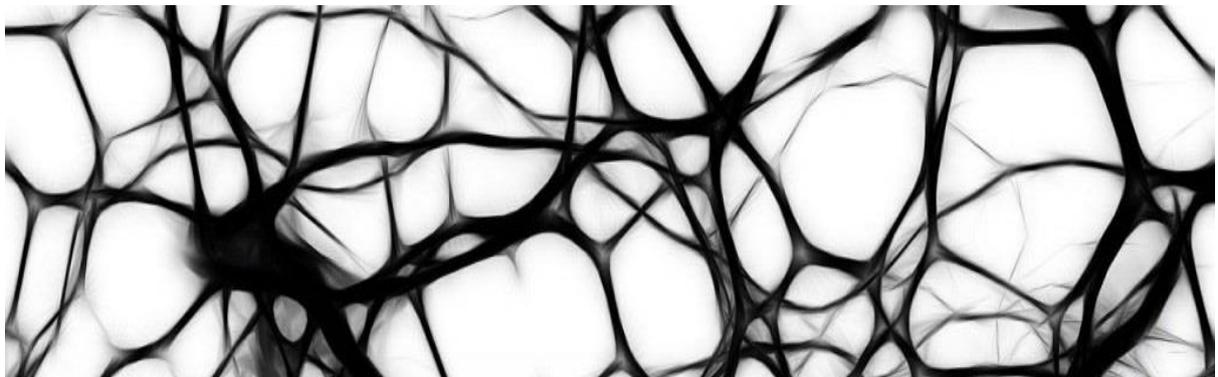


Metacognition: new developments and challenges

Institute of Philosophy

Online Conference, June 23rd – 26th 2021

Organised by Nicholas Shea and Joulia Smortchkova



INSTITUTE OF
PHILOSOPHY

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Introduction

In recent years the scope of metacognition research has expanded. Metacognitive processes seem to be involved in a variety of cognitive faculties: perception, action, memory, learning, decision making, and conceptual thought are just some examples. Metacognition encompasses many cases where it operates without the person engaging in deliberate and explicit monitoring or control. Evidence for metacognitive processes also extends to pre-verbal infants and non-human animals. These developments elicit questions about its nature and role. Are there fundamentally different types of metacognition? And if there are, how should we capture the distinction between them: meta-representational vs. non-meta-representational, procedural vs. analytic, experience-based vs. information-based, implicit vs. explicit, core vs. late-developing, or in some other way?

This three-day meeting brings together researchers working on the different aspects of metacognition from a variety of disciplinary perspectives with the aim of understanding its nature and role in cognition. Topics covered during the conference include metacognition in infants and non-human animals, its neural underpinnings, its place in education and in culture, the relation between metacognition and mindreading, the metacognitive aspects of cognitive faculties such as perception, memory, learning, and action, the nature of metacognitive feelings, methodological issues related to how metacognition is measured, and the different ways in which types of metacognition could be distinguished.



Programme Overview

Wednesday 23rd June - Afternoon session: 2.00pm - 4.30pm - Contributed talks.

2.00-2.20	Giacomo Melis , "Epistemic higher-order thinking and non-metarepresentational metacognition"
2.20-2.40	John Dorsch , "The Case for Embodied Metacognition: Between Evaluative and Metarepresentational Accounts"
2.40-3.00pm	Oriane Armand , "Inferential metacognition of perceptual and value-based decisions"
3.00-3.30pm	Break
3.30-3.50	Sunae Kim , "Relation between metacognition and mindreading in young children: Cross-cultural investigation"
3.50-4.10	Kirsten H. Blakey et al. , "Capacities for explicit metacognition may facilitate distinctively human cumulative culture"
4.10-4.30pm	Monika Derda , "Disentangling the metacognitive component of conscious representation: questions and challenges"

Thursday 24th June - Morning session: 10.00am - 12.30pm - Invited Talks

- 10.00-10.45am **Louise Goupil** (University of East London) "Core and situated metacognition"
- 10.45-11.00am Break
- 11.00-11.45am **Ophélie Deroy** (University of Munich) "Cold and warm metacognition: Confidence as a social communicative emotion"
- 11.45am-12.00pm Break
- 12.00-12.30pm Panel session: **Louise Goupil** and **Ophélie Deroy**

Afternoon session: 2.00 - 4.30 pm - Poster Session and Invited Talks

- 2.00-2.40pm Online poster session: session A
- 2.40-2.45 Break
- 2.45-3.25pm Online poster session: session B
- 3.25-3.30pm Break
- 3.30-4.15pm **Alex Rosati** (University of Michigan) "The primate roots of human metacognition"
- 4.15-4.30pm Panel session: **Alex Rosati** and **invited speakers**

Friday 25th June - Morning session: 10.00am - 12.30pm - Invited Talks

- 10.00-10.45am **Josef Perner** (University of Salzburg) "Are identity statements metacognitive?"
- 10.45-11.00am Break
- 11.00-11.45am **Joëlle Proust** (CNRS) "Dual-processing in metacognition: educational implications"
- 11.45am-12.00pm Break
- 12.00-12.30pm Panel session: **Josef Perner** and **Joëlle Proust**

Afternoon session: 2.00 - 4.30 pm - Invited Talks

- 2.00-2.45pm **Steve Fleming** (UCL) "Neural and computational components of confidence formation"
- 2.45-3.00pm Break
- 3.00-3.45pm **John Morrison** (Barnard College, Columbia University) "Probabilities in perception, probabilities about perception"
- 3.45-4.00pm Break
- 4.00-4.30pm Panel session: **Steve Fleming** and **John Morrison**
- 5.00pm onwards Virtual drinks



Invited Speakers



Ophélie Deroy holds the Chair in Philosophy of Mind, at the LMU, and is the former deputy director of the Institute of Philosophy. She specialises in philosophy of mind and cognitive neurosciences, and has widely published on issues related to multisensory perception, metacognition and social interactions, both in philosophical and scientific journals. Her research looks more particularly at non-conceptual contents of experience, and non-verbal interactions. She is an active promoter and a leading advocate of stronger connections between philosophical and scientific approaches to the mind.

“Cold and warm metacognition: Confidence as a social communicative emotion”. Unless psychology aims only to explain lab-behaviour, it is somewhat strange to read that embodied and affective components of metacognition may arise “from processes that are well adapted to the real world, but not the laboratory” (Sakhar & Rahnev, 2020, p. 1), and see researchers persist in seeing them as sources of noise or bias, for our lab-ideal of optimal behaviour. Here I argue for the opposite view that affective and embodied components form the core of confidence, which is primarily a social and communicative emotion (ie. the 'warm' account), and that the near-optimality in confidence measured in the lab partly comes from the instruction to refrain from social motivations, and be accurate (i.e. the 'cold account').



Steve Fleming is a Sir Henry Dale Wellcome Trust/Royal Society Fellow at University College London. In addition to his primary appointment at the Department of Experimental Psychology, he is a Principal Investigator at the Wellcome Centre for Human Neuroimaging, and Group Leader at the Max Planck-UCL Centre for Computational Psychiatry and Ageing Research. His research focuses on understanding how the human brain supports self-awareness and metacognition, and how these processes are altered in disorders of mental health. To do this he combines theoretical models with a range of behavioural and cognitive neuroscience approaches including functional and structural MRI, TMS, M/EEG and eye tracking. Steve's research has been recognised with the William James Prize from the ASSC, the Wiley Prize in Psychology from the British Academy, a Philip Leverhulme Prize in Psychology and the British Psychological Society Spearman Medal.

“Neural and computational components of confidence formation”. People are often aware of their mistakes, and report levels of confidence in their choices that correlate with objective performance. In my talk I will focus on these estimates of decision confidence as a testbed for theories of metacognition. I will outline how we can derive metrics of metacognitive sensitivity from confidence rating data, and use these metrics to understand the structure of metacognition across distinct tasks. I describe a computational framework that envisages confidence formation as a series of steps, culminating (in the case of human adults) with explicit metacognitive representations that can be used to guide behaviour. By combining novel experimental designs that disentangle these computational steps with brain imaging, we are starting to link these distinct aspects of metacognition to the functions of the medial and lateral prefrontal cortex. In conjunction with studies of comparative anatomy and individual differences, these results help establish a neural basis for human metacognition.



Louise Goupil is a post-doctoral researcher at the University of East London BabyDevLab. Her research focuses on the cognitive and metacognitive underpinnings of communication and cultural transmission. She is also interested in how language and communication shape conscious perception and metacognition. During her PhD at the Ecole Normale Supérieure (Paris, FR), she investigated the development of metacognition and help-seeking behaviors in preverbal infants. She then joined IRCAM/CNRS (Paris, FR) as a post-doctoral researcher, where she conducted various projects focusing on vocal communication of confidence, and joint action in musical contexts. Her current project funded by a H2020 Marie Curie fellowship investigates early social word-learning and curiosity from a dyadic perspective, using a combination of behavioral methods and dual EEG.

“Core and situated metacognition”. My talk will start from two observations. The first one is that children younger than 4 generally provide inaccurate metacognitive judgments when prompted to do so verbally. The second observation is that toddlers display behaviors and neural signatures that suggest that they can already deploy core forms of metacognition — such as the ability to evaluate decision confidence and to monitor errors — when they perform very simple tasks. I will then present a model that attempts to explain how young children progress from these core metacognitive abilities to more sophisticated abilities allowing them to communicate full-fledged, conceptual metarepresentations to others through conventional communication. My suggestion will be that this involves at least five developmental processes, whereby children learn to use core metacognitive signals as a function of their situation within a specific environment and socio-cultural setting.



John Morrison is associate professor of philosophy at Barnard College, Columbia University. He is an affiliate of Barnard's Neuroscience and Behavior Department as well as Columbia's Mind Brain Behavior Institute. He is also a member of Columbia's Center for Theoretical Neuroscience and a mentor in its Neurobiology and Behavior Graduate Program. He is an editor of the Journal of Philosophy. He has received fellowships from the Mellon Foundation, the National Endowment for the Humanities, and the Data Sciences Institute. He is currently working on two projects. The first is an attempt to develop a useful and precise framework for attributing representations and inferences to the brain. The second is an attempt to unravel Baruch Spinoza's claims about minds, bodies, God, and their essences.

“Probabilities in perception, probabilities about perception”. A number of experiments purport to show that human and non-human subjects cognitively assign probabilities to their own perceptions. For example, some studies purport to show that subjects assign probabilities to whether their perceptions are accurate. But there's often another interpretation: that the probabilities are in the perceptions themselves. In that case, the probabilities are about the stimulus, not about the perception, and the experiments don't really show us anything about metacognition.



Josef Perner is Professor emeritus of Psychology at the University of Salzburg, member of the Centre for Cognitive Neuroscience, and founder of the Doctoral College "Imaging the Mind". He is best known for co-authoring with Heinz Wimmer the False Belief Task. His empirical work focused on the development of perspective taking in relation to theory of mind, counterfactual reasoning, identity, alternative naming, etc. His theoretical work centred on the nature of mental representation and the implicit-explicit distinction, and more recently on Teleology as a common sense alternative to theory of mind and mental simulation. His current preoccupation is mental files theory as an explanation of why all the abilities he has studied relate to each other developmentally and in the brain.

"Are identity statements metacognitive?". Metacognition is understood as cognition at a meta-level above the object level of cognition about objects and their properties. Defining the meta-level as meta-representation seems too strict. This can be illustrated with statements of identity, e.g., "Émile Ajar is Romain Gary." At the object level the statement carries no information. Since EA and RG are the same person, Roman Kacew (RK), it means no more than "RK is RK." So, "EA is RG" must be informative at some other level. It can't be meta-representation, "EA and RG represent the same person," as nothing in the statement refers to *representing*. Nevertheless, the statement causes us to change our thinking about this person: think of one, not two. I will appeal to mental files theory to bring out these changes more clearly and try to identify a level of interpretation above the object level but beneath meta-representation.



Joëlle Proust is an emeritus CNRS Director of Research at Institut Jean-Nicod, Ecole Normale Supérieure, Paris. After completing a state doctoral thesis on the history and the philosophy of logic, she explored philosophical aspects of human and animal cognition. Her work on agency led her to collaborate with Marc Jeannerod on schizophrenic agentive awareness. For the last twenty years, her research concentrated on metacognition: she was the PI of an interdisciplinary ESF-EUROCORE project (2006-9) devoted to comparative and conceptual issues. An advanced grant of the European Research Council (2011-2016), allowed her interdisciplinary team to study the influence of cultural diversity on metacognition both in children and adults. She is now testing innovative educational practices based on metacognitive studies within the French Scientific Council of National Education.

"Dual-processing in metacognition: educational implications". A number of researchers define "metacognition" as "knowing what one knows"; on this view, a metacognitive competence requires the ability to conceptually characterize one's own cognitive activity and thought contents. Others define it more broadly as "a set of abilities allowing individual agents to control and monitor their own cognitive activity" – where "cognitive activity" is taken to mean "activity with an informational goal". On this definition, it makes sense to distinguish predictive-evaluative processes based on the subjective experience gained in a cognitive task (procedural metacognition) from processes based on theorizing about one's own mind (analytic metacognition). No consensus has emerged yet about the most appropriate definition. This presentation will apply the scientific requirements for accepting or rejecting cognitive dissociations in order to clarify the hypotheses concerning the functional unicity or duality of metacognitive processes. The educational implications of favouring a given definition will be pointed out.



Alexandra Rosati is an Assistant Professor of Psychology and Anthropology at the University of Michigan, where she directs the Cognitive Evolution Group. She received a BA from Harvard in Psychology, and a PhD from Duke in Evolutionary Anthropology. Dr. Rosati’s research examines the evolution of the human mind by comparing how different primate species think about the world, with a particular focus on decision-making, social cognition, and the origins of flexible behavior. Dr. Rosati also co-directs Primate Learning in Action, a collaborative educational project spreading knowledge about primate cognition, behavior, and conservation.

“The primate roots of human metacognition”. Comparative research examining the minds of our closest primate relatives is uniquely positioned to provide new insights into the emergence of complex human cognition. Metacognition—or thinking about one’s own thoughts—shapes many aspects of human cognition and behavior, from decision-making to social reasoning. In adults, metacognitive processes also often draw on or are influenced by language. Given this, can non-linguistic animals engage in metacognition, and if so what aspects? I will examine evidence for other primate’s capacities for a suite of metacognitive skills, as well as related capacities for social cognition and decision-making. I will use this pattern of phylogenetic linkages and dissociations between different species to understand what metacognition is, its relationships to other skills, and its potential evolutionary functions across species.



Contributing Speakers



Oriane Armand (LMU Munich), “Inferential metacognition of perceptual and value-based decisions”. “Oops, that was pepper. Did I not pick the right shaker or are they mixed up?” In ecological environments, monitoring our choices is useful to adjust our model of the world and our behaviour. We review empirical work that defines the role of confidence in inferential learning. At the decision level, confidence tracks different sources of errors such as the reliability of our perceptual evidence (e.g. was it the salt shaker) or of the policy on which we base our strategies (e.g. could they be mixed up?). We discuss how these perceptual and value-based monitoring have complementary roles in the inferential framework. At the global level, experience from many decisions can inform the agent about whether or not to expect errors based on the context’s stochasticity, and adjust her behavioural flexibility accordingly. Lastly, we discuss the implication of inferential metacognition in the clinical literature.



Kirsten Blakely (University of Stirling) et al. “Capacities for explicit metacognition may facilitate distinctively human cumulative culture”. Real world instances of cumulative culture likely involve learners acquiring social information that is limited in its availability. It is reasonable to suggest then that capacities for appropriate information seeking could determine whether or not a particular population exhibits cumulative culture. The ability to seek out and use relevant social information has been proposed to depend on advanced metacognitive capacities. To investigate this, we presented 3- to 8-year-olds with a task requiring them to identify which of four possible demonstrators could provide critical information for solving a novel problem. The results revealed age-related improvements in children’s ability to seek out and use relevant social information that occurred at around the same age that we see advances in children’s metacognitive understanding. Therefore, the findings indicate that capacities for explicit metacognition may be necessary to recognise the relevance of social information and might explain why cumulative culture is largely restricted to humans.



Monika Derda (Jagiellonian University) et al. “Disentangling the metacognitive component of conscious representation: questions and challenges”. The global neuronal workspace (GNW) hypothesis assumes that consciousness arises thanks to information becoming accessible within a wide-spread brain network (Dehaene & Changeux, 2011). Recently, Shea and Frith (2019) attempted to refine the GNW proposing that the conscious representation should be also characterized by its metacognitive component. Here, we question how such a metacognitive component is computed and discuss potential neural underpinnings of its computation. We first discuss whether metacognitive component is an inherent part of a conscious representation, or whether it is a separate, independent process aimed at monitoring the quality of information processing. Secondly, we review possible neural implementations of metacognitive component, focusing on electrophysiological data. We concentrate on a centro-parietal positivity (CPP), an EEG potential observable around 500 ms after stimulus presentation. Following Peters (2021) theoretical distinctions between weak, intermediate, and strong versions of Metacognition as a Step Toward Explaining Phenomenology, we conclude discussing to what extent the neural computations are homogenous, irrespectively of the variety of conscious contents



John Dorsch (University of Edinburgh) “The Case for Embodied Metacognition: Between Evaluative and Metarepresentational Accounts”.

A debate rages on between evaluativists and metarepresentationalists about whether evaluative metacognition (EM) is sufficiently robust. Metarepresentationalists charge EM as trivializing metacognition as arising from, what are argued to be, cognitively inexpensive mechanisms that would render metacognition ubiquitous and rob it of its significance in explaining the emergence of agency. I argue EM can be best shored up against this charge by appealing to the complex brain-body interface producing epistemic feelings, an interface which, as of now, little is known about. After introducing the problem of disambiguation that captures this charge, I argue for appealing to epistemic feelings as the solution. I present recent empirical evidence that illuminates their underlying mechanism as constituted by patterns of bodily arousal that can be best described as representing patterns of neuronal activity in the *de re* mode of reference. The result is the case for embodied metacognition at the conceptual centre between EM and metarepresentational metacognition (and perhaps an end to the dispute?).



Sunae Kim, (Eötvös Loránd University) “Relation between metacognition and mindreading in young children: Cross-cultural investigation.”

Metacognitive abilities are heavily studied and discussed, but we know little about universal and culturally specific aspects of metacognition. I will present some cross-cultural data on metacognition and mindreading in young children. By doing so, my aim is three-folds. First, I will examine the theoretical accounts on the relationship between metacognition and mindreading. Secondly, I will address different motivations and functions metacognition and mindreading may operate on and how metacognition and mindreading might be socially and culturally modulated. Finally, I will point out different metacognitive components as well as different types of tasks (and measurements) and highlight a methodological challenge to cross-cultural task validity.



Giacomo Melis, (University of Stirling) “Epistemic higher-order thinking and non-metarepresentational metacognition”

I develop insights from the study of epistemic rationality and explore whether they might shed light on the notion of implicit awareness involved in the controversy over metarepresentational and procedural accounts of metacognition. I distinguish between mere awareness of reasons and awareness of epistemic reasons as reasons. Roughly, the former only requires that the relevant reasons are mentally represented in belief-formation; the latter also demands that the subject individuates her reasons for belief and appreciates their normative force. I link the notion of awareness of reasons as reasons with the processing of epistemic concepts and suggest that it goes beyond object-level cognition while falling short of metarepresentation, and avoiding the ubiquity-problem that some have suggested afflicts procedural accounts of metacognition.



Poster Directory

Poster Session A, Thursday June 24th, 2.00pm – 2.40pm

- Poster 1 Adam Bulley, Karolina M. Lempert, Colin Conwell, Muireann Irish, Daniel L Schacter - “Intertemporal choice reflects value comparison rather than self-control: insights from metacognitive confidence”
- Poster 2 Sofia Navarro-Báez, Monika Undorf, Arndt Bröder - “Cue learning via hidden covariation in judgments of learning JOLs: Explicit or implicit contributions?”
- Poster 3 Xiao Hu, Jun Zheng, Ningxin Su, Tian fan, Chunliang Yang, Yue Yin, Stephen M Fleming, Liang Luo - “A Bayesian Inference Model for Metamemory”
- Poster 4 Baike Li, Xiao Hu, Chunliang Yang, Liang Luo - “Mechanisms Underlying the Reactivity Effect of Confidence Ratings on Perceptual Decision-Making”
- Poster 5 Sebastian Hellmann, Michael Zehetleitner, Manuel Rausch - “Modelling confidence and reaction times in perceptual decision-making”
- Poster 6 Tony Cheng, Lynn Chiu, Linus Ta-Lun Huang, Ying-Tung Lin, Yi Chuan Chen, Hsing-Hao Lee, Su-Ling Yeh - “Metacognitive confidence in perception, interoception and memory”
- Poster 7 Kristy Armitage, Alex H. Taylor, Thomas Suddendorf, Jonathan Redshaw - “Young Children Spontaneously Devise External Solutions to a Cognitive Problem”
- Poster 8 Cate Maccoll, Jonathan Redshaw - “Metacognitive Evaluations in Children’s Cognitive Offloading Decisions”
- Poster 9 Szabolcs Kiss, Zoltán Jakab - “Understanding Privileged Access and Metacognition in Children”
- Poster 10 Polina Arbuzova - “Monitoring internal vs external information and domain-general question in metacognition”
- Poster 11 Liu Cuizhen - “Prediction Biases Perceptual Decision and Introspective Judgment”

Poster Session B, Thursday June 24th, 2.45pm – 3.25pm

- Poster 12 Yunxuan Zheng, Danni Wang, Qun Ye, Futing Zou, Yao Li, Sze Chai Kwok - "Diffusion property and functional connectivity of superior longitudinal fasciculus underpin human metacognition"
- Poster 13 Madeleine Payne, J. Habicht, A. Bowler, N. Steinbais, T.U. Hauser - "I know better! Adolescents use emerging metacognition to allow them to ignore false advice from others"
- Poster 14 Paulius Rimkevičius - "Metacognition of Philosophical Concepts"
- Poster 15 Kaisa Kärki - "Procedural metacognition is necessary for intentionally omitting"
- Poster 16 Kai Xue, Medha Shekhar, Dobromir Rahnev - "Examining the robustness of the relationship between metacognitive efficiency and metacognitive bias"
- Poster 17 Anna Strasser - "How deep is the gap between one-function and two-functions approaches of metacognition?"
- Poster 18 Sofia Rappe - "Figuring out what is real in the predictive mind"
- Poster 19 Manuel Rausch, Michael Zehetleitner - "How to measure metacognition? Evaluating false positive rates of traditional and hierarchical measures of metacognitive accuracy"
- Poster 20 Nura Sidarus, Martina Kavanova, Vincent Valton, Jonathan Roiser, Adrien Kerebel - "Instrumental learning is disrupted by difficulty in an incidental decision"
- Poster 21 Sergiu Spatan - "A Metacognitive Account of the Feeling of Uncertainty"

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