

The metaphysics of dispositions and causes

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1.1 Introduction

In explaining what happens, we commonly use both dispositional and causal concepts. A historian might refer to the belligerent disposition of a nation-state, and use this to explain why a neighbouring state was so anxious to seek an apparently unwise alliance. A physicist might have occasion to mention the disposition of a metal to expand when heated, and use this to explain why a measurement was inaccurate when taken in abnormally hot conditions. The contexts of explanation – physics and history – are very different, but the concepts are recognisably causal and dispositional in both cases.

So philosophers of science, and epistemologists more generally, have ample reason to be interested in these concepts. What presuppositions do we bring to our causal and dispositional talk? Under what conditions might these concepts fail to explain in the way we would like them to? Are they truly universal in their application, or are they the sorts of concepts that ought to disappear once we have achieved a “mature” science?¹

Metaphysicians, also, have plenty to interest them in these concepts. What exactly are the referents of our disposition-talk and causation-talk? Should we be realists about causes and dispositions? Should that realism be tempered by a sort

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1. As Russell (1913) famously suggested was the case with respect to causation in physics.

of reductionism, or should it appeal to some kind of primitive causal or dispositional feature of the world?

In addition to the very tangible utility of dispositional and causal concepts in our empirical explanations, they are also of *philosophical* utility. When we turn to examine attempted conceptual analyses of all manner of phenomena, we frequently find causal and dispositional concepts playing a crucial role. For example, there have been attempts to analyse moral responsibility in terms of a disposition or capacity to choose in accordance with reasons.² There is a famous line of thought in the philosophy of language that attempts to analyse reference as a matter of causal links between our occurrent use of a term and the referent of that term.³ Along similar lines, there are causal theories of perception.⁴ Also, in both philosophy of language and philosophy of mind, some have thought that propositional attitudes such as belief and desire are obviously dispositional.⁵ Finally, in epistemology, causation and dispositions are neatly combined in the reliabilist approach, which analyses warrant as being *caused* by a *reliable* mechanism, where reliability is arguably a dispositional concept.⁶

So these concepts often appear together, and both are of marked importance in explaining the world around us, in both philosophical and experiential contexts.

Moreover, philosophers have used the same, or similar, analytic approaches to understanding both concepts. Most prominently, it has been tempting to try to analyse both causal concepts and dispositional concepts in terms of counterfactual conditionals. In the case of causation, the basic thought is that an effect depends counterfactually upon its cause: had the cause not occurred, the effect would not have occurred also.⁷ For dispositions, the obvious thought is that if the object bearing the disposition were to find itself in suitable triggering circumstances, a characteristic manifestation would ensue.⁸

2. E.g. M. Smith 1997, 2003.

3. This idea is strongly associated with the work of Saul Kripke, for instance, though strictly speaking Kripke eschews any attempt to give an analysis of reference (1980: 93).

4. Grice 1961.

5. This idea has its ancestry in, e.g., Ryle 1949, but is best known in works such as Putnam 1975, Lewis 1972, and Armstrong 1981.

6. Goldman 1967.

7. See Lewis 1973a for the most influential proposal on these lines.

8. Conditional analyses of dispositions have recently been championed in, for example, Lewis 1997 and

There is no consensus that such conditional analyses can succeed, for either dispositions or causation. However, it is rarely disputed that there is some sort of link between conditionals and dispositions, and between conditionals and causation. Sceptics about conditional analyses usually concede, for instance, that the truth of a certain conditional sentence may point to the instantiation of a dispositional property, a causal relation, or both.

Given that there is some rough overlap, then, between these two notions, in the sense that both seem to be interestingly related to counterfactual conditionals, there is a *prima facie* case that the two are in fact metaphysically connected. But even if we are unconvinced concerning any such hard connection, there is still the thought that we might learn methodological lessons from comparing the two types of analysis. If the analysis of causation has progressed further than the analysis of dispositions, is this because there are techniques being used in the investigation of causation which are unknown to those studying dispositions? Part of the intent of this volume is to sketch a way for those working in different traditions – especially in philosophy of science and in metaphysics – to think about dispositions and causes more ecumenically.

Characteristically in analytic philosophy, the papers collected here do not aim at any overt synthesis. A reader looking for a grand unified theory of dispositions and causation will no doubt be disappointed. But the papers are written with an eye to drawing together the discourse of different sub-disciplines, and to uncovering common themes.

In the remainder of this introduction, I shall first discuss, in Section 1.2, the *prima facie* case for accepting that dispositions and causes are deeply interrelated. In Section 1.3, I canvass some prominent ontological accounts of dispositions and causes and examine how these are connected in such theories. Finally, in Section 1.4, I briefly introduce each of the contributions to this collection, and indicate how they bear on the central themes surveyed here.

1.2 The prima facie case for interrelation

Of course, many kinds of things can be said with conditional sentences. From the mere fact that conditionals of one sort have been used in an effort to analyse dispositions, and conditionals of a similar sort have been used in an effort to analyse causation, it does not follow that the underlying mechanisms are the same in all respects.

However, there is a strong prima facie case that, at bottom, if there are natural necessities of any kind in the world, they are all to be understood as grounded in the same species of basic fact. Both causation and dispositions do seem to be concerned with some kind of natural necessity. Given the cause, the effect *must* happen – or at least must have a certain non-zero probability of happening. From the disposition and the stimulus conditions (if any are required), the manifestation *must* ensue – or at least must have a certain non-zero probability of ensuing. The connection, whether between cause and effect or disposition and manifestation, is not conceptual or a priori. It seems to be the result of a natural process, whose non-occurrence is conceivable without contradiction. But it also seems that there is some substantial connection between these events, and that they are not merely juxtaposed as a matter of coincidence. Whatever this “connection” amounts to, it is plausibly the same in both sorts of case.

This is not suggested as a self-evident metaphysical truth, but rather as a hypothesis worth exploring, if only because of the attractive prospect of unification that it opens up. The explicanda appear to be similar in both cases, even if, in both, it is hard to give a robustly satisfying account of what is happening. So it may be reasonable to proceed on the assumption that the very same metaphysical apparatus are in play in both cases.

One way to mediate the required connection might be through laws of nature. Perhaps the thing which unifies dispositions and causes is that both must be backed by law. What then, are laws? We have become familiar with a number of answers to this question over recent years. Some argue for a sort of reduction of laws to facts about regularities.⁹ Others embrace a sort of non-reductivism, argu-

9. Lewis 1973b, 1983b, 1994.

ing that laws are constituted by higher-order nomic relations between properties.¹⁰ And others insist on a more primitivist account of laws.¹¹

In addition to those familiar options, however, another idea has risen dramatically to prominence in recent years: that laws are ultimately founded in the dispositional nature of basic properties. On this view, properties are essentially such as to confer certain causal powers or dispositions. A property like *being massive*, for instance, confers upon its bearers the power to resist acceleration. It also confers the power to generate gravitational forces – or to interact with the gravitational field. Because these powers are essential to the property of mass, lawlike truths, such as “masses attract in accord with the gravitational law”, are necessary rather than contingent.

Such views have gone under a variety of names. Sometimes they are referred to as dispositionalist accounts of properties, or as dispositional essentialism.¹² Others have characterised closely related views as causal structuralism, or as the causal theory of properties.¹³

The general view in question is – at least in its usual formulations – at odds with Humean claims about the irreality of necessary connections. Many take this to be a very serious drawback. Others consider it to be solidly backed by empirical discoveries. Non-locality in quantum mechanics, for instance, might be thought clearly to demonstrate that there are necessary connections spanning distinct spatiotemporal regions, so a Humean denial of necessary connections cannot be correct.¹⁴

This dispute aside, the causal theory of properties seems to suggest that the phenomena of causation and at least some low-level dispositional properties share the same ultimate ground: the essentially power-conferring nature of the basic properties.¹⁵ That said, no causal structuralist has gone very far towards advanc-

10. Armstrong 1978, 1983; Dretske 1977; Tooley 1977, 1987.

11. Carroll 1994.

12. Ellis and Lierse (1994) use the latter term for their position. Armstrong (1997) eschews such a view, but when criticising it calls it a “dispositionalist” account.

13. For causal structuralism, see Hawthorne 2001. For the causal theory of properties, see Shoemaker 1980, 1998.

14. See Loewer 1996 where this point is raised and the Humean claim reformulated to accommodate quantum entangled states.

15. This hoped-for unification has perhaps been most tantalizingly discussed in George Molnar’s

ing a detailed theory of causation, explicating it in terms of basic properties that are essentially power-conferring. So it is yet to be seen whether the wished-for unification of causation and dispositions in the metaphysics of properties can be achieved.

1.2.1 *Finks, masks, preemption, and other nuisances*

There is another notable reason to think that an attempt to understand dispositions in terms of causes, or vice versa, might be useful. The sorts of counterexamples which have proved most problematic for an analysis of dispositions in terms of counterfactuals appear deeply similar to the counterexamples that have dogged the counterfactual analysis of causation.

For dispositions, the paradigm counterexamples involve the manifestation failing to ensue despite the occurrence of the usual stimulus event, for one of two reasons: first, something might interfere with the causal process that normally connects stimulus and manifestation; or secondly, something might opportunely intervene to nullify the causal basis of the disposition, before it can be manifest. The first type of counterexample, known as a mask or an antidote, can be identified in many familiar phenomena of everyday life.¹⁶ My pot plant is disposed to dry out if left in the sun. The attempted analysis in terms of a counterfactual would be:

Were this pot plant left in the sun, it would dry out.

As it happens, the pot plant *is* left in the sun, but I *mask* this disposition by diligently watering it. So the antecedent is true, but the consequent is false. Nonetheless, the plant still has the disposition.

The second type of counterexample is known as a fink.¹⁷ Suppose a man is disposed to become violent when he is drunk. Knowing this fact, his companion slips a sedative into his beer. When sedated, he will lose the disposition to become violent when drunk. The sedative, moreover, will sedate the man more quickly than the alcohol will make him drunk. Before drinking, then, the man has the

posthumously published work, *Powers* (2003).

16. Masks and antidotes are discussed in Bird 1998, Choi 2003, and Johnston 1992.

17. The idea of a finkish disposition is due to C. B. Martin (1994). An important later article on the topic is Lewis 1997.

disposition to become violent when drunk. But if he does become drunk – by drinking the beer – then he will first become sedated, and lose the disposition. The stimulus condition will occur, but the manifestation will not. In such a case any simple conditional analysis must fail.

There are, of course, many efforts to overcome these and other problem cases in the literature. My aim here is not to survey the range of such attempts, but to draw out the structural similarity between cases of these sorts and cases of the sorts that trouble counterfactual theories of causation.

There is a large variety of counterexamples to *any* attempted analysis of causation, and a corresponding array of ingenious proposals for defusing them. At the risk of falling into hasty generalisation, however, it seems safe to say that the most recalcitrant sort of counterexample – at least for counterfactual analyses – is the case of *late preemption*.¹⁸ A well-worn example involves two children throwing rocks at a bottle. Both children throw with perfect accuracy. Billy, however, throws more slowly than Suzy. Suzy's rock hits and smashes the bottle. Obviously, Suzy's throw is the cause of the bottle smashing. However, a simple counterfactual analysis of causation would say that Suzy's throw is a cause if and only if:

- (1) Had Suzy's throw not occurred, the bottle would not have smashed.

And this counterfactual is clearly false. The bottle would still have smashed, because Billy's rock would have done the job.

Now recall the case of masking that I put forward earlier. Unlike a preemption case such as we have just seen, in which the effect could have come about one way but in fact came about another way, the story of the pot plant is better described as a case of *intervention*. In order to stop the manifestation – a dry plant – coming about, I intervened in the causal process to obtain a preferable result. Similarly in cases of finkish dispositions: we cannot assimilate these to the paradigm of preemption, because the finkishness means that a *different* effect comes about. So there is no obvious way to analyse cases of finkish or masked dispositions in terms of preemption.

On the other hand, at a stretch, it appears possible to identify masking in cases

18. Also known as “late cutting”. See Lewis 1973a: 200–7 and Menzies 1989.

of preemption.¹⁹ Consider the system involving Suzy's rock and the bottle. The counterfactual which was false of this system, but which conveys the basic idea of causal dependence, is (1), above. Now suppose we were to try and associate that counterfactual with a disposition. We get the strange-sounding ascription "The system involving Suzy's rock and the bottle is disposed to leave the bottle unbroken, if Suzy's rock is not thrown". Though the locution is awkward, this does seem like a plausible ascription of a disposition to the system. Certainly, the disposition is not a fundamental one, but it is no less real for that.

Billy's rock, then, represents a sort of mask for this disposition of the system. If you were to try to manifest the disposition – by asking Suzy not to throw her rock – the bottle would still smash. Billy's rock interferes with the causal processes by which the disposition would otherwise become manifest.

Such considerations strengthen the case for taking dispositions and causes to be somehow deeply interconnected. When you try to understand dispositions in terms of counterfactuals, you run into problems. When you try to understand causation in terms of counterfactuals, you also run into problems. Moreover, the problems seem to be of the same genus. A reasonable heuristic assumption, therefore, is that a correct understanding of dispositions would shed light upon the nature of causation, and vice versa.

1.3 Prominent accounts in the literature

Let us consider, then, the relations between causation and dispositions in a few prominent metaphysical theories.

1.3.1 Lewis

1.3.1.1 Lewis on causation

For David Lewis, causation is – in its most basic incarnation – a relation of *influence* between distinct events.²⁰ *C* influences *E* if and only if a relation of counter-

19. This idea has been put forward by Stephen Yablo, in an unpublished paper, "Causation as a disposition to lose E on losing C", presented at the Dispositions and Causes Conference, University of Bristol, 2005.

20. Lewis's mature position is propounded in Lewis 2000. That paper represents the culmination of a program begun in his earlier, seminal paper, "Causation" (Lewis 1973a). Descendants of the preemp-

factual dependence exists between them. The counterfactual dependence may be any of the following species:

- *How* E occurs might depend on how C occurs. (Had the cause happened differently, the effect would have happened differently.)
- *When* E occurs might depend on when C occurs. (Had the cause happened earlier or later, the effect would have happened earlier or later.)
- *Whether* E occurs might depend on whether C occurs. (Had the cause not happened the effect would not have happened.)

And in addition to these there may be hybrid forms of dependence: whether the effect occurs might depend on when the cause occurred, etc. To illustrate: whether and when conception occurs depends – among other things – on when, whether, and how copulation occurred. So there is a multifarious relation of causal influence between copulation and conception.

For Lewis, then, facts about causal influence depend upon facts about counterfactuals. Counterfactuals in turn are analysed in terms of laws of nature: but more about these later.

1.3.1.2 *Lewis on dispositions*

Lewis's analysis of dispositions (1997) runs as follows:

- (2) x is disposed to give response R to stimulus S if and only if, for some intrinsic property B possessed by x , if x were exposed to S and were to retain B for an appropriate interval, x 's being B would be an x -complete cause of x being R .

The essential idea here is that, to have a disposition, an object must be such that it would manifest the response if exposed to the stimulus. In addition, this manifestation must ensue in virtue of an intrinsic property B which the disposition-bearer possesses. Finally, this idea of “in virtue of” is captured

tion problem mentioned above still afflict Lewis's later position Schaffer 2001.

by the thought that x 's being B is an x -complete cause of the manifestation. x -completeness simply captures the idea that no other intrinsic properties of x are required for the manifestation to occur.

Obviously, the account involves counterfactuals. Moreover, it involves counterfactual claims about causation. An egg is disposed to break if struck because it has an intrinsic property which, if the egg were struck, *would cause* the egg to break.

A full understanding of Lewis's metaphysics of dispositions and causation, therefore, requires a close look at the analysis of counterfactuals.

1.3.1.3 *Lewis on counterfactuals*

Lewis is well known for championing a possible-worlds semantics for counterfactuals.²¹ Possible worlds are – at least at first blush – theoretical devices used for the semantics of modal languages.²² Something is necessary if true in all possible worlds, and contingent if true in some, but not all, possible worlds.

Lewis argued that if we were to define a suitable metric of similarity between worlds, which we may call loosely “closeness”, we could analyse the counterfactual locution “Had it been that A , it would have been that C ” as follows:

- (3) The closest worlds where A is true are all worlds where C is true.

So a counterfactual such as “had I eaten eggs for breakfast, I would not have been so hungry at lunchtime” is true if the closest possible worlds in which I ate eggs for breakfast are all worlds in which I am not so hungry at lunchtime.

What makes for closeness of worlds? The details need not detain us here. The crucial point for our purposes is that the laws of nature play a very large (though not exclusive) role in determining closeness. Worlds with the same or similar laws are *ipso facto* very close. When evaluating a counterfactual like that above, we do not consider the possibility that in addition to eating eggs for breakfast, the laws of nature might have been very different, such that egg-eating induces enormous

21. See especially his 1973b and 1979.

22. I shall set aside the issue of the ontological status of possible worlds. See Lewis 1986b for his notorious defence of realism about possible worlds.

hunger. A world like that is exorbitantly far from the actual world, and so is irrelevant to the truth of the counterfactual.²³

Thinking back to the sorts of counterfactuals that must be true for a thing to have a disposition, these counterfactuals evidently must be backed by laws of nature. The fragile egg that will break if struck must have this disposition in virtue of its intrinsic properties, but also in virtue of suitable laws of nature that dictate how things with the properties of eggs respond to being stressed. It is ultimately because these laws obtain that the counterfactuals are true.

And much the same can be said about all cases of causation. It is because certain laws obtain that the right sorts of counterfactuals are true, and hence that certain pairs of events are related as cause and effect. It is in virtue of all manner of laws governing chemical and biological events that whether conception occurs depends on when and whether copulation occurs: so that relation of causal dependency itself depends on laws, as do all causal relations.

1.3.1.4 *Lewis on laws*

What then, are these crucially important laws? It is here that Lewis's neo-Humeanism become most evident. Laws of nature, for Lewis, are truths that play a central role in the best systematization of all contingent facts. The best systematization is one that is achieved using an appropriate language,²⁴ which is deductively closed and axiomatized, and which has an optimal trade-off between simplicity and strength (or optimal information content, in other words). The laws are simply the theorems of the best system established by such means.²⁵

23. But why think that in a world similar to this, except that I eat eggs for breakfast, there would be any difference in what happens at lunchtime? Surely a difference in what happens at lunchtime is itself going to count against the closeness of the worlds. A world where I eat eggs at breakfast, but thereafter everything is just as it is in the actual world, would surely be the closest one could get?

Not so, for it would – claims Lewis – wreak havoc with the laws to make the history of the world “reconverge” to the actual history, after a divergence such as egg-eating. So the divergence from actual events necessary to bring about an egg-eating can be achieved by a relatively minor violation of physical law, but it would require a much more significant violation of physical law to bring about a reconvergence to actual events. These issues are broached in Lewis 1973b: 75–7, but significantly developed in Lewis 1979. It should be noted that this account has been criticised as insupportable on our current understanding of physical laws (Price 1996: 148–52, Elga 2001).

24. That is, one in which all the predicates involve only natural properties (Lewis 1983b: 41–2).

25. The best-system analysis is first proposed in Lewis 1973b: 73–4. It is further refined in his 1983b: 41–3; 1980: 123–8; and 1994: 231–6.

The laws, then, ultimately *depend* upon the overall pattern of particular events. This is notably in contrast to the intuitive understanding of laws as *determining* the particular events: the Humean order of explanation reverses the intuitive order, in which the particular events depend upon the laws.

Putting concerns with the counterintuitive relationship between laws and particular events to one side, what does Lewis's account tell us about dispositions and causation? It says that both depend upon laws; and ultimately, this means that both depend upon the overall pattern of contingent events.

1.3.2 *Armstrong*

1.3.2.1 *Armstrong on laws*

For present purposes, the most salient difference between Armstrong's system and Lewis's is that Armstrong has a radically different conception of laws of nature. Armstrong's account of laws is intended to capture the intuitive order of dependency: laws of nature ultimately determining patterns among particular events.

Armstrong claims that laws are relationships, not among events themselves, but among universals (or properties – I shall not make anything of the distinction here).²⁶ An initially helpful way to grasp the profound difference this makes at the level of ontology is to consider *non-lawlike* relations between properties. Suppose pink is a prettier colour than orange. And suppose also that that every *instance* of pink is prettier than every *instance* of orange. We now have two purported facts: one about a relation between properties, the other about a relation between the instances of those properties.

- (4) Pink is a prettier colour than orange.
- (5) All instances of pink are prettier in colour than all instances of orange.

Does (4) explain (5), or does (5) explain (4)? In the case of the present example, it is probably more plausible that the fact about the instances explains the fact about the properties. But if one grants for the sake of the example that pink and orange are real and basic universals, one might expect that the explanation

26. This idea was first proposed by Armstrong in his 1978, then developed at more length in Armstrong 1983; and more recently in Armstrong 1997: chapters 15 and 16. A similar account of laws was independently advocated by Fred Dretske (1977) and Michael Tooley (1977, 1987).

runs from the universals to the instances. It is because of the relation between the colours themselves – the properties – that we observe the regularity among all of the instances.

Supposing this sort of explanation is indeed possible, one can see how a relation of lawful connection between universals might generate an attractive and powerful explanation of the connection between instances of those universals. For Armstrong, it is in precisely this fashion that a law explains its instances.

A pressing question for Armstrong is whether any of the connections he requires between universals obtain *contingently*. Quite plausibly, the sort of relation between universals suggested by (4) above is an internal relation. Given the nature of pinkness and the nature of orangeness, their relative prettiness is thereby determined. In order for these universals *not* to stand in this relation of difference in prettiness, there would need to be some change in the universals themselves. Hence it is plausible that the relation is essential to these colours, and (4) is a necessary truth. In Armstrong's own articulation of the law-making relation, however, it appears that the very same universals could stand or not in such a relation as a matter of contingent fact.

1.3.2.2 *Armstrong on dispositions*

For Armstrong, like Lewis, dispositions depend upon laws. Roughly, for something x to be disposed to R when S , is just for x to have some property ϕ and for there to be a law that all « ϕ & S »-things are caused to manifest R .²⁷

Armstrong's laws, like Lewis's, can be said to "support" counterfactual reasoning; and laws like this are enough to ensure something like a conditional analysis of dispositions. (Armstrong, though, is not committed to the success of any such conditional analysis.)

27. Armstrong has also made much of an objection to accounts of dispositions which do not reduce them to categorical properties and laws. See Armstrong 1997: 79. For recent responses, see Bird 2005b, Handfield 2005.

1.3.2.3 *Armstrong on causation*

Standard causation, for Armstrong, is simply lawlike connection between properties, manifest in individual instances of those properties.²⁸ For example, suppose it is a law that salt dissolves in water. Whenever an instance of this dissolution occurs, there is a token of the lawlike relation between two complex properties: the property instantiated when solid salt is immersed in water and the property instantiated when salt is dissolved in water. This token relation just is an instance of causation.²⁹

So wherever laws are at work – at least in typical cases – there will be causation. Recall that dispositions are always backed by suitable causal laws: dispositions, then, involve causation whenever they are manifest. And causation and dispositions are intimately related through the common root of laws.

Putting aside differences over the fundamental metaphysics of laws, we can see a striking convergence between Armstrong and Lewis in this regard. They agree that the manifestation of dispositions involves causation, and that both dispositions and causation ultimately depend on more basic laws of nature.

1.3.3 *Dispositionalism*

In canvassing a third, dispositionalist account of dispositions and causes, I am reluctant to use a single author as an exemplar. For the breadth of vision evident in his work, Brian Ellis certainly stands out as the obvious candidate.³⁰ But there are two reasons for hesitating to conduct the discussion solely in terms of Ellis's work. First, given the apparent recent increase in interest in dispositionalism, there are a number of card-carrying dispositionalists in the market; but the differences between their theories are not yet clearly established, and it is not clear how tight a family they will form. Secondly, Ellis's theory has a number of features which I take to be inessential for our purposes here. In much the same way as I disregarded Lewis's modal realism, and ignored the debate between Armstrong and Lewis over the standing of universals, I wish here to avoid controversies over the existence of natural kinds, and over the need to embrace an all-pervasive essentialism of the

28. Singular causation is also possible, but need not concern us here. See 1997: chap. 14.

29. Armstrong 1997: 218–9.

30. Ellis 1999, 2001, 2002; Ellis and Lierse 1994.

sort that Ellis favours. I am not persuaded, however, that this sort of separation can be neatly effected without doing some injustice to Ellis's views, so I propose not to take the risk.

1.3.3.1 *Dispositionalism on dispositions and laws*

An important alternative to the views of Lewis and Armstrong is to suppose that the basic properties – what are frequently referred to as *natural properties* – are themselves essentially dispositional. That is, the properties which would be mentioned in a complete and ideal physical theory, including perhaps such familiar properties as mass and charge, are themselves essentially power-conferring properties. Necessarily, things which instantiate these properties would *thereby* have certain powers. For instance, mass confers the power to resist acceleration, and also the power to attract other masses in accordance with gravitational laws.

This view entails that there is a special sub-class of dispositions – those associated with the natural properties – whose members are fundamental and irreducible. These dispositions are not analysable or reducible in terms of facts about laws and non-dispositional properties. Rather, it is simply the nature of these properties to be dispositional.

Other dispositions – those which do not seem to be relatively fundamental, but which are multiply realisable, macroscopic, and presumably reducible to something more basic – are prone to be understood by the dispositionalist in a way reminiscent of Lewis or Armstrong. These do depend upon the properties of the object which has the disposition, and the laws which govern the behaviour of those properties. This brings us, however, to the status of laws for a dispositionalist.

Dispositionalism compels its adherents to accept that at least some of the laws of nature hold necessarily – not as a matter of conceptual or logical necessity, but as an a posteriori metaphysical necessity.³¹ This is because if mass (for instance) is essentially such as to confer the power to resist acceleration, then a statement asserting that things with mass resist acceleration is a necessary truth. So laws such as ' $F = ma$ ', which we may take to be describing with more precision the disposition of masses to resist acceleration, are similarly necessary.

31. See Ellis 2001: 219–20; Molnar 2003: 199; and also, for further discussion, Bird 2005a and Bostock 2003.

But not all laws are like that. Conservation laws and symmetry principles, for instance, appear not to have a form which would license our ascribing causal powers to natural properties. So on the dispositionalist account these laws may not hold as a matter of metaphysical necessity.³²

Dispositionalism, then, radically overhauls the relationship between dispositions and laws. Instead of all dispositions depending upon contingent laws, at least some important dispositions are irreducible features of the natural properties. Moreover, the sorts of laws which are typically used to ground dispositions are – according to the dispositionalist – necessary laws: corollaries of something essential in the natural properties.

1.3.3.2 *Dispositionalism on causation*

The dispositionalist account of causation is much less developed. The broad outlines of the strategy are clear: causation ought not to depend – in Humean fashion – on contingent laws that emerge from the global pattern of events. Rather, in at least their most elementary form, causal relations must be a matter of certain powers – those which are essential to the natural properties – being manifested.

One interesting dispositionalist proposal is due to Ellis (2001: 50): he proposes that there is an essential connection between at least the most fundamental dispositional properties and *causal processes*. The thought appears to be that different types of causal processes form *natural kinds*. So the *process* of salt dissolving in water is a natural kind, in that all instances of this process share objective structural features. Ellis's suggestion is that such features are the dispositional properties which are the constitutive “grounds” of such process-kinds. Perhaps a suitable analogy here is the way in which chemical elements are the “grounds” of certain other natural chemical kinds. Just as you cannot have a protein without nitrogen, you cannot have a process of salt dissolving in water without water and salt!

While this might appear to be a triviality, it hints at ways of articulating a dispositionalist account of causation. If there is this sort of link between fundamental causal powers and causal processes, then it might be natural for a dispositionalist to explore the sort of process-based theory of causation first inspired by work

32. This point is raised in Chalmers 1999; see Ellis 2001: §7.9 for an attempted explanation. For a related point, that dispositionalists cannot account for all natural necessities, see Fine 2002.

of Russell, and developed more recently by Wesley Salmon (1984, 1998) and Phil Dowe (2000).³³ (On Salmon's account, however, a causal process itself is understood in terms of its distinctive *disposition* to "transmit a mark". So there may be a final layer of dispositionality underlying any such account.)

Whether or not such a project is fruitful, crucial issues for a dispositionalist theory of causation remain unexamined. Suppose a dispositional property becomes manifest in the following scenario: there is a certain basic property P , which confers the power to cause response R upon exposure to stimulus S . An object, x , instantiates P and is exposed to S at t_1 – call this event 'C'. Subsequently, at t_2 , x instantiates R – call this event 'E'. So we would – in normal circumstances – ascribe a causal relation to C and E .

(6) x 's being P and S at t_1 caused x 's being R at t_2 . (C caused E .)

According to a more reductionist approach to causation, like that championed by Lewis, (6) is equivalent to a certain fact about E 's being counterfactually dependent on C . That counterfactual dependence in turn depends upon laws, which themselves depend upon the global mosaic of property instantiations.

For dispositionalists, the question is how much of this Lewisian picture they *must* reject. Evidently, they can *agree* to the first step that a causal claim is equivalent to a counterfactual claim. It is in the further analysis of the counterfactual that the difference emerges. For the dispositionalist, whether or not such an analysis of the counterfactual goes via laws, it must not *terminate* in a global pattern of property instantiations. Rather, it will terminate in the essentially power-conferring natures of the basic properties. So on the sort of approach just sketched, a dispositionalist might co-opt much of the analytic work of Lewis, and his fellows in the counterfactual school of causation, but reject the Humean analysis of counterfactuals.³⁴

Another option is to reject the entire approach of analysing causation in terms of counterfactuals, and to argue – in similar vein to Armstrong – that causation

33. In Handfield 2008 I attempt to use Ellis's idea that dispositions are necessarily linked to processes to develop a theory combining some of the attractive elements of dispositionalism with the Humean commitment to avoiding necessary connections between distinct existences.

34. This sort of approach might harmonize especially neatly with that of Ann Whittle (this volume), who attempts to treat essentially power-conferring properties in a nominalist fashion, as simply being the obtaining of conditional predicates.

requires some sort of real “physical” connection between cause and effect. The obtaining of counterfactuals concerning *C* and *E* may be a reliable symptom of a case of causation, but cannot be constitutive of that causation.

On this second route, however, we encounter a time-honoured and recalcitrant question: what is this “real connection”, and how does it relate to what is essential in the natural properties? It would be an unfortunate drawback of a theory if it required both the concept of a *power* and the concept of *cause* to be analysed, ultimately, in terms of primitive ideas that cannot be brought under any common explanatory umbrella.

There is little explicit discussion of this sort of issue among dispositionalists. Certainly there is more temperamental affinity between dispositionalism and a primitivist, anti-Humean account of causation. But the matter seems to remain open.

1.3.4 *Intrinsicness*

Another important issue that emerges from the debate between dispositionalists and their opponents is whether or not dispositions are intrinsic properties, and whether or not causation is an intrinsic relation.

Despite its apparent intuitive familiarity, the correct analysis of the concept of intrinsicness has been a matter of recent debate.³⁵

Many attempts at definition suggest that an entity instantiates a property intrinsically if and only if the instantiation is *independent* of how things stand with any other distinct entities. So one way of trying to capture the idea of intrinsicness-as-independence has been to say that a property is intrinsic if and only if it is compatible with *loneliness*. That is, that a thing can have the property while being unaccompanied by any other contingently existing object.³⁶

Problems with this manner of analysis tend to arise when it is applied to properties that are unlikely to be natural – such as the property of *loneliness* itself. Obviously, loneliness is compatible with loneliness, but it is very doubtful that it is intrinsic!

35. For example, see Denby 2006; Francescotti 1999; Humberstone 1996; Langton and Lewis 1998, 2001; Lewis 1983a; Marshall and Parsons 2001; Vallentyne 1997; Weatherson 2001; Yablo 1999.

36. This manner of definition is originally due to Kim (1982), and was developed by Lewis (1983a).

An alternative strategy for defining intrinsicness, then, is to make an initial presupposition that the most metaphysically basic properties – the perfectly natural properties – are all intrinsic.³⁷ One can then define *duplicates* as objects which share all of their perfectly natural properties. And a property is intrinsic if and only if it is necessarily shared between duplicates. The property of loneliness, then, is clearly not intrinsic, because any lonely thing has a possible duplicate that is accompanied.

This approach, however, is metaphysically heavy-handed for two reasons: first, it supposes that there are *perfectly* natural properties. What if there were infinite complexity in a world, such that there were no perfectly natural properties, but rather never-ending levels of structure, leading us to ever more basic properties, without end?³⁸ Secondly, the account presupposes that all of the perfectly natural properties are intrinsic, which, though it is certainly an intuitive idea, might conflict with a dispositionalist conception of the world, as we shall see below.

Whatever approach we take to defining intrinsicness, the concept is familiar enough when applied to monadic properties. The property «being a triangle» is readily understood as intrinsic,³⁹ and «being within a metre of some triangle» as extrinsic. When we try to apply the distinction to *relations*, there are some relations that are manifestly intrinsic («has greater perimeter than»), and others that are manifestly extrinsic («has been photographed more often»). In addition, however, are so-called “external” relations, such as «is contained within» and «is one metre removed from», and it is not certain how these should be categorised. It is disputable, for instance, whether such relations are compatible with loneliness, because that will depend upon one’s metaphysical conception of space.

Having raised this difficulty with external relations, I shall put it to the side, and simply assume that external relations are intrinsic.⁴⁰ With this introduction completed, we can ask how the various theories treat dispositional properties and causal relations with respect to intrinsicness.

37. This is the strategy Lewis employed in his 1983b.

38. A possibility of which Lewis was aware, and typically anxious to accommodate. See, e.g., Lewis 1986a. For sceptics about this possibility, the argument for infinite complexity is advanced with relish in Schaffer 2003.

39. Pace Skow 2007.

40. With some precedent: see e.g. Lewis’s treatment of relations: 1986b: 62.

1.3.4.1 *Intrinsicness of dispositions*

On a Lewisian theory (as indeed on most Humean theories), all dispositional properties are extrinsic. This is because the dispositions of a thing depend upon that thing's being subject to a certain sort of law of nature, and, for Humeans, to be subject to a certain law of nature is just to be implicated in a certain global pattern of events – itself analysable as an extrinsic property.

To illustrate: a particular cigarette has the disposition to produce smoke if lit. This is in virtue of laws about how the compounds in the cigarette will react in combustion, under conditions of sufficient but not abundant oxygen, at relatively low temperatures, and so on. Whether these propositions amount to laws, however, depends upon whether or not these propositions feature in the best systematization of contingent fact.

It is possible that there be a cigarette which is a perfect duplicate of our particular one, but which exists in a world where there is little or no gaseous oxygen, and consequently where there are no events of cigarettes being lit. In such a world, it may not be a law-like truth that cigarettes produce smoke if lit. So the cigarette might lack the disposition to produce smoke, despite being intrinsically perfectly similar to actual cigarettes.

On an Armstrongian theory, it is not as easy to adjudicate whether or not dispositional properties are intrinsic. Like the Lewisian theory, having a disposition is a matter of having a property P , and that property being involved in a law such that P things give response R in circumstances S . In the simplest case, the law would have the form $N((P \ \& \ S), R)$. Being subject to such a law of nature, however, is less transparently an extrinsic property than it is on the Lewisian theory of laws.

Putting aside the question of whether dispositions themselves are intrinsic, recall that, for Armstrong, laws of nature are relations of nomic connection between properties. These relations are external. Being external, relations of nomic connection are probably best thought of as intrinsic to their relata: presumably the relata could stand in such a relation, independently of what other things exist. Consequently, fiddling with the global mosaic of property-instantiations will do nothing to change whether P , S , and R stand in this relation, and there is no prospect of generating counterintuitive consequences of the sort shown above to arise from the Lewisian account of laws.

So on the Armstrongian account, the nature of dispositions is not fully determined by how they are related to concrete particulars like events. However, it still remains possible that there be an intrinsic duplicate of some object *O* which is not subject to the same laws of nature that *O* is. This would simply be a matter of instantiating the same natural properties, but in a world where different relations of nomic connection obtain. So a thing's dispositions depend upon relations to other distinct things, and in that sense dispositions are extrinsic.

Finally, on a dispositionalist account, certainly some dispositions might be extrinsic. Non-natural properties, such as vulnerability, might depend on contingent external circumstances in such a way that intrinsic duplicates could differ with respect to these dispositions.⁴¹ But the sorts of properties which are a distinctive feature of the dispositionalist ontology – those conferred by the fundamental properties – look like excellent candidates to be intrinsic. In the first instance, using the Lewisian strategy of defining intrinsicness in terms of naturalness, it will follow by definition that these dispositions are intrinsic, because they are always shared by natural duplicates. But even on definitions that do not tie intrinsicness so closely to naturalness, it is not possible for two intrinsic duplicates to be subject to different laws of nature, because dispositionalists are necessitarian about the laws of nature: the laws could not have been otherwise. Hence the strategy of showing that a disposition is extrinsic by considering duplicates which, being in different worlds, are subject to different laws, will be ineffectual.

That said, basic dispositional properties do not display complete *independence* from the existence of other entities or events.⁴² Given a disposition, given that it is exposed to its stimulus event, and given no interference, there is some sort of “compulsion” about this situation which constrains what can happen. The nature of this constraint is easiest to describe if the disposition is deterministic: the manifestation *must* occur. But if the disposition is non-deterministic it is much harder to say what this constraint consists in. Certainly the constraint is not then very

41. Jennifer McKittrick (2003) and Michael Fara (2001, 2005) have both argued for the *nomic possibility* of extrinsic dispositions in recent times, in the sense that intrinsic duplicates *subject to the same laws of nature* might differ in what dispositions they have. The nomic possibility of extrinsic dispositions was also evidently presupposed in earlier arguments by A. D. Smith (1977).

42. Brian Weatherson (2001) argues that the best prospect for defining intrinsicness is precisely in terms of a strong combinatorial independence. Following Weatherson's approach, it appears that dispositions could not be intrinsic.

tight. In some sense, anything *can* happen: it is possible both that the power will manifest and that it will not. On the other hand, we find ourselves wanting to say things like “some things can happen *more easily* than others”.

Supposing all dispositions to be probabilistic, then, the dispositionalist can make some case that powers are intrinsic in the sense that they are independent, and that this can be seen in the way the instantiation of a power is to a very large extent independent of what distinct events occur. On the other hand, there is the concern that this independence cannot be *total*. If it were, then what would distinguish these properties from categorical, non-dispositional properties?

Most likely, it seems that a dispositionalist is better off plumping for a restricted account of intrinsicness, which relates it directly to naturalness, without supposing that intrinsicness involves independence.

1.3.4.2 *Intrinsicness of causation*

On the naïve conception of causation opposed by Hume, the truthmaker for a singular causal judgment is an intrinsic relation – a relation of power, energy, or necessary connection – holding as a local matter of fact; whereas on the Humean replacement conception the truthmaker is a complex extrinsic matter determined partly by spatiotemporal relations and partly by global patterns of occurrences in the form of regularities. (Menziez 1999: 313)

As Menziez states, the Humean conception of causation holds that the truthmaker for a causal statement is a matter extrinsic to the causal relata. This is well illustrated on Lewis’s theory. In much the same way as we saw that whether or not an object possesses a disposition depends upon extrinsic facts about the global distribution of properties, so too whether or not a particular sequence of events is causal depends upon that global distribution. So the striking of a match and the subsequent lighting, though causally related in this world, could have happened in precisely the same way – intrinsically speaking – without being causally related. The regularities we typically observe, whereby phosphorus and oxygen react under the stimulus of heat, do not occur in such a world, or at least do not feature in the optimal systematization of contingent fact. Hence there are no laws regarding

the combustion of phosphorus, and the relevant counterfactual – “had the match not been struck, it would not have lit” – is false.

Armstrong, as a non-Humean, eschews this extrinsic account of the causal relation, and believes it to be an intrinsic relation (2004: 456). There are further idiosyncrasies of Armstrong’s account, such as his belief that this relation can be perceived, and that it is not necessarily law-governed. But other anti-Humeans, while retaining the core idea that the causal relation is intrinsic, adopt different attitudes to the matters of laws and perception.⁴³

The core feature of dispositionalist accounts of causation is that they all hold that the causal relation is at least *sometimes* intrinsic to the relata. Sometimes anti-Humeans appear to take the more heroic line that *all* causal relations are intrinsic; but this has a serious drawback. It appears that the relations picked out as causal in ordinary talk very often include extrinsic relations. For instance, imagine a golfer who is trying to make a putt. At the last minute a kangaroo jumps onto the green, and is headed towards the ball. If no one intervenes the kangaroo will stop the ball entering the hole. However, a passer-by yells at the ’roo, causing it to swerve away from the ball at the last minute. The ball drops into the hole. Relieved, the golfer points to the passer-by and says: “That bloke caused my putt to go in!”. Unless one is prepared to analyse this as not a literal truth, or as not reporting a kosher causal relation, then it has all the appearance of a causal relation that is extrinsic. The truthmaker for the causal claim is not a “local matter of fact” between the yell and the ball’s entering the hole. There is no credible way to construe the causal truthmaker as an intrinsic relation between these events.⁴⁴

Putting these hard cases aside, there are some instances of causation that appear susceptible to being understood intrinsically. Given the anti-Humean motives of a dispositionalist, one would expect such an account to be attractive. Such an account might go as follows:

(7) *C* causes *E* if and only if:

i. *C* occurs,

43. Others in this tradition include Anscombe 1971, Bigelow and Pargetter 1990, Fair 1979, Fales 1990, Tooley 1987.

44. Schaffer 2004.

- ii. *E* occurs,
- iii. had *C* not occurred, *E* would not have occurred.

Conditions (i) and (ii) are both obviously true in virtue of properties intrinsic to the pair *C* and *E*. Moreover, for a dispositionalist, (iii) is made true by the nature of the natural properties instantiated in *C*. So, assuming that all natural properties are intrinsic,⁴⁵ (iii) is also true in virtue of properties intrinsic to *C*. Therefore the causal relation itself is intrinsic to the relata-pair.

How well such an account can be defended is a matter that has not been adequately examined.

1.4 The papers

The papers in this collection represent a diverse range of approaches to the central theme. In this section, I briefly introduce each of them.

As already discussed, there is a live question as to the metaphysical relation between dispositions and causes. **Jennifer McKittrick**, in “Dispositions, Causes, and Reduction”, examines the prospects for a straightforward *reduction* of dispositions to causes, and vice versa. She argues that the prospects of a conceptual reduction, in either direction, are very poor. The attempt at a metaphysical reduction of dispositions to causes, she thinks, will likewise fail; but she concludes that it may be possible to metaphysically reduce causes to dispositions.

Other papers in the collection are concerned with related issues of reduction. **Antony Eagle**, in “Causal Structuralism, Dispositional Actualism, and Counterfactual Conditionals” critically evaluates the prospects of grounding metaphysical necessities in the dispositional nature of natural properties – an ambition of some dispositional essentialists. Eagle argues that the nature of counterfactual conditionals used to characterise dispositionality, being tolerant of exceptions and subject to extrinsic defeating conditions, makes dispositions incapable of grounding any substantive necessary truths.

Steven Barker, in “Leaving Things to Take Their Chances”, advocates a novel reductionist proposal: to ground both dispositions and causes in *chances*. This promises to avoid the complications that have been encountered in the past,

45. *Pace* the worries raised about this proposal for dispositionalists above (§1.3.4.1).

when dispositions and causation are understood – initially – via a deterministic paradigm, and we only later complicate our understanding by incorporating the possibility of probabilistic causes or dispositions.

The next two papers, by **Nancy Cartwright** (“Causal Laws, Policy Predictions, and the Need for Genuine Powers”) and **Richard Corry** (“How is Scientific Analysis Possible?”) engage in debate about the requisite ontology to explain the success of scientific inquiry. Both are attracted to a “three-level” ontology. At the bottom are *capacities*, or properties otherwise understood in terms of their power to generate certain effects. The second level is that at which the capacities are *exercised* – what Corry calls “causal influences”. And finally, through the combined effect of the totality of influences, we see the *manifest behaviour* of the system. A paradigm example of such an ontology would be Newtonian mechanics, in which there is mass and its attendant capacities to attract other masses and to resist acceleration (at the bottom-level), forces between the masses (the exercise of mass’s capacities), and finally accelerations and changes in motion (manifest behaviour).

Cartwright’s primary concern is to argue for the necessity of capacities: that without them the probabilistic generalisations we uncover (which she calls “causal laws”) are insufficient to guide our future interventions. Corry argues, first, that views such as Ellis’s dispositional essentialism are inadequate to capture the sort of invariant capacity that scientific analysis presupposes, and second, that Cartwright’s own account fails to be sufficiently realist towards the middle-level of the three-level ontology.

The next two papers consider properties that appear – prima facie – to pose difficulties for dispositionalists hoping to give a relatively unified ontology. **Timothy O’Connor** examines, in “Agent-Causal Power” what sort of causal power is required to explain the phenomenon of free-will. O’Connor argues that agent-causal power must be understood as an *emergent* power, arising from the arrangement of the physical parts of the agent, without being reducible to a purely physical cause. He then tries to show how such an emergent power could be accommodated within a dispositionalist metaphysic.

(The issue of emergence is also raised in Corry’s paper. Corry acknowledges the empirical possibility of emergence as a threat to the scientific method of analysis, and consequently as a threat to the ontological generalisations he makes. O’Connor’s paper thus throws some light on the sort of phenomena we might

expect to be most resistant to scientific inquiry.)

Alexander Bird considers another threat to dispositional monism: the possibility that structural properties are non-dispositional. In “Structural Properties Revisited”, he examines how to settle the question of whether or not structural properties – such as relations of spatiotemporal displacement – are dispositional or not. He concludes that the prospects of a background-free physical theory – recently championed by some physicists – are encouraging for dispositional monists, as it would appear that background-freedom of a theory constitutes grounds to think that all properties mentioned in it can be characterised dispositionally.

Also examining options for a dispositionalist ontology, **Ann Whittle**, in “Causal Nominalism” suggests that the dispositionalist idea of individuating properties by their essential causal powers be adopted, but without a commitment to realism about universals or tropes. Rather, properties can be understood in a nominalistic fashion, as sets of objects, unified by their dispositional–functional role. Having outlined her account, Whittle proceeds to weigh its plausibility in the light of several objections, such as allegations that the account suffers from vicious circularity, or that it has an unattractive similarity to Rylean behaviourism.

Finally, **Marc Lange’s** paper (“Why Do the Laws Explain Why?”) is primarily about laws of nature. He argues that laws are best accounted for as a set of counterfactual truths that have a property of “stability” which is a sort of robustness under other counterfactual suppositions. What makes Lange’s paper of direct relevance to the themes of the collection is that his preferred account of laws inverts the ordinary relationship between laws and subjunctive conditionals. For Lange, the conditionals are basic, and explain the laws. This has some affinity with the dispositional essentialist project, but is less metaphysically burdened by claims about essential natures of properties. Indeed, it most closely resembles Whittle’s nominalist version of dispositionalism, with its pared-down ontology of properties as sets of objects characterised by functional role.

References

- Anscombe, G. E. M. 1971. *Causality and Determination*. Cambridge: Cambridge University Press.
- Armstrong, D. M. 1978. *Universals and Scientific Realism*, vol. 2: A Theory of Universals. Cambridge: Cambridge University Press.
- . 1981. *The Nature of Mind*. Ithaca, N.Y.: Cornell University Press.
- . 1983. *What is a Law of Nature?* Cambridge: Cambridge University Press.
- . 1997. *A World of States of Affairs*. Cambridge: Cambridge University Press.
- . 2004. Going through the open door again: Counterfactual vs. singularist theories of causation. In *Causation and Counterfactuals*, edited by J. Collins, N. Hall, and L. A. Paul, 445–57. M.I.T. Press.
- Bigelow, J. and R. Pargetter. 1990. *Science and Necessity*. Cambridge: Cambridge University Press.
- Bird, A. 1998. Dispositions and antidotes. *The Philosophical Quarterly* 48: 227–34.
- . 2005a. The dispositionalist conception of laws. *Foundations of Science* 10: 353–70.
- . 2005b. The ultimate argument against Armstrong's contingent necessitation view of laws. *Analysis* 65: 147–55.
- Bostock, S. 2003. Are all possible laws actual laws? *Australasian Journal of Philosophy* 81: 517–33.
- Carroll, J. W. 1994. *Laws of Nature*. Cambridge: Cambridge University Press.
- Chalmers, A. 1999. Making sense of laws of physics. In *Causation and Laws of Nature*, edited by H. Sankey, 3–16. Dordrecht: Reidel.
- Choi, S. 2003. Improving Bird's antidotes. *Australasian Journal of Philosophy* 81: 573–80.
- Denby, D. A. 2006. The distinction between intrinsic and extrinsic properties. *Mind* 115: 1–17.
- Dowe, P. 2000. *Physical Causation*. Cambridge: Cambridge University Press.
- Dretske, F. I. 1977. Laws of nature. *Philosophy of Science* 44: 248–68.
- Elga, A. 2001. Statistical mechanics and the asymmetry of counterfactual dependence. *Philosophy of Science* 68: 313–24.
- Ellis, B. 1999. Causal powers and laws of nature. In *Causation and Laws of Nature*, edited by H. Sankey, 19–34. Dordrecht: Reidel.
- . 2001. *Scientific Essentialism*. Cambridge: Cambridge University Press.
- . 2002. *The Philosophy of Nature*. Chesham: Acumen.

- Ellis, B. and C. Lierse. 1994. Dispositional essentialism. *Australasian Journal of Philosophy* 72: 27–45.
- Fair, D. 1979. Causation and the flow of energy. *Erkenntnis* 14: 219–50.
- Fales, E. 1990. *Causation and Universals*. London: Routledge.
- Fara, M. 2001. Dispositions and their ascriptions. Doctoral thesis. Princeton University.
URL <http://www.princeton.edu/~fara/papers/dissertation.pdf>
- . 2005. Dispositions and habituels. *Noûs* 39: 43–82.
- Fine, K. 2002. The varieties of necessity. In *Conceivability and Possibility*, edited by T. S. Gendler and J. Hawthorne, 253–81. Oxford: Clarendon Press.
- Francescotti, R. 1999. How to define intrinsic properties. *Noûs* 33: 590–609.
- Goldman, A. 1967. A causal theory of knowing. *The Journal of Philosophy* 64: 357–72.
- Grice, H. P. 1961. The causal theory of perception. *Proceedings of the Aristotelian Society* Supp. vol. 35: 121–53.
- Handfield, T. 2005. Armstrong and the modal inversion of dispositions. *The Philosophical Quarterly* 55: 452–61.
- . 2008. Humean dispositionalism. *Australasian Journal of Philosophy* 86: 113–26.
- Hawthorne, J. 2001. Causal structuralism. *Philosophical Perspectives* 15: 361–78.
- Humberstone, I. L. 1996. Intrinsic/extrinsic. *Synthese* 108: 205–67.
- Johnston, M. 1992. How to speak of the colours. *Philosophical Studies* 68: 221–63.
- Kim, J. 1982. Psychophysical supervenience. *Philosophical Studies* 41: 51–71.
- Kripke, S. A. 1980. *Naming and Necessity*. Cambridge, Ma.: Harvard University Press.
- Langton, R. and D. Lewis. 1998. Defining ‘intrinsic’. *Philosophy and Phenomenological Research* 58: 333–45.
- . 2001. Marshall and Parsons on intrinsic. *Philosophy and Phenomenological Research* 63: 353–5.
- Lewis, D. 1972. Psychophysical and theoretical identifications. *Australasian Journal of Philosophy* 50: 249–58. Reprinted in Lewis 1999: 248–61.
- . 1973a. Causation. *The Journal of Philosophy* 70: 556–67. Reprinted (plus postscripts) in Lewis 1986c: 159–240.
- . 1973b. *Counterfactuals*. Oxford: Blackwell.

- . 1979. Counterfactual dependence and time's arrow. *Notus* 13: 455–76. Reprinted (plus postscripts) in Lewis 1986c: 32–65.
- . 1980. A subjectivist's guide to objective chance. In *Studies in Inductive Logic and Probability*, edited by R. C. Jeffrey, vol. 2. University of California Press. Reprinted (plus postscripts) in Lewis 1986c: 83–132.
- . 1983a. Extrinsic properties. *Philosophical Studies* 44: 197–200. Reprinted in Lewis 1999: 111–5.
- . 1983b. New work for a theory of universals. *Australasian Journal of Philosophy* 61: 343–77. Reprinted in Lewis 1999: 8–55.
- . 1986a. Against structural universals. *Australasian Journal of Philosophy* 64: 25–46.
- . 1986b. *On the Plurality of Worlds*. Oxford: Blackwell.
- . 1986c. *Philosophical Papers*, vol. 2. New York: Oxford University Press.
- . 1994. Humean supervenience debugged. *Mind* 103: 473–90. Reprinted in Lewis 1999, 224–47.
- . 1997. Finkish dispositions. *The Philosophical Quarterly* 47: 143–58. Reprinted in Lewis 1999: 133–51.
- . 1999. *Papers in Metaphysics and Epistemology*. Cambridge: Cambridge University Press.
- . 2000. Causation as influence. *The Journal of Philosophy* 97: 182–97.
- Loewer, B. 1996. Humean supervenience. *Philosophical Topics* 24: 101–26.
- Marshall, D. and J. Parsons. 2001. Langton and Lewis on intrinsic. *Philosophy and Phenomenological Research* 63: 347–51.
- Martin, C. B. 1994. Dispositions and conditionals. *The Philosophical Quarterly* 44: 1–8.
- McKittrick, J. 2003. A case for extrinsic dispositions. *Australasian Journal of Philosophy* 81: 155–74.
- Menzies, P. 1989. Probabilistic causation and causal processes: A critique of Lewis. *Philosophy of Science* 56: 642–63.
- . 1999. Intrinsic versus extrinsic conceptions of causation. In *Causation and Laws of Nature*, edited by H. Sankey, 313–29. Dordrecht: Reidel.
- Molnar, G. 2003. *Powers*. Oxford: Oxford University Press.
- Mumford, S. 1998. *Dispositions*. New York: Oxford University Press.
- Price, H. 1996. *Time's Arrow and Archimedes' Point*. Oxford: Oxford University Press.

- Putnam, H. 1975. The nature of mental states. In *Mind, Language, and Reality*, 429–40. Cambridge: Cambridge University Press.
- Russell, B. A. W. 1913. On the notion of cause. *Proceedings of the Aristotelian Society* 13: 1–26.
- Ryle, G. 1949. *The Concept of Mind*. London: Hutchinson.
- Salmon, W. C. 1984. *Scientific Explanation and the Causal Structure of the World*. Princeton: Princeton University Press.
- . 1998. Causation without counterfactuals. In *Causality and Explanation*, 248–60. New York: Oxford University Press.
- Schaffer, J. 2001. Causation, influence, and effluence. *Analysis* 61: 11–19.
- . 2003. Is there a fundamental level? *Noûs* 37: 498–517.
- . 2004. Two conceptions of sparse properties. *Pacific Philosophical Quarterly* 85: 92–102.
- Shoemaker, S. 1980. Causality and properties. In *Time and Cause*, edited by P. van Inwagen, 109–35. Dordrecht: Reidel. Reprinted (plus postscript) in Shoemaker 1984: 206–33.
- . 1984. *Identity, Cause, and Mind*. Cambridge: Cambridge University Press.
- . 1998. Causal and metaphysical necessity. *Pacific Philosophical Quarterly* 79: 59–77.
- Skow, B. 2007. Are shapes intrinsic? *Philosophical Studies* 133: 111–30.
- Smith, A. D. 1977. Dispositional properties. *Mind* 86: 439–45.
- Smith, M. 1997. A theory of freedom and responsibility. In *Ethics and Practical Reason*, edited by G. Cullity and B. Gaut. Oxford: Clarendon Press. Reprinted in Smith 2004.
- . 2003. Rational capacities, or: How to distinguish recklessness, weakness, and compulsion. In *Weakness of Will and Practical Irrationality*, edited by C. Tappolet and S. Stroud. Oxford: Clarendon Press. Reprinted in Smith 2004.
- . 2004. *Ethics and the A Priori*. Cambridge: Cambridge University Press.
- Tooley, M. 1977. The nature of laws. *Canadian Journal of Philosophy* 7: 667–98.
- . 1987. *Causation: A Realist Approach*. Oxford: Clarendon Press.
- Vallentyne, P. 1997. Intrinsic properties defined. *Philosophical Studies* 88: 209–19.
- Weatherson, B. 2001. Indicative and subjunctive conditionals. *The Philosophical Quarterly* 51: 200–16.
- Yablo, S. 1999. Intrinsicness. *Philosophical Topics* 26: 479–505.