Tools for causal analysis and philosophical theories of causation

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What is philosophy of causation?

1. What is causation?

   What *characterizes* these relations that we label "causal"?

   → "theories" of causation

2. How do we (mainly scientists, but not only) *identify* causal relations?

I think these questions should be related.

What is the method of phil. of causation?

"Conceptual analysis" mainly: confrontation between intuitions (sometimes scientifically informed) and suggested theories.

→ partially explains the plurality of theories of causation: concept that raises numerous, sometimes conflicting, intuitions.

Program for today

- For each of the major (families of) theories of causation, presentation of
  - the intuition it relies on,
  - how it most straightforwardly translates into methodology,
  - its main limitations.
- Focus on qualitative questions (Is C a cause of E?)

Hume on causation

- David Hume (1711-1776), British empiricist.
- *A Treatise of Human Nature* (1739-40), *Enquiries concerning Human Understanding* (1748).
- Against necessity or powers in nature.
- Three features of cause-effect relations:
  - spatio-temporal contiguity,
  - temporal succession,
  - constant conjunction, ie *regularity*.

Regularity theories today (1/2)

- Chiefly Mackie (1974).
- C causes E iff C is an ***i***nsufficient but ***n***on-redundant part of an ***u***nnecessary but ***s***ufficient condition.

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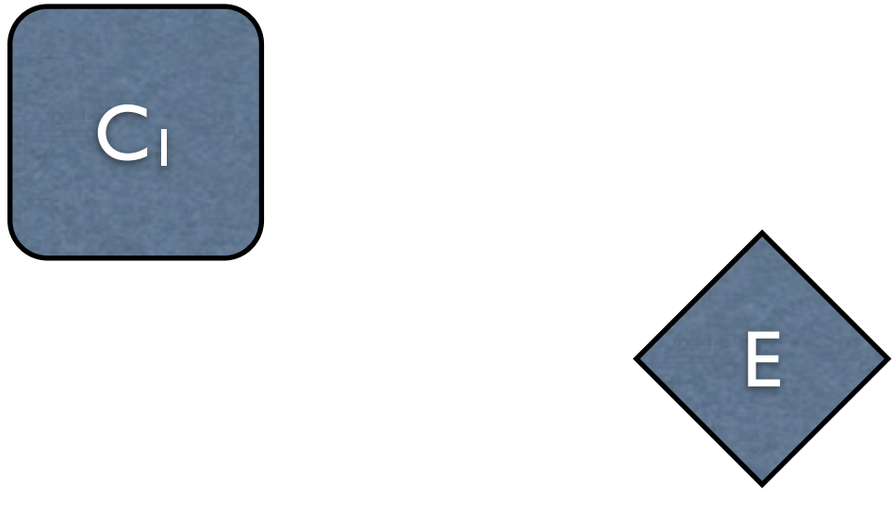

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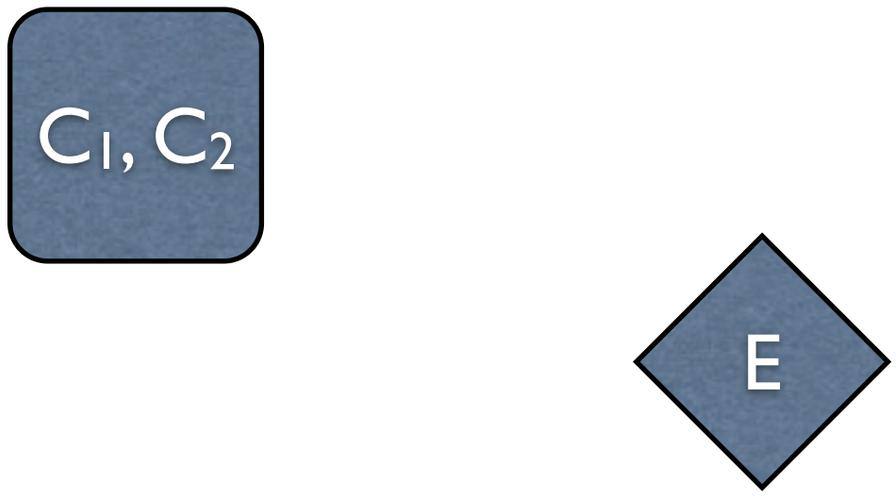

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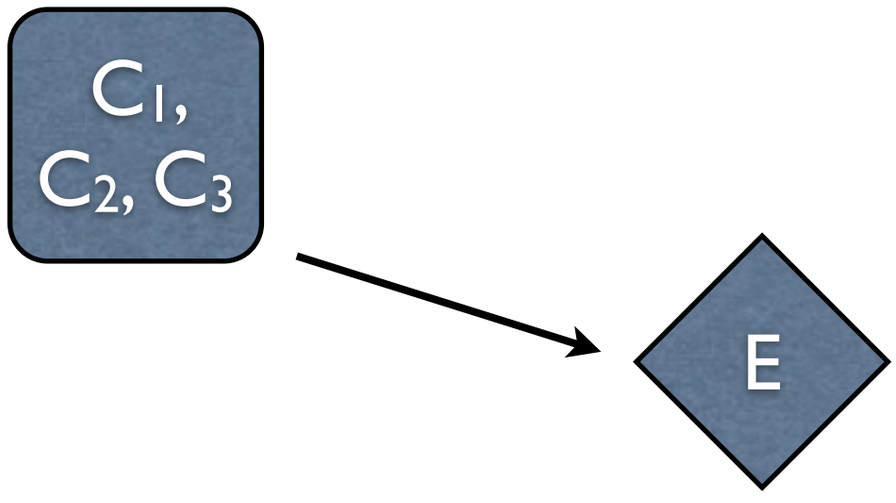

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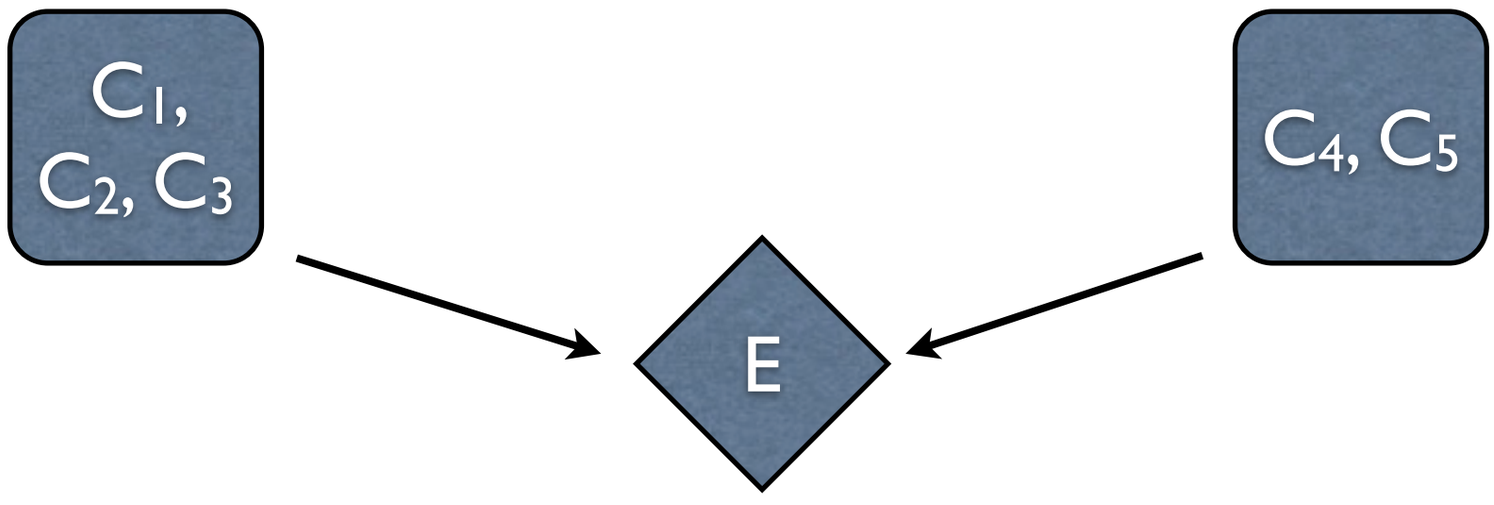
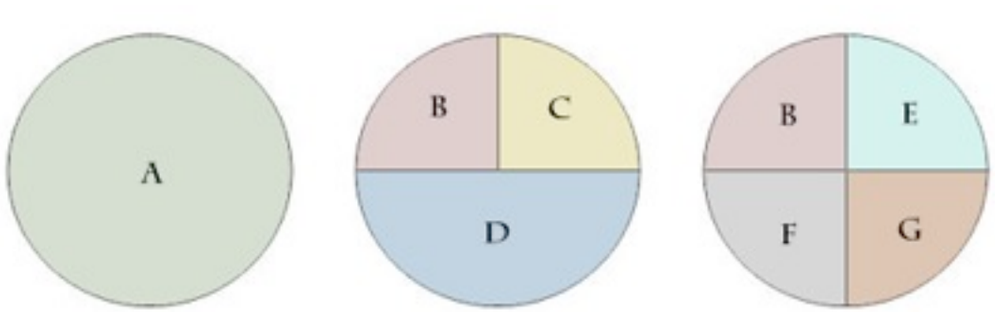


Regularity theories today (2/2)

- Very similar to Rothman's sufficient-component cause model (1976).



- Remaining problems:
  - direction of causation,
  - effects of the same cause,
  - not always possible to find such a sufficient complex.

Probabilistic theories: philosophy (1/2)

- Suppes (1970), Cartwright (1979 &1989), Skyrms (1980)...
- Focus on the intuition that, although causes are not always followed by their effects, they tend to make them happen.
- Roughly speaking: C causes E iff C raises the probability of E *ceteris paribus*.

  → circularity.

Probabilistic theories: methodology (2/2)

- From data to estimated probabilities
- Two strategies around circularity:
  - hypothetico-deduction (structural modelling),
  - weakened analysis of causation (Bayesian networks causal inference algorithms).

Counterfactual theories: philosophy (1/2)

- Also originate in Hume; Lewis (1973 & 2000), Collins, Hall & Paul (2004)...
- Fundamental idea: C causes E iff E would not have been the case if C had not been the case.
- Limitations:
  - conceptual, specifically overdetermination
  - methodological: impossible to observe counterfactual situations.

Counterfactual theories: methodology (2/2)

- potential outcome approaches.
- Conceptually, stick to the fundamental idea.

- **Methodological strategy:** replace "the impossible-to-observe causal effect on t on a specific unit with the possible-to-estimate *average* causal effect of *t* over a population of units"

  → requires specific statistical assumptions.

Interventionist theories (1/2)

- Focus on an epistemological intuition: we come to know causes by manipulating.
- Mainly Woodward (2003).
- Roughly: C causes E iff it is possible to change the value of E by manipulating C.

Interventionist theories (2/2)

- Members of the counterfactual family

  → methodological problems generically associated with counterfactual theories.

- Specific methodological problems linked to the identification of intervention variables.

Physical theories: philosophy (1/2)

- All the theories discussed hitherto are "difference-making" theories and fail to do justice to "production" intuitions.

- Physical theories focus on the physical features of cause-effect relations: C causes E iff C and E are related by
  - a causal process (Salmon, Dowe)
  - a causal mechanism (Glennan).

Physical theories: methodology (2/2)

- Most straightforwardly relate to observation **of** and/or experience **directed at the causal relationship**.

- Question whether production (specifically mechanistic) evidence is indispensable to identify causes and reason about causation.

  → "Russo-Williamson thesis" (2007)

Topics for further research

- Causal pluralism: are the different theories of causation incompatible? can we do justice to all intuitions? should several of them be held together? what does it mean?..
- Articulation between philosophy and methodology: refinements needed!

→ Philosophical meaning of methodological pluralism and of the multiplicity of intuitions connected with some methodological tools.

More specific discussion topics

- the direction of causation
- causally interpreting a model
- probabilities and the "causality principle"
- Hill criteria.

The direction of causation

- how to account for it?
- how to distinguish causes and effects?
- does it require to introduce time?...

Causally interpreting a model

- what does it take?
- is it an all-or-nothing question? is it possible that, within one and the same model, some but not all relations are causally interpretable?
- are there degrees of causal interpretability? what would such degrees measure?...

Probabilities and the "causality principle"

- why are there probabilities in medecine?
- what do they measure?
- do they invalidate the "causality principle"?
- do they imply or reveal some form of indeterminism?...

Hill criteria

- which conception(s) of causality are they compatible with?
- are they sufficient for causation? specifically, is knowledge of mechanisms required for causal knowledge?
- what can we say if they are not all satisfied, or if some of them are such that we don't know whether they are satisfied?