Metacognition from a Logical Point of View

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Who is Metacognition (the CRP)?

Senior collaborators

- Joëlle Proust (Coordinator), Institut Jean-Nicod, Paris, France
- Johannes Brandl, Universität Salzburg, Austria
- Hannes Leitgeb, University of Bristol, UK
- Josef Perner, Universität Salzburg, Austria
- Bernard Renault, Université, Paris, France
- John David Smith, State University of New York at Buffalo, USA
- Josep Call, MPI for Evolutionary Anthropology, Leipzig, Germany

What is Metacognition (the Concept)?

General working definition

- Often defined as “Thinking about thinking”
- Refers to cognitive control and monitoring of cognitive processes

Division of labour (roughly)

Experimental work

- Studies conducted with monkeys, apes, young children and adults (Call, Perner, Renault, Smith)

Conceptual work

- Studies in the Philosophy of Mind, Logic and Epistemology (Brandl, Leitgeb, Perner, Proust)

IP4: Metacognition from a logical point of view

People Prof. Hannes Leitgeb, University of Bristol, UK
Simone Duca (PhD student), University of Bristol, UK

Goal Inform (but also be informed by) the empirical research in the field by investigating the conceptual structure of Metacognition

Area Logical Constraints on Introspection in Belief Revision and Non-Monotonic Reasoning

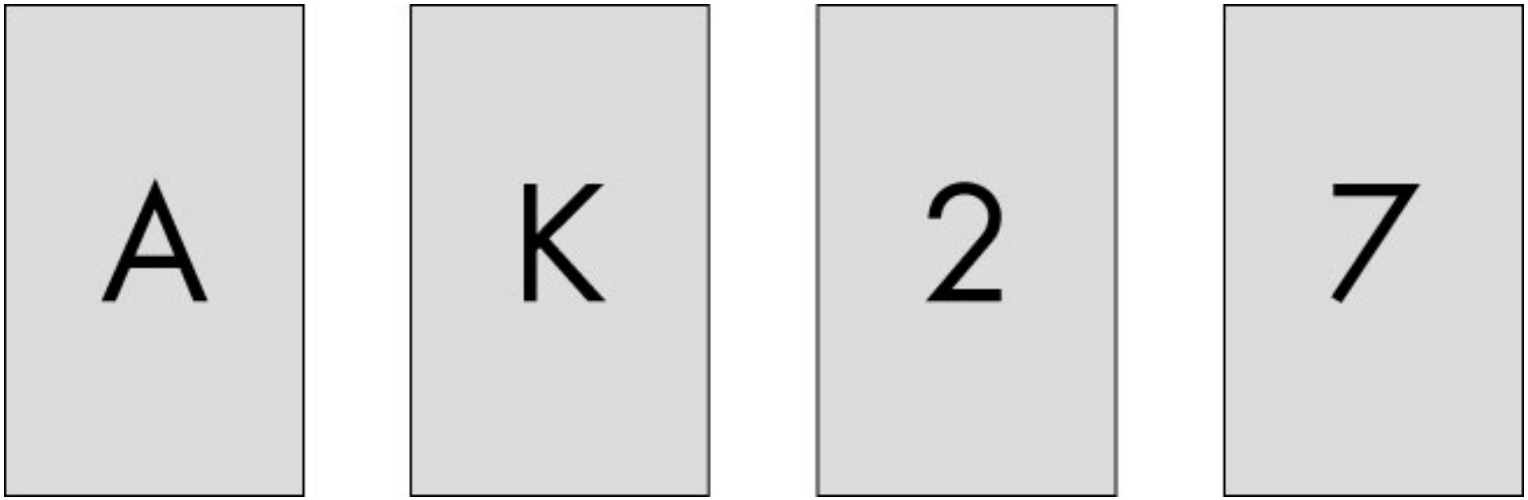
In particular:

- What are the kind of introspective capacities that rational agents in principle can or can not have?
- How is Metacognition related to Belief Revision?
- What formal limitations apply to Metacognition?

Our work so far

- “Conditional beliefs vs. Beliefs in conditionals” (Leitgeb)
- A probabilistic semantics for counterfactuals (Leitgeb)
- A probabilistic version of a result in Belief Revision proven by André Führmann regarding *introspective rational agents* (Duca-Leitgeb)
- The relation between (indicative) conditionals and rationality (Duca)

A case study: WST



S : "If there is a vowel on one side then there is an even number on the other"

Task : "Which card/s should one turn in order to decisively determine whether *S* is true or false?"

- If we model *S* via Material Implication, people's performance is generally very poor, i.e. according to classical logic they give the *wrong* answer
- It may be argued that this casts some doubts on the rationality on human reasoning

IQ What if we model *S* via Adams' probabilistic semantics for indicative conditionals, where the connective expresses a high subjective conditional probability?

Probabilistic validity for indicative conditionals

(Ernest Adams)

"How can arguments using indicative conditionals be probabilistically valid?"

- The more certain the premises the more certain the conclusion

Theorem

An argument is probabilistically valid (or p-valid) iff the following is the case:
"If each premise tends to 1 at the limit, then the conclusion necessarily tends to 1 (for all probability measures)".

For instance...

Classical validity	**Probabilistic validity**
Modus Tollens ✓	*Modus Tollens* ✓
Contraposition ✓	Contraposition X

A counterexample to Contraposition

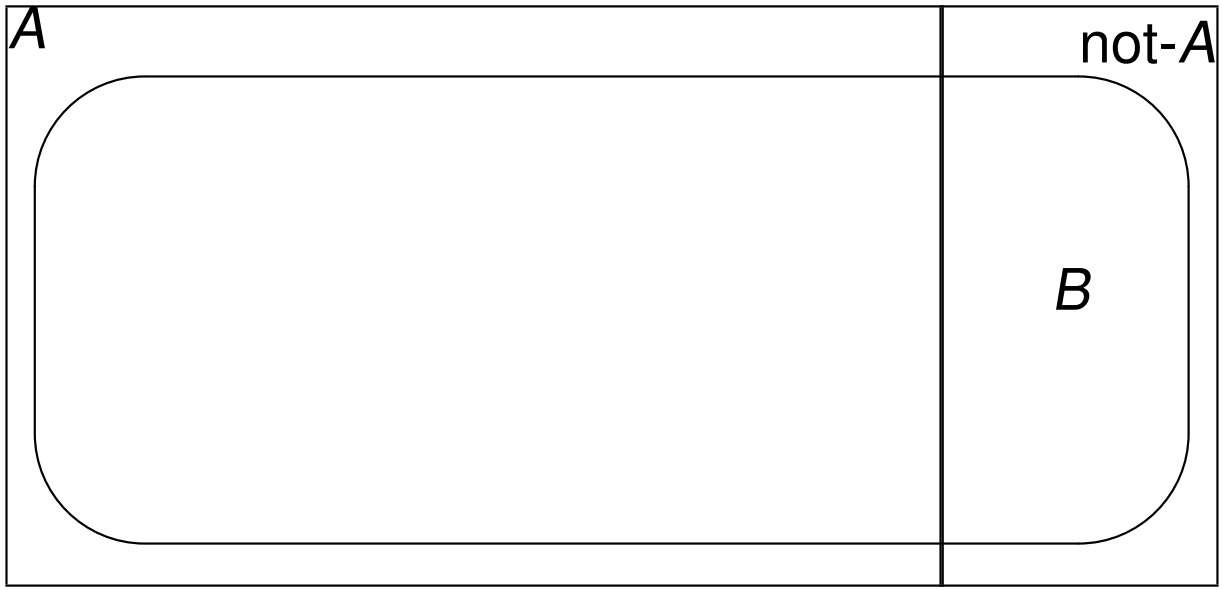


Figure: The probability of the conditional $A \rightarrow B$ is high, while the probability of $\neg B \rightarrow \neg A$ is low.

Back to WST

People's performance is generally poor. Why?

- Classically, because they fail to apply the rule of Contraposition.

But probabilistically, Contraposition is invalid!!!
So what?

- In performing the task, people actually do what they should, i.e. refrain from drawing a conclusion that is based on an invalid rule.

Conclusions

- My hypothesis is that people consider (unconsciously) whether to apply Contraposition and then actively reject doing so.
- Probability Logic set a normative (logical) standard that seems to better accommodate the data.
- Possible cooperation? Kleiter, Lowë, Gilio.

Thanks for your attention!

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