

Explanation 1

Seminar 7: Philosophy of the
Sciences

Wednesday, 9 November 2011

Readings (on course website)

Required Readings:

‘Commentary on Explanation’ by Cover and Curd

Optional Readings:

- i) ‘Two Basic Types of Scientific Explanation’, ‘The Thesis of Structural Identity’, ‘Inductive-Statistical Explanation’ by Hempel
- ii) ‘Arguments, Laws, and Explanations’ by Ruben
- iii) ‘A Deductive-Nomological Model of Probabilistic Explanation’ by Railton

Explanations

- An important aim of science is to explain what happens in the world around us
- Sometimes we seek explanations for practical purposes: e.g., why is the ozone layer disappearing
- Sometimes we seek explanations purely to satisfy intellectual curiosity

Science can provide explanations

Ex 1: Chemists can explain why sodium turns yellow when it burns

Ex 2: Geneticists can explain while male baldness tends to run in families

Question: But what is an explanation?

Hempel's theory of explanation

To give an explanation is to answer an explanation-seeking why question.

Example: Why is the ozone layer disappearing?

To answer an explanation-seeking why question, we must construct an argument whose

- i) conclusion states what needs to be explained, and whose
- ii) premises tells us why the conclusion is true.

Hempel's theory of explanation (cont)

There are 2 types of explanation:

- i) Deductive-Nomological explanations (DN explanations); and
- ii) Inductive-Statistical explanations (IS-explanations)

The form of a DN explanation

$C_1, \dots, C_n, L_1, \dots, L_m$ (explanans)

E (explanandum)

where C_1, \dots, C_n describe particular facts, L_1, \dots, L_n describe general laws, and E states the phenomena to be explained.

E may either state a particular fact or a general law

The form of a DN explanation (cont)

An argument of the above form is a DN-explanation iff

- i) It is valid
- ii) At least one of its essential premises is a general law that is testable by experiment or observation
- iii) All premises are true
- iv) If E states a particular fact, then no particular fact described by the premises post-date it

Example: Why did my plant die?

1. Everything that photosynthesizes gets sunlight (Law)
 2. Every plant that survives photosynthesizes (Law)
 3. My plant got no sun (Fact)
-
4. My plant died

Prediction and explanation: The symmetry thesis

Explanation and prediction are two sides of the same coin:

- i) Every adequate explanation is potentially a prediction
- ii) Every adequate prediction is potentially an explanation

Examples

Ex 1: The premises of the plant explanation could have been used to protect that the plant would die

Ex 2: Suppose we predict global temperatures will rise 4C by 2100 based on known particular facts and laws. Then if global temperatures do rise 4C by 2100 then these particular facts and laws can explain why it happened.

IS explanations

Hempel held that, in addition to DN-explanations, there are IS explanations.

Roughly, IS-explanations are like DN-explanations except they use statistical laws (concerning physical probability) instead of deterministic laws.

Example of a IS-explanation

Why did Jones recover from the streptococcus infection

Answer: Jones had penicillin when he had from the streptococcus infection, and it is a statistical law that anybody who has penicillin and the streptococcus infection is very likely to recover. So he recovered.

Example of a IS-explanation (cont)

In formal argument form:

$S_j.P_j$

$p(R | S.P)$ is close to 1

R_j

where the double lines signify 'makes practically certain' and 'p' expresses the physical probability operator.

Questions about IS-explanations

Q1: IS-explanations are meant to explain chancy events such as Jones recovering. But can chancy events be explained?

Q2: IS-explanations can only explain chancy events that have a high probability of occurring. But if high probability outcomes have explanations so too should low probability outcomes. (Consider the Roulette wheel case.)

The flag pole case

Suppose:

- i) The angle of elevation of the Sun is 37 degrees
- ii) The length of a flagpole is 15 m
- iii) The length of the shadow cast by the flagpole is 20 m.

Consider the following two explanatory-seeking why questions.

Q1: Why is the length of the shadow cast by the flagpole 20 m?

1. Light travels in straight lines (Law)
 2. Laws of trigonometry (Law)
 3. Angle of elevation of the Sun is 37 degrees (Fact)
 4. The flagpole is 15 m high (Fact)
-
5. The shadow is 20 m long (Explanandum)

Hence, according to Hempel's theory, 1-4 explain 5.

Q2: Why is the height of the flag pole 15 m?

1. Light travels in straight lines (Law)
 2. Laws of trigonometry (Law)
 3. Angle of elevation of the Sun is 37 degrees (Fact)
 5. The shadow is 20 m long (Fact)
-

4. The flagpole is 15 m high (Explanandum)

Hence, according to Hempel's theory, the length of the shadow and 1-3 explain the height of the flag pole! But this is false.

Consequence for the symmetry thesis

As well as refuting Hempel's theory of explanation, the flag pole case also seems to refute the symmetry thesis.

The symmetry thesis is false because (1-3,5) can be used to predict 4, but not to explain 4.

Birth control pills

A1) People who take birth control pills never become pregnant (Law)

A2) John is a man who takes birth control pills

A3) John has not become pregnant

B1-3 is a DN-explanation and, hence, according to Hempel's theory, an explanation. But this is false.

The fact that John has been taking birth control pill is not part of explanation of why he hasn't become pregnant.

Hexed water

Suppose salt has a (physical) probability of 0.95 of dissolving in water with 5min. Then the following argument is a IS-explanation.

B1. Hexed salt has physical probability of 0.95 of dissolving in water within 5min

B2. My sample of salt is hexed and put in water 5min ago.

My sample of salt has dissolved

Hexed water (cont)

Hence, according to Hempel's theory, the fact that my sample of salt dissolved in the water is partly explained by the fact the it was hexed.

But this is false.

(Note water becomes hexed when I cast a ineffective spell on it.)

A diagnosis

The explanans need cause (or contain a cause) of the explanandum. But this requirement is missing from Hempel's theory.

Next week we will look at two alternative accounts which appeal to causation to try to give a better theory of explanation.