | Klaus P Ebmeier2 | Mallar Chakravarty7 | Sana Suri1

1Department of Psychiatry, University of Oxford, Oxford, United Kingdom
2University of Oxford, Oxford, United Kingdom
3Radboud University, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands
4Cerebral Imaging Centre - Douglas Mental Health University Institute, Verdun, QC, Canada
5University College London, London, United Kingdom
6Université de Paris, Inserm U1153, Epidemiology of Ageing and Neurodegenerative Diseases, Paris, France
7McGill University, Montreal, QC, Canada

Abstract

Background: The sources of inter- and intra-individual variability in age-related cognitive decline remain poorly understood. We examined the association between 20-year trajectories of cognitive decline and multimodal brain structure and morphology in older age.

Method: We used the Whitehall II Study, an extensively characterised cohort with 3T brain magnetic resonance images acquired at older age (mean age = 69.52 ± 4.9) and 5 repeated cognitive performance assessments between mid-life (mean age = 53.2 ± 4.9 years) and late-life (mean age = 67.7 ± 4.9). Using non-negative matrix factorisation, we identified 10 brain components integrating cortical thickness, surface area, fractional anisotropy, and mean and radial diffusivities (Figure 1).

Result: We observed two latent variables describing distinct brain-cognition associations. The first describes variations in 5 structural components associated with low mid-life performance across multiple cognitive domains, decline in reasoning, but maintenance of fluency abilities. The second describes variations in 6 structural components associated with low mid-life performance in fluency and memory, but retention of multiple abilities (Figure 2). Expression of latent variables predicts future cognition 3.2 years later (mean age = 70.87 ± 4.9) (Figure 3).

Conclusion: Longitudinal cognitive decline and maintenance across diverse cognitive functions are both positively and negatively associated with distinct markers of cortical structure. Latent brain-behaviour relationships predict future cognitive performance.
