Ideas About Causation in Philosophy and Psychology

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Philosophical theories summarized here include regularity and necessity theories from Hume to the present; manipulability theory; the theory of powerful particulars; causation as connected changes within a defined state of affairs; departures from “normal” events or from some standard for comparison; causation as a transfer of something between objects; and causal propagation and production. Issues found in this literature and of relevance for psychology include whether actual causal relations can be perceived or known; what sorts of things people believe can be causes; different levels of causal analysis; the distinction between the causal relation itself and cues to causal relations; causal frames or fields; internal and external causes; and understanding of causation in different realms of the world, such as the natural and artificial realms. A full theory of causal inference by laypeople should address all of these issues.

The main purpose of this article is to survey philosophical theories of causation in a manner intended to be suitable for psychologists interested in causation. The article has two sections: The first presents brief summaries of philosophical theories of causation from Aristotle to the present. In the second, issues found in the philosophical literature are used to suggest new approaches to the study of causation in psychology.

Philosophical Theories of Causation

Several psychologists have written about selected philosophical theories of causation (Cook & Campbell, 1979; Einhorn & Hogarth, 1986; Hastie, 1983; Shaver, 1985; Shultz, 1982), but a comprehensive survey of the philosophical literature has, as yet, not been published in psychology. Most psychological research and theory on causal inference and attribution has taken some philosophical notion as its point of departure, so a wide survey of recent philosophy is likely to be of value as a source of new ideas and hypotheses about causal inference and attribution in psychology. It is not, however, the purpose of this article to evaluate the philosophical merits and weaknesses of theories, nor to provide a comprehensive review of the philosophical literature with its many debates between proponents of different views. Rather, from the point of view of use in psychology, my aim is to give summary sketches of the most important points of each theory. Although intended to communicate the essential character of each theory, these sketches are necessarily oversimplified; readers wishing a more complete exposition should consult the original sources. Mostly I have refrained from classifying different authors together, but in some cases I have adopted the groupings used by Beauchamp (1974), without meaning to imply that there are no differences between the views of different authors grouped together.

Theories of causation can form part of, or be derived from, a metaphysical doctrine. For example, Hume’s (1739/1978a, 1740/1978b) regularity theory of causation takes its essential character from the metaphysics of radical empiricism. These metaphysical doctrines are statements about the most basic things of which the world is made (Campbell, 1976; Carr, 1987). As such, the doctrines delimit, for their authors, the sort of things that can be causes. Thus, under radical empiricism, the basic things, or particulars, are instantaneous slices of experience, and according to Hume it must therefore be out of these that causal relations are constructed. I shall mention different ideas about what sort of things causes can be under individual theories, but a brief general comment is in order. Many philosophers talk of causal relations as relations between “events,” but there are many different definitions of what an event can be; and some philosophers have maintained that things other than events, such as omissions (contrasted with commissions), standing conditions, material substances, and properties of things, can be causes. Deciding what sort of thing a cause can be may have implications for the kind of theory of causation one finds acceptable, and vice versa.

Aristotle

The very word cause (or its Greek equivalent) meant to Aristotle something different than its modern usage. An account of causation was for Aristotle an account of the being of some particular thing, such as an oak tree. A full account of the being of an oak tree across the span of its existence required, according to Aristotle, reference to four types of cause:

1. Material cause: the material constitution of the entity, providing “the passive receptacle on which the remaining causes act” (Bunge, 1963, p. 32).
2. Formal cause: the contribution to the being of a thing of its form or shape—“the essence, idea, or quality of the thing concerned” (Bunge, 1963, p. 32).
3. Efficient cause, or precipitating cause: effects of antecedent events, external compulsion.

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4. Final cause: the end, reason, or purpose (Toulmin & Goodfield, 1962). The term purpose is perhaps too strong for this teleological contribution to being. The mature oak tree, for example, is the telos, or goal of development, not so much as a definite aim of the germinating acorn, but as the natural outcome of the inner directedness of the acorn's development into a tree. Aristotle saw something of this sort as essential if acorns were to grow into oak trees rather than into some other kind of thing.

Aristotle took organic development as his paradigm for explaining all material change, and he saw this in terms of development toward a mature form (e.g., the adult oak tree). He was prepared to apply this idea to the development of minerals in the ground and to the whole cosmos: “All material things, unless interfered with, will naturally change and develop turning, when properly fed and nurtured, from an immature to a ripe or adult form” (Toulmin & Goodfield, 1962, p. 137). In this there are two types of causal explanation: natural development to adult form, characterized in terms of final causes, and interference, characterized in terms of efficient causes. The same pair of types was used in the explanation of motion, such as projectile motion (Toulmin & Goodfield, 1961).

The Scientific Revolution can be seen, rather too simply, as the triumph of efficient causation and the abolition of final cause from scientific explanation. This is especially apparent in the theories of Descartes (Dijksterhuis, 1961), in which all things happened through efficient causation, that is, causation acting on a body from outside. Such a change was made possible by an associated change of metaphysics. Aristotle’s four causes were cast within a metaphysical system in which the most basic things of which the world is made were tiny, indivisible, indestructible bodies called atoms; and it was at this level that efficient causation was primarily meant to apply.

William of Ockham

Although Ockham, who flourished in the 14th century, was not the only philosopher of note to discuss causal relations before Hume, he was possibly the most influential part of a general move by Christian thinkers in the Middle Ages against Aristotle, and his ideas anticipated those of Hume and Mill. Aristotle had held that causes could be definitely known and that causal relations were in some sense relations of necessity. Ockham rejected both of these notions. He began with the theological premise that God can do anything that does not involve a contradiction. This implies that there can be no necessary connection between contingent things, because God always has the power to intervene, to render things otherwise. This entails a denial of necessity in the causal relation. Ockham argued that “something could be construed as an immediate cause when the effect it produces occurs in its presence and all other things being equal—fails to occur in its absence” (Grant, 1971, p. 30). This is virtually identical to the Joint Method of Agreement and Difference proposed by Mill (1843/1967; see p. 5). However, causal relations cannot be known with certainty, even by use of this principle, because it is always possible that the effect was caused directly by God, and there are no criteria for distinguishing physical causes from the fiat of God. Ockham therefore maintained the same kind of epistemological atomism and skepticism that were hallmarks of Hume’s philosophy, and has been called a radical empiricist (Grant, 1971).

Hume (1739/1978a, 1740/1978b)

Hume is the best-known advocate of a regularity theory of causation, although the notion of causation as constant conjunction between events goes back at least to Rome at the time of Cicero (Bunge, 1963). Hume’s philosophical orientation was radical empiricism. In this, only the content of experience (sense impressions) can be known. Hume proposed an epistemological atomism in which the experienced world is a series of instantaneous, atomistic time slices, logically independent of one another. Thus, even the experience of an object persisting in time is a construction of the mind, based on a series of time slices. This construction does not warrant the inference that the object will persist into the future. In fact, no inference about the future can be regarded as justified under radical empiricism.

The same skepticism applies to inferences about relations between objects. “There is no object which implies the existence of any other if we consider these objects in themselves, and never look beyond the ideas which we form of them” (Hume, 1739/1978a, pp. 86–87). Hume defined causation, therefore, as a construction of the human mind, and how the characteristics of that construction arise. He said nothing about causation outside of experience, although he seemed to accept that there is such a thing and used causal terms in his own arguments (Ducasse, 1974b).

Hume (1739/1978a, pp. 162–163) argued that if there were only particular conjunctions (i.e., if there were no repetitions of the same type of conjunction), then one could never form the idea of cause and effect. The importance of constant conjunction is simply that through it the mind can form the idea of cause and effect. People have the idea that the causal relation involves power, necessity, and efficacy, but these also are ideas formed by the mind from the resemblance of repeated occurrences of the conjunction of two objects. The essence of necessity is a propensity of the mind to pass from one object to the idea of its usual attendant, a propensity derived from the experience of constant conjunction.

Hume also stated that constant conjunction has nothing to do with what causation actually is, and that this is so because of the logical independence of events.

Hume’s main definition of cause, then, is “an object precedent and contiguous to another, and where all the objects resembling the former are plac’d in like relation of precedence and contiguity to those objects, that resemble the latter” (1739/1978a, p. 170). A second definition emphasizes the fact that this is purely a mental construction: “A cause is an object precedent and contiguous to another, and so united with it, that the idea of one determines the mind to form the idea of the other, and the impression of the one to form a more lively idea of the other” (1739/1978a, p. 170). Critical analysis of this can be found in Ducasse (1974b).
Kant (1781/1929)

It was to Hume's denial of necessity in the constant conjunction formula that Kant replied. The problem that Kant addressed was that of distinguishing between regularities that are merely accidental and regularities that are nomic or necessary, in that they follow according to a rule. Making this distinction would show constant conjunction to be inadequate as a statement of the causal relation and would restore necessity to the proper description of causation.

If I look at a wall, there is an order in my perceptions of the wall that corresponds to the movements of my eyes. However, I could choose to move my eyes in any way, thus producing any order of perceptions of the wall. By contrast, when I observe a boat moving downstream, the order of perceptions of positions of the boat is fixed. This exemplifies "following according to a rule," and when this occurs some causal relation is involved. So far for Kant a causal relation is a relation of necessary succession in time (Suchting, 1974). Observations of regular temporal succession are still important (Beck, 1974), and knowledge of causal connections is, as for Hume, inductive rather than logical. Where Kant disagreed with Hume was in arguing that necessity is not just a construction of the mind, but is ascertained by looking at which orders of representations of events are objectively determined. Emmet (1984, p. 12) quoted Schopenhauer as saying "Hume declared all consequence to be mere sequence; Kant, on the other hand, affirmed that there is no other [irreversible] sequence but consequence." More detailed discussion of Kant can be found in Shaver (1985).

Modern Regularity and Necessity Theories

Few philosophers now subscribe to Hume's regularity theory because it is overinclusive. Under Hume's main definition, day would be the cause of night, for example. However, both regularity and necessity theories of causation still exist. These theories agree that singular causal statements (i.e., statements about a causal relation on one occasion) are properly analyzed in terms of the causal regularities or laws of nature of which they are instances. This means that the emphasis has shifted to analysis of the nature of causal laws, and the disagreement between regularity and necessity theories largely concerns the form that causal laws should take. "Regularity exponents analyse laws as true, contingent, universal generalisations which are omni-

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by necessity. The necessity involved is not logical necessity but is, rather, a necessity in nature. A causal law is stronger than a universal generalization of fact only in that it expresses a boundary on empirical possibility.

Regularity theorists tend to accept the distinction between universal and nomological generalizations, but interpret it differently. For example, the relation of necessity may be seen as an attitude of mind rather than as a feature of nature (Ayer, 1963), or universal generalizations may be granted the status of laws merely because of the confidence that has been acquired in using them to make predictions, for example in science (Beauchamp, 1974).

Hume's (1739/1978a, 1740/1978b) regularity theory led to the postulation of a number of methodological principles for identification of causes by Mill (1843/1967). The following are three of these:

1. The Method of Agreement: "If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree, is the cause (or effect) of the given phenomenon" (p. 255).

2. The Method of Difference: "If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance in common save one, that occurring only in the former, the circumstance in which alone the two instances differ, is the effect, or cause, or a necessary part of the cause of the phenomenon" (p. 256).

3. The Joint Method of Agreement and Difference (also called the Indirect Method of Difference): "If two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common save the absence of that circumstance; the circumstance in which alone the two sets of instances differ, is the effect, or cause, or a necessary part of the cause, of the phenomenon" (p. 259).

There are other types of regularity theory. Although many philosophers have attempted to distinguish between causes and conditions, some have analyzed the causal relation in terms of conditionals. Several philosophers have argued that a cause is a sufficient condition for the occurrence of some effect, sometimes with the rider that the cause must precede the effect in time (Mill, 1843/1967; Sosa, 1975; Suppes, 1970). Galileo held that an efficient cause is a necessary and sufficient condition for the appearance of something (Bunge, 1963). Perhaps the best-known modern example of a conditional theory of causation is that of Mackie (1965, 1974, 1975). Summaries of Mackie's ideas have already appeared in the psychological literature (Einhorn & Hogarth, 1986; Hastie, 1983).

In Mackie's (1965, 1974, 1975) theory, a cause is an INUS condition. This can be explicated with the example of someone reporting that a fire was caused by a smoldering cigarette butt. In a case of this sort, the smoldering butt is an ingredient of an instance in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common save the absence of that circumstance; the circumstance in which alone the two sets of instances differ, is the effect, or cause, or a necessary part of the cause, of the phenomenon" (p. 259).

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scenario is not a necessary cause of fire (fires may be caused by other things), but, if adequately described, it is sufficient to cause a fire. The cigarette butt, by itself, is not sufficient to cause a fire (other conditions, such as the presence of oxygen, are required), but it is a necessary part of the scenario (the scenario would not have resulted in a fire without the smoldering butt). Thus, the smoldering butt is an insufficient but necessary part of a scenario that is unnecessary but sufficient for a fire to occur. This is an INUS condition.

Mackie (1965, 1974) placed this concept of causation in the context of what he called a causal field (a concept introduced by Anderson, 1938). This is a defined region within which an effect sometimes occurs and sometimes does not. Defining a causal field is a way of directing or limiting causal analysis: Once a causal field is defined, then causal analysis consists in a search for some difference between times on which the effect occurred and times on which it did not. For example, in asking “What caused this man’s skin cancer?” one may be setting up a causal field that consists of the man’s past history, and seek to answer the question by looking for a difference between the time when the skin cancer developed and the times when it did not. This has the important consequence that what one identifies as the cause may depend on how one defines the causal field. In the preceding example, one may decide that the man’s cancer was caused by exposure to radiation. However, suppose one had asked “why did this man develop skin cancer, when other men who were exposed to radiation did not?” Now a different causal field has been defined, and exposure to radiation cannot be identified as the cause because it does not differentiate the afflicted man from others in the causal field who were not afflicted. A cause, then, is an INUS condition within a defined causal field. Critical commentaries on this theory can be found in Sosa (1975).

A different type of modification to constant conjunction has been made by Suppes (1970). Suppes argued that constant conjunction is too restrictive in that it does not capture the probabilistic nature of many statements about causation in everyday life. Suppes defined events as subsets of a fixed probability space, instantaneous, and with their times of occurrence included in the formal characterization of the probability space. He then proposed that “one event is the cause of another if the appearance of the first event is followed with a high probability by the appearance of the second, and there is no third event that we can use to factor out the probability relationship between the first and second events” (p. 10). This is still a regularity theory, but constant conjunction has been replaced by probable conjunction. The point of the last clause is to associate the probability distinctively with the two events in the conjunction, to distinguish “genuine” from “spurious” causes. The theory is worked out more exactly with the aid of algebraic formulations.

Suppes (1970) dealt with statements about single occasions by saying that they imply probabilistic connections. For example, for the statement “I’ve been working all day and my feet are killing me,” Suppes argued that the speaker means to imply a probabilistic relation such that the consequent does not happen every time the antecedent does, but when it does the antecedent is the cause of it. Suppes also reanalyzed Mackie’s (1965, 1974, 1975) notions of INUS conditions and causal fields in terms of his probabilistic approach. This and other probabilistic theories of causation have been reviewed by Salmon (1984).

Causation as Production or Generation

Regularity theories involve analysis at the level of causal laws rather than single occurrences. Many other theorists have argued that the proper level of analysis of causation is that of singular causal statements. Many, although not all, of these analyses have used a concept of the causal relation as productive or generative in nature. Taylor (1966) argued that the productive relation is not analyzable, so that productive causation is a primitive concept. Others, however, have attempted to analyze or have added to this basic notion, and the following theories down as far as but not including Ducasse represent ways of elaborating the basic notion of causation as productive or generative.

Bunge (1963)

Bunge (1963) worked toward an adequate statement of the causal principle through a series of successive approximations that were in effect a critique of regularity theories. He set up a type of constant conjunction formula: “For all C and E, if C is the case then E is the case” (p. 38). This formula has three notions usually associated with causality: the conditionalness peculiar to lawfulness, the existential priority of cause over effect, and lack of exception. However, Bunge rejected it as inadequate because it does not account for the uniqueness of the causal connection: that is, it does not preclude the occurrence of E in the absence of C. This led Bunge to propose a more restrictive constant conjunction formula: “If C, then (and only then) E always” (p. 42). This also was rejected as inadequate because it only states an invariable coincidence. A noncausal proposition such as “red apples are sweet” fits this formula as well as causal propositions do.

The problem, then, was to find a formula that distinguishes between such invariable coincidences and causal connections and that excludes the former. To achieve this, Bunge (1963) regarded it as necessary to bring in some notion of “the active and productive nature that causal agents are usually supposed to possess” (p. 42). So the statement of the causal principle that Bunge regarded as adequate is “If C happens, then (and only then) E is always produced by it” (p. 47). Bunge did not regard causation and production as identical, but maintained that causation is a special case of production. He also argued that contiguity is not an essential part of causation.

Later in the same book, Bunge (1963) advocated a more elaborated concept of causation. “An adequate picture of causation is provided by a synthesis of self-determination and extrinsic determination, in which external causes are conceived as unchangers of inner processes rather than as agents moulding a passive lump of clay” (p. 197). His example is the act of releasing a bow. This is usually regarded as the cause of the arrow’s flight, but in fact the basic requirement is to store energy in the bow by bending it. Releasing the string then unchains an inner process, resulting in the flight of the arrow.
Manipulability Theory

Manipulability theory is a different kind of elaboration of the productive concept of causation. The basic notion of manipulability theory is that an adequate account of causation is founded on self-movement or manipulative human action. The causal relation is analyzed in terms of "production of y by manipulation of x" (Beauchamp, 1974, p. 115). There are several versions, of which three are mentioned here.

Reid (1863a, 1863b)

Reid's ideas were based on Aristotle's notion of efficient causation (described earlier); however, Reid argued that efficient causation necessarily consisted of the exercise of will, and that the notion of causation was derived from the consciousness of one's own voluntary exertions in producing effects. Efficient causation in inert matter also consisted in the exercise of will, but the will belonged to God rather than human beings. Not only were individual effects produced by the will of God, but also the laws of nature were the rules according to which God chooses to act. There is no causation other than the exercise of will by either human beings or God.

Collingwood (1940, 1974)

Collingwood claimed that there are three senses of the word cause, of which Sense I is historically the earliest of the three, Sense II a development from it, and Sense III a development from Sense II. Both Senses II and III logically presuppose Sense I, although it is Sense II that constitutes Collingwood's version of manipulability theory.

Sense I. "Here that which is caused is the free and deliberate act of a conscious and responsible agent, and 'causing' him to do it means affording him a motive for doing it" (Collingwood 1940, p. 285). A cause in Sense I is made up of two elements, a causa quod, or efficient cause, and a causa ut, or final cause. The causa quod is a situation or state of things existing (more precisely "known or believed by the agent in question to exist," p. 292); the causa ut is "a purpose or state of things to be brought about" (p. 292). It is possible to question whether the causa quod is an efficient cause in the strictly Aristotelian sense, but there is no question about the involvement of final cause. The causa ut is an intention, and "causing" an act in Sense I in no way compromises the free will of the actor. In addition, the causa quod and the causa ut can permissibly both be supplied by the actor: There is no necessity for either to be supplied by some other party.

Sense II. "Here that which is caused is an event in nature, and its 'cause' is an event or state of things by producing or preventing which we can produce or prevent that whose cause it is said to be" (Collingwood, 1940, p. 285). "The question 'What is the cause of an event y?' means in this case 'How can we produce or prevent y at will?' " (p. 296, emphasis added).

A cause in Sense II is not able to produce an effect by itself, but requires certain conditions, called conditiones sine quibus non (conditions without which not). Here Collingwood (1940) took up Mill's (1843/1967) contention that a cause is the sum of all conditions for an effect, those conditions that together constitute the invariable unconditional antecedent of the effect, and that what people ordinarily call a cause is one of these conditions. Collingwood argued that the selected condition, the cause in Sense II, is selected in accordance with a principle called the relativity of causes: "for any given person the cause in sense II of a given thing is that one of its conditions which he is able to produce or prevent" (p. 304)

For example, a car skids while cornering at a certain point, strikes the kerb, and turns turtle. From the car driver's point of view the cause of the accident was cornering too fast, and the lesson is that one must drive more carefully. From the county surveyor's point of view the cause was a defect in the surface or camber of the road, and the lesson is that greater care must be taken to make roads skid-proof. From the motor manufacturer's point of view the cause was defective design in the car, and the lesson is that one must place the centre of gravity lower. (Collingwood, 1940, p. 304)

Collingwood (1940) did not argue that this is what people always do. He allowed that they sometimes identify as the cause something they cannot produce or prevent, but his word for this is nonsense. "For a mere spectator (meaning someone who cannot produce or prevent any of the conditions of an event) there are no causes" (p. 307). This leads to a critique of Hume:

When Hume tried to explain how the mere act of spectation could in time generate the idea of a cause, where "cause" meant the cause of empirical science, that is, the cause in sense II, he was trying to explain how something happens which in fact does not happen. (p. 307)

Collingwood (1940) argued that the impression of power or force associated with causes in Sense II comes from social life and practical relations, specifically from events and impressions corresponding to cause in Sense I. The extension to events in nature is due to early animistic theories in nature, resting on anthropocentrism and anthropomorphism.

Sense III. "Here that which is 'caused' is an event or state of things, and its 'cause' is another event or state of things standing to it in a one-to-one relation of causal priority" (Collingwood, 1940, p. 285). This somewhat resembles Mill's (1843/1967) concept of the sum total of conditions.

In the necessary world to which sense III belongs a cause is necessary (a) in its existence, as existing whether or no human beings want it to exist, (b) in its operation, as producing its effect no matter what else exists or does not exist. There are no conditions sine quibus non. The cause leads to the effect by itself, or "unconditionally." (Collingwood, 1940, p. 313)

It must therefore be simultaneous with its effect, and coincident with its effect in space. The idea of production or compulsion in this comes from experiences conforming to cause in Sense I: "Causal propositions in sense III are descriptions of relations between natural events in anthropomorphic terms" (p. 322).

Von Wright (1974, 1975)

According to von Wright (1974a, 1975), human action can be seen as an interference in the "normal" course of events. Action can be either productive of some result (if it changes something) or preventive (if it makes something continue to be the case). This understanding of action is based on faith in certain sorts of counterfactual conditionals, specifically, the belief
that something would have continued to be the case or happened if one had not acted. For example, if von Wright turns over a loose piece of paper on his desk, his concept of his action and its result is based on his belief that if he had not turned it over, it would have stayed as it was.

The concept of a causal relation is dependent on this concept of action. People “verify” causal propositions by both doing something and noticing that a certain thing follows, and refraining from doing that thing and noticing that the other thing does not follow. This is not merely an observation of covariation or constant conjunction because it is based on action, and on the concept of action as productive. Action gives one the notion of counterfactuality, and counterfactuality enables one to distinguish causal regularities from accidental regularities. The idea of necessity in the causal relation comes from the idea of action as making a difference in the world.

**Emmet (1984)**

Emmet also saw causation as a productive or efficacious relation, but between occurrences rather than events. Occurrences are best described by verb nominalizations (e.g., “the killing of Caesar”) that capture the idea of something *happening* to something.

In some versions of manipulability theory, the cause is not the human action itself but the event or state of affairs brought about by it. For example, when one switches a light on, such theories would have it that the cause of the light’s coming on is the depression of the switch, which in turn is brought about by human action: “When by *doing p we bring about q*, it is the *happening of p which causes q to come*” (von Wright, 1974b, p. 49). Emmet’s model of causation is more in the action. “Roughly, I see a cause as something on which something happening to something else depends” (p. 5). So the action of depressing a light switch is the cause of the light’s coming on, because that is what the light’s coming on depends on. This is not a variant of manipulability theory, however, because the causal participants can be physical things, and their “actions” represent the operation of their causal powers. By referring to the causal powers of physical objects, Emmet aimed to avoid the charges of animism and anthropomorphism that have been leveled at the Aristotelian tradition, while retaining human action as a sort of paradigm case (see also next section).

Emmet (1984) also distinguished between immanent and transeunt causation. This can most easily be described in terms used by Johnson (1921). Johnson defined a continent as a persistent character recognizable over time, and an occurrence as a change in a continent. Transeunt causation is exemplified by one continent external to another acting on it, and immanent causation is exemplified by a change of state within a single continent. Emmet’s view of immanent causation is “as a mode of functioning internal to a system, and producing change and development over time” (p. 81). Emmet used this concept to deal with the problem of persistence of things, that is, the problem of how things go on being the same over time: “Persistence is possible because of an internal activity directed towards the future, and the product is inseparable from the activity” (p. 85). Emmet related transeunt causation to Aristotle’s notion of efficient cause and immanent causation to Aristotle’s notion of final cause, although without teleological overtones.

**Causal Powers**

A quite different type of singularist theory has been proposed by Harré and Madden (1975) and Madden and Humber (1974). In this the central concept is the “powerful particular.” A particular is, in ordinary language, a thing, and things can have powers. “Causation always involves a material particular which produces or generates something” (Harré & Madden, 1975, p. 5). Harré and Madden were at pains to avoid the animistic and anthropomorphic connotations of the concept of power in the history of philosophy, and argued that the causal powers of things are based on the “chemical, physical, or genetic natures of the entities involved” (p. 5). Although a causal power is a stable property of a material particular, it only produces an effect under appropriate conditions, termed releasing conditions. One of the examples used by Harré and Madden is the statement “Acid solution can turn logwood solution red.” According to Harré and Madden, this means that acid solution has the power to turn logwood solution red, but will do so only under certain releasing conditions, that is, when the two solutions are mixed together. Words such as *igniting, exploding, bending, breaking, and crushing* “are causal verbs expressing the powers that particulars have by virtue of their natures to make certain events occur under specific releasing conditions like scratching, alighting, falling, and submerging” (Madden & Humber, 1974, p. 177).

The other side of the coin from causal powers is the concept of a “liability.” Liabilities, like powers, are founded in the natures of physical objects and are the capacities of a material particular to undergo certain sorts of things. For example, in saying that copper is malleable, one is ascribing to it the liability to undergo certain sorts of change, such as change of shape when hit with a hammer.

Under the theory of powerful particulars, causation can be observed. The warrant for the perception of causation is on the same level as that for the perception of shape or motion. When one watches someone striking a match, for example, one perceives the causal connection between the striking of the match and its ignition, just as one perceives the shape of the match or its movement.

Shoemaker (1979, 1980) has put forward a different type of causal powers theory. “For something to have a power . . . is for it to be such that its presence in circumstances of a particular sort will have certain effects. One can think of such a power as a function from circumstances to effects” (1980, p. 113). This formula resembles the theory of powerful particulars inasmuch as both powers and circumstances are required for the production of effects. The more abstract definition is, however, a reflection of the fact that, for Shoemaker, the persistence of material particulars is not axiomatic, as it is for Harré and Madden. Indeed, causal powers can be invoked to explain the persistence of a thing because, according to Shoemaker (1979), causation is also a matter of properties staying the same. In the minimal case, there can be a causal relation between properties at one time and exactly the same properties at a later time, and causal powers are invoked to explain how the properties stay the
same. So, things have properties and it is in virtue of a thing’s properties that it has the causal powers that it has; the properties of a thing can be revealed through their contribution to the causal powers of that thing as shown in the production of effects. However, its causal powers, in turn, are responsible for the persistence of the thing across time.

**Ducasse (1965, 1969, 1974a)**

Ducasse also proposed a singularist theory, but not one involving the productive concept of causation. For Ducasse, the answer to the problem of the philosophical analysis of causation was to define narrowly the frame within which an instance of causation can be detected. Ducasse defined an event as a change or an unchange in a state of affairs. An unchange is an event when it is something not happening in a situation consisting otherwise of changes, and an unchange can be a cause only of an unchange.

Causation is the observable relation which obtains between the three terms of any strict experiment: if, in a given state of affairs S, only two changes (whether simple or complex) occur during a given period, one of them E occurring immediately after and adjacent to the other C, then, eo ipso, C proximately caused E, and E was the proximate effect of C. (1963, p. 84)

S includes all conditions (such as the presence of oxygen in the fire example described on p. 6).

Ducasse (1965, 1969, 1974b) stated that the relation so defined is not a sign of a causal relation, but is the causal relation itself. Because Ducasse regarded the definition as clear, the only problem is to be certain that what one observes conforms to it: so, in principle, causation is observable. In the fire example, Ducasse’s analysis would enable the identification of the smoldering butt as the cause of the fire (indeed it would enable one to observe the butt causing the fire) if one had been able to define some state of affairs and observe that the butt and the fire were the only changes in it.

**Hart and Honoré (1959, 1974) and Gorovitz (1965, 1974)**

These authors worked from a legal perspective, and their ideas about causation are perhaps more methodological than theoretical. Hart and Honoré (1959, 1974) pointed out an important difference between causal explanations in common sense and in science. In science one usually seeks to explain types of occurrence that usually or normally happen, but in common sense one generally seeks to explain a particular event that is a departure from what is usual or normal. From this, Hart and Honoré derived their notion of a cause as “essentially something which interferes with or intervenes in the course of events which would normally take place” (1974, p. 224). Causal analysis is therefore founded on some notion of what the normal sequence of events would be under given circumstances. The interference can, but need not, be a human action. Usual or normal things can be conditions but not causes. The cause is, so to speak, the difference that makes the difference.

Hart and Honoré (1959, 1974) reconsidered part of Collingwood’s (1940) manipulability argument. Collingwood argued, under Sense II of the word cause, that the thing that a person will identify as the cause is the thing that person can manipulate. The example used by Hart and Honoré is that of a man who gets indigestion after eating parsnips. Under Collingwood’s argument, the man’s wife might say that the indigestion was due to eating parsnips (because she can manipulate that), whereas his doctor might say that it was due to a stomach ulcer (because he can manipulate that). Hart and Honoré argued instead that the difference between these two analyses arises out of differences in the way the people set up the conditions. The man’s indigestion is an abnormal occurrence, but for the wife it is a departure from what usually happens when her husband eats a meal, whereas for the doctor it is a departure from what usually happens when other men eat parsnips. They choose different dimensions to consider, and hence find different causes for the departure from normality. Obviously, whether one regards something as a departure from normality may depend on which dimension one chooses to look at.

Causal analysis under the Hart and Honoré (1959, 1974) model requires some means of establishing what is “normal” and what is “abnormal,” as it is only proper to talk of causes in relation to abnormal occurrences. Gorovitz (1965, 1974) solved this problem by arguing that the words normal and abnormal should not be used and that causes can be identified simply by referring to some particular standard for comparison. There is no philosophical prescription for selecting a standard for comparison: Gorovitz said only that selection will be guided by the aims of the broader enquiry within which causal analysis is taking place. For Gorovitz, then, causal analysis is “differentiating factor analysis”: Causal analysis of any event can be given by identifying the factor that differentiates the state of affairs in which the event occurred from whatever standard for comparison is chosen.

Thus, the lighting of a match in a railroad smoking car is caused by its being struck against a box, because this is what differentiates the situation from all those wherein other matches are not struck. However, take a second example:

A match, having been pulled from the assembly line in a match factory, is struck in a supposedly evacuated chamber, the purpose being to test the hardness of the match head. But the chamber has not been properly sealed, and the match lights. (Gorovitz, 1974, p. 235)

This time, it is the presence of oxygen that will be cited as the cause because that is the factor that differentiates the situation from all those in which matches are struck in vacuum chambers and do not light, this being the “most natural” standard of comparison.

Gorovitz (1965, 1974) concluded his argument by saying that although common sense causal analysis involves differentiating the event in question from some particular standard, scientific explanation consists in the search for what differentiates the actual state of affairs from all possible standards for comparison, and that this will be a conjunction of all determining factors.

**Castaneda (1980)**

Castaneda’s (1980) argument begins with a critical analysis of Hume’s theory. Consider Hume’s (1739/1978a) own example of one billiard ball colliding with another and setting it in
motion. Hume regarded this as a perfect instance of a causal relation, and he found in it all and only his three defining features of causation: priority in time (precedency), contiguity in time and space, and constant conjunction. Castaneda imagined a case in which, when the moving ball reaches the stationary one, a mechanism under the table stops it dead and prevents the stationary ball from moving. At the same instant a second mechanism releases the hold of the first mechanism on the stationary ball and sets that ball in motion, with the same speed that it would have had if it had been struck by the moving ball.

The point of this example is that all three of Hume’s (1739/1978a) conditions are met and yet the moving ball does not cause the stationary one to move. To define the nature of the causal connection one must ascertain the difference between Hume’s case and that of Castaneda (1980). The difference, Castaneda argued, is that in Hume’s case something is transferred from one ball to the other. “Causation is a transfer of something from cause to effect” (p. 95). Castaneda did not say what sort of thing this was, suggesting that it might be energy or force but that this was a question for science. He referred to it as “causity” and argued that causity abides through the changes involved in causation (this seems to be implied by the notion of transfer) and so cannot be identified with any properties of things that do change. It is a real and pervasive aspect of the universe. Castaneda then discussed the nature of causal laws in terms of causity and postulated a principle of conservation: “If the universe is fully deterministic, the total amount of causity in it is constant throughout all changes” (p. 103).

Salmon (1984)

Salmon (1984) has given an account of causation that involves two distinct fundamental concepts of causation: causal production and causal propagation. Through causal propagation, what happens at one time and place can have a significant influence on what happens at other times and places. In Salmon’s account of causation, the basic entities for causation are not events but processes. Processes have greater temporal duration than events, and usually greater spatial extension: “A baseball colliding with a window would count as an event; the baseball, travelling from the bat to the window, would constitute a process” (p. 139). Not all processes are causal processes; “even a material object at rest will qualify as a process” (p. 140). The defining characteristic of a causal process is that it transmits energy.

What is crucial in identifying causal processes is the ability to carry a mark. Consider a pulse of light traveling from a spotlight to the wall of a planetarium. This is a causal process because it can carry a mark: For example, if you interpose a red filter between the spotlight and the wall, the light will be red all the way from the filter to the wall. Now imagine that the spotlight is rotated so that the light moves around the wall. The motion of the light around the wall is not a causal process because it cannot carry a mark: If you put a red filter on the wall, the light will be red when it hits the filter, but will cease to be red as soon as it moves away from the filter. The mark will not be transmitted.

That is causal propagation. Causal production (the production of marks, such as the mark of redness in the spotlight beam) is given a conditional definition in terms of the interaction between two causal processes. Consider the collision of a baseball with a window. The motion of the ball and the persistence of the window are both causal processes. (Salmon, 1984, explained the persistence of a physical object by arguing that if a process can transmit a mark then it can transmit its own structure: The persistence of the window is its ability to carry the marks that constitute its own structure. Persistence is therefore a type of causal process.) Now consider the moment at which the ball collides with the window. The interaction of the ball and the window is a causal interaction if the ball exhibits some definite characteristic Q before the moment and some modified characteristic Q’ throughout an interval immediately following it and if the window exhibits some characteristic R before the moment and some modified characteristic R’ throughout an interval immediately following it. Causal production, then, consists of changes in processes occurring through causal interactions, of which the collision of the baseball with the window is an example. Note that, despite the uses of the term production, this definition is conditional, not generative or productive in character.

Causation, then, involves both causal propagation and causal production: “Causal processes are the means by which causal influence is propagated, and changes in processes are produced by causal interactions” (Salmon, 1984, p. 170). Salmon’s other term for a causal interaction is “an interactive fork.” So, when a window is broken by boys playing baseball, “there is a collision of a bat with a ball (an interactive fork), the motion of the ball through space (a causal process), and a collision of the ball with window (an interactive fork)” (p. 176).

Relevance to Psychology

It is curious how similar two disciplines can sometimes seem when in reality they are on opposite sides of a great divide. Philosophers are concerned, roughly speaking, with what causation actually is (and this includes the idea that it may be only a construction of the human mind), whereas psychology is not. Rather, psychology is concerned with how people understand and perceive causation, make causal inferences and attributions, and so forth. Although these two concerns may not be unrelated, there is no requirement for any psychological theory of causal processing to pay heed to the actual nature of causation, whatever that may be.

However, perhaps more fundamentally, the methods of inquiry used in philosophy are essentially rational and use criteria such as logical coherence, imaginability, intelligibility, and freedom from ambiguity, whereas the methods used in psychology are essentially empirical and use criteria concerned with the status of evidence. Philosophy and psychology therefore engage in inquiries of different kinds, and the superficial resemblance of the questions asked in each should not be allowed to disguise their basic differences. One could no more design an experiment to test a philosophical notion than one could establish the truth or falsity of a psychological hypothesis by logic alone.

One can, however, ask questions of the form “how would people behave if their understanding of causation were exactly similar to that enshrined in this or that philosophical theory?” In other words, philosophical theories and notions can serve as
models for psychological theories, in which rationalist ques-
tions about possibility and so forth are effectively translated
into empirical questions about matters of fact. The job of trans-
lation has in some cases already been partly accomplished by
philosophers such as Mill (1843/1967), Hart and Honoré (1959,
1974), and Gorovitz (1965, 1974), who proposed methodologi-
cal principles of causal inference; the question only changes
from “is this how causal inference should be done?” which is
still on the side of philosophy, to “is this how people actually do
it?” which is psychological. Psychologists have already tried
this, of course, for Mill (Heider, 1958; Kelley, 1967) and Hart
and Honoré (Hilton & Slugoski, 1986), and Gorovitz’s ideas
appear at least to have been reinvented in psychological form
(Hesslow, 1988).

My aim in this section, then, is to draw out issues detectable
in the philosophical literature that can be translated into psy-
chological issues. In doing this, I am not attempting a compre-
ensive review of the psychological literature, although I shall
refer to published work in psychology where appropriate. Nor
am I attempting to suggest answers to the questions raised; it is
the raising of the questions, or the pointing out of their rele-
vance to psychology, that is the main intention. Although the
following survey cannot be guaranteed to raise all questions
that might usefully be derived from philosophy, it is systematic
in its representation of topics in the foregoing sketches.

The following issues are discussed: whether actual causal rel-
ations can be perceived or known; what sorts of things people
believe can be causes; the different levels of analysis, individual
causal connections, causal laws, and the nature of order in real-
ity; the distinction and relation between the causal relation itself
cues to causal relations; causal frames or fields; different
conceptualizations of causes internal and external to an organ-
ism; and understanding of causation in different realms of the
world, such as the natural and artificial realms. Although I treat
these issues under separate headings, they are certainly interre-
lated, and their interrelation is itself an issue for psychology.

Perception of Actual Causal Relations

The prevailing view in psychology seems to be that causal
relations cannot be known or directly perceived. As part of an
argument about the possibility of knowledge of one’s own men-
tal processes, Nisbett and Ross (1980) stated, “It is not contro-
versial that causal accounts for all nonmental processes are the-
oretically guided inferences and not direct observations”;
“causal processes cannot be observed” (p. 250). Rakover (1983)
also accepted that causal connections are unknowable, and
Cook and Campbell (1979) stated, “we agree with the positivists
that cause cannot be directly demonstrated” (p. 10). This idea
has found its way into the most recent edition of the Handbook
of Social Psychology: “It is logically impossible to observe
causal processes per se” (M. Ross & Fletcher, 1985, p. 112).

This skepticism perhaps derives from Hume’s (1739/1978a)
ideas about causation. However, in Hume’s radical empiricism
nothing in the objective world can be known, and all that can
be known is the content of experience, sense impressions from
moment to moment. The claim that causal relations in the ob-
jective world cannot be known is merely contained within this
general skepticism.

Some philosophers do not subscribe to this view, and the no-
tion that actual causal connections can be known or directly
perceived is part of more than one theory of causation (Du-
case, 1965; Harré & Madden, 1975). Given this, the statement
that it is logically impossible to know or perceive causal connec-
tions cannot be regarded as proven and could be false.

For perception of causation in the objective world, a psycho-
logical stance on whether causal connections can be known de-
dpends on, or at least relates to, theories of perception. Direct
perception of causal connections appears incompatible with a
cognitive approach, but may not be incompatible with a Gib-
sonian approach. Beliefs about causal connections among
events in one’s own mind depend not on a theory of perception,
but perhaps on something more akin to a theory of introspec-
tion. The least one can say is that this remains an unresolved
question at present. The idea that people depend on rules (or
cues or other judgmental devices) for causal inference rests on
the assumption that causal relations cannot be directly per-
ceived; if they can, then under some circumstances at least there
is no need for people to use rules or other inferential devices.
This issue therefore has significant implications for theories of
causal inference.

What Sort of Things Do People Believe Can Be Causes?

The fact that philosophers have various opinions as to what
sorts of things can be causes raises the possibility that laypeople
may also have beliefs on this topic. One simple hypothesis
would be that people have no belief as such, but that only those
things are causes that are identified as such in causal processing.
The problem of defining cause would then be taken care of nat-
urally by the way in which causal processing operates. However,
it is also possible that people do have a concept of cause, and
that certain things may be rejected as causal candidates because
they do not fit this definition. Philosophy suggests several
hypotheses about the sorts of things people may believe can be
causes:

1. “Events” or “happenings” (not forgetting that event itself
   has several possible definitions).
2. Standing conditions or states of affairs, such as causal pow-
   er of material particulars (Harré & Madden, 1975; Gorovitz,
   1965, 1974).
3. Interactions between occurrences and stable properties of
   things (Bunge, 1963).
4. Conditions, such as necessary and sufficient conditions or

To give an example, it is common in the attribution literature
to talk of causal attributions made to stable personality traits.
For some philosophers, traits cannot be causes because they are
not events by any definition, but rather are standing conditions
of some sort. Yet in many studies people are requested to rate
the extent to which some behavior was due to characteristics
of the person, and the person measure they are given specifies
these traits is that they see traits as a type of causal power (Harré
& Madden, 1975). Under this view, the peculiarity of saying that
a stable characteristic can be a cause of a transient behavior is dealt with by saying that the behavior occurs under some sort of releasing condition, which results in the generation of the behavior by the trait. Another possibility is that people believe that only events, such as short-lived behavioral intentions, can be causes, and that personality traits are not causally involved in behavior, but are just convenient ways of summarizing consistent individual differences in the sorts of behavioral intentions that tend to be formed. It can be seen from this that there is an intimate relation between beliefs about the sorts of things that can be causes and causal interpretations of behavior; attribution theory could be usefully extended by further consideration of this relation, as this would lead to more detailed explanation of the causal structures that underlie behavior in common belief.

Causal Connections, Causal Laws, and Order in Reality

At least three levels of analysis are detectable in the philosophical literature on causation: the level of singular causal connections (as in, for example, manipulability theory); that of causal laws and their nature (in modern regularity and necessity theories); and a superordinate level that one might call the nature of order in the universe in general. An example of the last of these is Bunge's (1963) principle of determinacy that, he claimed, exists in contemporary science: "The two components of this principle, under which the general law of causation is subsumed, are the genetic principle (Nothing springs out of nothing or goes into nothing) and the principle of lawfulness (Nothing unconditional, arbitrary, lawless occurs)" (p. 351).

Heider (1958) argued that people seek to comprehend the individual, transient events around them in terms of stable underlying properties, the dispositional properties of their world. This can be interpreted not only as a tendency to make causal attributions to stable rather than transient things, but also as a tendency to see individual causal connections as instances of general laws, much as a scientist would. The idea of laypeople as naive scientists has been perpetuated in work on causal attribution and human inference since Heider (Kelley, 1967, 1973; Nisbett & Ross, 1980; L. Ross, 1977) and has also been criticized (White, 1984). Despite its influence, there is little indication in the research literature of a tendency to consider singular causal connections (such as single behaviors) as instances of causal laws. The generalizations that have been studied in causal attribution tend to be of a more particular kind, such as the inference of a stable trait in some individual (Jones, 1979), or of the "commonsense maxim" variety, such as "the pen is mightier than the sword."

Yet it is probable that people do possess, and share, beliefs about not only causal laws but also superordinate order in reality. It has been argued (Farrington, 1944) that Greek science began with the adoption of a principle resembling Bunge's (1963) principle of determinacy: the idea that the universe and everything in it can be explained by reference to a small number of concepts of a wholly natural sort. This can be contrasted with belief in the arbitrary fiat of divine will, such that everything that happens is the work of some god and the universe has no natural laws; or, as Farrington did, with earlier "science" that involved the unsystematized accumulation of large numbers of empirical facts, not subsumed under general principles.

To some extent, action in social contexts depends on the assumption of overriding principles of order: The world must be stable enough for a bus timetable to be worth looking at, for example. Fletcher (1984) suggested the following list of assumptions as fundamental to common sense:

- the assumption that the world exists independently of our perception of it, that the causal relationships that have held in the past will continue to operate in the future, that other people possess states of conscious awareness, that we are the same person from day to day, and that people are sentient, self-aware creatures capable of self-control (unlike rocks and other inanimate objects). (p. 204)

Fletcher argued that assumptions of this sort are necessary not only for understanding the world but as a basis for rational action. This is the main point, perhaps: These assumptions about natural order are so basic to people's way of thinking that it is hard to see them as recent innovations in the history of ideas and harder still to see why any thinker (such as Hume) would reject them; but in their very basicity they shape the most ordinary actions. They allow one to regard the world as predictable; they make behavioral consistency appear to be a valid goal; and perhaps, in taking the working of reality out of the hands of gods, they allow one to feel a sense of mastery and control over the world.

Most specifically for causal inference, covariation (for example) is regarded as informative about causation because of the fundamental belief in a certain kind of order in the world: that the world is sufficiently stable for a given causal mechanism to operate in the same way from one to occasion to another, and that phenomena conform to a principle of parsimony under which it makes sense to account for a given set of occurrences as instances of a single mechanism. Assumptions like these can be revealed by asking how one would argue against a proposed violation of them—for example, a proposal that a given type of effect has a different cause every time it occurs.

Part of the natural order of the universe in common belief may be an order based on ideas of justice or natural morality. Lerner (1965; Lerner & Miller, 1978) has proposed that people have "a need to believe that they live in a world where people generally get what they deserve" (Lerner & Miller, 1978, p. 1030). This "just-world" hypothesis has been used to explain the results of several studies in which people derogated the victims of misfortune (Lerner & Simmons, 1966). Lerner and Miller (1978) also used the hypothesis to explain the tendency of victims of misfortune to blame themselves (Bulman & Wortman, 1977). The corollary would be a tendency for recipients of unusually good fortune also to believe that they deserve it and are therefore in some way superior to others: as far as I know, there has been no research on this corollary.

The just-world idea seems to represent a belief in morality as part of the natural causal fabric of the universe. However, for many people such a belief may be more personalized, in the form of religious ideas about the intervention of (for example) the Christian God in human affairs. Given that belief in the Christian God is common in the Western world, research on the role of this belief and its associated doctrines in causal inference
could contribute a great deal to the understanding of causation in common sense.¹

**Distinction Between the Causal Relation and Cues to Causal Relations**

There is a distinction in philosophy between what a causal relation is and how it may be identified. The latter is addressed, for example, by Mill’s (1843/1967) methodological principles, by the abnormal conditions idea (Hart & Honoré, 1959), and by differentiating factor analysis (Gorovitz, 1965, 1974). There is a distinction analogous to this in psychology, between what concept people may have of the nature of the causal relation and what cues they may use to identify or infer causal relations, what sorts of things they treat in effect as signs or symptoms of causation.

Take, as an example, conditional relations. Several conditional definitions of causation can be found in philosophy, where they are usually categorized under regularity theories. Psychological research suggests that people use information about conditional relations as cues to causation (Einhorn & Hogarth, 1986; Fincham, 1983; Hewstone & Jaspars, 1987; Shultz, Schleifer, & Altman, 1981), but this evidence, if valid, can be interpreted in two ways. It could mean that people understand the causal relation as being some kind of conditional relation. However, it could also mean merely that people have a concept of the causal relation that implies that a certain sort of conditional relation should hold between causes and their effects. Under the latter interpretation there is no limit on the range of concepts of the causal relation that people might have, except that concepts that do not imply the conditional relations that people are observed to use as cues to causal inference are not permitted. The use of a certain cue to causal inference may mean only that the cue’s validity is implied for people by whatever concept of the causal relation they possess. Similar remarks can be made about covariation. The evidence that people use covariation as a cue to causal inference (Mendelson & Shultz, 1976; Schustack & Sternberg, 1981; Shultz & Mendelson, 1975) may mean either that people have a covariational concept of causation or that they have a concept of the causal relation that implies, for them, covariation between cause and effect. In talking in this way, I do not mean to suggest that people reason out relations between cues and concepts of causation like philosophers.

It may be observed that there are two broad classes of philosophical theory of causation (although some theories may not fit into either class): singularist theories, which seek to define the causal relation in a single instance, and theories that require observation of multiple instances, such as regularity and necessity theories (Beauchamp, 1974). The latter class has particular problems with the cue–concept relation because, although it is legitimate to talk of a causal relation between things on some one occasion, such talk is excluded from those theories that define causation in terms of multiple occurrences. The danger is that theories of this kind may only be theories about cues to causation. Hume (1739/1978a) seemed to be aware of this problem, for he wrote of his definition as being drawn from circumstances extrinsic to the cause. More recent philosophers in the regularity and necessity traditions have tended to recast their inquiry as being one into the nature of causal laws, rather than causal connections (Beauchamp, 1974).

The relation between the cues that people use for causal inference and their concept of the causal relation has not been fully analyzed in psychology. Suppose that people’s concept of the causal relation is basically covariational. Such a supposition would have strong implications for the sorts of cues that people would use for causal inference. Information about covariation (possibly including information about conditional relations) would be preferred over all other possible cues: People may use a restricted range of other cues such as temporal and spatial contiguity and temporal order (these being the cues incorporated in Hume’s definition of cause), but only in conjunction with the use of covariation. This requires, of course, the use of information about multiple occasions. Such uses may be concealed from the experimenter by the fact that appropriate information is being retrieved from memory rather than sampled from the environment.

The available evidence goes against these implications. Although children (and adults) may use covariation as a cue to causal inference, they often experience difficulty in doing so (Siegler, 1975; Siegler & Liebert, 1974; White, 1988) and tend to disregard covariation in favor of other types of cue when there is conflict between them. These types include temporal contiguity (Mendelson & Shultz, 1976) and generative relations (Shultz, 1982; Shultz, Altmann, & Asselin, 1986; Shultz, Fisher, Pratt, & Rulf, 1986). Moreover, a covariational concept implies a reliable preference for sampling information about multiple occasions; in fact, the little available evidence shows that people prefer to sample more information about the one occasion in question for purposes of causal inference (White, 1989).

Unfortunately, the corollary argument for singularist theories does not hold, with one exception. The extreme version of the causal realist viewpoint would be that people can directly perceive all actual causal relations. This view implies that there is no need to utilize cues to causal inference, and any valid evidence that people did utilize cues would be sufficient to disprove this extreme position. This would not entail the abandonment of causal realism altogether, for less extreme positions are possible in which causal relations can be directly perceived under some specified conditions and not others. This would permit the use of cues to causal inference under those conditions when causal relations cannot be directly perceived.

Causal realism has a curious implication for scientific methods: Under those conditions in which causal relations can be directly perceived, science can be freed from dependence on empirical methods and covariation information for inferences about actual causal relations and causal laws. Observers reporting their perceptions of causal relations would be enough, and

¹ Since writing this section, I had lunch with a friend who told me that, in her belief, there were no natural laws at all in the universe and that everything that happened was directly caused by God. The only exception to this was the operation of human free will. Such regularity and order as the world may appear to possess is a reflection of the regularity and order in the will of God. This seems to me to underline the importance of studying differences between religious and secular causal thinking, for such differences may run very deep in people’s understanding of the world.
this would be a more direct type of evidence about causation than empirical methods could supply. The difficulty would be in knowing when direct perception of causal relations occurs. People could, for example, believe that they were directly perceiving causation when in fact some kind of illusion was occurring. For science, one has to ask whether causal realism may be valid or not but how one can know whether (and when) it is.

Particular singularist theories are specific about the concept of the causal relation but, with the exception of causal realist theories, not about the sorts of cues that people ought to use. Take the idea that people understand the causal relation as generative in nature. It is natural to suppose that if people had such a concept, then information about event generation ("generative cues") on some one occasion would be all that was needed for causal inference, and would be preferred over other cues. There is evidence to support this (Shultz, 1982; Shultz, Altman, & Asselin, 1986; Shultz, Fisher, et al., 1986; White, 1988), which is encouraging for adherents of psychological theories based on the generative concept (White, 1989).

However, possession of such a concept would not imply that other sorts of cues, such as covariation, would never be used for causal inference. The reason for this is that such a concept may have clear implications for patterns in the relation between cause and effect, across multiple occasions, for example. One does not know what these implications are because this would depend on the exact concept that people have. For example, if people believe that a given effect can only be produced by a certain thing, then that thing is a necessary condition for its effect, and people may well use information about conditional relations to test this implication. Whatever concept people may actually hold, the use of information about multiple occasions for causal inference does not entail that people do not have a generative concept of causation. Indeed, it is not clear at present what sort of evidence would falsify the hypothesis that they do. Shultz, Fisher, et al. (1986) have found what may be a way around this problem with their theory of priority among rules for causal inference. Under this theory, when generative cues are obvious they are used in preference to all other cues, but when they are not, an ordered set of criteria comes into play to govern the utilization of other cues. The evidence from their studies supports this priority rule and it is fairly unequivocal that if people did not use generative cues when these were "obvious," then one would be justified in inferring that they did not have a generative concept of causation.

Causal Frames

Several philosophers have argued, in different ways, that identification of causes is related to and facilitated by the definition of some kind of frame, only events in which are considered for purposes of causal analysis. Ideas of this sort include the causal field (Anderson, 1938; Mackie, 1965, 1974), a dimension for comparison for identification of abnormal conditions (Hart & Honoré, 1959), a standard for comparison for identification of a differentiating factor (Gorovitz, 1965, 1974), and a given state of affairs in which only two changes occur during a given period (Ducasse, 1965).

As philosophical proposals, these are intended as normative frames for proper causal analysis. Psychologically, causal frames may owe more to factors such as selective attention than to concepts of proper causal analysis. It might be useful, however, to regard causal inference as a form of problem solving. When one seeks the cause of some occurrence, one is faced with an indefinite and ill-defined problem space within which the cause resides. If the problem space is too large for an exhaustive search, and if there is no algorithm, then heuristics may be used to reduce the amount of the problem space that has to be searched for a solution (see Newell & Simon, 1972). Each of the types of causal frame proposed by the philosophers cited can be regarded as a heuristic selection of a subset of the problem space.

This conceptualization reveals some interesting features of causal inference. For example, people may arrive at an incorrect identification of a cause not because they are using wrong cues to causation but because they are using valid cues on a subset of the problem space that does not contain the cause; errors in causal inference can be due either to the use of invalid cues or to the use of an imperfect heuristic for narrowing down the search space. Failure to find a cause within a heuristically selected sub-space may lead to a kind of "mental set" effect, which can only be broken by realizing that one has to consider a different, so far unconsidered, part of the problem space. Moreover, if the problem space is not too large or the problem is of sufficient importance, then an exhaustive search may be carried out; and if people have a device that they treat as if it were an algorithm, then no selection within the problem space may be made.

Some psychological theories already make statements about the subset of the problem space that is searched (and how). In Kelley's analysis of variance model (1967, 1972, 1973), three independent dimensions are specified. Hilton and Slugoski (1986) have taken up the abnormal conditions idea of Hart and Honoré (1959) and defined a subspace consisting of those conditions without which the effect would not have occurred. The cause is then identified as the condition within this set that is abnormal in the context of its subject matter.) In each theory the same selection within the problem space is made for all causal inferences. Effects on causal attribution of different selections have recently been investigated by McGill (1989). There appears to be plenty of scope for further hypotheses on this issue (cf. Hastie, 1983).

Internal and External Causes

Heider (1958) proposed that the distinction between internal and external factors was basic in causal attribution. Since then, the internal–external distinction has been treated as basic in attribution theory (Jones et al., 1972) and research: Almost all empirical studies of attribution use the internal–external (or person–situation) distinction as a basis for constructing their dependent measures. The distinction has not, however, been entirely free of problems (Miller, Smith, & Uleman, 1981).

Distinctions corresponding to the internal–external distinction can be found in several places in philosophy, and the philosophical literature raises two questions that are of particular relevance to psychology, especially to causal attribution: Do different notions of causation apply (in common sense) to internal and to external causes, and can either internal or external
causes be sufficient alone, or must they interact in the production of an effect?

In Aristotle, internal and external causes are conceptualized differently: Internal causes are natural processes, which as the reader has seen are autonomous tendencies of an organism toward a mature form, and in which final cause is important; but external causes are conceptualized as interferences in natural processes or natural motion, and are seen more in terms of efficient causation. Emmet's (1984) distinction between immanent and transeunt causation is different in that the animistic and anthropomorphic content of the Aristotelian version has been abolished, but immanent causation is still distinct in character from transeunt causation, being “a mode of functioning internal to a system, and producing change and development over time” (p. 81).

In both theories, one type of causation can operate independently of the other, but in other theories causation necessarily involves an interaction of some sort, and in these interactions internal and external factors may have different roles. Bunge (1963) argued that external causes, understood as efficient causes, were insufficient as an account of the determination of effects, and that they were better depicted as “unchainers of inner processes” (p. 197). Causation necessarily involves both the inner process and the external unchainer of it. In the theory of powerful particulars (Harré & Madden, 1975), causation involves the production of an effect by the operation of a causal power under a specific releasing condition. The production of behavior by an actor, then, would involve the operation of causal powers of the actor, and external factors and events would have the role of releasing conditions. In Salmon's (1984) theory, external causation is associated with causal production, modeled as the change in characteristics of processes following their interaction; internal causation is associated with causal propagation, the transmission of a mark or property in a causal process. Causation is a complex interactive network of these two types of thing.

The extent to which the causal roles of internal and external factors are differentiated in common sense causal attribution is uncertain. It is perhaps a weakness of existing attribution theory that the interaction between internal and external factors is conceptualized statistically, when it is more likely that people see it as involving some definite structure or structures. Any of the theories cited may serve as a source of hypotheses about this common sense structure.

Causation in the Natural and Artificial Realms

Causation in the Aristotelian tradition involved reference to natural processes, in which the animistic and anthropomorphic notions of final cause and will or volition were given prominence. All natural processes tended toward a mature or adult form, which provided the goal, or telos, of development, not as a directing influence on development but as the natural culmination of the process (Toulmin & Goodfield, 1962). Even the stars possessed will, and it was their will that maintained them in their perfect, circular orbits.

In the Scientific Revolution, the notion of final cause was rejected and the physical universe was modeled solely in the terms of efficient causation. “Matter was essentially passive, inert, uncreative, soulless and static” (Toulmin & Goodfield, 1962, p. 188). Bronowski (1951) argued that this was the modern view of the world, “a machine in which whatever happens does so only because something else happened before” (p. 30). An event could be seen as a member of a causal chain stretching back to the First Cause.

Until the development of probabilistic views of the universe, as in the quantum theory (Bronowski, 1951), these two traditions constituted the principal alternative models for the physical universe, and one can therefore ask to what extent each of them has infiltrated common sense in the present.

Given that Cartesian dualism was a way of removing reference to spirits and will from the description of nature (Toulmin & Goodfield, 1962), one might suppose that, in common sense, ideas resembling Aristotelian causation are reserved for the operations of the human mind, and the physical universe is understood in mechanistic terms. Evidence from psychology, however, suggests that things are not so simple. Many studies have shown a propensity of both children and adults for describing inanimate events and occurrences in animistic terms (Bassili, 1976; Berzonsky, 1971; Heider & Simmel, 1944; Loof & Bartz, 1969; Michotte, 1963; Tagiuri, 1960). One could argue that both adults and children are using animistic terms as metaphors, or at most that animistic thought is confined to young children and atrophies during development. However, because a tendency to use animistic concepts even as metaphor is not what one would expect of a common sense founded on mechanism, it is also possible that it represents the continuation of an Aristotelian view of physical events. This possibility is strengthened by the fact that the tendency occurs in perception of mechanical causation. Michotte (1963) commented, about his studies of causal perception, that there was close agreement between the properties of the causal impression and the laws of mechanics. He also noted, however, a common tendency for his adult subjects to describe the causal relation in terms of human action—this for sequences involving collisions between two opaque rectangles.

Berzonsky (1971) ran structured interviews in which he gave young children events to explain. Berzonsky grouped the events into three categories: “familiar objects” (e.g., what makes a clock tick, a car move), “remote objects” (e.g., what makes the wind blow, it thunder), and “malfunctions” (e.g., what makes airplanes crash, a roof leak). Explanations were coded by using two main categories. “Nonnaturalistic” explanations included “motivational, finalistic, moral, magical, animistic and dynamic classes” (p. 710). Phenomenistic explanations and references to coincidence were also included. “Naturalistic” explanations were “of a logical or mechanical character,” “related to a given effect in an essentially physical manner” (p. 710).

The results showed that nonnaturalistic explanations were most frequent for remote objects, markedly less frequent for familiar objects, and least frequent for malfunctions. The reverse was the case for naturalistic explanations. Berzonsky (1971) interpreted this as an effect of familiarity. Familiarity was, however, confounded with another factor. The nine remote objects were all natural phenomena, as in the examples given. Of the familiar objects, six were artificial (human made) and three were natural. All four malfunctions concerned artificial objects. Berzonsky did not give separate results for the natural
and artificial members of the familiar-objects category, nor did he break down either of his coding categories in any way.

These results suggest, then, that mechanistic causation is in common sense the preferred model for (and only for) things that are artificial or literally machines, and that natural phenomena and things are interpreted along lines more reminiscent of Aristotelian thought. The distinction between natural and artificial things may be as fundamental in causal processing as that between human and nonhuman causation.

Other distinctions made in philosophy may also relate to this natural–artificial distinction. The heart of causation in Aristotle is the natural process, the autonomous unfolding or development of a natural object to mature form (or motion of an object to its proper sphere; Toulmin & Goodfield, 1961). In this scheme, therefore, immanent causation is basic, and interferences, transeunt causation, are conceptualized in relation to this basic notion. In mechanism the emphasis has switched, and transeunt causation, the action of forces on essentially passive and inert objects, has become the basic form of causation. The distinction between causal production and causal propagation (Salmon, 1984) may also relate to the natural–artificial distinction: Causal production, consisting of single causal connections dependent on spatial and temporal contiguity, may be deemed characteristic of artificial, mechanistic causation, and causal propagation, the carrying of a causal influence from one place or time to another, as a modification of properties of the carrier, may be deemed more characteristic of natural processes. Salmon's (1984) main example of causal propagation, the spotlight (see earlier) looks artificial, but in fact the beam of light itself is a natural phenomenon, produced in this case by artificial means.

To summarize, there may be two basic categories of events, each associated with a different model of causation: the natural domain, associated with Aristotelian causation, in which notions of final cause and will, volition, or agency predominate, with immanent causation and with causal propagation; and the artificial domain, associated with mechanistic causation, in which the notion of efficient, deterministic causation is predominant, with transeunt causation and with causal production. Making this categorical distinction is not meant to imply that there are no differences within categories. For example, if humans are the model for Aristotelian causation, then the tendency to apply notions of will, volition and agency within the natural domain may depend on some criterion of resemblance to other human characteristics.

Concluding Remarks

My main contention is that every instance of causal processing involves or implies something concerning each of the topics raised here. Let me illustrate this. Suppose one wishes to explain why a car accident occurred. The process used to identify a cause (e.g., that specified in the abnormal conditions focus model of Hilton and Slugoski, 1986) is only part of what is involved. The need for a process of the sort suggested implies that the actual cause was not directly perceived. Causal identification will be constrained by beliefs about the sorts of things that can be causes (for example, if only events can be causes, then the condition of the road will not be identified as the cause). The occurrence may be seen as an instance of a causal law (e.g., a law relating road holding ability to road wetness and tire condition). The understanding of the occurrence is founded on beliefs about order in reality (e.g., that reality is sufficiently stable for explanations that are valid for similar accidents to hold in the present case as well). Part of this natural order may be an order of morality ("drunk drivers deserve what they get"). The causal identification is founded on a concept of the causal relation (e.g., as a generative relation), which may legitimate the use of certain cues to causal identification, such as temporal contiguity or necessary conditions. The causal identification may be facilitated or otherwise be influenced by the choice of a causal frame (e.g., other occurrences on that stretch of highway, other occurrences involving that driver). It may specify an interrelation between internal and external factors that must conform to a causal structure believed possible in common sense (e.g., between a releasing condition and a causal power). Finally, the kind of causation involved takes its character from beliefs about the domain in question (e.g., events involving the car conceptualized in mechanistic terms).

These things are not merely ancillary to the process. A comprehensive theory of causal inference should include statements on all the issues identified here, organized into an integrated explanatory account. Theories that confine themselves to processes are incomplete in important ways.

There are obvious drawbacks to trying to cover so much ground in a little space, and each of the issues identified deserves more thorough treatment than it has received here. However, the advantage of treating issues in this way is that it helps to avoid fragmentation of the topic (Einhorn & Hogarth, 1986); and development of theory can only be aided by greater awareness of ideas and issues to be found in philosophy.

References


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