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# What is explanation? What is scientific explanation? lecture 15 and 16

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Uncontroversially, science aims to provide explanations.

Moreover, we seem to agree, when confronted with examples, whether or not they provide explanation.

Examples of common sense explanation, and explanations in particular sciences. The latter appeal to laws.

Further category: understanding. Allegedly, humanities provide understanding, over and above explanations.

Despite unanimity in diagnosing particular cases, there is no paradox-free model of explanation.

First model: nomological-deductive (C. Hempel 1950's).

Assumption: we explain facts, not laws.

To explain fact that *p* means to deduce *p* from laws of nature and some other facts.

(law = nomos (gr.))

Illustration: John rejects supper, though he has been deprived of food and sleep for 7 days, and is extremely fatigued.

(1) Hunger mechanism requires the functioning rhythmic contractions of the smooth muscles of a duodena (biological law)

(2) Extreme fatigue / deprivation of food or sleep impairs the functioning of smooth muscles of a duodena (law)

(3) John is extremely tired (fact)

(4) J's hunger mechanism does not function properly (from 1, 2 and 3)

(5) J rejects food.

Some explanations appeal to probabilities rather than certainties. Hence,

INDUCTIVE-NOMOLOGICAL MODEL (STATISTICAL VERSION)

To explain the fact that *p* is to exhibit that laws of nature plus other facts impose high probability on p.

Illustration:

explain the fact that that after 7 days John recovered from an influenza.

# PROBLEMS FOR THE NOMOLOGICAL MODELS

(a) Explanation is asymmetric, deduction is not.

Example: length of a shade and hight of a tower.

(b) There are deductions from laws of nature that are not (intuitively speaking) explanations.

Example: A Martian's “explanation” why Fred does not get pregnant.

(c) The problem of small probabilities.

Example: John suffers from general paresis because he's got untreated syphilis. This sounds like a good explanation because the only way to get general paresis is to have syphilis and not treat it. However, from the n-d model's perspective, it is not good, since only a small fraction of those with untreated syphilis develop general paresis.

Suggestion: consider an argument with small probabilities as a sketch of some future argument, with probabilities eliminated by an appeal to some determining factors.

Although this method is used in medical sciences, it is controversial in handling of quantum phenomena.

Causality kicks in:  a former soldier, once exposed to nuclear radiation, suffers from leukemia, whereas all other soldiers from his battalion, exposed as well to the radiation, are healthy. How is that possible?

A call for statistical-causal explanation.

# CAUSAL-STATISTICAL MODEL (SALMON)

To explain the fact that że *p* amounts to (1) exhibiting a causal mechanism leading to the occurrence of that fact and (2) to show that the factors appealed to are statistically relevant to the fact explained.

What is a causal mechanism?

(1) a process is a time-like worldline or wormline of some object;

(2) a proces is called “causal” if it can transmit marks.

Illustration: application to the story about a soldier with leukemia.

What does it mean that A is statistically relevant to B?

A slogan: A imposes higher probability on B.

Two equivalent formalizations:

(*) p(B \ A) > p (B) = p(B\A)p(A) + p(B\non-A) p(non-A), where

p( \ ) stands for conditional probability,

(**) p(B \ A) > p (B \non-A).

In itself, this is problematic: falling barometer's readings are statistically relevant to the coming storm. But the argument that "there is a storm because the barometer's readings have been falling" is childish.

One would like to say that there is a common cause of  falling barometer's readings and the coming storm. namely at atmospheric front with low pressure.

Common cause principle (Reichenbach)

Suppose that $p(B \setminus A) > p(B)$, but A does not cause B. Then there is some C, a common cause of A and B that satisfies:

(1) $p(A \setminus C) > p(A)$ $\quad p(B \setminus C) > p(B)$

(2) $p(A \setminus BC) = p(A \setminus C)$ $\quad p(B \setminus AC) = p(B \setminus C)$

(3) $p(A \setminus B \text{ non-}C) = p(A \setminus \text{non-}C)$ $\quad p(B \setminus A \text{ non-}C) = p(B \setminus \text{non-}C)$

humanistyczny i inżynierski. Dane statystyczne przedstawia poniższa tabela.

| Kandydaci i przyjęci na UD i jego dwa wydziały w 2007 r. | | | | | | |
|---|---|---|---|---|---|---|
| | K | M | $K \wedge H$ | $M \wedge H$ | $K \wedge I$ | $M \wedge I$ |
| kandydaci | 1400 | 1500 | 500 | 800 | 900 | 700 |
| przyjęci P | 700 | 700 | 100 | 200 | 600 | 500 |
| nieprzyjęci | 700 | 800 | 400 | 600 | 300 | 500 |
| proporcja | 1/2 | 7/15 | 1/5 | 1/4 | 6/9 | 5/7 |

Interpretując powyższe proporcje jako prawdopodobieństwa odpowiednich zdarzeń, mamy

$$\begin{aligned} 1/2 = p(P \mid K) > p(P \mid M) = 7/15, \ \text{ ale} \\ 1/5 = p(P \mid K \wedge H) < p(P \mid M \wedge H) 1/4 \ \text{ i} \\ 6/9 = p(P \mid K \wedge I) < p(P \mid M \wedge I) = 5/7. \end{aligned} \tag{6}$$

Problems:

(a) the common cause principle implies (if taken together with some intuitive assumption), Bell's inequities, which are most likely empirically violated.

(b) Simpson paradox for rising of probabilities.

# PRAGMATIC THEORY OF EXPLANATION (VAN FRAASSENA)

An explanation is an answer to a why-question.

What is a why-question?

First, draw a distinction: interrogative sentence vs question, analogous to the distinction

assertive sentence vs. proposition.

A why-question is a triple <P, X, R>,

where P is the question's theme, X is its contrast class, and R is the relevance relation.

Illustrations:

why P (theme) is not enough to capture a question?

(why *A* ate an apple? why A *ate* an apple? why A ate an *apple*?), with italic indicted stress.

Why P (theme) plus X (contrast class) is not enough, either?

Think of "Why J died (rather than survived) in an accident?" as answered by a coroner, a doctor, and a mechanic.

c - legal issues

d - medical issues

m - mechanical (related to a car, road etc.)