The Modal Limits of Dispositionalism

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1. Introduction

Dispositionality is a modal notion of a certain sort. When an object is said to have a disposition, we typically understand this to mean that under certain circumstances, the object would behave in a certain way. For instance, a fragile object is disposed to break when dropped onto a concrete surface. It need not actually break—its being fragile has implications that, so to speak, point beyond the actual world. According to *dispositionalism*, all modal features of the world may be accounted for in terms of its dispositional features.[1] Dispositions appear regularly in our ordinary and scientific discourse and seem to fit into a naturalistic worldview. In contrast, one need not delve far into the literature on (metaphysical) modality to run into the controversial notion of a *possible world*. If the dispositionalist is able to provide a reduction of the notions of possibility and necessity to dispositionality, avoiding this other debate, then so much the better for her view. In fact, she need only provide a reduction of one or the other, given the interdefinability of *possibly* and *necessarily*.

Of course, a modal theory requires more than a bare claim of reduction. A dispositionalist theory of modality should explain exactly how dispositionality relates to possibility or necessity. My aim in this paper is to assess the prospects for dispositionalism by examining the most promising theories. Sections 1 and 2 clarify the assumptions and desiderata of a successful dispositionalist theory of modality. Section 3 introduces the principles governing the dispositionalist theories that apparently meet the desiderata. Sections 4 through 6 show that dispositionalism nonetheless faces three problems: while dispositions help account for modal features of the world that are local, diachronic, or gradable, they cannot account for certain modal features of the world that are global, synchronic, or absolute. I end by discussing the costs of preserving dispositionalism.

Discussions of dispositions typically begin with their association with (counterfactual) conditionals. The disposition to repel electrons may be associated with the conditional, 'If x were to be near an electron, x would move away.' Likewise, fragility may be associated with the conditional, 'If x were to be dropped onto concrete, x would break.' This association is characterized by the 'Simple Conditional Analysis' (where S is a predicate corresponding to a stimulus and M is a predicate corresponding to a manifestation):

(SCA) Object x is disposed to M iff [if x were to S, then x would M].[2]

The form of this conditional is a simplification; there may be stimulus or manifestation conditions involving multiple objects, or in which different objects are involved in each. Furthermore, some dispositions appear to be associated with multiple stimulus conditions: a fragile glass would still break if thrown against a wall rather than dropped onto concrete. I will follow the convention that dispositions are individuated by their manifestation conditions, without committing to the natures of manifestations.[3]

On one dispositionalist theory of modality, (base) necessities are identified with universal generalizations of instances of SCA. Using this class of necessities, the possibilities are defined as those logically consistent with the necessities. However, despite its initial plausibility, SCA has been resisted on the grounds that there are cases in which the disposition is present and the stimulus condition is met, but the manifestation does not obtain. One case involves *finks*. Consider the fragile glass. Suppose that in some scenario, if the glass were dropped, a wizard would change the intrinsic structure of the glass so that it would no longer be fragile. Or consider the case of *masks*. Suppose that if the glass were dropped, the wizard would replace the hard surface below with a soft cushion and whatever else is needed to prevent the glass from breaking without losing its fragility. In both cases, the stimulus condition would be met but the manifestation would not obtain. In response to such scenarios, many revisions of SCA have been proposed, and correspondingly so have many new counterexamples.[4] For this reason, a dispositionalist theory of modality ought not to rely on the association between dispositions and conditionals.

The dispositionalist may hope to get around the objections to SCA by focusing on the 'fundamental' level of reality, which includes entities of ideal physics such as electrons, fermions, or whatever ideal physics concludes is fundamental.[5] Bird 2007, for instance, suggests that there are no interferers when it comes to dispositions of the fundamental entities; SCA serves as a mere approximation when it comes to the non-fundamental. However, the claim that there are no interferers at the fundamental level is a speculative assumption that requires further investigation. This sort of theory will be set aside.

Another version of dispositionalism places special emphasis on natural kinds like *electron* or *tiger*. On this theory, the conditionals constitute the essences of dispositional properties, which in turn figure in the essences of natural kinds. Both the dispositional properties and natural kinds figure in laws of nature like 'F=ma' or 'All electrons have negative charge.'[6] The laws, in turn, are the (base) necessities.[7] An examination of this sort of view is beyond the scope of this paper, but it faces various challenges in accounting for all necessities, as discussed elsewhere.[8]

A more promising approach to a dispositionalist theory of modality stresses that what underlie dispositions are not conditionals but essentially dispositional properties. Dispositional properties may be instantiated without ever manifesting, much less manifesting under the stimulus conditions specified by conditionals—they are real properties of the objects that instantiate them. As such, the conditionals serve merely as a guide to their

stimulus-manifestation conditions. The basic idea to be introduced in section 3 is that the dispositional properties of objects determine the space of possibilities.

2. Assumptions and Desiderata

I will assume *dispositional essentialism,* the view that some properties are essentially dispositional.[9] If the property of having negative charge is an essentially dispositional property, then it essentially disposes its bearer to move away from other negatively charged objects—any property that does not play this role is thereby not the property of having negative charge. In contrast, categorical properties are properties that are not essentially dispositional. It is sometimes said that categorical properties, unlike dispositional properties, 'float free' of their causal roles—categorical properties can be freely recombined whereas dispositional properties cannot.[10] Dispositional essentialism is often bundled with the view that some fundamental properties are essentially dispositional. Non-fundamental properties may be essentially dispositional as well on this view, in the sense that their dispositional characters are irreducibly dispositional. So even if the property of breaking is dependent upon more fundamental properties, it is not reducible to the non-dispositional. Many dispositional essentialists happen to be *dispositional monists* as well: they believe all fundamental properties are essentially dispositional rather than categorical.[11] I will not assume dispositional monism; the defender of essentially dispositional properties need not ban categorical properties from her total theory.

As dispositional properties are modal properties of a certain sort, defenders of essentially dispositional properties are *modal primitivists*: they accept modal features of the world that cannot be reduced to the non-modal.[12] Borghini and Williams 2008, 33 write, 'as far as we are concerned, dispositions are something we need in our ontology *anyway*, and we are not alone. A well-rounded account of worldly phenomena that does not include dispositions (or disposition-like entities) is bound to fail. And if that is the case, why bother going outside that framework to deal with possibility, if the dispositions can deal with it themselves?' Dispositionalism is the stronger view that all modal features of the world can be accounted for in terms of the non-modal and the essentially dispositional. The motivation is theoretical simplicity: why multiply primitive modal notions when one will do?

With these assumptions in place, here are four desiderata for a dispositionalist theory of modality.

> D1: *No more primitive modal notions are introduced*. Many eschew primitive modality—for just one of many anti-primitivists, see Lewis 1986. As the motivation for accepting primitive dispositionality comes not from modal theorizing but from other domains, the first desideratum is to not multiply primitive modal notions without good reason.

D2: *Actualism is not violated*. Dispositionalists are typically *actualists*: they believe that everything that exists actually exists. As such, a dispositionalist theory should not require the existence of any non-actual objects. Some dispositionalists believe that actualists must reject the existence of uninstantiated fundamental properties as well, but this is not obviously a consequence of actualism.[13]

D3: *All other things equal, possibilities that we would accept pre-theorizing are predicted*. Despite the constraint placed by D2, dispositionalism should be able to predict that there could have been, say, a talking donkey. If a modal theory fails to predict this possibility, then so much the worse for the theory. This is a defeasible requirement, since metaphysical theorizing often involves weighing the virtues of a theory against its disadvantages. I will focus on possibilities concerning concrete objects and will not demand that the dispositionalist account for logical or analytic possibilities.

D4: *The theory is informative*. A theory of modality should provide a convincing story of how it is that the source of possibility it posits yields the possibilities it thereby countenances. For example, the following principle is relatively uninformative: 'All states of affairs that are disposed to exist are possible.' We may concede that there are essentially dispositional properties without accepting just any proposal for how these relate to possibilities. D4 is in a sense a check on the D3, as it prevents the dispositionalist from simply asserting that all pre-theoretic possibilities and necessities are in fact predicted on her theory even if this is not plausibly the case.

3. Dispositionalism

Our understanding of a disposition typically comes through our grasp of its connection to its manifestation. This connection is weaker than that of necessity, but stronger than that of possibility. On the one hand, an instantiated dispositional property does not necessarily manifest—a fragile glass need not ever break.[14] On the other hand, it isn't merely possible that the fragile glass breaks. The glass is in some sense more likely to break; it has a tendency towards its manifestation. Vetter 2013; Forthcoming a; Forthcoming b suggests that the strength of modality involved in dispositional properties is that of 'easy' possibility.[15]

The strength of modality involved in dispositionality is hard to pinpoint. However, to account for possibility the dispositionalist need not give a full account of dispositionality. It is enough for her to say that whatever is disposed towards is thereby possible. The story will end up being more complicated than this, since we want to ensure that all possibilities are

predicted, as per D3. Furthermore, we want to ensure that the dispositionalist isn't given license to simply declare that every possibility is in fact predicted by her theory; as per D4, the theory must be informative.

I'll start by examining two closely-related approaches to a dispositionalist theory of possibility. The first is suggested by Vetter 2014 Forthcoming a; Forthcoming b though not defended in exactly the form presented here. Vetter theorizes in terms of *potentialities* rather than *dispositions*, where potentialities form a broader class that also includes *abilities*, *powers*, and similar notions. The crucial difference is that the modal connection involved in potentialities may lie either between possibility and necessity or at one of the extremities. This allows Vetter's own view—which we may call *potentialism*—to escape the objections in section 6, though it will still face the objections in section 4 and 5. Since the focus of this paper is on dispositionalist theories of modality, I will formulate the first view in terms of dispositions.

Consider this Vetterian principle, modified slightly from Vetter's own account:

(P) State of affairs S is possible iff some things have (iterated) dispositional properties $d_1,\ldots,d_n$, which have as their manifestation a state of affairs S.[16]

P is formulated in terms of the manifestation of some dispositional properties: not only can a single dispositional property manifest, *some* dispositional properties can manifest. Imagine that a magnetic ball is falling, but that it falls slower than it would if there weren't a magnet above attracting it. The state of affairs of the ball's falling at that speed is the result of both its weight and its magnetism. Or consider a baking-soda-and-vinegar volcano. The state of affairs of the volcano's erupting is a result of the dispositions of both the baking soda and of the vinegar.[17]

The 'iterated' part of P also requires explanation. Sometimes the manifestation of an instantiated dispositional property would lead to the instantiation of some other dispositional property, which in turn if manifested would lead to the instantiation of some other dispositional property, and so on. For instance, if the fragile glass were to be dropped onto a hard surface, then it would break into shards of glass which might then be disposed to scratch the surface. The glass has an iterated disposition: a disposition for a disposition that the surface is scratched. Note that the actual existence of the shards of glass is not required, so D2 is respected.

Acceptance of iterated dispositional properties allows for the prediction of many more possibilities than if the dispositionalist were restricted to non-iterated dispositional properties. So long as uninstantiated dispositional properties are 'anchored' in instantiated dispositional properties, their manifestations are thereby possible, no matter how remote. This helps ward off an objection to P based on D3 (pre-theoretically predicted possibilities).

In particular, P appears to predict the possibility of aliens: individuals that could exist but do not actually exist.

This is a good start.[18] However, P seems to fall short on D4 (informativeness). Consider the conjunctive possibility that a glass breaks and a lump of clay is molded. According to P, this is possible just in case some things $o_1,\ldots,o_n$ have (iterated) dispositional properties $d_1,\ldots,d_m$ which have as their manifestation the state of affairs of the glass's breaking and the lump of clay's being molded. Presumably among the $o_1,\ldots,o_n$ and the $d_1,\ldots,d_m$, some are involved in the explanation of the glass's possible breaking and others are involved in the explanation of the lump of clay's possible molding. It's hard to develop a satisfying treatment of this case using P alone.

Consider instead this group of principles endorsed by Borghini and Williams 2008 (mirroring the wording used for P):

(PA) An atomic state of affairs S is possible iff some things have (iterated) dispositional properties $d_1,\ldots,d_n$, which have as their manifestation a state of affairs S.

(PC) Where state of affairs S is a conjunction of states of affairs $S_1,\ldots,S_n$: $S_1\&\ldots\&S_n$ is possible iff S_1 is possible … and S_n is possible and $S_1,\ldots,S_n$ are compossible (that is, the existence of any of the $S_1,\ldots,S_n$ does not prevent the existence of any of the other of the $S_1,\ldots,S_n$).[19]

(PD) Where state of affairs S is a disjunction of states of affairs $S_1,\ldots,S_n$: $S_1\vee\ldots\vee S_n$ is possible iff S_1 is possible, … , or S_n is possible.

PA, PC, and PD respectively cover atomic, conjunctive, and disjunctive states of affairs. Borghini and Williams also include a principle for 'existential states of affairs', which (mirroring the wording used for P) is: 'A state of affairs X is possible iff some things have (iterated) dispositional properties $d_1,\ldots,d_n$, which have X as their manifestation.' I don't know what they mean by this, nor do they mention existential states of affairs again in the paper. They do consider negative states of affairs later on, though they don't provide a principle for the possibility of negative states of affairs or relatedly, universal states of affairs. I will return to this below.

Given that PA, PC, and PD fare better with respect to the D4 than P alone, I will primarily associate dispositionalism with this cluster of principles instead. There will be trade-offs in endorsing PA+PC+PD over P, and vice versa.

The next three sections discuss the shortcomings of dispositionalism. There are three respects in which dispositions aren't like some possibilities. Dispositions are *local*, *diachronic*, and *gradable*, whereas some possibilities are *global*, *synchronic*, or *absolute*.

These differences alone aren't reasons to reject dispositionalism. They are problematic only if the local cannot account for the global, the diachronic cannot account for the synchronic, or the gradable cannot account for the absolute. Specific problem cases appear to show just this.

4. The Local and the Global

Dispositions are local possibilities: they are possibilities for particular individuals. Locality is considered a virtue by some modal theorists. To illustrate, consider a nearby view, *essentialism* as defended by Fine 1994, according to which essence is prior to modality. This reverses the typical definition of essence in terms of modality: an object x has property F essentially $=_{def}$ necessarily, x has F.[20] As Fine argues, reducing essence to modality gets things the wrong way around—for one thing, there are properties that every individual has necessarily but not essentially, such as *being such that 2+2=4*. The details of essentialism are not important here. Its significance is that it reverses the direction of explanation so that instead of explaining essence in terms of modality, we take essence as primitive and explain modality in terms of it. What's necessary is that which holds in virtue of all essences.

Dispositionality, like essence, is a local matter. And like Fine, dispositionalists seek to explain all of modality in terms of it. However, while some possibilities are local, such as the possibility that a particular glass breaks, other possibilities are global: they concern the entire universe. (It won't matter for our purposes how well we can draw the line between local and global possibility.) Dispositionalism runs into problems trying to account for certain global possibilities. This problem has been broached elsewhere; Cameron 2008a, 273 writes that (a view much like) dispositionalism is unable to account for 'the possibility of there being different global laws of nature, or in general possibilities concerning how the world could have been globally.' Many dispositionalists bite the bullet with respect to the laws of nature: they say that the actual laws of nature are metaphysically necessary.[21] I'll grant for the sake of argument that this is the case. Nonetheless, there are other global possibilities that dispositionalism cannot account for—namely, certain negative and universal possibilities. These problems are familiar territory, as they mirror (to a large extent) the debate over *truthmakers*: entities which suffice for the truth of a claim.[22] However, the dispositionalist lacks an option that the truthmaker theorist may take to avoid the problems.

Let's start by considering two negative possibilities any modal theory should be able to account for. First, under normal conditions, a glass won't break when placed stably on a table—so it's possible that the glass doesn't break. Second, it's possible that JFK was not shot.

Borghini and Williams do not offer a principle stating the conditions under which a negative state of affairs ~S is possible. It is not obvious what such conditions would be. We cannot simply negate the right hand side of PA, for these conditions would tell us when it is

that a state of affairs S is not possible, not when it is that ~S is possible. Here is my suggestion:

(PN) Where ~S is a negative state of affairs: ~S is possible iff S conflicts with some possible state of affairs S*.[23]

Note that PN is being added as a recursive principle to PA, PC, and PD, so that S* cannot be ~S itself.

To illustrate, let's apply PN to our two cases. Consider the state of affairs of the glass's not breaking (~S): according to PN, this is possible just in case the state of affairs of the glass's breaking (S) conflicts with a possible state of affairs (S*). Presumably, S* is the glass's remaining stably placed on the table, and by PA is possible just in case it's the manifestation of some dispositional properties. The reason for appealing to a conflicting state of affairs is D4 (informativeness). While the glass does not break when it remains stably placed on a table, it does not dance, fly, or sing either. We need not associate the relevant dispositional property of the glass with all of these states of affairs as its manifestations (e.g. as an infinitely long disjunction). It suffices to associate the dispositional property of the glass with a positive state of affairs which conflicts with other states of affairs, and let the resulting negative possibilities be derivative. This is what PN does.

Next consider the state of affairs of JFK's not being shot (~S). According to PN, this negative state of affairs is possible just in case the state of affairs of JFK's being shot (S) conflicts with some possible state of affairs (S*). The story here is more complicated; a complex series of events must occur in order for JFK to be shot, requiring the instantiation of many properties. Now suppose that Lee Harvey Oswald had been prevented from ascending to the sixth floor of the Texas School Book Depository; JFK would then not have been shot. The state of affairs of JFK's being shot presumably conflicts with the state of affairs which is the manifestation of the dispositional properties involved in this alternate history.

All seems well so far. However, certain negative possibilities are more problematic. A special class of negative possibilities involves the possibility that an actually existing contingent object, like a particular glass, does not exist.[24] By PN, the glass's existing (S) conflicts with some possible state of affairs (S*). The dispositionalist needs a convincing story of what S* is in this case and what dispositional properties make it possible. S* cannot be just any state of affairs which does not involve the existence of a glass, for such a state of affairs may simply be silent on whether or not a glass exists. Furthermore, S* cannot just be the state of affairs of the glass's not existing, for this is the state of affairs whose possibility is at issue. So how could S* be a state of affairs which conflicts with the existence of a particular glass, without simply being the state of affairs of that particular glass's not existing?

One strategy is to say that S* is a *totality state of affairs*—informally, a state of affairs which is 'universe-sized'—and that S* does not involve the existence of the particular glass in question.[25] Presumably, S* is a highly complex state of affairs such as the state of affairs of x's being F, y's being G, z's being H, x's standing in R to y, and so on. However, none of these states of affairs—which are all positive states of affairs of something's being a certain way—conflict with the existence of the particular glass. In order for S* to conflict with the existence of the particular glass, it must involve a 'that's all' component, that there is nothing more in the universe. But this is a negative existential state of affairs, which was what we were trying to account for in the first place. To explain the possibility of the state of affairs of there being nothing more in the universe, we'd have to find a possible state of affairs which conflicted with the state of affairs of there being something more in the universe. Explanation runs out again.

The dispositionalist may say that the 'that's all' component is not a negative state of affairs, but a universal one: the state of affairs of everything's being either x or y or z, etc. However, in order for a universal state of affairs to figure in the possibility conditions for a negative state of affairs, we must have independent possibility conditions for universal states of affairs. It's difficult to see what these would be. A universal state of affairs cannot merely be reduced to states of affairs involving particular objects, for nothing about the existence of some objects rules out the existence of one more object. We may be able to get possibility conditions for *existential* state of affairs in terms of the possibility of states of affairs involving particular individuals. However, it is well-known that 'Everything is F' is equivalent to 'There isn't something that is not F', the latter of which is the negation of an existential claim. The problem of negative possibilities and the problem of universal possibilities are two sides of the same coin.

This worry applies only to certain negative and universal possibilities. The relevant negative states of affairs are those involving the non-existence of an object. There is no problem with negative states of affairs in which a particular object lacks a property, since these may be accounted for by PN. (I have been focusing on cases involving the non-existence of *particular* objects, but the arguments above also apply to states of affairs involving, for instance, the non-existence of some glass or other.) The relevant universal states of affairs are what are sometimes called 'accidental generalizations' and so do not hold of necessity. The possibility of certain non-accidental generalizations—such as the state of affairs of all fragile objects being disposed to break—may be accounted for on dispositionalism.

These are not entirely new problems in the context of the debate over truthmakers. If *truthmaker maximalism* holds, then every truth has a truthmaker; but the truthmaker maximalist then has problems with negative truths and universal truths which parallel the problems facing the dispositionalist. This should come as no surprise. The dispositionalist can be construed as a sort of truthmaker theorist, one who believes that the truthmakers for

modal truths are actually instantiated dispositional properties.[26] But while the non-dispositionalist truthmaker theorist may simply opt to reject truthmaker maximalism, the dispositionalist may not do the same. That is, she cannot simply say that not all modal truths have dispositional truthmakers, for her theory just is that all modality can be accounted for in terms of the dispositional features of the world.

I have been assuming that a totality state of affairs is a non-atomic state of affairs. Suppose the dispositionalist says that totality states of affairs are atomic states of affairs. In this case, by PA, some things have (iterated) dispositional properties which have as their manifestation the totality state of affairs. This totality state of affairs is something like the state of the affairs of things x, y, z, etc. being all and only the things that there are, which is explained by the disposition to be all and only the things that there are. (The stimulus conditions are that there are no more things.)[27] However, this move appears *ad hoc* and also runs afoul of D4 (informativeness).

Here is another attempt to deal with the problem. I have been assuming thus far that nothing less than a totality state of affairs could account for the possibility that some particular glass does not exist, on the grounds that anything less would not conflict with the existence of the glass. However, there is another option available to the dispositionalist. She may say that there are essential features of the glass that must be present in any state of affairs in which it exists. For instance, she may accept a Kripkean principle of origin essentialism: for the glass to be the particular glass it is, it must be made from particular materials in a particular way. For a state of affairs to conflict with the glass's existence, it need only involve the start, but not the end, of the process that leads to that glass. But this strategy is in tension with D1 (no more primitive modality). The requirement that the glass is essentially associated with a particular origin is a modal requirement.

Perhaps the dispositionalist may distinguish between atomic and non-atomic negative states of affairs, where ~S is atomic iff S is an atomic positive state of affairs. She may then accept PN for non-atomic negative states of affairs, and PA for atomic negative states of affairs. The idea is that there are dispositions to manifest negative characteristics—for instance, brittleness may be described as the disposition to not break. However, this move would not help with the glass's not existing, as there are no dispositions to not exist.

The discussion thus far has assumed the principles proposed by Borghini and Williams—PA+PC+PD—with the suggested addition of PN. But why not avoid complications by endorsing the simple Vetterian principle P instead? Given P, *any* state of affairs S is possible just in case some things have (iterated) dispositional properties which have S as their manifestation. While this would get around the problems articulated in this section, the dispositionalist would have to embrace a vast ontology of dispositional properties. Any complex state of affairs S would be the result of dispositions which had S as their manifestation. But one motivation for adopting dispositionalism was that it allowed us to use relatively mundane modal features of the

world to account for the more exotic ones. Adopting exotic dispositions just to get around these problems removes this advantage.

5. The Diachronic and the Synchronic

Dispositions are in a sense *diachronic*: they're typically characterized in terms of causation, a diachronic process. The instantiation of a dispositional property typically has implications for what comes next rather than what is the case now. But some possibilities are *synchronic*, where what's possible seems to be a matter of the non-diachronic properties and relations of the objects in question. In these cases, there aren't plausible dispositional explanations.[28]

Consider the state of affairs of a glass's having a mass of 400g. The dispositionalist, applying PA, says that this state of affairs is possible just in case some things have (iterated) dispositional properties which have as their manifestation a glass's having a mass of 400g. To fill out the story, we may imagine a causal process which leads to the formation of such a glass. However, consider the possibility that such a glass could have existed *ex nihilo*. There is no contradiction in the idea that such a glass exists at the beginning of the universe, or that it appears out of thin air. We may make the point more directly by considering the possibility that a glass having a mass of 400g comes into existence *ex nihilo*, or that it always exists in a universe which has no beginning. Neither of these states of affairs is adequately explained by PA.[29]

The dispositionalist may protest that this case violates D3 (pre-theoretically predicated possibilities), as it is not plausible that a glass could have existed *ex nihilo*.[30] But there are other cases to consider. There is also tension between the diachronic and the synchronic when it comes to conjunctive states of affairs. Consider the impossible state of affairs of a glass's having both a mass of 400g and a mass of 500g. Since this is a conjunctive state of affairs, the dispositionalist looks to PC for an explanation of its impossibility:

(PC) Where state of affairs S is a conjunction of states of affairs $S_1,\ldots,S_n$: $S_1\&\ldots\&S_n$ is possible iff S_1 is possible … and S_n is possible and $S_1,\ldots,S_n$ are compossible (that is, the existence of any of the $S_1,\ldots,S_n$ does not prevent the existence of any of the other of the $S_1,\ldots,S_n$).

PC invokes the notion of *compossibility*, which if left unreduced would be a primitive modal notion, and would thus violate D1 (no more primitive modality). Borghini and Williams provide an explanation of compossibility: $S_1,\ldots,S_n$ are compossible just in case 'the existence of any of the $S_1,\ldots,S_n$ does not prevent the existence of any of the other of the $S_1,\ldots,S_n$'. But the worry is now transferred to the idea of a state of affair's preventing the existence of another state of affairs. Even if *prevention* is not a modal notion, it is certainly

not something that should be left unexplained. In fact, it sounds like a causal notion: the handcuffs prevent the burglar's escape, as they caused her not to escape.

Returning to our glass case, PC says that the state of affairs of a glass's having both a mass of 400g and a mass of 500g is possible just in case the glass's having a mass of 400g is possible, the glass's having a mass of 500g is possible, and they're compossible—that is, neither state of affairs prevents the existence of the other. If we cash out compossibility in terms of prevention, then PC rules that these states of affairs *are* compossible, as neither causes the other not to be. This is the wrong result; whether these states of affairs are compossible should not be a matter of what came before. Without an adequate non-modal explanation of compossibility, the dispositionalist cannot reduce synchronic possibility to diachronic possibility.

Finally, this tension is also found in the principle for negative possibilities proposed on behalf of the dispositionalist:

(PN) Where ~S is a negative state of affairs: ~S is possible iff S conflicts with some possible state of affairs S*.

PN provides a recursive principle for the possibility of negative states of affairs at the cost of invoking the notion of a state of affair conflicting with another state of affairs. Our example was of the state of affairs of a glass's not breaking. PN tells us that it's possible that the glass does not break in virtue of there being a possible state of affairs which conflicts with its breaking—for instance, the state of affairs of the glass's remaining stably placed on the table.

Is *conflicts with* an irreducibly modal notion? The two relevant states of affairs are that of the glass's breaking and of the glass's remaining stably placed on the table. We could give a non-modal explanation of their conflicting if they involved contradictory properties of the glass, such as having a mass of 400g and not having a mass of 400g. But they are not. An adequate non-modal explanation might take the form of some theory of property constituency, but the burden is on the dispositionalist to give such a theory. It is not obvious what such a theory would be. The property of breaking is not 'about' the property of remaining stably placed on the table, any more than it is 'about' the property of being a ceramic vase. Nonetheless, it can be co-instantiated with the latter and cannot be co-instantiated with the former.

Suppose that the dispositionalist appeals to the distinction between the fundamental and the non-fundamental. When we look at the fundamental properties upon which two conflicting non-fundamental properties depend, their conflicting can somehow be explained. But even if such a theory can be given, there are plausible cases where two fundamental properties are not co-instantiable, but where there is no non-modal explanation, as with the properties of having mass 400g and having mass 500g.

6. The Gradable and the Absolute

Dispositions are *gradable* whereas some possibilities are *absolute*. Dispositions seem to come in degrees: a glass may be more disposed to break than a ceramic vase, and a fragile object is more likely to break than a non-fragile object. The state of affairs of a glass's breaking may accordingly be said to be 'more possible' than the state of affairs of a ceramic vase's breaking, and the state of affairs of a glass's breaking may be said to be 'easily possible'. (I am borrowing Vetter's terminology, and like her, will not offer a precise definition.) On the other hand, we can also talk about possibilities without grading them: the state of affairs of a glass's breaking is absolutely possible. We thus have two ways of classifying states of affairs: as 'absolutely possible' or as 'easily possible' (with 'more possible than' entering the picture when we compare states of affairs).

These are not exclusive categories—any easily possible state of affairs is absolutely possible. This is not to say that easy possibility can be reduced to absolute possibility.[31] In fact, the dispositionalist requires an account of absolute possibility in terms of easy possibility, as she reduces all possibility to dispositionality. She gets part of this account for free, since every easy possibility is an absolute possibility. But she still needs to show that *all* absolute possibilities are reducible to easy possibilities. The 'iterated' part of PA is meant to account for some of this. Unfamiliar states of affairs may be anchored in actually instantiated dispositional properties so long as we can get to them eventually—that is, just in case there is a disposition for a disposition for … such that the remote state of affairs is a manifestation of that iterated disposition.

But the dispositionalist will be hard-pressed to account for them all. Consider a scenario in which a cigarette is puffed, and the smoke diffuses evenly in the air. The dispositionalist can give a fairly straightforward story of why this state of affairs is possible: the smoke diffuses evenly as a result of its disposition to do so. However, the following state of affairs is also possible: the smoke collects in a small cat-shaped ball in the corner. It is less plausible in this second case that the smoke has a disposition to manifest this state of affairs.

It may be tempting to say that while the smoke is not disposed to collect into a cat-shaped ball, it has the potentiality to do so. The problem with this response is that it is not dispositionalist. When introducing the Vetterian principle in section 3, I mentioned that Vetter herself trades in potentiality rather than dispositionality. Potentiality is a graded modality that ranges from possibility to necessity, which allows the potentialist to appeal to potentialities of the smoke that are unlikely to manifest. But the theory of modality under scrutiny is not potentialism, but dispositionalism. Perhaps those sympathetic to dispositionalism should turn to potentialism instead. But as I also mentioned in section 3, this view still does not escape the objections in sections 4 and 5.

In any case, the dispositionalist may still argue that while it is not intuitively plausible that the smoke has a disposition to collect into a cat-shaped ball, it does have this disposition.

In particular, she may point out that given deterministic laws of nature, under certain conditions the smoke *must* collect into a cat-shaped ball. At this point, it would be useful to once again appeal to the division between the fundamental and the non-fundamental. While the laws of nature do not 'govern' smoke *per se*, the laws of nature 'govern' smoke particles, or rather, the more fundamental entities that constitute smoke. (As mentioned earlier, many dispositionalists want to explain the laws of nature in terms of dispositions rather than the other way around.) Of each of these of these fundamental entities, we may say that under very specific initial conditions—which include the laws of nature—such-and-such will manifest. These dispositions of fundamental entities may not be as familiar as 'fragility', but they are arguably more fundamental dispositions.[32] The dispositionalist thus has a story of how an unlikely possibility reduces to dispositionality by appealing to the fundamental level.

Unfortunately, this story depends on the laws of nature being deterministic. Suppose that the laws of nature are merely probabilistic. Now consider an entity which has a half-life of ten seconds. It is unlikely, but possible, for the entity to decay after three hundred years. Given the laws of nature and the relevant initial conditions, the particle *may* decay after three hundred years. However, it would be a stretch to say that the particle has even an iterated disposition to do so. The dispositionalist may wish to defend a deterministic physical theory—such as Bohmian or Everettian mechanics—for independent reasons, but there is no consensus on such a view in the scientific community.

7. Concluding Remarks

I have argued that while dispositionalism seems well-suited to account for possibilities that are local, diachronic, and gradable, it cannot account for certain possibilities that are global, synchronic, or absolute.

The dispositionalist may bite the bullet and deny that the purported possibilities really are possibilities. Borghini and Williams 2008, 37 write in response to other problems:

> Let us start by pointing out that speaking of the possibilities we 'need' is very odd indeed. This implies that we know what is metaphysically possible, and that it is the task of an ontologically motivated account like dispositionalism to provide the truthmakers for that set of possibilities. This puts the cart before the horse. The dispositional properties provide the grounds for what possibilities there are; any state of affairs not grounded in the actual dispositional properties is not metaphysically possible. The set of actual dispositional properties determines the space of what is metaphysically possible, not the reverse.[33]

There is something right in this. We don't want our metaphysical theories to be completely constrained by our intuitions. On the other hand, this attitude is one that may be

adopted by *any* theory of modality, no matter how implausible. It cannot be the whole story. Rather, the thought is that the few purported possibilities that the correct theory cannot account for are (i) not obviously possible for independent reasons, and (ii) outweighed by the overall effectiveness of the theory in accounting for other things (be it other possibilities or non-modal data). D3 allows our intuitions to be outweighed. However, these cases are rejected by the dispositionalist only because they are counterexamples.

The dispositionalist may also respond by rejecting D4: she may say that she cannot give an absolutely informative theory connecting primitive dispositionality to all other modal notions—perhaps informativeness is overrated. The dispositionalist nonetheless expects primitive dispositions to somehow explain these other notions. The problem with this attitude is that all other things equal, it is better to be able to give a theory of modality, even if one is a modal primitivist. There is a modal primitivist view, sometimes called *modalism*, according to which true necessity and possibility claims are primitively true. If the dispositionalist can formulate an adequate theory of modality, she will be able to claim advantage with respect to D4 over modalism.

The upshot of this paper is not that we must reject the existence of essentially dispositional properties. Rather, one who accepts essentially dispositional properties needs further resources to fill out her modal theory, resources better suited to account for the global, the synchronic, and the absolute. For instance, she may adopt further primitive notions, giving up D1, or she may reject actualism, giving up D2, and allow herself the resources of genuine possibilia. But buyer beware: these resources come at a cost.[34]

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[1] This view is suggested (whether or not developed) by Borghini and Williams 2008, Contessa 2010, Ellis 2001, Jacobs 2010, Molnar 2003, Mumford 2004, and Vetter Forthcoming a; Forthcoming b. Note that Vetter's Forthcoming b contains the most up-to-date presentation of her views.
[2] SCA was proposed by Lewis 1997. It should be understood as a time-indexed principle.
[3] For the debate over which dispositions are associated with which conditionals, see Manley and Wasserman 2008 and follow-up discussion from Bonevac, Dever, and Sosa 2011, Choi 2011, Vetter 2011, and Manley and Wasserman 2011.
[4] Cases of finks are introduced in Martin 1994; cases of masks (or 'antidotes') are introduced in Johnston 1992 and Bird 1998. For a recent summary of objections based on interferers, see Manley and Wasserman 2008. For a discussion of the analysis of dispositions, see Mumford 1998.
[5] Not everyone agrees; see Schaffer 2009.
[6] Consider scientific essentialism as defended by Ellis 2001.
[7] Necessitarians about laws of nature include Shoemaker 1998 and Bird 2005.
[8] See section 10.3 Bird 2007. Bird 2007, 218 (footnote 143) also suggests the equivalence of 'Necessarily, φ' with 'If it were the case that ~φ, then it would be the case that φ', a strategy employed by Hill 2006, Kment 2006 and Williamson 2008 in different contexts. However, there is nothing distinctively dispositionalist about this view.
[9] Defenders include Ellis 2001, Mumford 2004 and Bird 2005; 2007.

[10] I am assuming a clean division between dispositional and categorical properties; for skeptical discussion, see Mellor 1974.
[11] A view closely related to dispositional monism was first proposed by Shoemaker 1998. Other dispositional monists include Mumford 2004 and Bird 2005; 2007. Dispositional essentialists who aren't dispositional monists include Ellis and Lierse 1994, Ellis 2001, and Heil 2003.
[12] For instance, see Molnar 2003, 200, Borghini and Williams 2008, 33, and Jacobs 2010, 233.
[13] Many actualist theories face the problem of aliens discussed in Lewis 1986, in both object and property forms. The dispositionalist builds a partial solution to the problem of aliens into her theory's principles, as discussed in section 3. However, I will argue in section 6 that this fix is inadequate.
[14] See Schrenk 2010 for an argument against the reduction of dispositionality to necessity.
[15] Anjum and Mumford 2011 make an analogy with normativity and intentionality, and Schrenk 2010 makes an analogy with Newtonian force.
[16] Although I won't presuppose any particular account of the nature of states of affairs, let's assume that (i) they are abundant and (ii) some do not obtain.
[17] Step 1: Make a volcano base. Step 2: Fill the crater with warm water and just a dash of dishwashing liquid, baking soda, and red food dye. Step 3: Add vinegar, and watch it erupt!
[18] I am setting aside a complication: Must the stimulus conditions of the conditionals be possible in order for the manifestation to be possible? If they do, there is danger of regress, since P is introduced in order to explain possibility. Thanks to a referee for this point.
[19] The appeal to *compossibility* is immediately worrisome—left unreduced, compossibility is a primitive modal notion, which violates D1. I return to this in section 5.
[20] Or alternatively: an object x has property P essentially just in case necessarily, whenever x exists, x has P.
[21] See Bird 2007, Ellis 2001, Shoemaker 1998, and Vetter 2014.
[22] For instance, see Russell 1985 and Armstrong 1997. For a nice overview of problems with truthmakers, see Rodriguez-Pereyra 2006.
[23] For now, I am ignoring the fact that *conflicts with* appears to be a modal relation between states of affairs. Let's assume temporarily that some non-modal analysis of *conflicts with* can be given. I will express some skepticism in section 5.
[24] There is a relevant exchange in which Cameron 2008a argues against dispositions-based truthmakers for 'It is possible that none of the actual contingent beings existed' and Contessa 2010 argues in favor. The cases I discuss tell on this possibility.
[25] Discussion of this strategy in the nearby truthmakers debate may be found in Merricks 2007, 39–67, and in follow-ups in Cameron 2008b and Merricks 2008. As far as I know, its current form originates in Armstrong 1997.
[26] The dispositionalist need not be a truthmaker theorist: there are various ways to explain the connection between states of affairs and the dispositions which figure in their possibility conditions. For instance, the dispositionalist may appeal to *grounding* or *metaphysical semantics*.
[27] Thanks to Ross Cameron for suggesting this formulation of the problem.
[28] Though Nolan Forthcoming argues that there are non-causal dispositions, his examples are still diachronic. Furthermore, even if some dispositions were synchronic, there still wouldn't be plausible dispositional explanations of the cases discussed in this section.
[29] These states of affairs might not count as synchronic, but in any case they illustrate that the possibility that a glass has a mass of 400g shouldn't be tied to dispositions.
[30] Thanks to a referee for worrying about this case.
[31] Vetter 2013; 2014 argues that it cannot be so reduced.
[32] Fragility itself may really be a collection of more specific dispositions, such as the disposition to break under such-and-such very precise conditions. For the relevant debate, see footnote 3.
[33] Vetter Forthcoming a also endorses bullet-biting to some extent. For bullet-biting in the context of truthmakers, see Contessa 2010.
[34] Thanks to Ross Cameron, Heather Demarest, Tom Donaldson, Jonathan Schaffer, Barbara Vetter, Dean Zimmerman, and an audience at the University of Geneva for very useful feedback.