

3

Causation, Regularities, and Time: Hume's Theory

It is fitting for both historical and philosophical reasons to begin the discussion of causation with David Hume's theory and its contemporary developments. Hume's theory is the starting point for most modern treatments of causation, and the problems his theory must surmount are problems for all theories of causation. Some philosophers believe that Hume was right, though they would add that his account of causation needs refinement. Others, including me, would reject Hume's theory. Nevertheless, my views owe a great deal to Hume.

3.1 Hume's Theory

Hume argues that causation involves a regular association between cause and effect with the cause contiguous with its immediate effects and preceding them. He also argues that the human psychological propensity to pass from an "impression" (perception) of a cause to an idea of its effects (or from an impression of an effect to an idea of its cause) leads people mistakenly to believe that there is a necessary connection between cause and effect. This account takes the mystery out of causation, while retaining the all-important links between causation and regularities and explaining the mistaken belief that there is more to causation than regularity, contiguity, and time order.

Hume claims to clarify the content of our "ideas" (mental contents) and of the relations among them, and he does not clearly demarcate philosophy from introspective psychology. His account of causation is constrained by his empiricism – that is, his view that all our ideas derive from preceding impressions of sense or reflection. He is saying that nonlogical terms have meaning only if one can tell by observation whether they apply to things and that the evidence for all claims concerning matters of fact derives from observation.

In Hume's view, the way to clarify ideas, including the idea of causation,

is to determine what impressions they derive from.

Complex ideas may, perhaps, be well known by definition, which is nothing but an enumeration of those parts of simple ideas, that compose them. But when we have pushed up definitions to the most simple ideas, and find still some ambiguity and obscurity; what resource are we then possessed of? . . . Produce the impressions or original sentiments, from which the ideas are copied. These impressions are all strong and sensible. They admit not of ambiguity. They are not only placed in a full light themselves, but may throw light on their correspondent ideas, which lie in obscurity. (1748, p. 41)

In the case of a complex idea such as causation, one must either find the complex impression of which it is a copy or determine its components and trace them to the simpler impressions from which they derive.

Hume maintains that within the complex idea of causation are the ideas of temporal priority, spatial and temporal contiguity, regularity, and necessary connection. In the *Treatise* Hume argues that all causes must come before their effects, or else none of them would (Book I, Part III, §2). I do not understand this argument, and Hume does not repeat it in the later account in the *Inquiry*.¹ In the later treatment, Hume takes it as obvious that causes precede their effects. It seems plausible, however, that causes may continue to exist after some of their effects have begun. For example, one may still be in the act of striking a match after it has begun to light. So one should take Hume's temporal priority condition to require only that a cause *begin* before its effects begin.

The spatial-temporal contiguity requirement creates difficulties for Hume, because he believes that mental things stand in causal relations even though they are not located in space (*Treatise*, Book I, Part IV, §5). Hume omits the contiguity requirement in his later account of causation in the *Inquiry*. Modern materialists do not have this objection to the spatial contiguity requirement, but many would question whether a theory of causation should rule out remote causation without more detailed inquiry (Spohn 1983b, p. 84). Developments in quantum theory also cast a cloud over contiguity requirements. As we shall see, however, it is hard to make a Humean account of causation plausible without relying on a contiguity condition. Even if contiguity is not built into the truth conditions for causal claims, it is an element of familiar causal processes.²

It is not clear from Hume's account whether the notion of a regularity is contained in people's actual idea of causation or whether instead it *should*

¹ For an attempt to reconstruct this argument, see Beauchamp and Rosenberg (1981, pp. 192–5).

² I shall not explore the difficulties that are involved in the notion of contiguity. See Russell (1913), Taylor (1964), Brand (1980), and Beauchamp and Rosenberg (1981, ch. 5).

be a part of their idea, since it is an aspect of causation itself. Hume speaks of a "constant conjunction" among "similar" objects. According to Hume, when *a* causes *b*, "objects similar to" *a* are invariably followed by objects similar to *b*. There are serious problems in this account. My waving my hand is similar to my striking a match, but my hand-waving is not usually followed by flames. Like most contemporary philosophers, I shall explicate the relevant notion of similarity in terms of the laws of nature in virtue of which *a* causes *b*. If there is a law of the form $(x)(Ax \rightarrow Bx)$, then objects similar to *a* are events of kind **a** – that is, other instantiations of *A* – and objects similar to *b* are events of kind **b**. Recall that I am assuming that one knows the relevant aspects of events and has thus already identified the "similarity."

The problems with Hume's notion of constant conjunction don't stop with the identification of the relevant tropes. Even if one has identified the tropes, the relation between them is not invariable. Turning a switch causes a bulb to light, but the bulb does not always light when the switch is turned. Hume maintains that when the relation is not invariable, then one has not fully specified the cause. Turning the switch is only a part of the cause of its lighting. The cause is turning the switch when the battery is charged, the bulb in good repair, and

This response to the fact that what we call causes are not invariably linked to their effects conflicts with ordinary usage and the scientific concern to identify "causal factors" that promote the occurrence of effects without by themselves requiring them. Furthermore, if the description of the cause is logically independent of the statement that the effect occurs, then it is virtually impossible to specify explicitly a set of conditions, the satisfaction of which will lead invariably to the effect's occurrence. Rather than calling the complete set of sufficient conditions – if there is one – "the cause," I shall call the separate causal factors "causes."

The fact that it is so difficult to specify a set of causes that is sufficient for an effect constitutes a reason to question whether the connection between cause and effect is deterministic. To say that smoking causes lung cancer seems to imply only that smoking increases the risk of lung cancer. Such considerations have led a number of philosophers to propose theories of probabilistic causation, which are discussed in chapter 9. Until then, I shall assume with Hume that causation is a deterministic relation. I defend this assumption in §9.5 and §9.7. To say that causes determine their effects is not to say that everything is caused or that nothing happens by chance, and it does not commit me to determinism. Taking causation to be a deterministic relation implies only that *if* something is caused, its causes are sufficient in the circumstances.

Passing over the problems concerning constant conjunction, to which I

will return in the next section, let us turn to necessary connection, the final element in the idea of causation. Although necessary connection is, Hume maintains, the most important part of the *idea* of causation, he also maintains that it is impossible to have any impression of necessity. All we can ever observe are successions of separate occurrences.

What is our idea of necessity, when we say that two objects are necessarily connected together? Upon this head I repeat what I have often had occasion to observe, that as we have no idea that is not derived from an impression, we must find some impression that gives rise to this idea of necessity, if we assert we have really such an idea. In order to [do] this, I consider in what objects necessity is commonly supposed to lie; and, finding that it is always ascribed to causes and effects, I turn my eye to two objects supposed to be placed in that relation, and examine them in all the situations of which they are susceptible. I immediately perceive that they are *contiguous* in time and place, and that the object we call cause *precedes* the other we call effect. In no one instance can I go any further, nor is it possible for me to discover any third relation betwixt these objects. I therefore enlarge my view to comprehend several instances, where I find like objects always existing in like relations of contiguity and succession. The reflection on several instances only repeats the same objects; and therefore can never give rise to a new idea. But upon further inquiry I find that the repetition is not in every particular the same, but produces a new impression, and by that means the idea which I at present examine. For, after a frequent repetition, I find that upon the appearance of one of the objects the mind is *determined* by custom to consider its usual attendant, and to consider it in a stronger light upon account of its relation to the first object. It is this impression, then, or *determination*, which affords me the idea of necessity. (1738, p. 154)

The idea of necessary connection is a mental (causal) consequence of regularities. The idea of necessity arises from the way in which human minds react to perceptions of regularities, not from any feature of the objects. All that causation consists of in the objects themselves (which is knowable to cognizers like human beings) is regularity, contiguity, and temporal priority of the cause to the effect. That is all there is to causation, although if one also wants to explain how people *think about* causation, it is important to add that the regular connection between cause and effect leads human minds to turn from the impression of one to the idea of the other and that this tendency of human minds makes people *feel* a further necessary connection. Thus Hume offers *two* definitions of causation in terms respectively of regularities and of the feeling of determination caused by the experience of regularities. Hume knows that his account will seem implausible, but having argued that power is unobservable and having given such a neat explanation for how regularities give rise to the idea of necessity, he thinks readers should find his arguments convincing.

3.2 Constant Conjunction

The notion of a constant conjunction between cause and effect – of a deterministic causal relation – requires clarification. Even if one has identified the relevant tropes, one must still characterize the regularities that obtain among them. J. L. Mackie, drawing on ideas of John Stuart Mill, argues that a cause, such as striking a match, need not be a necessary nor a sufficient condition for an effect, such as the match lighting. A cause is rather "at least an INUS condition" – that is, at least "an *insufficient* but *nonredundant* part of an *unnecessary* but *sufficient* condition" for the effect (1980, p. 62). Jonathan Bennett speaks more simply of "NS conditions" – necessary parts of sufficient conditions (1988, p. 44). For example, matches light in many conditions. They may be struck in the presence of oxygen in the right conditions of temperature, wind, and humidity. They may be kindled by the presence of a flame in other conditions. A match lights if and only if one or more of these sets of sufficient conditions obtains. Each of the sets of sufficient conditions is minimal in the sense that none of its conjuncts is redundant. The conjuncts of these minimal sufficient conditions are INUS conditions.

Mackie stresses that causal claims take for granted a "causal field," a background in which the INUS relation is situated.³ For example, the facts that a mouse is alive, breathes, eats, and defecates matter to whether it contracts cancer, but one would not regard them as causes of its contracting cancer. Such facts are instead part of the causal field. "The causal field in this sense is not itself even part of a cause, but is rather a background against which the causing goes on" (Mackie 1980, p. 63). *I take constituents of the causal field to be themselves causes or causal conditions that are relegated to the background for pragmatic reasons.* I will usually not mention the causal field explicitly.

According to Mackie, the general form of an INUS condition is:

For some G and for some H all $F(AG \text{ or } H)$ are B , and all FB are $(AG \text{ or } H)$ (1980, p. 67 [my relettering]).

F is the causal field, A is a causal factor, B is the effect, G is a variable that ranges over conjunctions of causal factors, and H is a variable that ranges over disjunctions of conjunctions of causal factors. When Mackie first introduces the notion of an INUS condition, he supposes that the other conjuncts, which together with A make up a minimal sufficient condition for B , are known, as are the other minimal sufficient conditions. But he notes that this is an idealization and that the formulation with second-order

³ Mackie credits John Anderson (1938) with introducing this notion.

existential quantification is the most we can say. One rarely if ever knows the full content of F and what values of G and H make the biconditional true.

The logical form of INUS conditions requires clarification. Are "A" and "B" propositions, properties, or events? It does not make much sense to take them to be event *tokens*, since concrete particulars cannot be conjuncts in necessary or sufficient conditions. That leaves propositions or properties. (Event types can be treated as properties.) Suppose **A** and **B** are propositions stating truly that events e_1 and e_2 occur. Then by virtue of the definition of the truth-functional "if and only if" connection, it will trivially be the case that **A** if and only if **B**, and **A** will be necessary and sufficient for **B**. To require that a proposition asserting that a cause occurs be at least an INUS condition for a proposition that an effect occurs is much too weak. That leaves properties.

The idea to be explicated is of a constant conjunction or a regular association, and so it seems that INUS conditions must be (second-order) quantified statements: there exists G and there exists H such that $(x)[Fx \rightarrow (Bx \leftrightarrow Gx \& Ax \text{ or } Hx)]$. "In the causal field F , every match lights if and only if it is struck and some conditions G are true of it or some other set of conditions is true of it."

If a causes b , then it must also be the case that B and A and some G are in fact true of the particular entity or set-up, and that no H distinct from $A\&G$ is, and that A is not redundant in the necessary condition $A\&G$. Otherwise the regularity $(\exists G)(\exists H)(x)[Fx \rightarrow (Bx \leftrightarrow Gx \& Ax \text{ or } Hx)]$ will not be relevant. On this construal, Hume's constant conjunction condition requires that a property of the cause a is in the actual circumstances (in which some G is instantiated and no disjunct of H is) necessary and sufficient for a property of the effect b . In cases of preemption or overdetermination some disjunct of H will be instantiated.

One can restate this more formally as:

a is necessary and sufficient in the circumstances for b in causal field F if and only if in F 1. $(\exists G)(\exists H)(x)(Gx \& Ax \text{ or } Hx \leftrightarrow Bx)$, 2. $B(c, t')$, 3. $A(c, t)$, 4. $(\exists G)G(c, [t, t'])$, and 5. $(H)(x)[(Hx \rightarrow Bx \& H[c, (t, t')]) \rightarrow G \& A \text{ are conjuncts in } H]$.

A and B are properties instantiated by a and b , c is the particular set-up, t the time when a begins, t' the time when b begins, and $[t, t']$ the interval between t and t' . (1) states that A is an INUS condition for B . (2), (3), (4), and (5) state that A , B , and some G are instantiated by the set-up at the proper time and that no H distinct from $G \& A$ is. (5) also implies that A is not redundant in the minimal sufficient condition for B that is instantiated in the set up at the time. In order to keep the clarification of "constant conjunction" separate from Hume's insistence that causes always precede

their effects, this account does not require that t and t' be distinct or that t precede t' . One may want to make explicit the temporal and spatial elements in clause (1), but I shall ignore this complication here (see pp. 56–7). This account of necessity and sufficiency in the circumstances is not Mackie's. He gives instead a counterfactual construal of the terms "necessary (or sufficient) in the circumstances" (1980, ch. 2).⁴

Although constant conjunction is an empirical proxy for necessary connection, the recognition that a property of one event is an INUS condition for a property of another does not always lead us to believe that the events have a necessary connection. For example, the law that light travels in straight lines establishes nomological connections between the height h of a flagpole, the length of its shadow s , and the angle of elevation of the sun a . Propositions stating the value of any two of these (plus absence of interference, etc.) constitute a minimal sufficient condition for a proposition stating the value of the remaining variable. Thus a value of a , the angle of elevation of the sun is an INUS condition for a value of s , the length of the flagpole's shadow; and in this case we are inclined to "feel" a necessary connection. But a value of a is also necessary in the circumstances for the value of h , the height of the flagpole, and obviously there is no necessary connection between the angle of elevation of the sun and the height of the flagpole. The most one can say is that a being at least an INUS condition for b is a necessary condition for the existence of a necessary connection in the circumstances between a and b .

A serious problem with this account of constant conjunction remains. Suppose that a coin is flipped only twice before it is melted down and that it lands heads both times. Thus, whenever this coin is flipped, it lands heads. So tossing this coin is necessary and sufficient in the circumstances for the coin to land heads. Yet no one would say that tossing this coin and its landing heads are, in the relevant sense, constantly conjoined. The problem is that the regularity between the tossing and the coin's landing heads is "accidental." The INUS condition linking cause and effect must be

⁴ Statements of quantitative relations among variables resemble statements of INUS conditions (Cartwright 1989, p. 28; Hoover 1990, pp. 218–19). Suppose, for example, that the fact that x has value x^* (at s, t) causes z to have value z^* (at s', t'). Then on this account of the regularities involved in causation it must be the case that the fact that x has value x^* is necessary and sufficient in the circumstances for the fact that z has value z^* . What this means in a quantitative case (supposing for simplicity that the relations are linear) is (1) that a functional relationship obtains such as $(x)(y)(z)(Fxyz \rightarrow (z = j + kx + my))$ (2') $Fx^*y^*z^*$ at $(s, [t, t'])$ (3') $z = z^*$ at (s, t') , (4') $x = x^*$ at (s, t) , and (5') $k \neq 0$. s refers to the "system" within which the quantitative relation holds. The quantitative relation has an antecedent condition ($Fxyz$) analogous to the causal field relativization mentioned above, because quantitative relations among variables typically hold only for particular set-ups and particular ranges of the values of the variables. The conditions are then analogous to those involving nonquantitative variables. In a particular causal field, the located value of z is caused by the located value of x in conjunction with other factors.

"nomological" or "lawlike."

With this addition, one then can state the INUS condition construal of the constant conjunction requirement. For simplicity the following formulation leaves the reference to the causal field implicit and treats G and H as properties rather than second-order variables. One can then state the following necessary condition for a deterministic causal relation:

DC (*Deterministic causation – causes as INUS conditions*) If a is a deterministic cause of b in set up c during the time interval $[t, t']$, then given laws of nature \mathbf{L} ,
1. $B(c, t')$ entails and is entailed by $\{A(c, t) \ \& \ G(c, [t, t']) \text{ or } H(c, [t, t'])\}$, but $B(c, t')$ is not entailed by $G(c, [t, t'])$, 2. $B(c, t')$ 3. $A(c, t)$, 4. $G(c, [t, t'])$, and 5. $\neg H(c, [t, t'])$.

A and B are the properties whose instantiations constitute aspects of the events a and b , c is the particular set-up, t is the time when a begins, t' is the time when b begins, $[t, t']$ is the interval between t and t' and \mathbf{L} some set of laws of nature. The entailment must not hold if \mathbf{L} is empty. **DC** states that a deductive relationship among properties, given laws of nature, is a necessary condition for a causal relationship. It would be more faithful to Hume to formulate **DC** as a nomological generalization over token events, but the formulation here is preferable nevertheless, because it avoids the misleading suggestion that there are regular co-occurrences between events instantiating properties A and B . The particular instance may be the only occasion in the whole of history that an event instantiating A causes one instantiating B . To speak of a regularity theory of causation as many contemporary philosophers do or to speak as Hume does of constant conjunction is misleading. The tokens are linked by laws, and if it were possible to recreate the circumstances repeatedly, then a regularity would certainly appear, but there is nothing in the notion of causal connections as instantiating lawful connections that rules out unique sequences of cause and effect.

The claim that causes are nomic INUS conditions for their effects appears to capture what one intends by maintaining that causation is deterministic and that it involves regularities. Both here and in later chapters *I shall take DC as a formal explication of what it means to say that causation is deterministic*. Humeans (like empiricists generally) cannot be fully satisfied with this explication, because it is difficult to distinguish nomic from accidental regularities. How could one possibly observe whether a regularity was merely accidental? Moreover, even supposing that one could distinguish laws from accidental regularities, how is one to spell out the link between laws of nature and specific nomic INUS conditions? These difficult problems do not count against the Humean account when it is compared to alternative theories of causation, because these are equally

problems for the alternative theories. So let us permit the Humean to rely on the distinction between lawlike and accidental regularities. Cause and effect are constantly conjoined if and only if a property instantiated by the first is nomically necessary and sufficient in the circumstances for a property instantiated by the second.

3.3 A Neo-Humean Theory of Causation

An updated Humean theory thus maintains that *a* is a direct cause of *b* if and only if *a* and *b* are distinct and contiguous, *A* is necessary and sufficient in the circumstances for *B*, and *a* precedes *b*. Although the distinctness condition may be implicit in the relation of *nomi*c necessity and sufficiency, which precludes logical necessity and sufficiency, it should not be forgotten. If *a* and *b* are cause and effect, they must be different events, they can have no parts in common, and the relevant tropes cannot entail one another.

Causes need not be direct causes, and one can go on to say that *a* is a cause of *b* if and only if *a* is a direct cause of *b* or there is a unidirectional chain of direct causation from *a* to *b*. But should one say such a thing without good evidence that there are no "remote" causes that operate without the help of any connecting chain? To these definitions, a Humean can add a psychological explanation of why people mistakenly believe that causation also involves some sort of power, efficacy, or necessary connection.

Hume has a simple theory of causal priority: Causes precede their effects.⁵ Many philosophers, myself included, have been dissatisfied with the stipulation that causes precede their effects. It may be true that causes always precede their effects, and it could be that the best theory of causal priority relies on time. But an acceptable temporal-priority theory of causal priority should rely on better evidence than the casual observation that causes typically precede their effects. Paul Horwich points toward the kind of argument that is needed. He maintains that temporal priority constitutes the asymmetry of causation, but that this claim is an *a posteriori* necessity, like the claim that water is H₂O (1987, pp. 140–5). His account is not subject to the criticism that a theory of causation ought not to foreclose the possibility of simultaneous or backwards causation without attending to the evidence. Yet Horwich provides only a problematic sketch of the relations between time and other asymmetrical features of causation, and he makes no serious argument for the claim that the temporal priority constitutes the asymmetry of causation. Indeed his own defense of the possibility of

⁵ Beauchamp and Rosenberg defend the view that Hume has no theory of causal priority at all! They interpret Hume to deny that causation itself is asymmetrical. The asymmetry people find in causal relations reflects the fact that events that are causally related are not simultaneous.

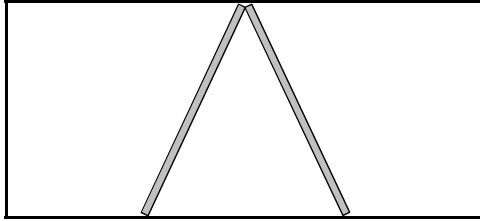


Figure 3.1: Simultaneous and reciprocal causation

simultaneous causation contradicts his claim that temporal precedence constitutes causal priority.

Many people believe that some causes are simultaneous with their effects (Taylor 1966). Suppose, for example, I take two boards and lean them against one another so that they support one another. After I walk away, one has the situation shown in figure 3.1: The left board holds up the right board and the right board holds up the left board. Doesn't the position of each causally depend on the position of the other?⁶ Should a philosophical theory deny this possibility on the grounds that causation is always asymmetric or on the grounds that causes always precede their effects in time? For an example of asymmetrical simultaneous causation, consider the relationship between tastes and prices in general equilibrium theory (Hoover 1993). Tastes influence prices even though there are no temporal relations in the model.

One can dispute both these examples. The position of the right board at time t in fact depends on the position of the left board slightly *before* t (Frankel 1986, pp. 365–6; Mellor 1995, pp. 220–4). If one were to vaporize the left board at t , the right board would not yet have moved. So apparently simultaneous mutual causation reduces to asymmetric causation by temporally prior causes. In the second case, there is an implicit temporal story in the background.

These responses are not without their problems. Is there a time when the left board is vaporized and the right has not yet begun to move? It is not as if the right board takes its bearings before it begins falling. In the second case, the relations between the explicit model and the implicit theory remain unarticulated. In any case, the possibility of explaining away such cases settles nothing. Should reference to an implicit temporal story be necessary in order to make sense of the claim that tastes are supposed to determine prices, even though tastes do not precede prices? How much physics should

⁶ This example is discussed by Pollock (1976, p. 173), Fair (1979, p. 230), and Frankel (1986, pp. 361, 365–6).

be written into theories of causation? Speculative contemporary physical theories suggest that some causal influences go backward in time. Should a philosophical theory cast its fortunes with some physical theories and rule out others without considering the evidence? Finally, identifying causal and temporal priority makes it impossible to explain why the direction of causation and the direction of time match.

Defenders of a Humean theory might try to relax the requirement that causes precede their effects by embedding particular causal relations within larger chains. One might, for example, say that a is causally prior to b if (1) a precedes b or (2) a is causally between c and b and c precedes b or (3) b is causally between a and d and a precedes d . This suggestion is, however, empty until one has provided some theory of the relation "is causally between." Reichenbach provided such a theory (1956, §5), but only for nonsimultaneous events.

Paul Horwich argues for a more promising version of this strategy. Consider figure 3.2a, which (apart from my lettering) reproduces a drawing of Horwich's (1987, p. 136). Suppose that there are basic laws connecting the pairs (a, c) , (a, b) , and (b, d) . The temporal priority of c to a and b to d establishes that c directly causes a and b directly causes d . If we then "maximize causal continuity (so that causal priority in one part of the chain may be 'smoothly' extended to adjacent parts)" (Horwich 1987, p. 136), we should draw the remaining arrow from " a " to " b ."

To see the problems with this argument, one should notice first that graphs of real situations do not look like Horwich's picture. The picture in figure 3.2b is more accurate. a and b will have many causes and effects. In particular, suppose that e is a direct cause of b and f a direct effect of a . If we draw the arrow between " a " and " b " the way Horwich does, there is a causal chain: $c \rightarrow a \rightarrow b \rightarrow d$ and b and f are related only as effects of their common cause a . If we draw the arrow in the other direction, there is a causal chain $e \rightarrow b \rightarrow a \rightarrow f$, and a and d are related only as effects of their common cause b . Which way should one draw the arrow between " a " and " b ?" If c causes d , then there has to be a directed path from " c " to " d ." If, in addition, there are no other causal relations among these variables, then the edge must go from " a " to " b ." But the indirect causal relation between c and d is supposed to be constituted by the existence of a chain of direct causation. The direction of the edge between " a " and " b " is presupposed by the existence of the path between " c " and " d " and cannot be determined or constituted by it.

One might be able to infer that a is a direct cause of b if one had some way to know that c caused d that did not depend on knowing that there was a causal chain linking them. What motivates Horwich's argument is, I think,

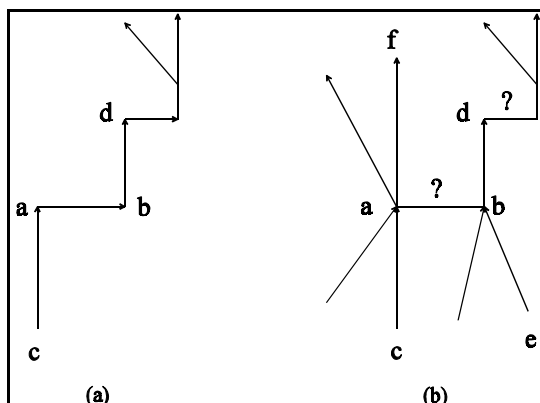


Figure 3.2: Allowing for simultaneous causation

the sensible thought that there may be lawlike connections between events of kinds *c* and *d* which require a causal explanation, and it may be that one can rule out all the alternatives that do not depend on *c* being an indirect cause of *d*. Such a theory goes beyond Hume in asserting that lawlike connections require causal explanations, but appears in principle to permit one to relax the temporal priority requirement. The details of such a theory are not easy to fill in, and I shall not attempt to formulate explicitly the conditions for "causal betweenness." Although Hume's theory might thus in principle be revised to encompass some simultaneous causation, I shall ignore this complication in what follows and take Humean views to require that causes precede their effects.

For the record, here is an explicit formulation of the Humean theory of causation:

(H) (*Humean theory*) *a* is a *cause* of *b* if and only if *a* is a direct cause of *b* or there is a unidirectional chain of direct causes running from *a* to *b*.

a is a *direct cause* of *b* if and only if *a* and *b* are distinct, *a* is nomically necessary and sufficient in the circumstances for *b*, *a* and *b* are spatially and temporally contiguous, and *a* begins before *b* begins.

3.4 Spurious Causation

A thunder clap is not caused by a contiguous lightning flash, even though the two apparently satisfy all the conditions of Hume's account of causation. Hume's theory falsely implies that contiguous and temporally successive effects of a common cause are related as cause and effect. The complex of problems that arise here is called by David Lewis, "the problem of

epiphenomena." One can also call this "the problem of spurious causation."

The Humean account of causation implicitly defines a symmetrical notion of "direct causal connection." Events are directly causally connected if they are distinct, contiguous, and necessary and sufficient for one another in the circumstances. To address the problem of epiphenomena, one must either find some way to deny that effects of a common cause are causally connected to one another, or one must amend Hume's temporal precedence account of causal asymmetry. Although I believe that the problem of spurious causation can be solved only by an improved account of causal priority, let us consider how one might attempt to rule out causal connections between effects of common causes. (The fact that their concomitance seems in some sense "causal" is not decisive, since one is free to take "causal connection" to be a technical term.)

On what grounds might one deny that effects of a common cause are causally connected? It is hopeless to argue that effects of a common cause are never truly contiguous. Consider, for example, the relations among images in a mirror (Edwards, cited in Faust and Johnson 1935, p. 335, Kim 1984, pp. 257–8). Perhaps, one can instead strengthen the sort of regularity required for a *direct* connection between cause and effects. Paul Horwich, for example, insists that the laws relating causes and their direct effects be "basic" and that the nomic connection between a cause and its direct effects not require reference to any third event or state of affairs (Horwich 1987, pp. 134–5; see also Clendinnen 1992, pp. 351–3). Such basic nomological connections will never obtain between effects of a common cause, and so one will never mistakenly take them to be related as cause and effect. I question whether any conditions on laws and on the relations between laws and causes can be strong enough to rule out causal connections between effects of a common cause without ruling out direct causal connections between genuine causes and effects. On Horwich's account, for example, it turns out that there is no direct causal relation between the length of a pendulum and its frequency of oscillation, because the law of the pendulum requires reference to the presence of the Earth and hence is not basic (1987, p. 166).

One might instead add some clause to Hume's account to the effect that if *a* and *b* are effects of a direct common cause, then they are not directly causally connected. An explicit stipulation to this effect will not serve, since *a* and *b* may be effects of a common cause and *also* be related as cause and effect. A more promising suggestion would be to say that *a* and *b* are directly causally connected if (1) they are distinct and contiguous, (2) *A* is nomically necessary and sufficient in the circumstances for *B*, and (3) when one "controls for" or "holds fixed" common causes of *a* and *b*, *A* is still

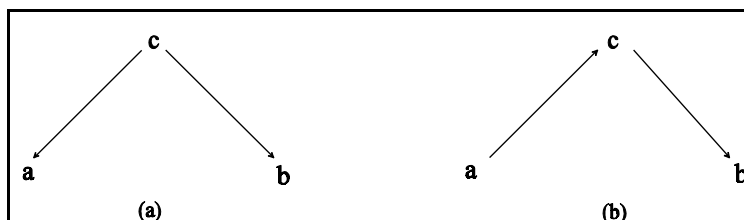


Figure 3.3: Common causes and causal chains

necessary and sufficient in the circumstances for B . (Since causal connection is a symmetrical relation, the positions of a and b can of course be reversed.) The idea is that if the regular association between types a and b in the circumstances is due entirely to common causes, then once the occurrence or nonoccurrence of these common causes is specified, whether a occurs should be irrelevant to whether b occurs. If A appears to be necessary and sufficient in the circumstances for B because a and b are effects of a common cause c , then including that cause in the "circumstances" makes a redundant. If A is "truly" at least an INUS condition for B , then a and b cannot be effects of a common cause. Thus it seems that no revision to Hume's account is necessary after all. When a and b are effects of a common cause, A will not be necessary "in the circumstances" for B .

This suggestion fails. Suppose that causal relations are deterministic and that c is a common cause of a and b , which stand in no other causal relation to one another. The proposal is that once we include C in the circumstances, then A will not be necessary for B . But, given determinism, if one includes A among the circumstances, it may be that C is not necessary and sufficient in the circumstances for B . One needs some reason to deny that a is causally connected to b that is not equally a reason to deny that c is causally connected to b . To cope with this problem, one might make use of the theory of causal priority and argue that it is a rather than c that is irrelevant to the occurrence of b , because c precedes a . But suppose that $c \rightarrow a \rightarrow b$. One does not want the possibility that C is necessary and sufficient in the circumstances for B to imply that a is not a cause of b . Furthermore, there is a danger of circularity, since one is relying on the notion of causation to define causal connection.

It is questionable whether Humeans have any further response to the problem of spurious causation. There is more to causation in the objects than regularity, contiguity, and temporal priority *among those objects*. In figure 3.3, the only difference is the direction of the causal arrow between a and c . The theory of causal priority rather than the theory of causal

connection ought to explain why effects of a common cause are not themselves cause and effect. (A key to causal asymmetry lies, I shall argue, in what is not shown in the figure – in the lawlike relations that aspects of cause and effect bear to other things.)

3.5 Redundant Causation

There are also problems concerning two varieties of *redundant causation*. The first involves *overdetermination*. The redundant causes are on a par: There are two or more events that are equally capable of bringing about the effect all by themselves. The shots of separate soldiers in a firing line might be an example. Since none of the shots is necessary in the circumstances for the effect, none would count as a cause on the Humean view of causation (H). Perhaps one can simply accept this implication of the analysis: None of the separate shots caused the death. The death was instead caused by a complex event constituted out of the separate shots.⁷ Work remains to be done, because it is not clear what this complex event is. I believe that the problems concerning causal overdetermination do not point to any special difficulties with a Humean view, because they arise in similar ways for all the competing theories of causation.

In cases of *causal preemption*, the redundant causes play different roles. "One of them, the *preempting cause*, does the causing; while the other, the *preempted alternative*, waits in reserve" (Lewis 1986d, p. 199). Here is a memorable example:

A man sets out on a trip across the desert. He has two enemies. One of them puts a deadly poison in his reserve can of drinking water. The other (not knowing this) makes a hole in the bottom of the can. The poisoned water all leaks out before the traveler needs to resort to this reserve can; the traveler dies of thirst.⁸

A correct analysis of causation ought to say that the preempted alternative – poisoning the canteen in this case – did not cause the traveler's death, but that the preempting cause – drilling the hole – did. The Humean analysis apparently implies that neither the poisoning nor the drilling caused the death, for in the circumstances, which include the presence of the other potential cause, neither is necessary for the death.

One way to cope with the difficulty is to note that it is only direct causes, not causes in general, that must be necessary and sufficient in the circum-

⁷ Causal overdeterminants need not be simultaneous. The bullets from two successive shots of soldiers who stand at different distances from the condemned prisoner can arrive at the same time and overdetermine the death.

⁸ Quoted from Mackie (1980, p. 44), who based it on Hart and Honoré (1959, pp. 219–20), who in turn drew on an example of McLaughlin (1925–6, pp. 149, 155n).

stances for their effects and that neither the poisoning nor the drilling is a direct cause of the traveler's death. The drilling (and not the poisoning) still counts as an indirect cause of death, because there is a unidirectional chain of direct causation between the drilling and the death, while there is no chain of direct causation connecting the poisoning and the death. This resembles the way David Lewis defends his counterfactual analysis of causation from the apparent counterexamples provided by cases of causal preemption (1973a). I shall argue in chapter 13 that attention to spatiotemporal chains of direct causation is the best way to respond to most cases of preemption, regardless of one's general theory of causation.

This solution to the problem of preemption depends on there being causal intermediaries between the preempting cause and the effect that cut the connection between the backup cause and the effect and then go on to bring about the effect. In the context of David Lewis's theory, in which links in a causal chain need not be spatiotemporally contiguous, this assumption is not always satisfied. In cases of "late" preemption, only the occurrence of the effect itself may cut a chain of counterfactual dependence that would have led to that same effect, and hence Lewis's account mistakenly implies that the effect is causally dependent on the preempted alternative. It is plausible to maintain in contrast that one will never find a chain of direct spatiotemporally contiguous causation from a preempted alternative to the effect. Or so I shall argue in chapter 13.

Another way that has been suggested for dealing with the problems posed by cases of causal preemption might be tried here. Which factor is truly the cause may affect the character of the effect. In Mackie's canteen case, the traveler dies of thirst and not of poison, and drilling a hole in the canteen is necessary in the circumstances for dying of thirst, while poisoning the canteen is not. If one is precise enough in the description of the effect, then it may turn out that the preempting cause but not the preempted alternative will be necessary in the circumstances for the effect.⁹

This method of dealing with cases of late preemption seems to me less convincing than attempting to assimilate cases of late preemption to cases of early preemption. If one insists on describing effects in such detail, one will be committed to counting everything that affects any detail of an event or its time as a cause of the event. David Lewis argues that the results are absurd:

⁹ More radically, one might maintain that all the causes of an event are essential to it. If any of event *e*'s causes had been different in any way, *e* would not have occurred. So preempting or overdetermining causes are necessary to their effects, and some of the problems of overdetermination and preemption apparently disappear. The difficulties of distinguishing preempted from preempting causes and causes from causal overdeterminers have, however, only been swept under the rug. I am indebted to Gordon Barnes for clarifying my thinking here.

Boddie eats a big dinner, and then the poisoned chocolates. Poison taken on a full stomach passes more slowly into the blood, which slightly affects the time and manner of the death. If the death is extremely fragile [that is, if it must have all of its detailed features], then one of its causes is the eating of the dinner. Not so. (1986d, p. 198)

Unlike Lewis, I think that one of the causes of (a feature of) Boddie's death is his eating a full dinner. Eating a full dinner does not explain why Boddie died or why Boddie died that evening, but it explains Boddie's slow death. Similarly, if one wants to know why an executed prisoner was struck by seven bullets and what caused his seven-bullet death, one can say that one of the causes was soldier #4's shot. One is free to consider what explains any particular aspect of the effect that one pleases.

This freedom does not, however, vindicate the fragile-events response to problems of overdetermination and preemption. When a coroner seeks the causes of Boddie's death, he is not seeking the causes of his slow death, and someone asking why the executed prisoner died is not asking why the prisoner died a seven-bullet death. Moreover, there are cases where a fragile construal of events apparently will not help. Suppose the second murderer in the story of the reserve canteen pours out the poisoned water in the mistaken belief that it was not poisoned and then refills the canteen with a poisoned solution of the same chemical constitution. The traveler would have died in exactly the same way at exactly the same time if the second enemy had not acted, yet the actions of the second enemy still caused the death.

Overdetermination and preemption constitute obvious complications for Hume's account of causation. In the case of overdetermination, the difficulty is not so much that Hume's theory implies something mistaken, as that we do not know what to say about such cases. In cases of preemption, there will often be a chain of direct causation only from the preempting cause to the effect and so Hume's account will work fine. I shall return to the problems of preemption and overdetermination in chapter 13.

3.6 The Problems of Causation

Hume's account appears to be unsatisfactory in the following regards:

1. It lacks a theory of laws and of the relations between laws and specific nomic INUS conditions.
2. It either implies falsely that successive and contiguous effects of a common cause are related as cause and effect or it implies falsely that many causal intermediaries are not causes.
3. It closes apparently empirical questions concerning the possibility of backwards causation and remote causation.

If the fundamental difficulties raised by successive and contiguous effects of common causes can be solved and if the distinction between lawlike and accidental generalizations can be drawn in a satisfactory way, and if we set aside the possibilities of remote and backwards causation, then the Humean theory of causation is attractive. Given these three ifs, it is a powerful theory. To appreciate its strengths, consider for a moment how it fares with respect to the criteria of adequacy set out in the first chapter.

1. *Intuitive fit*: A theory of causation should fit our intuitions. Obviously Hume's account is in serious trouble with respect to successive effects of common causes and in some trouble concerning simultaneous causation. Otherwise, it seems that Hume's theory fits most of our intuitions, except those concerning necessary connection, which it explains away. There are also the complications of overdetermination and preemption but the competitors have trouble with these, too.

2. *Empirical adequacy*: Like theories in physics or psychology a good theory of causation should fit the facts. Apart from problems with spurious causation, Hume's account apparently fits much of scientific usage and explains what role causal language plays. By taking some of the metaphysical mysteries out of causation, Hume's theory legitimates and explains the role of causal notions within science.

3. *Epistemic access*: A good theory of causation should explain how one finds out what causes what and, ideally, assist in learning more about causal relations. Hume reduces the problem of identifying causes to the problem of identifying nomic regularities in which the further conditions of contiguity and succession are satisfied. The only mysteries concerning causation are the mysteries concerning laws themselves, which are arguably unavoidable in science. Hume's account is explicitly motivated by empiricist scruples, and it responds to them as well as any alternative.

4. *Superseding competitors*: A good theory of causation should be better than competing theories and help explain why they succeed and fail. We have not yet examined any competitors, so the application of this criterion will have to wait.

5. *Metaphysical coherence and fecundity*: A good theory of causation should clarify the links between causation and other relations, such as temporal relations, and it should help one to answer other metaphysical questions, such as why people know so much more about the past than the future. The extent of coherence turns largely on what account can be given of the notion of a law of nature. The fecundity of Hume's definition is controversial, though any account that has been used by so many philosophers and scientists must be fecund.

It is thus obvious why Hume's theory still demands serious attention. In

addition to presenting and refining a Humean view of causation and displaying its unresolved difficulties, this chapter has also introduced central problems for theories of causation that will recur throughout the book. The problems so far are:

Regularity and necessity

Singular and general: What are the relations between token causal claims and regularities?

Laws: What are the relations between causation and laws, and what are laws?

Necessity: Can one make any sense of the necessity, efficacy, or power of causes?

Indeterminism: Are there merely probabilistic causes?

Contiguity: Are direct causes always contiguous with their effects?

Priority: How do cause and effect differ? What is the connection between causation and time?

Spurious causation: Are effects of a common cause causally connected to one another? How do effects of a common cause differ from cause and effect?

Redundancy

Overdetermination: What should one say about cases of causal overdetermination?

Preemption: Can a theory of causation correctly identify preempting factors as causes and correctly rule preempted alternatives not to be causes?

This book is mainly concerned with causal priority, but I shall have to say something about the other problems, too. I shall set aside the difficulties involving preemption and overdetermination until chapter 13.