Paul W. Humphreys

Scientific Explanation: The Causes, Some of the Causes, and Nothing But the Causes

1989

Outline

1. context
2. constraints on causal explanation
3. canonical form
4. confusing argument
5. claim: probabilities are not explanatory
6. consequences
7. crystals

Context

- **Hempel:** D-N and I-S
  - **difficult examples:** flagpoles, barometers, hexed salt
- **Salmon:** S-R
  - **difficult examples:** vitamin C

Task

- “to provide an account of the nature of singular causal explanations”

Characteristic Features

- multiple
- separable
- causal

Example

- enzyme-catalyzed reaction rate is affected by:
  - enzyme concentration
  - substrate concentration
  - temperature
  - substrate pH
  - oxidation of the sulfhydryl groups
  - high-energy radiation

Constraints on Causal Explanations

1. explanations must correctly represent the *multiplicity* and *separateness* of causal influences on a given phenomena

Probabilistic Causes

- **contributing:** the bubonic plague bacillus will produce death in 50%-90% of untreated cases
- **counteracting:** treatment with tetracycline antibiotics reduce the chance of death to 5%-10%

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The Canonical Form

- *A* because **Φ**, despite **Ψ**

- *A* = the *explanandum*
- **Φ** = a (non-empty) set of *contributing causes*
- **Ψ** = a (possibly empty) set of *counteracting causes*

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Enzyme Example

- A = the increase in reaction velocity of a metabolic process
- $\mathbf{\Phi}$ = enzyme concentration, substrate concentration
- $\mathbf{\Psi}$ = oxidation, irradiation

Enzyme Example

(***A***) the increase in reaction velocity occurred *because*…

(**Φ**) of the increases in enzyme and substrate concentration to optimality, *despite*…

(**Ψ**) the increasing oxidation of the dehydrogenases and irradiation by ultraviolet light

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✅ *multiple*, *separate* causes
✅ *diverse* causes
✅ *incomplete*, yet *true*

4. Ontology

Argument

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- **goal:** extend this condition to ***probabilistic*** cases

Argument

- **one unargued assumption:** there are such things as *physical chances*, which are grounded in structural features of an indeterministic system
- **intuitive picture:** physical probabilities are *dispositional properties*
  - alterations in the structural basis result in an alteration of the associated probability distribution

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- **recall:** the characteristic feature of a *probabilistic contributing cause* is that it raises the chance of the effect
  - i.e. it produces an increase in the value of the chance of the effect

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  - i.e. it produces an increase in the value of the chance of the effect
- so: assuming the existence of physical chances, the *direct effect* of a contributing cause in an increase in the chance (of some property)

Argument

- **conclusion:** just like the deterministic case, a *probabilistic contributing cause* increases the value of a quantitative **variable**
  - for the probabilistic case, the **variable** is the *value of the chance*
  - a factor is causally relevant if it *invariantly* changes the propensity for an outcome

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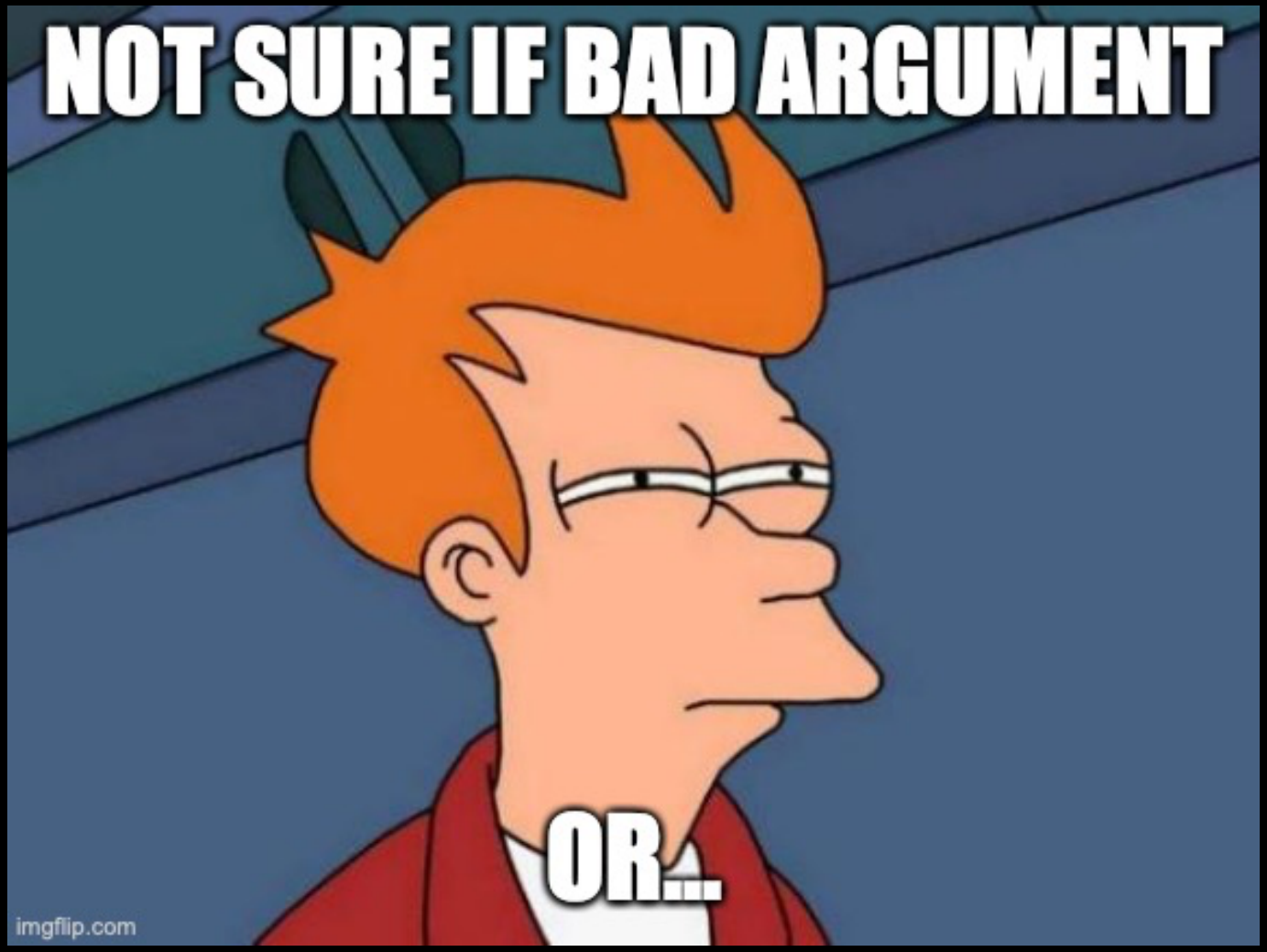
- **caveat:** this argument relies on the idea that the *precise value of the probability* is *not* something that is involved in explanations of stochastic phenomena
  - to be established in section 5


NOT SURE IF BAD ARGUMENT
OR...
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- **claim:** probabilities have *no explanatory role*
- **to be rejected:** an essential part of a probabilistic explanation is the attribution of a *true probability value*
- **because:** explanations which require the true probability value to be cited *cannot omit* even absurdly small probabilistically relevant factors *and remain true*

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- **where:** a factor is *causally relevant* only if it *invariantly* changes the propensity for an outcome

In Contrast

- if: only *causally relevant* factors are explanatory
- where: a factor is causally relevant if it *invariantly* changes the propensity for an outcome
- then: specification of one (or some) of the causally relevant factors will allow a *partial yet true* explanation, even in cases where the other factors are not known, and the *true probability value* cannot be calculated

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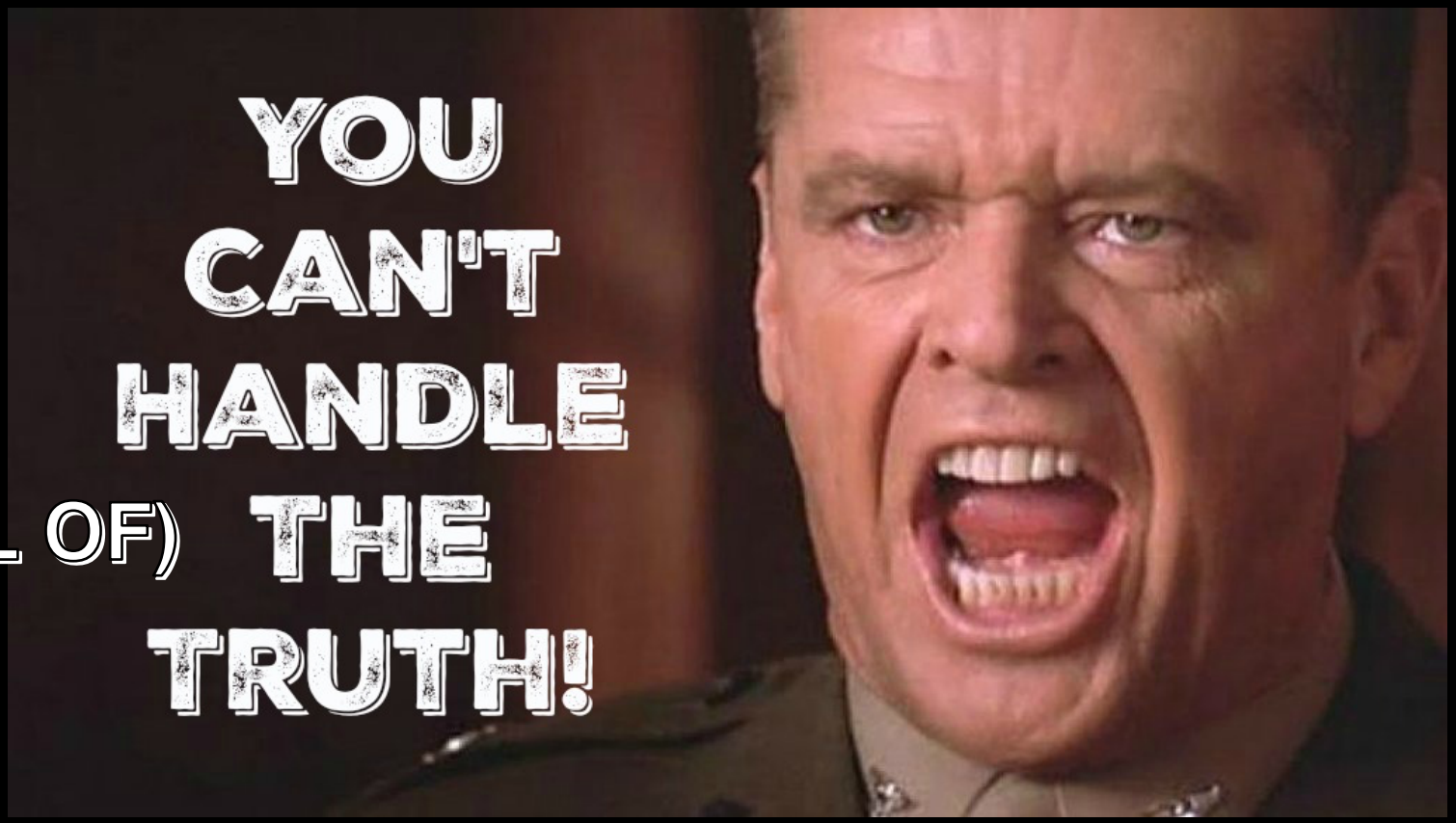

(ALL OF)

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5. there is ***no symmetry*** between predictions and explanations
6. aleatory explanations are ***conjunctive***

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- **question:** there are other ways of presenting causal explanations besides the canonical form… *does our choice of representation actually matter*?
- Humphreys: *yes*, it does matter

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- alternative accounts:
  - have difficulty keeping out *causally irrelevant* information
  - may conflate *relevant/irrelevant* factors or *contributing/counteracting* causes, even if the explanans and explanandum sentences are true

6. Why Ask Why-Questions?

- alternative accounts:
  - have difficulty keeping out *causally irrelevant* information
  - may conflate *relevant/irrelevant* factors or *contributing/counteracting* causes, even if the explanans and explanandum sentences are true
- the most direct way to avoid such problems is to use a form of explanation which mirrors the *separate* structure of causal influences – such as the ***canonical form*** presented in this paper

Crystals

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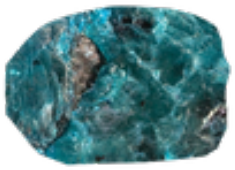

three constraints on causal explanations

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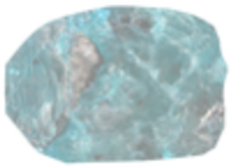

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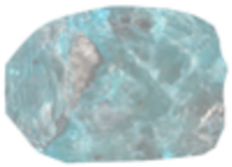

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