Philosophy of Science

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Motivations

What is philosophy of science?

- Second-order discipline that reflects on science
  (Either a particular science or science in general)
- Looks to establish the foundations of scientific inquiry
- Examples of questions that philosophy of science addresses:
- What is a scientific theory? What is its structure?
- Is scientific reasoning reliable? If so, why?
- Is science rational?
- What is the relationship between hypotheses and evidence?
- Can science give us a “true” picture of “reality”? Does it?
- What is a scientific/physical/natural law?
- Can science provide explanations? Does it?

Why philosophy of science?

'Philosophy of science is about as useful to scientists as ornithology is to birds' (Feynman)

'So many people today—and even professional scientists—seem to me like somebody who has seen thousands of trees but has never seen a forest. A knowledge of the historical and philosophical background gives [one] that kind of independence from from prejudices of his generation from which most scientists are suffering. This independence created by philosophical insight is—in my opinion—the mark of distinction between a mere artisan or specialist and a real seeker of truth' (Einstein)

'It always surprises me that no one points out that ornithology would indeed be a great use to birds—if they could ask the ornithologists for advice, and if they could understand it.' (Maudlin)

Three aspects of science

- Predictive
- Descriptive
- Explanatory

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Three positions

- Anguished sceptic: ‘Aaaaaaah.... We can’t know anything! Maybe I am just a brain in a vat!’
- Instrumentalist: ‘Ahhhhh....Who cares? Science is just a tool to predict experimental outcomes.’
- Reflective deliberator: ‘Hmmmm... This allows me to identify my core metaphysical and epistemological commitments, which I can then update as I learn new things about the world.’
- Philosophy of Science: A useful tool for the reflective deliberator.

Why is scientific reasoning reliable?

Philosophical exercise: Induction

- How does science/how do scientists infer predictive laws from observations?
- One straightforward answer: Using *inductive* inferences.
- Inductivism: Scientific generalisations, laws and hypotheses can gain positive support from empirical evidence.
- Goal for today: Try to understand/develop an account of the relationship between evidence and hypotheses.

Induction

- **Induction**: (Roughly) A form of reasoning in which premises take the form of singular statements (usually observation statements) and the conclusion takes the form of a generalisation.
- Useful comparison: Deduction.
- Inductive arguments: Concerned with premises providing *support* for a conclusion (in a sense to be made precise).
- Deductive arguments: Concerned with guaranteeing the preservation of truth between premises and conclusions.

Induction vs deduction

- Question: How does one justify an inductive inference/rule?
- (Well... how does one justify a deductive inference/rule...?)
- Is the following a good argument?
  1: If India won the cricket world cup, then they were the best team in the world.
  2: India won the cricket world cup.
  C: They were the best team in the world.

Why was that a good argument?

- The form of the argument: P, If P, then Q. Therefore Q.
- What allows us to infer Q from P and if P then Q?
- (Notation: If P then Q: $P \to Q$; P and Q: $P \wedge Q$)
- Possible justification: Add a new premise: $(P \wedge (P \to Q)) \to Q$.
- But what justifies this?
- Response: $(P \wedge (P \wedge (P \to Q) \to Q)) \to Q$
- And so on...

Nelson Goodman's response

- Deductive inferences can be given a justification that does not descend into an infinite regress.
- Some paradigm cases of deductively valid arguments are used to propose inference rules.
- These inference rules allow us to determine whether non-paradigm cases of deductive inference are justified.
- Back-and-forth between individual arguments shaping the rules, and rules determining which other arguments are valid.
- Suggestion: Play the same game for induction (thus avoiding the infinite regress)
- Moral: Don't ask about how to justify induction as an inference rule. Ask instead how to describe/characterise valid inductive arguments.

What do good inductive arguments look like?

- All that matters is how pieces of evidence *support* a conclusion. Good inductive arguments are those in which evidence supports a conclusion.
- Introduce a new concept: **Inductive confirmation**
- To **confirm** is to increase the **probability** that the conclusion is true.
- **Non-contradiction**: If a sentence S inductively confirms a sentence P, then any other sentence, S' that reports the same observations as S should not inductively confirm its negation, $\neg P$.
- Proposal: Scientific hypotheses are inductively confirmed by non-contradictory evidence.
- Promising...?

A gruesome obstacle

- Define a new term ‘grue’: An object is **grue** if and only if either it is observed before some time, t, and found to be green, or else it is blue.
- Grue and green: Grass outside the window now.
- Grue but not green:
- Green but not grue:
- Important: The object itself does not (have to) change colour at t.

A gruesome obstacle

- All evidence for emeralds been green on New Year's Day 2020 is also evidence for their being grue on that day.
- A purely formal account of induction gives us contradictory predictions based on the same evidence.
- **Non-contradiction** violated.
- Problem: This can be generalised easily.
- Think of any term that is a good basis for an induction. I can construct infinitely many equally well confirmed terms such that non-contradiction is violated.
- This is the **new riddle of induction**.

Responses

- Suggestion 1: Green is simpler than grue; it is not defined using an ‘or.’
- Suggestion 2: Green picks out a ‘natural kind’.
- Suggestion 3: Green is ‘entrenched’.
- Further suggestions...?

Conclusion

Conclusion: Where does that leave us?

- Remember where we started: Trying to understand the relationship between evidence and hypotheses.
- Plausible claim: Scientific reasoning is inductive.
- Consequence: No amount of observation will allow us to determine whether a generalisation is true.
- Response: We are not interested in guaranteeing infallibly the truth of generalisations. We just want to characterise good inductive inferences.
- Consequence: No amount of past observation will determine which type of generalisation is good. (New riddle of induction)
- Further responses depend on commitments that go beyond just the sum total of observations.
- Reflective deliberators rejoice—this is precisely what philosophy of science is for!