

# **Metacognition:** **new developments and challenges**

**Institute of Philosophy, School of Advanced Study,  
University of London**

**Online Conference, June 23rd – 26th 2021**

*Organised by Nicholas Shea & Joulia Smortchkova*

**Memory slices by Anna Strasser**  
**DISCLAIMER: JUST MEMORIES – AIMING FOR CORRESPONDENCE  
WITH REALITY BUT CANNOT GUARANTEE IT.**

Wednesday  
23rd June

**Giacomo Melis**

“Epistemic higher-order thinking and non-metarepresentational metacognition”

**John Joseph Dorsch**

“The Case for Embodied Metacognition Between Evaluative and Metarepresentational Accounts”

**Oriane Armand**

“Inferential metacognition of perceptual and value-based decisions”

**Sunae Kim**

“Relation between metacognition and mindreading in young children: Cross-cultural investigation”

**Kirsten H. Blakey et al.**

“Capacities for explicit metacognition may facilitate distinctively human cumulative culture”

**Monika Derdra & Michał Wierzchoń,**

Disentangling the component of conscious representation: questions and challenges”

# Epistemic higher-order thinking and non-metarepresentational metacognition

implicit vs explicit | automatic information-processing vs autonomous decision-making  
mental representation simpliciter vs reflective mental representation | unreflective vs reflective

MAIN CLAIM

IMPLICIT METACOGNITION STILL HAS A DISTINCTIVE THEORETICAL ROLE

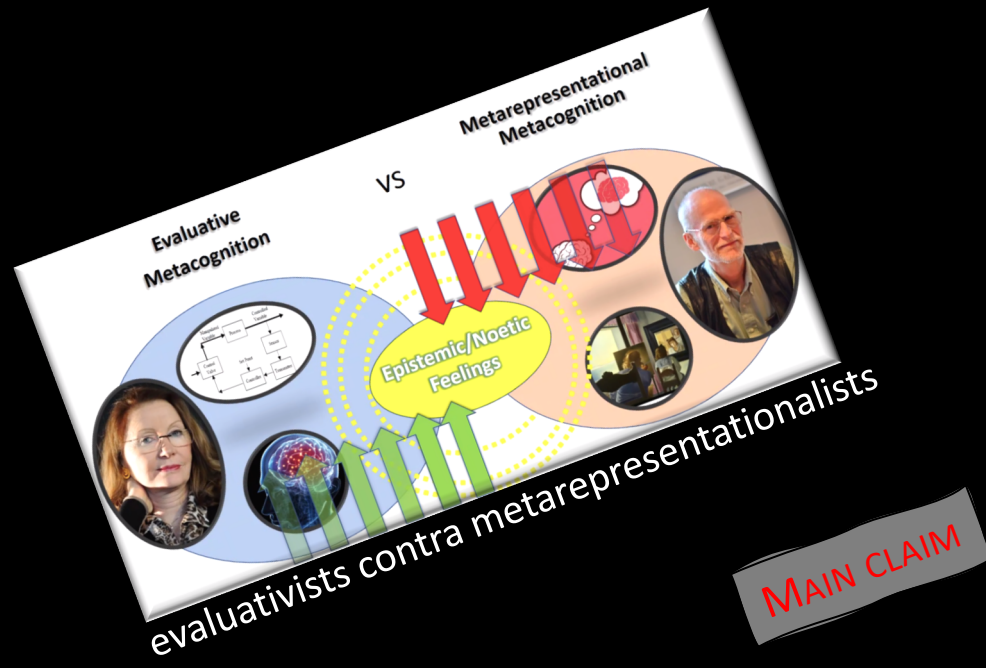
- to form a belief for a reason one must have the relevant reasons
- to have a reason one has to have an attitude towards it
- not metarepresentational
- awareness of reasons as reasons clearly distinguished from mere awareness

contra Carruthers

...it might be said that curiosity is implicitly metacognitive...because it requires agents to monitor their own states of knowledge, detecting and responding appropriately to a state of ignorance. You can describe this as a form of metacognition if you like, but it completely trivializes the notion. (Carruthers 2018: 139).



# The Case for Embodied Metacognition Between Evaluative and Metarepresentational Accounts



## WHAT ARE EPISTEMIC FEELINGS?

error signal = epistemic feeling?

**NO !**

epistemic feelings involve a complex brain-body mechanism that error signals do not have

## EMBODIED METACOGNITION: HYPOTHESIS

epistemic  
feelings

patterns of  
bodily arousal

represent

dispositions for  
cognitive action

patterns of  
neuronal activity



John Dorsch



# Inferential metacognition of perceptual and value-based decisions

decision-confidence contributes to learning



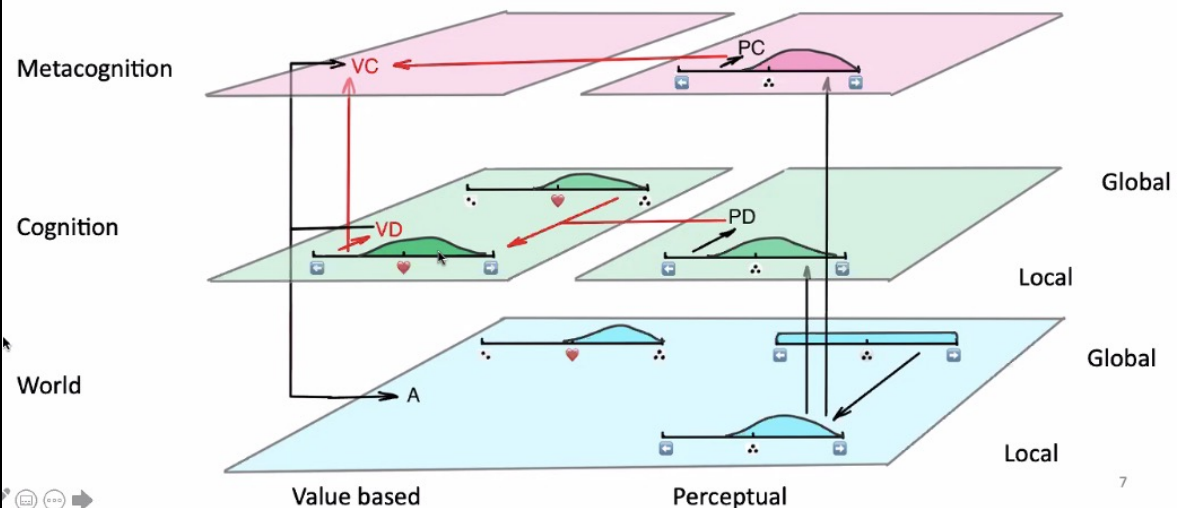
MAIN CLAIM

metacognition contributes to learning (reliability in dual process)  
and mirrors its computation



## Reframing metacognitive monitoring:

2. Self-consistency theory: confidence tracks coherence between decision and norms



# Relation between metacognition and mindreading in young children: Cross-cultural investigation

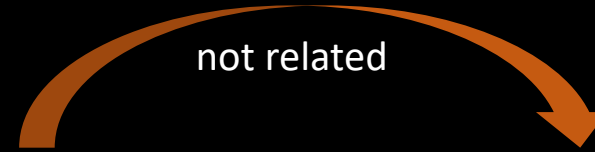
experiment: Do mindreading abilities relate to metacognition?

- Participants: 4-year-old German (N = 37, 20 girls; mean age = 4.54) and Japanese (N = 39, 18 girls; mean age = 4.55) children.
- Three tasks
  - Explicit meta task (adapted from Rohwer, Kloo, & Perner, 2012)
  - Implicit meta task
  - 2 FB tasks



SOCIALLY & CULTURALLY MODULATED	explicit mindreading	explicit metacognition	implicit metacognition
	Japanese	same	same (better than explicit meta)
German	better	same	same (better than explicit meta)

not related



other findings:

German children better in selective learning than Japanese children.  
Japanese children better in selective teaching than German children.

No group difference in the implicit meta.  
Neuro-typical adults performed better in the explicit meta than adults with autism.  
Explicit meta related to mindreading.  
Implicit meta not related to either explicit meta or mindreading.



# Capacities for explicit metacognition may facilitate distinctively human cumulative culture

Discontinuity in cumulative culture could be due to humans' use of explicitly metacognitive SLSs

## Explicitly metacognitive SLSs:

- Reasoning-based and consciously represented
- Driven by causal understanding of the potential value of social information
- Available only to humans

## Implicit SLSs:

- General-purpose associative learning processes or biologically selected biases
- Directs learning towards information which is most likely to be useful
- Used by both humans and animals

experiment:  
choose the appropriate problem solution  
from 4 alternatives



older children	younger children
explicitly metacognitive SLSs	heuristic model-based biases (implicit SLSs)



# Disentangling the component of conscious representation: questions and challenges

How is the metacognitive component computed?

Three questions:

- Metacognitive component as **an inherent part** of conscious representation and/or **higher-order** representation?
- How is the **metacognitive component** represented at the psychophysiological level?
- To what extent the neural computations are **homogenous**, irrespectively of the variety of conscious contents?

\* theoretical distinctions between weak, intermediate, and strong versions of Metacognition *Peters (2021)*

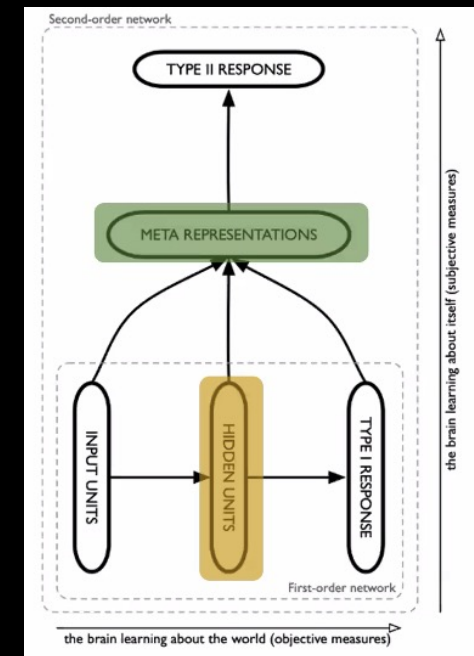
\* not-inherent = separate, independent process aimed at monitoring the quality of information processing

**FIND ANSWERS REGARDING possible neural implementations BY electrophysiological data**

- centro-parietal positivity (CPP), an EEG potential observable around 500 ms after stimulus presentation



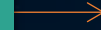
Il Monika Derda



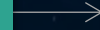


Thursday 24th  
June

**Louise Goupil** (University  
of East London)  
“Core and situated  
metacognition”



**Ophélie Dero**  
(University of Munich)  
“Confidence as a  
communicative  
emotion”



**Panel session:**  
Louise Goupil and  
Ophélie Dero

Online poster session:  
session A



Online poster session:  
session B

**Alex Rosati** (University  
of Michigan)  
“The primate roots of  
human metacognition”



**Panel session:** Alex  
Rosati and invited  
speakers



# Core and situated metacognition

## HOW TO RECONCILE THE TWO OBSERVATION?

children younger than 4

1. **struggle to provide metacognitive reports & justify their beliefs**  
(Ashtington et al. 1998, Taylor et al. 1994, Flavell 200, Rohwer et al. 2012 ....)
2. **non-verbal measures suggest that they already engage in metacognitive monitoring & control during simple tasks**

(e.g. evaluate decision confidence and to monitor errors)

(Balcomb & Gerken 2008, Ghetti et al. 2013, Goupil & Kouider 2016a/b, 2019, Geurten 2018, Kim 2016, 2020 ...)

### MAIN CLAIM



e.g., fluency, error and confidence signals that provide evidence about the probable reliability of a past, ongoing, or upcoming cognitive activity

- o) maturation
- 1) selection
- 2) self-awareness
- 3) discretization
- 4) conventionalization

e.g., doubt; phenomenological experience associated with consciously experiencing / accessing metacognitive signals

# Confidence as a communicative emotion

embodied & 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)

➤ researchers persist in seeing them as sources of noise or bias

## MAIN CLAIM

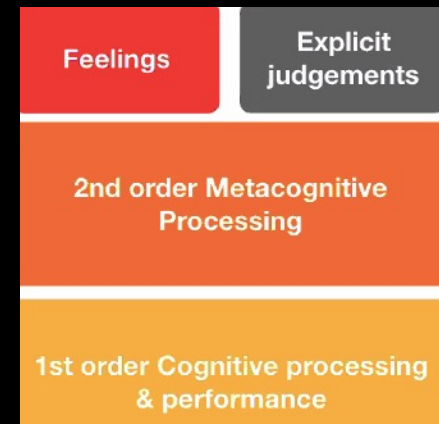
- social & communicative emotion form the core of confidence
- near-optimality in confidence measured in the lab partly comes from the instruction to refrain from social motivations, and be accurate (i.e. the 'cold account')

in favour of social communication

Agent level metacognition (by contrast with unconscious one) has a social value because of the message it transfers between a sender and a receiver, and this solves evolutionary pressures in a way that explains, or dispenses from regretting, its labelled inefficiency.

rather than social optimization

Efficient agent level metacognition (also) has a social value and solves evolutionary pressures for interactive individuals (moderate versions)





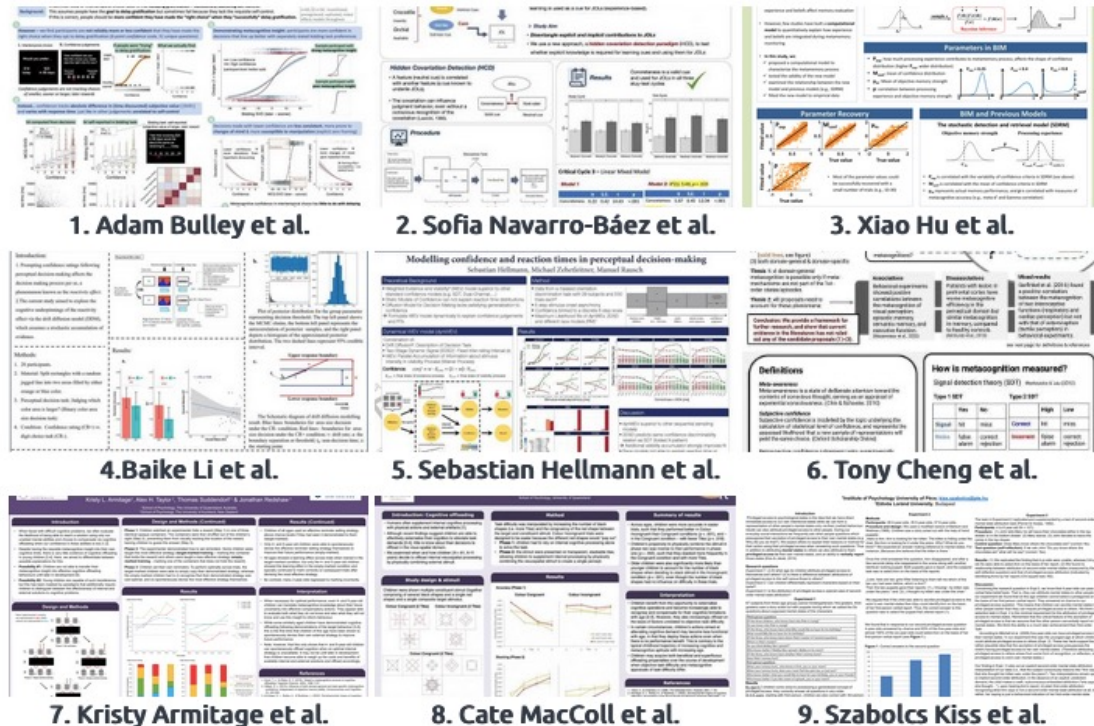
# POSTERSESSION IN WONDER



## METACOGNITION OF CONCEPTS

HOME METACOGNITION CONFERENCE PI PUBLICATIONS EVENTS BLOG PODCASTS AHRC PROJECT LINKS CONTACT Q

Protected: Online Poster Gallery



# The primate roots of human metacognition

Decision-making?

Self-monitoring,  
executive functions,  
confidence estimates

Social cognition?

Explicit knowledge  
representations,  
theory of mind

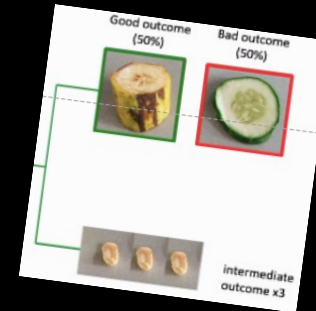
Metacognition shapes many aspects of cognition and behavior,  
from decision-making to social reasoning.

uncertainty responses

- opting out if trial is difficult



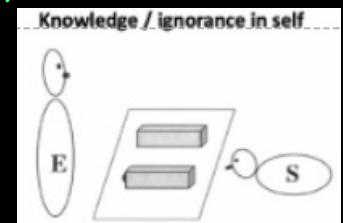
decision-making  
under uncertainty  
→ risk-avoiding



information-seeking to  
resolve risk-taking



don't like  
ambivalence



## MAIN CLAIMS

1. → There is complex cognition without language

2. further evidences indicate shared & divergent ontogenies

future research: holistic view of multiple skills

Alex Rosati  
(University of Michigan)





Friday 25th  
June

- Josef Perner (University of Salzburg) “Do identity statements require metacognition?”
- Joëlle Proust (CNRS) “Evidence for the dual role of feelings and attitudes in metacognitive awareness: educational implications”
- Panel session: Josef Perner and Joëlle Proust
- Steve Fleming (UCL) “Neural and computational components of confidence”
- John Morrison (Barnard College, Columbia University) “Probabilities in perception, probabilities about perception”
- Panel session: Steve Fleming and John Morrison
- onwards Virtual drinks





# Do identity statements require metacognition?

## CAN MENTAL FILES EXPLAIN WHERE THE META IS?

### Metacognition:

cognition at a meta-level above the object level of cognition about objects

- defining the meta-level as meta-representation seems too strict
- development of understanding identity statements & success in FB- task is comparable → What is the common component?  
→ indexed files

### statements of identity:

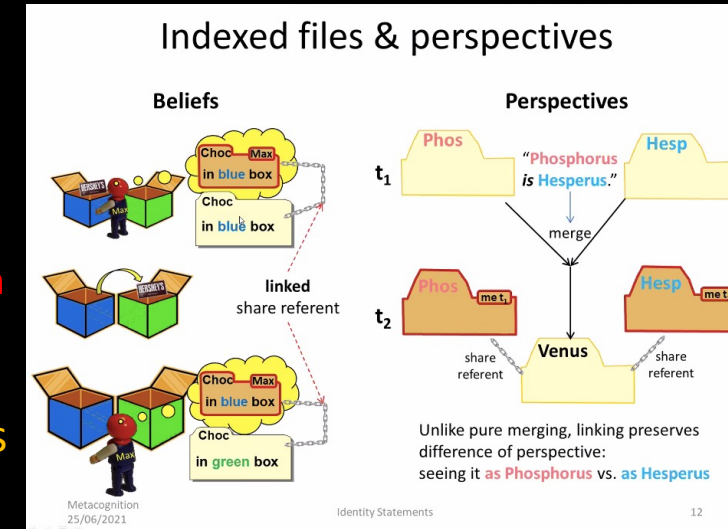
- object level: no additional information but informative at some other level
- → metalinguistic level

#### • Lesson 1

- To explain why agents do something or what something means, one often resorts to explanations in “meta-” terms.
  - Phosphorus is Hesperus means that they are different **names** for the same entity (metalinguistic)
  - Why does the chimp look first inside the tube before committing himself—because he **knows** that he better **knows** where the bait is before choosing (metacognitive)
- This may well be so but not necessarily.

#### • Lesson 2

- What changes at age 4 years is more general than an ability for metarepresentation (Flavell 1986; Perner 1986).
- It is the ability to deal with coreferential files for
  - processing identity information
  - understanding different perspectives (beliefs).



# *Evidence for the dual role of feelings & attitudes in metacognitive awareness: educational implications*

## METACOGNITION:

a set of abilities allowing individual agents to control and monitor their own cognitive activity

- predictive-evaluative processes (**procedural metacognition**) & processes based on theorizing about one's own mind (**analytic metacognition**)
- functional duality of metacognitive processes

## educational implications

- If metacognition essentially involves forming relevant beliefs, teach students general facts about learning (strategies, etc.) !

- metacognition depends, in addition, on subjective evaluations of how they learn, train students to become sensitive evaluators!



# Neural and computational components of confidence

ESTIMATES OF DECISION CONFIDENCE AS A TESTBED FOR THEORIES OF METACOGNITION

metacognitive sensitivity versus confidence

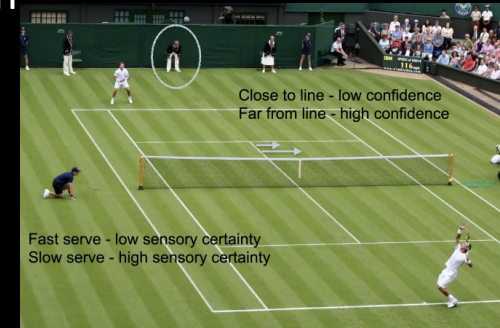
1. *sensory uncertainty*:  
first order uncertainty about  
properties of the world

2. *decision uncertainty*  
metacognitive uncertainty about  
our decisions about the world

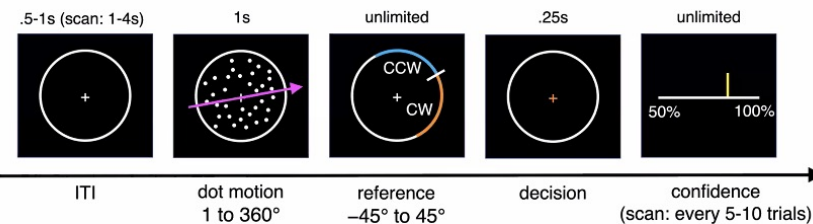
experimental design that disentangle both

fast serve: low sensory certainty  
slow serve: high sensory certainty

close to line – low confidence  
far from line – high confidence



## Experimental paradigm



Bang & Fleming  
(2018) PNAS

- brain imaging → link distinct aspects of metacognition to functions of the medial and lateral prefrontal cortex  
+ studies about comparative anatomy & individual differences:  
→ establishing a neural basis for human metacognition


# *Probabilities in perception, probabilities about perception*

IF THERE IS PROBABILITY IN THE PERCEPTION NO METACOGNITVE PROCESS IS NEEDED?

No, then the probabilities are about the stimulus, not about the perception, and the experiments don't really show us anything about metacognition

OR

Yes , subjects can still assign probabilities to whether their perceptions are accurate.

- 
1. Deny there are probabilities in perception
  2. Expand metacognition to include probabilities in perception
  3. Find ways to dissociate probabilities in and about perception
  4. Add more criteria for metacognition

## 4 examples

Subject	Dolphins Smith et al. 1995	Monkeys Kornell et al. 2000	Rodents Kepecs et al. 2008	Humans Koizumi et al. 2015
Stimuli	A: tones at 2100hz / B: tones at 1200-2099hz	9 lines of different lengths	mixtures of odors A & B	superimposed leftward & rightward gratings
Decision	A, B, or opt out	1: identify longest line / 2:safe bet or risky bet	1: identify dominant odor / 2: continue waiting for reward or start new trial	1: identify dominant grating 2: rate one's confidence in first decision
result	opt out for difficult stimuli	1. that line is the longest 2. safe bet	1. A is dominant 2. stop waiting	1: leftward grating is dominant 2: confidence rating of 2