# Philosophy of Science

Lecture 10: The Problem of Induction

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# Today's Agenda

- Goal: To learn about the two main problems for inductive reasoning and the sciences that rely on it: induction is not justified (inductive skepticism) and there is no formal theory of induction (Grue problem).

- Breakdown
  1. Inductive Skepticism and the Problem for Science
  2. Iterative Inductive Skepticism
  3. Humean Inductive Skepticism
  4. The Grue Problem

# 1. Inductive Skepticism and The Problem for Science

# What is Induction?

- *Induction*, recall, is to be contrasted with *Deduction.*
  - *Deduction*: a form of argument in which the premises, if true, logically guarantee the truth of the conclusion.
    - This is largely because deduction is *non-ampliative:* there is no content in the conclusion that is not already mentioned in the premises.
    - The meanings of the logical expressions of our language (e.g., not, and, or, if…then, all, some, is) give us a procedure for extracting that content from our premises in a logical demonstration (a proof).
  - *Induction*: a form of argument in which the premises, if true, make the conclusion *probable* or *likely* to be the case, but there is no logical guarantee.
    - Induction is an *ampliative* form of inference: there is content in the conclusion that is not found anywhere in the premises.
    - Since it takes more than just the meanings of our logical expressions to get at the conclusion, there must be something about the *world itself* that connects the truth of the premises to the likelihood of the conclusion.

# Three Forms of Induction

- There are three forms of induction (the last one is often considered something separate altogether, but that's debatable)
  1. **Inductive Projection**: given some sample of cases, we conclude something about the next subsequent case.
     - E.g., if every jellybean I've pulled out of an opaque bag has been red, I have reason to believe that the next one that I pull out will red.
  2. **Inductive Generalization**: given some sample of cases, we conclude something about EVERY subsequent (possible) case.
     - E.g., if every jellybean I've pulled out of an opaque bag has been red, I have reason to believe that EVERY jellybean in the bag is red.
  3. **Abduction**: given some range of phenomena, the best of all competing explanations of that phenomena is *probably* accurate.
     - E.g., if every jellybean I've pulled out has been red, I have reason to believe that the jellybean manufacturer intentionally produced a bag of red jellybeans (because the competing explanation – that they intended to produce a random assortment – is implausible; we'd have expected other colors if that were the case).

# Induction and Certainty

- Since induction is not enough to guarantee the truth of our inductively driven conclusions, induction is not enough to give us *certainty*.
  - Certain knowledge is impossible with any form of induction, if we get any knowledge at all from it, we only get probabilistic knowledge.
    - That is, we might be able to know, with certainty, that something is probably the case; but we can't know, with certainty, that it is the case.
    - But we might not even get that…

# Inductive Skepticism

- There are (at least) two kinds of skepticism regarding induction.
  - **Iterative Inductive Skepticism**: We cannot know, with certainty, that something, X, is probably the case.
    - We only know that it is only probably the case that X is probably the case, (probability all the way down);
    - But if we only know that it is probable that it is probable that it is probable…. that our conclusions, X, are probable, then that leaves A LOT of room for doubt, because with each iteration of "it's probable that" we seem to lose a bit of confidence in our conclusion.
    - With an infinite iteration, our confidence approaches 0.
  - **Humean Inductive Skepticism**: We have no reason to think that the future is going to resemble the past.
    - If we have no reason to think that the future will resemble the past, then inductive reasoning is not justified.

# The Problem for Science

- If either iterative or Humean skepticism about induction is warranted, then there is a serious problem for Science!
  1. Our scientific theories rely on the assumption that the future will resemble the past.
     - (even if we doubt the existence of causation).
  2. So, if that assumption is not justified, then our scientific theories are not justified.
     - Why? Because justified conclusions/theories require justified assumptions.
  3. If Humean skepticism is true, the that assumption is NOT justified.

  4. If our scientific theories are justified, then our inductive justifications for those theories must provide us with confidence in those theories.
     - Why? Because if our justification provides no confidence in our conclusion, then that conclusion is not justified.
  5. If Iterative skepticism is true, then our inductive justifications for those theories do not provide confidence in those theories.
     - Since, for every "it is probable that" we tack in front of our conclusion, or confidence in that conclusion decreases; and with an infinite number of "it is probable that's" tacked on, our confidence approaches 0.
  6. **Therefore, either form of skepticism about induction implies that our scientific theories are not justified.**
     - **Without justification, we should remain skeptical about science.**

# 2. Iterative Inductive Skepticism

# A Return to Aristotle

- To see why we should be iterative inductive skeptics, let's look back to Aristotle.
- Recall: the regress problem… in order to be certain about our conclusions, we must be certain about the truth of our premises being fed into the (syllogistic) deduction.
  - To be certain about those premises, we must derive them from other certain premises.
    - To be certain of those premises, we must derive them from other certain premses
      - …
- This sequence of certainty either goes on for ever, or it comes to a halt at some self-evident truth.

# Self-Evidence and Logic

- Aristotle, of course, suggested that there is an innate capacity to identify self-evident truths, which could provide the basis for all knowledge.
- But recall, a thousand years later, along came the skeptic, who says we cannot be certain of anything except for trivial claims in logic…
    - E.g., “I think; therefore I am” has the form: d thinks, therefore, some x is such that x thinks. It’s a trivial inference.
    - Other E.g.’s: P or not-P, if P then P, not(P and not-P), P if and only if P… etc.
- Eventually, most empiricists gave up on “certain” knowledge. They worked on the idea that we can acquire knowledge without absolute certainty, through induction (plus a bit of deduction as well).

# The Argument for Iterative Inductive Skepticism

1. If an argument is inductive, then the conclusion's being probable depends on the truth of the premises.
2. If the probableness of an inductive conclusion depends on the truth of the premises, then, if we are less than certain that all of the premises are true, then we are less than certain that the conclusion of inductive argument probably holds.
3. If we are less than certain that the conclusion of an inductive argument probably holds true, then we can only think it to be probable that the conclusion is probable.
4. If we can only think it to be probable that the conclusion is probable, then the conclusion must (at least implicitly) have an extra "it is probable that" tacked on to the front.
5. By taking the extra "it is probable that" to the front of the conclusion, the argument remains inductive.
6. Thus, If the argument remains inductive, and premises 1-5 of THIS argument is true, then (assuming that we are less than certain that all of the premises are true) for every "it is probable that" that we place in front of the conclusion, we must tack on an extra "it is probable that."
7. Thus, (from 6), if an argument is inductive (and we are less than certain that all of the premises are true), then there is an infinite number of "it is probable that"s in front of the conclusion.
8. For every additional "it is probable that" that we have in front of a conclusion, our confidence in that conclusion should marginally decrease.
9. Thus, (from 7 and 8), if an argument is inductive (and we are less than certain that all of the premises are true), then there should be an infinite number of marginal decreases to our confidence in the conclusion; and with an infinite number of decreases in confidence, our confidence in the conclusion approaches 0.
10. Unless all of the premises of an argument are trivial facts about logic, and (as a matter of fact) they never are in an inductive argument, we are always less than certain that the premise is true.
11. Thus, (from 9 and 10), if any argument is inductive, then we should have (approaching) no confidence in its conclusion.

# 3. Humean Inductive Skepticism

# Humean Inductive Skepticism: An Example

- Why be a Humean inductive skeptic? Here's an example to get us started…
- The Sour Candy Example:
  - Suppose that you have a jar full of candies, and all the red ones that you have tried up until this very moment have turned out to be sour.
  - Although you haven't tried ALL the red candies, you still generalize:
    1. All of the red candies I have tasted up until now have been sour
    2. Therefore, the next red candy I taste will also be sour
  - But what justifies this generalization? It's not deduction (b/c it's ampliative: I'm talking about a candy I've never had before).
  - But we cannot appeal to the fact that induction tends to get it right most of the time, since that would be justifying induction via induction, and we have no reason (yet) to think that induction is justified. (question begging)
    - If self-justifying is allowed, then the tarot/dice/8-ball method of coming to conclusions could also be used to justify itself.
- See the problem? Let's make it into a formal argument to make it sharp.

# First: Some Terminology

- Before getting to the argument, we need some new terminology.

- **Demonstrative**: a form of inference is demonstrative if and only if it is non-ampliative…
  - The premises, if true, necessitate the conclusion.
  - i.e., Deduction

- **Non-demonstrative**: a form of inference is non-demonstrative if and only if it is ampliative.
  - The premises, even if true, do not necessitate the conclusion.
  - i.e., induction, abduction, magic 8-balls, fortune cookies, etc.

# Humean Inductive Skepticism: An Argument

The argument:

1. If a method of inference is justified, it must either be justified via demonstrative, or non-demonstrative justification methods.
2. If an amplitative inference could be justified demonstratively, it would not be amplitative (recall: demonstrative implies non-amplitative).
3. If amplitative inferences were justified non-demonstratively, then that would be circular. (recall: ampliative = non-demonstrative)
4. Circular justification is not sufficient for justification.
   - Induction cannot justify induction; otherwise circular justifications would be permitted, and the crystal ball inference method would be justified. Which it's obviously not.
5. Thus, ampliative inferences cannot be justified; they are unjustified inference methods.
6. <u>Induction (and abduction, and tarot, and fortune cookies) is an ampliative inference method</u>
7. Thus, Induction (and abduction, and tarot, and fortune cookies) is not justified.
8. Thus, neither is science (oops!) [since the justificatory basis of sci. theories is induction/abduction]

# Solution 1: Deductivism

- **Deductivism:** Karl Popper suggests that we transform all inductive arguments into deductive ones.

1. Every red candy I've tasted so far has been sour
2. Thus, the next one will be sour

*Becomes*…

1. Every red candy I've tasted has been sour
2. If every red candy I've tasted has been sour, then the next candy I will taste will be sour
3. Thus, the next one will be sour.

# The Problem with Deductivism

- **Problem**: what is our justification for premise 2? We have no justification but inductive justification for it. Without justification of the premise, the conclusion cannot be justified either.
  - The conclusion is only justified insofar as it's premises are.
  - Note: Popper doesn't care. His goal is to refute Premise 2 not to show it to be true.

# Solution 2: The Pragmatic Response

- **The Pragmatic Response:** it would be prudentially unwise to give up our trust in induction. Our decision to assent to induction is a practical decision, and if we were to avoid making inductive inferences, then we would fail to reap the practical benefits of science!
  - i.e. It would be impractical to take the problem of induction seriously.

- **Problem**: to be prudentially justified, one must make an appeal to the fact that induction has worked so well in the past in order to make your pragmatic conclusion. But that's an example of induction dressed up differently. So you haven't escaped the circle. You've just ignored the problem.

# Solution 3: Primitivism

- **Primitivism:** it's ok to be circular with induction, since induction is actually the fountain (source) of *all* justification.
  1. If deduction (necessitation) didn't turn out to be inductively justified, then it would not be likely to guarantee truth. But that's absurd, so deduction is inductively justified.
  2. If **abduction** (inference to the best explanation – another non-demonstrative method of justification) wasn't justified inductively, then the abductive conclusions we draw would be less than likely.
  3. If we can continue like this for *any* intuitively justified method of reasoning, we will always find that it must pass the inductive test.
     - E.g. tarot cards/dice rolls/magic 8-balls all fail the inductive test, and this is exactly *why* they are unjustified; if they all miraculously passed the inductive test, then I'd take those sorts of things to Vegas.
  4. Thus induction is absolutely foundational (in the rock-bottom sense).
  5. A foundational method of justification needs no justification other than itself.
  6. Thus it does not matter if the justification of induction is circular.

# Problem with Solution 3:

- Ok. That might defeat Hume. But how do you defeat the iterative problem?
  - Science isn’t out of the mud just yet…

# 3. The “Grue” Problem

Nelson Goodman

# No Theory of Induction?

- Nelson Goodman argues that that there is another riddle of induction.

- Consider the following inference:
  - All of the emeralds every witnessed before this moment have been green.
  - Thus, the next emerald witnessed will be green
    - Alternatively: “Thus, all emeralds witnessed will be green”

- This is a classic inductive inference, presented in standard form.

# The Grue Inference

- Now, Let's define "Grue."
  - First, Let 't' = this very moment in time.
  - Something, x, is grue if and only if x was witnessed before t and was green, or is witnessed after t and is blue.

- Now here's the argument again: since all emeralds witnessed before t have been green, premise 1, below, is true.
  1. All emeralds witnessed before t have been grue.
  2. Thus, the next emerald witnessed (after t) will be grue.
- Clearly, the conclusion is bad: given the definition of 'grue' the conclusion implies that the next emerald we see will be blue!!!
  - That's not right.

- The lesson: just because a property held consistently in the past, does not give any warrant to think that it will hold in the future.
  - While you might think that this is unique to weird properties like grueness, the point is, the logical form of inductive reasoning is unreliable. It is then hard to see how there can be any good formal theory of induction.

# Discussion Questions

- In this lecture, we learned about some of the problems for induction, and why they pose a problem for science.

- Discussion Questions:
  1. Do any of the arguments here sway you to a Popperian view that divorces science from induction? Why or why not?
     - Basically saying that the way science is really done today is all wrong.
  2. Is there a way to escape the iterative problem for induction? How?
  3. Is primitivism a good way to escape the Humean problem? If not, why not?
  4. Are you troubled by the Grue problem? Why or why not?