A Plenitude of Powers

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Abstract

Dispositionalism about modality is the view that metaphysical modality is a matter of the dispositions possessed by actual objects. In a recent paper, David Yates has raised an important worry about the formal adequacy of dispositionalism. This paper responds to Yates' worry by developing a reply that Yates discusses briefly but dismisses as *ad hoc*: an appeal to a 'plenitude of powers' including such powers as the necessarily always manifested power (or disposition) for 2+2 to be 4. I argue that the reply is not *ad hoc* at all, by defending the metaphysics of dispositions that should underly it. I then argue, first, that a proper understanding of dispositions' degrees provides us with an argument for such necessarily always manifested dispositions; second, that all the natural attempts to block that argument can be resisted without being *ad hoc*; and third, that pragmatic considerations explain our intuitive resistance to the ascription of necessarily always manifested dispositions. Dispositionalism can be formally adequate after all.

1 Introduction: dispositionalism and formal adequacy

Dispositionalism about modality, or *dispositionalism* for short, is the view that metaphysical modality is a matter of the dispositions – or the powers or potentials – possessed by actual objects.[1] As David Yates puts it in a recent paper

[1] As a matter of terminological convention, I will use 'disposition' and 'power' interchangeably in this paper. Section 4 will briefly comment on their difference in ordinary English.

> At a first pass, <possibly, David Yates is a dancer>, if true, is made true by powers certain actual things have, or had, such that the manifestations of those powers would have resulted in or constituted my being a dancer. It need not be the case that I alone have the powers in question. Perhaps some of the relevant powers belong to dance teachers I never had; or to music I never heard; perhaps they are powers to bring about mutations in my DNA prior to birth, such that had those powers manifested, I would have been less clumsy and more inclined to dance than I actually am. (Yates 2015, 411)

Dispositionalism is an attractive view for the 'new' or 'hardcore' actualists (see Vetter 2011 and Contessa 2009) who wish to ground modality directly in actuality without the detour through possible worlds. It has gained support in recent years (see, for instance, Borghini and Williams 2008, Jacobs 2010, and Vetter 2015), but compared to its competitors it remains a somewhat underexplored option in the metaphysics of modality.

There has been some debate about the *material* adequacy of dispositionalism, that is, about whether or not it provides the right truth-values for claims of possibility and necessity (see Cameron 2008, Contessa 2009, Borghini and Williams 2008, Vetter 2015, ch.7, and Wang 2015). Putative counterexamples tend to take the form of possibilities for which the dispositionalist seems unable to provide a matching disposition: the possibility that none of the actual existing contingent beings had existed, for instance (see Cameron 2008). Of course, the dispositionalist may bite the bullet on some putative counterexamples and claim that the opponent is simply mistaken about the alleged metaphysical possibility (as suggested in Contessa 2009); it may be *conceivable* that none of the actual contingent objects existed, but the dispositionalist has no reason to believe in a strong conceivability-possibility link in any case. Alternatively, she may try to point to relevant dispositions (Vetter 2015, ch.7) which do provide the required grounding for the alleged possibilities.

Recently, David Yates (2015) has raised a distinct objection against dispositionalism, which does not rely on intuitions about particular examples. Rather, it calls into question the *formal* adequacy of dispositionalism: does metaphysical modality, on the dispositionalist view, exhibit the right kind of formal structure that is required for it to deserve the title of metaphysical modality in the first place?[2] In particular, does metaphysical modality, on the dispositionalist view, conform to system **T** of modal logic, as characterized by the addition to classi-

[2] I address formal adequacy in Vetter 2015, but I do not there consider Yates's challenge.

cal propositional logic of the following two axioms along with a rule of necessitation?

(K) $\Box(p \supset q) \supset (\Box p \supset \Box q)$

(T) $\Box p \supset p$

Yates argues that it does not; or rather, that it does not on the view which he labels *strong dispositionalism*. Strong dispositionalism is characterized by the following definitions of possibility and necessity, proceeding purely in terms of dispositions (Yates 2015, 414; read '$> [p]$' as the predicate 'is a power to bring about p'):

POSS$_1$ $\Diamond p \equiv \exists \phi > [p](\phi)$

NEC$_1$ $\Box p \equiv \neg \exists \phi > [\neg p](\phi)$

NEC$_1$, of course, defines the necessity operator simply as the dual of the possibility operator in POSS$_1$.

Now, Yates says, take a necessary truth, say the truth that 2+2=4. Dispositions, it is natural to assume, are concerned with what is contingent and changeable.[3] Nothing has a disposition to bring it about that 2+2=4, and nothing has a disposition to bring it about that ¬ 2+2=4. Necessary truths and falsehoods are simply not within the *reach*, we might say, of any object's powers: they hold, or they fail to hold, irrespective of the powers that things have, and irrespective of which powers are exercised. In this respect, then, necessary truths and necessary falsehoods are on a par. Powers, or dispositions, are symmetric with respect to them: they do not reach either necessary truths or necessary falsehoods.

It is this symmetry that leads into trouble for strong dispositionalism if we read $\Box$ as expressing necessary truth. For we can apply NEC$_1$ twice to show that both $\Box 2 + 2 = 4$ and $\Box\neg$2+2=4 are true: nothing has a power to bring it about that ¬ 2+2=4, hence we have $\Box$2+2=4. But further, nothing has a power to bring it about that 2+2=4; introducing double negation, we get that nothing has a power to bring it about that ¬¬2+2=4, hence we have $\Box\neg$2+2=4. This is bad enough in itself; but it is a matter of material adequacy, not formal adequacy. Yates now argues that in addition, it leads to fomal inadequacy: it makes dispositionalism violate the basic axioms of the logic of metaphysical modality, (K) and (T).

The counterexample to (T) is straightforward. We have just seen that both $\Box$2+2=4 and $\Box\neg$2+2=4 come out true by the lights of NEC$_1$. (T) then allows us to infer the false ¬ 2+2=4: *reductio*! What is worse, (T) allows us to infer in addition the true 2+2=4; by conjunction introduction we get the contradictory 2+2=4 ∧¬ 2+2=4; *reductio* indeed!

[3]This is an assumption which I will challenge in what follows.

To get a counterexample to (K), let p be $\neg$ 2+2=4, and q any contingent proposition. Then the antecedent of (K) is true: nothing has a power to bring it about that $\neg(\neg$ 2+2=4 $\supset q)$, since to have such a power would require a power to bring it about that $\neg$ 2+2=4 $\wedge\neg q$, which in turn requires a power to bring it about that $\neg$ 2+2=4;[4] and we have just seen that nothing has such a power. $\Box\neg 2+2=4$, as we have also just seen, must be true, since nothing has a power to bring it about that $\neg\neg$ 2+2=4. But by hypothesis, $\Box q$ is false, since q is contingent. So the consequent of (this substitution instance of) (K) is false while its antecedent is true; and so we have a counterexample to (K).

These results are clearly unacceptable. Yates proposes to deal with them by weakening dispositionalism: instead of POSS_1 and NEC_1, he suggests that the dispositionalist should adopt[5]

POSS$_3$ $\Diamond p \equiv \{p \vee \exists\phi > [p](\phi)\}$
NEC$_3$ $\Box p \equiv \{p \wedge \neg\exists\phi > [\neg p](\phi)\}$

These definitions express *weak dispositionalism*, according to which

> $< p >$ is possible iff $< p >$ is true *or* there is a power to bring it about that p[, and] $< p >$ is necessary iff $< p >$ is true *and* there is no power to bring it about that $\neg p$.' (Yates 2015, 419)[6]

Weak dispositionalism solves the problem by blocking the problematic conclusions: it is not necessary that $\neg$2+2=4, simply because it is not true that $\neg$2+2=4; it *is* necessary that 2+2=4 because it is true that 2+2=4 and nothing has a power to change that. On weak dispositionalism, necessary truths are those truths that nothing has a power to change. Accordingly, what is possible, on the weak dispositionalist view, has two sources: one is actual truth, the other is the powers that objects have. In some cases these may overlap (when a power is actually exercised), but there will be possibilities that have only one such source. The possibility that 2+2=4, for instance, has its source in the actual truth of the proposition that 2+2=4, while the possibility that I be a carpenter has its source in my unexercised power to become a carpenter.

I think that weak dispositionalism is an acceptable last resort for the dispositionalist, and I am not going to argue against Yates's positive view in this paper. I take it, however, that strong dispositionalism,

[4] I am assuming that we can perform such basic logical transformations as that from $\neg(p \supset q)$ to $(p \wedge \neg q)$ in the scope of the power operator $>$. If that assumption is rejected, then so much the worse for the dispositionalist!

[5] I have omitted Yates's POSS_2 and NEC_2. In an addendum to his paper, Yates points out that a similar view to his has been put forward by Pruss 2011, 165-171.

[6] '$< p >$' is used to refer to the proposition that p.

i.e., dispositionalism along the lines of POSS_1 and NEC_1, is preferable if it is to be had: it gives a unified dispositional picture of metaphysical modality. In the remainder of this paper, I wish to defend strong dispositionalism against Yates's counterexamples.

My response strategy, or one that is very close to it, is discussed briefly by Yates under the label 'a plenitude of powers' (Yates 2015, 416). The strategy is to say that there are indeed the dispositions required for an asymmetry between necessary truths and necessary falsehoods, and that they are possessed by everything whatsoever: everything has a disposition for it to be the case that 2+2=4, but nothing has a disposition for it to be the case that ¬ 2+2=4. Yates objects to this strategy as follows:

> The powers that metaphysically explain <p>'s *possible* truth would causally explain <p>'s *truth* if combined in the appropriate way. The putative universally uninstantiated power to be an x such that 2+2=4, by contrast, has no connection with the truthmaker for <2+2=4>, whatever that might be. It has neither reciprocal partner powers, nor any other condition on its manifestation, for it is never unmanifested.
>
> To say the possible truth of <David Yates is a dancer> is grounded in powers to bring it about that I am a dancer involves a substantive empirical claim about the causal structure of the world. By contrast, the claim that everything has the always activated, irreducibly modal power to be such that 2+2=4 is hardly different from the claim that it is *possible* that 2+2=4. What makes the non-reductive explanation of modality offered by dispositionalism informative is that we have independent access to the explanantia. Positing *ad hoc* powers of a different kind, which are not amenable to scientific investigation, and whose sole function is to mop up a residue of possibilities left unexplained by those that are, is unhelpful. The principle of plenitude promises new explanantia for the residual possibilities, but delivers little more than a restatement of the explananda using a different term. (Yates 2015, 416)

My goal in this paper will be to show that the posited powers are not, after all, *ad hoc*.

Clearly, if the strategy is simply to state that there are the required powers then Yates is right to accuse the proponent of the plenitude response of adhocery. But in what follows, I aim to show that the required plenitude of powers is motivated independently of strong dispositionalism. A closer look at dispositions in their own right is all we need to get our required explanantia.

Let me immediately note, however, where I will diverge from the response strategy that Yates envisages. I do not wish to claim that *everything* has the power to be such that 2+2=4, but merely that *something* has such a power.[7] This claim raises two objections, both of which can be found in the passage from Yates: first, *what* has the relevant power? Typically, we want the powers that ground possibilities to be related to the objects, if any, that the possibility is about. But abstract objects such as the numbers 2 and 4, if they exist at all, seem to be the wrong kind of object to qualify as possessors of powers. (Yates's appeal to the 'connection with the truthmaker for <2+2=4>' can be read as pointing in this direction.[8]) The second objection is more clearly at the forefront of the above-cited passage: even if we had a plausible bearer for such a power, it would be a power that is *necessarily always* manifested. But why believe that there are such powers? Powers, or dispositions, seem to concern how things can change, not how things have to be at all times. I will refer to the second objection as the 'necessary manifestation' aspect of the challenge, and the first as the 'whose power?' aspect. Sections 2–4 will be concerned with the 'necessary manifestation' aspect. The 'whose powers?' aspect will be addressed much more briefly, in section 5, where I will argue that the considerations on necessary manifestations can be carried over to this aspect, though the exact shape and nature of the response depends on metaphysical assumptions that go beyond dispositionalism itself.

The basic idea behind my argument is this. Our concept of metaphysical modality is a philosophically rather refined one that goes considerably beyond our ordinary modal notions, and it has taken time and effort on the part of philosophers to develop and clarify this notion. Dispositionality has not as yet received the same kind of attention and rigorous treatment. If we want to be dispositionalists about modality, we will need to develop an extended and more rigorous notion of metaphysical dispositionality, which like metaphysical modality will include some surprising limiting cases in its scope, and will lead us to accept statements that sound infelicitous, or at least odd.[9] But the dispositionalist must be allowed the same metaphysical rigour and refinement

[7] I refrain from making the stronger claim not because I think that it is false – I do not – but because it is not needed for present purposes and would require arguments that go beyond the ones here offered. See Vetter 2015, ch. 5.

[8] David Yates informs me (personal communication) that he did not intend the 'whose powers?' objection with his above-cited remarks, but I think it is worth addressing; I will consider his intended reading of the relevant passage in section 6.

[9] I will stick with 'odd' or 'strange' to describe the sentences in question, since talk of infelicity may seem to suggest that the sentences are ungrammatical.

that theories of modality have long enjoyed. If she is, then she can meet Yates's challenge and hold on to strong dispositionalism.[10]

A final note on the goal of my argument. I aim to show that the (revised) 'plenitude of powers' response to Yates's objection is not *ad hoc*. To do so, I need to argue from premises that are motivated independently of strong dispositionalism. I need not, and I cannot in the space of this paper, defend each premise (though I do believe that they are, and that strong dispositionalism is, true). Instead, I will have to content myself with pointing to the existing literature on dispositions in a number of places.

One assumption that I will be making bears emphasizing at the outset. I will assume a liberal or 'abundant' conception of properties (powers and otherwise) throughout. That is, I will not worry whether any of the powers or dispositions discussed in what follows deserve to be counted as 'properties' on some more sparse conception of properties. I will not defend this assumption since it must be shared by Yates. Yates' preferred version of dispositionalism, as captured in POSS_3 and NEC_3 has to share this assumption: after all, it asserts the existence of powers to bring about p, for any (arbitrarily complex) value of p. The power to bring it about that David Yates is a dancer and 6 feet tall is, presumably, not a sparse property; but it is required for both POSS_1 and POSS_3 to account for the truth of <Possibly, David Yates is a dancer and 6 feet tall>. An alternative approach would require not that there is an exactly corresponding power for every possibility, but merely a dispositional truthmaker for every modal truth. It remains to be seen how such an approach would deal with issues of formal adequacy.

2 Necessary manifestations: the argument from degrees

Suppose that an object x is necessarily always M, i.e., x is necessarily M if and as long as it exists. Many philosophers would maintain, for instance, that I am necessarily always human, and everyone should agree that I am necessarily always dancing-or-not-dancing. Why should we believe that I have a disposition to be human, or a disposition to be dancing-or-not-dancing?

[10]Part of the argument in this paper is loosely based on material in my Vetter 2015, which is centrally concerned with the formal adequacy of dispositionalism. Unfortunately, Yates and I wrote our respective pieces without one's knowing of the other. So I welcome the opportunity to draw together these lines of argument, sharpen some of them and expand on others in response to Yates's excellent paper.

Note that it is the combination of 'necessarily' and 'always' that makes the example so challenging. If it is necessary that x is M *at some time* – if, for instance, it's necessary that I die at some time – we might be less hesitant to ascribe a disposition, since there is at least some change involved. If x is always M but only contingently so – if, for instance, a certain wire conducts electricity for its entire existence – we may well ascribe a disposition: the wire is a conductor, and that fact together with certain other facts about it *explains* why it is always conducting, even though it might have failed to do so. But when necessity and permanence combine, as in the case of my being necessarily always human or my being necessarily always dancing-or-not-dancing, it becomes difficult to see how the corresponding disposition ascription might be true.

In this section, I will argue, to the contrary, that being necessarily always M is not only compatible with, but indeed entails, being disposed to be M. The argument will be somewhat schematic; sections 3 and 4 go on to flesh it out by defending it against objections.

Because I have separated the 'necessary manifestations' part of Yates's argument from the 'whose powers?' part, I need not (yet!) defend the view that everything, or indeed that any concrete object, has a disposition to be such that 2+2=4. We will worry about the bearer of the potentiality to be such that 2+2=4 later and restrict claims in this section and the next to concrete objects and their genuine properties, as opposed to mere Cambridge properties like the property of being such that 2+2=4. For the time being, I want to defend the following claim:

Claim: If x is necessarily always M, and if being M is a genuine (not a mere-Cambridge) property of x, x has a disposition to be M.

(The restriction to genuine properties will be tacit in what follows, and will play a role only in my choice of examples.)

Before arguing for this claim, let me insert a quick clarification about invoking necessity here. To the dispositionalist, strong or weak, necessity itself is to be understood (at least partly) in terms of dispositions. Thus x's being necessarily always M amounts to nothing having a disposition for x to ever be not-M (plus x's being M, for the weak dispositionalist). It seems to me unclear how such a state of affairs should preclude x itself from having a disposition to M; but it is also by no means obvious how it should imply that x has the disposition.

My starting point in arguing for the claim is the simple observation that dispositions come in degrees. A champagne glass is more fragile than a tumbler, some people are more irascible, sociable, or loquacious than others, and a rubber band is more elastic than a cotton cloth. Now, when a property comes in degrees, we can ask whether there is a maximum of that property, and what it is. Think of a gradable

property as a determinable with determinates ordered by a relation of 'greater than'. When the property of being F has a maximum, then one of its determinates is greater than all others, and no other determinate is greater than it. When there is no such greatest determinate, and the scale of ever greater determinates goes on indefinitely, then the property has no maximum. Thus the property of being tall is gradable but appears to lack a maximum: while there may, at any given time, be a tallest object, there is no greatest height; the scale of ever greater heights can go on indefinitely. The property of being flat, on the other hand, does have a maximum: to be maximally flat is to have no bumps whatsoever. On which side, then, do dispositions fall? To support my claim, I will argue that dispositions have a maximal degree, and that the maximal degree of a disposition to M amounts to a lack of the disposition not to M. From there it is easy to argue that being necessarily always M, so far from amounting to a lack of the power or disposition to M, in fact is a way of having that disposition to the maximal degree.

I give two versions of the argument, one directly in terms of dispositions, the other drawing on the resources of possible-worlds semantics.

The argument from degrees, version 1. Given that dispositions come in degrees, even a non-reductionist account of them should have something to say about how those degrees behave. I submit that the following two principles, one for intra-object comparison and one for inter-object comparison, would have to be part of any more comprehensive study of the degrees of dispositions:

Transitivity If x is more disposed to M than y, and y is more disposed to M than z, then x is more disposed to M than z.

Proportionality If M and N are contradictories, the degrees of an object's dispositions to M and N are indirectly proportional, i.e.: the more x is disposed to M, the less x is disposed to N, and *vice versa*.

I take it that Transitivity is obvious; it is provided here only for further illustration. The plausibility of Proportionality can be seen by considering examples. The more fragile something is, the less disposed it is to remain unbroken (when struck); the more mild-tempered someone is, the less irascible she is (taking 'mild-tempered' to express the disposition to remain calm (when provoked), and 'irascible' the disposition to get angry (when provoked)); the more I am disposed to talk, the less I am disposed to remain quiet, i.e. to not talk; and so forth.

Now we can use Proportionality to argue for my claim, as follows.

As a limiting case of the proportionality principle, we can say that if M'ing and N'ing are contradictories (and both qualify as genuine properties of x), as x's disposition to M reaches the maximum, its

disposition to N must reach a minimum, and vice versa; that is, x is maximally disposed to M just in case x is minimally disposed to N. The absolute minimum of a disposition, in turn, should be the lack of it. So we can say that x is maximally disposed to M iff x is not at all disposed to N. For any pair of contradictory predicates M and N, then, it follows that at least one of 'x is disposed to M' and 'x is disposed to N' must be true. Applied to the cases that interest us, this means that I must have either a disposition to be human or a disposition not to be human; either a disposition to be dancing-or-not-dancing, or a disposition not to be dancing-or-not-dancing.[11] Faced with the alternative, I take it, we should prefer the necessarily always manifested disposition to the necessarily never manifested disposition.[12]

This is the first version of the argument from degrees. It does not strictly prove the truth of my claim (for one thing, I have only given intuitive motivation for Proportionality), but it shows it to be a plausible consequence of a plausible principle, and therefore theoretically very well motivated. At the very least it places the burden of proof firmly on the opponent.

The argument from degrees, version 2. A more detailed version of the argument from degrees can be given *if* the dispositionalist is allowed the resources of the more standard, possible-worlds based, semantics for disposition ascriptions. This may seem anathema: is the point of dispositionalism not precisely to circumvent the need for appeal to possible worlds? To this I say, yes and no: dispositionalism is in fact intended to provide a *metaphysics* of modality that does without possible worlds; but it is not obviously barred from using the framework of possible worlds as a useful model, so long as it is clear that there is no special link between that framework and the metaphysics of modality (any more than there is a special link between the framework and other phenomena it has been used to model – knowledge, vagueness, obligation, and many others). My second argument, then, will make use of possible-worlds semantics as a formal model that

[11] Note that a disposition can come in degrees even when its manifestation does not. Even for a simple on/off-condition, such as a match's lighting or not, we can distinguish between different degrees of the corresponding disposition: one match may be very easy to light, while another, being old and a bit wet, is only barely disposed to light. Being human may not admit of degrees, nor does dancing-or-not-dancing, but the corresponding dispositions still do.

[12] Some might be happier with necessarily never manifested dispositions (such as the disposition not to dance-or-not-dance); after all, dispositions can be masked, and why should they not be necessarily masked? But our cases are hardly cases of masking. If a disposition is masked, we generally have some way of pointing to its basis in the object that has it, as well as to the circumstances that mask it. But what should the basis for a disposition to satisfy a contradiction be, and what the relevant mask? I see no way to answer these questions.

serves to bring out some of the formal features of dispositions and their ascription.

The gradability of dispositions has been pointed out and examined in most detail by David Manley and Ryan Wasserman (see Manley and Wasserman 2007, Manley and Wasserman 2008). Manley and Wasserman propose the following account of comparative degrees of a disposition:

> **(MORE)** x is more disposed than y to M when C if and only if x would M in more C-cases than y.
> (Manley and Wasserman 2008, 77; I have replaced 'N1' and 'N2' with 'x' and 'y' respectively.)

C-cases are those cases in which the object is subject to the disposition's stimulus condition, C. Cases, in turn, are more finely individuated than worlds: a single world may contain a number of cases where a given object is subject to C. We can think of cases as centred worlds, i.e., triples of a world, a time, and an object. Not every case is relevant for a given disposition ascription: at least, a C-case must contain the object with the relevant disposition, and fulfil some more general conditions, such as having the actual laws of nature.

Thus, for instance, if fragility is the disposition to break when struck, (MORE) tells us that the champagne glass is more fragile than the tumbler just in case the champagne glass breaks in a greater proportion of the possible cases in which it is struck, than the tumbler does of the possible cases in which *it* is struck. Manley and Wasserman argue that for some cases the restriction, C, is empty. Thus fragility might be the disposition to break, period. In that case (MORE) would tell us that the champagne glass is more fragile than the tumbler just in case the champagne glass breaks in more possible cases, period, than does the tumbler. Some others have argued that this is in fact true of all dispositions; but the modelling of degrees remains the same (we merely remove all reference to C from (MORE)).[13]

Now we may ask again: given this understanding of degrees, do dispositions have a maximum, a determinate such that no other determinate of that property is greater than it (like flatness), or are its determinates ordered in an infinite ascent (like tallness)?

Manley and Wasserman's (MORE) suggests that dispositions fall on the side of flatness. There is a maximum to M'ing in more possible cases than something else: M'ing in all possible cases. If x M's in

[13]My own argument for this claim is in Vetter 2014, but see also Lowe 2011. With or without the restriction to a condition C, both accounts are faced with the problem of making sense of proportions among the presumably uncountably many possible worlds or cases; Vetter (2014) and Manley and Wasserman (2008) offer different suggestions on how to solve that problem.

all the possible cases in which it is subject to condition C, then the proportion of x's M'ing cases among x's C-cases is as high a proportion as it gets: it is 100%.

Now suppose that x is necessarily always M. This means that x is M at all times in all possible worlds; in other words, that x is M at all centred worlds or cases. *A fortiori*, x is M at all cases where it is subject to a stimulus condition C, whatever C is (and even if C is empty), or in all the relevant cases *simpliciter* (on the no-stimulus view). But that is just what it is to be maximally disposed to M (when C). So if x is necessarily always M, x is maximally disposed to M (when C). And to be maximally disposed to M (when C), surely, is to be disposed to M (when C). It would be odd indeed if the scale of being more and more disposed to M were to suddenly 'break off' just before its maximum was reached.

Being necessarily always M entails being maximally disposed to M, given (MORE), but not *vice versa*. We have seen that not any centered world will count as a (C-)case relevant to a given disposition. Those cases will conform to certain general requirements, such as our laws of nature; they should contain the object in question having certain intrinsic properties (the disposition itself, or its categorical base); and where a disposition has a non-empty stimulus condition C, the relevant cases will be only those where the object is subjected to C. If an object is M in all those cases, it does not follow that it is M in all cases (all centred worlds) whatsoever. Thus it might be that x is maximally disposed to M (when C), and hence is M in all the relevant (C-)cases, even though x could easily fail to be M since it could easily lose the disposition. The implication from necessarily always M'ing to being maximally disposed to M is only one-way; but a one-way implication is all that the strong dispositionalist needs. It ensures that I am maximally disposed, and hence that I am disposed, to be human, to be dancing-or-not-dancing, and so forth.

This, then, is the second version of the argument from degrees: given (MORE), our best model for the degrees of dispositions, the maximum of a disposition to M is modelled by an object's M'ing in all the relevant cases; if an object is necessarily always M, then it will M in all the relevant cases; therefore, if an object is necessarily always M, it will be maximally disposed, and hence it will be disposed, to M.[14]

[14] A similar idea is suggested by Neil Williams in the context of his defense of 'static dispositions' (more on which below): he imagines a 'continuum' of dispositions to persist, where '[a]t one extreme are those objects with dynamic dispositions for their immediate annihilation', while 'at [the] far end of the spectrum, objects would be so strongly disposed for survival that no circumstance could arise in which the disposition to persist would fail to be manifested' (Williams 2005, 310). The same kind of continuum is also proposed for the dispositions to change / maintain one's shape.

I expect that the opponent will object to both versions of the argument from degrees by pointing out that the argument was overly schematic: (MORE), (Proportionality), and the considerations based on them were not intended to apply, and indeed they do not apply, when 'M' and 'N' stand for such properties as being human or being dancing-or-not-dancing, and the same holds for any purely dispositionalist variant of the argument (i.e., one that does without appeal to possible cases). I will respond to this challenge in the next section.

3 Resisting the argument?

The argument of the previous section has been rather schematic, with 'M' standing in for all kinds of properties. The opponent will, of course, complain that this schematicity is misleading: we cannot just ascribe dispositions to M for all sorts of property M. And that, she will claim, is where the argument from degrees fails: in typical cases where something is necessarily M, M'ing is just not the right sort of property to serve as the manifestation of a disposition. In such cases, (MORE) or whatever other principles the dispositionalist offers for comparative disposition ascriptions does not apply; so the argument from degrees will not even get started. In this section, I will address this strategy.

Before I begin, however, I would like to remind the reader what I aim to show. I want to reject Yates's claim that an appeal to a 'plenitude of powers' is *ad hoc*. To do so, I appeal to some views and arguments that are extant and motivated in the literature and can coherently be combined. To avoid the charge of adhocery, it is enough if I show that these views and arguments are motivated independently of dispositionalism about modality, and that accepting them does yield a plenitude of powers; I cannot here defend them at any length. One such view that I have already sketched is the account of dispositions' degrees encoded in (MORE); in what follows I will appeal to a few others in addition.

With this in mind, what might be the relevant restrictions on properties that may be the manifestation of a disposition?

Yates indicates some restrictions in his (already cited) argument against the 'plenitude of powers' response:

> The powers that metaphysically explain $< p >$'s *possible* truth would causally explain $< p >$'s *truth* if combined in the appropriate way. The putative universally uninstantiated power to be an x such that 2+2=4, by contrast, has no connection with the truthmaker for <2+2=4>, whatever that might be. It has neither reciprocal partner powers, nor any other condition on its manifestation, for it is never unmanifested. (Yates 2015, 416)

I will return to the point about the truthmaker for the proposition that 2+2=4 in section 5; recall the distinction between the 'necessary manifestation' problem and the 'whose powers?' problem in section 1. For present purposes, we can extract three related putative problems with necessarily manifested powers from this passage: they are not causal; they have no 'partner powers'; and they have no trigger or stimulus conditions.

Each of these objections can, however, be questioned. Let us begin with the last point: the required dispositions would have no manifestation conditions, for they are always manifested. However, as I have already indicated above, a number of philosophers have pointed out that dispositions need not come with a manifestation condition. Molnar (2003) already argued that there are unconditional, spontaneously manifesting dispositions (at least) in particle physics. Manley and Wasserman (2008) point out dispositions that seem to lack a stimulus condition: the assumption that there must always be a stimulus to trigger a disposition, they say, is

> plausible only given a paltry diet of examples. In fact there are plenty of dispositions that do not have any particular stimulus conditions. Suppose someone is highly disposed to talk, but there is no particular kind of situation that elicits this response in him. He is disposed to talk when happy, when sad, with others or by himself—he is just generally loquacious. (Manley and Wasserman 2008, 72)

Lowe (2011) and I (Vetter 2014) have argued that dispositions are quite generally to be individuated without appeal to any stimulus, trigger, or manifestation condition. The absence of a suitable condition for their manifestation is, then, not a reason to reject necessarily manifested dispositions straightaway.

Similar considerations apply to the other two criteria.

Many dispositions have 'partner powers': a sugar cube's disposition to dissolve when immersed in water partners with water's disposition to dissolve sugar when in contact with it, my disposition to have a yellow sensation when looking at yellow objects partners with a yellow disk's disposition to cause yellow sensations in ordinary perceivers;[15] and so on. But not all dispositions are like this. The spontaneous or otherwise 'trigger-less' dispositions mentioned in the previous paragraph presumably lack dispositional partners.

Many, indeed probably most, dispositions are causally involved in their manifestation: thus when a fragile vase breaks, this is typically caused by its fragility in conjunction with the occurrence of a suitable stimulus event, such as the vase's being dropped onto a concrete floor.

[15]The example is due to Lewis (1997).

But with stimulus-less dispositions, it is not clear that their manifestation must always be a matter of causation. Moreover, Daniel Nolan (2015) has recently provided a long list of examples for 'noncausal dispositions', where there is a triggering condition, but it and the disposition together do not plausibly cause the manifestation. Nolan's examples include a volcano's disposition to smoke prior to eruption (where the manifestation condition, the eruption, happens after the manifestation, the smoking); the dispositions of photons 'to travel at a speed of $3 \times 10^{10} m/s$ in the circumstances of the speed of light being $3 \times 10^{10} m/s$ (and not being $3 \times 10^{9} m/s$ as it is in our world)' (Nolan 2015, 10); and the Nile's disposition to flood after Sirius rises at dawn (Nolan 2015, 7).

If, in the passage cited above, Yates is read to implicitly make the claim that *all* powers have manifestation conditions, partner powers, and/or a suitable causal role in their manifestation (and then inferring by modus tollens that our necessarily always manifested powers cannot be powers after all), the argument fails: none of the three conditions is a necessary condition for something to be a power. Of course, Yates does not explicitly make the claim that *all* dispositions must have a causal role in their manifestation, partner powers, and/or manifestation conditions. He may be merely pointing out a number of disanalogies between typical dispositions and the putative necessarily always manifested dispositions. But the strong dispositionalist need not claim that necessarily always manifested dispositions are typical, paradigmatic cases of dispositions. They are not. They are, rather, limiting cases. What the strong dispositionalist needs to do is make a case for including the limiting case as just that: a limiting case. I have attempted to make that case in the preceding section. In order to reject it, the opponent needs more than disanalogies with certain typical cases of dispositions; she needs a general restriction on what an object can have dispositions to do, which rules out the necessarily always manifested dispositions required for strong dispositionalism.

In general, it seems to me that our feeling of resistance against necessarily always manifested dispositions has to do with the idea that dispositions are, in some sense, *dynamic*, while the necessarily always manifested dispositions would, in some sense, be *static*. Dispositions, it might be thought, must always manifest in a change. In fact, a restriction of manifestations to *changes* may be behind the three typical features that Yates cites. Changes are typically caused (hence the appeal to causation) by certain conditions (hence the appeal to manifestation conditions) that involve other objects and their dispositions (hence the appeal to 'partner powers'). But the requirement that a disposition must manifest in a change is more general than those other requirements: it is met by a particle's spontaneously manifested power to decay, by dispositions such as loquaciousness which come without

a specific stimulus condition, and by Nolan's noncausal dispositions. However, it is not necessary that a disposition's manifestation constitutes a change. Williams (2005) has argued that we need dispositions for unchanging states to explain the causal goings-on in the world, such as objects persisting, keeping their shape, or retaining their distance from each other; such 'static dispositions', as he calls them, provide 'the causal glue of the universe' (Williams 2005, 318; see also Williams 2017).

Moreover, the problematic feature of our dispositions cannot be located in either their being necessarily manifested, or their being always manifested, alone; as we have seen above, neither of these features on its own has to be objectionable. Let me rehearse and add a little more detail.

If it is necessary that I die at some point, I may still be said to have a disposition to die (at some point) – a disposition which we might ascribe with the term 'mortal'. The necessity of a disposition's manifesting does not count against its being a disposition, at least so long as the manifestation is not always present – call such dispositions 'necessarily sometimes manifested dispositions'. But a disposition may also be manifest throughout its possessor's existence. If a wire is always conducting electricity, we would still call it a conductor (disposed to conduct electricity); if an electron is always exerting the appropriate attractive and repulsive forces,[16] we would still call it negatively charged (disposed to exert the appropriate forces); if an economy is constantly, throughout its existence, showing certain patterns of behaviour typical of market-orientation, we would still call it market-oriented (disposed to show those patterns of behaviour)[17]. Hence being always manifested does not count against a disposition, either, at least so long as the manifestation is contingent – call such dispositions 'contingently always manifested dispositions'.

Of course, for both necessarily sometimes exercised dispositions and contingently always exercised dispositions, there will be possible cases, of the kind relevant for the disposition, where the disposition fails to be manifested – both actual and possible cases for the first type of dispositions, only possible ones for the second. With necessarily always manifested dispositions, on the other hand, there is *no* case where it fails to be manifested. This suggests the following necessary condition on something's having a disposition to M:

[16] I adopt, for the sake of the example, Bird's view that it is the exertion of the force, not the actual attracting or repelling, that counts as the manifestation of charge: see Bird 2007. If you want to object that the magnitude of the exerted force may still vary, let me stipulate a case where it does not, because the electron's environment does not change in the relevant respects.

[17] The third example is from Schrenk 2016.

(Two-way) x has a disposition to M (when C) only if there is some (C-)case in which x does not M.[18]

We could then add (Two-way) as a further necessary condition in (Proportionality) and (MORE);[19] or we might take (MORE) and (Proportionality) to be implicitly restricted to values of M for which (Two-way) is met. Either way, the argument from degrees in section 2 is blocked.

But (Two-way), too, is subject to counterexamples. Consider what Molnar (2003) calls 'continuously manifested powers':

> These are powers that are exercised for as long as they exist. When they cease to be exercised they cease to exist. ... Rest mass is such a power according to General Relativity. Massive objects are spontaneously manifesting the gravitational power in continuous interaction with space-time. (Molnar 2003, 86f.)

Molnar's 'continuously manifested powers' are exercised so long as they exist, and that is part of their very nature. Of course, for the power to be exercised as long as it exists is not yet for an individual to exercise the power as long as *it* exists. But it may well be true of massive objects that they are *necessarily* massive (what kind of object would they be if they were not massive?), and hence necessarily always manifesting their rest mass. Or consider an animal's disposition to metabolize: so long as the animal exists (i.e., is alive), that disposition is always manifested; and again, it may well be true that the animal is necessarily an animal, and that to be an animal is (among other things) to metabolize, so that the animal is necessarily always manifesting its disposition to metabolize. Still, we should be able to say that the massive object has the gravitational power that Molnar is speaking about, and that an animal is disposed to metabolize.

Of course, metabolizing involves change, even if it is performed throughout an animal's existence. But the same is true of being human.

[18] (Two-way) would follow from a conception of 'dispositional modality' as found in work by Stephen Mumford and Rani Anjum: see Mumford and Anjum 2011a, Mumford and Anjum 2011b, Mumford and Anjum 2014. My arguments can be taken as objections to their conception too.

[19] As follows:

(MORE*) N1 is more disposed than N2 to M when C if and only if N1 would M in more C-cases than N2, *and N1 does not M in all C-cases*.

(Proportionality*) If M and N are contradictories *and an object possesses both the disposition to M and the disposition to N to some positive degree*, then the degrees of the object's dispositions to M and N are indirectly proportional, i.e.: the more x is disposed to M, the less x is disposed to N, and *vice versa*.

To be dancing-or-not-dancing, to be sure, need not involve any changes in an object's behaviour (I may possess the disjunctive property by always possessing the same one of its disjuncts, e.g. by never dancing); but the same is true of a massive object's interaction with space-time, which may, but need not, involve an actual movement.

I have considered, and rejected, a number of objections to the necessarily always manifested dispositions that the strong dispositionalist needs to posit: their lack of stimulus conditions and partner powers; their acausality; their static nature; and most straightforwardly, their being necessarily always manifested. None of these features, I have argued, needs to be objectionable in itself. The opponent may claim that they are nevertheless objectionable when combined with each other. But at this point it seems to me that the burden of proof has shifted: if it is accepted that none of the considered features is objectionable in its own right, why should we rule out the combination? If there are stimulusless powers, acausal powers, non-partnered powers, and necessarily always manifested powers, why can't some of the stimulusless, acausal, non-partnered powers also be necessarily always manifested? What would be added by combining these features over and above the features themselves, that would suddenly constitute a barrier for there to be such dispositions?

Intuitively, of course, necessarily always manifested dispositions of the kind that I have been proposing may still be hard to accept. How could the property of being dancing-or-not-dancing be the *manifestation* of a disposition? What is there left to manifest, when everything is trivially dancing-or-not-dancing? As Mumford and Anjum (2011a) put it, such a disposition 'would be redundant: why would something need a disposition towards F if it is necessarily (or essentially) F in any case?' (Mumford and Anjum 2011a, 387) The answer, as I have argued above, is that there are good theoretical reasons for such dispositions nevertheless being present, and for the necessarily always obtaining properties to be their manifestations. In the next section, I am going to propose a principled way of explaining away the recalcitrant intuitions. The ascription of a disposition to M to an object that is necessarily always M is, I am going to suggest, true but odd for pragmatic reasons – much like the corresponding cases for possibility. Section 5 will then go on to discuss the remaining 'whose powers?' aspect of Yates's challenge.

4 Explaining our resistance

Let us briefly take stock. Yates's counterexample to strong dispositionalism was based, in part, on the idea that where x is necessarily always M, x has no disposition to be M, and no disposition not to be

M. Against the counterexample, I have defended a view of dispositions that justifies the inference from 'x is necessarily always M' to 'x has a disposition to be M'. The inference breaks the Yatesian symmetry between properties that are necessarily always possessed and those that are necessarily never possessed by an object, and thereby also that between necessary truths and necessary falsehoods that was the crux of Yates's argument. I have argued that the view of dispositions which justifies this inference is on good theoretical standing, for reasons that are independent of strong dispositionalism. However, the view, and in particular the inference in question, remains somewhat counterintuitive. This section addresses the question how much of a problem that is.

I would like to begin by noting that the corresponding inference for possibility, which the strong dispositionalist is trying to capture by the strategy that I am suggesting, is not entirely intuitive either. Outside philosophy, when the truth of 'necessarily p' is accepted, the statement 'possibly p' will seem strange to many. Even within philosophy, there is one traditional notion of possibility on which 'possibly p' not only does not entail, but is incompatible with, 'necessarily p', and a fortiori with 'necessarily always p'.[20] Without systematic reflection on the logic of possibility, I venture that most people would reject such statements as

(1) a. It is possible that I am human.
b. I could have been human.

(2) a. It is possible that I am dancing-or-not-dancing.
b. I could have been dancing-or-not-dancing.[21]

[20]Failure to hold these two notions apart has led to such arguments as the following, which appeared as late as 1955 in *Philosophical Studies*:

> 1. A necessary truth cannot possibly be false.
> 2. A necessary truth is true.
> 3. What is true is possibly true.
> 4. What is possibly true could be false.
> From 2, 3, and 4, we can conclude:
> 5. A necessary truth could be false.
> (Weiss 1955, 31)

The problem, of course, is that premise 3 uses our present notion of possibility, while premise 4 uses the alternative notion that we might label 'contingent possibility'. The argument appears as an example of an equivocation in Rosenberg 1978.

[21]I include the 'could have' formulations because they seem to me to be more idiomatic expressions of metaphysical possibility. The locutions 'possibly' or 'it is possible that' are used in ordinary English primarily, or even exclusively, to express *epistemic* possibility, i.e., something like compatibility with what we know. See Kratzer 1981, DeRose 1991.

Nevertheless, I would maintain together with most contemporary philosophers, the statements in (1) and (2) are true. Why then do they sound bad?

I take it that a natural answer to that question will appeal to pragmatics. By Grice's first maxim of quantity ('Make your contribution as informative as is required', Grice 1989, 308), we ought not to make a weaker statement when we are warranted in making a stronger statement that would serve conversational purposes better. Now, conversational purposes rarely require only the information whether something is possible; outside philosophy, our interest in the possibility of a proposition generally derives from our interest in its truth or falsity. But if we know that 'necessarily p' is true, then we certainly have sufficient grounds for a stronger and conversationally more relevant statement than 'possibly p' – whether it is the statement that necessarily p, or simply the statement that p. By making the weaker statement, we appear to be flouting the maxim and thereby to implicate pragmatically that the stronger statement is one which we cannot make (either because it is false or because we have no grounds for it). But that implicature is false; hence our feeling of strangeness when confronted with statements such as (1) or (2). If further evidence is needed, note that the implicature can be cancelled by adding to our sentences (1) and (2) a cancelling clause of the form '... but I don't mean to suggest that I am not actually human / dancing-or-not-dancing'.

I submit that a similar strategy (albeit not quite the same) will serve the strong dispositionalist. In both cases, possibility and dispositions, we are pushed by systematic theoretical considerations to accepting the unintuitive limiting case; in both cases, expressing the limiting case feels odd. In both cases, I maintain, that oddness derives from pragmatics rather than semantics. But before I can properly make that claim, I need to be clearer on which statements I want it to apply to. In the case of 'possible', the explanation appealed to pragmatic purposes that arise in ordinary conversation, where the relevant terms ('possible', 'could have been') abound. But what about our dispositional terms?

I have been using 'disposition' and 'power' interchangeably. But in ordinary English, these terms are not entirely equivalent, and neither of them is used in quite the same way as they are in the philosophers' vernacular. 'Disposition', when applied to so-called philosophers' dispositions like fragility and solubility, is a term of art; in ordinary English it can express anything from willingness to statistical correlation, but we would not normally say that a glass is 'disposed to break' (see Vetter 2014, 147). 'Power', in ordinary usage, comes closer to the philosophical use, but it carries a connotation of agency that makes it odd at least to say that a glass has a power to break or a person the power to be made angry. Our best ordinary-language terms for philosophers'

dispositions are adjectives such as 'fragile' and 'irascible'; but a pragmatic explanation can hardly appeal to those, since our problematic disposition ascriptions are not expressed in such adjectives.

Suppose, however, that we had such an adjective, 'M-able', where some object x (or every object x that is M, or every object x whatsoever) is necessarily always M. Given that we know x to be necessarily always M, what purpose could such an adjective serve? Outside philosophy, we are interested in disposition ascriptions when we are interested in predicting an object's behaviour in the future (or its unknown past or present behaviour); but the object's being necessarily always M is a much more solid basis for such predictions. We are also interested in disposition ascriptions when we are interested in explaining an object's (known) behaviour; but such explanations tend to be causal, and our necessarily always manifested disposition will presumably not be causally involved in its manifestation. Moreover, the fact that x is necessarily always M will again provide a much more satisfying explanation. Finally, we are interested in disposition ascriptions when we classify objects or substances – into the water-soluble and the non-water-soluble substances, for instance, or into courageous and cowardly people – but when x is necessarily always M, it will best be classified as M, and if everything is necessarily always M, then there is no interesting classification to be had. There may be other reasons for interest in a disposition ascription outside philosophy, but I believe that a common theme has emerged: the statement that x is necessarily always M will always trump the statement that x is disposed to M for conversational relevance, at least when both are known to be true. Hence it is hardly surprising that we have no such dispositional adjectives, for when would we ever have the occasion to use them in conversation?

What, then, of the philosophers' disposition ascription involving the terms ' ... is disposed to ... ' or '... has a power to ... '? I submit that these are, as I said above, technical terms, but they are technical terms that are introduced not by giving necessary and sufficient conditions for their application. Rather, they are introduced by reference to paradigmatic examples: a *disposition* is a property such as fragility, solubility, and irascibility, etc. If this is so, then it is again no surprise that pragmatic restrictions which apply to the paradigmatic cases will be carried over to the technical term.

Given these background considerations, we can now explain the oddness of statements, in the philosophers' vernacular, such as

(3) a. I am disposed to be human.
b. I have a power to be human.

(4) a. I am disposed to be dancing-or-not-dancing.

b. I have a power to be dancing-or-not-dancing.

That reluctance, the strong dispositionalist may claim, is caused and justified, not by the falsity of (3) and (4), but by pragmatics. That x is disposed to M is a piece of information that we use primarily when we are interested in whether x actually is M, will be M, or would be M in some hypothetical situation. But if we know that 'necessarily, x is always M' is true, then we have, in any situation, sufficient grounds for a stronger and more relevant statement than 'x is disposed to be M'. By making the weaker statement, we appear to be flouting the maxim and thereby to implicate pragmatically that the stronger statement is one which we cannot make (either because it is false or because we have no grounds for it). But that implicature is false; hence our feeling of oddness. If further evidence is needed, note that the implicature can be cancelled by adding to the sentences in (3) and (4) a clause of the form '... but I don't mean to suggest that I'm not actually human / dancing-or-not-dancing; in fact I am necessarily human/dancing-or-not-dancing'.

In conclusion, it is open to the strong dispositionalist to argue that it is pragmatic considerations, *not* considerations of truth and falsity, that explain our reluctance to accept ascriptions of necessarily always manifested dispositions. This completes my response to the 'necessary manifestation' aspect of Yates's challenge.

5 Whose powers?

The question remains how we are to account for the possibility that 2+2=4, and thereby to avoid the multiply problematic claim that according to strong dispositionalism, necessarily, it is not the case that 2+2=4 since nothing has a disposition for it to be the case that 2+2=4.

If something had a power to be such that 2+2=4, then that power would be necessarily always manifested; this, we have seen, is unproblematic. But *what has* such a power? My answer to this question will basically take Yates's objection and turn it into a strategy. Yates's objection, recall was that

> [t]he putative universally instantiated power to be an x such that 2+2=4 ... has no connection with the truthmaker for <2+2=4>, whatever that might be. (Yates 2015, 416)

How do we use this as a strategy? As follows: we reject, as I have indicated in section 1, the idea that the relevant powers are 'universally instantiated' (or, at any rate, we do not appeal to that idea in order to solve the problem). Instead, we look for their bearers precisely among the truthmakers for such truths as <2+2=4>, whatever they are.

So the answer to the 'whose powers?' part of Yates's challenge depends on what is the truthmaker for '2+2=4', and in particular which objects are involved in making that truth true. If numbers are bona fide abstract objects, and the truth of 2+2=4 is a matter of such abstract objects standing in certain relations, then those are the objects whose powers we should look to. If we believe that numbers can be reduced to some other kinds of abstract objects, such as sets, then it is the relevant sets to which we need to attribute the relevant powers. And if '2+2=4' is made true instead by how things stand with concrete objects, either with particular such objects (inscriptions and sounds, or regions of space according to Field 1980) or with concrete objects in general (i.e., if '2+2=4' is true because some quantified claim about the objects there are is true), then those are the objects whose powers will be relevant for the possibility that 2+2=4.

If mathematical truths are made true by concrete objects, then the strong dispositionalist does not have a particularly deep problem with them; concrete objects are already assumed to have powers, including necessarily manifested ones. The powers that ground the possibility that 2+2=4 will be powers to have just those features in virtue of which the relevant objects ground the truth of '2+2=4'.

A more surprising claim, I take it, will be the claim that given realism about abstract objects such as numbers or sets, those abstract objects will have powers which ground the possibilities concerning them. The number 4, for instance, might then be said to have a power to be equal to 2+2; or perhaps the number 2 will have the power to yield 4 if added to itself. Such ascriptions of powers certainly sound strange;[22] but we have seen that strangeness is no evidence of falsehood if there is another explanation for it.

And there is indeed another explanation. We have already seen that disposition ascriptions appear strange when the disposition in question is necessarily manifested; we have seen, further, that there is reason to nevertheless take such disposition ascriptions to be true, and that there is a pragmatic explanation for the appearance of falsehood. Abstract objects such as numbers or (pure) sets[23] have the noteworthy feature that they have no genuine and contingent features. Every property of a number is such that either the number possesses it necessarily, or it is a mere Cambridge property, such as the property of being thought about by me. Moreover, this fact too does not appear to be contingent. Thus, if numbers or pure sets have powers at all, they will only have powers that are either necessarily manifested or powers whose mani-

[22] Or so I am conceding to Yates; but of course we have perfectly good dispositional predicates applying to numbers and their like, a classical example being 'divisible'.

[23] Though perhaps not other abstract objects, such as languages; and perhaps not even impure sets.

festations would be mere Cambridge properties. We do not generally ascribe dispositions for mere Cambridge properties, such as the power to be thought about by me. Whether that is for pragmatic reasons or because such ascriptions would be false, we can leave open here; even if there were such powers, we would generally have a more interesting power to ascribe to something else. We do not, as we have seen above, generally ascribe dispositions that are necessarily manifested. Hence there are no true ascriptions of powers to numbers or pure sets that we would generally be prepared to make. It is not surprising, then, that we find the idea of ascribing powers to such abstract objects odd. But the explanation does not require that the ascriptions in question must be false. If, as I have argued above, I have a power to be human and a power to be dancing-or-not-dancing, then why should not the number 4 have a power to be the result of adding 2 and 2 together?

6 Conclusion

There is certainly more to be said. But I believe that I have shown a way of answering both aspects of Yates's challenge which avoids the charge of adhocery. I have given a principled and independent motivation for accepting necessarily manifested dispositions, explained why the ascription of such dispositions nevertheless appears so odd to us, and pointed out the relevant bearers for the powers that ground such truths as the truth that possibly, 2+2=4.

On the version of dispositionalism that I have defended in this paper, we can accept Yates's POSS_1 and NEC_1, though we need to make a slight change to our reading of them. Yates read his operator $>$ as 'is a power to bring it about that'. Bringing it about, on any reasonable interpretation, is a causal or very nearly causal matter, and the dispositions to which strong dispositionalists, on my proposal, should appeal are crucially non-causal.

Yates will respond that *that*'s what is wrong with the powers that I am proposing on behalf of the strong dispositionalist: they are not connected in the right way to their manifestations. A fragile glass breaks, when it breaks, at least in part *because* it is fragile. But am I human *because* I am (maximally) disposed to be so, and is 2+2=4 because of anything's being disposed to that effect?

Perhaps not. What I hope to have shown is that a less restrictive conception of dispositions, one which does not require this kind of causal or quasi-causal connection, is available. The disagreement between the strong dispositionalist (as envisaged here) and those who,

like Yates, prefer weak dispositionalism is ultimately a disagreement about the nature of powers or dispositions. [24]

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