A Strange Kind of Power: Vetter on the Formal Adequacy of Dispositionalism

Abstract

According to dispositionalism about modality, a proposition <p> is possible just in case something has, or some things have, a power or disposition for its truth; and <p> is necessary just in case nothing has a power for its falsity. But are there enough powers to go around? In Yates (2015) I argued that in the case of mathematical truths such as <2+2=4>, nothing has the power to bring about their falsity *or* their truth, which means they come out both necessary and not possible. Combining this with axiom (T): $p \supset \Diamond p$, it is easy to derive a contradiction. I suggested that dispositionalists ought to retreat a little and say that <p> is possible just in case either *p*, or there is a power to bring it about that *p*, grounding the possibility of mathematical propositions in their truth rather than in powers. Vetter's (2015) has the resources to provide a response to my argument, and in her (2018) she explicitly addresses it by arguing for a *plenitude of powers*, based on the idea that dispositions come in degrees, with necessary properties a limiting case of dispositionality. On this view there is a power *for* <2+2=4>, without there being a power to bring about its truth. In this paper I argue that Vetter's case for plenitude does not work. However, I suggest, if we are prepared to accept metaphysical causation, a case can be made that there is indeed a power for <2+2=4>.

1. Dispositionalism and Formal Adequacy

According to dispositional theories of modality (hereafter 'dispositionalism'), a proposition <p> is possible just in case something has (or some things have) a power for <p>, and since necessity is the dual of possibility, <p> is necessary just in case nothing has a power for its falsity.[1] Depending on how we flesh out the notion of a power for <p>, dispositionalist theories with very different metaphysical and formal properties will result. In this paper I shall discuss Vetter's dispositionalism, paying particular attention to her arguments that there are enough powers available to yield a formally adequate dispositionalist modal logic. I shall argue that Vetter has not made a compelling case for the powers required to do the job, and suggest an alternative argument on behalf of the dispositionalist based on the notion of metaphysical

---

[1] Versions of dispositionalism are defended in Williams & Borghini (2008); Contessa (2010); Jacobs (2010); and Vetter (2015), which provides by far the most detailed and sustained defence, addressing not only the material adequacy of dispositionalism, but also the formal adequacy of dispositionalist modal logic. It should be noted that for present purposes, I shall not distinguish powers from dispositions, and use the terms interchangeably.

causation, and the corresponding idea of metaphysical causal powers. More on that presently.

First, let's clarify the central notion of a power for <*p*>:

> Metaphysical modality is puzzling because it does not fit into the schema of objects-with-properties. It seems to consist of facts that float free of any particular object: its being possible that there are talking donkeys, for instance. One of the attractions of Lewisian modal realism is that it anchors those free-floating facts in objects. One of its drawbacks is that the objects are otherworldly donkeys for or against whose existence we can in principle have no evidence. Dispositionalism promises to share the attraction without succumbing to the drawback: it, too, anchors possibilities in objects. But its objects are just the ordinary objects of this, the actual, world, with which we are in regular epistemic contact…By anchoring them in the dispositions of such objects, dispositionalism promises a plausible story about the epistemology of modality.[2]

On the basis of the quoted passage, it seems initially that Vetter is concerned solely with what I shall herein refer to as *efficient causal powers*: the powers of objects to bring about or cause events. I adopt a Kimian conception of events for present purposes,[3] where events are understood as objects having properties at times, and hence not distinguished from states. So conceived, efficient causal powers will often be powers to bring about change, but need not be. An object could have the power to keep moving in a straight line, for instance, or to hold its shape.[4] I am not committed to the view that efficient causal powers are exclusively powers to cause physical events, or exclusively due to physical properties. What is important is that efficient causal powers are powers to cause states, or changes in the states, of objects—to cause them to have or continue having certain properties. Efficient causal powers manifest when they are appropriately stimulated, or alternatively, when they meet their reciprocal partner powers,[5] and are *individuated* by these causal roles. Negative charge, assuming it to be an efficient causal power, is partially individuated by the fact that its bearers exert repulsive forces on each other—having this causal role is part of what makes negative charge the property it is. This claim is

---

[2] Vetter (2015), p. 11.
[3] See Kim (1976).
[4] Changes can then be understood in terms of sequences of Kim events.
[5] See Bird (2007a) for the stimulus-manifestation model, and Martin (2008) for the partner powers model.

typically unpacked in terms of relational individuation: efficient causal powers are individuated by their places in a second order causal structure, composed of powers (and possibly also non-powers) standing in primitive stimulus-manifestation relations.[6] And we can in principle come to know this structure through scientific investigation.

What is it to have an efficient causal power for <*p*>? I shall say that an efficient causal power for a proposition <*p*> is a power to cause a truthmaker for <*p*>, and thereby *bring about* that <*p*> is true. Call the position that results from combining dispositionalism with the claim that a power for <*p*> is an efficient causal power to bring it about that *p*, *narrow dispositionalism*. Narrow dispositionalism explains the epistemology of modality because (at least in principle) we have epistemic access to the defining roles of efficient causal powers. Could I have been an astronaut? Yes, provided there's a way of combining the actual efficient causal powers such that had they been so combined, their manifestation would have been, or included, my being an astronaut. Judging the truth values of such claims may be difficult, but it is at least based on our knowledge of the world, and of the efficient causal powers that are instantiated here.

In earlier work[7] I argued that narrow dispositionalism faces problems of both material and formal adequacy, as follows. Obviously <2+2=4> is possible, but there doesn't seem to be anything with the power to *bring it about* that 2+2=4. There is no efficient causal power with a truthmaker for <2+2=4> as its manifestation, because the truthmakers for mathematical propositions are beyond the reach of efficient causation. Narrow dispositionalism thus entails that <2+2=4> is not possible, which is a serious problem of material adequacy. However, it also (correctly) entails that <2+2=4> is *necessary*, since there is no efficient causal power to

---

[6] See Bird (2007b) for a defence of the relational individuation in pure powers ontologies; and see Yates (2018) for a defence of the relational individuation of powers in a structure that also includes realized non-powers.
[7] Yates (2015).

bring about that <2+2=4> is false either. As Vetter notes,[8] efficient causal powers are *symmetric* with respect to necessary propositions and their negations, in that they are not able to bring about either. As a necessary condition on being a theory of metaphysical modality, dispositionalism ought to yield a modal logic satisfying axiom T: $\Box p \supset p$ (equivalently, $p \supset \Diamond p$). But given (T), $\neg \Diamond p$ and $\Box p$ are inconsistent. From (T) and $\Box p$ we can conclude p, but from (T) and $\neg \Diamond p$ we can conclude $\neg p$. Hence narrow dispositionalism either: (i) results in an inconsistent modal logic, or (ii) is not a theory of metaphysical modality.

In response to this problem, I suggested weakening narrow dispositionalism, in a manner suggested by Pruss[9] on independent grounds, so that <p> is possible just in case either: (i) <p> is true, or (ii) something has (or some things have) an efficient causal power for <p>. Powers take care of the possibility of propositions that are possible but false, with the possibility of true propositions such as <2+2=4> grounded in their truth, rather than in powers to bring about their truth. Necessary propositions, correspondingly, are those truths whose truth value nothing has the power to change. Vetter, by contrast, argues that the problem with narrow dispositionalism lies not in its focus on powers, but in its focus on *efficient causal* powers. By way of response, she argues that the version of dispositionalism she had earlier defended has the resources to ground all modal truths in powers, resulting in a more elegant and unified theory.[10] Vetter's solution is to allow powers that are not efficient causal, and which necessarily always manifest, without stimuli or partner powers. I considered but dismissed this strategy on the grounds that the powers in question would be so far removed from efficient causal powers

---

[8] Vetter (2018). Note that Vetter doesn't use the term 'efficient causal power', but she is clearly referring to powers to cause events or changes, which is how I am using the term in question in the present work.
[9] Pruss (2011).
[10] In her (2018) Vetter argues that the dispositionalist theory detailed in her (2015) has the resources to respond to the arguments I gave in Yates (2015).

as to be powers in name only, posited ad hoc in order to solve the formal adequacy problem; Vetter responds by giving independent arguments for believing in them.

My solution, then, was to embrace what I shall herein refer to as *disjunctive dispositionalism*, with efficient causal powers taking care only of unactualized possibilities, while Vetter prefers a version of dispositionalism according which some powers are not efficient causal powers, and the resulting *plenitude of powers* does all the work of grounding modality. I shall refer to Vetter's theory as *broad dispositionalism*, because it recognises a broader variety of powers than just powers to cause events, which I had earlier tacitly assumed to be all the powers that there are. Broad dispositionalism seems to be a more elegant and unified theory, since it explains all modal truths in terms of primitively modal powers. By contrast, disjunctive dispositionalism grounds some possible truths in powers, and others solely in their truth.[11]

The rest of this paper proceeds as follows. In §2 I argue that Vetter's case for plenitude fails, and hence that broad dispositionalists need an alternative argument for the missing powers. In §3 I offer an alternative argument for plenitude based on the idea that if truthmaking is a form of metaphysical causation, then truthmakers can plausibly be said to have the power to make true. Whether the resulting form of broad dispositionalism is any more unified than disjunctive dispositionalism depends, I suggest, on whether such powers are deservedly so-called.

2. Vetter's Case for Plenitude

Vetter lays much of the groundwork for her case for plenitude in her (2015), but develops and clarifies the case in her (2018) response to my (2015), so I shall focus primarily on the latter

---

[11] Here is Vetter on disjunctive vs. broad dispositionalism: "I think that [disjunctive] dispositionalism is an acceptable last resort for the dispositionalist….I take it, however, that [broad] dispositionalism…is preferable if it is to be had: it gives a unified dispositional picture of metaphysical modality." (2018, p. 4 (ms)).

work in this section. There are several reasons why one might want to deny that anything has a power for <2+2+4>. As Vetter notes,[12] such a power: (i) could not possibly fail to manifest, at any time; (ii) would have neither a stimulus condition nor reciprocal partner powers; (iii) would not be a power to bring about what it was a power for, i.e. that 2+2=4. It follows right away that a power for <2+2=4> could not be an efficient causal power, and if one thought, as I had previously supposed, that all powers are efficient causal, then it would follow in addition that there is no power *simpliciter* for <2+2=4>. There are two possibilities, in principle, for powers that are not efficient causal: (A) noncausal powers, and (B) causal powers whose manifestations are not events. I will later suggest a strategy based on powers of type (B), but for now I shall focus on Vetter's arguments, which aim to defend powers of type (A).

Vetter's defence of plenitude comes in two parts. In the first gives an *argument from degrees* for the claim that if *x* has an intrinsic property P necessarily, then *x* is maximally disposed to P.[13] Although Vetter doesn't explicitly frame it as such, the argument, if successful, will establish that there are powers for necessary properties of either type (A) or type (B). The idea that things have powers for their necessary intrinsic properties is bound to take us beyond the range of efficient causal powers in *some* way. In the second part, she defends the argument from degrees against a potential objection that necessary properties are not suitable disposition manifestations, by arguing that there are independently motivated cases of dispositions that are relevantly similar to those that the argument from degrees is intended to establish. At this point, Vetter makes clear that she takes powers for necessary properties to of type (A). I address the argument from degrees in this section, and return to the issue of noncausal powers in §3.

---

[12] In her (2018). In noting this, Vetter is agreeing with my (2015) claims about the *nature* of putative powers for propositions such as <2+2=4>, but she goes on to argue that there is after all good reason to posit them.
[13] See Vetter (2018), §2 for a succinct presentation; for the full details, see Vetter (2015), chs. 2-3.

The argument from degrees depends on the following proportionality principle: where P and Q are contradictories, the degrees of *x*'s dispositions to P and Q are inversely proportional. Vetter uses 'contradictory' in a fairly informal sense here, sometimes referring to contraries, and sometimes to logically contradictory predicates. Examples given include: break vs. remain unbroken, remain calm vs. get angry, and talk vs. remain quiet. As the disposition of a vase to break goes up, so its disposition to remain unbroken goes down; the more one is disposed to get angry, the less one is disposed to remain calm; and the more one is disposed to talk, the less one is disposed to remain quiet. I shall focus on contradictories rather than contraries. Vetter's proportionality principle entails that at least one of '*x* is disposed to P' and '*x* is disposed to Q' is true. I shall refer to this latter claim as *universality*. Given universality, it's reasonable to conclude that where *x* is necessarily P, *x* is maximally disposed to P and minimally (i.e. not at all) disposed to Q. Here's how Vetter puts it:

> 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. Faced with the alternative, I take it, we should prefer the necessarily always manifested disposition to the necessarily never manifested disposition.[14]

By proportionality, whatever it is that has the property of being such that 2+2=4 intrinsically has inversely proportional degrees of the power for <2+2=4>, and the power for its negation. Given that <2+2=4> is necessary, we should say that the entities in question are maximally disposed for <2+2=4>, and not at all disposed for its negation. What kind of entities are they?

---

[14] Vetter (2018), p. 8 (ms). By "genuine properties" here, Vetter means *intrinsic* properties.

Vetter is clear that it is the fundamental truthmakers for <2+2=4>, whatever they might be, that have the property of being an *x* (or some *x*s) such that 2+2=4 intrinsically, so it's these entities that will come out as being maximally disposed for <2+2=4>. These object could be sets, numbers conceived as abstract objects, or concrete particulars. For present purposes I needn't commit to a position on the nature of the truthmakers for arithmetic propositions, but I will assume in what follows that they are Platonic numbers for ease of exposition. More important is to note that Vetter takes the bearers of the power for <2+2=4> to be its *truthmakers*:

> 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….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>.[15]

So, numbers have certain features in virtue of which they make propositions such as <2+2=4> true. They have these features intrinsically and necessarily, and so—assuming the argument from degrees works—are maximally disposed to have them. In other words, the power for <2+2=4> is the power to have the features in virtue of which its truthmakers make it true.[16]

Before proceeding, let us first clarify the parenthetical constraint in the proportionality principle, which is apt to be a little confusing: "and both qualify as genuine properties of *x*" could be taken to mean that *x* actually has both of the properties expressed by the predicates in question, but that is a contradiction. The predicates P and Q do not express dispositional properties here, but their manifestations, and given that they are by hypothesis contradictory, there is no way *x* could have both properties at once: one cannot both break and not break, or remain calm and get angry. There's no contradiction in the supposition that *x* is (to inversely

---

[15] Vetter (2018), p. 19 (ms).
[16] I shall return to the relationship between truthmaking and powers in §3.

proportional degrees) both *disposed* to break, and *disposed* to not break, but again, P and Q don't refer to dispositions. Rather, they will refer in this case to *breaking*, and to *not-breaking*. Hence, the intrinsicality condition is intended to restrict quantification to properties that are intrinsic to their bearers *when instantiated*.

Let us now clarify the relationship between proportionality and universality. Proportionality is the claim that for any pair of contradictory predicates P and Q expressing intrinsic properties of *x*, the degrees of *x*'s dispositions to P and Q are inversely proportional. Universality is the claim for any such pair of predicates, at least one of '*x* is disposed to P' and '*x* is disposed to Q' is true. Why does the latter follow from the former? Here Vetter assumes that the degrees of dispositions can be quantified, and that being X% disposed to Φ involves Φ-ing in X% of cases. It follows, since P and Q are contradictories, that their degrees must always add to 100%, because if I P in X% of cases, I must not-P in the remaining (100-X)% of cases. From this it follows right away that *x* is maximally disposed to P iff *x* is not at all disposed to Q. Hence, from the non-instantiation of one of a pair of contradictory dispositions, we can conclude the maximum degree of the other. It is therefore not possible to be neither disposed to P, nor disposed to Q. This is a somewhat surprising claim—who knew that things had so many powers? Granting the inference from proportionality to universality, I shall now argue that there are counterexamples to the latter, hence to the former.

Vetter's proportionality principle is the claim that where P and Q express contradictory intrinsic properties, like the properties of singing and of not singing, *x*'s *dispositions* to P and to Q are inversely proportional, from which it follows, as we have just seen, that at least one of the corresponding disposition ascriptions is true. This all sounds plausible when we consider simple dispositions like the disposition to sing or the disposition to break: all actual things are

to some degree disposed to break, and to an inversely proportional degree disposed to not break. If we allow the degree of one of these dispositions to go to zero, the other goes to maximum, such that the complete absence of either is sufficient for the presence of the other, and nothing can fail to have both. Crucially, however, Vetter considers only simple dispositional idioms constructed by prefixing a predicate expressing an intrinsic property, such as the property of singing, with 'the disposition to'. I am either singing or not singing; I can't be both, and I can't be neither. It's plausible that the more often I sing, the more *disposed* I am to sing, and the less often, the less so disposed. Someone who never sings is not at all disposed to sing, but then such a person must be maximally disposed to not sing. Hence, as per universality, everyone is (to some degree) either disposed to sing, or disposed to not sing. For simple dispositions such as these, it is difficult to avoid Vetter's conclusion. However, when we attribute dispositions, we often refer not only to the their manifestation properties, but also to the *conditions* under which they manifest. I shall now argue that in such cases, it is possible to have neither of the dispositions in question to *any* degree.

Disposition ascriptions of the form '*x* is disposed to M when C' often imply causality. Consider, for instance, the disposition to sing *when it rains*. Here 'when' implies 'when and because', and does not merely express a correlation between rain and singing. The manifestation property is the same as in the disposition to sing, but the specification of the disposition now refers to a stimulus condition. The disposition to sing when it rains is distinct from the disposition to sing when the sun shines, and both are distinct from the disposition to sing, *simpliciter*. Vetter's proportionality principle refers only to manifestation properties, so it implies that the disposition to sing when it rains and the disposition to not sing when it rains are inversely proportional. I don't think they are. Suppose for the sake of argument that the rain makes no difference to the probability of my singing. Suppose further that I am to some degree disposed

to sing, *simpliciter*. Now suppose that it's raining on some occasion, and I sing. Is this a manifestation of the disposition to sing *when it rains*? It can't be, on the assumption that the latter disposition implies causality. The rain made no difference to my singing on this occasion, I just happened to manifest my disposition to sing *simpliciter*, while it was raining.

If the rain makes no difference to whether or not I am singing, then I lack the disposition to sing when it rains. By parity of reasoning, I also lack the disposition to not sing when it rains. If universality is false for this disposition pair, then so is proportionality: the absolute minimum of each disposition is consistent with the absolute minimum of the other. We can see that proportionality fails here without considering just the minima. Imagine that as a young romantic, I was strongly disposed to sing when it rained. Now, bored with life, the rain, and everything, I do so only occasionally; but I am not—at least not yet—so jaded that the rain ever *prevents* me from singing. If these arguments are correct, then a reduction in the degree of a disposition does not imply an increase in the degree of its contradictory, so it's false that the degrees of contradictory dispositions must add to 100%.

It's because the 'when' in many common disposition ascriptions implies causality that proportionality fails. I am certainly sometimes disposed to sing *while* it rains, but there's no causal connection, so I'm not disposed to sing *when* it rains; nor, for the same reason, do I have the contradictory disposition to not sing when it rains. It's intuitive, however, that contradictory 'when' dispositions must instantiate *some* form of proportionality relationship. What then is the relationship? Let's say that being X% disposed to Φ when C involves Φ-ing when (and because) C in X% of cases. According to Vetter's proportionality principle, the degrees of contradictory dispositions must add to 100%, so that (for instance) being 60% disposed to Φ when C entails being 40% disposed to not-Φ when C. If the preceding arguments are correct,

this cannot be right, because I can be 0% disposed to sing when it rains, and 0% disposed to not sing when it rains. However, there is a weaker proportionality relationship that does hold. Suppose I am 60% disposed to sing when it rains. What follows that I am *at most* 40% disposed to not sing when it rains. The degree of a disposition places an upper limit on the degree of its contradictory, but crucially, does not determine a *lower* limit. That I am 60% disposed to sing when it rains does not entail that I am to *any* degree disposed to not sing when it rains, since it doesn't guarantee that the rain ever prevents my singing. The degrees of two contradictory dispositions add to *at most* 100%, but to at least 0%. And one who doubts the existence of a power for <2+2=4> might well suspect that this is a case where the sum of the degrees is 0%: nothing has, to any degree, either a power for <2+2=4>, or a power for its negation.

Now Vetter might offer the following response to this objection, based on her independently motivated view that dispositions are individuated by their manifestations alone.[17] According to Vetter, disposition ascriptions that seem to be individuated by both a stimulus and a manifestation property, such as the disposition to sing when it rains, should be understood as dispositions individuated solely by a complex manifestation. In the present case, this would be the disposition to be caused to sing by rain, whose manifestation is the complex property of *being caused to sing by rain*. Strictly speaking, this is not an intrinsic manifestation property, and so is outside the scope of Vetter's proportionality principle. However, let us assume that it is a suitable manifestation property for a disposition, and relax the "genuine property" condition to allow such properties in the scope of the principle. Our question now is this: does universality hold for dispositions so understood?

---

[17] Vetter (2014, 2015). This is one of the core commitments of Vetter's (2015) account of dispositions, but it is not clear to me whether or not she takes the argument from degrees to depend on it. Vetter's (2018) summary of the argument from degrees does not appeal to this commitment.

Whether we think of dispositions as having separate stimuli and manifestation properties or complex manifestation properties significantly affects how we should go about constructing their contradictories. If we think of dispositions as individuated by both a stimulus and a manifestation property, then for a disposition of the form 'the disposition to M when C', it's easy to construct contradictories: negate the manifestation predicate to get 'the disposition to not-M when C', leaving the stimulus term unchanged. The disposition is then contradictory in the sense that it is the disposition to do the opposite thing under the same conditions. By contrast, in the case of dispositions individuated solely by a complex manifestation, of the form 'the disposition to be caused to M by C', it's harder to construct the contradictory, because there are now two places where the negation can be introduced. If we construct the contradictory of this disposition by wide scope negation over its complex manifestation, then the contradictory will be: the disposition *not* to be caused to M by C, but if we use narrow scope negation, the contradictory will be: the disposition to be caused to *not*-M by C.

In the present case, wide scope negation yields: the disposition not to be caused to sing by rain. Plausibly, everyone either has the disposition to be caused to sing, or the disposition not to be caused to sing, by rain, so universality is safe. But is wide scope negation the *right* way to generate contradictories of dispositions as Vetter conceives them? Consider how the disposition not to be caused to sing by rain should be rendered in the commonplace 'when' parlance. If I am disposed not to be caused to sing by rain, it clearly doesn't follow that rain will *cause me to not sing*. Compare: a vase is disposed not to be broken by a fly landing on it, but it doesn't follow from this that a fly landing on it will cause the vase to *not* break. Hence the most natural way to render '*x* is disposed not to be caused to sing by rain' in the stimulus-manifestation idiom is: not [*x* is disposed to sing when it rains]. But that's just the negation of an ascription of the disposition to sing when it rains, and not an attribution of the contradictory

disposition. If contradictory dispositions could be generated merely by the negation of disposition ascriptions, then universality would be a logical truth: either *x* is disposed to Φ, or not [*x* is disposed to Φ].

In stimulus-manifestation terms, the contradictory of the disposition to sing when it rains is the disposition to *not* sing when it rains, and this seems more naturally rendered in Vetter's complex manifestation idiom by means of *narrow* scope negation: being caused to *not* sing by rain. So now it seems our pair of contradictories should be the dispositions: (i) to be caused to sing by rain, and (ii) to be caused to not sing by rain. But now we are right back where we started: it's possible to lack *both* of these dispositions, so once again universality is threatened, and with it proportionality. Even setting aside the above concerns about how best to render 'when' dispositions in terms of Vetter's complex manifestation idiom, it seems clear that (i) and (ii) are a pair of contradictory dispositions whose minima are mutually consistent.

Let's recap. Vetter's central claim is that where P is an intrinsic property, if *x* is necessarily P then *x* is maximally disposed to P. In order to establish this claim, she relies on *proportionality*: the claim that for any pair of contradictory predicates P and Q expressing intrinsic properties, *x*'s dispositions to P and Q are inversely proportional. The complete absence of one disposition then corresponds to the maximum degree of the other, and we can conclude, where *x* is necessarily P, that *x* is maximally disposed to P. However, there seem to be clear cases of disposition pairs, such as singing vs. not singing when it rains, whose minima are mutually consistent, and which therefore do not satisfy Vetter's proportionality principle. We can certainly set an upper limit of 100% on the sum of the degrees of two such dispositions, but the lower limit is 0%. Problematically, that allows a sceptic about plenitude to say that nothing is to any degree disposed for either <2+2=4> or its negation. I will now set aside the argument

from degrees, and turn to Vetter's defence of the claim that necessary properties such as the intrinsic properties of abstract objects are suitable power manifestations.

3. Efficient causal, Noncausal, and Metaphysical Powers

Vetter worries that the restriction to intrinsic properties in the argument from degrees may not be strict enough, and so addresses a potential objection that the features in virtue of which numbers make <2+2=4> true aren't the right kind of properties to be power manifestations. Now the argument given in §2 targets the proportionality principle, and applies to properties that are *clearly* suitable to be disposition manifestations, such as the property of singing. Even if the properties of numbers are suitable power manifestations, I don't think Vetter's argument from degrees would suffice to show that anything has the relevant power. In this section, I shall focus on Vetter's defence of the claim that the properties of numbers are suitable power manifestations. Vetter argues by analogy that such properties could be the manifestations of necessarily manifesting noncausal powers. I don't think the analogy works, but it is nonetheless instructive: it tells us something about the kind of powers we need to ground the possibility of mathematical propositions, and thereby points the way to an alternative to the argument from degrees as a means of defending plenitude.

An efficient causal power *for* a proposition <*p*> is a power to bring about that <*p*> has a truthmaker. An efficient causal power for <the window is broken> is a power to break the window—to bring it about that <the window is broken> is true. But numbers—again assuming mathematical Platonism—just *are* the truthmakers of <2+2=4>. Furthermore, *qua* abstract objects, they could not possibly be the bearers of efficient causal powers. Indeed, that is arguably part of *what it is* to be abstract, rather than concrete. Since they are in Vetter's view powers for the features in virtue of which numbers make <2+2=4> true, their manifestation is

just the instantiation of those features. Given that truthmakers are sufficient for truth, the manifestation of these powers in a sense results in the truth of <2+2=4>, but by no means brings it about. Powers for mathematical propositions, if they exist, are a strange kind of power. Vetter's strategy in defending them is to argue that for every strange feature they have, there is an independently motivated case of a power with that feature. The strange features Vetter considers are: (i) necessary manifestation properties, (ii) lack of stimulus conditions or partner powers, (iii) not being causally related to their manifestations. Having argued for powers that have some of these features individually, Vetter then challenges her objector to say why it should be any more problematic to have all of them.[18]

Although Vetter's purpose is to defend the argument from degrees by highlighting similarities between efficient causal and mathematical powers, I think the cases she gives actually highlight an important difference between them. As Vetter notes, there are some fairly straightforward cases of powers that manifest without conditions, such as the power of a massive object to curve spacetime, or the power of an electron to generate an electromagnetic field. It is therefore no problem for mathematical powers that they are condition-free. I also grant that there may be powers that manifest necessarily. Suppose, for example, that electric charge is the power to generate an electromagnetic field conditionally on being instantiated. Charge would in that case be a power with no stimulus conditions or partner powers, and it might also provide an example of a power that manifests necessarily. We would need to offer an argument that nothing could possibly interfere with its manifestation, but I will not attempt to do so here, since what I want to focus on is Vetter's defence of the claim that *noncausal* powers are unproblematic.

---

[18] (2018), §3. I grant here that the conjunction is unproblematic if each conjunct is.

Why suppose there to be noncausal powers? The examples upon which Vetter draws are due to Nolan.[19] A volcano is disposed to smoke prior to eruption, but its stimulus, the eruption, happens after its manifestation, the smoking. This looks to be a genuine disposition ascription, but it's not clear how the disposition in question could be among the causes of its manifestation, for the disposition is triggered only after it has already manifested. It is also plausibly true that the Nile is disposed to flood after Sirius rises at or just before sunrise, but there is clearly no causal connection between Sirius' rising at dawn and the Nile's flooding. The disposition is triggered by a condition that could not possibly be a cause of its manifestation, so once again there is no obvious causal role for the disposition itself in relation to its manifestation.

Now at least in the cases mentioned above, it's natural to say that the objects in question have causal powers that ground the noncausal powers in question. A volcano's smoking and its eruption are caused by magma manifesting its power to flow upwards through weak points in the Earth's crust, and this is obviously an efficient causal power. Similarly, the Nile has an efficient causal power to flood when certain weather conditions obtain, and those conditions happen to correlate with the rising of Sirius at or before sunrise. This is not to deny that the relevant noncausal powers exist, and I'm happy to grant that they do. However, they are not *fundamental* noncausal powers, but grounded dispositional states that can be explained in terms of more basic efficient causal powers.[20] It's not clear that all noncausal powers are like this, and Nolan offers further examples that don't seem to be, for instance the dispositions of one of a pair of quantum entangled electrons to be spin up if the other is measured to be spin down.

---

[19] Nolan (2015).

[20] Nolan acknowledges this point, and anticipates that it may be argued that noncausal powers are not fundamental but grounded in causal powers; see his (2015), pp. 429-31.

Causal interpretations of what happens during measurement are problematic, because the causal influence would have to travel faster than light, which makes the relevant disposition look noncausal. And in this case, it's not obvious that there are any efficient causal powers available that could explain the correlation, which makes it look *fundamentally* noncausal. However, the interpretation of quantum non-locality is hugely controversial. Depending on what we say about causation, we might have no choice but to say that the measurement of one entangled particle causes changes in the quantum state of the other.[21] Or it may be that quantum nonlocality is to be explained by local causality in a more fundamental structure such as the wavefunction on 3N-dimensional configuration space, with the fundamental dynamics giving rise to the appearance of nonlocality when projected onto our 3-dimensional space.[22] But in that case, quantum entanglement seems similar to Nolan's more mundane cases after all, in which noncausal powers are grounded in efficient causal powers.

What I want to suggest now is that the gulf between the noncausal powers Vetter draws attention to, and putative mathematical powers, is much wider than she acknowledges. In fact, a power for <2+2=4> would seem to be so strongly noncausal that we might wonder why it deserves to be called a power at all. The disposition to smoke before erupting is noncausal in that the disposition itself is not among the causes of its manifestation. However, its manifestation property—smoking—certainly *has* causes, and its causes are among the grounds of the corresponding noncausal disposition. The volcano has the efficient causal power to emit smoke, and the efficient causal power to erupt, and it normally manifests these powers sequentially, which explains why it has the *noncausal* power to smoke before erupting. It's one

---

[21] See for instance Bigaj (2017). Note that the resulting superluminal causation is not to be confused with superluminal *signalling*, which is widely accepted to be ruled out by special relativity.
[22] Ismael & Schaffer (2016).

thing, however, to identify a disposition that doesn't cause its manifestation; it's another thing entirely to posit a disposition whose manifestation doesn't *have* a cause.

When we ascribe noncausal dispositions like the disposition to smoke before erupting, we say something about the event-causal structure of the world, and it's that structure that makes the disposition-ascription true. The putative power for <2+2=4> is dissimilar in a crucial respect. If there were such a power, it could not be grounded in an efficient causal power for <2+2=4>, because there is no such power. The power for <2+2=4> would be a power for a proposition whose truthmaker is beyond the reach of efficient causation, and that's a significant *dis*analogy between it and the independently motivated cases of noncausal powers to which Vetter appeals. In sum, noncausal dispositions that are grounded in an underlying efficient causal structure give us no reason to believe that the necessary properties of numbers are suitable power manifestations. I grant that there are powers that don't cause their manifestations, but we need something stronger than that: powers whose manifestations are not part of the event-causal structure of the world at all.

Let's recap. Given that there are no efficient causal powers for propositions such as <2+2=4>, the broad dispositionalist has two options: either (A) noncausal powers, or (B) powers that are causal but whose manifestations are not events. Vetter argues that there are powers for necessary propositions by arguing that there are powers for necessary intrinsic properties, as limiting cases of dispositionality, which comes in degrees. I have already expressed my doubts about that argument, but even if it works, it remains unclear that properties of numbers are suitable power manifestations, and so unclear that they are within the scope of the argument in the first place. Vetter argues that they are suitable power manifestations by analogy with other powers that manifest necessarily and non-causally. As we've seen, however, the sort of

noncausal powers for which we have independent motivation seem to be grounded in efficient causal powers. But it's their total disconnection with efficient causation that makes the putative powers for propositions like <2+2=4> look like non-powers in the first place, so drawing attention to noncausal powers that are grounded in efficient causal powers doesn't help. In what follows I will suggest an argument for powers of type (B): powers that are in a sense causal, but which don't bring anything about, and whose manifestations are not events. This argument is an alternative to Vetter's argument for plenitude. It does not aim to establish that the necessary intrinsic properties in virtue of which numbers make <2+2=4> true are suitable power manifestations. Instead it aims to show that true propositions are themselves the manifestations of a certain kind of power. Note that this is not a line of argument I endorse— it is instead a sketch of the kind of argument that I think would be needed to establish plenitude.

We are in need of independent motivation for supposing that there are powers for propositions such as <2+2=4>. These powers must manifest necessarily, without stimuli or partner powers, and they cannot be powers to bring about events. I shall now suggest that such powers could be motivated by appealing to the notion that truthmaking is, in a sense, causal. Certain recent approaches to truthmaking treat it as a form of grounding. This avoids problems with purely modal approaches, according to which any entity that necessitates the truth of a proposition is a truthmaker for that proposition. On such approaches, anything is a truthmaker for a necessary proposition such as <2+2=4>. Intuitively, truthmakers should be relevant to what they make true—they should be among the entities that the proposition is *about*. Grounding-based approaches build in this kind of relevance in terms of the primitive notion that grounded entities, in addition to being necessitated by their grounds, exist *in virtue of* them.[23]

---

[23] Further discussion is beyond the scope of this paper. See MacBride (2019) for full discussion.

On a grounding-based approach to truthmaking, a true proposition <p> is true *in virtue of* the way the world is, and the part of the world that <p> is about is the ground of <p>'s truth.[24] But now suppose we say, following Alastair Wilson, that grounding is *metaphysical causation*.[25] This too is independently defensible. Grounds are sufficient for and metaphysically explain what they ground, and grounded entities depend on their grounds. Grounding and causation thus have several formal properties in common, and some have proposed analyses of grounding in terms of interventionist models of causation.[26] I need not commit to such claims for present purposes, since my aim is simply to point out that it is neither entirely implausible, nor without precedent, to treat grounding as a metaphysical form of causation. Now assuming truthmaker maximalism, <2+2=4> has a truthmaker.[27] If numbers are the truthmakers of <2+2=4>, and truthmaking is a form of grounding, and grounding is metaphysical causation, then the numbers are metaphysical *causes* of its truth. Now suppose further that causation of any kind always involves the manifestation of causal powers. It follows that numbers have a power for <2+2=4>, which they manifest in metaphysically causing its truth.

Assuming truthmaker necessitarianism—the view that truthmakers necessitate the truth of propositions they make true—truthmaking powers can't fail to manifest if instantiated. Given that the existence of the numbers is sufficient for the truth of arithmetic propositions, their truthmaking powers must be powers that manifest come what may. Metaphysical causal powers could also be said to have partners, in cases where the given truth refers to more than one entity. For truths like <2+2=4>, the most natural thing to say may be that the numbers 2 and 4 possess

---

[24] The first defence of this theory of which I am aware is in Rodriguez-Pereyra (2005). Several others have since defended variants of this claim. For more on the recent debate, see Trogdon (forthcoming).
[25] Wilson (2018).
[26] Schaffer (2016); Wilson (2018).
[27] Truthmaker maximalism is of course highly controversial; see Cameron (2008) for discussion of the main reason why sceptics tend to be sceptical—that is posits truthmakers for negative truths—and a defence of maximalism based on the claim that such truths are made true by the world, construed as having all its properties essentially.

reciprocal powers to make the given proposition true, and manifest these powers mutually. The identification of grounding with metaphysical causation is controversial, and we are still in need of an argument that powers are involved in distinctively metaphysical causal relations. However, whatever its plausibility, the argument given above is an independent argument for plenitude. We don't need to commit to the claim that things have the power to have their necessary intrinsic properties, because we can argue directly that true propositions—both necessary and otherwise—are the manifestations of metaphysical causal powers to make true.

Instead of trying to defend, as Vetter does, the claim that numbers have noncausal powers *to have the features* in virtue of which they make <2+2=4> true, we should cut out the middleman and say instead that they have a metaphysical causal power to make <2+2=4> true. There's nothing to stop us holding in addition that they have this metaphysical power in virtue of their necessary intrinsic features, but we don't need to say in addition that they have the power to have those features. The two proposals agree about the bearers of the relevant powers: on both accounts it is <*p*>'s truthmaker *x* that has a power for <*p*>. On Vetter's account, the power in question is the power to have the features in virtue of which *x* makes <*p*> true, while I am suggesting it is *x*'s power to make <*p*> true. Given truthmaker maximalism, the present proposal entails that for any true proposition <*p*>, something has a metaphysical power for <*p*>, because something makes <*p*> true. Whatever makes some proposition <*p*> true is the bearer of a metaphysical power for <*p*>, which it manifests in making <*p*> true, and which is just what, according to broad dispositionalism, is required to explain <*p*>'s possibility.

Let's compare this proposal to disjunctive dispositionalism, according to which <*p*> is possible just in case either <*p*> is true, or there is an efficient causal power to bring it about that *p*. On this theory, necessary truths are possible just because they are true, not because anything has a

power for them, and powers take care of the possibility of contingently false propositions. On the face of it, broad dispositionalism is to be preferred to disjunctive dispositionalism due to its increased unity, but appearances can be deceptive. We can write the disjunctive dispositionalist possibility operator as follows:

DD: $\Diamond p \equiv \{p \lor \exists\phi\rangle[p](\phi)\}$

Here '$\rangle[p]$' is shorthand for the predicate 'is an efficient causal power to bring it about that p', and '$\exists\phi\rangle[p](\phi)$' should be read as "something has, or some things have, an efficient causal power to bring it about that p."[28] The broad dispositionalist proposal outlined above appears more unified, since it grounds all possibility in powers, and permits a simple definition of the possibility operator according to which <p> is possible just in case something has, or some things have, a power for <p>. However, this obscures the fact that the theory posits two kinds of power: metaphysical and causal. Using the same notation as above for efficient causal powers, and using '$_T[p]$' for the predicate 'is a metaphysical power to make <p> true', we can write the broad dispositionalist definition of the possibility operator as a disjunction as well:

BD: $\Diamond p \equiv \{\exists\phi_T[p](\phi) \lor \exists\phi\rangle[p](\phi)\}$

The question now is: what we really gain by moving from (DD) to (BD)? We had to make several controversial assumptions to argue for metaphysical causal powers, so (BD) had better have significantly greater theoretical unity than (DD). However, the power to make a given proposition true is a very strange kind of power, and doesn't seem to resemble efficient causal

---

[28] Notation from Yates (2015). There I do not explicitly restrict quantification to efficient causal powers, but I did tacitly assume that all powers were efficient causal, so here I make the restriction explicit in the definition.

powers at all, at least as they are typically conceived by proponents of powers ontologies. As we saw in §1, efficient causal powers are typically said to be individuated by their places in a second-order causal structure. Powers to make true, by contrast, don't seem to involve much individuative structure at all—every such power is directed at the propositions it makes true, and necessitates the truth of those propositions just by being instantiated. According to (DD), possibility is grounded either in truth, or in the power to bring about truth; while given (BD), possibility is grounded either in the power to make true, or in the power to bring about truth. On reflection, it's not obvious that (BD) is more unified than (DD), due to the fact that (BD) grounds possibility in two very different kinds of power. The unity of a powers theory of modality depends not only on whether the properties to which we appeal as the grounds of modal truths are all called "powers"; it also depends on the unity of the set of powers to which we appeal. If metaphysical powers are powers in name only, then broad dispositionalism appealing to both efficient causal and metaphysical powers is *unified* in name only.

Against this it might be said that there is independent reason for thinking that metaphysical powers are similar enough to efficient causal powers for (BD) to constitute a unified theory. If grounding is metaphysical causation, and truthmaking is a form of grounding, then it's no major leap to hold that whatever makes <2+2=4> true has a genuine causal power to do so, even though it can't be the power to cause an event. Such powers manifest necessarily, and don't have stimuli or partner powers, but as Vetter points out, there are efficient causal powers with those features. Much turns on how persuasive the case for metaphysical powers is, and given the commitments we needed to argue for them, the certainly aren't cheap: (i) truthmaking is a form of grounding, (ii) grounding is metaphysical causation, (iii) all causation involves the manifestation of powers, (iv) truthmaker maximalism. The happier one is to embrace these commitments, I suspect, the more likely one will be to see (BD) as significantly more unified

than (DD). Conversely, dispositionalists who find the idea that truthmaking is causal dubious, or who accept that claim but have reservations about the idea that this kind of causation involves the manifestation of powers, will likely see a world of difference between the efficient causal power of a brick to break the window, and the metaphysical power of the shattered glass to make <the window is broken> true.

4. Conclusion

Dispositionalism is the claim that modality is grounded in the powers of things. Narrow dispositionalism is the combination of dispositionalism with the claim that all powers are efficient causal, but it suffers from serious problems of material and formal adequacy, since there are no efficient causal powers available to ground the possibility of propositions like <2+2=4>. My attempt to solve this problem in Yates (2015) was to embrace disjunctive dispositionalism, according to which the possibility of contingently false propositions is grounded in powers, with the possibility of truths following trivially from their truth. Vetter's solution is to embrace broad dispositionalism, according to which there is a plenitude of both efficient causal and noncausal powers available to ground possibilities.

Against the charge that plenitude is ad hoc, Vetter argues that dispositions come in degrees, with the necessary intrinsic features of objects being limiting cases of dispositionality. Powers for propositions such as <2+2=4> are then grounded in the powers of their truthmakers to have the necessary intrinsic features in virtue of which they make those propositions true. However, Vetter's argument from degrees fails to establish plenitude. Although it's plausible that dispositions come in degrees, there are clear cases of disposition pairs—such as the disposition to sing when it rains and the disposition to not sing when it rains—such that it's possible to instantiate neither of them to any degree. Hence, it doesn't follow from x's having P

intrinsically and necessarily that *x* has a power for P. As an alternative way of defending plenitude, I have suggested in the present work that if truthmaking is a kind of metaphysical causation, then we can argue for the existence of metaphysical causal powers to ground the possibility of truths that would otherwise seem beyond the reach of causality. Necessary truths are beyond the reach of efficient causation, but given truthmaker maximalism, no truth is beyond the reach of metaphysical causation, so for every truth, there is a power.[29]

REFERENCES

Bigaj, T. (2017). 'On Quantum Entanglement, Counterfactuals, Causality, and Dispositions', *Synthese*. https://doi.org/10.1007/s11229-016-1304-9

Bird, A. (2007a). *Nature's Metaphysics*. Oxford University Press.

Bird, A. (2007b). 'The Regress of Pure Powers', *Philosophical Quarterly* 57, pp. 513-534.

Cameron, R. (2008). 'How to be a Truthmaker Maximalist', *Noûs* 42, pp. 410-421.

Contessa, G. (2010). 'Modal Truthmakers and Two Varieties of Actualism', *Synthese* 174, pp. 341-353.

Ismael, J. & Schaffer, J. (2016). 'Quantum Holism: Nonseparability as Common Ground', *Synthese*. https://doi.org/10.1007/s11229-016-1201-2

Kim, J. (1976). 'Events as Property Exemplifications', in M. Brand & D. Walton (eds.), *Action Theory* (D. Reidel), pp. 310-326.

Jacobs, J. D. (2010). 'A Powers Theory of Modality—Or, How I Learned to Stop Worrying and Reject Possible Worlds', *Philosophical Studies* 151, pp. 227-248.

MacBride, F. (2019). 'Truthmakers', in *The Stanford Encyclopedia of Philosophy* (Spring 2019 Edition), Edward N. Zalta (ed). https://plato.stanford.edu/archives/spr2019/entries/truthmakers.

Martin, C. B. (2008). The Mind in Nature. Oxford: Oxford University Press.

Nolan, D. (2015). 'Noncausal Dispositions', *Noûs* 49, pp. 425-439.

Pruss, A. R. (2011). *Actuality, Possibility and Worlds*. New York: Continuum.

Rodriguez-Pereyra, G. (2005). 'Why Truthmaking?', in H. Beebee & J. Dodd (eds.), *Truthmakers: the Contemporary Debate* (Oxford University Press), pp. 17-31.

Schaffer, J. (2016). 'Grounding in the Image of Causation', *Philosophical Studies* 173, pp. 49-100.

Trogdon, K. (forthcoming). 'Grounding and Truthmaking', to appear in the *Routledge Handbook of Metametaphysics*.

Vetter, B. (2014). 'Dispositions Without Conditionals', *Mind* 123, pp. 129-156.

Vetter, B. (2015). *Potentiality: From Dispositions to Modality*. Oxford University Press.

Vetter, B. (2018). 'A Plenitude of Powers', *Synthese*. https://doi.org/10.1007/s11229-018-1758-z.

Williams, N. E. and Borghini, A. (2008). 'A Dispositional Theory of Possibility', *Dialectica* 62, pp. 21-41.

Wilson, A. (2018). 'Metaphysical Causation', *Noûs* 52, pp. 723-751.

Yates, D. (2015). 'Dispositionalism and the Modal Operators', *Philosophy and Phenomenological Research* 91, pp. 411-424.

Yates, D. (2018). 'Inverse Functionalism and the Individuation of Powers', *Synthese* 195, pp. 4525-4550.