Brain decoding of spontaneous memory processes

ABSTRACT:

Classically, the brain's operations are considered as essentially reflexive and mainly driven by external stimuli. In this perspective, brain function is predominantly geared to interpreting incoming stimuli and programming motor output. Another view posits that the bulk of brain's activity is intrinsic, spontaneous (i.e., it emerges in the absence of any identified external stimulus), and essentially aims at maintaining, processing information and adapt future behaviour by predicting the environment.
The objective of this project is to develop a research strategy for examining spontaneous memory offline processing in healthy human volunteers in order to characterize in a direct manner the neuronal correlates of a recently formed memory trace. We first used functional magnetic resonance imaging (fMRI) then moved on to electrophysiological data, acquired in original experimental protocol. We show that, to some extent, one can track the spontaneous replay of activity linked to learned material, i.e. mnesic traces, in rest fMRI data. With ECoG data, it is also possible to decode the quality ('math' versus 'non-math') of a subject's mentation. The new methodological tools developed rely on advanced machine learning techniques, to model brain activity. In particular the sparse multiple kernel learning approach is more sensitive than univariate methods to decode a variable of interest and provides an easy way to locate the information of interest, i.e. find the relevant signal features.

Keywords
Brain spontaneous activity, Memory, fMRI, Brain reading

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