Explanation 2

Seminar 8: Philosophy of the Sciences

Wednesday, 16 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

Explanans vs Explanandum

Explanandum = What is to be explained

Explanans =What does the explaining

Two types of explanandum: i) events, and ii) laws

Two types of explanation

Deterministic explanation of event e = an explanation of e in terms of deterministic causes and/or deterministic laws

Probabilistic explanation of event e = and explanation of e in terms of probabilistic causes and/or probabilistic laws

An example of probabilistic causation

- A gun contains a indeterministic roulette wheel with 99 red spots and 1 black spot.
- If the roulette wheel is spun, the physical probability of it landing on the black spot is 0.01.
- Triggering the gun spins the roulette wheel
- If the wheel lands on the black spot, it fires.
- Jane points the gun and triggers it.
- The triggering causes it to fire
- More precisely, Jane's triggering at probabilistically causes it to fire at t+1 with probability 0.01

Hempel's theory of deterministic event explanation

A deterministic event explanation is a DN-argument whose conclusion expresses an event

DN-arguments

An argument is a DN-argument iff

i) it is deductively valid

ii) It has an essential premise which expresses a (deterministic) law

iii) All of its premises which do not express (deterministic laws) express events

iv) its premises and conclusion are all true

v) If its conclusion expresses an event, then it does not pre-date any of the events expressed by its premises

Example: Why did my plant die?

1. My plant got no sun (Event)
2. Every plant that gets no son dies (Law)

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3. My plant died

Laws according to Hempel

Laws are “general regularities” that satisfy certain (hard to specify) conditions

A sentence of the form (1) expresses a law if it satisfies these conditions.

(L) $\exists x(Fxt \supset Gxt)$

Counterexample: Koplik Spots

Background: An occurrence of Pre-meazles infection at t-1 always causes Koplik spots to occur at t, and this is the only way Koplic spots come into existence . Pre-meazles infection at t-1 also independently cause meazles to occur at t+1.

Given this, K1-K3 isn’t an explanation of K3, even though it is a DN-argument.

Koplik Spots (cont)

K1) Jones has Koplik spots at t

K2) $\forall x \forall t$(x has Koplik spots at t $\supset$ x has meazles at t+1)

K3) Jones has meazles at t+1

Birth control pills

B1) John is a man who takes birth control pills at t

B2) Every man who takes birth control pills at t does not become pregnant at t+1 (Law)

B3) John does not become pregnant at t+1

B1-3 is a DN-argument 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.

A fix to Hempel's theory: Make laws explicitly causal

(Deterministic) laws should be of the form

(L') $\forall x \forall t$(Fxt causes Gxt)

rather than

(L) $\forall x \forall t$(Fxt $\supset$ Gxt)

Why Hempel wouldn't have liked this modification

Hempel thought that the concept of causation was suspect and needed analysis just as much as explanation does

Response:

i) Maybe we can analyse causation. If we can, then there is no problem with using causation to analyse explanation.

ii) Even if we can't analyse causation, causation is a better understood primitive notion than explanation.

How the modified theory deals with the Koplic spots case

The Koplic spots case is not a problem for the modified theory since (K2') is false.

(K2')) $\forall x \forall t$(x has Koplik spots at t causes x has meazles at t+1)

How the modified theory deals with the birth control pills case

The birth control pills case is not a problem for the modified theory since (B2') is false.

(B2') $\forall x \forall t$(x is a man who takes birth control pills at t causes x is not pregnant at t+1)

A simple version of Hempel's theory of probabilisitic explanation

A probabilistic explanation is a simple IS-argument

Def: A simple IS-argument is a DN-argument except that

i) Its premises express probabilistic laws rather than deterministic laws

ii) It is probabilistically good rather than deductively valid

An example of a simple IS-argument

S1) a is in state S at t

S2) $\forall x \forall t$(x is in state S at t $\supset$ P_t(x explodes at t+1)=0.99) (Probabilistic Law)

S3) a explodes at t+1

where 'P_t(x explodes at t+1)=0.99' mean the physical probability at t of x exploding at t+1 is 0.99.

The problem of probabilistic ambiguity

Background: Jones has strep at t. What is the physical probability that he will recover t+1?

Hempel: There is no objective right answer. It depends on which of Jone's properties the probability is meant to be relative to.

i) Relative to the having strep and taking penicillin, it is high (since most people who have strep and take penicillin recover)

ii) Relative to having strap and taking penicillin and having a weak heart, it is low (since most people who have strep and take penicillin and have a weak heart do not recover)

The problem of probabilistic ambiguity (cont)

As a result of this problem, Hempel complicates his theory of probabilistic explanation by making it relative to our beliefs.

But whether A explains B shouldn't be relative to what we believe!!

A solution

The physical probability of t of Jones recovering at t+1 is simply the probability relative to Jones's complete property at t: that is, the property they complete describes how Jones is at t

Given this solution, we can keep to the simple version of Hempel's theory of probabilistic explanation

Counterexample: Probabilistic Koplik Spots

Background: An occurrence of Pre-meazles infection at t-1 always deterministically causes Koplik spots to occur at t, and this is the only way Koplic spots come into existence . Pre-meazles infection at t-1 also independently probabilistically causes meazles to occur at t+1 with probability 0.99.

Given this, PK1-3 isn't an explanation of PK3, even though it is a simple IS-argument.

Probabilistic Koplik Spots (cont)

PK1) Jones has Koplik spots at t

PK2) $\forall x \forall t$(x has Koplik spots at t $\supset$ P_t(x has meazles at t+1)=0.99)

PK3) Jones has meazles at t+1

Probabilistic birth control pill cases are also a counterexamples to the current theory.

A natural fix: Make probabilistic laws explicitly causal

Probabilistic laws should be of the form

(PL') $\forall x \forall t$(Fxt causes Gxt with probability r)

rather than

(PL) $\forall x \forall t(Fxt \supset P_t(Gxt)=r)$

How the modified theory deals with probabilistic Koplic spots

The probabilistic Koplic spots case is not a problem for the modified theory since (K2*') is false.

(PK2')) $\forall x \forall t$(x has Koplik spots at t causes x has meazles at t+1 with probability 0.99)

Against the high probability requirement

Railton: If high probability events can be explained/are explicable then low probability events can be explained/are explicable. (See Roulette wheel case on p. 751-2 and p. 732 of readings.)

But simple IS-arguments can only explain high probability events

Another fix (inspired by Railton)

The causal cover theory of probabilistic explanation (CCL): A probabilistic explanation of an event e is:

i) A deductively valid argument with a) true premises, b) an essential premise expressing a probabilistic law, c) any premises not expressing laws expressing events, and d) a conclusion stating the physical probability of e;

together with

ii) A statement expressing e

Example

According to CCL, the argument A1-3 plus B is an explanation why the roulette wheel w landed on the black stop.

A1) w is in initial spinning state at t

A2) $\forall x \forall t$(x is in initial roulette spining state at t causes x to land on the black stop at t+1 with probability 0.01)

A3) P_t(w lands on the black stop at t+1)=0.01

B) W lands on the black stop at t+1

Comparison with Railton's theory

Railton's theory is similar to the CCL theory except:

Railton's theory does not appeal to explicitly causal laws, but instead appeals to "derivations from theoretical accounts of mechanisms" to deal with Koplic and birth control pill counterexamples

Comparison with Ruben's theory

Ruben's theory is very different from both the CCL theory and Railton's theory.

According to Ruben's theory:

i) Explanations need not be or contain arguments

ii) One explanation of event e is simply 'c causes e' (for any cause c of e)

A simple version of Ruben's theory: An explanation of event e is always a statement describing what caused e

Questions to think about

Q1) Is Railton's objection to the high probability requirement correct?

Q2) What is the best theory of explanation described here?

Q3) What problems do these theories face?