Workshop "The role of theory confirmation in science"

Abstracts

Adrian Currie
Robot Dinosaur Tails, Capacity Hypotheses and Testing the Deep-Past

In this paper I'll identify and explore a type of theory critical for paleobiology and other sciences of the deep past: what I'll call 'capacity hypotheses'. These are (in paleobiology at least) hypotheses about whether organisms with particular properties would be capable of particular behaviours. For instance, Ibrahim et al (2020) construct a series of robotic dinosaur tails, comparing the thrust generated by tails with Spinosaurus-like design to tails mimicking other theropods. They did this in order to explore a highly speculative idea: that Spinosaurus, the largest apparently-terrestrial theropod dinosaur, was in fact an aquatic pursuit predator.

When philosophers consider hypotheses in paleontology and other historical sciences, these are understood as fundamentally concerning the past: hypotheses either tell us what happened in the past, explain current traces in terms of past events and processes, or concern regularities enabling us to connect traces to their causal progenitors. Ibrahim et al, however, do not test hypotheses which concern the past, rather they establish that tails of that design are capable of presenting particular kinds of thrust. Their experiment, I'll suggest, is best understood as testing an ahistorical capacity hypothesis. This is then connected to the past via what I've called an 'evolutionary profile', which integrates various evolutionary, developmental, physiological, ecological and environmental features.

Recognising the often-central role of capacity hypotheses to sciences of the deep past matters for at least four reasons. First, it is often suggested that the hypotheses historical scientists examine are locally underdetermined. If historical science is often about capacities, then this claim falls short. Second, it is often suggested that historical science is about understanding token past events, and that tests historical scientists perform should be understood as testing past hypotheses. Capacity hypotheses are neither about token events and, due to being integrated into evolutionary profiles, do not directly test past hypotheses. Third, vertebrate paleontology is often in the business of exploring biological possibility by testing capacity hypotheses. Fourth, this exploration is fundamentally in dialogue with, and shaped by, the fossil record. Engagement with fossils ensures paleontology's historical perspective and helps identify biologically meaningful capacities at a useful level of description.

Siska De Baerdemaeker
MOND and MEA

While Lambda-CDM has emerged as the standard model of cosmology, a small group of physicists defends MOND (Modified Newtonian Gravity) as an alternative view on cosmology. Exponents of MOND have employed a broad, at times explicitly philosophical, conceptual perspective in arguing their case. This paper offers reasons why that MONDian defense has been ineffective. First, we argue that the

defense of MOND can best be reconstructed as an instance of meta-empirical theory assessment (MEA). The formal employment of MEA-type reasoning by MONDians is unconvincing, however, because it lacks the epistemic cogency required for successful MEA-type reasoning. In the last part of the paper, we draw some lessons for the debate and for MEA more generally.
This talk is based on joint work with Richard Dawid.

Genco Guralp
The acceptance of the expanding universe hypothesis and meta-empirical confirmation

The aim of this talk is to examine Dawid's views on "meta-empirical confirmation" in the context of empirical cosmology. I focus on one of the basic pillars of contemporary cosmology, i.e., the expanding universe hypothesis, and identify two puzzles regarding its confirmation. These puzzles rest on the following fact: Edwin Hubble, who is usually credited with the expanding universe discovery, repeatedly claimed that a conclusive experimental argument was in fact lacking, arguing that alternative explanations were not ruled out. Yet, despite Hubble's reticence, the expanding universe hypothesis gained acceptance starting from the early 1930s. This leads to the puzzles mentioned, as it is not clear: (i) how this confirmation occurred, and (ii) why the hypothesis gained acceptance so quickly. Examining the history of the confirmation of the expanding universe, I argue that meta-empirical arguments seem to have played a significant role. I also claim that meta-empirical considerations may necessarily be part of empirical confirmation in general.

Karen Kovaka and Rose Novick
Relative frequency controversies and the growth of biological knowledge

Relative frequency controversies are scientific disputes about how often different processes or patterns occur. They are common in the biological sciences, yet they are rarely settled and arguably wouldn't yield interesting knowledge even if they were. This poses a puzzle: Why do biologists routinely engage in such disputes? In recent work, Kovaka argues that relative frequency controversies can lead biologists to increase their understanding of the modal profile of the processes under dispute. Here, we consider some further consequences of this view. We contend that relative frequency controversies can generate recurrent, transient underdetermination about which causes are responsible for producing particular effects. As a result, the increases in understanding these controversies provide can come with decreases in biologists' ability to offer warranted explanations. We argue that this fits with a toolkit view of biological theory, and suggest some implications for theory confirmation in biology.

Conor Mayo-Wilson
Scientific Evidence and The Duty to Disclose

We argue that three theories of statistical evidence (likelihoodism, Bayesian confirmation theory, and robuse Bayesianism) answer the question, "When is a scientist obliged to disclose experimental data or analysis thereof?" Our argument is surprising, we think, because epistemologists and philosophers of science have often interpreted theories of evidence as answers to "purely epistemic" questions about

which hypotheses are favored or confirmed by data. We show that such theories can be derived from plausible ethical premises via rational choice theory. The premises of our argument are most plausible in diverse, egalitarian societies in which disseminating information is relatively costless.

Casey McCoy

Confirmation in Historical Linguistics

In this talk, I present the main method of historical linguistics, the comparative method, for reconstructing and establishing the ancestral proto-language of related languages. It is nearly unanimously accepted that certain comparative reconstructions, for example, of Proto-Indo European and Proto-Uralic, overwhelmingly confirm the relatedness of their daughter languages ---and even many aspects of their historical evolutions from the proto-language and characteristics of the proto-language itself. There are many proposals for relating languages that remain controversial however, such as the "Altaic" family, which purportedly includes Turkic, Mongolic, Tungusic, Koreanic, and Japonic languages. I explain how empirical and non-empirical assessment grounds the differing strengths of the various proposals.

Johannes Nyström
The Argument from Empirical Equivalence: A New Meta-Empirical Observation for Scientific Theory Confirmation?

Dawid [2013] proposes three 'meta-empirical' observations from which can be inferred that the number of possible empirically distinct theories in a domain of scientific inquiry is small, and which consequently increase the likelihood that a developed theory in that domain is an empirically viable account of the targeted phenomena. The observations thus amount to meat-empirical confirmation. I outline a fourth meta-empirical observation. Th *argument from empiricl equivalence* infers from an observation that multiple distinct theories make identical empirical predictions in a domain of inquiry that the number of possible empirically distinct theories in that domain is small. I argue that the stated observation amounts to meta-empirical confirmation and suggest some basic conditions that need to be met in Orderfor the proposed inference to become plausible.

Hiranya Peiris
Empirical Tests of Cosmological Inflation

Johanna Sarisoy
How Replications Inform Beliefs About Theory Confirmation

Abstract: The recent replication crisis in experimental psychology highlights the need to understand how replications influence experts' beliefs about theory confirmation and why experts frequently disagree

about the inferences to be drawn from replication to theory. To address this issue, I develop a definitional framework of replications that distinguishes between reliability replications and validity replications. Describing case studies in experimental psychopathology, I illustrate how the two kinds of replications influence experts' beliefs. Importantly, I argue that replication results can only be made sense of within a wider context of epistemic and non-epistemic considerations, which introduces the possibility of disagreement amongst experts.

Samuel Schindler
The two-stage view of theory assessment, re-assessed

Theory confirmation is thought to proceed in two stages: first, theories are probed for their empirical accuracy, and second, theories are then assessed for their theoretical virtues, such as simplicity and unifying power. These stages are neatly distinguished and presumed not to interact in many contexts in the philosophy of science. In this paper I will challenge this assumption. I will argue on the basis of several case studies that considerations concerning a theory's virtues plausibly do play a role in assessing the evidence in situations of experimental uncertainty. I will discuss what that might mean for theories of confirmation.

Beñat Monfort Urkizu.
Non-Empirical Physics and the Holographic Principle - The Viability of Contemporary Fundamental Theories with No Empirical Confirmation.

Non-empirical theory confirmation argues that, due to the progressive distancing of theory from experiment, the way of evaluating contemporary physical theories has changed: as empirical testing became more difficult, physicists developed new strategies to determine which theories are worth pursuing, making it possible to assess theories without empirical confirmation. The main goal of my talk is to comprehend the viability of non-empirical physical theories by understanding these new canons of theory assessment. In that direction, Richard Dawid tried to catch this new way of assessing non-empirical theories of fundamental physics by proposing three methodological arguments; namely the plain no alternative argument (NAA), the argument of unexpected explanatory coherence (UEA) and the metainductive argument (MIA). His central idea is that the synergy of these three arguments in support of a theory amounts to a form of non-empirical confirmation. In this workshop, I shall first sketch this philosophical framework in order to focus later on a concrete physically relevant non-empirical case study – the Holographic Principle – and investigate how that theory adjusts to the non-empirical theory assessment. The Holographic Principle is here introduced as a solution to the information paradox in black holes: due to the impossibility to measure what happens in the interior of the event horizon of a black hole, it was first thought that a basic law of quantum mechanics – the conservation of information – could be violated in the interior of black holes. This conflict of principles caused theoretical physicists to work on alternative theories to better understand the possible ways in which physics works under these extreme conditions. My central thesis is that Dawid's three arguments represent well the reasons why theoretical physicists keep trusting the Holographic Principle, but they do not guarantee its viability: I shall only engage with Dawid's non-empirical theory assessment

at a pragmatic level. Although the two roles of confirmation – the epistemic (formal) and pragmatic – are related, I think that the epistemic commitment that Dawid demands towards his three arguments is too hard. I shall proclaim Dawid's non-empirical methods have a legitimate role to play in physics, but I shall back that the Holographic Principle is pursuit-worthy rather than non-empirically confirmed. I shall defend this principal idea by focusing on the trust-generating part of confirmation. The case study of the Holographic Principle is interesting in this concern because of the role dualities play in concrete realizations of holography. Although it was first proposed in 1993, the Holographic Principle was not seriously considered until Juan Maldacena published his article about the gauge/gravity duality. I shall defend that physicists usually pay special attention to dualities: in spite of the lack of empirical corroboration, if the same result is obtained computing calculations using different theories, this result will draw their attention. If we are unwilling to epistemically engage with holography, the background of the gauge/gravity duality would not be cleared up, but it would still provide us with an extraordinarily useful tool to better understand the more fundamental nature.

Chris Smeenk
Eliminative Reasoning

Eliminative reasoning is an appealing way to establish a theory: observations rule out all the competitors, leaving one theory standing. This only works, however, if we have taken all the alternatives into account. There have been long-standing debates in philosophy regarding the upshot and limitations of eliminative arguments. In this talk, I will defend the virtues and clarify the limitations of eliminative reasoning, based on seeing how it has been used in gravitational physics. I will consider one case study of eliminative reasoning in detail, namely efforts to show that general relativity (GR) provides the best theory of gravity in different regimes. Physicists have constructed parametrized spaces meant to represent a wide range of possible theories, sharing some core set of common features that are similar to GR. I draw three main points from this case study. First, the construction of a broad space of parametrized alternatives partially counters the "problem of unconceived alternatives" (due to Duhem and Stanford). Second, this response is only partially successful because the eliminative arguments have to be considered in the context of a specific regime. Solar system tests of gravity, using the PPN framework, favour GR — or any competing theories that are equivalent to it within this regime. But, third, eliminative arguments in different regimes may be complementary, if theories that are equivalent in one regime can be distinguished in other regimes. These three points support a qualified defense of the value of eliminative reasoning.

James Wells
Experimental confirmation discovery as a radical culling of the theory canon

Before the Higgs boson was experimentally discovered in 2012 there were an infinite number of theories that were compatible with experimental data from high energy physics. After the Higgs boson was discovered there are still an infinite number of theories that are compatible. So what exactly was confirmed when the Higgs boson was discovered? It certainly was not a theory. Rather, a non-trivial theory expectation was confirmed for a narrow class of theories within the "theory canon" that

simultaneously eliminated the large complement of other theories within that canon. What makes this outcome worthy of the name "confirmation", then, was the radical culling of the theory canon made necessary by the new experimental result. One key implication of this discussion is the requirement of a creatively generated large theory canon so that confirmation discoveries that have transformative value to our understanding can be possible and pathways for future discoveries can be seen.