Campagne 2020 Contrats Doctoraux Instituts/Initiatives

Proposition de Projet de Recherche Doctoral (PRD)

Appel à projet IEcoSant - Initiative Eco de la Santé 2020

Intitulé du Projet de Recherche Doctoral : The Role of the Anterior Cingulate Cortex for Structure-to-Function Mapping in Decision-Making, Self-Control and Social Cognition

Directeur de Thèse porteur du projet (titulaire d'une HDR) :

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Code *(ex. UMR xxxx)* : UNR 7225, INSERM 1127

ED158-Cerveau, cognition, comporteme

Ecole Doctorale de rattachement de l'équipe & d'inscription du doctorant :

Doctorants actuellement encadrés par le directeur de thèse (préciser le nombre de doctorants, leur année de 1ere inscription et la quotité d'encadrement) : Léa Combette 2019 (co-encadrant Liane Schmidt, quotité 80%)

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Unité de Recherche :
Intitulé : INSEAD & ICM
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Cotutelle internationale : ☒ Non ☐ Oui, précisez Pays et Université :

Description du projet de recherche doctoral *(en français ou en anglais)*

3 pages maximum – interligne simple – Ce texte sera diffusé en ligne

Détailler le contexte, l'objectif scientifique, la justification de l'approche scientifique ainsi que l'adéquation à l'initiative/l'Institut.
Le cas échéant, préciser le rôle de chaque encadrant ainsi que les compétences scientifiques apportées. Indiquer les publications/productions des encadrants en lien avec le

projet.
Préciser le profil d'étudiant(e) recherché.

Why do we sometimes choose a piece of chocolate cake over an apple? Eating decisions are unique because they are characterized by the following features: (1) they are among the most frequent type of decisions made every day; (2) they are necessary for survival; (3) they are shaped by culture and other sociological factors; and (4) they have consequences for health and well-being. Thus the brain must integrate various metabolic and psychological factors during dietary decision making and its regulation. In turn, dietary decisions are extremely complex yet crucial to study because our ability to address the obesity epidemic and eating disorders, which are pressing economic and societal issues, depends on our understanding of them. It is for these reasons that many different disciplines study dietary decision making. Nonetheless, our choices of what and how much to eat remain poorly understood, and little is known about the factors that determine why some people can keep their weight low and others cannot.

The objective of the current Ph.D. proposal is to help addressing this issue through an interdisciplinary approach, bridging the gap between health, behavioral economic and neural science.

It consists of three closely related sub-projects that aim at shedding light on the specific role that the anterior cingulate cortex (ACC) and its structural connectivity to the brain's valuation (i.e., ventromedial prefrontal cortex (vmPFC) and ventral Striatum (vStr), Bartra et al. 2015) and control system (lateral pre-frontal cortex (lPFC), Ochsner and Gross 2005) play to (1) predict participants' ability to exercise self-control (sub-project 1) and (2) the processing and integration of social information during decision-making (sub-projects 2 & 3). Previous work in cognitive and social neuroscience has highlighted the ACC's important role in social cognition (Rotge et al. 2015) and cognitive control (Shenhav et al. 2013). However, its role in (dietary) decision-making, its control and how social cognition impacts them remains unknown.

The first study uses an existing data set of an ongoing project (N=100 participants) in the ICM's Control, Interoception and Attention Team (that the supervisor and "co-encadrant" are part of). This dataset combines white-matter connectivity measures (i.e. using Diffusion tensor imaging (DTI), grey matter density (i.e. voxel-based morphometry (VBM)) and functional magnetic resonance imaging data during a dietary decision-making task that allows capturing people's ability to exercise self-control. More specifically participants took part in a food choice (FC) task while undergoing an fMRI scan (adapted from Schmidt et al 2018). This FC task consisted of a series of non-hypothetical, incentive-compatible decisions and economic models asking participants to choose between two food items. The exact combination of food items is based on the participant's individual tastiness and healthiness ratings prior to each scanning session. To vary the degree of temptation, high-conflict trials (i.e., unhealthy item is tastier than healthy item) and low-conflict trials (i.e., the unhealthy item is less tasty than healthy item) are implemented for each participant. The goal of this study is to investigate whether (1) white matter tract connectivity between the ACC, and the brain's valuation and control system can be used as a marker to predict self-control (as previously used by the co-encardrant) and if so (2) whether this connectivity mediates the functional activation of those brain systems (i.e., function-to-structure mediation using the approach of Leong et al. 2015). The outcome of this first project would help our understanding of the brain mechanisms underlying individual differences in dietary

self-control abilities. This outcome is important from a health economics perspective because it might help to design more targeted and thus more efficient interventions.

The second study is a new study to be conducted in the academic year 2020/21 (CPP approval and funding already obtained by the supervisor). It examines the differentiation of brain structural connectivity as captured by DTI predicting the integration of social information in a social decision-making game (i.e., the cyperball task as previously used by the supervisor) and nociceptive signals in pain experiences in patients with chronic pain (rheumatoid arthritis). We further assess whether this connectivity mediates the functional correlates captured by fMRI during the social decision-making task or pain stimulation (using again the function-to-structure mediation analysis approach by Leong et al. 2015). We predict that the structural connectivity between the ACC, other areas involved in social cognition such as Theory-of-Mind and cognitive control mediate social rejection and pain experiences. In this second project, the Ph.D. student would not only be able to apply the methodological knowledge acquired in the first project but also be actively involved in the design, implementation and data collection of a brain-imaging experiment. The outcome of the second project promises to be helpful to improve our understanding of the (structural) brain mechanisms underlying social rejection and also provides a theoretical basis for the third study. Such an outcome might help to improve the brain physiology of social rejection and pain experience and their complex relationship.

The third study then brings the first two projects together and investigates how social information about other's choices is integrated during dietary decision-making. Social context is a key factor for eating behavior (Cruwys, Bevelander, & Hermans, 2015; Higgs & Thomas, 2016). Social norms and opinions of other people (i.e. Word-of-Mouth) can be a very efficient factor to promote healthier choices and a task to investigate social influence effects on dietary decision-making is currently being developed in the ICM's Control, Interoception and Attention Team. The objective of this study is to investigate the structural brain connectivity underlying social influence effects on (dietary) decision-making and its control, and whether the structural connectivity markers developed in sub-projects 1 and 2 can be used to predict if social influence can promote people's ability to make healthier choices. Specifically, in the first step the goal is to replicate our research team's previous findings that information about other's decisions influences food craving (as measured by willingness-to-pay, WTP, see Plassmann et al. 2007,2010) and one's ability to make healthier choices. The novel contribution is to investigate which brain systems show white-matter tract connectivity predicting those social influence effects and whether this connectivity mediates the functional correlates captured by fMRI (using again the function-to-structure by Leong et al. 2015). First data (N=50) has already been collected, but depending on the progress of sub-projects 1 and 2, it might be an option to extend this first data set by a second study to test generalizability and robustness of our findings.

Together this set of studies are a coherent, ambitious, novel yet feasible research agenda for a Ph.D. thesis in the area of health economics. The results of our research will contribute to building a novel theoretical foundation for explaining decision-making processes and what role social cognition might play to make healthier choices. Such a foundation could result in new ways to address important health issues such as the obesity epidemic (studies 1 & 3) and social rejection/pain (study 2) since it may help to design better interventions and developing brain

markers for risk assessment.

We are looking for a candidate with the following profile:

– completed Master degree in Psychology, Neuroscience, Behavioral Science, Economics or Biology

– Willingness to work in a highly interdisciplinary environment

– High enthusiasm and motivation for doing research in the field of health economics

– Proven experience with collecting and analyzing fMRI, VBM and /or DTI data

– Working experience with statistical analysis of data (Stata, R, and/or Matlab)

– Experience with computer programming (e.g., Python, Java, Psychtoolbox, E-Prime)

– Excellent communication and writing skills in the English language

– Good analytical skills (mathematics/statistics)

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à envoyer simultanément par e-mail à l'ED de rattachement et au programme :
cd_instituts_et_initiatives@listes.upmc.fr avant le 30 mars.