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Guest Editorial

As guest editor, I would like to put a spotlight on the logical perspective on reasoning. This month's interview is specifically devoted to the logical approach to games, an emerging field that is interested in the reasoning of players in strategic contexts, but also in their communication, information dynamics, and their beliefs about each other.

I am delighted that Johan van Benthem is sharing his attitudes and experiences concerning logic for games (and why he doesn't like this term) with us. Johan van Benthem is Henry Waldgrave Stuart Professor of philosophy at Stanford University, Jin Yuelin Professor of philosophy at Tsinghua University, and University Professor emeritus of pure and applied logic at the University of Amsterdam. He has published widely on logic in games, including a monograph and numerous research articles. Besides, he has worked on logics for computation and action, social interaction, and information dynamics, as well as numerous other aspects of logic.

Dominik Klein
University of Bayreuth and University of Bamberg

Features

Interview with Johan van Benthem

Dominik Klein : Could you start by telling us a little bit about your background, and how you got into logic?

Johan van Benthem : In high school, I gobbled up everything, from the humanities to the sciences. But my main ambition was to become a literary author uncovering the basic patterns of life, and who knows, even our destiny. However, after having had some teenage manuscripts turned down by a wise publisher, I went on to study physics in Amsterdam, and became interested in patterns of reasoning in scientific theories. An accidental logic course, which just happened to be taught at the top floor of our physics building, opened my eyes to the beauty of abstract 'thinking about thinking', and I have been sold ever since. I switched to a joint study, obtaining master's degrees in both mathematics and philosophy, the two purest branches of reasoning, that in my view nicely complemented each other. From that vantage point, over time, I saw analogies and related topics in linguistics, computer science, and the whole family of disciplines dealing with language, information, and computation. That is still my world today.

DK: Much of your work has been about logics of agency and multi-agent logics. How or why did you become interested in these topics?

JvB: : Originally, not at all! My dissertation is about mathematical perspectives on modal logic, a discipline given to us

by the philosophers, but which has benefited immensely from approaching it in a mathematical, and later also a computational stance. The 'correspondence theory' that I developed in that youthful work was all about seeking methodological unity through systematic translations, or correlations, between different logical systems and their research agendas. The joys of seeing shared patterns between what look like different schools is still a driving force in my research, as opposed to those people who think that every new idea needs to be a radical revolution.

Dynamics was not even on my horizon. Around 1980, I was into philosophy of science, and increasingly also, the logical study of natural language, where many avant-garde logicians saw the road of the future. I worked with logicians and linguists on generalized quantifiers, categorical grammar, and many other features of language, though mostly with an emphasis on mirroring the structure of the world, not on the people who actually use natural language to communicate. I am not repudiating any of that work today, but I do think it would be nice to return to these by now classical syntactic and semantic topics from an agency perspective.

Around 1990, I became interested in the dynamics of actions that produce or modify information. I proposed dynamic logics that turn these actions into first-class citizens, dragging them from the dimly lit backstage of informal stories behind existing systems. Doing so brings to light analogies across several fields, as in my book "Exploring Logical Dynamics" (1996). But the multi-agent perspective on all this, so natural because so many informational actions involve more than one agent, took again some time, maybe until about 2000. One excuse is that others were no faster than me: just think of how long it took semanticists to go on the road from world-descriptive truth conditions to update conditions where one agent influences another, and only then to game-theoretic perspectives where language users are on a par, and highly entangled when speaking and hearing, or writing and reading. My other excuse is my Calvinist upbringing, where social interaction with others was considered going the easy way of 'the world' (not good), distracting us from the only thing that really matters: one's relationship to the divine, and the account ledger of sins. Be that as it may be, afterwards, I went social all the way, and my book "Logical Dynamics of Information and Interaction" (2011) is as multi-agent as it gets.

DK: Let us slowly get into today's topic: Logic for Games. For a start: Could you very briefly sketch what the logical approach to game theory is about.

JvB: : Communication is a game – and interviews, no matter how impoverished as a form of communication, are games too. If I were to accept the phrasing of your question, I might end up in a losing part of the argumentation game tree where I do not want to be!

In my own work, games have entered naturally in a two-sided relation with logic. There has been a sort of battle of prepositions to name these directions. My "Logic in Games" distinguishes 'logic of games', the logical study of games, from 'logic as games', the game perspective on logical notions such as truth, invariance, and inference. Erich Grädel prefers "logic for games" and "games for logic", and maybe that makes the point better – though "for" to me has the connotation of development aid, which is not what I intend. I think that both perspectives are natural, both have an interesting and still growing theory, and it is their entanglement that makes the field.

Now for 'logic for games'. Even here I would like to make a distinction, to set the scope, and the claims one might make, right. A logical approach to games is not identical to a logical study of game theory — unless one somehow grants that games are the sole intellectual property of game theory, which then acts as their only licensed spokesperson. I would say that the logical approach to games tries to understand the nature of reasoning about, and also inside, strategic multi-agent scenarios. I believe that this is both important for its ubiquity, and because it brings together about every major notion studied in philosophical logic in one concrete setting: action, knowledge, belief, conditionals, preferences, intentions, and what have you.

In addition, computational logic, too, has many things to offer. For instance, I believe that equilibria in social behavior are close to fixed-points in computation, and are best understood that way. So, for many decades, logicians have already been thinking about game-related notions, be it usually in separate compartments. If you think of logic as a broad perspective without preset boundaries, this is where we want to be. Using the study of games helps us see new ubiquitous patterns across behavior, such as forms of rationality, dependence of knowledge and action, information flow, or goal dynamics.

In this light, one could think of logic as a rival to game theory in looking at games. However, this is not at all my aim: game theory has done a great job, and we are merely offering further perspectives and insights. Of course, there is also the more foundational stance. A logician could look at the structure of game theory and try to elucidate that, just as logicians have done with many other mathematical theories. I am interested in this line, too, including new mathematical notions of game equivalence, logical structure of basic theorems of game theory, and so on – but so far, there have not been many incisive examples of this sort of work. In particular, there are no striking limitation results yet about the logic of interaction, like the ones produced by Gödel and his generation in the Golden 1930s about proof and computation, that I find completely convincing. The successful modern world of game theory may be largely of the "Can Do" type, but sometimes the "Cannot Do" results are the more interesting for understanding what we academics are trying to achieve.

DK: Logical formalization is frequently described as a type of explication: By translating facts or theories into a logical apparatus, we can gain additional clarity - and maybe discover some novel relations. But classic game theory comes readily equipped with some powerful formal frameworks: Calculus and probability theory. So what exactly is it, that we can gain from a logical perspective on games?

JvB: : This is beginning to sound like a court of law, but " Your Honor, I object to some of the terms!" 'Translating' sounds mechanical, as if logicians want to translate everything into their formal systems. I see formal systems merely as tools to model reasoning practices and discover laws, so the goal to be achieved is not 'translation', but what I would call 'creative resonance'. And even 'explication', no matter how broad-minded in Carnap's mellower moments, seems a bit static. People then just do what they do, and we try to show them some

patterns in their behavior that they had not noticed before.

I would rather say that we are looking for shared interests and new topics where insights from both sides can help create new things. In fact, 'epistemic game theory', though largely an area where game theorists invented their own logical tools rather than going through the trouble of reading the best available textbooks or papers from logic, is a wonderful example of what can happen then. I very much like, not to say: admire, books like those by Andrès Perea and Adam Brandenburger, not to mention the classics by Aumann, Rubinstein and others. But I see much more potential for joint efforts, in all of the topics that I have mentioned above. One general perspective on what may emerge eventually here is the 'Theory of Play' proposed in van Benthem, Pacuit & Roy.

This is not just dialectics, to stay at a distance from refutable claims about the utility of logic when confronted with thriving competing fields. I once admired the old logicist idea of logic as a basis for everything, but I have come to think of this as misleading, and too unitary. Is arithmetic based on logic, calculus based on arithmetic, game theory based on calculus, and so on? One might just as well say that logic is based on arithmetic, since we cannot understand the simplest notions of logic such as inference patterns and truth tables without having a basic understanding of arithmetic. The logical perspective adds a dimension, I still hang on to that, but it is not the arbiter of putting things in their eternally correct order.

Ah, you say that Game Theory already found its loves: Probability Theory and Analysis. I think that logic can still easily find a place at the table. For instance, it seems to me that some crucial uses of Analysis in game theory are accidental: it was the only technology available at the time, e.g., to prove the Nash fixed-point theorem. But as I said earlier, I now think that metrizing the spaces and so on, in order to apply the Brouwer and Kakutani theorems, may lead us away from the essence of equilibrium, which may be captured better by qualitative fixed-point logics. (My apologies to you, Dominik, since I know that you have metrized spaces of models to bring dynamical systems theory to logic: that is all fine, but the opposite makes sense just as well.)

Logic and probability is in fact much easier: this is a booming interface today, not just confined to game theory, and I expect that a lot of foundational work today will result in a combined theory of the qualitative and quantitative that will have an impact on many fields, and that may even bridge the divide between logical and probabilistic methods in formal philosophy.

The last thing I want to mention is this. There is also an activist side to the history of logic not captured by 'study of reasoning', 'explication' and so on. Following Marx, whose dictum "Logik ist das Geld des Geistes" (Logic is the currency of the mind) is one of those deep German sayings one can ponder for a lifetime, logicians have not been content with just interpreting the world. They also changed it, for instance through the birth of computer science and AI. As just one instance, logic is a great source of inspiration for the design of new games and new forms of interaction, as shown in my book and in my current work with Fenrong Liu on graph games – and game theory and logic may well meet in this activist stance.

DK: There are a variety of interpretations to Game Theory: descriptive, prescriptive or predictive, plus some side branches such as mechanism design. Do you see logic fit particularly well with any of these sides, or is it neutral with respect to this division?

JvB: : The normative-descriptive distinction is tricky, and the two terms may just denote points on a spectrum. Logical validity is not determined by empirical studies or opinion polls in class, but it is also true that logical systems that are too far from reasonable practice would hardly have any interest. I think that the laws of agency studied in my work are valid, and in that weak sense, normative. But the agenda of the field also reflects non-normative perspectives: it is clearly influenced by descriptive concerns, and by the search for generality, coherence and beauty that permeates every scientific field. Having said that, normative perspectives do arise naturally in many places. For instance, they are needed to make sense of whole areas such as belief revision theory: what would it mean to 'correct' one's beliefs if there is no norm of correctness?

All this does not add up to a deep answer to your question, I am afraid. And if I had to characterize the views of the professional logicians I know on the issues you raise, it seems fair to say that these views are in flux, and nowhere near a considered consensus.

DK: Could you give us your perspective about the relationship between logic and reasoning. In a more orthodox perspective, you sometimes hear people say that philosophical logic should track standards of correct inference, making it partially normative. But this does not square well with the idea that, for instance, there are well-known counterexamples to the $S5$ axioms of knowledge - and yet we keep using these productively. So what exactly is it, that (multi) agent logic is or does?

JvB: : This is of course related to the previous question. But let me first say this.

Philosophical logic has tended to emphasize idealized systems (a notion that itself is not all that clear), and the touchstone for their adequacy was often 'philosophical intuitions', a mysterious talent that adolescents develop, especially in American PhD programs, and perhaps also in Oxford and Cambridge. But logicians and especially semanticists have also appealed to common sense judgments of language users, and nowadays one even sees philosophical talks referring to corpus data or experiments on Mechanical Turk. This would be closer to cognitive reality. Again, I see the same ambiguity as in my previous answer. Multi-agent logics model idealized agents, but if they were completely out of tune with human behavior, their staying power would be hard to explain.

Your example of $S5$ is very interesting. Despite decades of complaints, axioms that have come under heavy flak from critics do not seem to go away. I do not think this is just inertia, or disdain by logicians. One reason for the persistence may be theoretical attractions, but I also see another phenomenon. I find a view of logics as just modeling some given style of behavior a bit static. In science, we all know the phenomenon that a theory that does not quite fit the phenomena it was originally designed for may have lots of new, unforeseen applications. Likewise, I think that epistemic logic is best viewed as a theory, not of knowledge, but of the more abstract notion of 'semantic information'. And for that notion, the $S5$ axioms are just fine. Also, the descriptive aspects are not just all about us humans. If we take the design stance that I mentioned earlier, we can also use such systems to design computational agents that live by them, making norms and behavior coincide.

More generally, concerning the normativity that you mention, all the twists and turns of my answer to the previous question apply. My one published attempt at getting clear on the interplay of descriptive and normative in the study of reasoning

was a 2008 paper in Studia Logica – but I am sorry to tell you that my thinking in 2019 has not much progressed beyond what I could see back then.

DK: In your mind: What are the most important logical contribution to game theory. Do you want to recommend some papers or books?

JvB: : Again that emphasis! Inverting JFK, ask not what you can do for game theory: ask what game theory can do for you! Seriously, I would shamelessly recommend our survey for the Stanford Encyclopedia of Philosophy. After all, we did our best to be fair and comprehensive. There are also other great entries in the SEP on various other logic-games contacts. I also mentioned exciting and inspiring works by game theorists: Aumann, Brandenburger, Perea, Rubinstein, and others come to mind. In line with this, some books on multi-agent systems are very congenial, like those byWooldridge and Shoham & Leyton-Brown. As for logicians at the interface of logic and games, Robert Stalnaker was a pioneer, while Joseph Halpern may be the most innovative and active person today, injecting lots of new ideas of his own. To round out the picture, I would recommend looking at uses of games in logic and computer science. The books by Väänänen and Grädel, Thomas & Wilke are good sources. And finally, returning to the shameless stance, if you want a unified perspective on this whole world, look at my MIT book "Logic in Games"!

DK: Towards the end : Are you willing to risk a prediction? What will we see of logics for games within the coming 5 or 10 years?

JvB: : As I noticed recently on the Amsterdam science campus, modern universities have started offering complete academic curricula in futurology to beginning students. It has become that easy to predict the future, so why ask me? If I had to hazard a guess, and make it refutable as Popper wants us to, I would just follow some lines I suggested earlier on, and say that we will see a lot of integration between logic and probability in the study of games, that we will see logical bridges across the divide between classical terminating games and infinite evolutionary games, and that the field will move from the more a priori atmosphere of, for instance, my own work in this area to greater concreteness and applicability. Three refutable predictions: Dominik, I hope you are satisfied.

News

Truth and Semantics Kick-Off Workshop & Bristol Logic Meeting 3–4 May 2019

The Truth and Semantics Kick-off workshop & Bristol Logic Meeting took place at the University of Bristol on the 3rd and the 4th of May 2019. It was hosted jointly by the Foundational Studies Bristol (FSB) research group, as part of the Centre for Science and Philosophy at the University of Bristol, and the ERC Starting Grant 'Truth and Semantics' (TRUST 803684), and chaired by Johannes Stern, director of the project. The workshop was the first meeting of the project 'Truth and Semantics', and was intended as a platform for recent work in logic and philosophy of mathematics in the UK.

There were ten talks, ranging from philosophy of language, to philosophy of mathematics, to philosophical logic. The first was on deflationism about truth, by Kevin Sharp (St. Andrews), "Deflationism and creationism". Sharp argued that deflationism, according to which truth does not play any explanatory role whatsoever, is highly problematic, as it is not compatible with truth-conditional semantics. The second talk shifted the focus on modality and metaphysics: Volker Halbach (Oxford), in "The fourth grade of modal involvement", proposed a new account of *de re* modality conceived as a necessity predicate applying to formulae and variable assignments. In "The least of all evils", Carlo Nicolai (KCL) presented a new cluster of non-classical theories of transparent consequence and truth. The main feature of the logic underlying these theories, called by Nicolai "the substructural 'dual" of FDE" and presented as a sequent calculus, is that reflexivity is restricted to atomic formulae of the base language. Crucially, the resulting truth-theories admit full cut elimination and have a nice fixed-point style semantics. In his talk "Type-free Truth for Ramsey-Prior-Williamson-style truth-theories: an initial report" Beau Mount (Oxford) approached truth theories from a rather different perspective. Rather than taking a unary truth predicate as a primitive, he queried whether prominent truth theories á la Kripke-Feferman can be obtained if truth is defined on the basis of a binary Ramseyan 'says'-relation between sentences and propositions. In "Lifting the veil of type distinctions", Salvatore Florio (Birmingham) (joint work with øOystein Linnebo) looked into some of the technical and philosophical questions which arise when one attempts to lift "the veil" of syntactic type distinctions. He showed to what extent this can or cannot be done consistently, pointing at difficult issues arising in intensional settings. Walter Dean (Warwick) presented "The liar and the sorites: towards a uniform arithmetical treatment". He dealt with a topic of deep philosophical and technical interest: how are the paradoxes of truth and vagueness related to each other? Making a pivotal use of the arithmetised completeness theorem to provide interpretations of higher-order notions and vague predicates within the language of first order arithmetic, he showed that both kinds of paradoxes give rise to similar incompleteness phenomena. In "Precisifications in the Supervaluational Kripke Theory", Catrin Campbell-Moore (Bristol)

presented Kripke's fixed-point construction based on supervaluational logic and focused on the precisifications involved in the supervaluational jump. Her original analysis allowed to apply directly the construction to a wider range of notions, for example in epistemology, where the notion of an individual belief's recommendation is simply given to us by the scenario. In his talk, "Generic Validity", Jack Woods (Leeds) dealt with the question whether there is a most basic, foundational, or fundamental notion of logical consequence. He pondered the validity of some arguments put forward by logical pluralists, according to which no notion of logical consequence holds across all contexts. In a nutshell, Woods argued that pluralists? arguments do implicitly assume a single notion of validity that they intend their interlocutor to use, when evaluating their arguments. "Predicativity, Poincaré and constructive mathematics", by Laura Crosilla (Birmingham), gave an insightful overview of the use of predicativity in constructive mathematics. She discussed a proposal by Poincaré to characterise predicativity in terms of invariance, pointing out that this is a more appropriate notion of predicativity in the constructive case. The workshop ended with the inspiring "Loving the Universe", by Tim Button (Cambridge). He presented a new set theory, challenging the assumption widely made in classical set theory: there is the emptyset but there is no universal set. According to Button's theory, however, sets are arranged into well-ordered stages, but every set has an absolute complement. Hence, the universal set exists, as the absolute complement of the emptyset.

Luca Castaldo
Matteo Zicchetti
University of Bristol

Calls for Papers

Imprecise Probabilities, Logic and Rationality: special issue of *International Journal of Approximate Reasoning*, deadline 1 June.
Memory as Mental Time Travel: special issue of *Review of Philosophy and Psychology*, deadline 15 June.
Nancy Cartwright's Philosophy of Science: special issue of *Theoria*, deadline 1 November.

What's Hot in ...

Medieval Reasoning

I have been drafting this month's column on and off trains, planes, waiting at stations and airports, and in between talks at the symposium on *Validity throughout History* that has been going on at UCLA for the last few days. It is conference-hopping season, I guess, but I still feel a bit like a medieval *clericus vagans*. A couple of weeks ago, I was in St Andrews at a lovely workshop on the history of Arabic logic. I was one of the few Latin medievalists in a room of Arabists, which could have been the premise for a somewhat disorienting experience – of the sort that gives you that weird feeling of recognising something familiar and somewhat off centre at the same time. And instead it was not bewildering at all: perhaps because both traditions are in close conversation with Aristotle and the ancients, and probably because Latin-speaking medievals are greatly indebted to classical Arabic philosophy, their respective issues, discussions and often their techniques are very similar in a meaningful way. For instance, I was particularly amazed at how some innovative theories giving a logical analysis of impossible (non-)entities emerge in the 14th century both in post-classical Arabic logic and in the Latin tradition, without any evidence of one group of thinkers reading the other. I went home carrying a renewed, urgent awareness that we – the historians of different logical traditions – need to talk more to each other. So here I am, a week later, in LA at the end of the third day of a conference on the history of logic aiming to do exactly that. It's still too early to take stock of the conference as a whole: there is still a full day ahead of us and I could use some more time to digest and put a whole lot of new (to me at least) theories, methods, concerns and approaches into perspective. (You will likely end up getting a full report in next month's issue.) It has been a wonderful experience, in the most literal sense of the expression. More than once, I found myself struggling to see the rationale for some of the argumentative choices or the ultimate objectives taken up in some theories across the spectrum – from early classical Indian philosophy to some subjectivists logics in the late Russian empire – and yet at the same time I gained some new insight on the group of authors who are my primary research interest, without being any clearer on whether or not by logic they even intended the same thing! Who knows, maybe Lord Dunsany was right and logic is indeed like whiskey and loses its beneficial effect when taken in too large quantities. But one thing is for sure: in the last few days, we have been talking to each other, and we should keep doing that.

Graziana Ciola
Durham University

Mathematical Philosophy

Computational modeling in the form of agent-based models (ABMs), with a long tradition in biomedical and social sciences, has become increasingly popular in philosophy of science and social epistemology. In particular, simulations of scientific inquiry have been used for tackling a variety of questions concerning social aspects of science: from the impact of different social networks on the efficiency of knowledge acquisition, to the division of cognitive labor, to the study of norms that guide scientists facing disagreements etc. At the same time, the proposed models tend to be highly idealized, raising the question: What can we learn from them? As a result, discussions on the epistemology and methodology of models and idealizations have intensified in recent years, marking a new phase in the literature on ABMs of science.

We can roughly distinguish three phases in the research on ABMs of scientific inquiry (inspired by Thiele's et al. (*JASSS*, 17(3)11, 2014) two-phase distinction of the research on ABMs in general). The first phase is marked by the introduction of agent-based modeling to philosophy of science as a method that can be fruitfully applied to some important problems (some of which are mentioned above). The pioneering works of Zollman, Weisberg and Muldoon, Grim and Singer, Douven (building on the famous Hegselmann and Krause's model),

De Langhe—among others—kick-started this line of research around 2010. Most work done in this phase aimed at showing how to simulate scientific inquiry and how to use the simulations to fruitfully tackle philosophical problems. The emphasis here was on the fertility of the method, rather than on the reliability of the models or on the specification of their explanatory features.

In the second phase, previously proposed ABMs have been put to robustness tests and extended to novel application contexts. The robustness analysis includes the examination of the results of a model with respect to changes in parameter values (sensitivity analysis) and with respect to changes in idealizing assumptions of the model (derivational robustness analysis). For example, Rosenstock et al. showed that the results of the above mentioned Zollman's models hold only for a small portion of the relevant parameter space, while my collaborators and I (Frey and Šešelja, Borg et al.) showed that Zollman's results don't obtain when some of the idealizing assumptions are replaced or if we employ a structurally different, "argumentation-based" ABM. Similarly, a number of authors (e.g. Alexander et al., Thoma, Reijula (né Pöyhönen)) questioned the robustness of the results obtained by the famous Weisberg and Muldoon's model. On the other hand, previously developed ABMs have been enhanced in various ways to tackle related philosophical problems. For instance, a number of ABMs aimed at studying scientific polarization, biases or the spread of deceptive information have been built in view of Zollman's work (see works by Holman and Bruner or O'Connor and Weatherall's "The Misinformation Age: How False Beliefs Spread", YUP, 2019), while others enhanced Weisberg and Muldoon's epistemic landscape model (such as Currie and Avin's ABM aimed at examining different types of scientific methods).

Finally, recent discussions in the field have raised the question of empirical validation as a method of examining whether a model adequately represents its purported empirical target and provides reliable information about it. This marks the third phase in the research on ABMs of science, where the study of robustness is complemented with the requirement for an empirical embedding of the models, if they are supposed to be explanatory of actual scientific inquiry. For instance, Martini and Pinto have argued for the significance of empirical calibration of the models, i.e. for using empirical data as the input for ABMs, in view of which they can be tested; Harnagel has developed an ABM tackling the problem of science funding allocation using bibliometric data; Frey and I have used historical information about the mid-twentieth century research on peptic ulcer disease to examine whether the above mentioned Zollman's ABM is representative of this historical episode; finally, Thicke has proposed the criteria of representational and predictive accuracy as conducive to the capacity of a model to provide reliable explanations of predictions of actual scientific inquiry.

While the issues raised in the second and the third phase indicate the advancement of agent-based modeling as a philosophical method, they also come with certain challenges. On the one hand, both sensitivity analysis and derivational robustness can be complex, time-consuming procedures. On the other hand, empirical calibration and validation may be even harder to come by. First, empirical information, which should serve as an input for parameters of the given model, may be hard to estimate (e.g. a typical number of agents comprising the relevant community, typical behavioral features of scientists, which are implicitly assumed in the model rather than being elicited from data, etc.). Second, testing predictions of our ABMs may not be straightforward since the relevant empirical information may again be lacking.

These problems, however, are not unique to ABMs of scientific inquiry. They are at the core of contemporary discussions on scientific modeling and simulations in general. For instance, the tension between simple-but-highly-idealized and complex-but-descriptively-adequate models has a long tradition in the literature on ABMs in social sciences, going back to the so-called KISS ('Keep It Simple, Stupid') and KIDS ('Keep It Descriptive, Stupid') approaches (for the former see e.g. works by Axelrod and Epstein; for the latter e.g. works by Edmonds). Moreover, the question whether and how highly idealized models explain is well entrenched in contemporary debates in the philosophy of economics, as well as in the literature on explanatory properties of models across sciences.

While this suggests that the research on ABMs of science has increased both in scope and complexity in comparison to its beginnings, it also highlights the richness of the topic and the presence of numerous open questions that may greatly benefit from cross-disciplinary engagements. For instance, integrating ABMs of science with the research in digital humanities may help in the efficient usage of big data for an empirical calibration and validation of the models. Moreover, introducing standardized protocols for publications on ABMs (such as the 'ODD' protocol) to the philosophical literature may be an important step towards the reproducibility of the models, facilitating their robustness analyses. Altogether, we can expect to see more exciting developments in this emerging domain in the upcoming years.

Dunja Šešelja
Munich Centre for Mathematical Philosophy

Evidence-Based Medicine

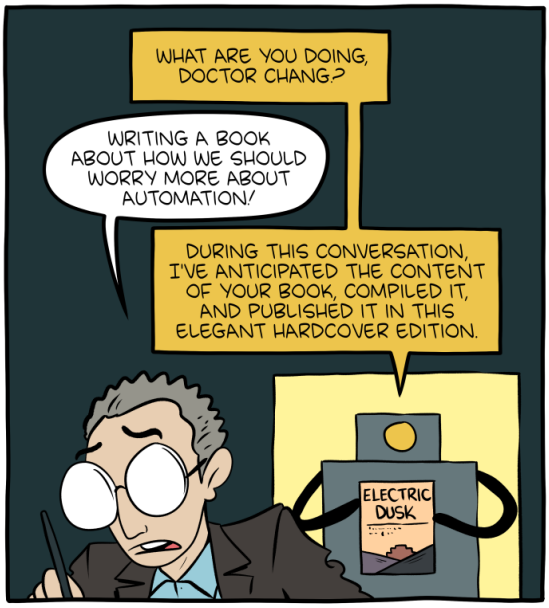
In the world of virology, there is an interesting tale of two interventions. Both are vaccines, well designed and efficacious. However, one intervention, the Human Papilloma Virus (HPV) vaccine, has recently been shown to be effective when administered as part of a national immunisation programme, while the other, the Measles vaccine, has recently seen a decrease in effectiveness. Some clarification of terminology is needed before describing how these efficacious interventions are diverging in effectiveness. If an intervention is efficacious, then it has been shown to work for participants in trials in which it has been tested. If it is effective, then it has been shown to work in the general population. An intervention that has been shown to be efficacious may struggle to show effectiveness for a number of reasons, e.g. differences in the biological make-up of the trial and general population. In the case I will present here, transition from efficacy to effectiveness has been confronted by social barriers to implementation.

First, the success story. HPV infection is a cause of cervical cancer. Vaccination is thus a potential intervention to prevent many cases of cancer. Recently, such a vaccine has for the first time been shown to be effective in a *national immunisation programme*, in Scotland. In fact, it has exceeded the expectations of researchers. The vaccine has prevously been shown to be effective at reducing the kind of cancerous growths that lead to cervical cancer when administered on a case by case basis. Extending those results in a national immunisation programme faces different challenges. If successful however, it can lead to effective eradication of infection in a population through herd immunisation. In Scotland, the authors estimate a vaccine effectiveness of 86% (95% confidence interval 75% to 92%) for the most severe outcome in women fully vaccinated at ages 12-13. A large reduction was observed whether the women were vaccinated or not (from a rate of 0.59% to 0.06%, an 89% decline), suggesting substantial herd protection. Interestingly, the vaccine was designed to target only two types of HPV (16 and 18), while the degree of reduction in infection indicates protection against related HPV types 31, 33, and 456 has occurred. National uptake of this vaccine seems to work, and even beyond the expectations of researchers involved in the design and implementation of the intervention.

The other intervention, the Measles vaccine, has declined in effectiveness over the last several years. Importantly, this is not the result of a drop in efficacy. Instead, social factors have caused a decline in immunisation rates leading to an increase in infection. This has challenged the effectiveness of an otherwise efficacious intervention. Over the past few years, there has been a sharp rise in total cases in Europe, from 25,863 in 2017 to more than 82,000 in 2018. There have also been 72 deaths from measles in Europe in 2018 compared with 42 in 2017. 4th and 5th on the list are France and Italy - countries both with notable resistance to vaccination. One issue is that vaccination coverage is currently not high enough to cause herd immunity - many high income countries have less than the 93-95% coverage rate needed. People who decide not to vaccinate may never get measles, but leave others at risk. This is especially the case for infants too young to get the vaccine, in whom the disease can be devastating. Scepticism over the measles vaccine can be traced back to the now discredited study by Andrew Wakefield 1998 linking the vaccine and autism. But widespread scepticism is now held over the safety and effectiveness of many vaccines, contrary to what our current best evidence says. This has lead to decisions to not vaccinate children, a major barrier to translating efficacy to effectiveness in many vaccines, as currently seen in the case of measles.

Vaccines are one of medicine's biggest success stories. Smallpox is eradicated in the wild, Polio in all but 3 countries (where social barriers exist to achieving full effectiveness). We seem to be able to add HPV to the list of viruses we can effectively vaccinate against. These cases show how our virological knowledge allows design of efficacious treatments, but this is never the end of the story. Many challenges face the translation of trial success to population level success, for any intervention. Vaccines face the strange challenge of being one of our best medical treatments, but due to mounting opposition to implementation, hindering real-world effectiveness. The solution to this challenge is highly likely to reside outside of medicine itself.

D.J. Auker-Howlett
Philosophy, Kent



So ends the last human job.

Events

June

PoP: Philosophy of Psychiatry, Lancaster University, 7 June.
MUoS: The Metaphysical Unity of Science, Rutgers University, 10–11 June.
NDiMM: New Directions in Medical Methodology, University of Kent, 11 June.
IAtS: Idealization Across the Sciences, Prague, 12–14 June.
Logic and Metaphysical Commitment, Israel: , 13–14 June.
EHPoW: Explanatory and Heuristic Power of Mathematics,Rome, 13–14 June.
P&P: Possibility and Probability, Kings College London, 13–14 June.
H-OE: Higher-Order Evidence, University of Southhampton, 14 June.
Tractable Probabilistic Modeling, Long Beach, California: , 14–15 June.
Prob&Stats: Conference in Probability and Statistics, University of Exeter, 18–21 June.
SECC: Scientific Explanations, Competing and Conjunctive, University of Utah, Salt Lake City, 26–28 June.

July

PoSE: Perspectives on Scientific Error, LMU Munich, 1–4 July.
A&N: Agency and Norms, Berlin, 5–6 July.
AO&C: Abstract Objects and Circularity, Munich Center for Mathematical Philosophy, 6–7 July.
PhiLogi: Workshop on Philosophical Logic, Buenos Aires, 31 July–2 August.

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 Medicine, Linköping University, deadline 4 June.
University Assistant: in Logic/Philosophy of Science, University of Vienna, deadline 9 June.
Research Associate: in Philosophy of Science, University of Kent, deadline 13 June.
Teaching Associate: in Philosophy of Science, University of Cambridge, deadline 17 June.

Studentships

8 Fully funded PhD grants: in Philosophy, including Logic and Philosophy of Science, University of Milan, deadline 24 June.