

NEW DIRECTIONS IN LAW-BASED EXPLANATIONS IN THE SCIENCES

Book of Abstracts

14–15 September 2026

*Centre for Philosophy of Natural and Social Science
London School of Economics*

Current as of 13th September 2026

Contents

Talks

- Mark Addis** — *Context dependent lawlike generalisations in complex model based reasoning systems using category theory*
- Solal Azoulay** — *The epistemology of CP laws in experimental economics*
- John Donaldson** — *Laws of nature and causal completeness*
- Sepehr Ehsani** — *Modelling scientific laws: From putative generalisations to nomological characterisation*
- Peter Fedichev & Jan Gruber** — *A minimal model explains aging regimes and guides intervention strategies*
- Laura R. Franklin-Hall** — *Are there explanatory laws of pregnancy?*
- Jinyeong Gim** — *Mechanistic explanation as law-based explanation: Reconsidering the role of laws in the organization of mechanisms*
- Jens Harbecke** — *Mechanistic constitution as a natural law in Better Best Systems*
- Patric Harting** — *Law-based explanations of chemical structure*
- Lina Jansson** — *Do symmetries explain conservation laws? Or vice versa? Or do neither explain the other?*
- Ye-Eun Jeong** — *What makes laws usable? Exceptionless laws, ceteris paribus practice*
- Jennifer S. Jhun** — *Nomological machines and near-decomposability*
- Stephan Leuenberger** — *Law and inference to the best explanandum*
- José Antonio Pérez Escobar** — *Mathematical explanations, laws, and law-like principles: An underexplored connection in biology*
- João Pinheiro da Silva & Ben Clark** — *Why conservation laws need not worry dispositionalists*
- Bryan Roberts** — *Is symmetry more fundamental than the laws of physics?*
- Deniz Sarikaya** — *Laws and theories in precision medicine*
- Laura Senis Villacé** — *From evidence to laws? Pragmatic constraints on nomological explanation in psychiatry*
- Hamed Tabatabaei Ghomi** — *The narrative path to precision*
- Philip H. Thonemann** — *How are laws in physics teaching and philosophy related?*
- Jidong Wang** — *Laws in linguistics: Law-like generalizations and evolutionary models*
- Andrew Wayne** — *A new pragmatics for law-based explanation*

Posters

- Daian Vlad Bica** — *The mismatch problem is the chief challenge of the Best System Analysis*
- Oliver Jin** — *Description versus explanation: Unification in Mach and Kitcher*
- Lina Mandal** — *Do scientific laws explain reality? On laws, models, and the limits of explanation*
- Brian Moon** — *Beyond laws and mechanisms: Admissibility and the reconstruction of scientific explanation*
- Nanxin Wei** — *Top-down laws and bottom-up mechanisms, companion in modelling*
- Yishu Zhuo** — *Necessitated to act: The lawlikeness of human action*

Panel Contributions

- Barbara Bravi** — *Statistical and machine learning modelling in biology: considerations and examples from immunology*
- Amir Feizi** — *Machine learning and generalisations in research on age-related diseases*
- Lorenzo Zucca** — *Potential parallels with legal philosophy and creative imagination*

1 Talks

Accepted and invited talks, arranged alphabetically by presenter surname.

Mark Addis

The Open University & London School of Economics

Context dependent lawlike generalisations in complex model based reasoning systems using category theory

Abstract

Complex socio-technical systems are heterogeneous so they cannot be modelled by a single approach (Simon 1962). From a socio-technical systems modelling perspective what is required is a commitment to the possibility that a given model and its relationships with other models can be fictional (Frigg 2010) and that models are effective decision making aids (Eckert and Hillerbrand 2022). The property of potentially being part of multiple subsystems makes complex systems inherently difficult to model with model analysis being affected by decisions about the allocation of parts to models. Epistemologically adequate modelling accounts need to offer a way of addressing such divergences and potentially incommensurability. One approach to modelling this complexity is applied category theory whose basic concept is that many formally describable structures can be described as maps (Mac Lane 1998).

The particular case of complex socio-technical system processes is considered with central concepts including flows, bottlenecks, margins, probability, change propagation and resilience. These concepts can be thought of as frames for concepts rather than concepts in themselves. There is scope for such concepts to have lawlike generalisations which take the form of parameters governing conceptual frames and which are instantiated in particular ways for particular versions of these concepts. In that sense concepts such as flows are candidate lawlike generalisations which are context dependent. Category theory is well suited to representing laws in a given explanation because it is about structural description which is a way of thinking about framing.

References

- Addis, M. and Eckert, C. (2026). Explanatory frameworks in complex change and resilience system modelling. Special Issue on Formal Representations in Model-Based Reasoning and Abduction. *Logic Journal of the IGPL*, 34 (2). <https://doi.org/10.1093/jigpal/jzae087.6>.
- Eckert, C., and Hillerbrand, R. (2022). Models in engineering design as decision-making aids. *Engineering Studies*, 14 (2), 134-157.
- Frigg, R. (2010). Models and fiction. *Synthese* 172 (2), 251-268.
- Mac Lane, S. (1998). *Categories for the Working Mathematician*. 2nd ed. Springer.
- Simon, H.A., (1962). The architecture of complexity. *Proceedings of the American Philosophical Society*, 106 (6), 467-482.

Solal Azoulay

University of Strasbourg

The epistemology of CP laws in experimental economics

Abstract

This communication investigates the epistemology of *ceteris paribus* (CP) laws in experimental and behavioral economics through the example of “social preference” models. We ask two separate questions. First, to what extent is it correct to claim that behavioral models like social preferences express CP laws ? Second, according to which criteria do economists settle a preference between alternative CP laws ?

Social preference models account for the sensitivity of economic agents to the payoff of other individuals. For instance, the inequality aversion model of Fehr and Schmidt (1999) assumes that individuals not only try to increase their own monetary gain but also to reduce the difference between them and others.

At first glance, social preference models seem to possess the formal features commonly attributed to CP laws. Taken literally, these models are lawful in the minimal sense of making counter-factually robust predictions about individuals behavior. The Fehr and Schmidt model, for instance, predicts that an inequality averse individual always accepts to reduce his own payoff by 1 \$ if it raises the other payoff by at least $(1 - \beta) / \beta$ \$ (where β is a structural, free parameter of the model). The lawfulness of the model clearly lies in the parameter " β ", which predict how an individual behavior change under varying budget constraints. On the other hand, social preferences are highly unstable because of their sensitivity to contextual variations : an econometric estimation of β in an experimental setting E1 will not necessarily be valid in another setting E2. This instability motivates the claim that social preferences models express CP laws, whose validity is limited by an implicit and largely unknown CP clause. However, we argue that actual research practices of economists are not always compatible with this reading of their models. The main problem is that structural parameters like β actually do not perfectly fit observed individual decisions, even in the same experimental setting. Strikingly, the experimental estimation of β is more often used as a qualitative tool for classifying individuals into different behavioral "profiles" ("selfish" when $\beta = 0$, "inequality averse" when $0 < \beta < 0.5$, etc.).

Regarding the second question, we claim that experimental economists face two opposite theoretical strategies to elaborate new social preference models. One strategy consists in eliminating law exceptions by generalizing their models. This requires to integrate the disturbing factors that are part of the CP clause as new functional variables of the model. The other strategy is to independently account for the exceptions that are included in the CP clause. We contend that economists choose between these strategies according to a mixture of epistemic and cognitive criteria. Epistemic criteria relate to the trade-off between the theoretical virtues of empirical accuracy and simplicity. Including new variables in a model makes it more accurate but also more complex, with a higher number of free parameters. Cognitive criteria refer to the intellectual burden placed on individual researchers. Accounting for the exceptions to a CP laws frequently require to study factors that traditionally belongs to other disciplines than economics.

John Donaldson

University of Glasgow

Laws of nature and causal completeness

Abstract

The idea that causes can be complete plays an important role in many debates, including those concerning the causal exclusion problem (Kim 2005; Gibb et al. 2013). Consider, for example, the following, simplified, causal exclusion argument.

1. Every physical effect has a complete physical cause (simple closure).
2. There is no overdetermination of physical effects (simple exclusion).
3. Thus, there are no non-physical causes of physical effects.
4. Thus, interactionist dualism is false.

Arguments of this type essentially involve the notion of a complete cause, but there is significant dispute in the exclusion literature about how best to understand what being a complete cause amounts to (Kim 2007; Loewer 2007; Hitchcock 2012; Won 2014; Gibb 2015; Vaassen 2021). A standard move is to hold that a cause is complete if it is sufficient for the relevant effect. However, this standard move is subject to well-known objections, including that it entails the implausible outcome that a complete cause must encompass the entire cross section of the backwards lightcone of the relevant effect (Vaassen 2021: 10343-10344).

I argue that such objections can be responded to successfully by appeal to a version of the causes/background conditions distinction which invokes Maudlin's notion of a quasi-Newtonian law: i.e. a law which involves a distinction between inertial versus deviant from the inertial behaviour (Maudlin 2007: 155-156). In sum, the proposal is that a complete cause can be understood as that which is, according to our best theory, a non-inertial cause of the effect, whilst also being a proper subset of a minimally sufficient condition of that effect. I discuss the potential benefits of understanding complete causes in this way, especially for those interested in evaluating the soundness of causal exclusion arguments.

References

Gibb, S. C. 2015. 'The Causal Closure Principle'. *The Philosophical Quarterly* 65 (261): 626–47.
<https://doi.org/10.1093/pq/pqv030>.

- Gibb, S. C., Edward Jonathan Lowe, and Rögnvaldur D. Ingthorsson. 2013. *Mental Causation and Ontology*. Oxford university press.
- Hitchcock, Christopher. 2012. 'Theories of Causation and the Causal Exclusion Argument'. *Journal of Consciousness Studies* 19 (5–6): 40–56.
- Kim, Jaegwon. 2005. *Physicalism, or Something Near Enough*. Princeton University Press.
<https://doi.org/10.1515/9781400840847>.
- Kim, Jaegwon. 2007. 'Causation and Mental Causation'. In *Contemporary Debates in Philosophy of Mind*, edited by Brian P. McLaughlin and Jonathan Cohen. Wiley-Blackwell.
- Loewer, Barry M. 2007. 'Mental Causation, or Something near Enough'. In *Contemporary Debates in Philosophy of Mind*, edited by Brian P. McLaughlin and Jonathan Cohen. Wiley-Blackwell.
- Maudlin, Tim. 2007. *The Metaphysics Within Physics*. Oxford University Press.
<https://doi.org/10.1093/acprof:oso/9780199218219.001.0001>.
- Vaassen, Bram. 2021. 'Causal Exclusion without Causal Sufficiency'. *Synthese* 198 (11): 10341–53.
<https://doi.org/10.1007/s11229-020-02723-y>.
- Won, Chiwook. 2014. 'Overdetermination, Counterfactuals, and Mental Causation'. *Philosophical Review* 123 (2): 205–29.
-

Sepehr Ehsani

London School of Economics

Modelling scientific laws: From putative generalisations to nomological characterisation

Abstract

Most current explanations in cell biology, as I have argued elsewhere, are mechanistic and could be augmented by the addition of cell-biology-relevant lawlike generalisations ('laws' for short). But very few, if any, laws have been established in cell biology, and the question remains how a putative law could be 'modelled' when it is first hypothesised. When we consider the development of cell biology since the 1950s, large molecules (i.e. mechanistic parts) were modelled using physical artefacts and later (or concomitantly) using computational simulations. But entire cellular mechanisms (consisting of many parts with interactions and organisations and so on) are often too complex to be amenable to artefactual modelling, and the usual means of modelling them in the field is through repeated revisions of mental maps and different diagrammatic representations. In this talk I will argue for a three-component approach to modelling laws: (i) that a putative cell-biological law can, if scientifically feasible, be examined using artefactual models, among other means; (ii) that such modelling could roughly be thought of as characterising the possible basis of the law or characterising its consequences (with potential overlap); and (iii) that a Giambattista Vico-inspired 'factum'—'certum'—'verum' framework could be used to assess the modelling progress of different putative laws relative to each other. The three criteria within this framework concern the informal/formal formulation of the law (factum), the empirical evidence supporting the generalisation (certum), and the type of regularities the law could capture or explain (verum). Finally, the principle of cellular synchrony will be used as a test case to illustrate the different stages and potential challenges of this modelling approach.

Peter Fedichev & Jan Gruber

Gero AI; National University of Singapore

A minimal model explains aging regimes and guides intervention strategies

Abstract

Aging generates remarkably universal patterns across species, yet the mechanistic origin of this universality remains obscure. Here we show that aging dynamics in complex organisms under very general assumptions reduce to three emergent macroscopic variables: a slow resilience mode, a cumulative damage variable, and physiological noise. This minimal model reproduces core features of aging across species, including the exponential rise in mortality, increasing variability and slower recovery with age, late-life mortality plateaus in short-lived organisms, and a species-specific lifespan limit. The framework unifies

molecular, physiological, and demographic observations within a single quantitative theory and predicts that interventions effective in short-lived organisms may have only transient effects in long-lived species such as humans. It further yields a taxonomy of intervention strategies that distinguishes disease-specific therapies from approaches capable of shifting intrinsic lifespan limits.

Laura R. Franklin-Hall

New York University

Are there explanatory laws of pregnancy?

Abstract

A familiar line of argument in philosophy of biology holds that biological generalizations cannot be explanatory laws because they are highly evolutionarily contingent. A common response grants the contingency but argues that contingent generalizations can nevertheless explain, provided they are sufficiently stable within their domains of application. This paper explores a different possibility: that some biological generalizations, including some that range across widely separated taxa, are not highly contingent after all. I develop this possibility through the case of pregnancy, asking whether there are laws—or at least lawlike generalizations—concerning pregnancy across animals. I consider evidence that these regularities are robust across alternative evolutionary histories, offer an explanation of that robustness in terms of recurrent demands imposed by internal gestation, and briefly consider what this implies for the explanatory role of laws in biology.

Jinyeong Gim

Chonnam National University

Mechanistic explanation as law-based explanation: Reconsidering the role of laws in the organization of mechanisms

Abstract

This paper argues that mechanistic explanation, contrary to a widely accepted view, is fundamentally lawbased. Since the critique of Hempel's covering-law model—most notably by Salmon—philosophers have tended to reject the explanatory role of laws and instead emphasize causal and constitutive relations within mechanisms. In contemporary accounts, explanatory relevance is often taken to reside in the identification of entities and activities organized to produce a phenomenon.

I argue that this shift overlooks a crucial dimension of mechanistic explanation. Scientific explanations aim not only to identify what produces a phenomenon, but also to answer how it occurs, when and where it takes place, how frequently, and at what rate. These questions concern the spatiotemporal organization of mechanisms, which is essential for explanatory understanding and is shaped by pragmatic constraints on modeling and representation.

Once such organizational demands are taken seriously, mechanistic explanation cannot be grounded in constitutive relevance alone. In many cases, especially when dealing with lower-level or non-manipulable subsystems, direct intervention is not feasible. As a result, the construction of the explanans necessarily relies on theoretical laws and generalizations that capture invariant relations governing the behavior of the system. This is evident in scientific practice: enzyme kinetics in molecular biology are modeled through Michaelis–Menten equations, while neural activity is explained using Hodgkin–Huxley equations and underlying physico-chemical laws of ion dynamics.

I therefore propose that mechanistic and law-based explanations are not competing alternatives but complementary aspects of a unified explanatory framework. Laws play an indispensable role in representing the spatiotemporal organization of mechanisms, particularly in contexts where direct causal manipulation is limited or impossible. Mechanistic explanation, properly understood, should thus be seen as a law-based practice embedded within a broader pragmatic–ontic framework.

Jens Harbecke

Witten/Herdecke University

Mechanistic constitution as a natural law in Better Best Systems

Abstract

The mechanistic approach to scientific explanation rejects the idea that phenomena are explained primarily by subsuming them under general laws. Instead, explanation proceeds by analyzing the mechanisms that underlie, realize, or constitute phenomena across multiple levels of organization (cf. Bechtel and Richardson, 1993; Glennan, 1996; Machamer, Darden, and Craver, 2000; Bechtel and Abrahamsen, 2005; Craver, 2007b; Craver and Tabery, 2017). Typically, a phenomenon is first identified and described as an input–output relation. Researchers then decompose it into the entities and activities that produce it at a given level, specifying their behaviors and interactions. These components often become explananda themselves, resulting in multi-level models, where causal and constitutive relations are systematically distinguished.

Building on this framework, a growing philosophical literature has addressed a wide range of issues concerning mechanistic explanation. These include debates over how mechanistic constitution should be defined (Craver, 2007c; Harbecke, 2010; Couch, 2011), whether mechanistic explanations are exclusive or dominant in certain scientific domains (Huneman, 2010; Chirimuuta, 2014), and how constitutive inferences should be regulated (Harbecke, 2015; Gebharder, 2017; Baumgartner and Gebharder, 2016; Baumgartner and Casini, 2017; Baumgartner, Casini, and Krickel, 2018; Craver, 2007c, 2007a; Krickel, 2018). Together, these discussions reflect increasing interest in the epistemic and metaphysical status of constitutive relations within mechanistic models.

This paper contributes to this debate by focusing on the status of constitutive mechanistic propositions. It pursues two closely related questions. First, it investigates whether such propositions exhibit epistemic lawlikeness, that is, whether they function like lawlike connections between variables rather than merely expressing logical or linguistic relations. Second, it examines whether mechanistic constitution can, from a metaphysical perspective, qualify as a natural law.

More specifically, the paper advances two hypotheses. Hypothesis (A) states that, at least in certain well-developed examples from contemporary cognitive science, constitutive mechanistic statements satisfy standard criteria of lawlikeness. Hypothesis (B) claims that, in at least some cases, mechanistic constitution also meets the metaphysical requirements for being a natural law. To support (A), the paper analyzes representative cases from cognitive science in light of prominent theories of mechanistic constitution and widely accepted criteria of lawlikeness. To support (B), it draws on recent accounts of laws of nature, in particular the Better Best System (BBS) approach developed by Loewer (1996, 2007), Cohen and Callender (2009), Albert (2001, 2012), and Frisch (2011). The BBS framework characterizes laws as principles that optimally balance simplicity, informativeness, and empirical fit, even if they are not strictly microphysical.

The talk is planned to proceed as follows. The first part reconstructs three research projects from neuroscience that exemplify the discovery and modeling of constitutive relations in the brain. The second part presents standard criteria for lawlikeness. Thirdly, the talk reviews leading accounts of mechanistic constitution and evaluates them with respect to both scientific practice and lawlikeness. It then argued that, given these results, constitutive mechanistic propositions can enter the BBS in some cases. In the end, a summary of the main findings is offered as well as a selection of open questions for future research.

Patric Harting

Lingnan University

Law-based explanations of chemical structure

Abstract

Chemical structure, the arrangement of atoms in three-dimensional space, is a key notion in chemistry and related sciences. Many chemists work to identify the structures of materials, to investigate the relationship between structure and properties or to find ways to make chemicals with particular structures. Chemical structure plays a significant role in explaining and predicting the properties of matter, as well as in understanding chemical synthesis and reaction mechanisms.

One way scientists study chemical structures is by *ab initio* structure modelling. This method works by starting from known laws of physics, in this case quantum mechanics, and computing the interactions between the different constituents of a given chemical. The modelling results are then compared to experimental findings.

This paper argues that (successful) *ab initio* modelling provides us with law-based explanations of chemical structures, but with some caveats. To support this claim I start by showing how the Deductive-Nomological (DN) model can be used to construct explanations for some simple chemical structures.

I then consider some challenges for this approach. The first is that it is virtually impossible, for computational and other reasons, to model even moderately complex molecules in full detail. I argue that this difficulty forces scientists to make pragmatic choices that trade off, e.g., accuracy versus speed. And ultimately, the right approach depends on the aims of particular scientists.

The second group of challenges arises for more complex cases, such as giving differential explanations for allotropes or isomers. E.g., why is this diamond and not graphite? In these cases it is not enough to show that a particular structure model is compatible with known laws, as there are often multiple physically possible configurations for a given set of atoms. That means we need additional premises that constrain the explanantia sufficiently to result exclusively in the structure we wish to explain. And in some cases we may need to include pragmatic considerations, e.g., of the intentions of people, for example by using contrast classes.

Lina Jansson

University of Nottingham

Do symmetries explain conservation laws? Or vice versa? Or do neither explain the other?

Abstract

While the mathematical relationship between symmetries and conservation laws is relatively clear, the direction of explanation, if any, is not. This talk argues that we should approach these questions from an epistemic rather than ontic notion of explanation and shows what an answer on an epistemic view might look like.

Ye-Eun Jeong

Columbia University

What makes laws usable? Exceptionless laws, ceteris paribus practice

Abstract

What makes laws usable in scientific explanation? I argue that even the application of exceptionless fundamental physical laws depends on an assumption usually associated only with *ceteris paribus* generalizations: an assumption of typicality about the state of the world. This reveals a pragmatic dimension of law-based explanation that is often overlooked in discussions of fundamental physics. Laws do not explain on their own; they do so only against a background of typicality assumptions. Importantly, the argument does not depend on rejecting reductionism.

Special science laws are often taken to hold only *ceteris paribus*: their application presupposes that certain background conditions obtain, even though those conditions are not specified by the laws themselves. Fundamental physical laws, by contrast, are typically regarded as exceptionless and universally valid. I argue that this contrast breaks down at the level of explanatory practice.

The reason is that scientific prediction and confirmation proceed on the basis of partial and coarse-grained information. In principle, the behavior of any subsystem follows from the complete microphysical state of the universe together with the dynamical laws. In practice, however, the fundamental laws alone drastically underdetermine what will happen: given only partial evidence, there are infinitely many microphysically possible evolutions consistent with it, including ones that would yield radically unexpected behavior. Nothing in the microscopic laws—whether classical or quantum—forbids, for example, a dropped cup from

veering sideways or disintegrating mid-air. The fundamental dynamical laws permit far more than we ever take seriously.

Yet we routinely use these laws to draw stable, reliable conclusions about subsystems. I argue that this is licensed by an implicit assumption: that the actual microstate of the world is typical among those compatible with our evidence—one that gives rise to the expected behavior of subsystems. Without this assumption, partial information would carry no determinate evidential weight.

This assumption, I suggest, is grounded in the probabilistic framework of statistical mechanics, which assigns overwhelmingly low probability to “abnormal” evolutions. The upshot is that both fundamental and special science laws rely, in practice, on typicality assumptions. What underwrites their explanatory power is not just dynamics, but a probabilistic structure that makes the world predictably well-behaved—and thereby makes scientific inquiry possible.

Jennifer S. Jhun

Duke University

Nomological machines and near-decomposability

Abstract

This talk argues that the equilibrium concept partakes in a methodology that aims to articulate *ceteris paribus* claims. As Nancy Cartwright (1995) has notably argued, *ceteris paribus* clauses help us characterize nomological machines that are productive of laws; bringing equilibrium into the picture also conveniently helps us tie Simon’s notion of near-decomposability in a useful way.

Stephan Leuenberger

University of Glasgow

Law and inference to the best explanandum

Abstract

The aim of the talk is to sketch an account of explanation in law, and explore what lessons we might draw from it for explanation in the sciences.

Suppose Jones is guilty of murder. What explains this fact? We might think that the answer is straightforward: it is fact that Jones killed with malice aforethought, and it is a legal rule that whoever kills with malice aforethought is guilty of murder. This is an instance of what we might call “law-based legal explanation.” It is an explanation in some sense, yet unsatisfactory in an important respect, due to a difference in how explanation relates to inference in the law and in paradigmatic sciences.

According to a standard story, science deploys inference to the best explanation. Crudely: we start with observed high-level facts *E*, consider various unobserved (perhaps unobservable) low-level potential explanantia, and infer the truth of the one that explains *E* best. This is inference to the best explanans of *E*.

The law, in contrast, deploys inference to the best explanandum. We start with observed low-level facts *E*: historical facts about what people in certain relevant roles (legislators, judges, government officials) said and wrote and voted on at various points in time. We then consider various unobserved (and indeed unobservable) high-level potential explananda (that Jones is guilty of murder, that Jones is guilty of manslaughter, that Jones is not guilty of a crime, etc), and infer the truth of the one that is best explained by *E*.

The account given in the last paragraph is drawing on standard theories about what determines legal facts (Dworkin, 1986; Greenberg, 2014; Hart, 1997), and a recent argument in Greenberg, 2025: that the epistemology of legal facts tracks their metaphysics, and that we can (as a community) only come to know them by inferring them from more the basic facts that determine them. I have substituted ‘explains’ for ‘determines’, and added an explicitly comparative element.

The notion of explanation is the same in inference to the best explanans (IBEans) and inference to the best explanandum (IBEndum); explanation always goes from the lower-level fact to the higher-level facts. What is different is the direction of inference: in IBEans, we typically start with knowledge of the (relatively) higher-level facts; in IBEndum, with knowledge of the (relatively) lower-level facts.

We do not start with knowledge of laws, whether natural or municipal, low-level or high-level. By dint of their generality, laws are not observable, and do not otherwise enjoy epistemic primacy. This is why explanations appealed to in IBEndum, unlike those in IBEans, cannot be law-based explanations; and this is why the explanation of Jones' guilt cited above is unsatisfactory.

The second part of the talk shall discuss whether IBEndum is a scientific as well as a legal method. The prime candidates where we might find it are sciences whose facts are constitutively tied to intelligibility or rationality, such as psychology and linguistics on a broadly Davidsonian picture.

José Antonio Pérez Escobar

Universidad Nacional de Educación a Distancia

Mathematical explanations, laws, and law-like principles: An underexplored connection in biology

Abstract

The topics of laws and law-like principles, on the one hand, and mathematical explanations in science, on the other, have largely developed in parallel, with remarkably little interaction between the two literatures. An exception is the work of Marc Lange, who explicitly connects mathematical explanation with laws and necessity, although his discussion focuses mainly on examples from physics and relatively simple mathematical cases, such as the division of apples. In biology, mathematical explanations have been argued to provide counterfactually robust, unificatory, and non-causal explanations. At the same time, they often appear to share important features with law-based and law-like explanations in this discipline. In this talk, I explore the connections between these two kinds of explanation in biology. I argue, first, that paradigmatic examples of mathematical explanation in biology can be characterized as law-like because they depend on being embedded in scientific theories sustained by law-like principles, such as natural selection. Second, I argue that the mathematical component does not explain a biological outcome by making it more necessary than the relevant biological laws or law-like principles alone could make it. Rather, its explanatory force depends on the explanatory and modal strength of the underlying biological principle. Thus, the strength of mathematical explanations in biology may be no greater than that of the law-like principles on which they depend, raising questions about their purportedly distinctive explanatory status and counterfactual robustness.

João Pinheiro da Silva & Ben Clark

University of St Andrews; Michigan State University

Why conservation laws need not worry dispositionalists

Abstract

Nancy Cartwright famously argued that the laws of physics lie; that is, laws hold only in highly idealized systems where certain criteria are met and interfering factors are absent. Laws are always *ceteris paribus* laws. Her position is thus naturally congenial to the powers-based (or dispositional) account of laws, which takes them to be properties (or to flow from the properties) of things rather than brute regularities (like the Humeans) or primitive governing facts (like the primitivists) or contingent necessitation relations between universals (like Armstrong-Dretske-Tooley).

Conservation laws, however, create a unique problem for dispositionalists: they seem to hold always and everywhere, with no exceptions. That is, because they do not seem to be about any particular thing, no single thing's nature or properties or powers seems capable of grounding them. Conservation of energy, for instance, does not seem to flow from any particular particle or system, but every particle or system seems subject to it. In attempting to solve this problem for dispositionalists, Kimpton-Nye (2022) has

recently proposed what he calls the “Powers-BSA account”, according to which conservation laws are the best systematic description of how all powers are possibly distributed.

In this presentation, we shall argue that while Kimpton-Nye’s account represents a step forward in a dispositionalist accommodation of conservation laws, it wrongly treats conservation laws as a uniform class of global constraints. We propose instead that there is a physically significant distinction that has been overlooked in the philosophy of laws debate.

We know from the work of Emmy Noether that conservation laws are always the product of some mathematical symmetry in a theory. But Noether’s theorem applies to two distinct types of symmetry: 1) conservation laws derived from external spacetime symmetries and 2) conservation laws derived from internal gauge symmetries (independent of spacetime geometry). Conservation laws are not a mysterious rule applied to all objects. They derive from distinct invariances of a system.

As such, the conservation laws most people refer to (that is, conservation of energy and momentum) are not present in systems that lack time-translation invariance or space-translation invariance respectively. Given general relativity, our universe is one such system, since it does not exist in a flat, static spacetime, but rather in a dynamic, curved spacetime, leading to a loss of global conservation of energy and momentum (which can be seen concretely with the phenomena of redshifting).

So, we propose that global conservation laws are a product of spacetime—namely, properties of spacetime configurations that possess the appropriate symmetry structure. And although there still seem to be other conservation laws that hold locally or independently of spacetime geometry (those derived from internal gauge symmetries), these do not determine physical outcomes, only what interactions are possible.

By drawing a distinction between these two kinds of conservation laws, we show that the apparent counterexample to Cartwright’s position dissolves and that, in fact, there is a plausible dispositionalist avenue for understanding conservation laws.

References

- Bird, A. (2005). The Dispositionalist Conception of Laws. *Foundations of Science*, 10(4), pp.353–370. doi:<https://doi.org/10.1007/s10699-004-5259-9>.
- Bird, A. (2009). *Nature’s metaphysics : laws and properties*. Oxford: Clarendon Press.
- Cartwright, N. (1983). *How the Laws of Physics Lie*. Oxford University Press.
- Cartwright, N. (1999). *The Dappled World*. Cambridge University Press.
- Chalmers, A. (1993). So the laws of physics needn’t lie. *Australasian Journal of Philosophy*, 71(2), pp.196–205. doi:<https://doi.org/10.1080/00048409312345202>.
- Corry, R. (2011). Can Dispositional Essences Ground the Laws of Nature? *Australasian Journal of Philosophy*, 89(2), pp.263–275. doi:<https://doi.org/10.1080/00048401003660325>.
- De Haro, S. (2021). Noether’s Theorems and Energy in General Relativity. [online] arXiv.org. Available at: <https://arxiv.org/abs/2103.17160> [Accessed 31 Mar. 2026].
- Einstein, A. (1916). The foundation of the general theory of relativity.. *Annalen Phys.*, 49(7), 769–822.
- Hirèche, S. (2021). Varieties of dispositional essentialism about natural laws. *European Journal for Philosophy of Science*, 11(3). doi:<https://doi.org/10.1007/s13194-021-00375-4>.
- Jaag, S. (2014). Dispositional essentialism and the grounding of natural modality . *Philosophers’ Imprint* , 14.
- Kimpton-Nye, S. (2021). Laws of Nature: Necessary and Contingent. *The Philosophical Quarterly*, 72(4). doi:<https://doi.org/10.1093/pq/pqab062>.
- Kimpton-Nye, S. (2022). How to be a powers theorist about functional laws, conservation laws and symmetries. *Philosophical Studies*, 180(1), pp.317–332. doi:<https://doi.org/10.1007/s11098-022-01903-5>.
- Livanios, V. (2009). Symmetries, dispositions and essences. *Philosophical Studies*, 148(2), pp.295–305. doi:<https://doi.org/10.1007/s11098-008-9328-8>.
- Maudlin, T. (2007). *The Metaphysics Within Physics*. Oxford Oxford University Press -04-19.
- Noether, E. (1971). "Invariant Variation Problems." Translation by M.A. Tavel, *Transport Theory and Statistical Physics*, 1(3), 186-207.

Bryan Roberts

London School of Economics

Is symmetry more fundamental than the laws of physics?

Abstract

Physicists have developed a standard dogma that the laws of physics stand in a hierarchy, with ‘meta-laws’ governing symmetry playing a more general and more fundamental than others. Philosophers of physics have demurred, arguing that inter-derivability and multi-realizability flatten or reverse the hierarchy. I defend the standard dogma, in the following sense: certain laws of symmetry (like time translation invariance and gauge invariance) are more general and more fundamental than local dynamical laws like Newton’s laws and the Schrödinger equation. I give a precise argument for this defence, and then reflect on some examples of laws whose position in the hierarchy is not yet clear.

Deniz Sarikaya

Vrije Universiteit Brussel / University of Lübeck

Laws and theories in precision medicine

Laura Senis Villacé

University of Valencia

From evidence to laws? Pragmatic constraints on nomological explanation in psychiatry**Abstract**

Many people explain the lack of strong law-based explanations in psychiatry by pointing to the complexity and diversity of what it studies. While this is partly true, it does not tell the whole story. This paper argues that the challenge of creating laws in psychiatry also comes from the ways evidence is gathered, judged, and combined. It examines how both the evidence hierarchy in evidence-based medicine (EBM) and newer pluralist approaches do not create the practical conditions needed to support stable scientific laws.

The EBM framework, described in key texts (e.g., Guyatt et al., 1992; Sackett et al., 1996), ranks randomized controlled trials (RCTs) and systematic reviews as the best evidence. However, as many have noted (Cartwright, 2007; Deaton & Cartwright, 2018; Worrall, 2007), RCTs mostly show causal effects for specific groups and do not easily support broader claims. Because of this, they are not well suited to back up the kind of stable, universal generalizations that scientific laws require. Instead of helping to find such laws, EBM tends to create a patchwork of evidence based on context-specific patterns.

Evidential pluralism developed in response to these problems, encouraging the use of different types of evidence, such as knowledge about mechanisms (Russo & Williamson, 2007; Williamson, 2019; Shan & Williamson, 2023). While this approach values the role of mechanisms, it brings a new problem: there are no clear rules for combining different kinds of evidence. This diversity, while helpful for understanding, makes it harder to achieve the stability and generality needed for scientific laws.

Based on this analysis, the paper introduces the idea of pragmatic conditions of nomologization, meaning the set of knowledge and method rules that allow a field to support law-like generalizations. Psychiatry does not meet these conditions, not just because its subjects are varied, but also because its methods of gathering evidence—shaped by both EBM and pluralist approaches—favor local results, context-awareness, and diverse evidence over broad, stable laws. In other words, the pragmatic conditions of nomologization that I want to present aim to account for why law-based explanations do not emerge in psychiatry. I argue that current evidence frameworks—both hierarchical and pluralistic—systematically privilege local validity and heterogeneity over the stability necessary for laws. This shift of the debate, from ontology to epistemology and the pragmatics of evidence, aims to shed light on the problem.

This leads to moderate skepticism about psychiatric laws. Strong laws are unlikely, and any possible “laws” should be seen as weak, limited, and dependent on certain conditions. This finding affects how we think about law-based explanations in sciences that lack strong laws and suggests that we should rethink how evidence, explanation, and understanding relate to one another.

Hamed Tabatabaei Ghomi

King's College London

The narrative path to precision

Abstract

What counts as a law in medicine? It is generally agreed that we do not have universal and fundamental laws in medicine, but evidence-based medicine (EBM), the prevailing paradigm of modern medicine, treats statistical population-level regularities as the closest substitute for medical laws. These statistical laws have successfully led to a range of reliable diagnostic strategies and treatment regimes. However, I contend that these so-called laws fail when it comes to precision medicine. Drawing on a complex-systems analysis, I show why and how EBM-based generalisations break down at the granularity precision medicine demands. I then suggest that narrative reasoning is the most promising approach to precision medicine and, given EBM's failure at this granularity, a superior replacement for it in this domain. In narrative precision medicine, a tailored and unique narrative is constructed for each medical case, and through it both diagnosis and treatment are tailored to the particular patient. This approach faces an apparent caveat: if every patient requires an individualised narrative, narrative precision medicine seems to be inherently case by case and thus unable to produce a cumulative body of precision medicine knowledge. I resolve this by drawing on the structural parallel between narrative reasoning and simulations of complex systems, and show that each of these yields robust coarse-grained and higher-level patterns despite transience and unpredictability at the fine-grained level. Although each narrative is built for an individual case, a bird's-eye view across many narratives reveals general patterns, discoverable by weak induction. These narrative regularities constitute a distinct, under-recognised class of law-like generalisation that is neither EBM's frequency-based regularities nor physics-style laws, but rather the kind of pragmatic, *ceteris-paribus* generality characteristic of complex sciences. Although developed for precision medicine, the framework generalises to other complex-systems sciences where strict law-discovery has stalled, and offers a new direction in law-based explanation for sciences that deal with complexity.

Philip H. Thonemann

London School of Economics

How are laws in physics teaching and philosophy related?

Abstract

The relationship in one direction is more interesting than in the other. Using student experimental investigation of stretching springs as an example, I suggest that the relevance of the philosophy of laws to secondary school physics teaching is modest: Teachers could encourage students to see a regularity such as Hooke's law_{OL} (the subscript is for Ordinary Language) as being only approximate, limited to some materials, *ceteris paribus*, and itself in need of explanation. They could contrast it with Newton's Third law_{OL}. Some of these ideas are already in a typical English 16-18 syllabus.

More interesting are the philosophical implications of the observation that it was precisely in these school lessons that we philosophers 'learned the meaning of physical law_{OL}', central to this workshop. Why the scare quotes and the subscript? Because this teacher-student process, far from giving us clear conditions for using 'law_{OL}' – the meaning of 'law_{OL}' – instead merely gave us the rough idea of explanatory regularities, which physicists indiscriminately call 'laws_{OL}', 'principles_{OL}', 'equations_{OL}', 'hypotheses_{OL}', and 'models_{OL}'. Nonetheless this learning process enabled us to successfully use 'law_{OL}' in the rough-and-ready Ordinary Language (OL) of physicists.

Reflecting on this process should make us extremely careful of our use of language when we are 'investigating laws_{OL}' philosophically. I propose that some of our problems_P (Philosophical problems) are insubstantial pseudo-problems_P generated by us taking the word out of its Ordinary habitat: "*What are laws_{OL}?*". If there are some substantial *extraordinary* problems_P, we can hope to solve them partly by engineering our own suitable concepts_P.

Jidong Wang

Fudan University / London School of Economics

Laws in linguistics: Law-like generalizations and evolutionary models

Abstract

Contemporary linguistics still appeals to various law-like generalisations, concerning language's statistical structure, crosslinguistic patterns, communicative efficiency constraints. Yet their status as genuine laws remains unclear. They are often supported by corpus statistics, typological regularities, or optimization comparisons, yet lack support from counterfactual robustness, mechanistic grounding and derivation from deeper principles. In this talk, I examine the current status of law-like claims in linguistics and argue that evolutionary and agent-based models can strengthen their explanatory value. These models can provide dynamic support by showing how certain regularities emerge, stabilise, and persist and how robust the results are under various conditions. This might be a promising way to develop law-based explanation in a comparatively law-light field such as linguistics.

Andrew Wayne

University of Guelph

A new pragmatics for law-based explanation

Abstract

Recent work on scientific explanation emphasizes its theory-relative aspects, especially in physics. Lina Jansson, Marc Lange and others recognize that whether an argument constitutes a genuine scientific explanation depends not just on features of the argument itself, such as its deductive structure or whether it contains a causal generalization, but also on its relation to relevant high-level laws. Jansson has developed a compelling account of explanation that highlights how higher-level laws of nature that are not part of an explanatory argument themselves licence explanatory inferences. For Lange, whether an argument qualifies as explanatory depends on whether properties featured in the explanation are themselves explained by higher-level laws (what he calls "natural properties"). On these theory-relative accounts, what makes an argument explanatory is fully determined by features of the argument itself and its theoretical context.

This talk presents a challenge for the theory-relative approach and shows how pragmatic factors play a role in scientific explanation. I argue that what makes an argument genuinely explanatory depends in part on how well it serves other scientific aims. Disciplinary communities prioritize diverse scientific goals in addition to explanation, including prediction, intervention, representation, realism, and understanding. Communities working with the same scientific models and within the same theoretical framework may legitimately maintain different explanatory standards based on their alignment with other disciplinary goals.

As I show, the challenge for the theory-relative accounts of Jansson and Lange is that high-level theory alone is insufficient to account for what makes explanations successful. Lange uses the case of Archimedes' principle to articulate and defend his account of explanation (2018, Ch. 11). According to him, in the context of hydrodynamics Archimedes' principle is not explanatory but in the context of energy conservation it is. This is because a key property in the explanation, the weight of the displaced water, is a natural property in the latter theoretical context but not in the former. I argue against this interpretation: Archimedes' principle gains explanatory power in hydrodynamics not through some theoretical connection to energy conservation but because it aligns with the discipline's goals of intervention and control.

This new pragmatics for law-based explanation shows how explanatory goals are sometimes closely aligned with other disciplinary goals, and whether an argument is a valid explanation may depend in part on how well it serves these other goals. It is a pragmatic dependence that goes beyond the relevant high-level theory. The result is an approach to law-based explanation that aims to capture both the diversity and the normativity of explanatory standards in science. It maintains that explanations track objective features of the world while acknowledging that what renders an argument explanatory depends partly on pragmatic factors including the goals and methods of the local scientific community.

2 Posters

Poster and flash-talk contributions, arranged alphabetically by presenter surname.

Daian Vlad Bica

Heinrich Heine University Düsseldorf

The mismatch problem is the chief challenge of the Best System Analysis

Abstract

Every philosophical view faces its defining challenge. This presentation argues that the central challenge for David Lewis's Best System Analysis (BSA) is the mismatch problem. According to the BSA, laws are the axioms of a deductive system that achieves the best balance between simplicity and strength (cf. Lewis, 1973). These axioms, however, must refer to Nature's own system-independent properties (cf. Lewis, 1983). Natural properties are metaphysically primitive, meaning they cannot be further analysed. Lewis maintains that fundamental physics is particularly well positioned to identify them, often citing examples such as mass, momentum, and spin as plausible candidates. This assumption introduces a potential mismatch for the Best System Theorist: the laws and the Lewisian distribution of natural properties identified may fail with the laws and properties recognized in scientific theories, particularly in physics (cf. Loewer, 2024).

This raises a pressing question: why should the metaphysical account of laws proposed by the BSA coincide with the laws employed in science? In practice, scientists rely on diverse theoretical vocabularies (e.g., Newtonian versus relativistic mass) when formulating laws (e.g., classical versus relativistic formulations of the law of gravitation), and these vocabularies may not correspond neatly to the language of natural properties. A satisfactory account of laws should therefore explain the epistemic and methodological role that laws play within scientific inquiry. For example, laws guide modelling activities (cf. Hicks, 2017) and enable scientists to generate predictions about the dynamics of systems (cf. Jaag & Loew, 2018).

To address this issue, I examine two major reformulations of the BSA that have been proposed in the contemporary literature. I claim that the Better Best System (in short, BBSA) (cf. Cohen & Callender 2011, Schrenk 2023) and the Pragmatic Best System (in short, Pragmatic BSA) (cf. Jaag & Loew 2018) provide promising strategies for resolving the mismatch.

The BBSA proposes that different scientific disciplines construct their own best systematizations using vocabularies tailored to their explanatory aims. Physics, chemistry, and other sciences may therefore employ distinct vocabularies (cf. Schrenk 2023). Proponents of the BBSA reject the Lewisian assumption that nature presents a single privileged vocabulary of perfectly natural properties. Instead, lawhood is understood as relative to a choice among alternative sets of predicates. By abandoning the idea of a fixed elite set of natural properties, the BBSA effectively dissolves the mismatch problem.

The Pragmatic Best System Analysis, by contrast, emphasizes the cognitive needs of scientific agents. On this view, laws are generalisations tailored for enhancing the cognitive efficiency of limited creatures with scarce resources; for instance, they facilitate predictions about the behaviour of certain systems (cf. Jaag & Loew, 2018). In this manner, laws are regarded as "partially prepared solutions to frequently encountered problems" (Ismael, 2015, p. 197). Consequently, the predicates in which laws are formulated becomes a cognitive matter for scientific agents to determine, thereby avoiding the mismatch problem.

Oliver Jin

University College London

Description versus explanation: Unification in Mach and Kitcher

Abstract

Contemporary philosophers of science commonly treat unification as a central feature of explanation. However, this understanding departs from an earlier tradition—exemplified by Ernst Mach—in which unification was regarded primarily as a feature of description. This paper argues that clarifying two distinct

conceptions of unification is essential for understanding the relation between laws, explanation, and theory evaluation.

I propose a distinction between intra-phenomena unification and inter-phenomena unification. Intra-phenomena unification - of Mach and Carnap—seeks to systematize events of the same kind into a single law or a conjunction of all events of that phenomenon, aiming for cognitive economy in representing repeated patterns. Inter-phenomena unification—exemplified by Kitcher and Ostwald—combines distinct phenomena under a common theoretical framework, as when Maxwell unified electricity and magnetism, or when contemporary physics pursues a “Theory of Everything.”

Despite their different focuses, both conceptions share a commitment to the role of laws in achieving unification. This shared commitment reflects a prolonged urge in the history of science: the desire to minimize the amount of unintelligibility. However, drawing on examples from astronomy and chemistry, I argue that systematic accounts of law could risk over-unification

My assessment shows this threat might arise when simplicity is prioritized over other criteria such as informativeness, determinacy, and scope. I argue that simplicity is often conflated with genuine cognitive and conceptual economy, leading to the mistaken preference for conceptually simple theories over genuinely economical ones.

To remedy this, I propose a pragmatist framework grounded in Mach’s doctrine of the Economy of Thought. On this account, the criteria for theory selection should be arranged hierarchically: simplicity should be the least weight, while determinacy and explanatory scope should be prioritized. This pragmatist adjustment, I conclude, safeguards scientific practice against the temptations of over-unification while preserving the legitimate role of unification in both description and explanation.

Lina Mandal

Jadavpur University

Do scientific laws explain reality? On laws, models, and the limits of explanation

Abstract

Scientific laws are often credited with explaining the world by subsuming phenomena under general principles. Yet their explanatory authority is far less direct than this picture suggests. It depends on scale and on modelling conditions that simplify the world in ways rarely realised in complex systems. This raises a pressing question: do scientific laws explain phenomena themselves, or only the idealised models through which those phenomena become tractable?

From Carl Hempel’s classical account of explanation as subsumption under laws to more recent critiques by Nancy Cartwright and Robert Batterman, philosophical debate has largely focused either on the logical structure of explanation or on the limits of laws in representing complex systems. However, comparatively less attention has been given to the conditions under which laws actually function as explanations in practice. In particular, the joint roles of scale-dependence and idealization in determining when laws succeed, and when they fail, remain insufficiently theorised.

This paper argues that law-based explanations do not directly explain concrete phenomena. Rather, they operate through idealised models whose applicability is strictly conditioned by assumptions of isolation, simplicity, and scale stability. The apparent universality of laws is thus not a basic feature of the world, but a consequence of working within regimes where systems can be rendered sufficiently tractable. As systems increase in complexity, these conditions erode, and the explanatory reach of laws correspondingly contracts.

The argument proceeds through conceptual analysis supported by a focused case study. First, it examines the contrast between Newtonian Mechanics and Quantum Mechanics, showing that law-based explanation is stratified across scales rather than unified across them. Second, it analyses how idealizations, such as treating systems as isolated or interactions as tractable, make the application of laws possible in the first place. Finally, it turns to the Three-body problem not merely as a case of technical difficulty, but as a philosophical limit-case: although the governing law is well established, the loss of predictive control reveals that formal validity alone is insufficient for explanation. The case thus exposes a structural gap between possessing a law and achieving explanatory adequacy.

The central claim is straightforward: having a law is not the same as having an explanation. Laws function as instruments within modelling practices, and their explanatory success depends on whether systems can be brought into forms that make those instruments usable. By shifting attention from the metaphysics of laws to their conditions of use, this paper argues that law-based explanation is fundamentally context-dependent. Laws do not directly explain reality; they delimit the conditions under which explanation becomes possible. This reframing both preserves the indispensability of laws and makes clear that, in complex domains, they cannot operate as self-sufficient explanatory resources.

Brian Moon

Perigean Technologies LLC

Beyond laws and mechanisms: Admissibility and the reconstruction of scientific explanation

Abstract

Recent philosophy of science has increasingly treated law-based and mechanistic explanations as complementary rather than competing forms of scientific understanding. Yet it remains unclear why such apparently different explanatory strategies are all capable of revealing objective features of the world. I propose that this question is best addressed by distinguishing ontological determination from epistemic reconstruction.

According to Admissibility Theory, reality consists of a unique actual complete history whose actuality is fixed by a unique admissibility structure defined over complete histories. Scientific explanation does not determine this history but progressively reconstructs the admissibility structure that uniquely determines it. On this view, laws reconstruct global admissibility invariants, mechanisms reconstruct organized local dependencies within the actual history, while probabilistic and mathematical explanations capture further aspects of the same underlying structure.

This framework reframes the relation between laws and mechanisms. Rather than competing explanatory paradigms, they become complementary modes of admissibility reconstruction. The resulting picture preserves the explanatory significance of scientific laws while locating their role within a broader ontology in which admissibility is fundamentally global, invariant, and eliminative.

Nanxin Wei

University of Birmingham

Top-down laws and bottom-up mechanisms, companion in modelling

Abstract

Traditionally, laws of nature and mechanisms have been treated in the philosophy of science with considerable metaphysical baggage. In recent years, however, and in keeping with a growing attentiveness to scientific practice, work on both subjects has been significantly liberalized. On one hand, *ceteris paribus* laws and model-based laws for the special sciences have been the subject of lively debate (Earman & Roberts 1999, Cartwright 2002, Woodward 2002), with laws of nature increasingly recast as laws of science more broadly construed. On the other hand, accounts of mechanisms have been radically expanded, accommodating dynamical evolution (Fang 2021), integrating with mathematical explanation (Fang 2024), and inviting structural or methodological interpretations (Jiang 2024, Ioannidis & Psillos 2022). These trends blur the boundary between law-based and mechanistic explanations, especially in modeling contexts, and raise the question of what, if anything, remains distinctive about each type of explanation (Cartwright et al. 2020).

I contend that certain conceptions of laws are particularly well-suited to preserving this distinction even when laws and mechanisms are deeply entangled in modeling practice — namely, laws understood as top-down constraints or regulating principles (Adlam 2022, Chen & Goldstein 2022), and, in the case of the special sciences, as carrying nomic governing force derived from theories of greater fundamentality or broader scope. Mechanisms, whether causal, structural, or otherwise, provide the bottom-up perspective on how phenomena are generated. On this picture, law-based and mechanistic explanations are not rivals

but can coexist in harmony, each contributing something irreducible to the other in the modeling scenarios that pervade scientific practice. I illustrate this through case studies drawn from the free energy principle and active inference in cognitive science, stochastic thermodynamics in biophysics, and design principles in systems biology.

Yishu Zhuo

University of Tennessee, Knoxville

Necessitated to act: The lawlikeness of human action

Abstract

If Gilbert Ryle's diagnosis in *The Concept of the Mind* is correct, then the mind—including the first-person consciousness—as a conceptual category enters a crisis when confronted with the mechanization and mathematization of the universe initiated by Galileo Galilei and his contemporaries. The crisis consists in the exile of the mind from the mechanized universe. Rather than merely defining the mind as non-mechanical and non-causal—a reluctant compromise made by René Descartes' and his contemporaries—the task for philosophy of mind is to re-establish the category of the mind with a rigor matching that of causality in a mechanized universe. The end, so to speak, is to end this exile. The goal has *not* been achieved in the nearly eighty years since the publication of *The Concept of the Mind*. If the mechanized universe is indeed built upon law-like causality and mechanisms in which the mind has no firm footing, the mind as a category may be in serious trouble.

However, I am not convinced that the geometrical-mechanistic universe has no place for the mind, as a conceptual category. My project therefore aims to recalibrate the category of the mind by reexamining the category of the body¹. I argue that explanations for natural phenomena originate in human actions, rather than the reverse. A explains α where A is an act and α is a phenomenon, rather than α explains A; and attentional structures of phenomena necessitate the manners in which humans act. The necessity is lawlike in the sense that it effectively follows the logical structure: α *is made to show* (with variations of tense, aspect and mood) the attentional structure (N) that demands either A or B where A and B are contrary acts. The idea that explanations are rooted in human related causes has historical resonance. In *Physics*, for instance, Aristotle discusses the four causes in terms of *aitia* (αἰτία), whose adjectival meaning is "guilty of", and whose meanings as noun include blame, guilt, responsibility, accusation and charge. The meaning also appears in words such as *aetiology*. More recently, Peter Machamer, Lindley Darden and Carl Craver (2001) argue that mechanisms in biology and neuroscience constitute one kind of cause, describable in verbal terms.

If my argument is plausible, then it helps alleviate the anxiety shared by causal and non-causal action theorists. That anxiety can be stated as follows: in developing theories of action, we must be careful about admitting causal necessity into accounts of action. Agential freedom must be retained at all costs. If we are not careful, causal necessity can easily encroach upon such freedom. Such worries rest on the assumption that causality is deterministic, whereas agential actions are not, where "deterministic" and "law-like" share the same extension in meaning. Carolina Sartorio (2023) argues that free actions are causal, and causality consists at most in probabilistic correlations grounded in counterfactuals rather than determinations. However, one might worry that such probabilistic correlations may still exhibit law-like features. If human actions are not freed from the governance of law-likeness, then they are not freed from determinism either. If instead, causality, as a concept, originates in human action, then the worry about causality as a force that originates in the natural world and threatens agential freedom simply dissolves.

¹ Given the predicament of the mind as outlined by Ryle, two diagnostics may be given: something is wrong either with how we conceptualize the mind or with how we conceptualize the body. Ryle thinks the legacy of Descartes leads us to tackle the problem in terms of the first diagnosis. I think we ought to reexamine 2 to make sure our conception of the body is indeed as set in stone as what we take lawlike causality makes it out to be.

3 Panel Contributions

Barbara Bravi

Imperial College London

Panel: Explanations and Generalisations in Context-Sensitive Domains

Statistical and machine learning modelling in biology: Considerations and examples from immunology

Abstract

Immunity is a paradigmatic example of a systemic behaviour where diversity, plasticity, history, and context-dependence play a major role, posing challenges to its quantitative modelling. In immunology, the increasing amount of data sampling immune responses at different scales has motivated and enabled the application of data-driven, machine-learning-based approaches as a quantitative way to automate and augment empirical investigation. In this talk, I will discuss the logic, tacit assumptions, and limits of such approaches, starting from the statistical perspective that frames this effort and focussing on the problem of prediction of immune response from molecular data.

Amir Feizi

Gero AI

Panel: Explanations and Generalisations in Context-Sensitive Domains

Machine learning and generalisations in research on age-related diseases

Lorenzo Zucca

King's College London

Closing Panel: New Directions in Law-Based Explanation — Laws, Creative Imagination, and Scientific Practice

Potential parallels with legal philosophy and creative imagination