10 Structural properties

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1 Introduction

Dispositional essentialists claim that dispositional properties are essentially dispositional: a property would not be the property it is unless it carried with it certain dispositional powers. Categoricalists about dispositional properties deny this, asserting that the same properties might have had different dispositional powers, had the contingent laws of nature been otherwise.

As I have described it, that debate concerns properties that can be characterized as dispositional. We could expand that debate to include another one. How many different metaphysical kinds of property are there? Just one, or two or more? The monist thinks that there is just one kind of property. The categoricalist described above is likely to be a monist, asserting that all properties are categorical in nature. On this view, all properties are alike in essence; they confer, of themselves alone, no potentialities, no causal powers. A (categorical) property can confer such powers, but only because there is a law relating that property to some other property. Armstrong is a categorical monist (Armstrong *et al*. 1996: 15–18; Armstrong 1997: 69, 80–3). Another kind of monist thinks that the distinction between different kinds of property is misconceived, and that dispositionality and categoricity are different aspects of one kind of property. Martin and Mumford have expressed this sort of view (Armstrong *et al*. 1996: 71–5; Mumford 1998: 64–7). A dualist may think that the distinction is well conceived and that some properties are categorical (i.e. are just as the categorical monist thinks all properties are), whereas some others are essentially dispositional. One could, perhaps, be a more liberal pluralist, thinking that substance and kind properties (being gold, being a tiger) and mathematical properties (being odd, being well founded) are yet different kinds of property, being neither dispositional nor categorical. Dualists and other pluralists may be egalitarian – none of the different kinds of property has any special priority relative to the others. Or they may be hierarchical, holding that one kind of property (the categorical, for example) explains or is the basis for the other kind(s).

In this essay I wish to examine the prospects for *dispositional monism*. This view is monistic in that it holds that there is only one kind of property, or,

more circumspectly, that there is only one kind of property in the metaphysics of science. (The properties I am discussing in this essay are Lewis's sparse properties; the dispositional monist need not account for non-sparse abundant properties.) But, in a mirror image of categorical monism, dispositional monism asserts that all properties are essentially dispositional. None is categorical.

This view faces severe challenges on more than one front. For example, dispositional essentialism is committed to the metaphysical necessity of the laws of nature. If some property D is *essentially* the disposition to manifest M whenever stimulated by S, then the conditional $(Dx \wedge Sx) \rightarrow Mx$ (possibly with an added *ceteris paribus* clause) is necessarily true. Our intuitions are that the laws of nature are contingent; our intuitions thus favour categoricalism about properties. The correct response to this challenge is simply to deny the dialectical force of intuition in this case. Our intuitions concerning necessity are notoriously unreliable, as Kripke has shown. Furthermore, it can be proved that even the categoricalist must accept that some apparently contingent higher level laws are in fact necessary.[1]

2 Structural properties

In the following I shall examine another, perhaps stiffer challenge which is presented by properties that seem not to be dispositional at all and are held up as paradigms of categorical properties. These are structural, typically geometrical properties. Take the science of crystallography. The explanation of the properties of a crystal will refer to its structure, which is a matter of the geometrical relations of the ions or molecules that constitute the crystal.[2] Since spatial relations are structural in the current sense, all sciences will depend on structural properties. A categoricalist might think that an object that consists of a set of masses in a particular spatial configuration has just been described in purely categorical terms. Whether the dispositionalist can account for mass is a question to be pursued elsewhere.[3] The present, greater challenge is to account for the spatial relations in dispositional terms.

Being triangular, for example, seems to bring with it no powers in the way that, say, being elastic or being negatively charged do. This is why those who think that *some* properties are essentially dispositional might be inclined to be dualists, permitting structural properties to be categorical. If one is inclined to be a dispositionalist across the board, how might one defend the claim that structural properties are, despite appearances, dispositional also? As in the objection concerning the alleged contingency of laws, the dispositional monist must argue that appearances are deceptive. It is not the case that structural properties do not confer powers necessarily.

'Conferring a power' has traditionally been cashed out in terms of entailing a counterfactual or subjunctive conditional. If that is appropriate, then the categoricalist challenge is committed to the following necessary condition on being a dispositional property:

(A) P is a dispositional property only if for some S and M and for all *x*:

P*x* entails if S*x* were the case, then M*x* would be the case.

The categoricalist about structural properties argues that structural property ascriptions entail no such conditionals:

(S) If P is a structural property then there are no S and M such that for all *x*:

P*x* entails if S*x* were the case, then M*x* would be the case.

(A) and (S) together entail that structural properties are not dispositional properties.

For example, if '*x* is triangular' entails no non-trivial subjunctive conditional then, given (A), triangularity is not dispositional. If on the contrary there is a sound argument that '*x* is triangular' does entail some such conditional, i.e. that (S) is false, then the categoricalist will have failed to show that triangularity is non-dispositional, and so triangularity cannot be employed as a counter-example to the claim that all properties are dispositional.

Even so, such an argument showing that (S) is false would not have shown that triangularity *is* dispositional. For that we would need the reverse of (A) to be true:

(B) P is a dispositional property if for some S and M, and for all *x*:

P*x* entails if S*x* were the case, then M*x* would be the case.

The conjunction of (A) and (B) yields a biconditional that is the so-called conditional analysis of dispositions:

(CA) P is a dispositional property if and only if for some S and M, and for all x:

P*x* entails if S*x* were the case, then M*x* would be the case.

3 A contest

Hugh Mellor argues that the ascription of triangularity does entail a subjunctive conditional, and hence that (S) is false for triangularity (and so (A) cannot be employed to show that triangularity is non-dispositional) (Mellor 1974). If his claim can be made to stick, then Mellor's argument may be used by the dispositional monist against the attack based on structural properties. In rooting for Mellor the dispositional monist will decry his opponent in the ensuing debate, Elizabeth Prior (1982), who argues that Mellor's alleged

entailment does not hold Elizabeth Prior (1982). (It should be pointed out that Mellor's aim is not to defend dispositional monism; rather it is to undermine the prejudice against dispositions that says they are not real or that if they are real that is only because they are identical to or supported by a basis composed entirely of categorical properties. As we shall see, Mellor's aim does not entail dispositional monism; but it is congenial to it. Prior is herself a dualist but a hierarchical one – categorical properties form the causal basis for dispositional properties.)

In what follows I shall see where this debate leads. Ultimately, I shall argue, it shows how a dispositional monist can indeed mount a satisfactory defence and can account for structural properties – although not in quite the way initially suggested by Mellor. This is an outcome with which the dispositional monist can be happy, since structural properties are prima facie a counter-example to their position. However, I will not be arguing here that structural properties *must* be accounted for as dispositions. In that sense the outcome will be a draw, in that both the dispositionalist and the categoricalist have, as far as the debate surrounding their relation to conditionals is concerned, satisfactory accounts of structural properties.

4 Dispositions and conditionals

However, before we look at that debate, we need to note that success for Mellor is, as it stands, not after all even a necessary condition for the truth of dispositional monism. Nor, for that matter, is it a sufficient condition on a successful dispositional account of structural properties. Success would be both and necessary and a sufficient condition on showing that structural properties are dispositional if the conditional analysis were true. But the conditional analysis is false – in both directions of the biconditional in (CA).

Given (A), success for Mellor is necessary for the truth of dispositional monism in this sense. There must be some conditional entailed by '*x* is triangular'; if there is not, triangularity is a counter-example. (Of course, Mellor's particular conditional might not be the right one – we shall return to this.) But if (A) is false, then the non-existence of such a conditional will not show that triangularity is non-dispositional. And (A) is indeed false, as is shown by the possibility of finks and antidotes (Martin 1994; Lewis 1997; Bird 1998).

Finkish dispositions are those which cease to exist upon the instantiation of the disposition's characteristic stimulus. Since the disposition ceases to exist, the manifestation is not brought about. So at some time when there is no stimulus event, the disposition exists. But the counterfactual 'were the stimulus to occur, the manifestation would follow' is not true. Lewis (1997) gives the following example. A sorcerer wants to protect a favourite but very fragile vase from breaking. His method of protection is to cast a spell that almost instantaneously changes the structure and material of the vase in such a way that it is no longer fragile, whenever (but only when) it is struck, dropped, etc. So the vase will not break when struck even though it is very fragile. Finks

operate by changing the disposition (or its intrinsic causal basis). But a disposition may depend for its characteristic functioning not only on the causal base that is intrinsic to its possessor but also upon properties of the environment; it may depend upon properties of the possessor of the disposition that are not part of the disposition's causal basis (such as properties acquired after the possessor has received the stimulus of the disposition – an example will make this clear shortly). An *antidote* works so as to interfere with the role of these other properties in the operation of the disposition (Bird 1998). An antidote to a poison may work either by changing the patient's physiology so that the poison cannot do the damage it normally does, or by repairing the damage done before it can result in illness or death. In such cases the antidote to the poison is an antidote in my sense, since it changes the environmental conditions required for the poison to do harm. An antidote to a poison might also work by reacting with the poison before it can affect the patient. In which case the poison's disposition to cause illness or death is a finkish one, and the antidote is not strictly an antidote in my sense. When a disposition receives its normal stimulus but in the presence of an antidote, the normal manifestation will fail to occur. Hence we have a disposition without the corresponding conditional. Changing Lewis's example, the sorcerer might alternatively decide to protect his vase by instructing a demon to repair any cracks that appear in the vase at lightening speed. So although striking the vase leads to cracks appearing in the vase as normal, these are repaired before they can join up, so preventing the vase from breaking. The normal functioning of fragility in causing breaking requires the cracks, which are properties of the vase, to remain; the antidote in this case works by changing properties of the possessor (rather than of the environment) that are brought about by the stimulus.

So it looks as if finks and antidotes make life more comfortable for the dispositional monist. By showing (A) to be false they seem to undermine the possibility of counter-examples before they get off the ground. On the other hand, showing that '*x* is triangular' does entail a conditional is not sufficient [*pace* (B)] to prove the dispositional monist right, for two reasons. The first reason mirrors the problem of finks and antidotes. Parallel arguments show the falsity of (B).[4] Finkishness can operate in reverse, so that an event S causes a disposition to come into existence and to yield its manifestation M. So, just before that event, the conditional 'if S were to occur, then M would occur' is true, but at that moment there is no disposition. Similarly, environmental conditions can conspire to make a conditional true without there being any disposition in the offing; this is a *mimic*.[5] A trivial case of this concerns any two actual facts *p* and *q*. According to Lewis 'if *p* were true, then *q* would be true' is true. But we do not think that any two actual facts are conjoined dispositionally. Mimics and reverse finkishness are counter-examples to the equivalence of dispositional statements and counterfactual or subjunctive conditionals, because they show that the conditional does not entail the existence of the disposition.

The second reason why success for Mellor does not entail the dispositionalist view is rather different. The categoricalist *can* endorse the claim that *some* statements asserting the instantiation of a non-dispositional property do entail a conditional. The categoricalist acknowledges that there are dispositional property terms, such as 'elastic', 'irascible' and so forth. The meanings of these terms, says the categoricalist, may well be conveyed by subjunctive conditionals. Hence there might well be some conditional C such that '*x* is elastic' entails C. But that will not show that the property we call 'elasticity' is essentially dispositional. The categoricalist view of dispositions is that elasticity is the name given to a certain categorical property complex in virtue of the fact that, in this world, with this world's laws, that property causes its possessor to stretch, temporarily, rather than break or deform permanently, when subjected to a moderate force. That is consistent with its being the case that the same property complex would not have that effect in a world with different laws. Putting things another way, the categorical monist can be happy with the thought that there are two kinds of predicate, categorical and dispositional, and that the difference between them turns on whether there is an analytical relationship between the predicate and a subjunctive conditional.

5 Rules of the contest

Should the conclusion of the previous section be that the truth of subjunctive conditionals is a red herring as regards dispositionality? No, I think not – but we should be careful. There is, as Charlie Martin (1994) has said, clearly some sort of connection between dispositions and conditionals, even if it is not one of straightforward entailment (Armstrong *et al*. 1996: 178). So we can still follow the debate, only we must umpire the debate by forbidding moves that exploit the differences between conditionals and dispositions discussed above. One side in the contest seeks to show that a property is dispositional by showing that it possesses an intimate link (that falls short of outright entailment) to a characteristic conditional; the other side will deny such a link. The contest is governed by two rules:

Rule 1: Any link established between a property and a conditional must be a metaphysical rather than a merely analytic one.

Rule 2: The existence of a link between a property and a conditional may not be refuted by appeal to finks or antidotes (or established by appeal to finks or mimics).[6]

With these rules in place and with careful umpiring to see that they are respected, we may still have an informative debate centred on the existence or otherwise of a relation between properties and conditionals.

6 Let the games commence …

The challenge to the dispositional monist is the claim that geometrical shape entails nothing as regards counterfactual or subjunctive conditionals. There is no C, it is asserted, such that C is a genuine, non-trivial, modal conditional and '*x* is triangular' entails C. Mellor states that there is just such a C. His candidate is 'if someone were to count *x*'s corners correctly, then the result would be three' which, he says, is entailed by '*x* is triangular'. Hence triangularity is at least no proven counter-example to dispositional monism – and (S) is false for triangularity. And to the extent that (B) can be relied upon, triangularity is shown to be dispositional.

The subsequent debate hinged on the interpretation of 'correctly'. Prior held that Mellor's claim acquired prima facie plausibility only because of the use of this word. For without it we would see that the entailment does not hold – people frequently count things and get the wrong answer. More significantly, we are entitled to consider another possible world in which the laws of nature are different so that its inhabitants make systematic errors in counting. (Prior suggests perceptual errors, but one could imagine deeper neurophysiological interference also.) The inclusion of 'correctly' is significant because it seems to rule out such cases. But, says, Prior, it does so only because we take the claim that a task was carried out 'correctly' as meaning that it was performed successfully, that it got the right result. Since it is analytical that triangles have three corners, it is also analytical that someone who counts the corners of a triangle correctly gets the answer three. And so the entailment does not seem to reflect the metaphysics of the property of being a triangle. Rather it depends only on analytic relations and so Mellor's argument falls foul of Rule 1.

Prior (1982) notes that Mellor states in a footnote that 'correctly' is intended to refer not to the result of counting but rather to the manner of counting. But she thinks that if this is so, then the entailment fails, since if it is only the manner of counting that is invoked, then counting in the unusual world with systematic error may be carried out in the correct manner without getting the correct result.

Prior has a second argument that invokes a different unusual world, in which the laws of nature are such that when one starts to count the corners or a triangular object, the object is caused to change the number of corners it has. Hence, if one counts as well as one can one will get an answer other than three.

What defence has Mellor against these two objections? He does not address the second. But he does not need to. The umpire rules out this objection as a foul – it is a clear contravention of Rule 2, since in the world considered, triangularity is finkish, in that the stimulus, counting, causes an object to lose its triangularity. As regards the first objection, here the accusation is that it is Mellor who has broken the rules.

Mellor responds that he can spell out precisely what counting correctly is without referring to the correctness of the result: it is to count the items in

question once each (and once only), which is to put them in a '1–1 correspondence with an initial segment of the sequence of positive integers 1, 2, 3 … The highest number in the segment is the result of the counting' (Mellor 1982: 97). Does this reply block Prior's appeal to Rule 1?

Let us compare '*x* is even', which entails 'if *x* were to be divided by 2, then the result would be an integer'. On one understanding, where dividing is understood as an abstract mathematical operation, this is clearly true. Does this make 'being even' a dispositional property? If so, it would be difficult to deny that being triangular or any other property is dispositional. If Mellor's claim is understood analogously, with 'counting correctly' taken to be an abstract mathematical operation, it might well be regarded as analytically trivial, and so outlawed by Rule 1. It is analytic that the set of corners of any triangle has three members. It is analytical that when any three membered set is put into 1–1 correspondence with an initial segment of the positive integers, the highest number in the segment is three. So Mellor's entailment is analytic. But is it *merely* analytic?

We need a test for the application of Rule 1, a test that distinguishes a merely analytic entailment from one that reflects the metaphysics of the entities involved. The test is this: if the entailment is not merely analytical it should continue to hold when we employ any rigid designator to pick out the entity in question. So 'S is the inventor of bifocals *entails* S invented bifocals' is a merely analytical entailment, since 'S is Benjamin Franklin' does not entail 'S invented bifocals'. While even if one thought that being H_2O is part of the definition of water, '*x* is water *entails x* is H_2O' would not be merely analytical, since, for example, '*x* is that substance which, in the actual world, is the main component of living things on earth *entails x* is H_2O' is also true (but not analytical).

By this test Mellor's entailment will not come out as merely analytical, since for any rigid designator 'D' that picks out the property of triangularity, '*x* is D' entails 'if someone were to count *x*'s corners correctly, then the result would be three' (where 'counting correctly' is still understood abstractly). Yet we should note that the efficacy of the test depends on the difference in modal properties between definite descriptions and rigid designators. But there is no such difference between mathematical definite descriptions and corresponding rigid designators. So the test does not seem to applicable here, and it is not clear that Mellor's entailment does not infringe Rule 1.

However, a different reason for dismissing Mellor's claim, on this understanding, is that it is in conflict with the thought that the stimulus of a disposition is a cause of the manifestation – dropping the fragile vase *caused* it to break, pulling the elastic *caused* it to stretch, and so forth. Although this is contentious in the eyes of some, we could add a third rule. Rule 3 would state that there must be a causal or nomic connection between the antecedent of the conditional and its consequent. Mellor's claim would outlawed by Rule 3 on the mathematical interpretation.

On the other hand, we might understand the dividing as an intellectual,

psychological operation, not as an abstract mathematical one. This allows the stimulus (i.e. dividing) to cause the manifestation (getting an integer as the answer). If we regard the process of counting the corners of the triangle in this way, then Mellor's claim looks to be a substantial one. However, we might then ask, can we be sure that his entailment holds under this interpretation? Someone batting for Prior's team could argue as follows that it does not. For now there is a gap between the fact of the corners of the triangle having been correlated with the set of numbers {1, 2, 3} and the fact of the subject's being in the mental state of getting the answer three. In normal cases this gap is traversed without difficulty. But in unusual cases it need not be. Where environmental conditions or the laws of neurophysiology are different, the counting may have been carried out correctly, the appropriate correlations having been made, yet the answer achieved is a number other than three. For example, we may imagine a 'killer triangle' whose particular size and angles interact with a subject's neurophysiology to kill them or to cause mental aberration. More directly, we could take the case of a triangle painted killer yellow.

Hence, the conditional is not entailed by the ascription of triangularity. However, this does not prove that Prior is right. We already know that in general disposition ascriptions do *not* entail the corresponding conditional, because of finks and antidotes. We saw Prior's case of a world where triangles ceased to be triangles when counting began is an invocation of a fink. The cases considered in the previous paragraph do not invoke finks (the triangles remain the same), but they do involve antidotes, since they interfere with the normal operation of the stimulus. Hence Prior's moves break Rule 2 again.

As we shall see, the debate is by no means concluded. Nonetheless, after the first innings it looks as if Mellor has the upper hand, just, and that triangularity is no less related to its conditional than dispositions in general are related to theirs.

7 Will the real disposition please stand up?

Even so, there is still all to play for. The problem next bowled at Mellor is the thought that although the entailment discussed seems to indicate a disposition, it is not, on reflection, clear that the disposition lies with the triangle rather than the counter. Consider the following:

> x is a normal observer *entails* if x were to count the corners of a triangle correctly then x would get the answer three.

Modulo finks and antidotes, this seems to be true. Given the link between dispositions and conditionals upon which we have been trading, this suggests that being a normal observer is dispositional, which is plausible enough. Note however that this entailment is equivalent to Mellor's entailment, if finks are excluded. So it look as if we have two dispositions for the price of one. Which is the real disposition?

That said, it is not clear that we have to choose between the two dispositions. Indeed, it might be perfectly correct to accept both. Martin (Armstrong *et al*. 1996: 135–6) has pointed out that dispositions frequently come in pairs of reciprocal disposition partners. The negatively charged electron is disposed to attract the positively charged proton; the proton is disposed to be attracted to the electron (and also to attract the electron towards it). In fact our discussion suggests that dispositions might always come in reciprocal pairs. For the following are, in general, equivalent (again in the absence of finks):

X *entails* were it the case that Y, then Z would be the case; and

Y *entails* were it the case that X, then Z would be the case.[7]

So it seems too hasty, simply because there is dispositionality in the subject (the counter), to exclude triangularity from genuine dispositionality. However, the resulting position remains unsatisfactory from the points of view of both the categoricalist and the dispositional monist. On the one hand the dispositional reciprocity between the triangle and the observer that is suggested by Mellor's account makes triangularity look like a secondary property, akin to a colour. But there is a clear disanalogy between structural properties like triangularity and secondary properties like colour, in that the latter have an explanatory role only in a limited portion of science, primarily the behavioural sciences. That is as it should be, since the manifestations of colours and all other secondary properties are the mental states of sentient observers. Yet structural properties play a role at the most general and basic level in science. And their doing so is independent of any power to produce effects in human observers. This does not show but does suggest that the reciprocity between triangle and observer is one sided, that the dispositionality comes primarily or even completely from the observer and not from the triangle.

On the other hand, the same line of reasoning will suggest to the dispositional monist that Mellor has not shown which disposition triangularity is. The existence of a property may be related to all sorts of conditionals. But not all of them reflect the nature of that property. In this case the conditional in question seems to make being triangular a secondary property, a property whose nature is to be a disposition to cause a certain effect in a human observer. One can deny that triangularity is a secondary property without asserting that it is a categorical (primary) property. Perhaps it should be understood as a genuinely tertiary property, one that is a disposition which is manifested not in human subjects especially but in some other, broader, class of entities, a class specifiable at a more general level in science.

In so far as we are still employing subjunctive conditionals as a sign of dispositionality, we should look for a conditional that reflects the nature of the (alleged) disposition, and a sign of this will be that the stimulus and manifestation reflect the role of the property in scientific explanation. In effect, both sides should accept this as Rule 4. Triangles may exist in pretty well any

possible world that has a physical component. It would be odd, if triangularity is a dispositional property, that it should be one whose dispositional nature, if it can be specified, is specifiable only in terms of entities (things that can count) that exist at a very limited range of possible worlds. Rule 4 says that if triangularity is to be shown to be genuinely dispositional, we should look for a conditional characterization that has appropriate generality.

8 Properties and geometries

I believe that there are conditionals for structural properties that come much closer to obeying Rule 4 than Mellor's. For example, the following:

> if two entities travelling at constant speed were simultaneously emitted from A, one along the line AC, and the other along the line AB where it is then reflected from B along the line BC, the former will reach C first.

is a conditional that, at first sight, seems to be entailed, barring finks and antidotes, by the proposition that ABC is an triangle.

The problem with this proposal is that the entailment suggested does not hold after all. The conditional is true in worlds where the geometry of space is Euclidean, but may not hold in worlds where the geometry is, for example, Riemannian. But that suggests a position for the dispositionalist. What the latter will hold true is (again barring finks and antidotes):

> ABC is an Euclidean triangle
>
> *entails*
>
> if two entities travelling at constant speed were simultaneously emitted from A, one along the line AC, and the other along the line AB where it is then reflected from B along the line BC, the former will reach C first.

Different subjunctive conditionals will be made true by Riemannian triangles, and triangles in Lobatchevsky–Bolyai geometry, and other kinds of geometry. So we have lots of different kinds of triangle property, each of which is dispositional. Space in Riemannian geometry has uniform positive curvature, whereas in Lobatchevsky–Bolyai geometry it has uniform negative curvature; strictly, we might expect a different property of triangularity for each degree of curvature.

So what of triangularity in general? What sort of property is that? Is it dispositional? The dispositionalist will deny that it is a dispositional property. It may nonetheless be a property in some acceptable but more general sense of 'property'. The dispositionalist is not required to account for everything we call a property. Rather, the dispositionalist is required only to account for *sparse*

properties. Abundant properties, which correspond (more or less) to predicates, form a much wider class that will include non-dispositional properties. So the dispositionalist's position will be that whereas 'being a Euclidean triangle', 'being a Riemannian triangle, with curvature *r*' and so forth may denote sparse properties, 'being a triangle' denotes only an abundant property. 'Being a triangle' is a generalization of the specific, sparse triangularity properties. Since the different triangularity properties do not have any dispositional powers in common, 'being a triangle' is not a dispositional property and no characteristic subjunctive conditionals are entailed by the fact of possessing it. This is no challenge to the dispositional monist, since there is no reason to take the general property of triangularity to be a sparse property.

We might bypass the question of whether any triangularity property, general or specific, is really a sparse property, by asking about the dispositionality of spacetime itself. Clearly the possibility of an explanation that invokes *x*'s triangularity supervenes on the spatio-temporal arrangements of *x*'s parts. This does not show that the supervening property is not a genuine sparse property. But if we were content that the subvening properties are all dispositional, we need not exercise ourselves so greatly over the status of the supervening ones. The set-up that is often invoked as exemplifying categorical but not dispositional properties is a set of masses arrayed in space–time. The lesson of general relativity is just that we may see the components of this set-up as dispositional. Each space–time point is characterized by its dynamic properties, i.e. its disposition to affect the kinetic properties of an object at that point, captured in the gravitational field tensor at that point. The mass of each object is its disposition to change the curvature of space–time, that is to change the dynamic properties of each space–time point.[8] Hence all the relevant explanatory properties in this set-up may be characterized dispositionally.

Before concluding that the dispositionalist has succeeded in defending a dispositional view of structural properties, we should ensure that the entailments being appealed to do obey all the rules laid down. Rule 4 requires an appropriate level of generality. We moved our attention from Mellor's entailments to these ones precisely to achieve that. Rule 2 required that we do not appeal to finks or antidotes or mimics in refuting or establishing an entailment, and clearly we have not done that. Rule 3 required that there be a causal connection between the antecedent of the conditional and its consequent. In this case that would require the transmission of the two entities along different paths to be a cause of their arriving at different times. Although not indisputable this does seem a defensible view. It is true that the claimed causal connection may well be a metaphysically necessary one, but the dispositionalist has no problems one that score, as I mentioned at the outset. Rule 1 looks more contentious, since the entailment is analytic. Once again the issue is whether the entailment is *merely* analytic. We will need to apply the test of rigid designation. Let ABC be a triangle in Euclidean space. We might rigidly designate the property of ABC that we are interested in using 'D' ('D' might be 'ABC's basic geometrical shape'). Then the question is, does 'XYZ is

D' entail the appropriate conditional? That all depends upon which property is indeed designated by 'D'. Remember that it is sparse properties that we are interested in. So if 'D' designates the property of being an Euclidean triangle, then the entailment holds; but if 'D' designates the property of being a triangle in general, then the entailment does not hold. Our view on this depends on which we think the sparse property really is, and as explained that depends on whether we are dispositionalists or categoricalists. So there is no untendentious application of Rule 1 to penalize this entailment. The dispositionalist has a consistent position that is in conformity with all the rules.

9 Dispositionalism versus categoricalism

The above sketches the account that the dispositionalist should adopt when faced with the challenge of geometrical properties. Geometrical property terms as we typically use them do not always denote sparse properties. That does not, however, prevent us from using them in explanations. This is because whenever it is true that some object or collection of objects possesses the geometrical property in question, it will also be the case that the object or collection possesses some sparse geometrical property or complex of sparse geometrical properties. The sparse geometrical properties will belong to specific geometries of space–time. Correspondingly, their instantiation will entail that the appropriate geometry does govern the local structure of space–time and will entail appropriate subjunctive conditionals. What goes for geometrical properties goes for structural properties more generally.

Although this is a coherent position for the dispositionalist to adopt, one which thus defuses the challenge presented by structural properties, it does not show that dispositionalism *is* the correct story about structural properties. The conclusion of the previous section shows that the categoricalist has an equally coherent story to tell. According to the categoricalist the generic structural properties are the real sparse properties; the specific structural properties are properties compounded of a generic property plus a specification of the nature of the space in which the particular possessing the property exists. So, for example, 'x is an Euclidean triangle' is equivalent to 'x is a triangle and x exists in Euclidean space'.

In turn, this suggests that neither the dispositionalist nor the categoricalist is likely to be able to win the debate between them by pointing to particular properties or classes of property that are alleged to be explained by one side but not the other. For every story the dispositionalist can tell, the categoricalist can tell a story and vice versa. Let the dispositionalist allege that D is a property whose possession by x entails (modulo finks and antidotes) the truth of the conditional: 'were it the case that Sx then Mx'. Then it will be a law that, *ceteris paribus*, $\forall x(\mathrm{D}x \wedge \mathrm{S}x) \rightarrow \mathrm{M}x$. The dispositionalist will claim that D is a sparse property, that the entailment is metaphysical, and that L is necessary. The categoricalist can respond by saying that there is no *sparse* property D. Instead the sparse property is some categorical B where 'x is D' entails 'x is

B' and 'x is B' itself entails no conditional. The law is the contingent $\forall x(Bx \wedge Sx) \rightarrow Mx$. The proposition '$x$ is D' is analytically equivalent to 'for some categorical property B, x is B and x exists in a world where the law $\forall x(Bx \wedge Sx) \rightarrow Mx$ holds'. The entailment is thus merely analytic. Conversely, if the categoricalist points to some property B that entails no laws and conditionals, then the dispositionalist can respond that whenever B is actually instantiated by some x then x also instantiates some sparse and truly dispositional property D that does entail laws and conditionals, and it is D that does the explanatory work that the categoricalist ascribes to B.

10 Conclusion

I have presented the debate between Mellor and Prior as a contest between the attempt to prove, subject to certain conditions (Rules 1–4), that the instantiation of a structural property entails the truth of a subjunctive conditional and the attempt to prove (subject to the same conditions) that it does not. The last section shows that at the end of play we must declare a draw in this particular game. However, as I indicated in the introduction, the Mellor–Prior debate is relevant to a larger competition between dispositional monists and their opponents. In that competition, the existence of structural properties was prima facie a stiff challenge to the dispositional monist. Mellor's side, in so far as it was representing dispositional monism, was playing away from home. A victory, proving that triangularity must be understood as essentially dispositional, would have been a very good performance indeed. But a draw away from home is highly respectable. Resisting the attack that structural properties must be understood categorically is a very useful result indeed for the dispositional monist. We have seen that what looked at first to be a reason to reject dispositional monism turned out to be no compelling reason at all. There is a perfectly coherent story to be told about structural properties as dispositional. Dispositional monism has resisted relegation and will live on to play another day.[9]

Notes

1 For details, see Bird (2001).
2 Note that in talking of 'structural' properties I am *not* intending to talk of properties as may be conceived of by structuralists of various kinds. A structuralist may maintain that all there is to some set of entities is the set of more or less formal relations between them. On such a view the essence of a property might just be its relations with other properties. This might indeed make properties dispositional, and certainly dispositional monism might be regarded as a structuralist account of properties, in that sense. But I am not begging the question in this chapter by thinking of 'structural' properties in this sense; rather, they are the properties of objects that exist in virtue of their spatial relations or in virtue of the spatial relations of their parts.
3 I return to this again briefly below.
4 Mellor (1974: 179–80) himself also rejects (B), for slightly different reasons.

5 Mimics are raised by Johnston (1992).
6 One could reformulate the conditional analysis (CA) so as to exclude finks and antidotes, and so remove the need for Rule 2. This is in effect what Mellor (2000) proposes. It is contentious whether the reformulation still constitutes an analysis. Either way it is more convenient for the following discussion, but equivalent to Mellor's proposal, to keep the simple conditional analysis and to exclude finks, antidotes and mimics via Rule 2.
7 These entailments are not equivalent *simpliciter*.
8 We can see Charlie Martin's reciprocal dispositionality, mentioned above, at work here.
9 I am grateful to Huw Price for helpful comments on a draft of this chapter.

References

Armstrong, D. M. (1997) *A World of States of Affairs*, Cambridge, UK: Cambridge University Press.

Armstrong, D. M., Martin, C. B., Place, U. T. and Crane T. (eds) (1996) *Dispositions: A Debate*, London: Routledge.

Bird, A. J. (1998) 'Dispositions and antidotes', *Philosophical Quarterly* 48: 227–34.

—— (2001) 'Necessarily, salt dissolves in water', *Analysis* 61: 267–74.

Johnston, M. (1992) 'How to speak of the colors', *Philosophical Studies* 68: 221–63.

Lewis, D. (1997) 'Finkish dispositions', *Philosophical Quarterly* 47: 143–58.

Martin, C. B. (1994) 'Dispositions and conditionals', *Philosophical Quarterly* 44: 1–8.

Mumford, S. (1998) *Dispositions*, Oxford: Oxford University Press.

Mellor, D. H. (1974) 'In defense of dispositions', *Philosophical Review* 83: 157–81.

—— (1982) 'Counting corners correctly', *Analysis* 42: 96–7.

—— (2000) 'The semantics and ontology of dispositions', *Mind* 109: 757–80.

Prior, E. (1982) 'The dispositional/categorical distinction', *Analysis* 42: 93–6.