Multivariate pattern analysis

Multivariate pattern analysis (MVPA) comprises a collection of tools that can be used to understand complex spatial disease effects across the brain.

Multivariate pattern analysis (MVPA) of fMRI data has proven to be more sensitive and more informative about the functional organization of the cortex than is univariate analysis with the general linear model (GLM). MVPA refers to a set of methods that analyze neural responses as patterns of activity, thus affording investigation of the varying brain states that a cortical field or system can produce, thus increasing the amount of information that can be decoded from brain activity, in contrast to simpler univariate measures that indicate the extent to which a cortical field or system is globally engaged. We first devised a prototype MVPA method in the course of the investigation of the functional architecture for face and object recognition in ventral temporal cortex [1].

Functional connectivity (FC) changes can occur prior to structural changes. A study by Byun et al. from the Seoul National University Hospital aimed to evaluate data-driven whole-brain FC associated with isolated rapid eye movement sleep behavior disorder (iRBD) using multivariate pattern analysis (MVPA).

This was a cross-sectional study of 50 polysomnography-confirmed iRBD patients and 20 age- and sex-matched controls. They used MVPA implemented in the connectome-MVPA CONN toolbox to identify data-driven seed regions for post hoc seed-to-voxel connectivity analysis. The association between FC changes and clinical characteristics, including cognition, depression, autonomic function, and daytime sleepiness, was evaluated.

MVPA revealed one significant cluster located in the left posterior insular cortex. Seed-to-voxel FC analysis using the cluster as a seed showed significantly reduced FC with two clusters located in the precuneus in iRBD patients compared to the controls. The degree of FC was associated with the Montreal Cognitive Assessment-Korean version scores ($r = 0.317$, $p = 0.025$).

This study emphasizes the insula as an important neural correlate associated with iRBD that was associated with cognitive function [2].

1)
Haxby JV, Gobbini MI, Furey ML, Ishai A, Schouten JL, Pietrini P. Distributed and overlapping representations of faces and objects in ventral temporal cortex. Science. 2001 Sep 28;293(5539):2425-30. doi: 10.1126/science.1063736. PMID: 11577229.
2)
Byun JI, Cha KS, Kim M, Lee WJ, Lee HS, Sunwoo JS, Shin JW, Kim TJ, Moon J, Lee ST, Jung KH, Chu K, Kim MH, Kim HJ, Shin WC, Lee SK, Jung KY. Altered insular functional connectivity in isolated REM sleep behavior disorder: a data-driven functional MRI study. Sleep Med. 2021 Jan 2;79:88-93. doi: 10.1016/j.sleep.2020.12.038. Epub ahead of print. PMID: 33485260.