

## Hilary Putnam — *The “Corroboration” of Theories*

- Popper’s position, recall, is that science does not proceed by use of the inductive method; but rather, that it proceeds by *falsifying* hypotheses. The central inference of the scientific enterprise is not

$$\frac{\begin{array}{c} T \text{ entails } E \\ E \end{array}}{\hline\hline T}$$

(For some theory  $T$  and some piece of evidence  $E$ ). But rather, the central inference of the scientific enterprise is:

$$\frac{\begin{array}{c} T \text{ entails } E \\ \text{not-}E \end{array}}{\hline \text{not-}T}$$

- That is: in science, we try to *falsify*, rather than *confirm*, theories.
  - A *test* of a theory is just an attempt to falsify it.
  - When a theory has sustained repeated attempts at falsification, Popper says that it has been “corroborated”, and he says that this gives us reason to *accept* (but not *believe!*) the theory. However, Popper does not think that corroborated theories are any more likely to be true than other, non-corroborated (and non-falsified) theories.
  - Because science does not utilize the first pattern of reasoning, but rather only the second, it does not use *inductive* methods, and Hume’s problem of induction does not arise for science.
    - \* **For the second inference is a deductively valid one.**
  - For this reason, Popper’s view is sometimes called ‘deductivism.’
- Putnam notes, however, that Popper’s general schema for understanding scientific reasoning relies upon the assumption that a theory  $T$  can *entail* a piece of evidence  $E$ :

$$\frac{T}{E}$$

- It is this presupposition that Putnam wishes to call into question. Putnam denies that a scientific theory can *entail* or *imply* any particular piece of evidence, or any particular observation, or any particular prediction.

- Consider, for instance, Newton's *Theory of Universal Gravitation* (TUG), according to which the force which any body exerts on any other body is directly proportional to the product of their masses and inversely proportional to the square of the distance between them:

$$F_{12} = G \cdot \frac{m_1 \cdot m_2}{d_{12}^2}$$

This, together with Newton's law of motion, relating the net force exerted on a body ( $F_N$ ) to its mass ( $m$ ) and acceleration ( $a$ ),

$$F_N = ma$$

tells us how to predict the future motion of any body, given a specification of the total forces acting upon it.

- Putnam observes, however, that *this* theory, on its own, doesn't entail anything about the orbit of the planets.

$$\frac{\text{TUG}}{\text{The earth's orbit will be elliptical}} \times$$

Since it could be that the earth is orbiting around multiple suns, or it could be that the moon is substantially more massive than the sun. If either of these possibilities obtained, then the premise (TUG) could be true even while the conclusion (The earth's orbit will be elliptical) is false. So, the argument above is not deductively valid. So, the TUG does not *entail* that the earth's orbit will be elliptical.

- If we want to derive a *prediction* from a theory like TUG, then we will have to assume certain *auxiliary statements* (AS) like

AS<sub>1</sub> No bodies exist except the sun and the seven planets

AS<sub>2</sub> The sun and the seven planets exist in a hard vacuum

AS<sub>3</sub> The sun and the seven planets are subject to no forces except mutually induced gravitational forces

These auxiliary statements are not any *part* of the theory; however, no prediction can be obtained without making auxiliary assumptions such as these.

- So, the real inference involved in deriving a prediction from a theory is something more like this:

$$\text{Auxiliary Statements (AS)} \left\{ \begin{array}{l} T \\ AS_1 \\ AS_2 \\ \vdots \\ AS_N \end{array} \right. \frac{}{E}$$

- However, that this spells trouble for Popper's deductivism, since, even though

$T$  entails  $E$

not- $E$

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not- $T$

is a deductively valid argument,

$$\begin{array}{c} T \text{ and } AS \text{ entail } E \\ \text{not-}E \\ \hline \text{not-}T \end{array}$$

is not. Since it could be that  $T$  and  $AS$  *do* entail  $E$ , and it could be that  $E$  is false, but nevertheless be the case that  $T$  is true — it would just have to be the case that one of the auxiliary assumptions is false.

- As Putnam points out, the history of science is actually littered with cases where scientists failed to reject theories when their predictions failed, but rather rejected one of their auxiliary assumptions and persisted in accepting the theory.
  - For instance, given the assumption that the sun and the seven planets are the only bodies and that there are no non-gravitational forces, Newton's TUG ends up making incorrect predictions about the orbit of Uranus. When the assumption that there the sun and the seven planets are the only bodies is dropped, however, and we replace it with the assumption that there is an extra planet, Neptune, with a certain mass and orbit, TUG makes correct predictions about the orbit of Uranus.
  - Leverrier hypothesized that Neptune existed, and it was later discovered.
  - Not only does this example show that Newton's TUG is not deductively falsifiable, since we could always reject one of the auxiliary assumptions instead of TUG, Putnam contends that, when this was done by Leverrier, *it was good science*.
  - Thus, Popper's deductivism 1) does not match scientific practice, and 2) does not give good advice about how scientists *ought* to proceed.