Counterlegals and Necessary Laws

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Abstract

Necessitarian accounts of the laws of nature have an apparent difficulty in accounting for counterlegal conditionals because, despite appearing to be substantive, on the necessitarian thesis they are vacuous. I argue that the necessitarian may explain the apparently substantive content of such conditionals by pointing out the presuppositions of counterlegal discourse. The typical presupposition is that a certain conceptual possibility has been realized; namely, that necessitarianism is false. (The idea of conceptual possibility is explicated in terms of recent work in two-dimensional modal semantics.) If this sort of presupposition is made explicit in counterlegal utterances, we obtain a sentence such as: 'If it turns out that the laws of nature are contingent, then if the laws had been otherwise, then such and such would have been the case.' Sentences of this type are non-vacuous, and very often true. I argue that this goes a long way towards resolving the difficulty for necessitarianism.

Introduction

The aim of this paper is to defend some of those philosophers who advocate the apparently melodramatic thesis that at least some of the laws are metaphysically necessary. In particular, I am concerned with Dispositional Essentialists (Dispositionalists, for short) – those who hold that the causal powers conferred by a natural property are essentially associated with that property.[1]

Dispositionalism entails that at least some of the so-called 'causal laws' are necessary. (Others, such as conservation laws, for instance, need not be necessary on

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1. Some well-known Dispositionalists include Brian Ellis (*Scientific Essentialism*, Cambridge UP, 2001), John Heil (*From an Ontologal Point of View*, Oxford UP, 2003), C. B. Martin ('On the Need for Properties: The Road to Pythagoreanism and Back', *Synthese*, 112 (1997), pp. 193–231), and Sydney Shoemaker ('Causality and Properties', repr. in his *Identity, Cause, and Mind*, Cambridge UP, 1984, pp. 206–33).

the Dispositionalist theory.) If positive charge is essentially such as to attract negative charges and repel positive charges in the way it actually does, then Coulomb's law, for instance, appears to report a necessary truth about positive and negative charge. While different interpretations of the law could perhaps evade this result, *some* proposition very like Coulomb's law, at least, must be necessary if Dispositionalism is true.

The problem with which this paper deals is one which faces not just Dispositionalists, but anyone who advocates the necessity of some of the laws. It is the problem of providing a realist semantics for counterlegal conditionals.

1   Nomicity and Counterfactuals

It has been forcefully objected against regularity accounts of laws that regularities fail to support counterfactuals.[2] If it is true that:

> All philosophers in the seminar room are wearing spectacles

this does not support the claim that,

> If another philosopher, *A*, were in the room, she would be wearing spectacles.

Lawful regularities, on the other hand, do support such inferences. For many Dispositionalists, part of their motivation for adopting a non-Humean account of law is a desire to build a stronger nomic framework for the evaluation of counterfactuals. Dialectically, at least, it is therefore important that those providing alternative accounts of laws also provide a good account of counterfactuals.

Paradoxically, this has not been easy – for both nomic necessitation theorists and Dispositionalists. If, when evaluating a counterfactual, we are primarily concerned to ask: 'What would the *laws* require, given the antecedent?' then we appear to be concerned with counterfactual worlds with the same laws as our own. This suggests the following sort of account:

> 'If it were that ϕ then it would be that ψ' is true iff the closest worlds with the same laws as ours where 'ϕ' is true are worlds where 'ψ' is true.

But not all counterfactuals will fit this model. Counterlegal conditionals, in particular, seem to be ruled out. If the antecedent is 'If the law of gravitation had been an inverse cube law', then there are no worlds with the *same* laws as ours where

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2. E.g. D. M. Armstrong, *What is a Law of Nature?* (Cambridge UP, 1983), pp. 46–52.

the antecedent is true. Any counterfactuals with this antecedent will therefore be *vacuous*. They will resemble counterlogical conditionals, such as 'If it were that *p* and not-*p*, then . . .'.

This seems highly counterintuitive. We find many counterlegals (unlike counterlogicals) to be highly assertible, and *prima facie* true. For example,

(1)   If gravity had obeyed an inverse cube law, the planets would have had very different orbits.

For Contingency theorists, provided they are prepared to forgo a law-guided analysis such as that above, such counterlegals pose no special problem. Crucially, this is because Contingency theorists believe that worlds with different laws exist, so there is no immediate danger that the conditional is vacuous. For the Necessitarian, however, there simply is no world where the antecedent is true. Therefore the prospects of a substantive interpretation of (1) look very grim.

The problems for Necessitarians do not stop here. In addition to explicit counterlegals such as (1), there are some counterfactuals of the form 'Had it been that φ it would have been that ψ', where φ is incompatible with the actual laws conjoined with a history which resembles the actual history. Consider a straightforward counterfactual, such as 'If I had a steak in the fridge, I would cook it for dinner tonight'. The closest antecedent-worlds which are accessible from this one are those where I have bought a steak from my favourite butcher. I only go to the butcher on Tuesdays. Today being a Monday, if I had bought a steak last Tuesday, I would have already cooked it by now. A world with the same laws as ours, and therefore a world where I am similarly rigid in my shopping habits, where I have a steak in the fridge on a Monday must be a world with a substantially different history from the actual world. Something odd must have happened in the past to inspire me to go to the butcher on a day other than Tuesday. The counterfactual must be a backtracker.

This may be tolerable, so long as the backtracking is not too drastic. But how can we be so confident that it is not? If the laws of nature are deterministic, the backtracking must proceed to the origin of the cosmos. This seems highly counterintuitive.

Worse still, it may be nomically *impossible*, even with massive backtracking, to bring about a world which contains myself, a steak, and my current hunger, all on a Tuesday. Once again, Necessitarianism about the laws pushes towards the conclu-

sion that the counterfactual will turn out to be vacuous.[3] Such counterfactuals are what I call *implicit counterlegals*. These conditionals appear to pose just as much of a problem for Necessitarians as explicit counterlegals.

2   Two types of possibility

Recall our (explicit) counterlegal:

(1)   If gravity had obeyed an inverse cube law, the planets would have had very different orbits.

Dispositionalists are committed – on the plausible assumption that mass does not obey an inverse cube law of gravity – to the metaphysical impossibility of the antecedent of this conditional. On possible-worlds semantics, therefore, the counterfactual is vacuous. Different theorists have different views on the truth-value of vacuous counterfactuals, but whatever its truth-value, it is highly implausible that such a counterfactual should be vacuous.

What can the Dispositionalist say to explain the apparent content of such counterlegal conditionals?

Imagine an early alchemist, who has discovered how to obtain hydrogen gas by means of a chemical process involving water. The alchemist does not know that hydrogen is a constituent of water. In fact she believes that water is an element, and that hydrogen is either a new element or – if it is compound – it is not a compound of water.[4]

This alchemist thinks, like many non-Dispositionalist philosophers, that the laws governing the behaviour of the elements are contingent. Hence she can entertain the thought:

(2)   Water might have lacked the power to be a reagent in the production of hydrogen.

A Dispositionalist would wish to argue that this is strictly false. Moreover, the Dispositionalist may wish to draw a link between the alchemist's utterance of this

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3. This objection has been raised against Dispositionalism by John Bigelow, 'Scientific Ellisianism', in Howard Sankey (ed.), *Causation and Laws of Nature* (Dordrecht: Kluwer, 1999), pp. 57–76, at §6. See also D. M. Armstrong, 'The Causal Theory of Properties: Properties according to Shoemaker, Ellis, and others', *Philosophical Topics*, 26 (1999), pp. 25–37, at §5.

4. Assume – despite any etymological implausibility – that the alchemist happens to call hydrogen by the same name as we do.

falsehood, and their ignorance of the chemical constitution of water. Given the alchemist thinks water is elemental, and has *no* constituents, *a fortiori* she would assent to:

> (3)   It is not the case that, necessarily, hydrogen is a constituent of water.

And given (3), it is very plausible to think that (2) is true. In effect, being ignorant of a metaphysical necessity about the constitution of water facilitates belief in the contingency of a particular law. Conversely, if one knows that water is necessarily H_2O (and therefore that (3) is false) one should be inclined – argues the Dispositionalist – to believe that (2) is false. The Dispositionalist might argue for this as follows:

> If something is necessarily a compound of *A* and *B*, yet cannot possibly engage in a reaction that yields *A*, then it is doubtful what is meant by the claim that it is a *compound*. Better to insist that being a compound entails being chemically decomposable into one's elemental constituents. Given that water is necessarily H_2O, it is also a necessary truth that it is capable of reacting to produce hydrogen.[5]

In a spirit of maximum charity, though, we may try to point out what is right about the alchemist's assertions above. Recall that Kripke contrasted some other – ostensibly epistemic – species of possibility with metaphysical possibility:

> Gold apparently has the atomic number 79. Is it a necessary or a contingent property of gold that it has the atomic number 79? Certainly we *could find out* that we were mistaken.[6]

Along similar lines, we could say that the alchemist is correct to think that:

> (2′)   It *could turn out* that water lacks the power to be a reagent in the production of hydrogen.

And:

> (3′)   It *could turn out* that hydrogen is not a constituent of water.

These claims are *prima facie* true, and do not offend against the central tenet of Dispositionalism. How can this technique of generous translation help us in the case of counterlegals, then?

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5. It is by no means *necessary* that the Dispositionalist subscribe to this argument, it merely provides a useful heuristic to introduce the semantic treatment of counterfactuals that follows.

6. Saul Kripke, *Naming and Necessity* (Harvard UP, 1980), p. 123, emphasis added.

The alchemist was led into modal error about the law-like proposition (2) because of her ignorance about the constitution of water. Analogously, the Dispositionalist may suggest that there is widespread ignorance about the truth of various metaphysical theses about the nature of the fundamental properties. For example, the Dispositionalist claims it is true that:

(4)   Mass is essentially such that it confers upon its bearers the causal power to attract other masses in accordance with an inverse square law.

But this is hardly a well-entrenched platitude of folk physics. Indeed, there is a relatively widespread intuition that the laws governing mass could have been otherwise, and this implies that there is at least a tacit *disbelief* in (4).

Like the alchemist, though, the modal intuitions of these Contingentists contain an element of good sense, even if Dispositionalism is true. It *could turn out* that mass is governed by an inverse cube law. Or to put it another way, supposing it turns out that mass essentially obeys an inverse square law of gravitation, it nonetheless could have turned out that we lived in a world where the property that played the mass role was "schmass", and schmasses attract each other in accordance with an inverse cube law.

More broadly, it could turn out – I take it – that Dispositionalists are *utterly* wrong about the essential nature of the natural properties. It could turn out, for instance, that David Lewis's hypothesis of Humean supervenience (HS) is true.[7] That is, the perfectly natural properties might be monadic properties of point-sized entities, and the only perfectly natural relations might be spatiotemporal. This would admittedly be very startling, since our best confirmed empirical theories appear to be incompatible with HS. But I think Lewis successfully carried the point that we have no decisive *a priori* grounds for ruling it out. If HS is true, then Dispositionalism is false. So there is at least one way the world might have turned out which is incompatible with Dispositionalism.

(I think all Dispositionalists should agree with this. If I am wrong about this, however, and there are some who hold that Dispositionalism is an *a priori* truth, then my argument henceforth applies only to what may be called *a posteriori* Dispositionalism.)

Supposing the world does turn out to conform to HS, would it then be the case that there are no laws, that there is no causation, etc? Perhaps some anti-Humeans are of the radical view that we should be error theorists about such concepts if HS turns out to be true. But those philosophers are hardly likely to have been worried

7. Lewis, *Philosophical Papers*, vol. 2 (Oxford UP, 1986), pp. ix–x.

by the threat of vacuous counterlegal conditionals – the threat which motivates this paper. Evidently they would be prepared to declare such vast tracts of folk-discourse false or vacuous if HS turned out to be true that they should be little perturbed if, on the supposition that Dispositionalism is true, merely counterlegal conditionals were rendered vacuous.

It is to the less strident anti-Humean, then, that my argument is directed. And for those philosophers, if HS turns out to be true then the laws are presumably something like cosmic regularities, for that is the gist of what all neo-Humean philosophers say they are. Consequently, the laws would turn out to be contingent. There is, then, at least one way the world could have turned out such that the laws of nature would be contingent.

To the utterer of the vacuous counterlegal (1), then, we may attribute the *presupposition* that things will turn out such that the laws of nature are contingent. The Dispositionalist claims this presupposition is false. But if we made the presupposition explicit, as a charitable means of refining the counterlegal, we would get something like:

(1′) *If it turns out* that mass could have been governed by an inverse cube law of gravitation, then *if mass had* obeyed an inverse cube law, then the planets would have had very different orbits.

This is something of a mouthful, but it does not face the immediate concern which faced (1). That is, it is not obviously vacuous, even if Dispositionalism is true. This is because it does not require that the laws be contingent. It merely requires that the laws *could turn out* to be contingent.[8]

If this is to provide a method for making sense of counterlegals, then the Dispositionalist needs to offer some coherent account of this alternative species of possibility. Just what is involved in saying that something which is necessarily true could nonetheless turn out otherwise?

2.1   What is this new species of possibility?

While Kripke did not develop the 'could have turned out' variety of possibility in any great detail, others have attempted to take this second notion a great deal further. A leading exemplar of this approach is David Chalmers, who calls this

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8. The idea of nesting conditionals in order to accommodate a non-Humean metaphysic of laws was suggested to me by the treatment offered in John Bigelow and Robert Pargetter, *Science and Necessity* (Cambridge UP, 1990), at pp. 246–50. Bigelow and Pargetter, however, use two standard counterfactuals, rather than an 'if it turns out that' conditional.

second notion of possibility 'primary' or 'deep epistemic' possibility. The latter is perhaps an unfortunate name, since epistemic possibility is frequently taken to be *possibility, for all one knows*. Chalmers' conception is clearly not that. Rather, p is (deeply) epistemically possible for Chalmers if and only if p is not *a priori* false.[9] Crudely glossed: anything which a Cartesian ego cannot rule out is deeply epistemically possible.

For fear of potential confusion with the traditional notion, Steve Yablo prefers to call Chalmers' concept 'conceptual' possibility.[10] I shall follow Yablo in this usage.

Chalmers presents two ways in which to flesh out the idea of conceptual possibility. The first is the one already touched upon: p is conceptually possible if and only if not-p is not *a priori*. The alternative is an explication via worlds and can be illustrated by way of that old chestnut, twin earth.[11] Take a world W where the watery stuff that fills the oceans and lakes, falls from the sky, is potable, flavourless, transparent, etc., is *not* H_2O, but XYZ. When Putnam and Kripke consider the hypothesis that the watery stuff might have been XYZ, they are urging us to consider world W as *counterfactual*, and that leads us to the conclusion that:

Had the watery stuff been XYZ, then water would (still) have been H_2O.

And this sort of intuition is used to support the claim that 'Water = H_2O' is metaphysically necessary. Roughly, then, p is metaphysically necessary if, for all worlds W, had it been that W, it would (still) have been that p.

There is another way of considering world W, however. We could consider W as a way that this world *might be*, or *could have turned out*. This way of considering W leads to a very different conclusion.

If it turns out that the watery stuff is XYZ, then water is XYZ.

A sentence p is *conceptually* necessary if for all worlds W, if it turns out that W is the actual world, then p will be true. Hence while it is not metaphysically possible, it is conceptually possible that water is XYZ. This way of construing the two types of possibility – inspired by work in two-dimensional modal semantics[12] – uses the

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9. See 'The Foundations of Two-Dimensional Semantics', <http://consc.net/papers/foundations.html> (2002), at §3.10.

10. 'Coulda, Woulda, Shoulda', in Tamar Szabó Gendler and John Hawthorne (eds), *Conceivability and Possibility* (Oxford: Clarendon Press, 2002), pp. 441–92, at p. 442.

11. Hilary Putnam, 'The Meaning of "Meaning"', in Keith Gunderson (ed.), *Language, Mind, and Knowledge* (University of Minnesota Press, 1975), pp. 131–93.

12. Two-dimensional semantics are discussed in Martin Davies and Lloyd Humberstone, 'Two Notions

same possibilia (worlds), but under different operations: consideration as a way the *actual world could have been but is not* (counter*factual*), and consideration as a way the *actual world could turn out* (counter*actual*).

What is the difference between these operations? Principally, it is that when we consider a world as counterfactual, we lock in the denotation of our rigid designators based upon how the actual world is, and our terms then have parochial denotations, even when describing other worlds. When considering another world as actual, however, the denotation of our rigid designators is up for grabs – to be settled by the alternate world.

(There is some dispute as to precisely what form of the conditional is most appropriate for the diagnosis of conceptual possibility. Chalmers favours either a straight indicative or perhaps an indicative 'if it turns out . . .' conditional, where Yablo argues that a subjunctive, 'if it had turned out . . .' formulation is superior.[13] I will tend to use the 'if it turns out' formulation in the indicative, but have no firm views on the matter. One thing in favour of Yablo's approach is that it makes salient the fact that the conditionals in question are very similar to counterfactuals, except with respect to the treatment of rigid designators. Indeed, in what follows, I shall employ semantics much like Lewis's possible world semantics for the evaluation of these conditionals.)

Above I considered first the way in which it could turn out that the law of gravity is an inverse cube law. This would require that it turn out that the occupant of the mass-role is what I called schmass. Consequently, the term 'mass' would turn out to denote a substance which, essentially, obeys an inverse cube law.

I also considered a way in which the world could turn out such that the laws of nature are contingent. Viz. HS could turn out to be true. In that case, the rigid designator 'law' could turn out to denote mere Humean regularity, or something of that ilk. The laws would thus turn out to be contingent.

If this argument is correct, then even where it is metaphysically necessary that *p*, it may be conceptually contingent that *p* is the case. Immediately, then, we see that there are a great number of sentences which express conceptual, but not metaphysical, possibilities. The task now remains to deploy these additional possibilities to rescue Dispositionalism from the objections it faced.

of Necessity', *Philosophical Studies*, 38 (1980), pp. 1–30; Frank Jackson, *From Metaphysics to Ethics* (Oxford: Clarendon Press, 1998); and Robert Stalnaker, 'Assertion', *Syntax and Semantics*, 9 (1978), pp. 315–32.

13. Chalmers, 'Does Conceivability entail Possibility?', in Gendler and Hawthorne (eds) *Conceivability and Possibility*, pp. 145–200, at pp. 169–71; Yablo, 'Coulda, Woulda, Shoulda', at §§9–10.

2.2 The method applied

Put very simply, the problem confronting the Dispositionalist was that, having denied the metaphysical possibility of many verbally describable scenarios, she needed to give a semantics for counterfactual utterances which make apparent reference to those scenarios. On possible-worlds semantics, this was problematic.

Suppose mass does in fact essentially obey an inverse-square law. It is not possible then, that mass could have obeyed an inverse-cube law. But it *could have turned out* that mass obeyed an inverse-cube law. *A fortiori*, then, it could have turned out that it was metaphysically possible that mass obey an inverse-cube law. The utterer of a counterlegal is presupposing that things have in fact turned out in such a way.

If Dispositionalists are correct, very often the presuppositions to our counterfactual discourse are false. But they are not *vacuous*. It is not as though we are presupposing that '2 + 2 = 5' is true. Rather, we are presupposing that a conceptual possibility has been realised. If our audience shares that presupposition, the conversation will proceed unheeded. Moreover, closely related to the strictly false counterfactuals which may be uttered in such a conversation, there are 'charitably refined' counterfactuals which are *true*. After refinement, 'Had it been that ϕ, it would have been that ψ', amounts to:

If it turns out that ϕ is metaphysically possible, then had it been that ϕ, it would have been that ψ.

Such presuppositions should be familiar to anyone who has been moved by Kripke's and Putnam's examples:

Necessarily, tigers are felines.

Necessarily, water is H_2O.

Necessarily, Hesperus is Phosphorus.

All of these are asserted under the presupposition that the proposition which is necessary is also *true*. If we discover in some years time that water is actually XYZ, or that tigers are robots, or that Hesperus is distinct from Phosphorus, no one will be concerned that the argument for necessary *a posteriori* truths has been impugned. And charitably refined, by making the presupposition explicit, all of these assertions would come out true.

To test this semantic strategy, suppose that the actual world, @, is deterministic and that Dispositionalism is true – thus all forward-tracking counterfactuals are

implicitly counterlegal. Consider then, a charitable refinement of the steak example:

(5) If it turns out to be true that there could have been a steak in my fridge (without massive backtracking), then if there were a steak in my fridge, I would cook it for dinner tonight.

Read as a material conditional, this is straightforwardly true, for the antecedent (we are supposing for the sake of the objection) is false. As a strict implication, on the other hand, the conditional is almost certainly false. But that seems to be an unduly strong reading. Rather than settling for a mere material conditional, however, I seek to vindicate the above conditional, interpreted as something like a counterfactual. (This is motivated – in part – by the similarity between the indicative conditional and the subjunctive 'Had it turned out that . . .' conditional as mentioned above. It is also motivated dialectically, however, by the desire to show that this account does more than merely vindicate implicit counterlegals by rendering them as material conditionals with false antecedents. That would be 'too easy' to be of interest.)

What would the nearest world – considered as actual – where there could be a steak in my fridge be like? We know what sort of world we 'want' to be close by: a world where steaks can appear in fridges like mine without massive backtracking. One way this could be the case is if the natural properties are capable of *spontaneous instantiation*.

Species 1   Call a world where all the properties are capable of spontaneous instantiation a species 1 world.

The central claim of Dispositionalism is that properties are essentially such as to confer the powers they do. In our typical conception of a power, there is an asymmetry. A power is usually thought of as a *power to cause X*, rather than as a *power to be caused by X*. Call the second sort of power a 'susceptibility', or a 'passive disposition'. Call the first sort a 'power' simpliciter, or an 'active disposition'.

Clearly, there is an intimate relationship between powers and susceptibilities. If *being uranium-235* is associated with the power to cause positron-emission, then *being a positron* is associated with a susceptibility to be caused by uranium-235. It is a live question, however, as to whether a property's passive dispositions are *exhaustively* determined by the active dispositions of those properties which can cause its instantiation. In particular, one might wonder whether a property is susceptible of being instantiated *spontaneously*. Call any such instance of spontaneous

instantiation a 'space-invasion'.[14]

If the actual properties were capable of space-invasion it would grant the Dispositionalist the very possibility needed to solve the problem of implicit counterlegals. Very roughly, there would be nearby possible worlds where the properties which would need to be instantiated to bring about the antecedent are spontaneously instantiated at the appropriate time. 'Bringing about', in this context, may either be by causal means, or simply by the properties of the antecedent events themselves being the ones (spontaneously) to irrupt.

In the case of the steak and my ensuing dinner, the simplest application of space-invasion will presumably involve the spontaneous instantiation of all of the properties of a steak in the vicinity of my refrigerator. Thereafter, all the laws governing the behaviour of red meat will come into play, ensuring that it will persist, be appetising, etc.

A bit less crudely, a space-invasion might involve the spontaneous firing of a key neuron in my brain a few hours earlier, causing me to vary my usual behaviour and go to the butcher on a Monday. In this way, space-invaders can do their job of bringing about counterfactual antecedents in just as subtle a fashion as Lewisian miracles.

If any properties are capable of space-invasion, then determinism is false. So @ must be a world where no properties are capable of space invasion. This is surely a conceptual contingency, however. It could have turned out otherwise.

The nearest species 1 world to @ is a world where *all* of the properties are different. But the dispositional roles that all of the properties occupy are importantly similar to the actual causal roles. The only difference is that every property *could* have been instantiated spontaneously. Thus the laws are different. Where the laws of the actual world will reflect the symmetry of the causal features of the properties, the laws of the closest species 1 world will be asymmetric. The laws will say that all events of type *A* will – excepting any spontaneous interference – cause events of type *B*. But it would not be true that all events of type *B* will be caused by events of type *A*. Some may be space-invasions.

Such a world will not be one where there *is* a steak in my fridge. But it will be the case that a steak could have been in my fridge, without massive backtracking. And moreover, it will be true that if there were a steak in my fridge, I would cook it for dinner.

14. I introduced this idea in 'Dispositional Essentialism and the Possibility of a Law-Abiding Miracle', *The Philosophical Quarterly*, 51 (2001), pp. 484–94, and argued there for the compatibility of space-invasion with the central theses of Dispositionalism.

The question then arises: are there other possible worlds where the antecedent of (5) is true that are closer to actuality than species 1 worlds? While I cannot pretend to be giving an exhaustive survey, below are some salient alternative ways the world could have turned out.

Hume worlds   are worlds where HS is true; worlds with no perfectly natural external relations except for spatiotemporal relations. These are worlds with just 'one damn thing after another', and no connection between them.

It seems reasonably clear that, if anything like the Dispositionalist thesis is true of the actual world, then a world like this will be much farther removed from actuality than a species 1 world. All of the hard-fought for features of a Dispositionalist ontology, such as laws, causation, and dispositionality, would turn out to be (or to supervene upon) mere cosmic regularities in a Hume world. If we discovered that the world was Humean, it would be a much more surprising discovery for Dispositionalists than the discovery that space-invasion is possible.

Even if I am incorrect in my judgement of similarity, however, I do not think that any problems arise for the Dispositionalist in consequence. For if the world turns out to be Humean, then there is no particular reason to think that the counterfactual about the steak would be false. For, as I suggested above, if the world is Humean, then Humean analyses of laws, causation, and counterfactuals will turn out to be broadly correct. And on a typical Humean analysis of counterfactuals, the steak example would most likely be true.

If our choice were between only these two ways the world could turn out, then regardless of whether Hume worlds or species 1 worlds are closer to actuality, the nested conditional (5) will be true.

Demi-Humean worlds   Of more concern than an outright Hume world is a sort of hybrid world. It is not obviously incoherent to suppose that, even if in the actual world all the fundamental causal laws are strictly necessary, it could have turned out that a subset of those laws were mere contingent regularities. If such a demi-Humean world turned out to be actual, it is not clear whether it would be correct to say that some of the causal laws are necessary and some are contingent; or whether it would be that there were some necessary laws and some contingent *quasi*-laws. If the latter were the case, then it seems likely that many of our counterfactual judgments would go awry.

In the steak case, for instance, suppose that a law L entails that I do not make spontaneous decisions to go to the butcher on a Monday unless I have a very special reason. A demi-Humean world of potential interest to us, then, is one where

L is a mere contingent regularity. If such a world – call it *W* – turned out to be actual, it would be possible for me to go to the butcher on a Monday for no particular reason, and therefore be possible for me to have a steak in the fridge on a Monday without massive backtracking.

But L is very likely to underlie all sorts of regularities other than my butcher-shopping habits. Quite possibly, if *W* were actual, then whatever dispositions I have to cook steaks, to look in fridges, to like the taste of meat, and so forth that are relevant to the truth of the counterfactual would similarly be backed, not by law, but by mere Humean regularity. Would it therefore be true that if I had a steak in the fridge I would cook it for dinner? It is by no means clear that I would.

It is not entirely clear to me, either, in virtue of what we may say that a species 1 world or a Humean world is closer to @ than a demi-Humean world such as the one I have been discussing. Below I shall sketch some principles of similarity which may entail that demi-Humean worlds are indeed farther from actuality. For now, however, I wish to discuss another variety of world which might also prove problematic.

Fine-tuned worlds Take a world where space-invasion is impossible. That should count greatly in favour of the world's being similar to the actual world. The laws of this world are very similar to the laws of @, except that some properties have a very specific additional causal power. Viz., in the individual circumstances of each property instance just before the steak is due to appear in the fridge, every property which is instantiated in the appropriate region of the fridge has the causal power to do 'whatever it takes' to bring about steak-in-fridge. For instance, suppose there is a molecule of N_2 gas in the fridge at a point where some gristle needs to be instantiated as part of the steak. Then the property *being N_2* must confer the causal power to cause gristle in circumstances *C*, where *C* are the circumstances the molecule is in just before the steak is due to arrive.

Such worlds may indeed be closer to the actual world than species 1 worlds. Both species are specified only vaguely, and both involve a significant change in the nature of the properties instantiated. Suppose that at least some fine-tuned worlds are closer to the actual world than any space-invader worlds. Would this be a problem? It might not be, for the fine-tuning may be sufficiently precise that it brings about a steak at the appointed time, and fails to do anything troublesome elsewhere. But may we be so confident that the fine-tuning will be so completely circumscribed in its effects? For reasons similar to those which made demi-Humean worlds a concern, I think not. Suppose that the universe has per-

fect mirror symmetry. Then not only do circumstances *C* exist in *my* fridge; the very same circumstances obtain in the fridge of mirror-me. Hence the fine-tuned laws would necessitate a steak in my doppelgänger's fridge also. If such worlds are the closest worlds where it turns out that a steak in my fridge is possible, then the counterfactual:

> If there were a steak in my fridge now, there would be a steak in my doppelgänger's fridge

would be true. That seems dubious.[15]

Without resorting to brute stipulation, then, can we say that some suitable species 1 worlds will always be closer than any fine-tuned worlds? In shameless imitation of Lewis's similarity metric for counterfactuals,[16] below are four criteria for estimating the similarity of worlds for the purposes of counter*actual* conditionals. As will become evident, this sketch is in need of further development if it is to yield a proper theory of counteractual semantics, but I am not proposing to defend such a theory here.[17] I primarily intend to show that conditionals like (5) are non-vacuous. If the semantic project commenced here can be developed to show that such conditionals are sometimes true, that is a bonus.

- *It is of the first importance to minimize the number of distinct domains in which divergence occurs.*

This criterion is motivated by my intuitive response to conditionals such as:

(1*) If gravity turns out to obey an inverse cube law, the planets will turn out to have very different orbits from what we believe them to have.

(1†) If gravity turns out to obey an inverse cube law, it will turn out that there is another force which explains the apparent inverse square law behaviour of the planets.

While I expect a certain amount of context-sensitivity could lead us to have very different intuitions about the truth of these conditionals on different occasions, I believe that in general, (1†) is the more plausible of the two. The moral of this, I suggest, is that in evaluating 'if it turns out that' conditionals, we are concerned

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15. Thanks to Stephen Barker for this objection.

16. Lewis, 'Counterfactual Dependence and Time's Arrow', repr. in his *Philosophical Papers* vol. 2, pp. 32–65, at pp. 47–8.

17. Brian Weatherson, 'Indicative and Subjunctive Conditionals', *The Philosophical Quarterly*, 51 (2001), pp. 200–16, has proposed an overtly epistemic theory of indicative conditionals that may be similarly congenial for my metaphysical purposes.

to restrict the number of different *types* of change which occur between the actual world and the counteractual scenario.

So for instance, if we start from an antecedent which involves a change in the laws, then we are relatively content to accept that there may turn out to be other changes in law-like phenomena, but we are relatively loath to change particular facts. Having admitted that gravity has turned out otherwise, we can readily countenance another change in the fundamental laws to account for the apparent orbits. It would be worse and messier to suppose that, in addition to a change in the laws, that there should be a change in the orbits of the planets from what they appear to be – even if that meant we could minimize the degree of change in the laws.

(The concept of different domains of change is evidently vague, but I shall make no further effort to reduce that vagueness in the present paper.)

- *It is of the second importance to maximize the spatiotemporal region of approximate match of particular fact.*
- *It is of the third importance to maximize the regular uniformity of the divergence from actuality in any given domain.*
- *It is of little or no importance to maximize the spatiotemporal region of perfect match of particular fact.*

These criteria are of particular importance if demi-Humean and fine-tuned worlds are to be further from @ than either Humean or species 1 worlds.

Compare Lewis's second criterion for counterfactual similarity, which directs us to maximize the spatiotemporal region of perfect match in particular matters of fact. If applied to counteractuals, this criterion seems to give the wrong result in cases such as the following: 'If water turns out be XYZ, then . . .', for consider two worlds:

W_1. A twin-earth world where Twoscar lives a life which exactly duplicates the structure of Oscar's life, back here in the actual world. Throughout the entirety of W_1, however, there is XYZ where in the actual world there is H_2O.

W_2. A world which is an exact duplicate of W_1, except for *one molecule*. In the depths of Loch Ness in W_1, there is a particular molecule of XYZ. In W_2, the counterpart of this molecule is H_2O. This is the only molecule of H_2O in the entire world.

The above conditional is surely to be evaluated at worlds like W_1, not W_2. But with respect to Lewis's second criterion – perfect match of particular fact – W_2 scores

better than W_1. W_2 matches the actual world in the region of one molecule in Loch Ness, as well as in every other region where W_1 matches the actual world. Hence W_2 ought to be deemed *closer*.

Something rather more like my third criterion seems to be at work in our belief that W_1 is the closer of the two worlds. In effect, having relaxed the second criterion, by allowing approximate match, the key difference between the worlds is the uniformity of the divergence from the actual. W_1 differs from the actual world in a more uniform manner. (Perhaps this sort of matching could be captured more formally in terms of the existence of a 1:1 transform between XYZ and H_2O.)

In something like the same manner, one can see how a species 1 world fares better than a fine-tuned world. A species 1 world is capable of being a perfect 'facsimile' of a deterministic world. It would simply be a world where, for every particular fact in @ involving properties P, Q, R, etc., there are corresponding facts involving space-invading properties P', Q', R', etc. A highly uniform substitution of properties is possible.

Fine-tuned worlds, on the other hand, may be reasonable facsimiles, but will have occasional glitches. For instance, the fine-tuned world where N_2 has gristle-causing powers in circumstances C is consequently a world where *there is some gristle in my fridge* (or there is some extra phenomenon which is preventing gristle from manifesting) while in the actual world, even after ignoring the global property swap required for the fine-tuning, nothing corresponds to said gristle. This is a non-uniform divergence from @. Hence we have some principled reason to say that species 1 worlds will at least in many contexts be closer than fine-tuned worlds, for they can provide a *uniform divergence from actuality* throughout a very large region indeed.

Similar reasoning applies to the choice between Humean and demi-Humean worlds. Having made the change in the domain of laws such that some laws are mere regularities, it is important to maximize the uniformity of this change. One obvious way to achieve that uniformity is by rendering *all* of the laws mere regularities, which is a Humean world.

The second criterion is an important constraint on the third. I take it that

If it turns out that Queen Elizabeth is a robot, then it will turn out that all humans are robots

is false, but if the third criterion is not suitably constrained, it might direct us to effect the change from human to robot in an all too pervasive fashion.

Having given at least a first sketch of a similarity metric for conditionals like (5), I note that there are other ways the world might turn out such that a steak

might have been in my fridge. For instance, the properties instantiated in a typical steak might all be capable of space-invasion, though the other properties are identical with the properties of @.

Or consider a slightly different possibility. A world just like the fine-tuned world described above, except that *being N$_2$* does not have a deterministic power to bring about gristle in circumstances *C*. Rather, it has a very small chance *propensity* to cause gristle. Moreover, all of the other property instances in the 'steak-expecting' region of my fridge have similar small chance propensities to bring about the required states-of-affairs to constitute a steak in my fridge.[18]

I do not pretend that adjudicating relative similarity of these worlds is a straightforward business. Perhaps the uniformity of change criterion holds them to be further away than the worlds already considered, but perhaps the first criterion of minimising domains of change admits them. In either case, however, I see little reason to be concerned by such worlds, for in both I take it to be *true* that if I had a steak in my fridge, I would cook it for dinner.

I conclude that, although the semantics of 'if it turns out that' conditionals could be developed in much greater detail, there is some reason to be optimistic that refined counterfactuals such as (5) will at least sometimes be true.

The remaining test for the proposed theory is whether it will deal with explicit counterlegals. I will not labour the point, as the hard work has all been done by now. A counterfactual of the form 'If mass had been governed by an inverse cube law of gravitation, . . .' may be charitably refined as:

> If it turns out that mass could have been governed by an inverse cube law of gravitation, then had it been so governed, the planets would have had very different orbits.

One sort of way the world could turn out such that mass could have been governed by an inverse cube law is a schmass-world. If such a world turned out to be actual, though, then it would be *true* that mass obeys an inverse cube law. I take it that this does not capture the presupposition of the person who entertains a *counter*legal. Rather, they are supposing that the world has turned out such that mass obeys something *other* than an inverse cube law, and yet *could have obeyed* such a law.

Humean worlds and demi-Humean worlds exemplify ways the world could have turned out such that the speaker's presupposition is true. Again, for the rea-

18. I am grateful to Barker and an anonymous referee for pointing out this sort of example.

sons discussed above, I suspect that our intuitive understanding of such conditionals pulls us towards the Humean world first, for it constitutes a more uniform change from the actual.

From a Humean world, the inner counterfactual is free to range over worlds where the laws are different, because laws will have turned out to be mere contingent regularities. Very likely then, the consequent will be true. Even if not, the counterfactual will at least be non-vacuous. Mission accomplished.

3 Conclusion

This paper has pursued a particularly narrow target: that of reconciling a Dispositionalist metaphysical thesis about laws and properties with a realist approach to counterfactual discourse. One might reasonably ask whether the elaborate contortions that have been required to achieve this reconciliation are not evidence for the falsity of either Dispositionalism or of realism about counterfactuals.

To properly address that question would require discussion of all the claimed benefits of the Dispositionalist thesis: a task which is beyond the scope of this paper. Despite failing to resolve the debate between Dispositionalists and their opponents, however, this paper has sketched a technique which may be of use in other debates. If we accept the Kripkean intuitions about the necessary *a posteriori*, then we must be prepared to accept that the traditional philosophical tool, *a priori* reflection, is not the royal road to modality. Philosophers must yield some territory to the scientists. And this means that objections analogous to the problem of vacuous counterlegals can be raised against *anyone*. We may, without realising it, be attempting to refer to metaphysical impossibilities. The problem is therefore not merely a skeleton in the closet of Dispositionalists – it is a problem for any neo-Kripkean. The strategy of charitable refinement, then, whereby our false presuppositions are turned into the antecedents of 'if it turns out' conditionals, may be of use in a great variety of philosophical contexts.[19]