Correlations between Cortical Gray Matter Thickness and Logical Memory

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Background:
At present there are 5.3 million individuals affected by Alzheimer’s disease (AD) in the US alone and the number grows as a new case is uncovered every 70 seconds.

Verbal memory decline is the earliest cognitive sign of Alzheimer’s disease. Wechsler’s Logical Memory I (LMI) and II (LMII) assess the immediate and delayed recall of contextual information, respectively. Brain imaging is a vital tool for the assessment of pathological changes in cortical thickness.

Objective:
To investigate associations between gray matter atrophy and logical memory impairment in cognitively normal elderly (NC) and mild cognitive impairment (MCI) subjects.

Methods:
Our study sample included 44 NC, and 24 MCI subjects from the UCLA ADRC database. Mean demographic information is presented in Table 1. We used ANOVA with post-hoc Bonferroni correction and Chi squared tests to examine for demographic and MMSE differences between diagnostic groups. LMI and LMII scores were age- and education-corrected.

We analyzed T1-weighted magnetic resonance imaging data (SPGR, TR 28 ms, TE 6 ms, FOV 22 cm, matrix 256x192, slice thickness 1.5 mm, no gap). After intensity normalization, the images were aligned to ICBM space. Following 3D hemispheric reconstruction, 38 sulci per hemisphere were traced and averaged across subjects. The cortical surfaces were parameterized, flattened and warped, allowing for explicit matching of cortical topography prior to averaging across subjects. Cortical thickness defined as the 3D distance from the gray/white matter to the gray matter/cerebrospinal fluid interface was computed at each hemispheric surface point and mapped onto the corresponding hemispheric model in exact spatial correspondence (see Figure 1). We used linear regression models to study the associations between LMI and LMII performance and cortical thickness while adjusting for age and education. The overall significance of the statistical maps was assessed using permutation methods with a threshold p<0.01.

Results:
Lower scores on LMI and II were associated with bilateral atrophy of the lateral and inferior temporal and precuneal cortex, and left-sided atrophy of the temporoparietal and orbitofrontal cortex. The map-wise corrected significance was p=0.026 on the right and p=0.009 on the left for LMI, and p=0.054 on the right and p=0.034 on the left for LMII. LMI showed both more widely distributed and stronger effects in all regions.

Conclusions:
As expected immediate and delayed verbal memory showed more significant associations in the left hemisphere. The temporal and precuneal regions play a role in episodic memory learning, immediate and delayed recall. Orbitofrontal atrophy leads to distractability and inability to inhibit interference from external stimuli, which in turn may result in poor LMI and LMII performance.