DISCUSSION
TWO NOTES ON THE PROBABILISTIC APPROACH TO CAUSALITY*

GERMUND HESSLOW

University of Lund

1. According to the Humean theory of causality the individual event A_t (the event of kind A occurring at time t) caused $B_{t'}$ (t' is assumed to be later than t) if and only if events of kind A are always followed by events of kind B. Many everyday examples of causal connections however refute this view, since it is seldom that the cause is *always* followed by the effect. Mumps, e.g., can cause sterility, but the probability of sterility given this illness is minimal.

For those who wish to retain the basic idea of the Humean approach there seems to be two ways of solving the problem. The first, which I will call the deterministic approach, can be briefly described as follows. An event A can be construed as a set of more elementary events $A_1, A_2, \ldots, A_n$, and the statement that A occurs as a conjunction A_1 occurs, A_2 occurs, etc. We then introduce the following definitions:

*D*1 A_t is a complete cause of $B_{t'}$ if and only if
- (*i*) A is always followed by B.
- (*ii*) There is no C such that C is always followed by B and C is a proper subset of A.
- (*iii*) A_t occurs.

*D*2 A_t is a cause of $B_{t'}$ if and only if
- (*i*) There is an event C_t which occurs and is a complete cause of $B_{t'}$.
- (*ii*) A is a non-empty subset of C.

Obviously this theory implies determinism in the sense that if an event has a cause, it has a sufficient (complete) cause.

The second approach, the probabilistic, requires of the cause that it should raise the probability of the effect. Suppes ([1], p. 12) gives the following definition:

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*D*3 A_t is a *prima facie* cause of $B_{t'}$ if and only if
(*i*) $t < t'$
(*ii*) $P(A_t) > 0$
(*iii*) $P(B_{t'}/A_t) > P(B_{t'})$

Both theories of course solve the above mentioned difficulty. In the next two sections I shall try to present two problems for the probabilistic theory that can be solved by the deterministic theory.

2. The basic idea in Suppes' theory is of course that a cause raises the probability of its effect, and it is difficult to see how the theory could be modified without upholding this thesis. It is possible however that examples could be found of causes that lower the probability of their effects. Such a situation could come about if a cause could lower the probability of other more efficient causes. It has been claimed, e.g., that contraceptive pills (C) can cause thrombosis (T), and that consequently there are cases where C_t caused $T_{t'}$. But pregnancy can also cause thrombosis, and C lowers the probability of pregnancy. I do not know the values of $P(T)$ and $P(T/C)$ but it seems possible that $P(T/C) < P(T)$, and in a population which lacked other contraceptives this would appear a likely situation. Be that as it may, the point remains: *it is entirely possible that a cause should lower the probability of its effect.*

Obviously this example is quite consistent with the deterministic theory.

3. Another obvious objection to *D*3 is that it allows as causes events that did not occur. Suppes deals with this objection in the following manner: We can "say that A_t is a *potential prima facie* cause of $B_{t'}$. When both events occur the potential becomes *actual*" ([1], p. 40). (This is related to drawing a distinction that Suppes' theory lacks, namely between causality as a relation between kinds of events and as a relation between individual events.) Instead of saying that A_t causes $B_{t'}$ we should say that A_t can or may cause $B_{t'}$, and that A_t did cause $B_{t'}$ only when both events occurred.

The relationship between potential and actual (or between generic and individual) causal relations is not so simple however. From the fact that A_t may cause $B_{t'}$ (e.g., smoking causes cancer) and A_t and $B_{t'}$ both occurred (John smoked and got cancer) it does *not* follow that A_t caused $B_{t'}$ (John's smoking caused his getting cancer).

Let us, returning for a moment to the terminology of the deterministic theory, assume that there are two kinds of events A and B that are complete causes of E and that A consists of A_1 and A_2. It would

then be reasonable to say that A_1 may cause E (and normally A_1 will raise the probability of E). According to Suppes we should then say that A_{1t} caused $E_{t'}$ if A_{1t} and $E_{t'}$ occurred. But A_{1t} caused $E_{t'}$ only if A_{2t} occurred. If this was not the case but rather A_{1t}, $-A_{2t}$, B_t and $E_{t'}$ occurred, then B_t but not A_{1t} caused $E_{t'}$.

Suppose that some people have a certain property A, such that those who smoke and have A always get cancer, while smoking has no effect on those who lack A, but those belonging to the latter group can get cancer in other ways. If John, who smoked and got cancer, was an A-person, the smoking caused the cancer, but if he was not an A-person, his cancer must have been caused by something else.

The fact that A_t may cause $B_{t'}$ and that both events occurred does not automatically warrant the conclusion that A_t caused $B_{t'}$. The truth of this statement is dependent on the presence of those factors that together with A_t constitute a sufficient condition for $B_{t'}$. Thus the statement that A_t caused $B_{t'}$ presupposes the presence of a sufficient condition, i.e., it presupposes the kind of determinism that follows from $D1$ and $D2$.

4. If a physician has two patients with the same illness and receiving the same treatment, but only one of them recovers, he can be sure to ask in what way they differed. I.e., he assumes that there is a factor which was present in one patient but not in the other that explains the different outcomes. This is the kind of determinism which is reflected in $D1$ and $D2$, and it is precisely this that Suppes finds objectionable and which is his main reason for adopting a probabilistic approach. In this example it is of no consequence if the physician actually believes that there is an explanation or if he merely acts as if there were, but in the example in the foregoing section this is not so. There the truth of a causal statement is dependent on the presence of the other factors.

The fact that determinism is doubtful or extravagant as a metaphysical thesis is not really relevant to the analysis of causation. What is relevant is if a deterministic assumption is so embedded in ordinary discourse as to affect the language of causality.

REFERENCES

[1] Suppes, P. *A Probabilistic Theory of Causality.* Amsterdam: North-Holland, 1970.