Nature Reviews Neurology **7**, 356 (2011); published online 14 June 2011; doi:10.1038/nrneurol.2011.96

NEURODEGENERATIVE DISEASE

Functional networks are altered in mild cognitive impairment

Functional networks in patients with mild cognitive impairment (MCI) are structurally random and less efficient than those in healthy individuals, according to the results of a study published in *PLoS One*. "We knew that the brain activity in certain regions was increased in patients with MCI," notes lead researcher Javier Buldú, in describing the impetus behind the work. "Our main motivation was not only to understand how the disease affects the functional network, but to use measurements of network parameters for the early detection of MCI and Alzheimer disease (AD)."

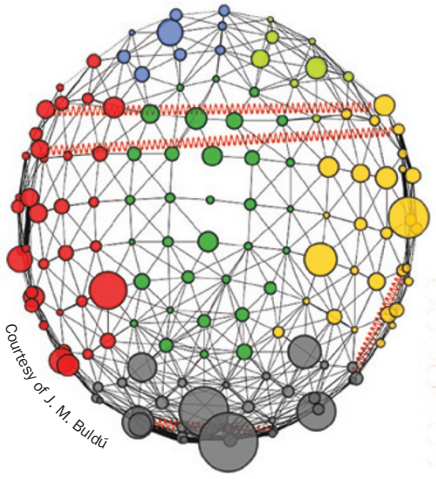
The researchers at the Centre for Biomedical Technology in Madrid, Spain used magnetoencephalography to assess functional networks in the brains of 19 patients with MCI and 19 healthy individuals during a memory task. This technique involves measuring magnetic fields resulting from brain electrical activity in 148 cortical regions.

The researchers applied statistical analysis to the resulting network structures to assess several properties of networks in each individual, including the synchronization likelihood (which indicates whether two regions are coordinated); the mean shortest path between connections; outreach (whether coordinated activity occurs at distant locations); and whether the connections in these networks represented an organized or random structure.

The structures of functional networks in individuals with MCI were distinguishable from the networks in healthy controls; in patients with MCI, network structures were more random, lobes in the brain were less segregated (reducing the modular structure of the network), and long-distance connections had increased activity.

The researchers designed an evolutionary model that simulates deterioration of functional networks to improve their understanding of the events that lead to the progression of disease. "The model reproduces all observed changes in the network parameters," says Buldú, "and shows how the increase in activity of the long-range connections promotes the damage associated with the disease."

Every year approximately 10–15% of patients with MCI will develop AD. Patients with AD display randomized functional networks, similarly to patients with MCI. However, whereas individuals with MCI have increased nodal connections, patients with AD have disconnected nodes. Buldú is now investigating whether the enhanced connections seen in MCI may correspond to the connections that will eventually show decreased activity in AD, perhaps as a consequence of continuous overload of the functional network. Several of the network parameters analyzed in this study showed statistically significant differences between patients with MCI and healthy individuals. "These parameters could be used to detect the appearance of MCI or prodromal AD," Buldú concludes.



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Original article Buldú, J. M. *et al.* Reorganization of functional networks in mild cognitive impairment. *PLoS One* doi:10.1371/journal.pone.0019584