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Probabilistic Causation, Cartwright and Interactive Forks

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Abstract

Germund Hesslow famously challenges probabilistic theory of causation by providing an example of a *probability-lowering cause*. Nancy Cartwright meets this challenge with her own probabilistic causal theory. In this essay I show how she can answer Hesslow's criticism, but then point to a related issue of her own theory. I argue that her theory cannot always distinguish between a cause for an event and an indication that an event occurred.

Introduction

Germund Hesslow[1] challenges probabilistic causal theory by providing an example of a *probability-lowering cause*. I shall define a probability-lowering cause as a situation S in which a cause C appears to lower the probability of its effect E. In her article 'Causal Laws and Effective Strategies', Nancy Cartwright meets this challenge with her own probabilistic causal theory.[2] My aim in this

[1] Hesslow, *Discussion: Two Notes on the Probabilistic Approach to Causality* 290 - 292.

[2] Cartwright, *Causal Laws and Effective Strategies* 419 - 437.

essay is to assess her theory and argue that, while it succeeds in meeting Hesslow's criticism, it does so at a certain cost. More precisely, I shall suggest that, in some instances, Cartwright's theory cannot distinguish between a cause for an event and an indication that it occurred.

My essay is structured as follows. I begin by formulating some relevant tenets of probabilistic causal theory in order to better contextualise the issue Cartwright aims to resolve. I then show how her theory answers Hesslow's challenge and, in a second step, flesh out the problem that then arises from Cartwright's own theory.

I. Probabilistic Causation and Cartwright

The basic idea behind probabilistic causation is very simple. Causes are assumed to increase the probability of their effects, or in other words a cause C bears some statistical relevance in bringing about a certain effect E. Consider the popular claim that smoking causes lung cancer. To posit that smoking is sufficient to cause lung cancer is obviously too strong as there are empirical counterexamples of smokers who never develop lung cancer. Yet between smoking and lung cancer there appears to be some kind of statistical connection. That is, smoking seems to increase the likelihood of developing lung cancer. Formally this can be represented as $p(E|C) > p(E)$, which reads as C causes E iff the probability of E given C is greater than just the unconditional probability of E.

Against this background, consider the following example by Hesslow. Contraceptive pills C and pregnancy P both cause thrombosis T. The probability of thrombosis given pregnancy may be higher than its probability given contraceptive pills. But since contraceptive pills lower the probability of pregnancy, the probability of thrombosis given the pills may be less than its probability without them. More formally: we can say that $p(T|P) > p(T|C)$, but because $p(P) < p(P|C)$, it seems that $p(T|C) < p(T)$. Yet surely it is correct to say that contraceptive pills do cause thrombosis in some way, so how could it be that the contraceptive pills lower the probability of thrombosis? Notice that our scenario has a twofold interaction of the contraceptive pills: (i) they lower chances of becoming pregnant which in turn reduces the risk of thrombosis while (ii) they also directly increase the risk of thrombosis. We may say they exert (i) a negative and (ii) a positive effect on thrombosis while (i) overall outweighs (ii). As Cartwright recognises, in such an example there are two causal factors, one of which dominates in its effect, i.e P in this case (p423). From this she concludes that the only situations in which a "particular factor is not correlated with any other causal factors are situations in which all other causal factors are held fixed" (ibid.), since we could then discount the impact of the other causal factor. Cartwright consequently hypothesises that:

C causes E if and only if $p(E|C \wedge F) > p(E|F)$,
where F is any alternative causally relevant factor.

In this formulation 'causally relevant factor' denotes any event that either causes E or ¬E, other than C or its effects, or any combination of such events.[3] We can now see how the causally relevant factor criterion (CRFC) answers Hesslow's criticism. This is because Cartwright's CRFC, F, holds fixed whether a woman becomes pregnant. So, by holding fixed the causally relevant factor of pregnancy P, we can isolate the *negative* effect of pills on thrombosis. Thus contraceptive pills increase the probability of thrombosis in women who do, and also who do not get pregnant, depending on whether we hold fixed the *negative* or *positive* effect in the twofold causal interaction. Since Cartwright's CRFC conceptually differentiates between different causal factors by isolating *viz.* holding them fixed in particular contexts, her theory provides an adequate solution the Hesslow's challenge of probability-lowering causes.

[3] Davis, *Probabilistic Theories of Causation* 142.

II. A Problem for Cartwright

However, Cartwright's theory faces another problem that I would like to address now. For this, it is necessary to consider the so-called screening-off definition that is implicit in Cartwright's theory. By screening-off I understand a type of probabilistic relationship in which a causally alternative factor F screens-off C from E just in case $p(E|C \wedge F)p(E|F)$. For example, firing a gun G may produce a flash F followed by a noise N. While it is true that $p(F|N) > p(F)$, the flash certainly does not cause the noise. The probability of the noise given both the firing of the gun and the flash is not greater than the noise's probability given just the firing, i.e. $p(N|G \wedge F)p(N|G)$. In this case firing the gun G screens off the flash F. Thus Cartwright's theory entails that C causes E only if there is no causally relevant screening-off factor F.

Now, consider what I shall call the LSE Printer Problem.[4] Suppose that sometimes the LSE library printers do not print properly which is regularly due to some malfunctioning software or incorrect installation. Suppose that whenever you press the print button on the printers, the printer either both prints your page and makes a loud beep noise, or it does not print your page at all. We can then say that the probability of a printed page is greater when both the button is pressed and the beep noise occurs than just when the button is pressed. We can express this as $p(P|B \wedge N) > p(P|B)$ in which P denotes the printing of the page, B the pressing of the button and N the occurrence of the beep noise. If $p(P|B \wedge N) > p(P|B)$ then B does not screen off N. But the beep noise does not cause the page to be printed. Thus we end up with a situation in which the screening-off condition fails to capture the correct causal picture since B should cause P viz. screen off N. In this particular case I suggest the problem appears to be this: within Cartwright's theory we cannot distinguish between a cause for an event and the indication that it has occurred. While both P (printing of the page) and N (beep noise) are causally independent effects of B (pressing the button),

[4] This type of example is also known as *interactive fork* (cf. Salmon, *Probabilistic Causality*).

they are not statistically independent since $p(P|B \wedge N) > p(P|B)$ and $p(N|B \wedge P) > p(N|B)$ holds. It thus appears that in this case, Cartwright's theory cannot determine whether the sound caused the paper to be printed, or indicated that it had been printed because the probabilistic formula has no way of distinguishing between the two. More generally, we can say that if in situations S featuring two events A and B, $p(A \wedge B|C) > [p(A|C) \wedge p(B|C)]$ is true, then Cartwright's theory cannot distinguish between causally independent effects of a common cause. This criticism has been more elaborately developed by D.W. Sharder who argues that the screening-off relation 'cannot always select the causally relevant factors from among the statistically relevant ones' and notes this as a general defect of probabilistic causal theories.[5] In the literature the issues with interactive-forks are usually dealt with by trying to explain the forks themselves away viz. deny that they really exist. Arguably, in apparent interactive-forks, the causes are incompletely specified. So, in the LSE Printer Problem, a more detailed description of the mechanisms of the printer would resolve the apparent problem.[6]

Conclusion

Concluding this paper, I have argued that Cartwright's theory solves the challenge posed by Hesslow because it can hold fixed the relevant causal factors that, in a twofold causal interaction, could potentially lead to a cause lowering the probability of its effect. I then turned to a more substantial problem inherent to her theory which is that it cannot always distinguish between a cause for an event and an indication that an event has occurred. As Davis remarks on this drawback: 'I would sound a death-knell for the approach [probabilistic theories] except for the fact that the alternatives' vital signs are equally weak.'[7]

[5] Shrader, *Causation, Explanation, and Statistical Relevance* 136 - 456.
[6] Spirtes, *Causation, Prediction, and Search*.
[7] Davis, *Probabilistic Theories of Causation* 153.

References

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