TITLE

THE PHILOSOPHY OF CAUSATION

LECTURE I

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Overview

- Introduction and Motivation
- David Hume and the Cataclysm of Causation
- After Hume: Mill and Mackie's **Regularity Theories**
- Hume Re-Interpreted: David Lewis' **Counterfactual Theory**
- Hume Made Chancy: **Probabilistic Theories**
- Somewhat Un-Humean: **Manipulability Theories**
- Another Take on Hume's Secret Connection: **Process Theories**

Introduction

- Establishing the truth of causal claims is a very important activity in most sciences
- This is because causal claims are thought to advance two central goals of the sciences:
  - Citing causes means to cite **explanatory** factors
  - Knowing causes provides knowledge of **means to bring about desired effects**
- (We will see that even these alleged truisms are in fact controversial)
- But for now let us assume that knowing causes is a good thing and see what the various philosophers have said about what that means and how we can achieve it

Examples

- Scientists, then, seek to establish the truth of claims such as:
  - A mother's diet causes her child's sex.
  - Classroom size causes educational achievement.
  - The success of psychoanalysis is to a large part attributable to the placebo effect
  - The assassination of archduke Franz Ferdinand caused the outbreak of World War I
  - The villains' action of stealing the sign was responsible for the accident

Some distinctions

- Singular vs generic causal claims:
  - ‘Smoking causes lung cancer’ vs ‘Jill’s smoking caused her lung cancer’
- Levels of analysis:
  - **Epistemology**: ‘How do we find out whether A causes B?’
  - **Semantics**: ‘What does it mean to say that A causes B?’
  - **Metaphysics**: ‘What in the world makes it true that A causes B?’

Background: ‘Hume’s problem’

- Starting point for virtually all contemporary discussions of causation is David Hume’s contribution to the topic
- Hume sought a total reform of philosophy
- In particular, he aimed to abandon the a priori search for theoretical explanations that supposedly give us insight into the ultimate nature of reality, replacing such (to him) unintelligible propositions with empirical, descriptive inquiry

Background: Hume's problem

- Every concept, in order to be meaningful, had to be associated with an idea, which in turn was thought of as a copy of a sense impression
- Thus, if causal statements were to be meaningful, there had to be corresponding sense impressions of 'causings'
- But what do we see when we see a causing?

Hume's Theory of Causation

- From the Abstract:

  Here is a billiard-ball lying on the table, and another ball moving towards it with rapidity. They strike; and the ball, which was formerly at rest, now acquires a motion… There was no interval betwixt the shock and the motion. *Contiguity* in time and place is therefore a requisite circumstance to the operation of all causes. 'Tis evident likewise, that the motion, which was the cause, is prior to the motion, which was the effect. *Priority* in time, is therefore another requisite circumstance in every cause. But this is not all. Let us try any other balls of the same kind in a like situation, and we shall always find, that the impulse of one produces motion in the other. Here, therefore is a third circumstance, *viz*. that of a *constant conjunction* betwixt the cause and effect. Every object like the cause, produces always some object like the effect. Beyond these three circumstances of contiguity, priority, and constant conjunction, I can discover nothing in this cause…

On Hume

- Note that Hume is a reductionist in two senses:
  - He first reduces claims about singular causings to claims about causal generalisations – ‘A caused B’ iff ‘A’s cause B’s’
  - And then reduces causal generalisations to statements about regularities – ‘A’s cause B’s’ iff ‘A’s are regularly followed by B’s and contiguous’

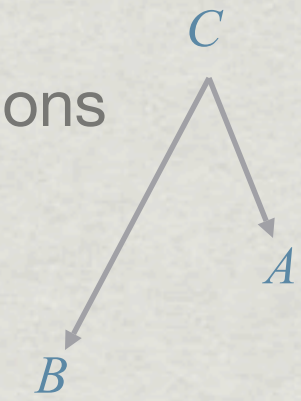
Mill: Introducing some complications

- J.S. Mill (1806-73): British philosopher and economist
- ‘It is seldom, if ever, between a consequent and a single antecedent that this invariable sequence subsists. It is usually between a consequent and the sum of several antecedents; the concurrence of all of them being requisite to produce, that is, to be certain of being followed by, the consequent’
- Plus: ‘Plurality of Causes’

Mackie: State-of-the-art regularism

- Based on Mill's insights and his own development, John Mackie regarded causes as INUS conditions for their effects:
  *I*nsufficient and
  *N*on-redundant parts of
  *U*nnecessary and
  *S*ufficient conditions
- In other words:
  ABC or DGH or JKL ⇔ P
- Note: the conditions may include absences and states in addition to events strictly speaking

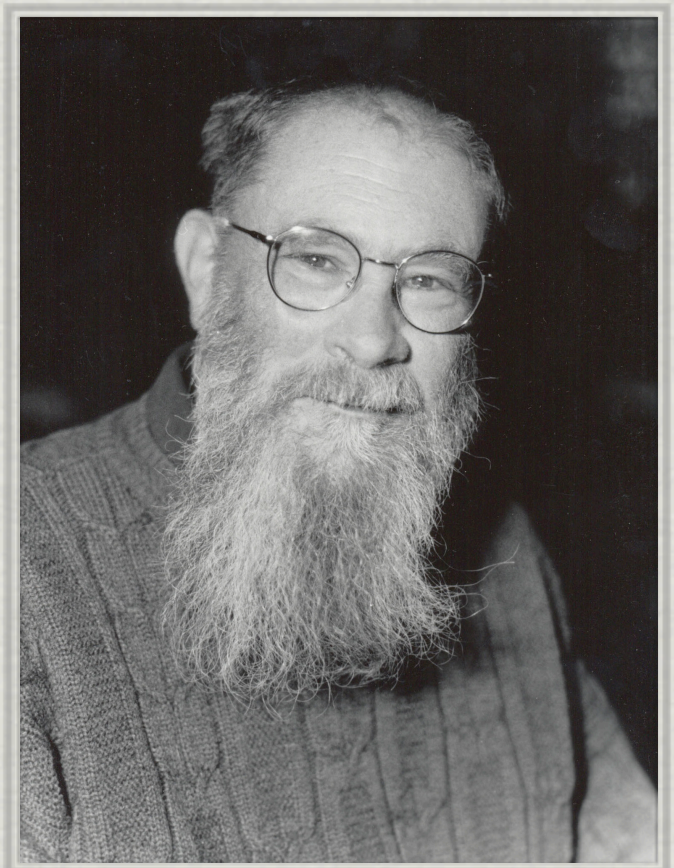
The Manchester hooters



- But Mackie noticed himself that INUS conditions can't be all there is to causation
- Suppose we have a structure of this kind:
- In concrete terms: A is the sounding of the Manchester hooters, B is the Londoners leaving work, C is it's being 5PM
- Here A is an INUS condition of B:
  - CX or Y ⇔ A; CZ or W ⇔ B
  - A¬YZ or W ⇔ B

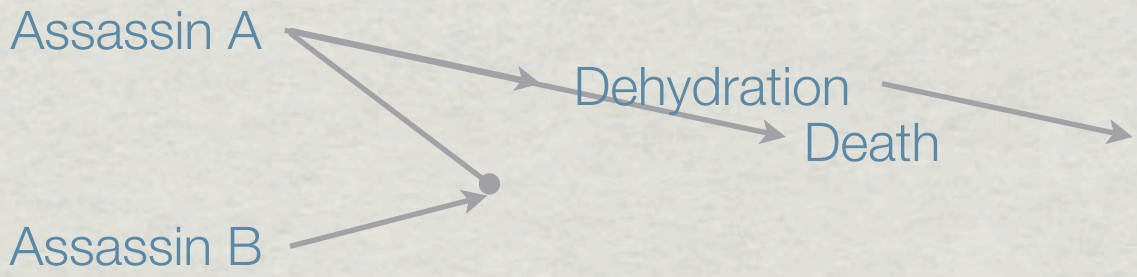
David Lewis: The Metaphysical Humean

- In 1973 Lewis thought that regularity theories were beyond repair
- But he found, also in Hume, a passage that allowed a different interpretation:
  We may define a cause to be an object followed by another, and where all the objects, similar to the first, are followed by objects similar to the second. Or, in other words where, if the first object had not been, the second never had existed.



Lewis' theory

- Counterfactual dependence is sufficient for causation but not necessary: causation is transitive, dependence is not
- Causation is thus defined in terms of chains of counterfactual dependence
- This saves the theory from so-called problems of early pre-emption: the desert traveller



Counterfactuals

- And B counterfactually dependent on A if and only if:

  'There is a *-A* world in which *-B* that is closer to *w* than any *-A* world in which *B*'
- Kit Fine pointed out that there is a problem with this definition. Suppose Nixon pressed the button; it now seems that a world in which a technical malfunctioning occurs that prevents the nuclear holocaust is more similar to our world than the world destroyed by a nuclear war
- In response, Lewis proposed the following ordering:
  1. Avoid big, widespread, diverse violations of law
  2. Maximise the spatio-temporal region throughout which prefect match of particular fact prevails
  3. Avoid small, localised, simple violations of law
  4. Do not worry about approximate similarity of particular fact, even in matters that concern us greatly

Problems with counterfactual theories

- Certain problems are recalcitrant, however
- Not all causal relations seem to be transitive
- One important class of problems has to do with so-called redundant causation
- For instance, late pre-emption, trumping...

Probabilistic theories

- ... are related to counterfactual theories in various ways; for instance,
  - they’re also basically Humean
  - at least early theories were reductive
  - they also regard causes as difference makers
- But they focus on causal generalisations rather than singular causation

Probabilistic theories

- Few causes are known to determine their effects with certainty, for a variety of reasons including:
  - Genuine indeterminism (quantum mechanics)
  - Enabling conditions
  - Disturbing factors
- At best, thus, causes are thought to raise the probability of their effects
- For instance; A causes B iff $P(B \mid A) > P(B)$

Probabilistic theories

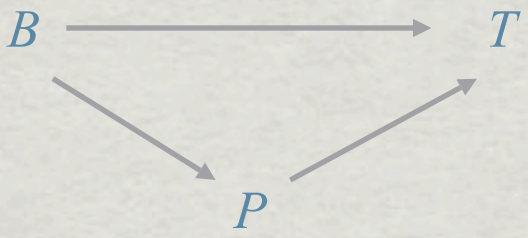
- In this version, the theory suffers again from the problem of epiphenomena (or the problem of confounders)
- For instance, the drop in the barometer reading raises the probability that a storm will occur but the former doesn’t cause the latter

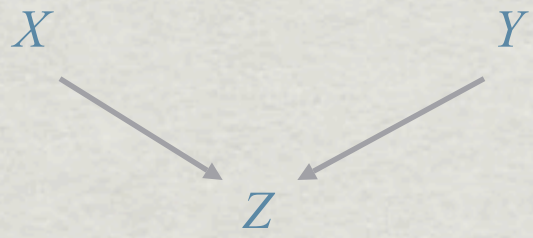
Probabilistic theories

- Suppes distinguished two stages of causal analysis
- First, earlier events that raise the probability of later events of interest are deemed ‘prima facie causes’
- In order to determine whether a prima facie cause is genuine we look for a partition such that each element of the partition ‘screens off’ the prima facie cause from the effect (the effect is probabilistically independent of the prima facie cause, given each element in the partition)
- A cause is genuine if it is a prima facie cause and there is no such partition

Probabilistic theories

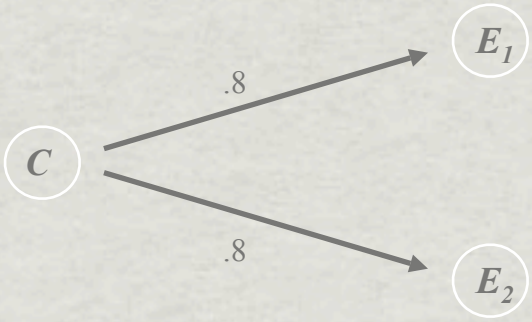
- Probabilistic dependence is, however, neither necessary nor sufficient for causation:
- Lack of necessity: ‘cancelling’ causes
- Lack of sufficiency: unfortunate populations (e.g., colliders, non-stationary time series...)





Probabilistic theories

- Moreover, not all common causes screen off their effects



- In indeterministic contexts, even the full common cause does not screen off its effects:
  $P(E_i \mid C) = .8$; but: $P(E_1 \mid E_2) = 1$; hence:
  $P(E_1 \mid E_2) > P(E_1)$; but $P(E_1 \mid E_2, C) > P(E_1 \mid C)$

Probabilistic theories

- In the 1990's the method has been developed into a powerful tool for causal inference – Bayes' nets – where two assumptions are central
  - The Causal Markov Condition ('In V, conditional on a variable's parents, each variable is probabilistically independent of every other variable except its descendants')
  - The Faithfulness Condition ('In a causal graph, no probabilistic independencies hold other than those predicted by the CMC')
- The CMC is a generalisation of the earlier screening-off condition, the faithfulness condition is analogous to the requirement that every cause is a prima facie cause; hence the same counterexamples apply

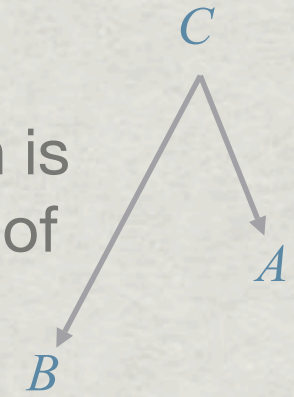
Causation and recipes

- Yet another theory of causation that uses the idea of ‘difference making’ is the manipulability theory
- Douglas Gasking, also frustrated by the enduring problems with regularity theories, noticed that causation has an additional connotation: if X causes Y we should expect to be able to use X to manipulate Y

Causation and recipes

- An attempt at a reductive (agency) theory of causation has been made by Menzies and Price according to whom A causes B iff $P_A(B) > P_{\neg A}(B)$, where '$P_X(Y)$' is the so-called agency probability: the probability of Y given X has been set by an agent
- It is generally accepted that this kind of theory is deficient for various reasons, including:
  - It is anthropomorphic (is that a deficiency?)
  - The notion of 'setting A by an agent' is under-characterised

Causation and recipes



- Clearly, not every manipulation or **intervention** is appropriate to serve as a basis for an account of causation
- Thus, think of an ideal experiment; we want to make sure that the intervention on the cause is the only source of variation in the effect

Causation and recipes

- Under ideal circumstances, intervention I has the following properties (e.g., Woodward 2003):
  - I causes C
  - I is a “switch” variable for C
  - Any causal influence from I to E goes through C
  - I is independent of any other cause of E
- As an ideal test, all right but:
  - It’s not practical
  - Not all causal relations may be testable in this way

Causation and recipes

- Hence, James Woodward defines causality counterfactually:
- A causes B if and only if B would change if an appropriate manipulation (see above) on A were to be carried out.
- Problems:
  - How do we evaluate counterfactuals?
  - Operationalism: isn't 'wiggling' a test for causality rather than a definition?
  - Not all causal relations may be stable under 'wiggling'

Wesley Salmon: Hume mechanised

- Salmon originally worked within the probabilistic paradigm but later found its difficulties insurmountable
- What the probabilistic account is missing is the fact that causes are connected to their effects by a continuous process or mechanism

Process accounts

- Salmon distinguished the concepts ‘causal production’ and ‘causal propagation’; ‘production’ remains a probabilistic notion to him, but ‘propagation’ is cashed out in terms of processes
- A causal process (as opposed to pseudo process) is one that is able to transmit a mark: inserting a filter at the source of a light will permanently colour the light; colouring the illuminated spot on the wall won’t
- Nancy Cartwright pointed out that this theory will have to be formulated in counterfactual terms in order to avoid counterexamples (‘Let P be a process that... *would* remain uniform with respect to a characteristic Q, which it *would* manifest...’

Process accounts

- In Phil Dowe's reading, Salmon's theory has the following propositions:

(I) A process is something which displays consistency of characteristics

(II) A causal process is a process which can transmit a mark

(III) A mark is transmitted over an interval when it appears at each spacetime point of that interval, in the absence of interactions

(IV) A mark is an alteration to a characteristic, introduced by a single local interaction

(V) An interaction is an intersection of two processes

(VI) A causal interaction is an interaction where both processes are marked

Process accounts

- Phil Dowe later criticised a variety of aspects of Salmon's theory, including:
  - its **circularity** (a mark is introduced by an interaction, which is a causal notion)
  - its **vagueness** (Cambridge properties can be 'characteristics', which leads to counterexamples)
  - its use of **counterfactuals** (because counterfactuals require necessary connections, which Salmon sought to avoid)
- and, in turn, developed his own version: the conserved quantity theory

Process accounts

- The conserved quantity theory has only two propositions:
  - Definition 1. A causal interaction is an intersection of world lines which involves exchange of a conserved quantity
  - Definition 2. A causal process is a world line of an object which manifests a conserved quantity
- ‘World line’: collection of points on a spacetime diagram which represents the history of an object
- ‘Conserved quantity’: any quantity that is universally conserved according to current scientific theories

Process accounts

- Dowe's theory can certainly avoid certain difficulties with Salmon's but it isn't free of problems either
- The main trouble is with the assumption that all cases of causation involve continuous processes – for not all do
- In particular, cases of causation by omission show that this condition is not always met
  - the not-so-constant gardener
  - the air traffic controller

Conclusion

- Though a number of philosophers still work within one or the other of the mentioned paradigms in search of a universal theory of causation, many have given up and turned to other issues
- The reason is that every theory that seeks to define causation (whether reductive or not) seems to be subject to counterexamples that won't go away
- In the next lecture, I will discuss some of the more interesting topics in the contemporary debate