# Neural basis of cognitive reserve in ageing

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## ABSTRACT

Recent studies indicate that life-course experiences such as education and bilingualism can potentially enhance cognitive reserve and reduce risk of developing dementia. These life-course experiences have been found to enhance cognitive functions and are also associated with structural and functional changes in the brain. How all these changes are linked to cognitive function is still not clear and the topic is under considerable debate due to various confounding factors associated with the relationship.

In this study, we aimed to investigate the neural basis of cognitive reserve using education and bilingualism as proxy measures, in a cohort of elderly subjects with normal cognition aged > 50 years). All 50 subjects were participants of the *Tata Longitudinal Study of Cognitive Ageing* that aims to determine risk and protective factors for cognitive decline in the elderly in the Indian context. Subjects were classified as having *high cognitive reserve* (Literate and/or Bilingual) and *low cognitive reserve* (Illiterate and Monolingual), based on their education and language use. All the participants were evaluated with a comprehensive cognitive test battery, structured questionnaire for language use, education and other potentially confounding lifetime experiences.

Volumetric assessment of whole gray and white matter using T1-structural MR images and tractography using diffusion tensor imaged (DTI) were performed. Subjects with high cognitive reserve ($n$=40) and low cognitive reserve ($n$=10) were compared for differences in cognitive functions and MRI parameters after adjusting for relevant confounding factors. Differences in total and regional brain volumes (inT1-structual MRI) and functional anisotropy (FA) values in regional white matter (in DTI) were explored in the two groups. The specific effect of bilingualism was also explored in a subset of age and education matched monolingual and bilingual subjects.

Subjects with high cognitive reserve were found to outperform age matched group with low cognitive reserve on measures of executive function, memory and visuospatial functions as assessed by the test batteries. Grey matter volume differences between the two groups of high and low cognitive reserve cohorts were observed in the left and right thalamus. Tract-based spatial statistics (TBSS) analysis of whole brain revealed decreased FA values in the left and right anterior thalamic radiation in low cognitive reserve cohort compared to high

cognitive reserve group. The other areas showing decreased FA were the left superior and inferior longitudinal fasciculus. High gray matter volume was noted in right frontal pole in monolinguals, while in case of bilinguals, the posterior temporal and occipital lobe regions showed significantly high gray matter volumes. Monolingual population also showed decreased FA in bilateral anterior thalamic radiation and bilateral superior longitudinal fasciculus.

The results may point to disturbances in the input-side (thalamic relay) transmission of information as well as possible break-down or slow-down in inter-hemispheric integration of information in multiple domains in subjects with low cognitive reserve linked to low literacy and monolingualism.