

## Determinism

### DETERMINISM DEFINED

The syllabus defines determinism as ‘the belief that a determinate set of conditions can only produce one possible outcome given fixed laws of nature’. Determinism is a view about causality. In its most common form, it holds, first, that every event – everything that happens or occurs – has a cause (universal causation). Second, it holds that given the total set of conditions under which the cause occurs, only one effect is possible (causal necessity). These views can plausibly claim to reflect our commonsense notion of causality, and they are strongly supported by the way natural science investigates the world.

#### Universal causation

Suppose there is water on the kitchen floor. We assume that there is a causal explanation of how the water got there, even if no one knows what it is. If the mess was not caused at all, then we would consider it a miracle. Suppose a pipe burst. So we say ‘If the pipe had not burst, there would not be water on the kitchen floor’. Causes ‘make a difference’.

Why think ‘every event has a cause’? This isn’t an empirical discovery, because we haven’t discovered the cause of *every* event. However, as science has progressed, it has explained more and more events, so that we may believe that we *could* – in many cases, in practice, but *always in principle* – discover the cause of an event. ‘Every event has a cause’ is best understood as a *commitment* that we make. To think that some event has *no* cause would be to give up on trying to account for it by science at all. Universal causation is a commitment of science.

Again, laws of nature are universal – there is no part of the universe in which they don’t apply. So every event – at least every *physical* event – falls under the laws of nature. So every physical event was caused in accordance with these laws.

#### Causal necessity

‘The burst pipe caused the kitchen floor to become wet’ is about this one occasion. But we expect that on other occasions if pipes burst in the kitchen, the floor would be wet. Our idea of causality includes the idea of *regularity*, that the same cause will operate in the same way on different occasions. This allows us to formulate laws of nature.

If on another occasion, a pipe burst, but the floor remained dry, there must be something between that situation and our original one which is *different*. (For example, that the whole house is well below freezing, so that the water in the burst pipe is and remains ice – so it stays where it is, and the floor remains dry.) If the burst pipe caused the mess, then this licences us to say that, if all other factors remain exactly the same, ‘Were the pipe to burst, then there would be water on the kitchen floor’.

The idea of regularity leads to the stronger thought that, given this cause – in exactly this situation – only one outcome is *possible*. In a different situation, a burst pipe might not lead to water on the floor; but in this situation, not only does the burst pipe lead to a wet

floor, but it *had* to. The situation determines a *unique* effect. This is the idea of *causal necessity*.

These two ideas – universal causation and causal necessity – give us determinism: a determinate set of conditions can only produce one possible outcome given fixed laws of nature.

## **DETERMINISM DEVELOPED**

### **The state of the universe**

We said that in the same situation, the same cause (a burst pipe) must lead to the same effect (a wet floor), as long as the two situations were the same. But any number of things may disrupt the cause producing the effect: a meteor could land at the moment the pipe bursts, destroying the kitchen floor, a simultaneous explosion of gas could turn all the water into steam – so the burst pipe doesn't lead to a wet floor.

To defend the idea of causal necessity, we need to be able to say that there is only one possible outcome, given the cause. Given the possibilities just mentioned, how can we? We need to consider anything that *could* have an effect. How can we do this? The safest, and most complete, specification of the situation is *the entire state of the universe at that moment*. With the universe in that state (including the pipe bursting), the next state of the universe (including the wet floor) must follow, given the laws of nature.

We don't normally talk of 'the state of the universe'. But we need to get rid of 'other things being equal' – as long as allow this, the effect isn't the only *possible* event. So to capture causal necessity, we can take into account all 'other things' – the entire state of the universe. From this state, only one state can be caused by it and will follow it. The past determines a unique future. Determinism, then, is the view that given the state of the universe and the laws of nature, only *one* unique state of the universe can occur next.

### **Causal chain**

As the universe continues through time, so the events which are effects of earlier causes become causes of later effects. This gives us the idea of a *causal chain*. This event, G, was caused by an earlier event, F, which in turn was caused by an earlier event, E, and so on. So any event is determined by what caused it; its causes were determined by what caused them; and so on, back through time. So any event is determined by what happened in the *distant past*. The entire future of the universe was causally fixed from the first moment; from that first moment on, no other set of events than what has actually happened and will happen was physically possible. This is the very strongest statement of determinism.

## **DETERMINISM AND HUMAN ACTION**

Physical determinism – determinism expressed in terms of physical causes and laws – provides the clearest most persuasive example of determinism. But determinism is a completely general doctrine, which could be just as true of human beings, our choices and actions, as it is of physical objects.

### **Action and causation**

If all causation is deterministic, then wherever we find causation, we find determinism. Are our actions caused? Intuitively, we say 'yes'; we explain our actions in terms of motivation, and it is natural to think of motivation as a kind of causation. Motivation –

being moved – can feel like a psychological ‘force’, which is a causal idea; motivation makes things happen.

Notice that we use statements like ‘If he had wanted to learn, he wouldn’t have thrown away his books’, and ‘If he were to want a drink, he would go to the kitchen’ – expressing the kind of regularity involved in causation. The same motives produce the same actions, at least in similar situations. (If the action is different, then we appeal to different causes or situation.)

We rely on this regularity all the time. We expect that others will, in their *voluntary* actions, act in very specific ways, e.g. in taking goods to market, I expect others to come, to want to buy, and so on. People’s choices and actions are regular.

Determinism threatens free will like this: Our actions are events. Therefore, they have causes. Given the causes they have, no action is possible other than what we actually do. If we couldn’t do any other action, then we do not have free will, e.g. to choose between doing different actions. The argument can be run at the level of choices as well: our choices are events, and so have causes. Given those causes, only one choice is possible. So we are not free to choose anything other than what we actually choose.

## **DETERMINISM DISTINGUISHED FROM PREDICTABILITY**

Scientists can get predictions wrong. But this is no objection to determinism. Determinism is not the claim that we can predict every event accurately; it claims that every event is predictable *in principle*. The reason we cannot and do not predict events accurately is because we do not know everything about the laws of nature nor about the ‘determinate set of conditions’ that leads to the effect. A being that did have this knowledge would be able to make completely accurate predictions.

This goes for choices as well. Determinism doesn’t claim that anyone can come to know *all* a person’s mental state and experiences so as to be able to predict what they do. But it maintains that *if* we had this knowledge, we could predict what they do.

We should also note that predictability doesn’t entail determinism. For example, you may simply know that if you offer someone prawns or meat, they will choose meat because they don’t like prawns. Similarly, you can predict that a friend of yours will help this old lady across the street, because he is a kind person, in a good mood, and has just said that this is what he will do. These examples don’t show that choices are determined, even if they can be predictable.

## **CHANCE AS COMPATIBLE WITH DETERMINISM**

If things happen by chance, does that make determinism false? What is ‘chance’ at one level can be explained at another level. For example, you might bump into an old friend ‘by chance’, i.e. you hadn’t arranged to meet. But if physical determinism is right, then this event was caused, in accordance with the laws of physics; and in that sense, it didn’t happen by chance at all. But does chance operate at the physical level?

### **Chaos theory**

Chaos theory is about how some complex systems, e.g. the weather, work. Given ‘same cause, same effect’, we might expect that if we get the cause wrong by just a little bit,

then our predictions of the effect will just be slightly wrong. But this isn't always true. A very small difference in the initial causal conditions can lead to a very big difference in effect; a popular – if unproven! – example is that a butterfly flapping its wings in Europe may lead to a storm in China.

The theory has been *misunderstood* to say that different effects can be produced by causes so similar as to be 'the same' – for all we can tell. But while we may not be able to specify the cause precisely enough to predict the effect accurately, chaos theory is completely deterministic: different effects require different causes; the effect is still predictable in principle (see p. xxx), though not in practice; and given the *precise* cause (or causal chain), the effect must follow.

### Quantum mechanics

Quantum mechanics is a theory about what happens at the sub-atomic level of physics. Many people believe that it is a *probabilistic* theory – that it can only say what will happen, e.g. when a radioactive atom will 'decay', with a degree of probability. And probability is the degree of chance that something will happen.

However, we can argue that because the probabilities at the sub-atomic level are *fixed*, so at the level of our normal interactions with the world, events happen perfectly deterministically. Sub-atomic probabilities don't become chance at the macrophysical level.

However, one interpretation of quantum mechanics goes further than chance. It says that sub-atomic states are *not determinate*. A famous example (known as Heisenberg's Uncertainty Principle) is this: we cannot measure both the velocity and the position of an electron at one moment; if we measure how fast it is moving, we cannot tell exactly where it is; if we measure where it is, we cannot tell just how fast it is moving. Some physicists argue that we may say that the electron *does not have* a determinate velocity and position - it acquires one or the other when we measure it.

It is worth noting, however, that many physicists disagree with this interpretation and argue that what happens sub-atomically is fully determinate and determined (Schrödinger's equation shows that sub-atomic states change in a perfectly regular manner). Some argue that the apparent indeterminacy is just to do with our ability to make measurements. Some argue that there are 'hidden variables', causes we don't know about, and these cause events deterministically.

But even if the indeterminacy interpretation is right, this *still* isn't incompatible with determinism in this sense: determinism claims only that a *determinate* set of conditions will produce only one possible outcome. If sub-atomic states are not determinate, then determinism doesn't apply to sub-atomic states. So the same sub-atomic state may cause or be followed by a number of different possible outcomes on different occasions without conflicting with determinism.

We can object that the indeterminacy interpretation does undermine determinism. If sub-atomic states are indeterminate, then everything physical is indeterminate, because everything physical is ultimately composed of sub-atomic states. So determinism is false.