Model-based FMRI study of neural bases of human decision-makingal pathogenicity

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Laboratory

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Subjects / Tools-Methodologies

1 : Neurosciences/fMRI
2 : Psychology/Behavioral recordings
3 : Applied mathematics/Modeling and simulation

Summary of lab's interests

The prefrontal cortex (PFC) subserves decision-making and executive control, i.e. the ability to make decisions and to regulate behavior according to external events, mental models of external contingencies, internal drives and subjective preferences. Our overall aim is to understand the functional architecture of the human PFC and computational mechanisms of PFC function. The PFC function is known to operate along three major dimensions, namely the affective, motivational and cognitive control of action subserved by the orbital, medial and lateral sectors of the PFC, respectively. Our specific objectives are to solve the following three open issues of critical theoretical significance: (1) the functional organization of motivational control in the medial prefrontal cortex; (2) the mechanisms that enables the PFC to control the learning of representational sets required for cognitive control; (3) the functional interactions between the medial and lateral prefrontal cortex, i.e. the integration of motivational and cognitive control into a unitary decision-making and control system. We address these theoretically and methodologically challenging issues by elaborating computational models that integrate learning and control mechanisms, and in relation to these models, by conducting functional magnetic resonance imaging experiments in healthy humans.

Summary of project

For several years, the Laboratory of Cognitive Neuroscience (LNC) has been developping a functional model of the human prefrontal cortex which gives insights to the mechanisms of human decision making. More specifically it tries to characterize the cognitive processes responsible for the human ability to adapt in an uncertain environment. In fact, adaptative behaviors can be distinguished according to two opposite types of processes: - Perseveration which is necessary for learning new behaviors; - Cognitive flexibility, that is the capacity to switch from one behavior to another when detecting possible explicit or implicit changes in the environment. The experiments run at the LNC also showed that adaptative abilities are very variable from one individual to the other. The laboratory has just proposed a theoretical solution to answer the question of the link between perseveration and learning, cognitive flexibility and exploration. The goal of the proposed project is to validate this functional theory at the neurobiological level and to seek a neurophysiological explanation to the interindividual variability. This research project will adopt the model-based fMRI (functional Magnetic Resonance Imaging) approach in order to test the theoretical model at the neural level. The study, according to the observed behavioral results and the model s predictions, will seek to determine the cerebral mechanims associated to these cognitive processes, to elucidate the role of the different neuromodulators in the interindividual variability and possibly correlate the observed cognitive phenotypes to distinct individual genotypes.