

Theoretical Virtues and Non-Empirical Guides in Scientific Theory Development

Room M2.3 Conference Centre Fredrik Nielsens Vej 2-4 8000 Aarhus C

Day 1 (Nov 23rd)

Just before 9:30	Coffee, welcome and introduction	
9:30-10:15	Elena Castellani and Richard Dawid <i>Unification and the Element of Surprise</i>	Chair: Samuel Schindler
10:25-11:10	Rasmus Jakslund <i>A meta-empirical analysis of template derivations</i>	
11:10-11:30	Coffee break	
11:30-12:15	Martin King <i>Theory Choice in the Age of Models</i>	Chair: Harald Wiltsche
12:15-13:15	Lunch in cafeteria	
13:15-14:00	Karen Crowther <i>Consistency as a constraint on quantum gravity</i>	
14:00-14:20	Coffee break	Chair: Richard Dawid
14:20-15:05	James Fraser <i>The Overlap Response to Underdetermination</i>	
15:15-16:00	Rune Nyrup <i>Rationality and pursuit in scientific theory choice, or Tom Kuhn and Tom Bayes meet Charlie Peirce</i>	
18:00	Dinner at "Syv Ni13". Click here.	

Day 2 (Nov 24th)

9:30-10:15	Rawad El Skaf and Patricia Palacios <i>What Can we Learn (and not Learn) from Thought Experiments in Black Hole Thermodynamics?</i>	Chair: Harald Wiltsche
10:25-11:10	Samuel Schindler <i>Inference to the Best Explanation, Bayes, and data conflicts</i>	
11:10-11:30	Coffee break	
11:30-12:15	Patrick Duerr <i>Ad-hocness in the Modified Gravity/Dark Matter Debate</i>	Chair: Karen Crowther
12:15-13:15	Lunch in cafeteria	
13:15-14:00	Mike Stuart <i>Aesthetic value as a non-empirical guide in experimental physics</i>	
14:00-14:20	Coffee	Chair: Samuel Schindler
14:20-15:05	Frida Trotter <i>Breaking underdetermination with norms: How normative assumptions about what science ought to do influence our views on what science is</i>	

Abstracts

Elena Castellani (Florence), Richard Dawid (Stockholm), and Radin Dardashti (Wuppertal)

Unification and the Element of Surprise

There is a long-standing debate on the question to what extent unification generates confirmation value. One main position, represented by Wayne Myrvold, asserts that confirmation value is only generated if the unifying theory renders seemingly distinct phenomena informationally relevant for each other. Michel Jansen, to the contrary, argues that explanatory power provided by unification generates confirmation value. In this talk, we will propose a different take on the issue. From the proposed perspective, the element of surprise when finding a unified theory plays a central role in increasing credence in that theory. The presented approach attributes confirmation value to a wider range of unification cases than Myrvold but is more constraining than Jansen.

Karen Crowther (Oslo)

Consistency as a constraint on quantum gravity

The search for quantum gravity is motivated and constrained by goals of theoretical and empirical consistency. Arguably, the primary motivation for QG is to find a theory that consistently combines general relativity and quantum theory and describes the domains where both theories are thought necessary. Additionally, there are perceived inconsistencies within GR and QFT which many physicists take to indicate that these are not fundamental theories, and thus also motivate the search for QG. The goal of consistency also underpins some of the most basic constraints upon the theory being sought. With the aim of gaining insight into the search for QG and the structure of the theory itself, I explore the role of inconsistencies in motivating and constraining QG, as well as the heuristic use of inconsistency in science more generally.

Patrick M. Duerr (Jerusalem and Oxford)

Ad-hocness in the Modified Gravity/Dark Matter Debate

The paper examines a key methodological complaint about a rivalling proposal to the standard cosmological model's postulate of Dark Matter, a modification of gravitational theory, the so-called Modified Newtonian Dynamics, MOND -- the charge that it's ad-hoc. I demonstrate how Schindler's coherentist model of ad-hocness captures, and insightfully fleshes out, the underlying -- but too often insufficiently articulated -- hunches of this critique. MOND and its relativistic and field-theoretic extensions indeed come out as severely ad hoc: they don't cohere well with either theoretical nor empirical-factual background knowledge. In fact, as my complementary comparison to the cosmological standard model's postulate of Dark Matter shows, with respect to ad-hocness, MONDian theories fare worse than the cosmological standard model.

Rawad El Skaf (Milan) and Patricia Palacios (Munich)

What Can we Learn (and not Learn) from Thought Experiments in Black Hole Thermodynamics?

Scientists investigating the thermal properties of black holes rely heavily on theoretical and non-empirical tools, such as mathematical derivations, analogue experiments and thought experiments. Although the use of mathematical derivations and analogue experiments in the context of black hole physics has recently received a great deal of attention among philosophers of science, the use of thought experiments in that context has been almost completely neglected. In this paper, we will start filling this gap by systematically analyzing the epistemic role of the two thought experiments that gave birth to black hole thermodynamics, namely Wheeler's demon and Geroch's engine. We will argue that the two main epistemic functions of these thought experiments are to reveal and resolve inconsistencies, in line with El Skaf's (2021) approach to TEs. We will, then, go beyond El Skaf's approach by stressing an important difference between the strategies employed to assess the reliability of each epistemic function

James Fraser (Durham)

The Overlap Response to Underdetermination

Two standard responses to putative instances of underdetermination of theory by evidence are to: i) attempt to identify apparently rival theories as equivalents, and ii) invoke extra-empirical virtues to break the would-be evidential tie. I flesh out a third line of response: in cases where the descriptive content of underdetermined theories overlap (but is not identical) it remains possible to maintain high credence in the claims they hold in common. I apply this strategy to increasingly controversial case studies: to the case of absolute velocity in Newtonian Gravity, to the underdetermination between different cutoff models in quantum field theory, and to the underdetermination between rival interpretations of quantum mechanics. I conclude by pointing out that in order to use this overlap strategy to identify trustworthy components of current theories one must employ assumptions about how thoroughly we have explored the space of relevant theories. Consequently, forms of theory assessment which are not strictly empirical necessarily enter.

Rasmus Jakslund (Agder, Norway)

A meta-empirical analysis of template derivations

Avoiding ad hoc elements is regarded as an important theoretical virtue. Through a case study, this paper argues that whether the steps of a derivation are ad hoc can depend on the details of another derivation and whether this other derivation is used as template for the target derivation. It is, of course, hardly surprising that we judge a derivation to be ad hoc based on factors external to the derivation itself. However, the external elements will usually be the scientific context that the derivation is embedded in. The case study is interesting, therefore, since the judgement here also depends on how the derivation was generated, i.e., on the context of discovery. This is taken as a clue that this phenomenon is of meta-empirical origin. That our credence in a derivation based on a template should be less than our credence in the same derivation that did not use the template is proposed analyzed as a negative instance of Dawid's "unexpected explanation argument." The discovery that a derivation is based on a template is evidence

that the conclusion of the derivation is not unexpected and that we should therefore not factor UEA in, as we might otherwise inadvertently do, when we set our credence in the derivation.

Martin King (Bonn)

Theory Choice in the Age of Models

The lack of new physics discoveries at the LHC has changed the field of particle physics in a number of significant ways. One is that many of the long-cherished principles, such as naturalness, that guided model development for decades are falling to the wayside. Physicists are increasingly turning to model-independent methods and to models that do not exemplify epistemic theoretical virtues considered by some, such as Douglas, as being necessary criteria. Simple, unifying models with large empirical scope, like supersymmetry, are being increasingly passed over in favour of effective models with narrow scope that are relatively easy to assess with existing data. In this paper, I diagnose the poor fit of epistemic virtues with the models that are largely being pursued in particle physics as reflecting a decreasingly epistemic attitude. The paper further discusses the novel empirical approaches that are being turned to as new primary guides in theory development.

Rune Nyrup (Cambridge)

Rationality and pursuit in scientific theory choice, or Tom Kuhn and Tom Bayes meet Charlie Peirce

Wesley Salmon proposed an influential Bayesian reconstruction of Thomas Kuhn's account of theory choice. This was intended to accommodate Kuhn's observations about the use of non-empirical "values" in theory choice, in a way that preserves the rational credentials of scientific reasoning. However, this argument relies on a false dichotomy, namely that non-empirical values must either play an evidential role in theory choice or else threaten the rationality of science. This paper highlights a third option, first developed in C. S. Peirce's mature account of abduction: theoretical values often guide decisions about which theories to pursue, rather than assessments of evidential support. Crucially, and pace Salmon and Kuhn, theoretical values playing this role in no way threatens the rationality of scientific reasoning. Not only does this view allow us to sidestep many of the conundrums about the role of non-empirical values in theory choice; it also undermines many independent arguments for the conclusion that they must play an evidential role.

Samuel Schindler (Aarhus)

Inference to the Best Explanation, Bayes, and data conflicts

Champions of Inference to the best explanation (IBE) have long sought to reconcile the idea that the theory that best explains the evidence is most likely to be true, with the best available theory of confirmation, namely Bayesianism. In this paper, I argue that extant accounts, which employ direct, indirect, and negative strategies to achieve this reconciliation, are all wanting. My own proposal, which I motivate with several prominent historical case studies, is that in contexts of evidential uncertainty explanatory concerns can affect belief in the data supporting the theory in question. I argue that my proposal not only meets three

important desiderata for reconciling IBE and Bayes, but my proposal also avoids the concerns raised previously against extant accounts.

Mike Stuart (Taiwan)

Aesthetic value as a non-empirical guide in experimental physics

Abstract: In some cases, scientists take aesthetic values (like beauty, symmetry, and clarity) as indicators of epistemic value. What we want, as philosophers of science, is a normative account that spells out if, when, and why this is legitimate to do. Philosophers in the past have mostly tackled this question by identifying beautiful experiments and trying to explain how the aesthetic value they display connects to some epistemic value(s). While this has been a useful strategy, I will consider a different kind of case: AI-designed experiments in physics. These are ugly, and there is reason to believe they are only going to get uglier. Interestingly, in cases of high complexity, the use of AI-designed experiments tends to decrease the aesthetic value of experiments while increasing their epistemic value. Thus, aesthetic value is not a good guide to epistemic value in certain domains of physics, and this generalizes to other domains facing similar challenges.

Frida Trotter (Lausanne)

Breaking underdetermination with norms: How normative assumptions about what science ought to do influence our views on what science is

In this paper I defend the view that some cases of underdetermination of theories by evidence are "broken" via resort to arguments of normative nature. This may stand in opposition with the idea that theory choice would always be based exclusively on "objective" grounds, for instance via an assessment of a theory's superempirical virtues. Interestingly, holding different normative assumptions with respect to what science ought to do may motivate different views of science altogether. In order to expose my argument in detail, I focus on the underdetermination of different interpretations of quantum mechanics by evidence, and refer to examples of normative assumptions defended by some of their prominent proponents. I conclude with remarks on the possible application of techniques of non-empirical theory assessment to this specific case of underdetermination.