Cognitive and computational neurosciences studies to decipher how the social context affects individual food decisions

Institution
Sorbonne Université (Paris, France)

Doctoral school
Ecole Doctorale Cerveau Cognition Comportement (ED3C)

Disciplins
Computational Neurosciences, Behavioral Neuroscience, Brain Imaging

Hosting laboratory
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Key Words:
Reinforcement learning, Human eating behavior, Brain imaging

Scientific environment of the project:

Excessive intake of sugars and salt are linked to deleterious consequences on Human health. Current strategies to design and favor healthier options have limited effects due to their poor acceptability. SHIFT proposes a multidisciplinary approach, combining life, social and computer sciences to understand the determinants, mechanisms, and levers to modulate the acceptability of a meal option. This project will address precise alimentary situations where margins of improvement with respect to salt and sugar reduction are possible, ie. acceptability of (i) water or low energy beverages in substitution of sodas and (ii) sugar- or salt-reduced options at the end of main meals. Interdisciplinary research activities will be conducted at the populational, contextual and individual scales to decipher criteria driving the acceptability foods. SHIFT gathers 5 academic partners: The “Physiologie de la Nutrition et du Comportement Alimentaire” lab (UMR PNCA; INRA-AgroParisTech-Université Paris-Saclay, project leader), the “Institut des Systèmes Intelligents et de Robotique” (ISIR, Sorbonne Université-CNRS-INSERM), the “Mathématiques et Informatique Appliquées” lab (UMR MIA; INRA-AgroParisTech-Université Paris-Saclay), the “Alimentation et Sciences Sociales” lab (ALISS; INRA), the School of Psychology of the University of Birmingham and an industrial partner: Danone Nutricia Research (Global Nutrition Department)

Work Programme:

In the selection of foods as in many other decision processes, individuals tend to conform to social norms (i.e. a collectively-established acceptable behaviour). For instance, when eating with others, if individuals are offered to choose between two foods, they will take the decision that conforms to the choices made by the others guests. In some cases, for instance when all guests need to make a choice within a very short time lapse, there might be an uncertainty on this social norm. Before making their decision, individuals infer the appropriate choice from the available information of the choices made by others and after taking their decision, subjects judge the appropriateness of their own decision the basis of the overall choices of commensals. The acceptability of a food option is modulated by whether or not it is imitated by the commensals.

The aim of this thesis is to explore how the social context affects individual decisions. The student will study the question from the point of view of the individual: what are the contributions of various types of social modulation (imitation, conformity

to a social norm) to food choices? Fundamental to every decision is the brain's ability to internally evaluate subjective values. The theoretical framework of this thesis, the "value-based decision-making" (Pessiglione et al., 2006, Johnson & Ratcliff, 2014), suggests that, although from an external point of view, the outcome of a decision can be reduced to a binary phenomenon (acceptance or rejection) the underlying mental computation of the value is represented as a continuous function. Our working hypotheses are that the aforementioned social modulations to food choices can be integrated in an individual-centric modeling approach of decision-making (as has been shown in simpler contexts by Burke et al. (2010)), that the influences of these various types of modulations can be disentangled, so as to help identifying the possibly specific neural substrates. In this thesis, we will design a behavioural task dedicated to investigate the different causes of social modulations, and we will then explore which brain circuits are involved, using fMRI. We will use the theoretical tools of value-based decision-making to model the mechanisms by which social modulations affect decision. This will allow us to derive time series of internal variables of the model as regressors to refine the analysis of fMRI data.

The student will work to establish a fully specified model of a decision task incorporating mathematical formalizations of the social modulations. The model will be based on the so-called model-free reinforcement learning algorithms (Sutton & Barto, 1998), to which additional value update modalities will be added in order to take into account the influence of commensals.

References

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