Assessing Large-scale Brain Connectivities in Mild Cognitive Impairment

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Principal Investigators

LIU, TIANMING

Institution

UNIVERSITY OF GEORGIA

Contact information of lead PI
Country

USA

Title of project or programme

Assessing Large-scale Brain Connectivities in Mild Cognitive Impairment

Source of funding information

NIH (NIA)

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€ 1,259,733.03

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01/09/2013

Total duration of award in years

4

The project/programme is most relevant to:

Alzheimer's disease & other dementias

Keywords

Acquired Cognitive Impairment... Aging... Alzheimer's Disease... Alzheimer's Disease including Alzheimer's Disease Related Dementias (AD/ADRD)... Bioengineering... Brain Disorders... Clinical Research... Clinical Research - Extramural... Dementia... Diagnostic Radiology... Neurodegenerative... Neurosciences

Research Abstract

DESCRIPTION (provided by applicant): There has been significant amount of effort in the literature in measuring the hypothesized widespread structural and functional connectivity alterations in MCI by diffusion tensor imaging (DTI) and/or resting state fMRI (R-fMRI). For instance, the ongoing ADNI-2 project already released dozens of DTI and R-fMRI datasets for early MCI patients. However, a fundamental question arises when attempting to map connectivities in MCI: how to define and localize the best possible network nodes, or Regions of Interests (ROIs), for brain connectivity mapping, and how to perform accurate comparisons of those connectivities across different brains and populations? These still remain as open and urgent problems. Approaches: Our recently developed novel data-driven approach has discovered a map of Dense Individualized and Common Connectivity-based Cortical Landmarks (DICCCOL) in healthy brains. These landmarks possess intrinsically-established correspondences across brains, while their locations were defined in each individual's local image space. In this project, we propose to create a universal and individualized ROI reference system for MCI specifically, by predicting and optimizing the DICCCOL map in well-characterized MCI subjects to be recruited from Duke Medical Center. The resulted DICCCOL map in MCI, named DICCCOL-M, will be annotated into functional networks by concurrent task-based fMRI, R-fMRI, DTI and MRI data. We propose to predict DICCCOL-M in ADNI-2 subjects based on DTI/MRI data and assess the hypothesized large-scale connectivity alterations in ADNI-2 subjects and their longitudinal changes for the purpose of MCI conversion prediction. Significance: 1) The created DICCCOL-M map can be considered and used as a next-generation brain atlas, which will have much finer granularity and better functional homogeneity than the Brodmann brain atlas that has been used in the brain science field for over 100 years. 2) The algorithms will be developed and released based on the open source platform of Insight Toolkit (ITK). The dissemination of the algorithms and associated datasets to the community will significantly contribute to numerous applications in brain imaging that rely on accurate localization of ROIs. 3) Despite recent DTI and R-fMRI studies in the literature to assess brain connectivities in MCI/AD, connectivity alterations in large-scale networks, e.g., over 358 DICCCOL ROIs, and their relationships to AD progression are largely unknown. This knowledge gap will be significantly bridged in this project by assessing these large-scale networks represented by DICCCOL-M in Duke and ADNI-2 subjects.

Lay Summary

PUBLIC HEALTH RELEVANCE: The proposed studies will develop, validate and apply predictive models of large-scale brain networks derived from well-characterized MCI and control neuroimaging data (Duke Bryan Alzheimer's Disease Research Center) on the ADNI-2 dataset. This project will develop and validate connectivity-based imaging parameters that are predictive of AD progression for early diagnosis of AD.

Further information available at:

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Investments > €500k

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United States of America

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Alzheimer's disease & other dementias

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2016

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N/A

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