Boethius Prize 2012: Winning Essay

In Defence of Determinism

by **Robert Stone**

Aim

A traditional view of the world holds that it is deterministic, that everything that happens is determined by what went before, that nothing happens at random. Recent discoveries in quantum physics – especially the apparent indeterminism in some processes – have led some to believe that the world as a whole, rather than being deterministic, is "probabilistic". My aim is to examine a pair of arguments which purport to show that causes in the everyday world do not determine their effects but merely make them more probable, and to argue that this in no way undermines the thesis that the everyday world is deterministic.

D.H. Mellor, in his book *The Facts of Causation* (parts of which are reprinted in Crane and Farkas's *Metaphysics*), argues for what he calls "causal indeterminism", namely the view that causes are not – or need not be – sufficient to produce their effects but simply raise their probability. He uses two sub-arguments that I wish to discuss: the first is about probability, the second about causation itself.

Probability

On probability, an area which Mellor develops in his later book *Probability: a Philosophical Introduction*, he uses, among others, two classic examples of probability to illustrate his view. There is, first, the case of radioactive decay (1999, 420), in which atoms of a radioactive element decay at a certain rate but in such a way that for each individual atom there is only a probability that it will decay in a given time. There are, second, the common examples of coin-tossing and die-throwing (1999, 426 and 2005, 25), where the odds of the coin landing or of the die showing a 6 can be easily calculated. In fact I know a physics teacher who illustrates the probability at work in radioactive decay by getting his students to throw 500 dice repeatedly and to count the instances of various faces landing uppermost. My contention is that, although the second type of probability is a useful illustration of the mathematics of the first, it is of a totally different kind.

Imagine that we focus on one particular radium atom, called Ron; and let us call one of the dice, the 375th to be thrown, Don. Physicists believe that, even if we know everything there is to know about Ron and all his fellow-atoms, we have absolutely no way of telling when he will decay; all we have is a probability of decaying within any given time, as well as the knowledge that half the atoms will have decayed by a certain time (1622 years, in the case of radium). The reason we know the probability is that observations have been made in the past, and it has been shown that radium atoms decay at a certain rate and so presumably, by induction, will do so in the future. This probability, with the resulting rate of decay, is an *intrinsic feature* of radium. As a physicist expresses it, distinguishing the behaviour of subatomic particles from that of objects in the everyday world, "We cannot predict with certainty what will happen in the quantum world – not because our theories are not good enough or because we lack sufficient information, but because Nature herself operates in a very 'unpindownable' way" (Al-Khalili 2003, 59).

Now let us consider Don, the 375th die. When the student throws him in the air, she will do so with a certain force, a certain twist, in a certain direction, a certain distance from the ground, and in certain atmospheric conditions; and there will be plenty of other variables too. All these variables will have an influence on the outcome of this particular throw; the familiar (since Newton) laws of physics will ensure that Don lands with a 6 uppermost – or a 5, or a 4, etc. If an observer could somehow observe all those variables precisely, he would be able to predict which of Don's faces would be uppermost. The reason we assert that the probability of a 6 being thrown is one in six is that we simply do not know, and cannot observe, the various factors which are determining the outcome; we have no more reason to believe that those factors will cause one face to fall uppermost than any other. So the "probability" is merely our ignorance. This is an entirely different situation from that of radioactive decay, where we *do* know all that needs to be known and the impossibility of certain prediction is due to the *intrinsically* "probabilistic" behaviour of subatomic particles.

These two examples seem to illustrate very neatly two of the types of probability identified by Mellor (2005, 7), but in a different way from that which he intends. The probability of the radium atom's decaying is "physical probability", the actual *chances* of its decaying, which are between 0 and 1. The probability we give to a die turning up a 6 is "epistemic probability" (termed "evidential probability" in his earlier work: 1999, 426); the *actual* (physical) probability of a particular throw being a 6 is either 0 or 1, depending on the precise nature of the throw and other relevant conditions. The 1 in 6 probability which we give it is not a genuine feature of the situation; it is the nearest we can get when all that we know is that a six-faced die is being thrown. It is rather like placing bets on Pink Gin (the name Mellor uses: 2005, 11) having won the Derby yesterday when we haven't yet heard the result; we know that the actual physical probability of Pink Gin having won is either 1 or 0, but we can nonetheless intelligently calculate its epistemic probability (between 0 and 1) on the basis of our knowledge of Pink Gin's previous form and other relevant considerations. The fact that the relevant variables in this case are in the past, whereas in the case of the die being thrown they are in the present (or future), makes no difference to the principle.
Mellor takes J. Leslie to task for confusing these two types of probability. Leslie's theory of chance (as expressed in *Universes*) implies, says Mellor (1999, 426), that, when we see a coin land on its edge, its chances of landing like that were 1, and "it had no chance of doing otherwise". Mellor claims that that is only its *evidential* probability, given that we've seen it land that way; the actual *chances* (physical probability) were very small indeed, and it is only the fact that we know it landed on its edge which makes us assign it the (evidential) probability of 1. In fact the reverse must be true. We, in our ignorance of how the coin would be (or was being) thrown (the direction, twist, etc.), had to make do with a guess, based on past statistics; that is *evidential* probability, based on our (lack of) knowledge of present conditions. The *actual* probability (which has now also become the evidential probability) was 1 – as the resulting throw demonstrated. So I agree with Mellor that "the distinction between chance and evidential probability is fundamental" (1999, 426); but I believe that, in this area at least, he gets them the wrong way round.

I have been assuming in the above argument (as did Leslie) that the world of dice and coins – in fact the whole world above the quantum level – works deterministically, so that dice and coins land in a way that is *determined* by all the relevant factors involved in the throwing. My point is not that the everyday world *must* be deterministic – the subject of a separate enquiry – but that the notion of probability in this world works perfectly well, and usefully, when we assume it is. The probability associated with dice and coins is of a quite different kind from that of radioactive decay, and has no implications for the question of whether the everyday world is deterministic.

Causation

1. Simple vs. Complex

Now let us look at Mellor's discussion of causes on a larger scale. One of the problems with discussing causation – leaving aside the question of whether causes and effects are events or properties or whatever (Mellor 1999, 414) – is that people talk of single causes producing single effects, or of general rules by which single causes produce single effects. Hume has to take some of the blame for this, as his famous example of the billiard table – where the motion of the cue ball causes the object ball to move on contact, as can be predicted on the basis of previous observations (Hume 2007, 20) – is of a highly atypical kind. It is a remarkably closed environment, where the number of variables is kept to a minimum (by the smooth surface of the table and the sphericality of the balls), and the "cause" and "effect" are in quick succession, immediately visible, and extremely simple to identify.

In the billiard-table environment causation does seem fairly certainly deterministic. If the cue ball strikes the object ball with a certain force and at a certain point, the latter will move off in a certain direction for a certain distance: that is more or less precisely predictable. If – as we see on TV during snooker championships – a ball does not move as predicted, it is assumed (and usually observed) that there was a speck of dust on one of the balls which interfered with the contact; what no one ever does is shrug his shoulders and say, "Bad luck, but these rules of physics have only a 98% probability of working." The effects are assumed to be *determined* by their causes; a strangeness in the effect is due to a glitch in the cause.

In a less artificial, closed environment, however, such as a weather system or a traffic accident, it is a much more complex business seeing links between cause and effect; it is in this area that Mellor argues for his causal indeterminism. Yet the difference between the two situations is not, I will argue, that on the billiard-table causation is deterministic and in a weather system indeterministic, but that the weather system is so much more complex that the "cause" is far more difficult to pin down.

2. What caused X?

Let us look at the issue first from the point of view of the effect. The usual question that arises in the case of a traffic accident, for example, is "What caused it?" and – here is the point – the answer is generally a *combination* of circumstances rather than a single factor. If the road was slippery, the driver tired, the street lighting poor, and the lorry badly parked, it may well be decided that these factors combined together to cause the accident; no one of them was enough on its own ("sufficient") to cause it, and it may even be that any three of them might been enough, thus rendering none of them individually "necessary". So those four factors were *contributory factors*, and the "cause" of the accident was the whole situation that obtained just before it happened.

How do we decide what we think are contributory factors? For one thing we tend, for practical reasons, to discount circumstances that are always, or regularly, or for a long time the case, such as the Law of Gravity, the existence of the driver, the fact that he was driving his car at all – or, for that matter, the entire history of the universe to date and the laws of nature, which is really the correct answer if the world is deterministic! We take such things for granted as part of the cause of any event. We focus on circumstances that were unusual or

abnormal in that place at that time. Yet we discount unusual things that are clearly irrelevant to the accident, for example the day of the month being a prime number.
Why do we identify some unusual/abnormal factors and not others as contributory to that accident? The answer is past experience, often backed up by statistical analysis. Research has shown that tired drivers have more accidents per 100 miles than fresh ones, and that fewer accidents happen in well-lit streets than in badly lit ones. It is hard to see how one could justify treating any of those factors as causally relevant unless there were evidence of that kind. There is no evidence (as far as I know!) that there are more accidents on prime-numbered days of the month than on other days, and so we don't admit that as a factor. Occasionally people suggest new ideas for possible "causes", and their suggestions are accepted or rejected after research has examined the statistical correlation between those circumstances and the alleged effects.

My point is that, in the world beyond the billiard table, we still see individual events as being determined, but being determined by a *combination of factors*, rather than by a single simple cause.

3. What does X cause?

As well asking about an event "Why did that happen", we also view causation from the opposite angle, the point of view of the "cause". When we are trying to prevent accidents or promote good health in the future, we try to discover what good or harm certain events (or other things) are likely to do: "What effect may this have?" That is when we gather statistics about, for example, the link between smoking and cancer – to take another of Mellor's examples (1999, 422).

It may be found that, among those who smoke 20 a day, the incidence of cancer is 40% higher than among those who do not smoke at all. Now no one claims that smoking therefore *ensures* that someone will get cancer, i.e. that it is a determining, or *sufficient*, cause of cancer; nor is it a *necessary* cause of cancer. We all know of smokers who die of old age at 95 and non-smokers who contract cancer at 40. This leads Mellor to label "Bill's smoking causing him to get cancer" as an example of "indeterministic causation" (1999, 422). Yet what we deduce from such statistics is that, like the poor street lighting, smoking is *one of a number of factors* which, *in combination with others* from that number, constitute the overall cause of cancer in people who get it. Other factors known (by statistical observation) to make cancer more likely are diet, physical fitness, genetic make-up, along with – no doubt – plenty of others which we don't yet know about. Any individual who contracts cancer does so because a certain combination of factors has determined that he must; no one of those factors need be either sufficient or necessary. To say that his smoking made him 40% more likely to get cancer is merely to state a statistic about the population at large; in his particular case, the amount of smoking he did was enough, when combined with the other relevant factors, to cause his cancer.

If it is the combination of factors that causes the cancer, it is irrelevant whether the individual factors themselves are deterministically caused by other individual factors. For example, if the cancer victim has a metabolic property which makes him more likely to get cancer if he smokes (Mellor's example), it is highly likely that the existence of that property is itself caused by a combination of prior factors, as is the smoking. There is no reason to accept Mellor's argument that "some of the causation is indeterministic" (1999, 422), just because the various factors, taken individually, are neither sufficient to cause the effect nor have individual factors that are sufficient by themselves to cause them. It is the whole idea of a single factor constituting a complete determining cause that needs to be abandoned.

4. Causation summarised

The fact that smoking, say, is not a *sufficient* cause of cancer, but is merely correlated with cancer at a more than random level, is exactly the way things ought to be in a deterministic world that is at least moderately complicated. We should expect the following pattern:

1. Anything that happens is *determined*: its actual determining cause is the entire history of the universe and its laws.

2. We *identify* as its cause (in a sense useful to us) a *combination* of those *factors* (aspects of the universe) that are (i) different from the norm, and (ii) especially correlated (as shown by statistics) with the event concerned.

3. Each of those factors is sometimes loosely termed "a cause", though in that sense it need be neither sufficient nor necessary.

Conclusion

When Mellor argues that smoking, say, is not a determining cause of cancer, since it is neither sufficient nor necessary, I can agree with him. But he seems to infer from this that the everyday world is indeterministic in general, rather than – as I would conclude from his arguments – that it is usual for an effect to be determined by a *combination* of factors, none in itself sufficient or necessary, which together constitute the determining "cause". His linking of probability in the everyday world with probability in the indeterministic world of subatomic particles implies that he believes the everyday world is simply not deterministic. In particular, when he says, "Must causes be in this sense sufficient for their effects: is what I shall call causal determinism true? Modern physics suggests that it is not" (1999, 420), and then cites the example of radioactive decay, he seems to be denying determinism in general. If so, I believe that neither (a) his description of statistical probability in the subatomic world nor (b) his demonstration that individual factors in overall causation need be neither sufficient nor necessary has any force against the notion that the everyday world, above the quantum level, is deterministic. The everyday world may or not be deterministic – though situations where the number of variables is reduced to almost zero, like the billiard table, suggest that it is – but Mellor's arguments from probability and individual causes do not undermine the deterministic thesis.

Bibliography

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