The Reasoner

Volume 13, Number 4
April 2019

thereasoner.org
ISSN 1757-0522

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Guest Editorial

Being a guest editor of The Reasoner I took the opportunity to interview Ulrike Hahn. Ulrike is a professor at the Department of Psychological Sciences at Birkbeck College, University of London, and director of the Centre for Cognition, Computation and Modelling. She's also part of the faculty at the Munich Center for Mathematical Philosophy as the Anneliese Maier Research Awardee.

Given her broad expertise, research interests, and methodological approaches, it would be hard to find a better one-word description to sum it all up, other than *reasoning*. Given my research interests, it was clear from the start that we will be talking mostly about decision-making and (bounded) rationality.

Gasper Štukelj
Munich Centre for Mathematical Philosophy

Features

Interview with Ulrike Hahn

Gasper Štukelj Hi Ulrike, thanks for doing the interview. Before I zoom in on the topic of (bounded) rationality, could you tell us a bit about your background and research interests?

Ulrike Hahn: I started out by qualifying as a lawyer (mistake..), before coming to the UK to do a Masters in Cognitive Science and Natural Language at Edinburgh University. That was followed by a PhD in Experimental Psychology in Oxford. I started out with an interest in reasoning and categorization, then went off and did psycholinguistics for a few years (because it seemed much more rigorous) and then stumbled into argumentation research together with Mike Oaksford, which turned out to be way more rewarding and interesting than I had expected. It was through that, that I then also became interested in probability judgment and decision-making –thanks to philosophers, actually, who kept telling us in reviews of our papers on Bayesian argumentation that Tversky and Kahneman had "already showed us that people aren't Bayesian"... so I thought I better read that stuff.

GŠ: Speaking of which, Kahneman (American Economic Review, 2003) mentions looking for "a cognitive illusion that is analogous to the visual illusion". You've co-authored two very interesting papers comparing moto-perceptual and economic decision-making (Jarvstad et al. PNAS, 2013; Cognition, 2014). Could you briefly explain them?

UH: Andreas Jarvstad (now a member of academic staff at City, U. of London) came to me asking about PhD possibilities. He couldn't make up his mind whether to work

on perception or cognition, and I suggested we do both. We expected to spend many years trying to examine the multitude of ways in which perceptual and perceptuo-motor tasks – which typically reveal optimal or near-optimal human performance – differ from classic, paper and pencil decision-making tasks within the cognitive psychology literature, which have seen performance classed frequently as rather poor. For example, probability information is both implicit and agent-internal in the former, but explicit, and agent external in the latter. Any of these factors could be giving rise to the performance differences observed, but we never really got around to these, because we didn't actually find any performance differences once you made the tasks exactly comparable in other ways. In particular, when you assessed performance in the same way. Whereas the cognitive psychology literature had focussed on the mere fact of violations of axioms of expected utility theory, the perceptual literature had typically evaluated performance relative to an ideal agent. Many of the 'violations' (say in Tversky and Kahneman's classic Econometrica paper) don't "cost" a lot to the agent, so give a somewhat overly negative perspective; so, from an adaptive perspective, optimal agent-style analyses seem preferable. At the same time, the Cognition paper sadly revealed that optimal agent-based analyses aren't always as robust as one would like.

GŠ: Do you think the findings are relevant for the ecological rationality research program? Could the equivalence in performance be taken as evidence for existence of e.g. motor heuristics (Raab, Curr. Op. in Psy., 2017)?

UH: For me, the big takeaway from the PNAS paper was that the individual differences between participants far outweigh any discernible differences produced by between domains (perceptuo-motor vs. cognitive) or description format (implicit probabilities versus explicit numbers). It seems to me we should be directing much more research in that direction.

GŠ: You've done a lot of work concerning normative standards in psychological research. What do you make of the quantum-theoretic approaches (Busemeyer & Bruza, Cambridge, 2012)?

UH: I'm afraid I'm not a great fan of quantum-theoretic approaches, though I know and like a lot Emmanuel Pothos who has published on them with Jerry Busemeyer (Emmanuel and I shared a PhD office back in the days…). I find the basis for the rationality claims (bounded or otherwise) dubious. They seem to want to appeal to classical probability and its normative foundations to provide the normative foundations for quantum probability by pointing out that the quantum framework is a generalisation. But you can't then use that argument to ground the theory for those bits where it is in direct opposition, such as the conjunction fallacy, so I don't see that going anywhere. At the same time, I simply see no adaptive rationale for quantum probability at the macroscopic level we inhabit. It is clearly entirely possible for Tversky and Kahneman's Linda to be a feminist and a bankteller, so what's the point?

GŠ: Bounded rationality is a psychological theory with a very descriptive flavor. What new do you see philosophers bringing to the table?

UH: I am hoping for a lot more rigour in taking the normative questions seriously.

GŠ: I've saved the most controversial question for the end. Would you say humans are rational or irrational reasoners/decision-makers?

UH: That's one of those glass half full/glass half empty issues: clearly, there are behaviours and beliefs around us that seem irrational, but there are also ample signs of rationality, both individually and collectively in the kinds of structures and institutions we have built up. The most important things to me are, one, to work out what truly should count as rational in a given context (with more normative foundation than just someone's intuition!) and, two, to not jump hastily into attributions of "irrational" for every belief, thought or behaviour that seems strange or different from our own. It's in that context that I suspect the irrationality card is massively overplayed and that helps no one, neither theorists nor us going about our daily lives.

GŠ: Is there anything more you'd like to share with the readers of the Reasoner?

UH: It seems like a great time for reasoning research!

News

Calls for Papers

HaPoC 2019: 5th International Conference on the History and Philosophy of Computing: , deadline 30 April.

Folk Psychology: Pluralistic Approaches: special issue of *Synthese*, deadline 15 May.

Imprecise Probabilities, Logic and Rationality: special issue of *International Journal of Approximate Reasoning*, deadline 1 June.

Nancy Cartwright's Philosophy of Science: special issue of *Theoria*, deadline 1 November.

What's Hot in …

Medieval Reasoning

Having been in Durham for a couple of months now I am extremely impressed at how lively an intellectual environment it is, particularly in my area of interest – i.e. historical approaches to rational philosophy, especially in the middle ages. If you happen to be in this area, you can find the many activities sponsored by the Durham Centre for Ancient and Medieval Philosophy at this address: `http://www.dcamp.uk/calendar/`.

Among other things, I am very excited for the upcoming workshop on *Britain's Early Philosophers* (April 1-2), organised by Sara Uckelman. When I must describe the work I do, I tend to define myself overall as a medievalist. And yet I know much less about philosophy in the earlier middle ages than I do of the later centuries. This is not just because my particular area of expertise is between the 12th and the 15th centuries – even if that plays a role – but also because scholars haven't been talking of those earlier centuries as much or have often maintained the assumption that early medieval philosophy was philosophy only loosely speaking. Nonetheless, working on these earlier authors, from the supposedly darkest hour of the dark centuries,

forces us to deal directly and unavoidably with the usual issues on our preconceptions about philosophy, logic and rationality, vs their nature and the shapes that they have taken throughout history, especially in contexts where they don't seem immediately recognisable. This is why the upcoming workshop, bringing together scholars working on philosophy in Britain in the earlier middle ages, is particularly interesting and exciting, especially for a late medievalist like myself. http://www.dcamp.uk/britains-early-philosophers/

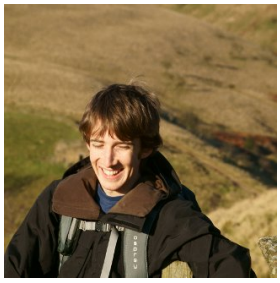
The lineup is great and includes talks on Alcuin's logic (Jack Coopey) and on Abbo of Fleury's arithmetic (Clelia Crialesi), which might be of particular interest to our readers.

If you would like to join us, just drop Sara a line (s.l.uckelman@durham.ac.uk).

Graziana Ciola
Durham University

Uncertain Reasoning

I'm writing this month's "What's Hot..." column about a paper that is quite new, and I'm still trying to digest its results. So this column is my attempt to understand what's going on.



Let's start with your standard betting argument for constraints on rational belief. It's irrational to accept a set of bets that guarantee you a sure loss, and depending on what further rational constraints you agree to, this will give you some form of norm for how you ought to set your prices for gambles (probabilism for example). How easy is it to decide whether a particular set of gambles is immune to sure loss? Even if the state space is finite – so the problem is at least decidable – this problem is, in general NP-hard. That is, it is a computationally demanding task to figure out whether a certain set of gambles avoids sure loss. You're essentially searching a really big space of sets of gambles to find out if there are any that (i) you are committed to finding acceptable because of the rationality constraints and (ii) suffer a sure loss. If there are any such, then your set of gambles is incoherent. Is there a less demanding kind of rationality, where you are only expected to be able to perform computationally less demanding search tasks? It turns out that there is. (I'll give you the reference at the end of the next paragraph, because writing it out here would spoil the punchline of this column.) If you only require your agent to search for gambles that satisfy (i) and (ii) in a systematically smaller space of sets of gambles (one for which the search is achievable in polynomial time) then you could be "P-coherent". One can then prove that if you are not also coherent in the stronger sense – that is, if you do not avoid sure loss in the more demanding sense – then there are only a limited number of ways your set of gambles and associated price assignments could be. This is an interesting, if slightly weird result. But the really wild stuff happens when we add one further ingredient.

So far we've been assuming that we're dealing with your standard classical set-up of gambles over a set of states. What if, instead, we considered gambles that result from the action of a self-adjoint operator on a Hilbert space? That is, what if we described events not by sets of states, but by projections onto a subspace of a vector space? What happens is this: for a suitable definition of polynomial-time-searchable space of gambles, you can essentially derive quantum mechanics from just the principle that you ought to be P-coherent! That is, from just that idea that you ought to figure out if you're suitably coherent in a computationally tractable way, plus some assumptions about what gambles you're committed to accepting, you can show that your prices for gambles can exhibit all the weird properties of quantum mechanics (e.g. entanglement). This is a surprising result. You get the theory of quantum mechanics out of just insisting that you ought to be able to figure out if you're coherent in a computationally tractable way. Here's the reference: Benavoli, Facchini and Zaffalon "Computational Complexity and the Nature of Quantum Mechanics" arXiv:1902.04569v1.

As you can probably tell, I'm still digesting this result. I find the result intriguing. I can't pretend I fully understand it yet, but it's a weird and surprising fact. I'm not sure I know what this means about the interpretation of quantum mechanics, or whether it really even tells us anything new (after all, "Quantum Bayesianism" is not new). But the connection to computational complexity is a new twist. It's another interesting and possibly deep connection between computational complexity and quantum mechanics (the more standard connection being the fact that quantum computers can solve some kinds of hard problems much faster than conventional computers). (For more on the topic of computational complexity in a very accessible form, see Aaronson "Why Philosophers Should Care About Computational Complexity" arXiv:1108.1791).

Seamus Bradley
Philosophy, University of Leeds

Mathematical Philosophy

In this column, I'd like to talk about *truthmakers*: those things in the world (states of affairs, actions, events, etc.) that are responsible for the truth or falsity of our claims about the world.—Truthmakers have been around in philosophy for a while, especially in metaphysics. The project of truthmaker metaphysics is to use truthmakers as a guide to metaphysics and ontology. The idea would be, for example, to take statements about numbers, like "there are just seven swans on the lake" or Kant's ubiquitous example of "7 + 5 = 12," to determine their truthmakers, and to let the results of this investigation tell us whether numbers exist, what's their nature, etc. This is roughly the metaphysical project of David Armstrong and others.

But truthmaker metaphysics is not what I think is "hot" in mathematical philosophy. What I'd like to talk about, instead, is a different kind of project involving truthmakers: the project of truthmaker *semantics*. I wish to propose that we mathematical philosophers can help realize the philosophical potential of this project, which has recently been championed by Kit Fine and others (see Fine's overview piece "Truthmaker Semantics," in *A Companion to the Philosophy of Language, Second Edition*, edited by Bob Hale, Crispin Wright, Alexander Miller, Wiley 2017).

The idea is to use truthmakers in order to elucidate semantic concepts, like content, aboutness, or truth. In this way, truthmaker semantics differs from truthmaker metaphysics, which is primarily interested in metaphysical questions, like what exists or what's the nature of things.

Truthmaker semantics is an alternative to standard possible-worlds semantics. This difference comes out clearly when we think about how the two semantics think of semantic content. In possible-worlds semantics, the content of a proposition is typically understood in terms of the possible worlds where the proposition is true. In truthmaker semantics, in contrast, the idea is to model the semantic content of a proposition in terms of its truthmakers.

Truthmaker semantics has cut-and-dry applications in metaphysics, and this is also where we can clearly see the advantage it provides over the possible-worlds approach. In his more programmatic piece "Hyperintensional Metaphysics," Daniel Nolan proclaims: "The twenty-first century is seeing a hyperintensional revolution" (*Philosophical Studies* 171(1): 149–160). By this he means that metaphysicians have come to realize that *hyperintensional concepts*, i.e. concepts which can differ among necessary equivalents, are central to many important metaphysical questions.

The concept of *metaphysical grounding*, which is typically glossed as the relation of one truth holding *in virtue of others*, provides an illustrative example. Intuitively, the propositions that $7 + 5 = 12$ and that $e^{i\pi} + 1 = 0$ have different grounds—the one holds solely in virtue of facts about the natural numbers while the other holds, at least partly, in virtue of facts about the rational and irrational numbers. But the two statements are necessarily equivalent! They are both, after all, necessary truths. This means that grounding is a hyperintensional concept: two necessarily equivalent propositions can have different grounds.

But from this it follows that there is simply no way of giving a semantics of ground purely in terms of possible-worlds. The propositions $7 + 5 = 12$ and $e^{i\pi} + 1 = 0$ are true in exactly the same possible-worlds (all of them!), meaning their semantic content in possible-worlds semantics is the same. Consequently, in possible-worlds semantics, we cannot account for their different grounds.

This is, in a sense, old news. We know that possible-worlds semantics is intensional and thus obviously has issues with hyperintensional concepts. But before the start of the "hyperintensional revolution," this was largely seen as inconsequential for most of philosophy, especially metaphysics, since hyperintensionality was viewed as a primarily epistemological phenomenon. Only in recent years, the significance of hyperintensional phenomena has begun to be appreciated in other subfields of philosophy, like in metaphysics.

And that's where truthmakers enter the picture again. In his "Guide to Ground," which in 2012 was included in the *Philosopher's Annual* (Volume XXXII), Kit Fine argues that we can give a truthmaker semantics for metaphysical ground: the idea is (roughly) that we can understand grounding as a special kind of truthmaker preservation. In this way, truthmaker semantics can do something that possible-world semantics can't: account for the hyperintensional concept of metaphysical ground.

It's perhaps a bit of a grandiose claim, but I'd like to suggest that truthmaker semantics has the potential to play the same role for the hyperintensional revolution that possible-worlds semantics has played for what Nolan calls the "intensional revolution" of the last century. By this, Nolan means the rise of modal/intensional distinctions and the use of the possible-worlds framework that analytic philosophy experienced in the second half of the twentieth century. The formal work on possible-worlds semantics carried out by Barcan-Marcus, Carnap, Hintikka, Kripke, and others functioned as a catalyst for this development. My proposal is that truthmaker semantics can play a similarly catalyzing role for the hyperintensional revolution.

Part of the appeal of the possible-worlds framework derives from its versatility: it has found fruitful applications in metaphysics, epistemology, philosophy of language, ethics, and elsewhere in philosophy. Well, neither are the applications of truthmaker semantics limited to metaphysics. To give just one example of the many interesting applications that have surfaced in recent years, consider Stephan Krämer's paper "A Hyperintensional Criterion of Irrelevance" (*Synthese* 194(8): 2917-2930), in which Krämer uses truthmaker semantics to tackle hyperintensional issues in Bayesian confirmation theory. Now this is where things get interesting for us mathematical philosophers: there are many other applications to explore and work to be done.

My hope is that we truthmaker semanticists will help put the hyperintensional revolution on solid philosophical footing by providing robust mathematical results. But perhaps another hyperintensional semantics, like impossible-worlds semantics, will prove to be more fruitful, or perhaps the hyperintensional revolution will fail altogether. There's only one way to find out: Let's get to work!

PS: If you got interested in truthmaker semantics, consider joining our summer school in Hamburg this year: https://hamburgersommerkurs.wordpress.com/.

Johannes Korbmacher
Munich Centre for Mathematical Philosophy

Events

April

SHE: Seminar on Historical Epistemology, University of Milan, 2 April.

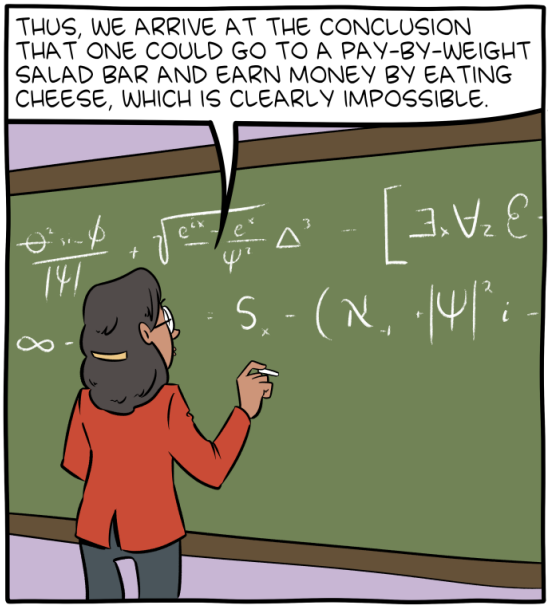
LoE: Workshop on Levels of Explanation, University of Birmingham, 3 April.

ResLog: Reasoning, Argumentation and Logic in Natural Language: Experiments and Models, Ruhr University Bochum, 3–5 April.

Formal Methods and Science in Philosophy III, Dubrovnik, Croatia: 11–13 April,

.MA: Conference on Mathematical Ability, Utrecht University, 17 April.

H-OE: Higher-Order Evidence, University of Southampton, 25 April.



Disproving the idea of negative mass was remarkably easy.

May

EMaTC: Episodic memory and Temporal cognition, University of Antwerp, 2–3 May.
ExLog: Explaining Explanation Using New Developments in Logic, Belgium, 6–8 May.
SSR: Science Self-regulation: Between Marketization, Bureaucratization, and Professionalization, Belgium, 9 May.
BMiPoS: Mental Imagery and Bayesian Models in Philosophy and Cognitive Science, Belgium, 9 May.
BtB: Beyond the Brain. Reconceptualizing Mental Disorders, University of Edinburgh, 9–10 May.
TiPoB: Recent Trends in the Philosophy of Biology, Bilkent University, 17–18 May.
OiSR: Objectivity in Social Research, University of Bergen, 23–24 May.
PPoMK: Philosophical Perspectives on Medical Knowledge, University of Genoa, Italy, 28 May.
LogiDis: Workshop on Logical Disagreements, University of Bergen, 28–29 May.

June

Logic and Metaphysical Commitment, Israel: 13–14 June,
.
Tractable Probabilistic Modeling, Long Beach, California: 14–15 June,
.
SECC: Scientific Explanations, Competing and Conjunctive, University of Utah, Salt Lake City, 26–28 June.

Courses and Programmes

Courses

SSA: Summer School on Argumentation: Computational and Linguistic Perspectives on Argumentation, Warsaw, Poland, 6–10 September.

Programmes

APhil: MA/PhD in Analytic Philosophy, University of Barcelona.
Master Programme: MA in Pure and Applied Logic, University of Barcelona.
Doctoral Programme in Philosophy: Language, Mind and Practice, Department of Philosophy, University of Zurich, Switzerland.
Doctoral Programme in Philosophy: Department of Philosophy, University of Milan, Italy.
LogiCS: Joint doctoral program on Logical Methods in Computer Science, TU Wien, TU Graz, and JKU Linz, Austria.
HPSM: MA in the History and Philosophy of Science and Medicine, Durham University.
Master Programme: in Statistics, University College Dublin.
LoPhiSC: Master in Logic, Philosophy of Science and Epistemology, Pantheon-Sorbonne University (Paris 1) and Paris-Sorbonne University (Paris 4).
Master Programme: in Artificial Intelligence, Radboud University Nijmegen, the Netherlands.
Master Programme: Philosophy and Economics, Institute of Philosophy, University of Bayreuth.
MA in Cognitive Science: School of Politics, International Studies and Philosophy, Queen's University Belfast.
MA in Logic and the Philosophy of Mathematics: Department of Philosophy, University of Bristol.
MA Programmes: in Philosophy of Science, University of Leeds.
MA in Logic and Philosophy of Science: Faculty of Philosophy, Philosophy of Science and Study of Religion, LMU Munich.
MA in Logic and Theory of Science: Department of Logic of the Eotvos Lorand University, Budapest, Hungary.
MA in Metaphysics, Language, and Mind: Department of Philosophy, University of Liverpool.
MA in Mind, Brain and Learning: Westminster Institute of Education, Oxford Brookes University.
MA in Philosophy: by research, Tilburg University.
MA in Philosophy, Science and Society: TiLPS, Tilburg University.
MA in Philosophy of Biological and Cognitive Sciences: Department of Philosophy, University of Bristol.
MA in Rhetoric: School of Journalism, Media and Communication, University of Central Lancashire.
MA programmes: in Philosophy of Language and Linguistics, and Philosophy of Mind and Psychology, University of Birmingham.
MRes in Methods and Practices of Philosophical Research: Northern Institute of Philosophy, University of Aberdeen.
MSc in Applied Statistics: Department of Economics, Mathematics and Statistics, Birkbeck, University of London.
MSc in Applied Statistics and Datamining: School of Mathematics and Statistics, University of St Andrews.
MSc in Artificial Intelligence: Faculty of Engineering, University of Leeds.
MSc in Cognitive & Decision Sciences: Psychology, University College London.
MSc in Cognitive Systems: Language, Learning, and Reasoning, University of Potsdam.
MSc in Cognitive Science: University of Osnabrück, Germany.
MSc in Cognitive Psychology/Neuropsychology: School of Psychology, University of Kent.

MSc in Logic: Institute for Logic, Language and Computation, University of Amsterdam.
MSc in Mind, Language & Embodied Cognition: School of Philosophy, Psychology and Language Sciences, University of Edinburgh.
MSc in Philosophy of Science, Technology and Society: University of Twente, The Netherlands.
MRes in Cognitive Science and Humanities: Language, Communication and Organization: Institute for Logic, Cognition, Language, and Information, University of the Basque Country (Donostia San Sebastián).
Open Mind: International School of Advanced Studies in Cognitive Sciences, University of Bucharest.
Research Master in Philosophy and Economics: Erasmus University Rotterdam, The Netherlands.

Jobs and Studentships

Jobs

Post doc: in Philosophy of Science, University of Southern Denmark, open until filled.
Chair: in Philosophy, University of Edinburgh, deadline 5 April.
Post doc: in Truth and Semantics, University of Bristol, deadline 14 April.
Professor: in Statistics, University of Kent, deadline 15 April.

Studentships

PhD position: in Individual and Collective Reasoning, University of Luxembourg, open until filled.