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& Speaker Abstracts

Invited Talks

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Friday, May 29

Paris Brain Institute, Pitié-Salpêtrière Hospital

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How Incentive Motivation Shapes and Biases Metacognitive Judgments

Maël Lebreton

Paris School of Economics, France

When: 09:30 - 10:00

Session: Talk Session 1: Metacognition of decision making

Day / Venue: Wednesday, May 27: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Marion Rouault

Metacognition, the ability to reflect on and evaluate one's own cognitive processes, is fundamental to adaptive decision-making. Yet accumulating evidence suggests that confidence judgments are far from neutral readouts of internal uncertainty: they are systematically shaped by motivational and affective states. In this talk, I will present a body of work examining how incentive motivation biases probabilistic and metacognitive judgments. Building on converging evidence from perceptual decision-making and reinforcement learning paradigms, I will argue that incentive-induced effects on confidence are best captured by a class of models in which motivation specifically amplifies evidence from the chosen option during confidence computation, a mechanism producing characteristic overconfidence in rewarded contexts. I will further present neuroimaging evidence implicating the ventromedial prefrontal cortex as a key locus where motivational and metacognitive computations interact. Finally, I will examine these mechanisms in clinical populations, as a window into the computational roots of impaired self-assessment. Taken together, this work advances a unified, computational account of motivated metacognition across normal and pathological dimensions.

How disconfirmatory evidence shapes decision confidence

Annika Boldt

University College London, UK

When: 10:00 - 10:30

Session: Talk Session 1: Metacognition of decision making

Day / Venue: Wednesday, May 27: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Marion Rouault

In this talk, I will present recent work on how decision confidence is computed from evidence. When assessing our decisions, a normative strategy would give equal weight to each piece of evidence when computing confidence. However, recent work suggests that the brain instead overweights decision-congruent information. This phenomenon is known as the positive-evidence bias. Here, we re-analysed nine datasets (N = 176) in which participants judged the average colour of eight shapes and reported their confidence. This paradigm allowed us to cleanly dissociate the influence of choice-confirming and choice-conflicting evidence on confidence. Contrary to both the normative account and the positive-evidence bias, we find that participants systematically overweight evidence that conflicts with their choice. To explain this response-incongruent weighting, we extended a log-posterior-ratio model to account for confidence judgements. The results show that the same robust averaging mechanism that shapes decisions also governs confidence: evidence near the category boundary carries greater weight, and this disproportionately amplifies the influence of incongruent samples. In a preregistered experiment (N = 32), we provide empirical evidence for this interpretation by showing that shifting the category boundary alters confidence in otherwise identical stimuli. Together, these findings suggest that confidence is shaped not by confirmatory evidence, but by sensitivity to disconfirmatory evidence, arising as a downstream consequence of the decision process itself.

Computational mechanisms of perceptual confidence

Michael Pereira

Grenoble Institut des Neurosciences, France

When: 10:30 - 11:00

Session: Talk Session 1: Metacognition of decision making

Day / Venue: Wednesday, May 27: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Marion Rouault

Confidence ratings are a cornerstone of metacognition research, as they provide a direct behavioral measure of how individuals monitor the reliability of their own perceptions and decisions. Understanding the mechanisms behind confidence is critical, not only to better understand decision-making and self-monitoring, but also because confidence has been linked to different psychiatric symptoms related to anxiety, compulsivity or psychotic dimensions. In this talk, I will first show how computational models of post-decisional evidence accumulation can explain diverse patterns of confidence ratings observed during detection tasks. The predictions of these models were compared to electrophysiological data, including single-neuron recordings. I will also discuss how these models shed light on possible decisional origins for metacognitive noise that cause dissociation between confidence and task performance. Finally, I will explore how confidence weighs prior expectations and whether this weighting is linked to false alarms, offering insights into the relationship between metacognition and false perceptions.

Neural correlates of adaptive decision-making in changing environments

Elisabeth Parés-Pujolràs

University College Dublin, Ireland

When: 11:30 - 12:00

Session: Talk Session 1: Metacognition of decision making

Day / Venue: Wednesday, May 27: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Marion Rouault

Making accurate decisions in noisy environments requires integrating evidence over time. Studies of simple perceptual decisions in static environments have identified two signals in the human electroencephalography (EEG) that evolve with similar dynamics, with one (the centroparietal positivity, CPP) appearing to compute the running integral and continuously feed it to the other (motor beta lateralisation). However, it remains unknown whether and how these signals serve distinct functional roles in more complex scenarios. In this talk, I will present results from a recent study where we used a volatile expanded judgement task that dissociates raw sensory information, context-optimal belief updates, and the evolving belief itself. We find that motor beta lateralisation encodes the evolving belief across stimuli, tracking changes of mind, while the CPP locally encodes the subjective belief updates associated with each individual stimulus. These results suggest a computational hierarchy where momentary belief updates can be computed sample-by-sample at an intermediate processing level indexed by the CPP before being funnelled downstream to motor areas. Our findings thus highlight the need to probe neural decision signals in unconventional task settings in order to better understand how flexible changes in their functional roles may underpin adaptive behaviour.

A Unified Framework for Metacognition in Psychiatry

Tricia Seow

University College London, UK

When: 12:00 - 12:30

Session: Talk Session 1: Metacognition of decision making

Day / Venue: Wednesday, May 27: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Marion Rouault

Altered metacognition is increasingly recognised as a defining feature of psychopathology across diagnostic boundaries. Yet the field remains fragmented: cognitive neuroscience and clinical disciplines define metacognition differently, operate with distinct methodologies, and rarely speak to one another, leaving a gap between mechanistic understanding and therapeutic application. I propose that a hierarchical framework can begin to close this gap. In this talk, I present empirical evidence that a framework spanning local trial-level judgements to global self-referential beliefs can explain seemingly contradictory metacognitive patterns in psychopathology, such as the coexistence of local overconfidence and global underconfidence in compulsivity as a worked example. I then outline how expanding this hierarchy to incorporate clinical metacognitive constructs, including distortion awareness and meta-theoretical beliefs, offers a principled scaffold for integrating neuroscientific and clinical perspectives. This framework provides both a roadmap for computational modelling of cross-level interactions and a basis for more targeted metacognitive interventions in mental health.

Energetic Constraints on Decision Making

Clay Holroyd

Ghent University, Belgium

When: 13:30 - 14:00

Session: Talk Session 2: Theoretical models of decision-making

Day / Venue: Wednesday, May 27: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Mathias Pessiglione

Resource rational accounts of decision-making hold that choice behavior is constrained by various resource limitations on cognitive processing. For example, cognitive effort is a cost that penalizes selection and engagement of effortful tasks. Although the existence of this cost is not in dispute, the reason why cognitive effort should be costly is controversial. Here I will present an account of cognitive effort based on control-theoretic principles that relate cognitive effort to the fact that brain neuroanatomy and neurophysiology render some neural states more energy-efficient than others. I introduce the concept of the "controllosphere," an energy-inefficient region of neural state space associated with high control, which surrounds the better known "intrinsic manifold," an energy-efficient subspace associated with low control. Integration of control-theoretic principles with classic neurocomputational models of cognitive control suggests that dorsolateral prefrontal cortex (DLPFC) implements a controller that can drive the system state into the controllosphere, anterior cingulate cortex (ACC) implements an observer that monitors changes of state of the controlled system, and cognitive effort reflects a mismatch between DLPFC and ACC energies for control and observation. On this account, cognitive effort scales with the energetic demands of the DLPFC control signal, especially when the consequences of the control are unobservable by ACC. Further, I propose that neural transitions through the controllosphere lead to a buildup of neural waste. Cognitive effort therefore prevents against neural damage by discouraging extended periods of high control.

Double-sided opportunism in infrastructure investment: Theory and experiment

Béatrice Boulu-Reshef

Cergy Paris Université, France

When: 14:00 - 14:30

Session: Talk Session 2: Theoretical models of decision-making

Day / Venue: Wednesday, May 27: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Mathias Pessiglione

Governments' efforts to promote private and non-governmental investors' participation in the financing of infrastructures have been impeded by double-sided opportunism - either the governments by changes in regulation and expropriation, or investors by deviations from expected investment, output quality, and price. The essential features of the strategic interactions that underlay infrastructure investments are modeled using an infinitely repeated prisoner dilemma game with voluntary participation and termination. We propose a mechanism to mitigate double-sided opportunism by exchanging an exit (put) option for the investor and a bail-out (call) option for the government on the investor's present value of outlays. The optimal participation and termination rules are derived, and the micro-mechanisms at stake are tested using controlled laboratory experiments. We show that, compared to conventional unilateral exit options, concurrent exit and bail-out options (i) reduce ex-ante entry barriers and, thus, induce higher partnership formation and (ii) increase alliance sustainability. The mechanism also applies to public-private partnerships and other settings with partially aligned goals and informational asymmetries, including mergers and acquisitions, managerial compensation, concessions for natural resources, franchises, and cooperatives.

Biological profits of irrational computations in the orbitofrontal cortex

Juliette Bénon

University of Zurich, Switzerland

When: 15:00 - 15:30

Session: Talk Session 2: Theoretical models of decision-making

Day / Venue: Wednesday, May 27: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Mathias Pessiglione

Why do humans and animals systematically violate rational decision-making? Recent work suggests that altered computations in perceptual, motor and memory systems in the brain may arise from informational, metabolic or robustness constraints on their internal connectivity structure. However, whether and how such neurobiological constraints shape the architecture of decision systems such as the orbitofrontal cortex (OFC) remains unclear. In this talk, I will consider the possibility that systematic errors in decision-relevant computations are the inevitable consequence of the internal connectivity structure within orbitofrontal networks, shaped by distal biological constraints. We used recurrent neural networks (RNNs) as in silico models of both rational and empirically grounded (irrational) decision-relevant computations performed by the OFC. These models reproduce key electrophysiological properties of the OFC and reveal systematic interferences underlying irrational decision-making. Importantly, although irrational RNNs do not bring informational or metabolic benefits, they display enhanced tolerance to damage when compared to their rational counterparts, suggesting that some forms of irrational behavior may be the incidental outcome of distal evolutionary pressure on the tolerance to orbitofrontal circuits' damage.

Bridging task-level and spatial cognitive maps for goal-directed navigation

Giovanni Pezzulo

National Research Council of Italy, Rome, Italy

When: 15:30 - 16:00

Session: Talk Session 2: Theoretical models of decision-making

Day / Venue: Wednesday, May 27: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Mathias Pessiglione

Humans and other animals demonstrate remarkable abilities to construct sequential plans, from organizing goal-directed actions to navigating complex environments. In this talk, I present a hierarchical active inference framework that learns generative models supporting cognitive maps across multiple levels of abstraction. These maps link task-level representations - such as goals and subgoals - with spatial representations that guide action in physical environments. Through simulations of spatial navigation tasks, including paradigms analogous to rodent spatial alternation experiments, I show how interactions between hierarchical layers enable the flexible integration of task and spatial information. Disrupting these interactions leads to impaired planning and decision-making, consistent with empirical findings on hippocampal-prefrontal cortex dynamics. This framework provides insights into how the brain might support goal-directed, flexible navigation by integrating abstract and spatial cognitive maps within neural circuits.

Cross-species study of statistical learning - from behaviour to mechanism

Athena Akrami

University College London, UK

When: 09:30 - 10:00

Session: Talk Session 3: Hidden internal states in decision making

Day / Venue: Thursday, May 28: NeuroModulation Institute, Sainte-Anne Hospital

Chair: Florent Meyniel

A defining feature of animal intelligence is the ability to discover and update knowledge of statistical regularities in the sensory environment, in service of adaptive behaviour. This allows animals to build appropriate priors, in order to disambiguate noisy inputs, make predictions and act more efficiently. Despite decades of research in the field of human cognition and theoretical neuroscience, it is not known how such learning can be implemented in the brain. By combing sophisticated cognitive tasks in humans, rats, and mice, as well as neuronal measurements and perturbations in the rodent brain and computational modelling, we seek to build a multi-level description of how regularities in temporally extended tasks are learned and utilised. In this talk, I will specifically focus on a cross-species model to study statistical learning, in both feedback-based and non-feedback-based settings.

An explanatory link between history biases and lapses

Diksha Gupta

University College London, UK

When: 10:00 - 10:30

Session: Talk Session 3: Hidden internal states in decision making

Day / Venue: Thursday, May 28: NeuroModulation Institute, Sainte-Anne Hospital

Chair: Florent Meyniel

Even in simple tasks, subjects with significant experience often deviate from the optimal policy. In this work, we identify a unified mechanism that gives rise to two commonly observed suboptimalities that have been traditionally considered distinct - history biases (the undue influence of trial history on decisions) and lapses (seemingly random, evidence independent decisions). We present both theoretical and empirical support for a shared, parsimonious cause that produces both. We show that a single mechanism - that is normative under misbeliefs of non-stationarity - gives rise to both history biases and apparent lapses simultaneously, acting as an explanatory link that accounts for their empirical co-occurrence and co-modulation. This mechanism corresponds to history-dependent updates to the initial state of a drift-diffusion model (DDM) from trial to trial, and naturally produces lapse-like choices in previously overlooked and mischaracterized DDM regimes where initial state fluctuations are large. We test our model's predictions by performing trial-by-trial fitting on a new rat dataset consisting of 152 rats (> 5.7 million choices) and by developing a novel reaction-time task. Our model improves the ability to precisely predict decision-making dynamics within and across trials by positing a process through which agents generate quasi-stochastic choices.

Adaptive arousal regulation: How ongoing fluctuations in pupil-linked arousal shape task performance

Simon van Gaal

University of Amsterdam, Netherlands

When: 10:30 - 11:00

Session: Talk Session 3: Hidden internal states in decision making

Day / Venue: Thursday, May 28: NeuroModulation Institute, Sainte-Anne Hospital

Chair: Florent Meyniel

Task performance is highly dependent on the momentary arousal state of the brain, which fluctuates over hours, minutes, and even seconds. The textbook relationship between arousal and performance is captured by an inverted U-shape, as described by the Yerkes-Dodson law. This law suggests optimal performance at moderate levels of arousal and impaired performance at both low and high levels. Although this law is standard textbook material for Psychology and Neuroscience students, surprisingly little is known about its overall applicability, its sensitivity to context, and its neural implementation. I will present recent studies in which we increased the overall arousal level of human participants using drugs that affect cholinergic and noradrenergic systems. At the same time, we measured pupil size (as an index of arousal) and brain activity while people performed different perceptual decision-making tasks. First, we show that performance is indeed optimal at intermediate levels of arousal, and that this pattern holds across different tasks (discrimination, detection) and sensory modalities (visual, auditory). Second, catecholaminergic enhancement increased overall arousal and shifted the entire arousal-performance curve, illustrating that the arousal-performance relationship is adaptive, similar to well-known normalization mechanisms in neuroscience. We can capture these results in a biologically plausible computational model, in which catecholaminergic modulation alters a disinhibitory neural circuit that encodes sensory evidence. Recent data from mice supports this proposed mechanism. Together, these findings underscore the flexibility and efficiency of neural circuits shaping the arousal-performance relationship, both within and across arousal states.

Structure uncovered: understanding temporal variability in perceptual decision-making

Anne Urai

Leiden University, Netherlands

When: 11:30 - 12:00

Session: Talk Session 3: Hidden internal states in decision making

Day / Venue: Thursday, May 28: NeuroModulation Institute, Sainte-Anne Hospital

Chair: Florent Meyniel

Studies of perceptual decision-making typically present the same stimulus repeatedly over the course of an experimental session but ignore the order of these observations, assuming unrealistic stability of decision strategies over trials. However, even 'stable,' 'steady-state,' or 'expert' decision-making behavior features significant trial-to-trial variability that is richly structured in time. Structured trial-to-trial variability of various forms can be uncovered using latent variable models such as hidden Markov models and autoregressive models, revealing how unobservable internal states change over time. Capturing such temporal structure can avoid confounds in cognitive models, provide insights into inter- and intraindividual variability, and bridge the gap between neural and cognitive mechanisms of variability in perceptual decision-making.

Constraint and advantage: the two faces of noise in decision-making under uncertainty

Valentin Wyart

École Normale Supérieure, Paris, France

When: 12:00 - 12:30

Session: Talk Session 3: Hidden internal states in decision making

Day / Venue: Thursday, May 28: NeuroModulation Institute, Sainte-Anne Hospital

Chair: Florent Meyniel

Human decisions made under uncertainty are not only subject to biases, but also to internal noise. In this talk, I will present recent experimental evidence that sheds light on the nature of this noise and its dual impact on decision-making. First, noise acts as a constraint that explains how humans solve decision problems under uncertainty, including a range of decision biases otherwise seen as idiosyncratic. Second, in artificial neural networks, noise shapes the selection of abstract and resilient task representations that provide a significant advantage in challenging conditions, and resemble patterns measured in human brain activity.

Probing serotonergic mechanisms of controllability estimation across species

Romain Ligneul

Centre for Neuroscience Research of Lyon, France

When: 13:30 - 14:00

Session: Talk Session 4: Monoaminergic control of decision making

Day / Venue: Thursday, May 28: NeuroModulation Institute, Sainte-Anne Hospital

Chair: Lucie Berkovitch

The brain can be envisioned as a complex controller whose main role is to help the organism reach and maintain the most desirable states of the environment. However, not all environments are equally controllable, and changes in environmental controllability require constant adaptation of cognitive and motor processes. Controllability estimation may thus play a key role in the regulation of action in health and disease, but its cognitive and neurobiological underpinnings remain poorly understood. In this talk, I will present model-inspired cognitive tasks that revisit the long-standing idea that serotonin plays an important role in controllability estimation and its downstream consequences. First, I will show how controllability estimation mechanisms are altered in depression and modulated by serotonergic antidepressants. Then, I will present preliminary results indicating that the core computational operations involved in this process can be studied in rodents, opening the path to a deeper understanding of the relationship between controllability and serotonin signaling.

Fast dopamine dynamics in the conscious human brain during Pavlovian-instrumental conflict and risky behaviour

Dan Bang

Aarhus University, Denmark

When: 14:00 - 14:30

Session: Talk Session 4: Monoaminergic control of decision making

Day / Venue: Thursday, May 28: NeuroModulation Institute, Sainte-Anne Hospital

Chair: Lucie Berkovitch

Dopamine - one of the brain's major neuromodulators - is crucial for healthy neural function. Yet, our understanding of how and why has been impeded by an inability to measure fast dopamine dynamics in humans. In this talk, I will present an approach for obtaining electrochemical estimates of subsecond fluctuations in dopamine (and other neuromodulators) in the conscious human brain. This unique opportunity arises in neurosurgical patients, such as movement disorder patients undergoing deep brain stimulation surgery and epilepsy patients undergoing seizure monitoring. In a first project, I will present evidence that dopamine in human anterior cingulate cortex supports reinforcement learning at the more abstract level of behavioural policies - specifically, the extent to which a default policy, Pavlovian responding, should guide action selection. In a second project, I will present evidence that dopamine in human motor thalamus signals reward prediction errors as seen in the striatum and that the strength of this signalling predicts individual risk preferences. These projects are joint work with Azadeh Nazemoroaya, Wanjun Lin, Peter Dayan and Read Montague.

Ultrasound neuromodulation of human deep brain circuits in affective and effort-based decision-making

Miriam Klein-Flügge

University of Oxford, UK

When: 15:00 - 15:30

Session: Talk Session 4: Monoaminergic control of decision making

Day / Venue: Thursday, May 28: NeuroModulation Institute, Sainte-Anne Hospital

Chair: Lucie Berkovitch

I will present recent work examining deep cortical and subcortical circuits during affective and motivated decision-making, focusing on advances in causal neuromodulation using transcranial ultrasound stimulation (TUS). TUS allows us to move beyond correlational descriptions of function by directly and non-invasively manipulating activity in deep brain circuits. In the first study, we provide evidence that TUS can modulate connectivity and metabolites in the human basolateral amygdala (BLA) and demonstrate the BLA's causal role in interpreting ambiguous emotional information during affective approach-avoid choices. In the second study, TUS is used to stimulate a deep medial prefrontal cortex region, the perigenual anterior cingulate cortex, showing its role in cost-benefit arbitration when deciding whether to accept or reject high-conflict effort-reward options. Third, across multiple domains, we are beginning to move beyond the timescale of individual trials to more naturalistic, intermediate timescales. Here, I will focus on work characterising how background contextual features shape motivation. Taken together, our work moves from correlational studies toward causal investigations of deep subcortical-cortical brain circuits using timescales of increasing relevance for flexible human behaviour. We believe this is an important step toward understanding the neural mechanisms underlying decision-making across health and disease.

Neuromodulation, learning, and the topography of brain activity

Alice Hodapp

NeuroSpin / INM, France

When: 15:30 - 16:00

Session: Talk Session 4: Monoaminergic control of decision making

Day / Venue: Thursday, May 28: NeuroModulation Institute, Sainte-Anne Hospital

Chair: Lucie Berkovitch

Learning in dynamic and stochastic environments requires the brain to continuously update its beliefs in the face of uncertainty. Neuromodulatory systems have long been proposed to play a central role across learning contexts. Supporting this idea, I will show that physiological proxies of neuromodulatory tone such as pupil dilation and heartbeat show domain-general signatures of learning-related variables. Furthermore, in recent neuroimaging work, we showed that the cortical topographies of confidence and surprise are likewise largely invariant across experiments varying in sensory modality, task structure, and the quantity being learned. If neuromodulatory systems contribute to these representations, their receptor and transporter distributions across the cortex should partly constrain where these effects emerge. We tested this prediction using PET-derived receptor and transporter density maps, and found that they account for a significant portion of the spatial organization of both confidence- and surprise-related activity. Distinct receptor and transporter patterns mapped onto learning-related activity, including both known catecholamine pathways and novel opioid associations. Together, these findings support a domain-general neuromodulatory account of adaptive learning and provide receptor-level hypotheses for future pharmacological work.

From momentary decision-making to sustained sense-making: Reward-learning framework of knowledge acquisition

Kou Murayama

University of Tübingen, Germany

When: 09:30 - 10:00

Session: Talk Session 5: Intrinsic motivation and decision making

Day / Venue: Friday, May 29: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Alizée Lopez-Persem

In recent years, interdisciplinary research on curiosity has surged, exploring how individuals naturally pursue knowledge without external incentives. However, this growing field has largely overlooked the extensive psychological research on interest development and trait curiosity/interest. This talk presents a unifying conceptual perspective, the reward-learning framework of knowledge acquisition (Murayama, 2022), which bridges these previously separate areas. The framework posits that knowledge acquisition acts as an intrinsic reward, reinforcing information-seeking behaviors through a reward-learning process. Importantly, this process can establish a positive feedback loop that sustains and amplifies information-seeking over time. This perspective offers a compelling explanation for how momentary curiosity can evolve into a long-term inclination for knowledge (trait curiosity/interest). This perspective also underscores the need to integrate semantic sense-making processes into decision-making models.

From phone notifications to browsing social media: how reinforcement learning may explain digital information consumption

Irene Cogliati Dezza

Université Libre de Bruxelles, Belgium

When: 10:00 - 10:30

Session: Talk Session 5: Intrinsic motivation and decision making

Day / Venue: Friday, May 29: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Alizée Lopez-Persem

In an increasingly information-rich world, humans constantly face decisions about which information to seek or avoid. From checking phone notifications and browsing social media, to deciding whether to read news about global crises or view financial statements, these information-seeking choices fundamentally shape our daily experiences and wellbeing. Despite the prevalence and importance of such decisions, a critical gap remains in our understanding of the mechanisms through which different motivational factors drive information-seeking decisions. This knowledge gap has significant implications for emerging phenomena like "doomscrolling" and "deliberative ignorance". In this talk, I will present a novel reinforcement learning framework providing a mechanistic account of both adaptive and maladaptive information-seeking patterns in our increasingly complex information ecosystem.

Disentangling the Influences of Curiosity and Active Exploration on Spatial Memory

Ellen O'Donoghue

Cardiff University, UK

When: 10:30 - 11:00

Session: Talk Session 5: Intrinsic motivation and decision making

Day / Venue: Friday, May 29: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Alizée Lopez-Persem

Curiosity has long been assumed to shape exploration, and in turn, to promote spatial memory for explored environments. However, little research has directly investigated these claims. Recently, Cen et al. (2024) demonstrated that when participants feel more curious about specific virtual environments, they (1) explore those environments more thoroughly, and (2) display better memory for environmental layouts. These data support the existence of a relationship between curiosity and spatial memory; however, because participants always had the opportunity to act on their curiosity (by using it to guide their exploration), the precise nature of that relationship remains uncertain. Here, we ask whether curiosity directly promotes spatial memory, or whether its benefits depend on the ability to actively guide your own exploration. Through a yoked design, two groups of participants engaged in either active or passive exploration through a set of novel virtual environments. This manipulation allows us to disentangle the influences of self-reported curiosity (varying trial-by-trial across all participants) and active exploration (manipulated between groups).

Improving performance without effort: a dissociation between intrinsic and extrinsic motivation

Jade Seguin / Mathias Pessiglione

University of Geneva, Switzerland / Paris Brain Institute, France

When: 11:30 - 12:00

Session: Talk Session 5: Intrinsic motivation and decision making

Day / Venue: Friday, May 29: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Alizée Lopez-Persem

Students may learn their course either because the course is interesting or because they aim at a good grade. Intuitively, performing tasks because they are interesting or enjoyable (intrinsic motivation) seems less effortful than performing tasks because they are instrumental for obtaining some benefits (extrinsic motivation). Yet, standard models of effort allocation to task performance consider intrinsic and extrinsic motivation as targeting two types of rewards through the same costly cognitive control process. We introduce an alternative 'different-cost model', in which intrinsic motivation improves task performance by providing effortless direct drive, whereas extrinsic motivation improves performance through the exertion of effortful cognitive control. The predictions of this model were tested across a series of studies, during which volunteers memorized information with various levels of self-reported interest and various amounts of monetary reward associated to correct recall. Both interest and reward (intrinsic and extrinsic motivation) were found to improve memory performance, following a pattern that was better captured by the new different-cost model than the classical same-cost model. Neurophysiological evidence further supported the predictions of the new model: to attain an equal performance level, only extrinsic motivation triggered pupil dilation and activated brain regions associated with cognitive control (in the lateral prefrontal cortex). Lastly, in populations with impaired cognitive control, such as patients with low-grade glioma, extrinsic motivation had little effect on performance compared to intrinsic motivation. Together, these findings suggest that working under intrinsic motivation might relax the demand on cognitive effort and hence prevent the accumulation of fatigue.

Autonomy as a Context-Dependent Motivational Mechanism for Learning

Lieke van Lieshout

Donders Institute, Radboud University Nijmegen, Netherlands

When: 12:00 - 12:30

Session: Talk Session 5: Intrinsic motivation and decision making

Day / Venue: Friday, May 29: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Alizée Lopez-Persem

Autonomy is an important driver of intrinsic motivation and is often linked to better learning and memory. However, it remains unclear how autonomy interacts with other motivational factors that shape learning. In particular, little is known about how autonomy interacts with other intrinsic motivational factors, such as competence, with extrinsic motivational factors, such as monetary reward, and whether these interactions generalize across different sociocultural contexts. In this talk, I present two studies investigating autonomy as a context-dependent mechanism underlying declarative memory formation. In the first study, we examined whether the effects of autonomy depend on perceived competence. Participants completed an object-learning task in which they either made choices themselves or followed imposed actions, while task difficulty was manipulated using visual noise. Increasing task difficulty reduced perceived competence and memory performance. Importantly, autonomy mainly improved memory under lower difficulty conditions, suggesting that its benefits decrease when competence is low. In the second study, we investigated how autonomy interacts with monetary reward across cultures. Dutch and Chinese students completed a learning task in which autonomy and reward were manipulated independently. Across both groups, autonomy improved memory performance. However, monetary reward had a stronger positive effect in Chinese than Dutch participants, suggesting that sociocultural context shapes the influence of extrinsic motivation on learning. Together, these findings suggest that autonomy does not affect learning in isolation, but interacts dynamically with other motivational and sociocultural factors.

Emotions as high-impact decisions: A goal-directed theory of behavior and affect

Agnes Moors

KU Leuven, Belgium

When: 14:00 - 14:30

Session: Talk Session 6: Emotions related to decision making

Day / Venue: Friday, May 29: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Julie Grèzes

The talk outlines the goal-directed theory (GDT) of behavior and affect. According to this theory, most behavior is the result of a goal-directed cycle in which (a) a discrepancy detection stage compares a current, anticipated, or imagined state with a desired state, and (b) a behavior selection stage chooses an overt or covert behavior option that can reduce the discrepancy when one is detected. Positive and negative affect can arise in each of these stages: positive/negative affect when a discrepancy is absent/present, and positive/negative affect when behavior options that can reduce the discrepancy are present/absent. The GDT holds that the entities that people call emotions map onto one or more components of this cycle. Contrary to the intuition that emotions stem from dedicated innate modules, the GDT proposes that the machinery underlying so-called emotions is the same as that underlying instrumental behavior. Emotional cycles typically revolve around highly valued goals, which makes discrepancy reduction more urgent and leads to more vigorous and often maladaptive action tendencies and behavior. If emotions are understood as high-impact decisions in this sense, then research on how emotions influence decision-making can be seen as examining how one type of decision-making influences another. The talk concludes with a computational implementation of the GDT's account of affect. This model can be simulated across diverse input scenarios and can guide empirical tests of this account.

In what sense moods represent future prospects? A layered account and its cognitive consequence on decision making.

Stéphane Lemaire

University of Rennes, France

When: 14:30 - 15:00

Session: Talk Session 6: Emotions related to decision making

Day / Venue: Friday, May 29: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Julie Grèzes

It has been argued by several philosophers, psychologists and neuroscientists that moods represent one's perspective of future successes. This would cohere with their tendency to favor either action or rest. Such a representation may however be understood in three different ways. According to a first account, moods imply a perceptual representation of one's prospects, or a conscious thought or belief about them. However, even if this may often be true, one may argue that moods can occur without any such conscious representation, possibly in very simple organisms. Supposing that this is possible, a further question bears upon the nature of unconscious representations of prospects. Teleosemantic approach to representations (Dretske, Millikan, Neander) allow that (brain) states can count as representation when they are statistically correlated to a state and they are exploited to influence behavior, and in this case, in decision-making. One might however insist with Burge that the attribution of representations requires the ability to draw purely cognitive inferences, that is, inferences among representations in the teleosemantic sense. Rather than claiming that one of these views is the correct one, moods may present an interesting case in which it is fruitful to admit three layered types of representations of one's prospects of success, which then allow us to understand their respective functions, interactions and also their behavioral and cognitive limits.

Mood fluctuations shift economic cost-benefit trade-offs

Roeland Heerema

Paris Brain Institute, France

When: 15:30 - 16:00

Session: Talk Session 6: Emotions related to decision making

Day / Venue: Friday, May 29: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Julie Grèzes

Do we make decisions differently depending on the mood we are in? Ample empirical evidence from everyday life proves that we do, and recent theoretical accounts suggest there might be adaptive purposes of the influence of mood in our choices. I will present a set of studies that set out to demonstrate this mood effect in economic cost-benefit trade-offs. Experiments in the lab and online showed a systematic modulation of the choice bias parameter by mood, so that happiness increased the predisposition to accept risks, delays, or efforts in order to gain large rewards. Conversely, sadness increased the propensity to choose safe, immediate, and effortless alternatives for lower rewards. We found that this effect was consistent across studies, regardless of whether mood fluctuations were experimentally induced or naturally occurring; or whether they were quantified by subjective ratings or physiological recordings. I will conclude by discussing consequences of extreme mood bias, and their implications for the study of mood disorders in computational psychiatry.

Parallel influences of mental health and bodily signals on decision-making

Camilla Nord

University of Cambridge, UK

When: 16:00 - 16:30

Session: Talk Session 6: Emotions related to decision making

Day / Venue: Friday, May 29: Paris Brain Institute, Pitié-Salpêtrière Hospital

Chair: Julie Grèzes

Emotions and mental health exert profound influences on decision-making. Homeostatic signals from the body contribute to both, yet are typically absent from conceptualisations of aberrant decision-making in psychiatric conditions. In a series of experiments, we discovered a parallel influence of mental health and bodily signals on effort-based decision-making, spanning circadian rhythm, menstrual cycle, and metabolic health. These parallel processes may play a key role in driving the comorbidity between mental and physical health, and in particular the increased mortality rates in mental health conditions like major depression. We also link this work to a broader theoretical model of energy allostasis - predicting the energetic condition of the body - which may be disrupted across metabolic and mental health conditions.