Phil 420: *Metaphysics*
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[Handout 15]

Wesley Salmon: *Probabilistic Causation*

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It seems to me that probabilistic causal concepts are used in innumerable contexts of everyday life and science.
Examples:
1. diet soft drinks → cancer
2. skid on ice → car accident
3. exposure to low levels of radiation → leukemia
4. eating very spicy food → gastric distress
5. …

It may be well maintained that in all such cases a fully detailed account would furnish invariable cause-effect relations, but this claim would amount to no more than a declaration of faith.

Main Objective:
___ To examine three previous proposals on probabilistic causation and point out their flaws.
___ In shall briefly sketch what seem to be the appropriate ways of circumventing the problems associated with these three theories of probabilistic causality.

§ Reichenbach's Macro-statistical Theory

Reichenbach's concepts:

(1) [Causal betweenness]: B is *causally between* A and C.

……… **→ A → B → *C* → …**

For a causal chain of events: A → B → *C*, where A, B, *C* stand for a class of events (i.e., not singular events)

Note: Conditional probability is the probability of some event *A*, given the occurrence of some other event *B*. Conditional probability is written *P*(*A*|*B*), and is read "the probability of *A*, given *B*". (*Wikipedia*)

An event *B* is causally between the events *A* and *C* if the relations hold:

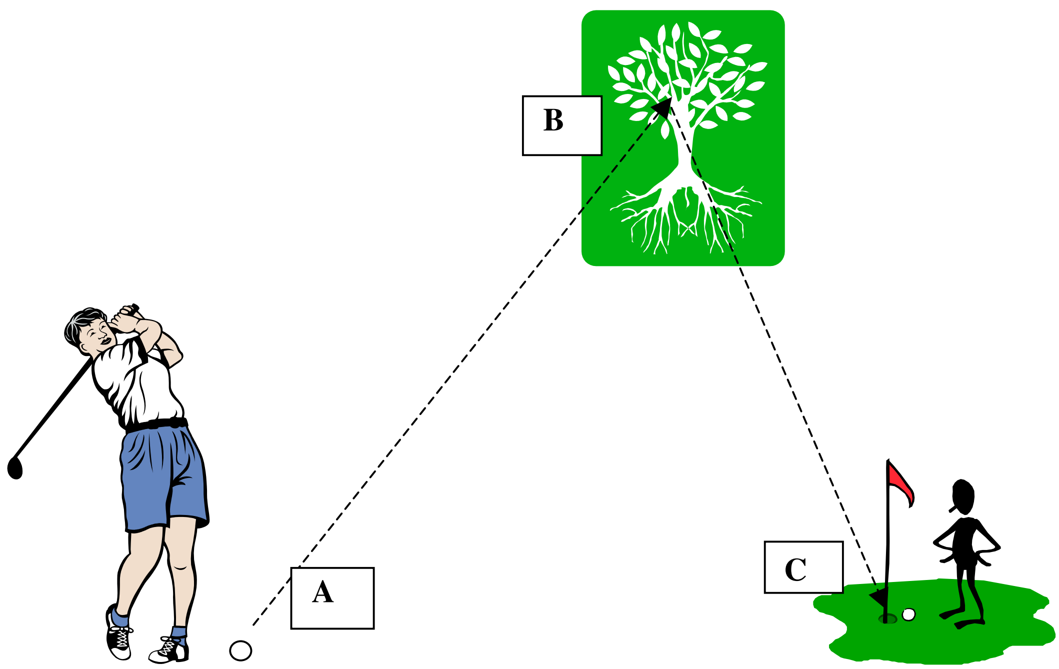
1 > *P*(*C*|B) > *P* (*C*|A) > *P* (C) > 0
[the probability of ***C*** given B is higher than the probability of ***C*** given A, and both are higher than the probability of ***C*** itself] ➔ A is relevant to the occurrence of ***C***, but B is more highly relevant to C.

1 > *P*(*A*|B) > *P* (*A*|C) > *P* (A) > 0
[the probability of A given B is higher than the probability of A given ***C***, and both are higher than the probability of A itself] ➔ ***C*** is relevant to the occurrence of A, but B is more highly relevant to A.

***P*(*C*|A.B) = *P*(*C*|B)**
[the probability of ***C*** given A and B equals the probability of ***C*** given only B] ➔ B screens A off from ***C*** and ***C*** off from A – B renders A and ***C*** statistically irrelevant to one another.

Problem with this analysis:

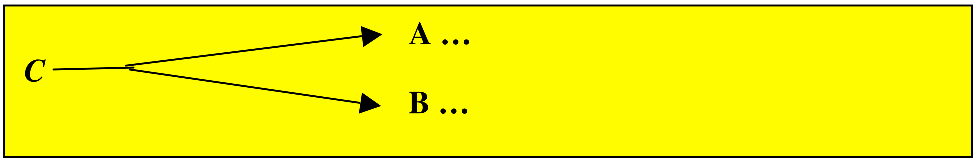
Suppose a golfer makes a shot that hits a limb of a tree close to the green and is thereby deflected directly into the hole, for a spectacular birdie… we would ordinarily estimate the probability as being still lower. Yet when we see the event happen, we recognize immediately that hitting the branch in exactly the way it did was essential to the ball's going into the cup. (In this case, the probability of ***C*** given B is actually lower than the probability of ***C*** given A.)



The crucial feature of this example is that the guy makes the birdie 'the hard way'. Since much which goes on in life happens 'the hard way', we should be able to find an abundance of everyday sorts of counterexamples.

Another example:
___ A pool player has an easy direct shot to sink the 9-ball, but he chooses, for the sake of his subsequent position, the much more difficult play of shooting at the 2-ball and using it to put the 9-ball into the pocket. The initial probability of his sinking the 9-ball is much greater than the probability of getting the 9-ball in the pocket if his cue-ball strikes the 2-ball, but the collision with the 2-ball is causally between the initiation of the play and the dropping of the 9-ball into the pocket.

(2) [conjunctive fork]: If two or more unlikely events, A and B, suddenly happening together, and there is no direct causal connection between A and B, then there must be a common cause.



The motivation for introducing this concept is to characterize the situation in which an otherwise improbable coincidence is to characterize the situation in which an otherwise improbable coincidence is explained by appeal to a common cause.

e.g. If a particular group of students all suddenly came down with a severe gastric illness, there must be a common cause, e.g. the cafeteria food they all consume.

e.g. If two students turn in identical term papers for the same class and if one did not copy from the other, then they must both be copying from the same source.

$P(A.B|C) = P(A|C) \times P(B|C)$
[Given ***C***, the probability of A and B happening is the same as the probably of A's happening multiplied by the probability of B's happening (all given ***C***) – here it is because the occurrence of A and the occurrence of B are mutually independent, given ***C***].

$P(A.B|\bar{C}) = P(A|\bar{C}) \times P(B|\bar{C})$
[Given ~***C***, the probability of A and B happening is the same as the probably of A's happening multiplied by the probability of B's happening (all given ~***C***)].

$P(A|C) > P(A|\bar{C})$
[the probability of A's happening given ***C*** is higher than the probability of A's happening given ~***C***]
$P(B|C) > P(B|\bar{C})$
[the probability of B's happening given ***C*** is higher than the probability of B's happening given ~***C***]

Counterexample:
___ There are many coincidence that do not share the same cause.

A = the coffee being ready at 8 am
B = the other person's showing up
C = Brown taking the 7:30 bus to arrive earlier in the office
___ The three events satisfy Reichenbach's requirement for a conjunctive fork, but clearly Brown's bus ride is not a cause of either the coffee being made or the other person's early arrival

Conclusion:

We must regard Reichenbach's attempt to provide an account of probabilistic causation as unsuccessful.

§ Suppes's Probabilistic Theory

Suppes's Main Concepts:

1. **[*prima facie* cause]:**

___ An event B is said to be a *prima facie* cause of an event A if B occurs before A and B is positively relevant, statistically, to A.

A is a *prima facie* cause of *C* ➔ $P(C|A) > P(C)$

2. **[spurious cause]:**

___ An even B is a *spurious cause* of an event A if it is a *prima facie* cause of A and it is screened off from A by a partition of event C_i which occur earlier than B.

3. **[genuine cause]:**

___ A genuine cause is a *prima facie* cause which is not spurious.

4. **[screening off]:**

___ To screen off is to take place between two events (to be a partition of) A and B, and to prevent A from succeeding B.

***Salmon:**

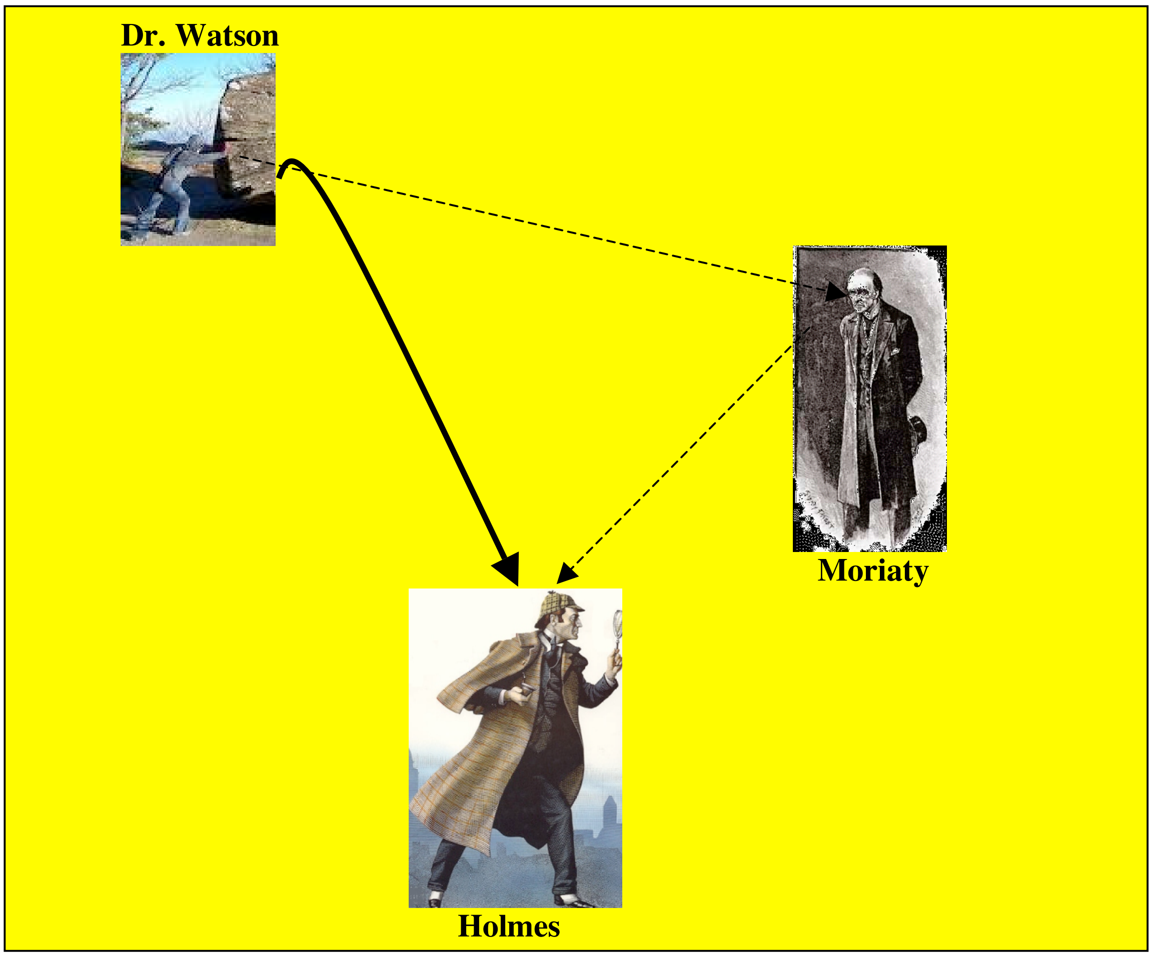
While there is general agreement that positive statistical relevance is not a sufficient condition of direct causal relevance – we all recognize that the falling barometric reading does not cause a storm – the question is whether it is a necessary condition. Reichenbach assumes that causal relevance is a special form of positive [statistical] relevance. Suppes makes positive statistical relevance a defining condition of prima-facie causes, and every genuine cause is a *prima facie* cause.

Problem:
It is the *negative statistical relevance* of the cause to the occurrence of the effect which give rise to the basic problem.

Hesslow's challenge:
___ It is possible however that examples could be found of causes that lower the probability of their effects.
e.g. contraceptives causes T, but pregnancy also causes T; hence, contraceptives lower the probability of T
___ *it is entirely possible that a cause should lower the probability of its effect*

*** In that case, then "positive statistical probability" is not even a necessary condition for causality.**

*** A fun case to consider: what is the causal connection in the following case?** (p. 149)



§ Salmon: A Modest Suggestion

*** The problem of the above theories:**
___ The fundamental source of difficulty in all three of the theories discussed above is that they attempt to carry out the construction of causal relations on the basis of

probabilistic relations among discrete events, without taking account of physical connections among them.

There is a strong tendency on the part of philosophers to regard causal connections as being composed of chains of intermediate events, rather than spatio-temporally continuous entities which enjoy fundamental physical status. Such a viewpoint can lead to severe frustration, for we are always driven to ask about the connections among *these* events.

Salmon's View on 'Causation'

1. **Causation should be viewed as a process, not as a relation among discrete events.**
2. **When discrete events bear genuine cause-effect to one another – there are spatial-temporally continuous causal processes joining them.**
3. **These causal processes transmit causal influences, which may be probabilistic, from one region of space-time to another…..**
4. **We cannot guarantee that cause-effect relations must always involve relations of positive statistical relevance; however, it seems intuitively compelling to argue that a cause which contributes probabilistically to bringing about a certain effect must at least raise the probability of that effect vis-à-vis some other state of affairs.**
5. **What we want is an *internal* positive relevance, not a general positive statistical relevance.**

The general ingredients in a satisfactory qualitative theory of probabilistic causality are:

(1) a fundamental distinction between causal processes and causal interactions
(2) an account of the propagation of causal influence via causal processes
(3) an account of causal interactions in terms of interactive forks
(4) an account of causal directionality in terms of conjunctive forks
(5) an account of causal betweenness in terms of casual processes and causal directionality

If an adequate theory of probabilistic causality is to be developed, it will borrow heavily from the theories of Reichenbach and Suppes; these theories require supplementation rather than outright rejection.

Appendix:

§ Salmon's Proposed Theory of Causation

1. Two Basic Causal Concepts:
___ production: how one thing causally produces another
___ propagation (transmission): how causal influence can be propagated through time and space.

2. Process Ontology (vs. physical thing ontology or event ontology)

[processes vs. events and objects]
1. Events are relatively localized in space and time, while processes have much greater temporal duration (and sometimes greater spatial extent).
2. In space-time diagrams, events are represented by points, while processes are represented by lines.
3. Processes are not simply collections of discrete events that are serially ordered.
4. But even a material object at rest will qualify as a process.

III. Processes vs. Pseudo-Processes:
___ Causal processes and pseudo-processes are separable by the mark criterion.

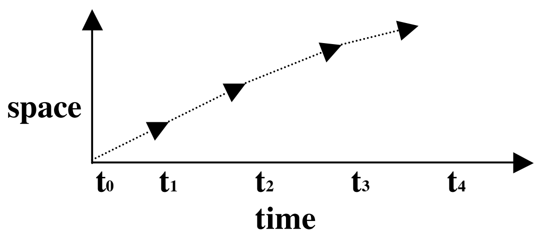
[The Mark Criterion]:
___ Causal processes are those that *can* transmit a mark; pseudo-processes are *incapable* of doing so.
1. With causal processes, if we intervene locally at a single place, we can produce a change that is transmitted from the point of intervention onward; with pseudo-processes we cannot do so.
2. A causal process transmits its own structure, while the pseudo-process does not.
3. Causal processes transmit their own uniformities of qualitative and structural features (they are thus 'self-determined'). The regularities of pseudo-processes, on the other hand, are parasitic upon causal regularities exterior to the 'process' itself.
4. A causal process transmits signals, energy, information and causal influence, while a pseudo-process does not.

§ The 'At-At' Theory of Causal Propagation

*** The At-At Theory of Motion: (at-space and at-time)**

___ Motion is defined as relation of an object's position and the moments of time. To move from point A to point *B* is simply to be *at* the appropriate point of space *at* the appropriate point of time.

___ For the arrow to move from *A* to *B* is simply for it to occupy the intervening points at the intervening instants. The motion of the arrow consists in being *at* particular points of space *at* corresponding moments.



§ Conclusion

Causation = A causal *process* that transmits marks, structures and causal influences from one space-time event to another.