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From Possibility to Properties? Or from Properties to Possibility?

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Abstract

This paper contrasts two metaphysical accounts of modality and properties: Modal Realism which treats possible entities as primitive; and Strong Dispositionalism in which metaphysical possibility and necessity are determined by actually existing dispositions or powers. I argue that Strong Dispositionalism loses its initial advantages of simplicity and parsimony over Modal Realism as it is extended and amended to account for metaphysical rather than just causal necessity. Furthermore, to avoid objections to its material and formal adequacy, Strong Dispositionalism requires a richer fundamental ontology which it cannot explicate without appealing either to possible worlds or to an account of counterfactual truth conditions, both of which Strong Dispositionalism was intended to replace.

Quine's argument in 'Two Dogmas of Empiricism' illustrates an important interdependence: modality is required to individuate intensional entities – properties, meanings, concepts and the like – and intensionality is required to determine modality.[1] Quine's target was the logical empiricist project which sought to explain necessity entirely in terms of analyticity; the problem being that, according to Quine, one cannot explicate analyticity without appealing to modality, since sameness of meaning requires the necessary coextension of predicates. For logical empiricists, this circle is vicious and disastrous, but I will not be concerned with their fate here. What is less frequently noted is that the interdependence to which Quine drew attention is also crucial for philosophers of a more realist persuasion, since it captures the close connection between two important metaphysical notions of properties, meanings or concepts on the one hand and possibility and necessity on the other. For realists, Quine's circle need not be vicious since it marks ontological rather than epistemological interdependence, and it can be cured by ontological commitment to a primitive category or categories of entities which will serve to determine the rest.

If the intensional entities in question are properties, then this allows two directions in which the metaphysical explanation can run: possibility may be taken as primitive and used to determine

[1] W. V. Quine 'Two Dogmas of Empiricism', *Philosophical Review* (1951) **60**: 20–43, reprinted in W. V. Quine, *From a Logical Point of View* (Cambridge, MA: Harvard University Press, 1953): 20–46.

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properties; or properties may be presupposed which serve to ground possibility. The former strategy underlies one of the most well-known contemporary accounts of modality, David Lewis's Modal Realism. This takes possible individuals as primitive and uses these to ground possible worlds which, in turn, facilitate metaphysical accounts of properties, causation, the semantics of counterfactuals and more.[2] On the other hand, the latter strategy has quite recently been proposed by supporters of a dispositional account of properties who take causal powers or dispositional properties as primitive and use these to provide truth-makers for modal claims.[3] Unlike Lewis's account, such theories are actualist because possibility and necessity are entirely grounded in entities which exist in the actual world. Furthermore, one might call them 'hardcore' actualist theories because they aim to provide truth-makers for modal statements in terms of actual properties without first using these to derive possible worlds.[4] Thus, hardcore actualists aim to avoid both the ontological extravagance of Modal Realism and the commitment of other actualists to abstract entities which play the role of possible worlds, such as world-books or sets of propositions,[5] thereby providing a naturalistic account of modality if the world can be naturalistically understood.

The purpose of this paper is to investigate the prospects of hardcore actualism providing a viable account of modality; that is, whether it is plausible to think that properties determine possibility. To do so, I will concentrate upon one of the more thoroughly formulated versions of hardcore actualism known as 'Strong Dispositionalism' in

[2] David Lewis, *On the Plurality of Worlds* (Oxford: Blackwell, 1986).

[3] Supporters of dispositionalist accounts of modality include: C. B. Martin and John Heil, 'The Ontological Turn', *Midwest Studies in Philosophy* (1999) **23**: 34–60; A. R. Pruss, 'The actual and the possible', in *The Blackwell Guide to Metaphysics*, ed. R. M. Gale (Oxford: Blackwell, 2002): 317–33; Alexander Bird, *Nature's Metaphysics* (Oxford: Oxford University Press, 2007); Andrea Borghini and Neil E. Williams, 'A Dispositional Theory of Possibility', *Dialectica* **62** (2008): 21–41; Jonathan D. Jacobs, 'A powers theory of modality: or, how I learned to stop worrying and reject possible worlds', *Philosophical Studies* **151** (2010): 227–248; Barbara Vetter, 'Recent Work: Modality without Possible Worlds', *Analysis* Reviews **71** (2011): 742–754; *Potentiality: From Dispositions to Modality* (Oxford: Oxford University Press, 2015).

[4] The term 'hardcore actualism' is due to G. Contessa, 'Modal Truthmakers and Two Varieties of Actualism', *Synthese* **174** (2010): 341–353.

[5] For a comprehensive discussion of non-hardcore actualism, see John Divers, *Possible Worlds* (London: Routledge, 2002).

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which metaphysical possibility and necessity are grounded in the powers or dispositional properties of actual individuals.[6] I will argue that once this theory has been formulated so that it avoids some rather obvious objections, the intuitively attractive actualist ontology with which it began has been complicated to the extent that it forfeits its advantages over its main rival, Modal Realism.

In what follows, I will draw upon Modal Realism to make a comparative assessment of the plausibility of Strong Dispositionalism. This strategy is not intended to suggest that Modal Realism is the only alternative to Strong Dispositionalism on offer, nor even that it is the most viable one; there are plenty of objections to Modal Realism which I will leave undiscussed. Nevertheless, the centrality of Modal Realism in much contemporary philosophical thought makes it a good metric against which to compare this novel proposal which is formulated so differently. Theoretical comparisons of the type I will make are useful in metaphysics, since they give us an indication of how much success to expect and how much 'failure' or obscurity to allow: it is usual to see how well a theory measures up to our pretheoretical desiderata but, because no theory does so perfectly, it is instructive to consider how well the theory does in comparison with other, more well-established theories.

I will begin by sketching the main features of Modal Realism, in order to provide the basis for comparison, and introduce Strong Dispositionalism. I will then consider ways in which the ontology of dispositional properties is refined in order to avoid two objections: the first objection concerning the material adequacy of Strong Dispositionalism which maintains that there are intuitively plausible modal truths which lack dispositional truthmakers; and the second, concerning its formal adequacy which objects that Strong Dispositionalism is not a suitable basis for a plausible version of modal logic. I will argue that although these objections can be avoided, the amendments required serve to complicate the theory and to make the entities which it employs more obscure. I will then investigate whether the Strong Dispositionalist can explicate her richer ontology, thereby rendering these amendments harmless, and conclude that it is difficult to see how she will be able to do so without employing either the ontology of possible worlds or an account of counterfactual truth conditions, both of which Strong Dispositionalism was intended to replace. At best, Strong Dispositionalism loses the explanatory advantages it could initially claim over modal realism and has a lot of explanatory work still to do. At worst, Strong Dispositionalism cannot be

[6] I will primarily draw upon the work of Vetter, *op. cit.*, 2015, alongside Borghini and Williams *op. cit.* and Jacobs *op. cit.*

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coherently explicated except by appeal to ontology or to conceptual apparatus which it was formulated to avoid.

1. From Possibility to Properties: Lewis's Sales Pitch

Famously – or some might say 'infamously' – the modal realist regards non-actual, possible entities as existing in the same sense as actual ones.[7] Possible worlds, including the one we call 'the actual one', consist in maximal spatio-temporal related individuals, they are maximal mereological sums of the individuals at that world which are their parts. Furthermore, actuality is indexical: a world w is actual (and the other worlds possible) relative to the individuals in w. There are infinitely many of these worlds, existing in spatio-temporally isolation from one other, and therefore individuals in one world cannot be in causal contact with those in others. This presents epistemological problems about the justification of modal claims if one considers that being in causal contact with something is a necessary condition for having knowledge or justified beliefs about it.[8] But one need not think this, and it is open to the modal realist to develop alternative accounts of modal epistemology.

Lewis recommends accepting what seems to be an ontologically extravagant theory for the philosophical work that it does: according to him, the explanatory benefits make the ontological costs worthwhile. The principle benefits claimed for Modal Realism are as follows:[9] First, the modal realist's fundamental ontology of spatio-temporally related individuals and sets is clear and precise (if we allow, for a moment, the indulgence that these include possible but non-actual individuals); in Lewis's terminology, it is 'safe and sane'.[10] Second, this ontology of individuals and sets can provide set-theoretic

[7] David Lewis, *Counterfactuals* (Oxford: Blackwell, 1973), 85; *op. cit., passim*.

[8] This condition is famously thought to make knowledge of abstract objects problematic. See Paul Benacerraf, 'What numbers could not be', *Philosophical Review* **74** (1965): 47–73; 'Mathematical Truth', *The Journal of Philosophy* **70** (1973): 661–679. I will predominantly be concerned with ontological rather than epistemological matters in this paper.

[9] Given that this paper is primarily a critique of Strong Dispositionalism, I will not examine whether modal realism lives up to the claims which I make for it here. Importantly, if it does not, Strong Dispositionalism's position will be comparatively better. See Divers *op. cit.*

[10] The term 'safe and sane' originates with Lewis (*op. cit.* 1986, 141, 143, 155) and has been employed in metaphysical discussions of modality since.

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identity criteria for abundant properties and for propositions. Properties can be identified with sets of actual and possible individuals, while propositions can be identified with the sets of possible worlds at which they are true. Thus, constitutive identity criteria (which prove impossible to formulate set-theoretically in an ontology which includes only actual entities[11]) are available to the modal realist, making a form of class nominalism about properties viable once again. Additional categories, such as meanings, may be rehabilitated on the basis of the respectability of these entities. For philosophers who consider the provision of constitutive identity criteria for a category of entities to be important, and to offer an insight into the general nature of the members of that category, this feature of modal realism is an important one because it legitimizes a range of intensional entities which would otherwise be regarded as slightly mysterious. Third, modal realism aims to be reductive: modal operators can be eliminated in favour of quantification over possible worlds. Fourth, modal realism offers a wide modal range: in addition to the worlds in which the properties of this, the actual, world are distributed differently but still behave as they do in this world, there are metaphysically possible worlds in which the actual laws of nature are false, and perhaps (*contra* Lewis) worlds which are even stranger with respect to the actual one; for instance, worlds which differ in the logical laws they involve or which contain 'impossible' entities.[12] Fifth, the ontology provides truth-makers for modal statements including counterfactuals, thereby facilitating a counterfactual account of causality and a way of explaining causal laws.

Since my primary interest in this paper is not modal realism but a theory which contrasts with it, I will not evaluate these purported advantages here. But taken at face value, modal realism offers a host of explanatory benefits in return for the ontological commitment it requires. What does Strong Dispositionalism have to offer in its place?

[11] See Quine *op. cit.*, 31 and 'On the individuation of attributes' in *Theories and Things* (Cambridge, MA: Harvard University Press, 1981): 100–112; David Armstrong, *Universals and Scientific Realism vol. 1: Nominalism and Realism* (Cambridge: Cambridge University Press, 1978): 28–43 for famous counterexamples to this thesis.

[12] For modal realism about metaphysically 'impossible' worlds, see T. Yagisawa, 'Beyond Possible Worlds', *Philosophical Studies* **53** (1988): 175–204. For difficulties with this view and with unrestricted modal range more generally, see Sophie R. Allen, 'Curiosity kills the categories: a dilemma about categories and modality', *Metaphysica* **16** (2015): 211–30.

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2. From Properties to Possibility

In contrast to Modal Realism, Strong Dispositionalism grounds modality in a very different way. The basic ontological category employed is that of causal powers or dispositional properties, fine-grained entities which have their causal roles essentially. (I will use 'power', 'causal power', 'dispositional property' and 'disposition' synonymously in what follows. I will reserve 'potentiality' which appears later for more specific use.) A power just is the capacity to bring about a certain manifestation or effect, or else the power to bring about that manifestation given the appropriate stimulus or when instantiated in combination with reciprocal partner powers. Thus, even if a certain power remains unmanifested by the individual which instantiates it, that power determines what that individual could do, would do and must do in different conditions.[13]

Aside from the question of whether such essentially causal or modal properties are acceptable – which I will take, for the purposes of this paper, to be settled in the affirmative[14] – there are further points of disagreement between dispositionalists themselves about the nature of powers. One important difference of opinion concerns whether uninstantiated powers exist; that is, whether powers should be treated as Platonic transcendent universals which exist even if they are uninstantiated,[15] or whether we should adopt an Aristotelian conception of powers, such that powers exist if and only if they are

[13] Kit Fine ('Essence and Modality' *Philosophical Perspectives* **8** (1994): 1–16; *Modality and Tense* (Oxford: Oxford University Press, 2005)) argues for a slightly different hardcore actualist account of modality, using essences instead of dispositional properties to ground modality. I will not debate the relative merits of Fine's essentialist modality versus dispositionalism here, although further discussion of this point can be found in Barbara Vetter, 'Essence and Potentiality' MS academia.edu.

[14] For arguments in favour of a dispositionalist conception of properties see, for example, Sidney Shoemaker, 'Causality and Properties', in Peter van Inwagen, ed. *Time and Cause* (Dordrecht: D. Reidel, 1980): 109–35; Stephen Mumford, *Dispositions* (Oxford: Oxford University Press, 1998); George Molnar, *Powers: a study in metaphysics* (Oxford, Oxford University Press, 2003); Alexander Bird, *Nature's Metaphysics* (Oxford, Oxford University Press, 2007); Alastair Wilson, 'Schaffer on laws of nature' *Philosophical Studies* **164** (2013): 653–667; and against, see Jonathan Schaffer, 'Quiddistic knowledge' *Philosophical Studies* **123** (2005): 1–32.

[15] Bird *op. cit.* holds a restricted version of this view. See note 16.

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instantiated.[16] The former Platonic conception affords a far broader range of actually existing powers, since powers may actually exist although they are never instantiated by any actual individual (even in the sense of their being instantiated without manifesting). Perhaps, for instance, there is a power analogous to gravity which makes massive objects repel each other, a power which is never instantiated by any actual individual but which according to the Platonic version of dispositionalism actually exists.[17] On the other hand, the supporter of the Aristotelian conception of powers rejects such uninstantiated, alien powers, although she accepts that certain instantiated powers exist unmanifested.

Although Platonic actualism offers a greater range of possibilities than Aristotelianism, it does so by treating powerful properties as abstract entities, entities which are aspatial and (most probably[18]) atemporal. Moreover, since the modal strength of powers to manifest further powers is presumed to obtain on the basis of their intrinsic natures, the Platonic conception of powers also requires that there be necessary causal connections between abstract powers, rather than their instantiations, which further complicates the theory.[19] Like Modal Realism's possible worlds, abstract entities bring their own metaphysical and epistemic challenges and so Strong Dispositionalism would be in a comparatively stronger position if abstracta were not presupposed specifically to ground modality. Furthermore, on an Aristotelian conception of powers, Strong Dispositionalism would be

[16] The instantiation here is tenseless: a property exists if and only if it has been, is, or will be, instantiated in space-time.

[17] There is room for the Platonists to disagree about which uninstantiated powers exist. For instance, one might restrict the range of powers to those which *could* be instantiated alongside those which actually are and resist alien universal powers which could never be instantiated by actual individuals. (One might do this to account for the fact that certain determinate quantities of a determinable, such as mass, are not actually instantiated.) However, in the context of grounding modality, one might prefer a wider range of powers in order to ground a wider range of possibilities and thus include alien powers among the universal powers which exist. Since I will concentrate upon the Aristotelian conception, I will not examine these options here.

[18] For a notable exception, see Quentin Smith, 'Absolute Simultaneity and the Infinity of Time', in Robin Le Poidevin, ed., *Questions of Time and Tense* (Oxford: Oxford University Press, 1998): 135–183.

[19] While Plato accepted the existence of causal relations between abstract forms, it is not popular among contemporary philosophers. See for instance *Phaedo*, 96a, 97c-d.

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able to provide an entirely naturalistic or physicalist account account of modality should naturalism or physicalism be true. With this in mind, I will begin by presuming Aristotelianism about powers and require that actual powers respect the Principle of Instantiation: only those powers which are instantiated by actual individuals exist.

Although the foregoing paragraph appears to suggest that powers are universals, one does not need to accept this view. One could alternatively maintain that powers are tropes, or that they are primitive property-like entities which cannot be analysed further. Any plausible account of the ontological basis of properties is open to the strong dispositionalist with the only restriction being that one would have to avoid any account of objective similarity and difference which requires modal realism. So, for instance, one could not ground powers by appealing to certain versions of resemblance nominalism for either individuals or tropes.[20]

The dispositionalist exploits the natural modal force inherent in dispositional properties in order to provide an account of ways the world might be, might have been or must be. For instance, it is possible that the glass I am drinking from will break, it is possible that this paper was written in German rather than English, and it is necessary that the ice cube in my water will melt at room temperature. While the modal realist grounds these claims in the existence of possibilia, the strong dispositionalist maintains that all such truths about possibility and necessity are determined by the existence of powers.

To put the account into formal terms, the strong dispositionalist makes two related claims:

POSS: $\Diamond p \equiv \exists \varphi \rangle [p](\varphi)$

It is possible that P *if and only if* there exists a power Φ to bring it about that P

NEC: $\Box p \equiv \neg \exists \varphi \rangle [\neg p](\varphi)$

It is necessary that P *if and only* if there is no power to bring it about that P is not the case.

(where '$\rangle [p](\varphi)$' is shorthand for 'φ is the power to bring about p')[21]

[20] For instance, the Resemblance Nominalism in Gonzalo Rodriguez-Pereyra's *Resemblance Nominalism* (Oxford: Oxford University Press, 2002) or Resemblance Class Trope Nominalism, as discussed in Douglas Ehring, *Tropes: Properties, Objects and Mental Causation* (Oxford: Oxford University Press, 2011).

[21] The formal versions are due to David Yates, 'Dispositionalism and the Modal Operators', *Philosophy and Phenomenological Research* **91** (2015): 414. Since NEC and POSS are interdefinable, we need only one of them. I have chosen a version of dispositionalism which quantifies over

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The advantage claimed by the dispositionalist is that an account of possibility and necessity can be given solely on the basis of actual entities, the powerful properties which exist in the actual world. Such an account of modality is not only set apart from Modal Realism in its commitment to actualism, but also because of the nature of powers it is non-reductive. The natural modal force inherent in powers which makes causal processes occur when such powers are instantiated in the appropriate circumstances is treated as a primitive in the theory, not open to further analysis. The truth conditions of de dicto necessity and possibility are grounded by objectively existing modality in the world.

Does this failure to provide a reductive account of modality count against Strong Dispositionalism? On this point, it is best for the strong dispositionalist – in fact, any dispositionalist – to remain unrepentant. Accepting that causal powers exist involves denying the Humean claim that there are no necessary connections between distinct individuals. Reduction of modality is not required because natural necessity is an intrinsic feature of powers or dispositional properties, entities which are thought by the dispositionalist to exist anyway and which have not been postulated specifically for the purpose of providing truth-makers for modal statements. Furthermore, the strong dispositionalist urges, these powers are neither ontologically nor epistemologically mysterious, despite the long history of suspicion about the existence of such entities due to the empiricist worry that we cannot have experiential evidence of what something could or must do, only what it actually does. (If there are dispositional properties such as solubility and fragility in nature at all, the empiricist tends to think, then they are reducible to categorical, or non-dispositional bases, or else statements about them can be translated into counterfactual conditionals.[22]) It is an overly strong version of empiricism, the dispositionalist argues, that

powers and not over the individuals which have them (*pace* Vetter, 2015 *op. cit.*), since this allows the theory to account for a wider range of possibilities from the outset. For instance, it is more plausible to think that the possibility that this paper was written in German rather than in English is determined by powers instantiated by its author (me) and my environment and history, rather than by powers which the paper itself instantiates.

[22] Nelson Goodman, *Fact, Fiction and Forecast* (Cambridge, MA: Harvard University Press, 1954); Elizabeth Prior, *Dispositions* (Aberdeen: Aberdeen University Press, 1985); David Lewis, 'Finkish Dispositions', *The Philosophical Quarterly* **47** (1997): 143–158; D. H. Mellor, 'The Semantics and Ontology of Dispositions', *Mind* **109** (2000): 757–780.

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precludes our being justified in believing that a sugar cube could dissolve even though we have not put it in water, or that the wine glass is breakable, even though we have not yet thrown it onto a stone floor. We encounter such dispositional properties in our ordinary experience of the world because we are in causal contact with them, and so the epistemic difficulties associated with our finding out about the non-actual but possible entities of modal realism do not arise. Once we have abandoned strict empiricism, the acceptance of necessity in nature does not seem so odd.

These considerations about the ubiquity of causal powers are also brought to bear on another difference between Strong Dispositionalism and Modal Realism: unlike the latter, the former does not claim to have clear, independent constitutive identity criteria for the fundamental ontology of its theory. Powers or dispositional properties are individuated by their manifestations, or by their respective stimuli and manifestations,[23] but in both cases this involves their being individuated by another power or powers. There are no non-circular identity criteria to be had. However, the dispositionalist can argue that identity criteria are not required to legitimize her ontology. Although, as the empiricists recognised, the modal nature of powers is not part of our ordinary experience, powers themselves enter into causal relations with us. More controversially, one might contend that first person experience of our own abilities and dispositions can give us an insight into the intrinsic nature of dispositions.[24] Furthermore, one might argue that the Quinean demand for identity criteria for every ontological category is too strong,[25] and that the provision of constitutive identity criteria should only be a requirement in cases where the

[23] Individuation by manifestations alone is preferred by Strong Dispositionalists about modality. See Borghini and Williams *op. cit.*, 24, 27 and Vetter *op. cit.*, 2015, 35 and ch. 3 *passim*. For simplicity, I will not discuss Borghini and Williams' distinction between dispositions and dispositional properties since nothing in my argument depends upon this.

[24] I will not rely upon establishing this point. Not only would one have to argue that we do indeed have first person experience of instantiating dispositions as agents, one would also have to affirm that this conception generalises to properties which are not a matter of our direct subjective experience. See Stephen Mumford and Rani Lill Anjum, *Getting Causes from Powers* (Oxford: Oxford University Press, 2011), 176.

[25] W. V. Quine, 'On what there is', *Review of Metaphysics* **5** (1948): 21–38, reprinted in W. V. Quine, *From a Logical Point of View* (Cambridge, MA: Harvard University Press, 1953): 1–19; 'Ontological Relativity', in *Ontological Relativity and Other Essays* (New York: Columbia University Press, 1969): 28–68.

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entities in question are abstract, or causally isolated from us in other ways such as Lewis's non-actual possible worlds. Although identity criteria might be methodologically useful, one might object that they are not required in the case of powers, especially on the Aristotelian conception of them. Because the powers it postulates are familiar to us from everyday experience, Strong Dispositionalism does not have to match Modal Realism in this respect.

One clear advantage which Strong Dispositionalism can claim over Modal Realism is that, for the most part, possibilities are determined locally: what a thing could do is determined by the powers which that particular thing has. Thus, for instance, it is possible that the water glass on my desk will break because the glass is fragile and fragility is a disposition which will make it the case that the glass breaks if struck with the requisite force. Not only is this localized modal power in line with our intuitions, but it also ensures that Strong Dispositionalism is not susceptible to what has become known as Kripke's 'Humphrey objection' which is brought against modal realism and its denial of transworld identity in favour of counterparts.[26] The modal realist says that it is possible that Humphrey rather than Nixon won the 1968 US presidential election because there is a possible world in which a counterpart of Humphrey won the election. But, the objection goes, it does not matter to Humphrey (or anyone else) that someone very much like him won the election (in fact, that a lot of people very much like him won the election) because these counterpart people are not Humphrey himself. For the modal realist, the possibility of Humphrey's winning has nothing to do with the actual individual Humphrey. On the other hand, for the strong dispositionalist, the possibility that Humphrey won the election is grounded by properties which Humphrey actually instantiated; the possibility can be traced to what the actual Humphrey was like. One need not, of course, be a strong dispositionalist to solve or avoid the Humphrey Objection: one can retain modal realism and permit (*pace* Lewis) transworld identity, or else another non-dispositionalist version of actualism will make it the case that the possibility of Humphrey winning is grounded in the actual Humphrey. However, it is significant that Strong Dispositionalism can respect the intuition that what a thing can or must do is determined by something about it, rather than by entities with which it is in no causal contact such as non-actual possible individuals, or abstracta.

[26] Saul Kripke, *Naming and Necessity*, (Cambridge, MA: Harvard University Press, 1980): 45, note 13.

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To summarise, Strong Dispositionalism shares Modal Realism's explanatory power in the sense that it provides an account of the truth conditions of counterfactuals and modal claims, and the ontology of powers can be employed to provide an account of causality and also of natural laws.[27] The account of modality on offer is localized, actualist and will also be naturalistic if the world is. Where the theories differ is in their formulation: Strong Dispositionalism is neither reductive nor provides identity criteria for the fundamental entities it employs. But crucially, it is in virtue of the very nature of those entities that the strong dispositionalist can claim that she does not need to meet such requirements in order to make her ontology 'safe and sane': irreducibly modal powers are part of what we experience in the world.

3. Some refinements to Strong Dispositionalism

So far, the ontology of powers or dispositional properties has a good prospect of providing an account of natural, causal or nomic necessity.[28] Dispositional properties are, as we currently understand them, paradigmatically causal entities and it is because of intuitions surrounding the natural necessity which accompanies causal processes that powers provide a plausible actualist account of causal modality. But the strong dispositionalist wants more than this. In particular, she wants to give an account of *metaphysical* necessity and possibility, not merely the more restrictive causal or nomic necessity, without thereby giving a deflationary account of metaphysical modality which claims that metaphysically possibility is nothing more than either what is causally possible or what is possible according to the laws of nature (if these are different). But are there enough dispositional properties to ground this broader modal range?

There are two immediate challenges for the Strong Dispositionalist, both of which arise from the concern that there are not enough powers to ground every metaphysical possibility and necessity. The first

[27] Stephen Mumford, *Laws in Nature* (London: Routledge, 2004); Bird, *op. cit.*; Wilson, *op. cit.*

[28] I shall, for the purposes of this paper, assume that the dispositionalist can at least do this. However, for an argument against the view that dispositional properties produce their manifestations as a matter of necessity, see Mumford and Anjum, *op. cit.*, 8.2. which might undermine the project to employ powers to ground modality. Their conclusion is challenged in Vetter *op. cit.* 2015, 92–3; Anna Marmadoro, 'Dispositional Modality vis-à-vis Conditional Necessity' *Philosophical Investigations* **39** (2015): 205–14.

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problem arises from concerns about the *material adequacy* of Strong Dispositionalism: there are some intuitively plausible modal truths which appear to lack actual truthmakers of either the dispositional or non-dispositional variety. The second challenge arises because some truths appear to have non-dispositional truth-makers and this threatens the *formal adequacy* of Strong Dispositionalism; that is, whether it can be used as the basis for a plausible version of formal modal logic. I will argue that although the strong dispositionalist can meet both of these challenges, she does so at the cost of postulating increasingly implausible actual powers. These create further problems with formal adequacy and they introduce an additional dimension of ontological complexity which may be impossible to explain without recourse to non-dispositional accounts of modality.

3.1 Material Adequacy

Are there enough powers instantiated by actual individuals to ground every metaphysically possible truth, and every metaphysically necessary one? The problem of material adequacy can be distinguished into two problems of differing levels of severity, a local problem and a more general one: first, there may be metaphysical possibilities for which the requisite truthmaking powers are not instantiated among the individuals or environment to which the possibilities pertain; second, there may be metaphysical possibilities requiring alien powers which (perhaps) could never be instantiated by actual individuals. I will concentrate upon the former, local problem, although I will also touch upon the latter. The reason for this bias is that initially it is more important for the strong dispositionalist to solve the former problem because with the latter she could simply bite the bullet and argue that such alien powers do not exist. It is *prima facie* acceptable for actualists to deny that the range of genuine possibilities is as wide as the modal realist would insist.[29] There may be, for instance, no genuine counterlegal possibilities which could only be actualized were the actual laws of nature false.

Even disregarding the possibilities grounded in alien powers, there is still a problem with material adequacy. As it stands, Strong Dispositionalism faces some obvious counterexamples. For instance, take the following sentences:

i) It is possible that my eldest great grand-daughter is a famous mathematician.

[29] For instance, see Borghini and Williams, *op. cit.* 35–40; Wilson *op. cit.*; Vetter, *op. cit.* 2015, 267–273.

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ii) It is possible that I'm a Wing Chun Master.
iii) It is possible that the Golden Gate Bridge melts.

All of these statements appear not to have actual powers which make them true, but we would intuitively judge that they are all true metaphysical possibilities. Fortunately, strong dispositionalists have suggested ways to account for metaphysical possibilities such as these by expanding or enriching the ontology of actual powers.

The first method deals with examples such as (i). It is possible that my eldest great grand-daughter is a famous mathematician even though I have no great grand-daughters and may never have any. However, this seems to be a genuine possibility and, even by strict actualist lights, it seems very plausible to think that the world currently contains powers which could bring (i) about. To see how this could occur we need to think in terms of the powers which actually manifesting powers might bring about, and the powers which these powers might bring about, and so on. In other words, we need to think in terms of *iterated* or *higher order* powers.[30]

Borghini and Williams suggest a way to rank this hierarchy, ensuring that it is grounded in powers which are actually manifested in the world. If we treat the actually instantiated powers as first order, we can rank the powers which these first order powers have the power to produce as second order, the powers which second order powers have the power to produce as third order, and so on.[31] Iterated powers deal adequately with future possibilities in which the individual involved does not yet exist (and may never exist), such as the possibility of my eldest great grand-daughter being a famous mathematician, because actually instantiated powers have the power to bring about powers which bring about powers and so on… that I have a grand-daughter and that she is a famous mathematician. Furthermore, higher-order powers can deal with possibilities which will never be actualized, such as the possibility of my being a Wing Chun Master. There are actually instantiated powers which could have brought about my having the power to be one, or else instantiated powers to bring the former powers about, thus I possess a higher-order power to become a Wing Chun Master

[30] I will use these terms interchangeably.

[31] *op. cit.* 30–1. As Vetter notes, there is some confusion in Borghini and Williams' text about the numbering and direction of the ordering (*op. cit.* 2015, 135, note 25). Since the question of where to start ordering is largely arbitrary, I will simply aim for consistency in what I say, rather than attempting to determine what Borghini and Williams intend to say.

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after all. Lack of training, talent and patience, in addition to the failure of a long chain of favourable conditions to manifest, means that the power to be a Wing Chun Master remains unmanifested by me, but the higher-order power nevertheless grounds the possibility that I could have become one and this higher-order power ultimately exists in virtue of first-order powers. Higher-order powers broaden the range of possibilities which the strong dispositionalist can account for by grounding every possibility which actually instantiated powers or combinations of them could bring about.

How broad a range of possibility do iterated powers permit? This general question is both fascinating and difficult. Most higher order powers will also be actually instantiated as first order powers by other individuals, but some may not be: given the right combination of powers, the world might have contained dragons, or Cartesian egos, or silicon-based life. Thus, iteration might facilitate an actualist account of merely possible entities. Furthermore, Borghini and Williams claim that their account of possibility is not simply restricted to nomic possibility and necessity but is 'supernomic'; novel laws of nature might be added to those which exist already, in virtue of the novel iterated powers, and new possibilities emerge. The question of the modal range that actual powers permit is complicated because it requires consideration of how properties can combine to produce novel properties, and exactly how 'novel' these are. Since, as I noted, the actualist dispositionalist can stand her ground against some general questions about material adequacy, I will delay discussion of this matter for another time.

The possibility in (iii) of the Golden Gate Bridge melting cannot be dealt with by higher-order powers and requires different treatment. Borghini and Williams argue that such possibilities are grounded by more specific, finely-grained powers. In (iii), the power to melt *is* instantiated by the bridge, and so it is first order, but simply calling this dispositional property 'the power to melt' is elliptical for the complicated set of conditions which would be involved in a steel bridge melting. However, it is not obvious how this strategy is to work in conjunction with Borghini and Williams' claim that powers are to be individuated by their respective manifestations, rather than by their stimulus conditions and manifestations.[32] The additional detail required to specify the Golden Gate Bridge's *power to melt* and to differentiate it from the Bridge's *power to remain solid* is not part of the former power's manifestation – its melting – but part of the conditions required for the power to

[32] Borghini and Williams, *op. cit.* 24 and 27.

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manifest, that is the stimulus conditions which must obtain. Borghini and Williams' strategy to account for unlikely metaphysical possibilities is not compatible with their conception of powers or dispositions being individuated by their manifestations alone. Furthermore, individuating powers in a more specific and fine-grained way according to both stimulus and manifestation also distinguishes powers from each other in a way in which our ordinary modal statements do not. When we assert (iii), that it is possible for the Golden Gate Bridge to melt, we mean that it is possible that a process will occur which is basically the same as that which occurs when an ice cube melts. The finer-grained individuation of powers would obscure this similarity: the power to bring about the melting of the Golden Gate Bridge would be a distinct power from that which brings about the melting of the ice cube, due to the difference in causal conditions required.

Vetter avoids this problem and pre-empts the localized material adequacy objection by characterising a slightly different conception of a power or disposition, a category of entities which she calls '*potentialities*'. Like powers, potentialities give an individual the power to do something, or to instantiate a further potentiality or potentialities (so there can be iterated potentialities), or to make a state of affairs come about; but unlike powers, potentialities are also possessed by individuals as a matter of degree. Thus, the Golden Gate Bridge instantiates the potentiality to melt to a minimal degree, while an ice cube instantiates it to a very high degree. Arguably, we can also explain some cases which employed iterated powers by appealing to potentialities being instantiated by degrees: I might still be said to instantiate the potentiality to be a Wing Chun Master to a minimal degree because were I to take up training now (and a host of favourable circumstances transpired), the possibility of my becoming a Wing Chun Master could be actualized.

Does it matter that accepting both iterated potentialities and potentialities had by degrees might provide more than one set of truth-makers for some possibility claims? I think that it does not because one can argue that it allows us to explain the different senses in which assertions about possibility are made. Currently, there is a *very* slim possibility that I could actually become a Wing Chun Master, grounded by the potentiality I have to become one which I possess to a minimal degree; while the possibility of my being a Wing Chun Master is *also* grounded in another sense by potentialities I previously instantiated to a high degree, which ground higher-order potentialities that I became one. These are ways the world could have been which will not be actualized. Explanation in terms of iterated potentialities does not conflict with explanation in terms of potentialities had as a matter of degree.

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3.2 Formal Adequacy

If Strong Dispositionalism is to provide a competitive account of modality, then it should be able to form the basis of a plausible formal modal logic. Otherwise, formal theories based upon possible world semantics will remain the standard and Strong Dispositionalism will be, at best, a metaphysical sideshow. I will raise two difficulties concerning formal adequacy, although there are others.

The first problem arises if any actual truths are made true by properties which are non-dispositional. Consider the following three examples:

iv) Individual *c* is square.
v) $2 + 3 = 5$
vi) The Golden Gate Bridge is either dancing or not dancing.

First, it will seem plausible to those who are not committed to pan-dispositionalism about properties that sentences (iv)–(vi) are made true by properties which are not dispositional but *categorical*; that is, they are qualitative properties which do not have their causal or modal power essentially. In this instance, these would be the properties of *being square*, mathematical properties such as *adding up to 5*, and the property of *either dancing or not dancing*.

Second, although there are different ways of formulating formal systems of modal logic, certain axioms are widely considered to be crucial, among which is Axiom (T) that *if P is true, then it is possible that P*:

$$(T) \vdash p \supset \Diamond p$$

However, if the truthmakers for (iv)–(vi) are not dispositional, then there are actualized possibilities which appear to lack dispositional truthmakers, and so are not possible according to POSS which holds that *it is possible that P if and only if there is a potentiality to make it the case that P*. Thus, 'Individual c is square' is true, but 'It is possible that individual c is square' is false, and so Axiom (T) turns out to be false.[33]

Given that Axiom (T) is widely considered to be essential for a plausible system of modal logic, this outcome would be a disaster

[33] Yates argues that axiom (K) $\vdash \Box (p \supset q) \supset (\Box p \supset \Box q)$ fails for the same reason as (T). I will not consider this problem separately since it can be rectified by the best response I suggest to preserve (T) which is to insist that all truthmaking properties are dispositional. *op. cit.* 2015, 414–5.

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for Strong Dispositionalism. The strong dispositionalist needs a remedy and there are three which would preserve her position.[34] First, she might insist that there are powers or potentialities to ground possibilities alongside categorical properties; for instance, that there is a *power to make it the case that c is square* which determines the truth of the proposition 'It is possible that c is square'. However, postulating such a power just to make POSS true seems *ad hoc* and also leaves the strong dispositionalist in a peculiar situation with respect to the truth-makers of (T). In some cases at least, the antecedent of (T) is made true by a different truth-maker to the consequent (the categorical property *being square* and *the power to bring it about that something is square*) with no clear ontological relationship between them. To counter this, the strong dispositionalist might secondly argue that *the power to bring it about that something is square* is also a truth-maker for the actual truth that 'c is square', but that move seems ontologically uneconomical, and again – given that there is a categorical property as a truth-maker already – rather *ad hoc*. The existence of purely qualitative, categorical properties creates problems for strong dispositionalism, even if such properties are not thought to play a role as truthmakers in non-actual modal truths. In light of these points, the third, remaining move is the most plausible one for the strong dispositionalist: commit to a pan-dispositionalist ontology, one in which *all* properties have their dispositional natures essentially.

There are various ways in which one might accept pan-dispositionalism and yet allow a place for paradigmatically categorical properties. For instance, one might characterise 'categorical' properties as powers which are constantly manifesting,[35] or else take a dual

[34] David Yates urges the strong dispositionalist to admit defeat at this point, on the basis of examples such as (iv)–(vi), and proposes an account he calls 'Weak Dispositionalism' which amends POSS and NEC to:

$$\text{POSS (Weak):}\ \Diamond p \equiv \{p \vee \exists \varphi\rangle[p](\varphi)\}$$
$$\text{NEC (Weak):}\ \Box p \equiv \{p \,\&\, \neg\exists\, \varphi\rangle[\neg p](\varphi)\}.$$

Since my concern is the defence of Strong Dispositionalism, I will not explore this proposal here, although Yates' mixed account potentially requires different truth-makers for some contingent truths and the possibilities associated with them. Thus his view would be susceptible to criticisms of the mixed truthmaker solution in the present paragraph. Yates, *op. cit.* 419.

[35] Andreas Hüttemann, 'A disposition-based process-theory of causation' in Stephen Mumford and Matthew Tugby, eds. *Metaphysics of Science* (Oxford: Oxford University Press, 2013): 101–122.

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aspect view of properties[36]: for instance, that *being square* is the manifested qualitative aspect of a property which is also essentially dispositional. Vetter's preferred solution again exploits potentialities which are instantiated by degrees: the powers which are always manifesting are potentialities which are instantiated to a maximal degree. However, although this approach deals with the paradigmatically categorical properties which would otherwise cause trouble for dispositionalism, such as (arguably) *being square*, or *being red*, it will not on its own resolve cases which involve necessary truths such as '2 + 3 = 5' or 'The Golden Gate Bridge is dancing or it is not dancing'. There is a further difficulty concerning *which* actual entities instantiate these continuously manifesting potentialities such as those which act as truthmakers for (v) and (vi).

In the case of potentialities which ground logically necessary truths such as (vi), the answer to this question may have to be that *everything* instantiates such potentialities to the maximal degree. This strategy countenances an abundance of potentialities which manifest all the time. Although this may be acceptable in the case of logical potentialities – perhaps we might regard logical potentialities as somehow derived from the distribution in individuals of more prosaic potentialities, such as the potentiality to melt, or to dance, and so on – it is not an attractive option in the case of mathematical potentialities; we do not want to have to say that everything has the continuously manifesting potentiality *to make 2 + 3 = 5* (and every other mathematical truth).

A very vague answer which the strong dispositionalist can give is that *something but not everything* instantiates such dispositions.[37] A more specific answer might, in the case of mathematical truths, point towards the various different accounts of mathematical ontology on offer. Depending upon what one thinks that numbers are, one might think that the potentialities for numbers to enter into relationships with one another are instantiated by those entities, and that they manifest such dispositions continuously (to use Hüttemann's terminology). If one thinks that numbers are abstract objects for

[36] Robert Schroer, 'Can a single property be both dispositional and categorical? The "Partial Consideration Strategy" partially considered', *Metaphysica* **14** (2013): 63–77.

[37] A reply given in a paper by Vetter on 26th November 2014, University of Oxford.

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instance, it seems plausible enough to say that the powers of 2, 3 and 5 combine to make it the case that 2 + 3 = 5. This would involve, of course, it being plausible that abstracta can instantiate dispositional properties, and while the Platonist about powers would have no difficulty with this shift to potentialities being instantiated by abstract entities, it is not clear whether it is compatible with the Aristotelian conception of powers. Alternatively, if one thinks that the ontology of mathematics is somehow determined by concrete, spatio-temporally located entities, then one might think that mathematical truths are made true by the potentialities of those spatio-temporally located things, or by iterated potentialities of those things.[38]

I will not undertake a full survey of the options for mathematical ontology due to limitations of space, but it seems clear that at least some accounts of what numbers are would permit one to say what it is which instantiates the potentiality to make mathematical statements true (and ensures that there is no power to make them false, thereby making them necessary). The strong dispositionalist can save Axiom (T).

A second point of contention concerning the formal adequacy of modal logic based on potentialities concerns Axiom (S4), *if it is possible that it is possible that P, then it is possible that P*:

$$(S4) \vdash \Diamond\Diamond p \supset \Diamond p$$

Given POSS, the possibility of P requires there being a power or a potentiality to bring P about, and so the possibility of the possibility requires a potentiality to bring about a potentiality that P. Given the introduction of higher order potentialities, we can make sense of the existence of potentialities to bring about other potentialities, but it seems highly implausible to say that the existence of a higher order potentiality implies the existence of one of a lower order. For instance, I have the (at least) second order potentiality to speak Kurdish, on the basis of which we would be happy to say that it is metaphysically possible that I speak Kurdish. But I know no Kurdish words, nor grammar, nor do I have lessons nor a book to teach myself from: what grounds the second order potentiality is that I instantiate first order potentialities to acquire each of those things. But that does not seem to be enough to say that I have the

[38] However, this kind of broadly physicalist view of mathematical ontology is rare. See J. S. Mill, *A System of Logic*, Book II (London: Longmans, Green and Company, 1843): Chapters 5 and 6.

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first order potentiality to speak Kurdish; that is a potentiality instantiated by my Kurdish-speaking colleague, but not by me.

Vetter – the only strong dispositionalist to have taken the formalisation as far as to consider the matter – seems unsure about whether to commit to an equivalent axiom for her system of potentiality.[39] She accepts that (S4) does not hold when we consider whether the existence of potentialities to produce potentialities entails potentialities, but then she introduces a generalised conception of iterated potentialities – potentiality* – which pays no heed to the order of iteration. Thus, she argues that having the potentiality* to produce the potentiality* to M entails having the potentiality* to M. Given her generalisation, this seems acceptable; but her generalisation to potentiality* does not seem acceptable because it only holds if we treat all orders (including first order) potentialities as simply 'iterated' potentialities (potentiality*), and this removes important information about the ultimate grounding of all potentiality in first order, actually instantiated potentialities. A precise assessment of Vetter's position should be undertaken elsewhere, as I cannot do justice to it here, and it is enough for my argument to cast doubt upon the truth of (S4) given the account of higher order potentialities under consideration.

Unlike (T), the inclusion of (S4) is negotiable and some systems of formal modal logic do without it.[40] However, if we take the ordering of higher order potentialities seriously and their being grounded by first order, actually instantiated ones is important, then it is not an acceptable move to remove the distinction between first order potentialities and the rest; but if we retain the distinction, we cannot admit (S4), since it would collapse all higher potentialities into first-order ones.

4. Potentialities: a 'safe and sane' ontology?

From the preceding discussion, there are ways in which the strong dispositionalist can avoid objections about the material and formal adequacy of her theory. However, the fundamental category of entities which is employed has changed radically from its fairly intuitive beginnings: we have moved from causal powers which were individuated by their manifestations, to potentialities which can be possessed as a matter of degree (and are individuated by both manifestation and degree), can be iterated or of higher orders, can

[39] Vetter, *op. cit.* 2015, 212.

[40] Nathan Salmon, 'The Logic of What Might Have Been' *Philosophical Review* **98** (1989): 3–34.

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be non-causal, can be continuously manifested and can be possessed by abstract objects. The ontologically richer category of potentialities is more abundant and more fine-grained, with many more potentialities instantiated by every actual individual than could be detected by ordinary experience or determined by experimentation.

The first worry arising from this shift is that the admission of non-causal potentialities results in the loss of a key argument in favour of the dispositional conception of properties, and hence also in favour of Strong Dispositionalism. This argument is based upon the plausibility of constitutively identifying and individuating properties in terms of their causal or nomic roles, in the absence of other plausible criteria to do so.[41] But it does not, of course, apply to non-causal potentialities, once these are postulated. The Strong Dispositionalist does not appear to have a good argument for extending the ontology to include these entities except for the fact that she wishes to give a uniform and actualist account of modality. A primary motivation for pan-dispositionalism has been lost once non-causal potentialities are allowed.

A second worry is that the strong dispositionalist has also forfeited her justification for not having to provide identity and individuation criteria for the fundamental entities in her ontology. In addition to potentialities being individuated along a causal or qualitative dimension – there being different kinds of them according to their manifestations – the admission of degrees introduces another way in which potentialities may differ from each other. Since such entities were introduced to act as truthmakers for a huge range of rarely actualized possibilities, such as the possibility of the Golden Gate Bridge's melting, or its tasting of chocolate, such entities will not be part of our everyday experience of the world, nor is it obvious that an individual possesses such potentialities to a low degree on the basis of those potentialities which it actually manifests. Thus, the claim that we do not require identity criteria for potentialities because they are part of our everyday experience is not plausible in the way that it was for powers.

Potentialities might be exactly the right kind of property-like entities to ground modality, but as potentialities have been made ontologically richer than mere powers, they have become progressively less 'safe and sane' as an ontological category. Those who are concerned about admitting the modal realist's possible but non-actual

[41] Shoemaker, *op. cit.* For further discussion about the options for individuation, see S. R. Allen, *A Critical Introduction to Properties* (London: Bloomsbury, 2016), Ch. 5.

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individuals which exist in the same sense as actual ones might be equally concerned about potentialities.

This worry might be ameliorated if we had a better understanding of what it is for a potentiality to be possessed as a matter of degree, a question to which I will turn in the next section.

5. How should we understand potentialities being possessed by degrees?

What can one say about what it means for a potentiality to be possessed to a degree? So far we have only intuition and a few comparative examples:

a) The Golden Gate Bridge has a lower degree of potentiality to melt than an ice cube does.
b) 2 + 3 has a maximal potentiality to be identical to 5.
c) The kettle has a greater degree of potentiality to heat the water than the candle does.
d) The Golden Gate Bridge has a (rather) minimal degree of potentiality to taste of chocolate.
e) The electron has a maximal degree of potentiality to repel other electrons.

Vetter argues that the best way of understanding a maximal degree of potentiality is in terms of there not being a potentiality to do otherwise.[42] If (b) and (e) are genuine examples of a potentiality being possessed to a maximal degree, then that is because there is no potentiality which grounds 2 and 3 not being identical to 5 when added together, nor is there a potentiality which would ground an electron's attracting other electrons. I will not contest this analysis because I think that the philosophical problems really start when one considers how we are to understand what grounds potentialities of intermediate degrees, and this has not yet been given a thorough explanation.[43]

There is an easy explanation, but it does not resolve the conceptual problem: in many cases, potentialities will be had to a specific degree by an individual because that individual has other potentialities (and

[42] *op. cit.* 2015, 86–92.

[43] Vetter (*ibid.*) agrees that further explanation is required, but only hints at the correct analysis. Hence much of my discussion will proceed from first principles.

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so does its environment, if they are extrinsic potentialities) which ground the former ones. The Golden Gate Bridge has a low degree of potentiality to melt *in situ* and an even lower degree of potentiality to taste of chocolate because of other potentialities it has. But these grounding potentialities will also be instantiated to a certain degree, as will the potentialities which ground them. Either we eventually get to fundamental potentialities which are themselves instantiated to some degree or other (which can be explained no further)[44], or the chain of grounding continues indefinitely because the world is infinitely complex. Both horns of this dilemma result in a situation where being instantiated to a certain degree remains unexplained.

Given the examples (a)–(e) above, there are (at least) three ways of understanding a potentiality's being possessed by a degree. Let us consider the options in terms of a comparative claim concerning two individuals, b and c.

An individual b possesses the potentiality to M to a greater degree than individual c does *if and only if*

I) b manifests *more M* than c does
II) b manifests M *more often* than c does
III) b's manifesting M is *more likely* than c's manifesting M

Reading (I) would fit examples (a) and (c): the Golden Gate Bridge does begin the process of melting on a hot sunny day (the steel it is made of expands, at least) but it does not turn to liquid as an ice cube does. The candle flame heats the water a little bit, but not as much as the kettle does. The intensity of the respective potentialities varies in the different cases. This reading also fits some of what Vetter says about degrees: 'Typically, the disposition's degree is (inversely) correlated with that of its stimulus. Thus, in general, a glass that is more fragile will break if struck with a lesser force, and one which is less fragile will break only if struck with a greater force.'[45] So, given an exactly similar stimulus, the disposition with the greater degree would have a greater or more intense effect.

[44] There is disagreement over whether fundamental potentialities are instantiated to a maximal degree. Vetter, following Bird, suggests that they are; while Cartwright disagrees. In fact, explaining the degree to which higher level potentialities are possessed might be made easier if they were not. *Ibid*., 86; Bird, *op. cit*.; Nancy Cartwright, *Nature's Capacities and their Measurement* (Oxford: Oxford University Press, 1989). It is difficult to resolve this dispute until we have a better idea of what a potentiality's being possessed to a degree involves.

[45] *Op. cit*. 2015, 43.

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However, one might worry that (I) does not permit a stable account of a potentiality being had to a maximal degree: there would have to be a maximal strength or intensity of a potentiality to permit this to occur and that is only likely in a few special cases in which the maximum strength of a physical or natural property has an upper limit. Example (e) is not, on this reading, true because something else (with a stronger charge) would repel an electron more strongly than another electron.

In addition, in mathematical examples such as (b), there would be no lesser degrees: what would it mean to say that something (anything) has lesser degree of potentiality to be identical with 5 than 2 + 3 does? There would, in such cases, either be *no* potentiality to do so in an individual (or group of entities) or a *maximal* degree, with no way of understanding the scale in between. Thus we have a subset of potentialities which we cannot understand as being possessed as a matter of degree.

Reading (I) does not coherently capture degrees of potentialities; nevertheless, one might think that it does capture our intuitive understanding of a potentiality's 'being possessed to a certain degree'.[46] However, the intuitive pull of (I) will be something of a drawback if we now opt for one of the other readings and yet cannot provide a full explanation of it.

Let us consider (II). Does b have the potentiality to M to a greater degree than c does if and only if b manifests M *more often* than c does? The first thing to note is that 'more often' cannot literally be a claim about the behaviour of the potentiality as possessed by a particular b (say) because the manifestation of some potentialities is not repeatable in a particular. A glass breaks *once* (if at all) because it is fragile to a high degree, the glass does not break *more often* than a lump of lead. What we require to make sense of this reading is a claim generalized over similar individuals:

(A) Individuals intrinsically like b manifest M more often than those intrinsically like c in similar circumstances.

But (A) seems incorrect. If we keep the circumstances fixed, then an ice cube will melt on an ordinary Californian summer's day and the Golden Gate Bridge will not, which (one might think) is fine and fits our desired analysis. However, a bridge like the Golden Gate Bridge would never melt in such circumstances while an ice cube

[46] This reading seems to be close to Mumford and Anjum's conception of powers having *intensity*. They also call the intensity of a power its 'degree'. *op. cit.* 2011, 24–26.

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always will and so we have lost our desired notion of degrees. One might not think that this matters, except that a bridge like the Golden Gate Bridge would never melt in such circumstances nor would a granite bridge, and yet we would be inclined to say that the granite bridge has a greater degree of potentiality to melt than the Golden Gate Bridge does. But there is nothing to ground the difference in degrees.[47]

This problem of accounting for unactualized possibilities leads one to think that we need to consider the range of circumstances in which b manifests M compared to c, and not merely consider a specific context. This adjustment brings the reading (II) of 'more often' closer to (III) that b has the potentiality to M to a higher degree than c if and only if it is *more likely* that b manifests M than it is that c does so. I will examine what remains of (II) together with (III). We could try to analyse (III) in two ways:

(B) b manifests M in a greater range of circumstances or causal contexts than c.
(C) Individuals intrinsically like b manifest M in a greater range of differing circumstances than individuals intrinsically like c.

Can we capture what is meant by 'more often' or 'more likely' with (B) that 'b manifests M in a greater range of circumstances or causal contexts than c'? Again, we have the problem that the manifestation of the potentiality might not be repeatable; there is no way to make sense of the increased frequency of manifestation in such cases except by considering particulars similar to b. Otherwise, we will be forced to rely upon subjunctive conditionals of the form: '*Were* b to be in circumstances X (say), then b would manifest M.' (Were the Golden Gate Bridge to be subjected to a temperature of 5000 degrees Celsius, it would melt.) Thus, we would be advised to opt for reading (C).

Secondly, even if the manifestation is repeatable by a particular b, a potentiality's manifesting will be contingent upon whether or not b is

[47] One might protest at this example on the basis of statistical thermodynamics: there is a minimal but non-negligible chance that the Golden Gate Bridge will melt, so it is incorrect to say that it will *never* melt on an ordinary California summer day. However, this minimal likelihood will also be true of the granite bridge and so the required contrast will not be captured except perhaps by consideration of counterfactual situations. If we consider actual bridges, there have been no cases of melting (at least none of which I am aware). Thus this analysis of degrees of potentialities would not be an actualist one.

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ever in the appropriate circumstances to manifest M. We want to say that b could have potentiality F to a high degree even though b never actually manifests M at all because b is never in the right conditions. For instance, a particular sugar cube has the potentiality to dissolve to a high degree even though it is never actually in contact with liquid. If we want to capture this, we would again have to revert to subjunctive conditionals along the lines of 'Were b and c to be in similar specific circumstances, b would manifest M more often than c would'. If this is true for all circumstances, then b has potentiality F to a higher degree than c does.

However, the problem in both these cases is that subjunctive and counterfactual conditionals have crept back into the analysis of what it is for a potentiality to be possessed as a matter of degree. But one of the advantages of Strong Dispositionalism was supposed to be that potentialities could ground the truth of counterfactuals, rather than counterfactuals being required to ground potentialities and the degrees with which they are possessed. Nor (of course!) will it help to revert to a possible worlds analysis to give an account of whether b and/or c manifest M in different situations, although that too would solve our problem. Understanding degrees according to (B) seems to bring back the conceptual apparatus or the ontology that Strong Dispositionalism was intended to replace.

Given the foregoing discussion, the reader might already suspect that I am not particularly optimistic about the prospects for (C). Recall that:

(C) Individuals intrinsically like b manifest M in a greater range of differing circumstances than individuals intrinsically like c.

However, it is not clear that we can rely upon the range of *actual* circumstances to make sense of the likelihood of a potentiality manifesting. Recall the example of the two bridges which prompted the rejection of (A) above: a granite bridge has a greater degree of potentiality to melt than the Golden Gate Bridge (and steel bridges like it) but the number of actual cases in which bridges of either variety have melted is zero (to the best of my knowledge). If we can't bring in possible circumstances or possible worlds, or else formulate subjunctive conditionals of the form 'Were a bridge like the Golden Gate Bridge to be dropped into an active volcano it would melt' and determine their truth values, then (C) does not capture such cases.

There is probably more to be said about this final probabilistic approach to possessing a potentiality to a degree. It is initially an intuitively compelling analysis, but capturing the likelihood of a

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potentiality's manifesting requires more than consideration of actual cases of manifestation.[48] The problem here is predominantly with those potentialities which are possessed to a low degree: the unactualized metaphysical possibilities such as the Golden Gate Bridge's melting or its tasting of chocolate. We seem forced to take into consideration merely possible circumstances to give an account of these degrees, or else to resort to counterfactual or subjunctive conditionals of the kind which Strong Dispositionalism was intended to replace. A coherent explanation of the potentialities required to ground metaphysical necessity and possibility threatens to be circular.

The Strong Dispositionalist might respond that we should accept potentialities anyway as a matter of brute fact, using counterfactuals or possible worlds merely as heuristic devices. However, this move loses her a key advantage over the modal realist. Moving from powers to potentialities which are possessed by degrees introduced an extra dimension to the nature of these entities, and the increased complexity of iterated potentialities further obscured what the members of this novel category are like. Now, the modal realist's ontology of possibilia does not seem so obscure: we can understand what possible but non-actual spatio-temporal individuals would be like – at least we would know a talking donkey if we saw it – but we would not ordinarily recognise that an actual donkey instantiates the higher order potentiality to talk to a low degree.

Furthermore, if we accept that the degree of possession of a potentiality by an individual b is grounded by how individuals intrinsically similar to b behave when they instantiate that potentiality (even if these are restricted to actual individuals), then we have lost another key advantage of Strong Dispositionalism. The dispositional grounding of possibility is no longer a local matter; what a particular can and cannot do is determined by its potentialities, but the nature of those potentialities – in particular, the degree to which b possesses them – depends upon the behaviour of individuals distinct from b.

[48] Vetter, *op. cit.* 2015, 71–74 appeals to worlds 'as a heuristic device' but the problem with the heuristic use of worlds or counterfactual conditionals is that it never permits an explanation of what a potentiality's being had to a degree *is* (only what it would be were there possible worlds, for instance).

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6. Conclusion

What began as a parsimonious account of modality based on actual causal powers now requires an abundant ontology of potentialities which are largely isolated from experience. At worst, the enriched ontology of potentialities has made Strong Dispositionalism circular because their nature depends upon the entities or the conceptual apparatus they were postulated to replace. At best, Strong Dispositionalism seems destined to lose the advantage it claimed of giving a localized account of modality and has some difficult explanatory work still to do. If the strong dispositionalist does not produce this explanation and requires us to accept potentiality by degrees as a matter of brute fact, then she loses another key advantage over the modal realist concerning the coherence and plausibility of her fundamental ontology.

The promise of an actualist, naturalistic account of metaphysical possibility based on dispositional properties is attractive and not worth giving up on (yet). But, as I hope to have shown in the course of this paper, the ontological costs are much higher than first anticipated, and the ontology required may not be coherent at all. Furthermore, the increasing ontological complexity and specificity introduced in the course of the theoretical adjustments from powers to potentialities are reminiscent of the epicycles required to save Ptolemaic astronomy from refutation. The Strong Dispositionalist project is at risk of becoming what Lakatos would call a 'degenerating' research programme: fixing problems as they are found but not providing novel and useful explanations.[49] Nevertheless, if giving a comprehensive account of metaphysical modality proves futile, the dispositionalist can still lay claim to providing a plausible account of causal possibility and necessity; or else she could settle for giving a deflationary account of metaphysical modality, so the causal account is all that is required. I will leave these options open for consideration another time.[50]

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[49] Imre Lakatos, 'Science and Pseudoscience', in G. Vesey, ed., *Philosophy in the Open* (London: Open University Press).

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