From Combinatorialism to Primitivism

Jennifer Wang

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Abstract: Modal primitivism is the view that metaphysical modality cannot be reduced to something entirely non-modal. It is often rejected for reasons of ideological simplicity; according to this theoretical virtue, the fewer primitive notions a theory requires, the better. Reductive theories of modality like Armstrong's combinatorialism are thus thought to hold the ideological high ground. According to combinatorialism, what's possible is reducible to recombinations of objects with fundamental properties and relations. If this reduction succeeds, then we have a theory that uses no primitive ideology in its explanation of the modal beyond what we already need to explain the non-modal. I argue that combinatorialism faces two problems: the problem of spatiotemporal relations and the problem of determinates. I then show that in order to get around these problems the combinatorialist must adopt a primitive non-modal notion of her own.

Next, I defend a modal primitivist theory that takes as its primitive notion the notion of incompatibility between properties and relations. I show that such a theory is systematic, and may reduce the combinatorialist's primitive non-modal notion. This shows that the theories are on an ideological par. Finally, I argue against reasons to think that there is something especially problematic about primitive modal notions as compared to primitive non-modal notions.

Keywords: metaphysics, modality, recombination, primitive, ideology, fundamental

Consider this sentence: "There could have been a talking donkey." Is this sentence "primitively true"? That is, is it immune to explanation in more basic terms? Probably not. Donkey truths can presumably be explained in terms of truths about arrangements of microscopic particles, or whatever are the basic elements of ideal physics. Still, this sentence asserts a *modal* claim: that it is *possible* that there is a talking donkey. We may grant that donkey possibilities can be explained in terms of microscopic possibilities, and still ask: Are sentences about microscopic possibilities primitively true? Are there any modal truths that are primitively true?

To the latter at least, I say yes. I am a *modal primitivist*—that is, I believe there are modal truths whose explanations require the use of primitive modal terms. Many eschew primitivism in favor of reduction. One of the biggest reasons for rejecting primitivism stems from considerations of ideological simplicity, where ideology comprises the notions needed to state a theory. For example, Lewis writes (1986 [242]), "Primitive modality is bad news, and more kinds are worse than fewer." And Sider writes (2012 [267]), "The good reason for opposing modal primitivism is simply: ideological economy."

In this paper, I argue against one prominent reductive theory of modality in order to show the ideological cards aren't stacked against modal primitivism. According to *reductive combinatorialism*, defended most prominently by Armstrong (1989, 1997), we can reduce modal claims to non-modal claims via combinatorial principles of some sort. My aim in this paper is to deflate the apparent advantage of reductive combinatorialism over modal primitivism by showing two things: first, with respect to primitive notions, the views are on a par, and second, adopting a modal primitive can lead to a systematic view. Here's the plan for the paper. I start by discussing what it means to adopt a primitive (§1). I then introduce reductive combinatorialism (§2). Next, I present two problems for which the reductive combinatorialist must adopt primitive notions: the problem of spatiotemporal relations (§3) and the problem of determinates (§4). I then introduce my view, *incompatibility primitivism*, and show how it can handle both cases (§5-6). Finally, I argue against reasons to think that primitive incompatibility is problematic (§7) and against reasons to think that primitive modal notions in general are problematic (§8).

Note that modal primitivism is not in conflict *per se* with the use of combinatorial principles—such principles can be used to merely generate modal truths from other modal truths. However, the reductive combinatorialist thinks that recombination is in some way constitutive of modality, which the modal primitivist denies.[1] I will reserve the term 'combinatorialism' for 'reductive combinatorialism' and the term 'primitivism' for 'modal primitivism' throughout this paper, unless it is clear that they are otherwise employed.

1 Primitive Notions

Modal primitivism is sometimes thought of as the view that one of the modal operators ('□' or '◊') is a primitive notion. For example, Fine writes on behalf of the modal primitivist (1977 [117]), "[T]he possible exists as a *manner* in which things happen. It exists as a mode, not an object. In the proper language for expressing modal truths, the modal primitives will be adverbial (sentential connectives)..."[2] But this is not the only way to be a modal primitivist. The notion of *essence* is plausibly a modal primitive; so are the notions of *power* and *disposition*.[3] I will present a view that takes as primitive the notion of *incompatibility* between properties or relations. What does it mean to accept a primitive notion, and are some more acceptable than others? I first talk about primitive notions generally, and then consider the case of primitive modal notions.

Primitive notions are those that are left unreduced in a theory; they constitute what Quine calls the "ideology" of a theory.[4] Since they are theory-relative, there can be notions that are primitive relative to one theory but not relative to another. For example, biologists might take the notion of *atom* as a theoretical primitive for their purposes, despite the fact that atoms can be further explained chemically.

Primitive notions must be distinguished from the things in the world to which they may "correspond": objects, properties, relations, etc. In metaphysics, we're sometimes

[1] Sider writes (2005 [693, footnote 8]), "An analysis of possibility says what possibility *is*, and so a combinatorial analysis of possibility *identifies* possibility facts with facts about combinations."
[2] Also see Lewis (1986 [13-14]), Forbes (1989 [78]), and Peacocke (2002 [486]).
[3] In each of these cases, there is debate over whether the notion involves primitive modality. For contemporary discussions of essence, see Fine (1994, 1995), who rejects modal primitivism, Adams (1979, 1981) and Brody (1973). For discussion of dispositions or powers, see Bird (2006, 2007).
[4] See Quine (1951).

concerned with the *fundamental* structure of the world. The idea that the world is ordered by metaphysical dependence relations is an old thought that has resurfaced in recent years.[5] The *fundamental* objects, properties, or relations are those that do not depend on anything. Given the widespread defense of fundamentality talk, I will simply assume these things: that there are more or less fundamental objects, properties, or relations, that the less fundamental are grounded in the more fundamental, and that the most plausible candidates for fundamental objects are whatever it is that physics posits as fundamental, be it particles, fields, waves, or spacetime points.[6] I will also start by assuming that there is a fundamental level of objects, properties, and relations. This assumption is known as *well-foundedness*: grounding chains must always terminate. Well-foundedness leads to *completeness*, the thesis that the fundamental objects, properties, and relations form a basis upon which all other objects, properties, and relations supervene. Finally, I assume that all fundamental properties and relations are categorical rather than dispositional.[7]

The primitive notions of metaphysics, arguably, cannot be further reduced relative to *any* theory. Despite this, they can still fail to pick out fundamental objects, properties, or relations. The world may have a certain structure for which we must introduce primitive notions, but we may nonetheless reject the existence of corresponding fundamental entities for considerations of ontological parsimony. For example, the endorser of primitive modal operators need not think that the "manners in which things happen" are fundamental properties. The primitive incompatibilities that I endorse need not correspond to fundamental relations in the world (though I am happy to say that they do).

The modal primitivist thinks that the metaphysical explanation of modal truths sometimes bottoms out in irreducibly modal features of the world. For example, the explanation of the truth of the sentence "There could have been a talking donkey" might bottom out in the application of a primitive possibility operator to some sentence like "There are microscopic particles such-and-such arranged in such-and-such a way." Nolan argues that we should adopt a broader conception of what makes a primitive modal; for example (2002 [43]), "a theory which analysed modal operators in terms of possible worlds conceived of as *sui generis* abstracta would also count as being committed to modal primitives—the modal primitives being the worlds (and perhaps the "true according to" relation postulated as well)." Nolan proposes that the primitivist is one who requires more resources to explain the modal than what is already available to explain the non-modal.[8]

However, we haven't quite addressed the question of what the target of analysis is in the first place; that is, what counts as "modal"? As a working criterion, let's say that a modal primitive is a primitive notion that we understand in paradigmatic modal terms like "can," "must," and "possible." For a notion to be modal we need not have a conceptual *reduction* of

[5] See for example: Fine (2001), Rosen (2010), Schaffer (2009a, 2010a, 2010b), and Sider (2012).
[6] Schaffer is in some sense an exception; he argues that the entire cosmos is the most fundamental object (2007, 2009a, 2010a, 2010b). However, that the fundamental objects are microscopic is inessential to my argument.
[7] I assume this because dispositional properties (or relatedly, powers or potencies) are often modally characterized. The reductionist about modality denies that there are modal properties at the fundamental level, so out of charity to her, I ignore the possibility of such fundamental properties.
[8] This also appears to be the sort of view that Cameron (Forthcoming) endorses.

the notion in modal terms—in many cases we can understand a notion, or understand how to apply it, without requiring reduction. Rather, the criterion requires that our grasp of the notion is through clearly modal notions. For example, the notion of a possible world as *a way the world might have been* counts as a modal primitive since when characterizing worlds we use paradigmatically modal terms: they're ways the world *might* have been, or properties the world *could* have instantiated. The notion that I employ, *incompatibility*, might be understood as what holds of properties that *cannot* be co-instantiated. But it doesn't matter much whether we can judge every notion to be either modal or non-modal.[9] As Cameron (Forthcoming) points out, the real question is whether or not we are happy with the notions we've used to ground modal sentences.

Many are in fact *not* happy with primitive modal notions. This paper focuses on the worry that adopting modal primitives violates the theoretical virtue of simplicity. According to a principle of simplicity, more primitive notions are worse than fewer; what primitive ideology we can eliminate, we should. What I aim to show in the following sections is that although the primitivist accepts a primitive notion that the combinatorialist does not, the combinatorialist needs to adopt non-modal primitive notions that the primitivist doesn't need.

2 Combinatorialism

The intuitive idea behind combinatorialism is that what's possible can be reduced to recombinations of elements of a certain sort (e.g. objects with properties and relations). The motivations for such a view are tied up with anti-primitivist and Humean sentiments.[10] Here I introduce as my main target the sort of combinatorialism advocated by Armstrong (1989, 1997), who was inspired by Skyrms (1981) and Wittgenstein (1961). The basic idea is this: "In our Combinatorial Scheme, *all simple properties and relations are compossible*."[11]

Consider this formulation ("FR" for "Fundamental Recombination") of Armstrong's principle, understood as constitutive of metaphysical possibility:[12]

[9] Nolan points out that the line between the modal and the non-modal may be difficult to draw; see his (2002 [45]).

[10] I address the anti-primitivist sentiments in §8. The Humean intuitions are usually tied to this slogan: "There are no necessary connections between distinct existences." There are some minor issues with this formulation of "Hume's dictum" (which deRosset discusses in his (2009)). First, it is unclear what counts as a necessary connection; after all, any two objects are trivially related by the relation of necessary non-identity. Second, we need to be clear on what count as distinct existences, or distinct objects—an object and proper parts are arguably connected by the relation of necessary overlap. I suspect these issues can be avoided by formulating the principle this way: "It is never the case that the instantiation of a fundamental property or relation precludes or necessitates the instantiation of another fundamental property or relation." However, even this formulation runs into potential problems. If the relation of identity is fundamental, for example, then the instantiation of any fundamental property by an object will necessitate the instantiation of the identity relation. In any case, we should keep in mind two things about Hume's dictum: (1) It should be understood as a constraint on a theory of modality, not a reduction, and (2) it is meant to have intuitive appeal, but is not analytically or logically true.

[11] Armstrong (1997 [49]).

[12] Two things: First, I replace Armstrong's talk of "sparse universals" with talk of fundamental properties or relations, which shouldn't affect discussion. Second, note that some modal claims, like "Necessarily 2+2=4," appear to concern abstracta. If abstract objects necessarily exist and necessarily have certain properties, then they will never fail to exist nor fail to have certain properties, and so cannot be the elements of recombination. Rather than try to incorporate issues concerning abstracta into our discussion, I will set them aside.

(FR) Any pattern of instantiation of any fundamental properties and relations is metaphysically possible.[13]

It is easy to see why we need the qualification of fundamentality. If we permitted the recombination of any objects and properties or relations whatsoever—assuming an abundant property ontology—we would end up with "possibilities" where there are square circles. Absolutely free recombination is not extensionally adequate.

My sympathies lie with the view that the fundamental properties and relations are not all modally independent of each other. In each of the next two sections, I will show that (i) given plausible candidates for fundamental properties or relations, FR has a problem of overgenerating possibilities, and (ii) the fix for combinatorialism involves accepting primitive notions.[14]

Before moving on, I should explain why Lewis, a well-known defender of a principle of recombination, is not my main target. Lewis's principle appears in his (1986), and is roughly this: For any part *x* of possible world *w*, and any part *y* of possible world *v*, there exists a possible world which contains only a duplicate of *x* and a duplicate of *y*.[15] The problem with taking Lewis's principle as a reductive combinatorial principle is that it can't be a reductive principle for anyone who doesn't also have a non-modal account of possible worlds. The principle itself only generates worlds from other worlds. Thus, someone who accepts Lewis's combinatorial principle but thinks that possible worlds are *sui generis* modal objects—that they are defined as entities that *could* exist—does not have a reductive theory of modality.

3 The Problem of Spatiotemporal Relations

In discussions of fundamentality and recombination, some have noticed that location relations are apparently special. This is because given certain background assumptions, location relations (and certain other spatiotemporal relations) are not freely recombinable. In this section, I discuss problem cases for FR given these choices: (a) substantivalism or relationism about spacetime, and (b) which spatiotemporal relations are fundamental.

Let's start with the assumption of substantivalism, according to which spacetime points and regions (or whatever entities ideal physics identifies with spacetime) exist. On a common version of substantivalism, the fundamental spatiotemporal relations include relations like *is located at*, which hold between objects and regions of spacetime. We then have a straightforward argument to the failure of FR: FR entails that it's possible that some *x* is located at some *y*, even if *x* is not an object or *y* is not a region of spacetime. But this is not

[13] We may cash this out linguistically by saying that a pattern of instantiation is described by a sentence like this: There exist objects *a*, *b*, … fundamental properties P_1,P_2,... and fundamental relations R_1,R_2,… such that $P_1(a)$ and $\sim P_2(a)$ and $R_1(a,b)$, etc.

[14] Other arguments have been advanced against combinatorialism. Thomas (1996) and MacBride (1999) argue against combinatorialism based on the supposed "infused modalness" of universals and particulars, purportedly showing that combinatorialism isn't really reductive. More recently, Schaffer argues (2010a) that given certain plausible views, there are necessary connections between any two objects.

[15] Duplicates are brought in to avoid some of the issues with transworld identity. For other formulations, see Nolan (1996 [239]), Efird and Stoneham (2008 [485]), and Divers and Melia (2002 [16]).

possible, so FR is false. Call this a case of "relata mismatch." To block this case, we apparently must require that the relata of *is located at* be respectively an object and a region. However, to require this is to posit a necessary connection between *is located at* and *is an object* or *is a region*; this is not a connection that the combinatorialist will want to leave primitive.

Suppose instead that relationism about spacetime is true—that is, that spacetime points do not exist, and spatiotemporal relations are nothing but relations between objects. On relationism, relations like *is located at*, if they exist at all, are non-fundamental. In their place, the relationist posits fundamental spatiotemporal relations that hold between objects, like *is five feet from*.[16] But if such distance relations are fundamental, then FR is false: According to FR, it's possible that *x* is five feet from *y*, and that *x* is six feet from *y*. But this isn't possible. To block this purported possibility requires a different necessary connection: a restriction on the instantiation of more than one distance-in-feet relation by a pair of objects. However, this isn't the only problem with distance relations. According to FR, it's possible that *x* is five feet from *y*, and *y* is six feet from *z*, but *x* is twelve feet from *z*. This violates the triangle inequality, which states that for any three points *A*, *B*, and *C*, the distance between *A* and *B* added to the distance between *B* and *C* must be at least as great as the distance between *A* and *C*. So again, FR is false. The triangle inequality is really only the tip of the geometrical iceberg.[17] The problem arises in different forms depending on what one takes as her primitive geometrical notions—there will always be constraints that a geometry must satisfy. Call this the problem of "metric constraints."

Maudlin (2007) points out that one way to solve the problem of metric constraints is to take *path length* rather than *distance* as fundamental; distance may be defined as the minimal length of a continuous path from one point to another. We then get the triangle inequality for free: for any three points *A*, *B*, and *C*, the minimal distance between *A* and *C* is as least as short as the distance between *A* and *B* added to the distance between *B* and *C*, since a path from *A* to *B* connected to a path from *B* to *C* is a path from *A* to *C*. However, going this route appears to require substantivalism, since it requires positing fundamental path lengths.

This last consideration isn't problematic for a different version of substantivalism, supersubstantivalism, which adds to the thesis that spacetime regions exist the thesis that objects *just are* spacetime regions.[18] Given this, the supersubstantivalist can adopt Maudlin's strategy of taking path lengths to be fundamental, and is thus not faced with the problem of metric constraints. Furthermore, the supersubstantivalist is not faced with the problem of relata mismatch that arose for the ordinary substantivalist, since *is located at* is not fundamental. Still, this view doesn't provide an entirely satisfactory solution for the combinatorialist. The supersubstantivalist must still take for granted that path lengths satisfy

[16] I set aside worries about units of measurement and realism. I also set aside for simplicity the view that *is five feet from* is fundamentally a relation between two objects and the number five, or even a relation between two objects, the number five, and some standard of measurement.
[17] At the very least, analogous problems arise for quadruples, quintuples, and so on as well; see Maudlin (2007 [89])
[18] For different ways to be a supersubstantivalist, see Schaffer (2009b).

constraints *like* metric constraints—for example, that the sum of the lengths of paths between points *A* and *B*, and *B* and *C*, is the length of a path between *A* and *C* via *B*. Call these "path length constraints."

In response, the defender of supersubstantivalism and fundamental path length may try to appeal to analyticity: it's simply part of what we mean by 'path length' that it satisfies the principle. The relationist defender of fundamental distance may in fact say something similar: it's simply what we *mean* by 'distance' that it satisfies the triangle inequality. But this strategy doesn't help either defender. Even if it were part of the meaning of these terms that such constraints were satisfied, we cannot preserve FR, for this principle says that *any* distribution of fundamental properties and relations is metaphysically possible. (I don't mean to exclude the possibility that some truths are necessary partly in virtue of being *analyticities*; however, on pain of violating FR, the combinatorialist's fundamental relations cannot analytically entail necessary connections between fundamental properties and relations.)

I've noted that there appear to be necessary connections between certain fundamental properties or relations that violate FR. Rather than accept these necessary connections as primitive, the combinatorialist may opt to revise her principle. Presumably this will involve adding to FR constraints on the distribution of certain fundamental properties and relations. Suppose, for example, that the combinatorialist who endorses relationism and fundamental distance relations wants to accommodate metric constraints. She cannot add these constraints one by one, as a list of banned distributions of distance relations, on pain of unsystematicity. Instead, she may add to her list of primitive notions the notion of being a determinate of the same determinable; equipped with this notion, she may require that the distribution of fundamental properties and relations is such that no two objects instantiate two determinates of the determinable *is five feet from*, etc.[19] Issues concerning determinates and determinables will be discussed in more depth in the next section.

The problems above arose on the assumption that location and distance relations are fundamental relations. Let's think about what happens if we reject this assumption. Recall the familiar distinction between intrinsic and extrinsic relations: intrinsic relations supervene on the intrinsic properties of their relata; extrinsic relations do not. The relation *is more massive than* is intrinsic, since we need not specify anything beyond the masses of the objects in question to determine whether the relation holds. On the other hand, whether location or distance relations are instantiated appears to be independent of the intrinsic properties of their instantiating objects. Thus, we have good reason to believe that if location and distance relations are non-fundamental, they are grounded in other relations.

What might the fundamental relations that ground location and distance relations be? Any proposal will have to take into account the fact that the problem of relata mismatch is only an instance of a more general problem of constraints on fundamental relations for the combinatorialist. If there are any fundamental relations that require some but not all of their relata to have certain fundamental properties or stand in certain fundamental relations, then FR fails. Here's another way to put it. Call a relation R of arity n *modally permutable* iff

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[19] This wouldn't be the whole solution; recall that the triangle inequality problem arises for quadruples, quintuples, and so on, so the principle must have constraints corresponding to all of these as well.

whenever R is instantiated (in order) by $x_1,\ldots,x_n$ then for any permutation $m_1,\ldots,m_n$ of numerals $1,\ldots,n$, R *can* be instantiated (in order) by $x_{m1},\ldots, x_{mn}$. If there are any fundamental relations that are not modally permutable, then FR fails. Combinatorialism thus requires that all fundamental relations are modally permutable.

Dorr (2004) has defended a view about fundamental relations that satisfies this principle.[20] He argues that all fundamental relations are *permutable*, where a relation R of arity n is *permutable* iff whenever R is instantiated, in order, by $x_1,\ldots,x_n$, for any permutation $m_1,\ldots,m_n$ of numerals $1,\ldots,n$, R is also instantiated, in order, by $x_{m1},\ldots, x_{mn}$. Since permutability is a stronger condition than modal permutability, this view will have the consequence that all fundamental relations are modally permutable. However, this response is not entirely satisfactory. First, the burden is on the combinatorialist who endorses Dorr's picture to provide plausible examples of the modally permutable spatiotemporal relations that purportedly ground location and distance relations. Dorr himself, not being concerned with combinatorialism in his (2004), has not offered grounds for the problematic relations *is located at* or *is five feet from*.[21] Second, even though this view escapes problems with relata mismatch, it does not escape problems with metric or path constraints, since these problems do not concern modal permutability.

4 The Problem of Determinates

In "New Work for a Theory of Universals," Lewis says that natural properties explain objective similarity and dissimilarity in the world: the extent to which two objects resemble each other depends on the perfectly natural properties that they share. Arguably, the perfectly natural properties just are the fundamental properties. But a dilemma arises when we observe that many candidates for fundamentality are *determinates* of *determinables*. For example, the property *has mass* is a determinable whose determinates are specific mass properties, like *has mass 1g* and *has mass 2g*.[22] (From here on, I will usually mean by "determinate," "absolute determinate," where absolute determinates are properties that are determinates of some determinable, but do not themselves have any determinates. Likewise, I will usually mean by "determinable," "absolute determinable": those that are not determinates of some further determinable.) Here's the dilemma for the combinatorialist. It seems that the determinable *mass* cannot be fundamental, if the fundamental is that which explains objective similarity and dissimilarity. Two objects that both have mass 1g are more similar to each other with

[20] Fine (2000) advocates another radical view of relations according to which for some relations, ordering among relata does not make sense. However, I don't include his view with Dorr's since on Fine's view, it still makes sense to talk about relations holding of objects in certain manners—this will allow us to generate the problem of relata mismatch in a slightly different form, since not all relations are such that they can hold of any objects.

[21] Here's something close in Dorr (2004 [181]): "…the three-place non-symmetric predicate 'between' which might feature in a formalization of Euclidean geometry construed as a theory about points of space might be analysed in terms of a binary symmetric "overlap" relation whose relata include line segments as well as points: '*x* is between *y* and *z*' is taken to mean 'every line segment that overlaps both *y* and *z* overlaps *x*.'"

[22] While I am using grams as the unit of measure of mass, this is not an essential feature of determinate mass. Also, note that I am ignoring issues about the nature of mass, since there is a debate about whether it's intrinsic or extrinsic, etc. If mass is too problematic, pretend we're talking about some other suitable physical quantity.

respect to mass than to an object that has mass 2g. On the other hand, all three objects resemble each other in virtue of having the determinable *mass*. Thus, it seems that determinates are what ground fine-grained similarity relations. But once we take determinates to be the fundamental properties, the combinatorialist is in trouble. If an object instantiates *has mass 1g*, then it cannot also instantiate *has mass 2g*. Either one is not fundamental, severing the intimate connection between fundamentality and perfect naturalness, or FR is false.

Armstrong proposes a solution: accept that only one such determinate is fundamental, and take the other determinates of that determinable to be grounded in recombinations of them. In the case of mass, for example, some determinate *has mass Xg* is the fundamental property. Call such a determinate a *minimal property*. If there are minimal mass properties, then an object which instantiates mass *Y*g does so in virtue of having parts that instantiate mass *X*g. The problem with combinatorialism is thus avoided: the reason that *has mass 1g* and *has mass 2g* are not co-instantiable is that they are both grounded in recombinations of the minimal mass *has mass Xg*, and their co-instantiation would require having different numbers of parts.[23]

Still, this proposal has been rejected. For one thing, it faces technical problems that I won't rehearse here; see Sider (2005) and Eddon (2007). Second, even if there is a minimal mass *X*g, why must it be the case that *it's* the minimal mass? If mass *X*g is the minimal mass, it must be at least the smallest *actually* instantiated mass—this is because all other masses are instantiated by the object's having parts that instantiate *X*g. Notice that this prohibits partless objects from having greater than minimal mass. Furthermore, given FR, mass *X*g must also be suited to ground all possibly instantiated masses. So it seems that mass *X*g must be the smallest *possibly* instantiated mass as well. It seems like *a priori* reasoning should lead us to conclude that there is no smallest possibly instantiated mass, because for any mass, there seems to be no conceptual barrier to thinking that there can be a smaller mass. On the other hand, the combinatorialist might say that the claim that the smallest mass is the smallest possibly instantiated mass is an *a posteriori* necessity that we endorse for theoretical reasons. This isn't a position that *science* would force us to adopt—even if there turned out to be an actually smallest mass, the laws of nature might have been different, permitting a possibly smaller mass. The motivation for this position is the view that it's meant to support.

Instead of endorsing minimal mass, the combinatorialist may deny that any determinate mass is fundamental. To do this, she must provide grounds for such properties. This raises a host of questions: what kinds of properties are masses grounded in? Are the grounding properties intrinsic or extrinsic to the massy object? Are they determinates or determinables? There is a distinct literature addressing these questions about the nature of mass, and perhaps they will be answered in a way favorable to the combinatorialist.[24] But we only took mass as an example of a purported fundamental property. There are others to examine, like charge, spin, and whatever other properties physics gives us, all of which have

[23] An exception is the case where the properties each have an infinite number of parts, as Eddon (2007) points out.
[24] See Bigelow and Pargetter (1988), Armstrong (1988), Hawthorne (2006).

determinates. It would be too hasty to simply assume that we'll be able to justify minimal properties for all of these.

A natural move for the combinatorialist is to accept fundamental determinates, but deny FR as formulated. She may instead reformulate her combinatorial principle so that it only allows recombinations of determinate properties and relations that fall under distinct determinables—that is, *determinably-distinct* properties and relations.[25] We may then reformulate FR:

> (FR*) Any pattern of instantiation of any determinably-distinct fundamental properties and relations is metaphysically possible.

FR* prohibits one object from instantiating two determinate properties of the same determinable, or *n* objects from instantiating, in order, two determinate *n*-place relations of the same determinable.[26] To restrict her original principle, the combinatorialist must admit into her ideology the notions of determinate and determinable, or more succinctly, the relation of *co-determinacy*. She must apparently accept this notion as primitive, as analyses of the notions of *determinate* and *determinable* are notoriously modal-centric.

Recently, some have defended that determinables rather than absolute determinates are fundamental; see Hawthorne (2006), Weatherson (2006), and Denby (2001). The basic picture is this: Metaphysically, the fundamental properties are determinables like mass and charge, and the non-fundamental properties include *has mass 5g* and *is positively charged*. (Weatherson actually rejects that *properties* are the fundamental kind rather than *quantities*. I don't think this view differs much from the view of the property-fundamentalist who takes determinable properties to be the fundamental, but offers a non-standard account of property instantiation.) Objects have determinate properties by instantiating particular values of determinables—the extension of the determinate will be the set of objects that instantiate the value with which it's associated. We can think of the 'values' in question as representatives of the ways the determinable can be instantiated—e.g. a value for every determinate shade of

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[25] The terminology is from Saucedo (2011 [17]): "$F_1,\ldots,F_n$ are determinably-distinct $=_{df}$ F_i is not a determinate of F_j, F_j is not a determinate of F_i, and there is no property or relation G such that both F_i and F_j are determinates of G (for any $i,j \in [1,n]$ with $i \neq j$)."

[26] There remains a question for the combinatorialist of *which* determinables are relevant for determinable-distinctness. Saucedo says that he is only concerned with first-order properties and relations, excluding second-order properties and relations like *is a property*. This is purportedly because (2011 [17]) "some first-order properties or relations may count as being determinably-distinct even if you happen to believe that they are all determinates of second-order properties such as being a property, being a relation, being a property or relation, etc." However, it just seems wrong to say that *is red41* is a determinate of *is a property*; what instantiate *is red41* are objects, not properties. Still, there is a first-order property that all objects have: *has a property*. If *is red41* and *has mass 1g* were both determinates of *has a property*, then these would turn out to be not determinably-distinct; excluding second-order determinables does not help here. One way to get around this problem would be to follow Russell in drawing a distinction between predicative and impredicative properties: those that do not tacitly involve quantification over properties, and those that do. If we excluded impredicative properties as well, then *has a property* wouldn't be relevant to determinable-distinctness. However, there is some controversy over the distinction; see Feferman (2005). Furthermore, the same problem arises given *any* property that all objects have, some of which are plausibly predicative; candidates include *is an existent* and *is concrete*.

red, with respect to the determinable *red*, or a real number value with respect to the determinable *mass-in-grams*. However, ideologically, we've replaced the notion of *instantiation* with *gradable instantiation*, which is represented as a function from objects to values of a fundamental determinable. This raises the question of *why* it is that an object can only gradably instantiate one value of a determinable, which will lead to problems parallel to those presented in this section.

5 Incompatibility Primitivism: The Idea

I endorse a view that I call *incompatibility primitivism*. According to incompatibility primitivism, there are primitive compatibilities or incompatibilities between properties. Ordinary compatibilities and incompatibilities—for example, the incompatibility between the properties *is a bachelor* and *is married*—are grounded in the primitive ones. One primitive can do the work of two, so I will assume for our discussion that *is incompatible with* is the fundamental relation. (The technical apparatus of the view is agnostic as to whether *primitive incompatibility* is mere ideology, or corresponds to a fundamental incompatibility relation.) I start by assuming that incompatibilities can only hold between two properties to simplify discussion; however, this will need to be generalized so that incompatibilities can hold between multiple properties and relations.

On incompatibility primitivism, any two properties P_i and P_j are either incompatible or not. Let there be a set of *primitive incompatibilities* $\mathbf{\Psi}$. (That is, $\mathbf{\Psi}$ is the set of pairs of primitively incompatible properties.) One might think that the set $\mathbf{\Psi}$ must obey certain restrictions—for example, that there is no proper subset $\mathbf{\Phi}$ of $\mathbf{\Psi}$ such that respecting $\mathbf{\Phi}$ and $\mathbf{\Psi}$ generates all the same possibilities. To make this more precise, let's define a *possible world* as a distribution of (abundant) properties over objects such that for no object *a* will it be the case that there's any $\{P_i,P_j\}\in\mathbf{\Psi}$ such that *a* instantiates both P_i and P_j.[27] We can then define *derivative incompatibilities* as those pairs of properties Q_i,Q_j such that (i) $\{Q_i,Q_j\}\notin\mathbf{\Psi}$, and (ii) there aren't any possible worlds such that for any object *x*, *x* instantiates both Q_i and Q_j.[28] For example, *has mass 41g* and *has mass 42g and has positive charge* might be derivative incompatibilities. The properties *is a bachelor* and *is married* are presumably incompatible in virtue of the incompatibility of *is unmarried* and *is married*, or whatever it is that grounds *is a bachelor*. We may account for *necessitations* between properties in a similar fashion: that the property *is a bachelor* necessitates the property *is unmarried* is grounded in the incompatibility of *is a bachelor* and *is married*.

For the most part, I will not take a stance on the relation of non-fundamental properties to fundamental properties; I will also remain agnostic on what primitive incompatibilities there are. Incompatibility primitivism is introduced here as a framework view. I will assume that certain incompatibilities are primitive when they're intuitively so, but these are negotiable. Also, notice that I do not assume that primitive incompatibilities can only hold between fundamental properties. Some, like Sider (2012), have the "purity

[27] The "possible worlds" defined here are used for a limited purpose.

[28] Here are two other derivative notions: *self-incompatibility* is the special case where P_i and P_j are incompatible and P_i=P*j*, and $P_i$and P_j are *compatible* just in case it's not the case that P_i and P_j are incompatible.

intuition"—for our purposes, this means they think that primitive modal notions cannot apply to the non-fundamental. But I don't share the purity intuition, so I won't assume it. However, for those with the purity intuition, I provide an accommodating account of incompatibility primitivism in the Appendix.

In defining possible worlds as distributions of (abundant) properties over objects that respect primitive incompatibilities, I am endorsing a combinatorial principle of sorts—that is, I am allowing that any distributions of properties and relations over objects that respect the primitive incompatibilities are metaphysically possible. My target in this paper has only been the *reductive* combinatorialist; incompatibility primitivism may still be combined with combinatorial principles. However, given that I argued above against the reductive combinatorialist's principle, to proceed I need to show that these problems don't arise for the incompatibility primitivist.

First, let's revisit the problem of determinates. Recall that if there are fundamental properties that are determinates, then the combinatorialist must adopt the restricted principle FR*. This in turn requires adopting the ideology of *co-determinacy*. I will argue that if this maneuver succeeds for the combinatorialist, then incompatibility primitivism may analyze this notion. But first, notice that on her own view, the incompatibility primitivist has the resources to simply stipulate that certain fundamental properties are primitively incompatible with other fundamental properties. For example, assume that *has mass 4g* and *has mass 5g* are fundamental properties. The combinatorialist says that these properties cannot be instantiated by the same object because they are determinably-distinct; the incompatibility primitivist stipulates that they are primitively incompatible. For the incompatibility primitivist, there's no further ground for their incompatibility. But the incompatibility primitivist does not thereby have an *unsystematic* solution to the problem of determinates. She may say that although certain fundamental properties are primitively incompatible, they fall into a non-fundamental determinate-determinable structure such that certain possibilities may be characterized, though not reduced, by FR*.

Here's the idea. For FR* to be extensionally adequate, it must be the case that the fundamental properties can be grouped in such a way that any pair of fundamental properties that fall under the same determinable *cannot* be co-instantiated, but any pair of fundamental properties that *do not* fall under the same determinable *can* be co-instantiated. This may be mimicked on incompatibility primitivism by requiring that for any distinct fundamental properties Q_i, Q_j, and Q_k, if Q_i and Q_j are primitively incompatible, and Q_j and Q_k are primitively incompatible, then Q_i and Q_k are primitively incompatible. (Note that I am not saying that this *is* a requirement on incompatibility primitivism.) Call this feature of the space of fundamental properties the *Euclidean property*. We can then form a partition $\mathbf{\Pi}$ of fundamental property space by grouping together all sets of fundamental properties that are mutually incompatible. Any pair of fundamental properties are considered determinates of the same determinable just in case they're grouped under the same cell of $\mathbf{\Pi}$. (This can be shown by appealing to the fact that relations that are reflexive, transitive, and symmetric are equivalence relations—let R be a relation that holds over fundamental properties Q_i and Q_j

just in case $Q_i=Q_j$ or $\{Q_i,Q_j\}\in\boldsymbol{\Psi}$. R is trivially reflexive and symmetric. If $\boldsymbol{\Psi}$ has the Euclidean property, then it's transitive as well.[29])

Notice that this analysis of co-determinacy only works if the space of fundamental properties has the Euclidean property; we cannot partition the fundamental properties into a determinate-determinable structure if there are fundamental determinates that fall under different determinables that *cannot* be co-instantiated. However, the combinatorialist herself must deny this possibility if FR* is to be extensionally adequate. It is a mark against her view if, say, *is red41* is determinably-distinct from yet incompatible with *has mass 5g*.[30] Also, notice that for FR* to succeed, there must also be a way to distinguish fundamental and derivative co-determinates. The notion of *co-determinacy* is meant to sort fundamental properties like *has mass 41g* into groups under determinables like *has mass*; it is not itself meant to sort purported derivative determinates like *has mass 41g and is red42* into groups under derivative determinables like *has mass and is red*.

The other problems for the combinatorialist involved relations. The present account does not cover relations or for that matter, incompatibilities involving three or more properties. For these, we need a generalized version of incompatibility primitivism. The generalized version requires introducing technical notation; this is because sometimes we need to specify *how* properties or relations are incompatible. For example, we cannot simply talk about the incompatibility between *is located at* and *is not a region*; we need a way to say that *is not a region* cannot be instantiated by the second relatum of *is located at*.

In the next section, I set out the generalized version of incompatibility primitivism, using the notion of a *variable listing* of a property or relation to represent the fact that

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[29] We can also give a more direct proof. Let A be any set. Define a *relation** over A as any set of two-membered sets $\{a_i,a_j\}$ where $a_i,a_j\in A$ and $a_i\neq a_j$. Let a relation* C have the *Euclidean property over A* if this holds: if $\{a,b\}\in C$ and $\{a,c\}\in C$, then $\{b,c\}\in C$. Where a partition of A is a set of pairwise disjoint subsets of A such that their union is A, and R is a relation* with the Euclidean property,

(*) R partitions A.

(*) should seem intuitive, but here's a proof. We want to show that there exists a partition of A into $A_i\subseteq A$ such that $A=\cup A_i$ and for any A_i and A_j in the partition, $A_i\cap A_j=\varnothing$. For any $a\in A$, let there be an $A_i\subseteq A$ be such that (i) $a\in A_i$, (ii) for all $b\in A$ where $b\neq a$, $b\in A_i$ iff $\{a,b\}\in R$, and (iii) there are no other elements in A_i. We want to show that for any $A_i,A_j\subseteq A$, either $A_i=A_j$ or $A_i\cap A_j=\varnothing$. Suppose $a\in A_i\cap A_j$. Suppose that for some $b\neq a$, $b\in A_i$ but $b\notin A_j$. If $b\in A_i$, then by clause (ii), $\{a,b\}\in R$; but then again by clause (ii), $b\in A_j$, a contradiction. So given that $a\in A_i\cap A_j$, if for any b, $b\in A_i$, then $b\in A_j$. So if A_i and A_j share any element, they share them all and $A_i=A_j$. On the other hand, if they don't share any elements, they're disjoint. We've shown that R partitions A.

Now, let **FP** be the set of fundamental properties, and consider the primitive compatibilities that hold between fundamental properties. Define Ψ as the set of sets of pairs of these primitively incompatible fundamental properties. If such a set exists, then we have by (*) that Ψ partitions **FP**. Let each cell of the partition correspond to a determinable, and the members of the cell its determinates. This, of course, only gets us a definition of the "fundamental" determinables. For example, if spin up and spin down are fundamental properties, then given that they're primitively incompatible, and that neither is primitively incompatible with any other fundamental properties, they will be partitioned into the same cell. This cell will intuitively correspond to the determinable property *has spin*. No cell will correspond to the property *has spin and has mass*, but presumably such determinables can be built up out of other determinables.

[30] This is only to point out, of course, that if *is red41* and *has mass 5g* are incompatible, then the combinatorialist must either deny that they're fundamental properties, or must argue that they're not determinably-distinct—perhaps the "correct" determinable with which to sort determinable-distinctness is *is colored* rather than *is red* or *is blue*.

properties and relations may be *coordinated*. The idea is that each property or relation may be associated with an ordered tuple of variables—one variable for a property, n variables for a relation of arity n. If the relation *is located at* is associated with variable listing $(\boldsymbol{x},\boldsymbol{y})$, and the relation *is not a region* is associated with variable listing $(\boldsymbol{x})$, we can say that *is located at* and *is not a region* are incompatible under variable listings $((\boldsymbol{x},\boldsymbol{y}),(\boldsymbol{x}))$. This represents the fact that whatever goes into the left argument place of *is located at* cannot also have the property *is not a region*. The generalized version of incompatibility primitivism can also handle the other cases above. Recall the problem of metric constraints given relationism: the triangle inequality, among other geometric principles, cannot be violated. According to incompatibility primitivism, where $n+m<o$, the relations *is n feet from*, *is m feet from*, and *is o feet from* are incompatible under variable listings $((\boldsymbol{x},\boldsymbol{y}),(\boldsymbol{y},\boldsymbol{z}),(\boldsymbol{x},\boldsymbol{z}))$. (The next section may safely be skipped for those uninterested in the implementation of this idea.)

6 A More Careful Formulation

In our representation of incompatibilities between properties and relations, we want some way to represent the fact that the co-instantiation of properties and relations may be *coordinated*: that is, that properties and relations are only compatible given certain distributions. Here, I will introduce the idea of a *variable listing* in our linguistic representation of the *coordination* of properties and relations. Suppose there are properties and relations **Q**, where the properties have arity 1 and the relations have arity 2 or greater. For any Q in **Q** of arity n, let $Q(\boldsymbol{v}_1,\ldots,\boldsymbol{v}_n)$ be *Q under variable listing* $(\boldsymbol{v}_1,\ldots,\boldsymbol{v}_n)$, where the $\boldsymbol{v}_i$ are any variables. For example, *has mass*$(\boldsymbol{x})$ is *has mass* under variable listing $(\boldsymbol{x})$, and *has mass-in-g greater than*$(\boldsymbol{x},\boldsymbol{y})$ is *has mass-in-g greater than* under variable listing $(\boldsymbol{x},\boldsymbol{y})$.

Now, consider a variadic *incompatibility relation* Ψ:

$$\Psi(Q_1(\boldsymbol{x}_{1,1},\ldots,\boldsymbol{x}_{1,m1}),\ldots,Q_n(\boldsymbol{x}_{n,1},\ldots,\boldsymbol{x}_{n,mn}))$$[31]

where the $(\boldsymbol{x}_{i,1},\ldots,\boldsymbol{x}_{i,mi})$ are variable listings of each Q_i. Order does not matter for the relation Ψ—that is, it's a condition on Ψ that it's permutable—but it will be useful to use n-tuple notation rather than set notation for some of the definitions below. We will also stipulate that applications of Ψ are invariant under uniform substitutions of variables.

As an example of an incompatibility, the properties *has mass 5g*, *has mass 6g*, and *has mass-in-g greater than* are incompatible under variable listings $((\boldsymbol{x}),(\boldsymbol{y}),(\boldsymbol{x},\boldsymbol{y}))$. That is:

$$\Psi(\textit{has mass 5g}(\boldsymbol{x}),\ \textit{has mass 6g}(\boldsymbol{y}),\ \textit{has mass-in-g greater than}(\boldsymbol{x},\boldsymbol{y}))$$

As with the simple view discussed in the main text, let's distinguish between primitive and derivative incompatibilities. Let there be a set of *primitive incompatibilities* $\boldsymbol{\Psi}$ with members of the form $Y=\{Q_1(\boldsymbol{x}_{1,1},\ldots,\boldsymbol{x}_{1,m1}),\ldots,Q_n(\boldsymbol{x}_{n,1},\ldots,\boldsymbol{x}_{n,mn})\}$, where $Y\in\boldsymbol{\Psi}$ iff

[31] We may read "$\Psi(Q_1(\boldsymbol{x}_{1,1},\ldots,\boldsymbol{x}_{1,m1}),\ldots,Q_n(\boldsymbol{x}_{n,1},\ldots,\boldsymbol{x}_{n,mn}))$" as "$Q_1,\ldots,Q_n$ are incompatible under variable listings $((\boldsymbol{x}_{1,1},\ldots,\boldsymbol{x}_{1,m1}),\ldots,(\boldsymbol{x}_{n,1},\ldots,\boldsymbol{x}_{n,mn}))$" or "$\Psi$ holds of $Q_1,\ldots,Q_n$ under variable listings $((\boldsymbol{x}_{1,1},\ldots,\boldsymbol{x}_{1,m1}),\ldots,(\boldsymbol{x}_{n,1},\ldots,\boldsymbol{x}_{n,mn}))$." Unfortunately, there is no non-clumsy way of specifying a variable listing in ordinary talk.

$\Psi(Q_1(\boldsymbol{x_{1,1},\ldots,x_{1,m1}}), \ldots, Q_n(\boldsymbol{x_{n,1},\ldots,x_{n,mn}}))$. This set $\boldsymbol{\Psi}$ will have the constraint that there is no proper subset $\boldsymbol{\Phi}$ of $\boldsymbol{\Psi}$ such that respecting $\boldsymbol{\Phi}$ and $\boldsymbol{\Psi}$ generates all the same *possible worlds*: distributions of (abundant) properties and relations over objects such that for every $(Q_1(\boldsymbol{x_{1,1},\ldots,x_{1,m1}}), \ldots, Q_n(\boldsymbol{x_{n,1},\ldots,x_{n,mn}})) \in \boldsymbol{\Psi}$, there are no objects $a_{1,1},\ldots,a_{1,m1},\ldots, a_{n,1},\ldots,a_{n,mn}$ such that Q_1 holds of $a_{1,1},\ldots,a_{1,m1}$, and … and Q_n holds of $a_{n,1},\ldots,a_{n,mn}$. We can define *derivative incompatibilities* as those properties $S_1,\ldots,S_k$ under variable listings $((\boldsymbol{x_{1,1},\ldots,x_{1,m1}}),\ldots,(\boldsymbol{x_{k,1},\ldots,x_{k,mk}}))$ such that (i) $(S_1(\boldsymbol{x_{1,1},\ldots,x_{1,m1}}), \ldots, S_k(\boldsymbol{x_{k,1},\ldots,x_{k,mk}})) \notin \boldsymbol{\Psi}$ and (ii) there are no possible worlds such that for some objects $b_{1,1},\ldots,b_{1,m1},\ldots,b_{k,1},\ldots,b_{k,mk}$, S_1 holds of $b_{1,1},\ldots,b_{1,m1}$, and … and S_k holds of $b_{k,1},\ldots,b_{k,mk}$. Any properties or relations under variable listings that aren't incompatible are *compatible*.

This framework can accommodate specific metaphysical theses about primitive modality. For example, if one thinks that the instantiation of a property or relation cannot preclude or necessitate the instantiation of a property or relation by entirely distinct things, then one may add this requirement on Ψ:

> (H) Ψ holds of some properties and relations under certain variable listings only if any variable appearing in a variable listing appears in at least one other.

Let's return to the other problems for the combinatorialist. Recall that if certain spatiotemporal relations are fundamental, then whether or not we endorse substantivalism or relationism about spacetime, FR fails. Consider the case of mismatched relata on substantivalism: *is located at* can only hold between an object-region pair. On incompatibility primitivism, this is ensured by positing an incompatibility relation between *is located at* and *is not an object* or *is not a region* under certain variable listings:

$\Psi(\textit{is located at}(\boldsymbol{x,y}), \textit{is not an object}(\boldsymbol{x}))$
$\Psi(\textit{is located at}(\boldsymbol{x,y}), \textit{is not a region}(\boldsymbol{y}))$

These will turn out to be derivative incompatibilities:

$\Psi(\textit{is located at}(\boldsymbol{x,y}), \textit{is not an object}(\boldsymbol{x}), \textit{is not a region}(\boldsymbol{y}))$
$\Psi(\textit{is located at}(\boldsymbol{x,y}), \textit{is an object}(\boldsymbol{x}), \textit{is not a region}(\boldsymbol{y}))$
$\Psi(\textit{is located at}(\boldsymbol{x,y}), \textit{is not an object}(\boldsymbol{x}), \textit{is a region}(\boldsymbol{y}))$

Consider the problem of metric constraints on relationism: FR entails possible violations of the triangle inequality, and other metric constraints. On incompatibility primitivism, for any distance-in-feet relation, it must be the case that if x is *n* feet from y, and y is *m* feet from z, then if x is *o* feet from z, then *o* must be less than the sum of *n* and *m*. This can be cashed out by positing primitive incompatibilities between *is n feet from*, *is m feet from*, and *is o feet from*, for all *n*, *m*, and *o* such that $n+m<o$:

$\Psi(\textit{is n feet from}(\boldsymbol{x,y}), \textit{is m feet from}(\boldsymbol{y,z}), \textit{is o feet from}(\boldsymbol{x,z}))$

I had been assuming that the fundamental relation would be the two-placed relation *is five feet from* rather than the three-placed relation *is ___ feet from* which has as one relatum the number five. However, if we assume the three-placed relation is fundamental, the incompatibility primitivist may posit incompatibilities like this:

> Ψ(*is feet from*(***x,w,y***), *is feet from*(***y,v,z***), *is feet from*(***x,u,z***), *is five*(***w***), *is six*(***v***), *is twelve*(***u***))

7 Objections to Primitive Incompatibility

Two worries naturally arise from the fact that incompatibility primitivism posits lists of primitive incompatibilities. First, there is the worry that the view doesn't allow for the *nature* of the relevant class of properties to ground the modal relations between them. On Jubien's view, for example, something about the intrinsic nature of properties like *is yellow* and *is colored* grounds an "entailment" relation that holds between them. (Entailment and incompatibility are two sides of the same ideological coin: φ entails ψ iff φ and not-ψ are incompatible.) This view is very similar to the one presented here, save for the mention of intrinsic natures.[32]

Jubien stresses that the properties *is yellow* and *is colored* have complex intrinsic natures such that they differ intrinsically. Nonetheless, he wants to remain agnostic on deeper metaphysical issues, like the question of property constituency. Here's one reason for denying that entailment just is property constituency (2009 [93]): "The property of being a horse entails the property of not being a xylophone, but the latter property is surely not an intuitive constituent former (nor is the un-negated property). Being a horse and being a xylophone are nevertheless properties whose internal natures guarantee that anything that instantiates the former property also instantiates the negation of the latter."

I don't want to deny that properties may differ instrinsically. In particular, there are complex issues having to do with the relation between the fundamental and the non-fundamental that I have not addressed. For example, I haven't taken a stance on the relation between donkey facts and microscopic particle facts—are *is a donkey* and *is an arrangement of particles in such-and-such a way* primitively incompatible? When it comes to the relation between fundamental and non-fundamental properties or relations, I can agree with Jubien that incompatibility is grounded in intrinsic natures. But one may adopt both incompatibility primitivism about fundamental properties, and a different view about the relation between these and non-fundamental properties. One may say, for example, that the property *is a donkey* reduces to the property *is an arrangement of particles in such-and-such a way*. If the first property just is the second, then the fact that *is a donkey* is incompatible with *is a*

[32] Jubien takes entailment to ground modal facts (2009 [92]): "The idea of entailment as a relation between properties is not new. But I believe it has generally been misunderstood, even by philosophers who are entirely comfortable with Platonic properties. Philosophers typically offer a modal analysis of the notion, specifically: for P to *entail* Q is for the proposition that all P's are Q's to be necessary. Then they generally take *necessity* to be truth in all possible worlds (or else take it as primitive)…I think this analysis is backwards…"

xylophone will reduce to something about the incompatibility between properties involving arrangements of fundamental particles. (Though the view presented in §6 allows primitive incompatibility relations between fundamental and non-fundamental properties or relations, the view in the Appendix restricts this relation to the fundamental.) I will not decide the matter here; I only point out that the combinatorialist faces this question as well—FR and FR* only tell us what's metaphysically possible at the fundamental level, and are silent on the modal status of non-fundamental properties.

There still remains the question of whether or not the incompatibilities between fundamental properties or relations are grounded in their intrinsic natures. First of all, I reject the assumption that differing intrinsically implies having a *complex* intrinsic nature (not that Jubien assumes this—he does not discuss the question). We may say that *has mass 5g* and *has mass 6g* differ intrinsically without committing ourselves to the claim that their natures are complex. I want to deny that there's any interesting sense of *nature* that can do that job better than taking the modal relations as primitive. If the properties in question (like mass properties) are fundamental, then natures cannot themselves be properties that ground the fundamental properties. On the other hand, natures are sometimes cashed out in terms of higher-order properties, so that the nature of *has mass 5g* would be a higher-order property had by *has mass 5g*. It seems to me no more explanatory to say that some higher-order properties (we-know-not-what) of mass properties ground the fact that mass determinates aren't co-instantiable, than to say that the fact that they're not co-instantiable is grounded in a primitive incompatibility relation. In any case, on such a view we are left with a further question of the relation between the fundamental properties and their natures—do fundamental properties ground natures? Are natures themselves fundamental? Inviting these questions is undesirable, and avoidable: let there be no difference between the properties themselves and their "intrinsic natures."

(There are other views in the vicinity about what constitutes the "nature" of fundamental properties. Essence views seem to me to be similar, but I leave the project of examining these for another day. Potency views claim that the fundamental properties are dispositions or powers (see Bird (2007)). However, such views are committed to the equivalence of metaphysical and nomic necessity, and I prefer to leave my view weaker.)

Jubien officially takes no position about the "ultimate nature of property entailment." He suggests that for practical purposes, we may think of entailment as primitive. I am sympathetic to this attitude, anyways.

The second worry about incompatibility primitivism is that a mere list of primitive incompatibilities faces a charge of unsystematicity, of the same sort leveled against the combinatorialist who wanted to add a list of constraints to FR. While I feel the pull of this worry, I don't think the cases are completely analogous. The combinatorialist wants to reduce all of modality—it's her burden to provide a systematic reduction. The incompatibility primitivist, on the other hand, only claims that *given* some primitive modality, she can provide a systematic reduction of *some* modal claims via her combinatorial definition of worlds.

8 Objections to Modal Primitives

So far, I have argued for ideological parity between combinatorialism and incompatibility primitivism. Some might concede ideological parity, yet object that there is something especially problematic about the primitivist's notions. These are "spookiness" worries about primitive modal notions. In this section, I consider various ways to cash out "spookiness" worries. My own view is that there isn't anything especially strange about modal primitives. The fact that there are modal primitives doesn't mean, for example, that there could have been different primitive incompatibilities between fundamental properties, or that they're arbitrary.

Let's take a closer look at reasons one might have for rejecting modal primitives. First, one might along with Quine be skeptical of all modal notions.[33] This is not a reason to oppose modal primitives in particular. The reductionist about modality does not deny that there are consistent, coherent modal notions; she just thinks they are reducible to something else, much like the physicalist who accepts the existence of mental properties but reduces them to physical properties.

Second, MacBride advances an explanatory worry (1999 [473]): "If our aim is to explain what makes modal claims true then an appeal to the existence of irreducibly modal entities will lead us in an explanatorily fruitless circle. For our only grounds for supposing that there are these modal entities is that certain modal claims are true." The worry here is a little unclear. If he is saying that it is unsatisfying to explain the truth of some modal claims using modal terms—since the primitivist requires a modal primitive in explanation—then the primitivist may reply that it is no strong objection to her view to simply deny that explanation can terminate in the modal. Furthermore, we should be careful not to conflate metaphysical and epistemological explanation. Perhaps there is no epistemologically "satisfying" explanation of certain modal claims. However, the project is to give a *metaphysical* explanation of modal claims, and this can be done by elucidating the notions we use to explain our modal claims.

Third, there is the intuition that modality isn't the right *sort* of thing to include in a fundamental ontology. Sider writes (2003 [6]), "Accepting necessity or possibility as a primitive feature of reality would be like accepting tensed facts as primitive, or accepting dispositions as primitive, or accepting counterfactuals as primitive. While some are willing to make these posits, others seek to reduce "hypothetical" notions to "categorical" notions—notions which are in a sense "self-contained" and do not "point beyond themselves" as the hypothetical notions do." In his (2001 [41]), he writes, "Categorical properties involve what objects are actually like, whereas hypothetical properties 'point beyond' their instances." Merricks (2007) also expresses suspicion, in the case of tense, with past- or future-directed properties like *futurely is sitting*.

That there is such a distinction and that modal and tense properties fall on one side of it is not itself an objection to modal primitives. Thus, Cameron (2011) offers a proposal for *why* such properties in the tense case seem suspicious: they tell us nothing about how the

[33] See Quine (1943, 1953).

instantiating object presently is, intrinsically. This seems bad for the presentist, the usual defender of tensed properties, who believes that only the present time exists. This thought can be extended to the case of modal properties like *possibly is sitting*; the analogous worry is that such a property, if irreducible, tells us nothing about how an object *actually* is, intrinsically.

However, this proposal will count certain non-tensed and non-modal properties as hypothetical rather than categorical: for example, that an object instantiates the property *is to the left of an electron* tells us nothing about how the object is intrinsically (except perhaps that it can stand in spatiotemporal relations), and surely what information it does give us "points beyond" the object.[34] Cameron's proposal also fails to count certain tensed and modal properties as hypothetical, given plausible assumptions. Consider the property *is possibly an electron*. If the only sorts of things that *can* be electrons are electrons, then we can infer from an object's having this property that it is presently an electron. The immediate upshot of this is that the eschewer of hypothetical properties may only eschew some candidates for modal primitives. However, in the end, I don't think this is a good reason for rejecting any modal primitives. Some modal and tense properties indeed "point beyond" the objects that instantiate them and fail to tell us anything about the intrinsic actual and present natures of said objects. But that this is objectionable is at best an intuition not everyone may share.[35]

Fourth, there are broadly epistemological worries about modal primitives. Suppose that at the fundamental level, there are fundamental objects and properties. The fundamental objects might be things like electrons and quarks; their fundamental properties might be things like having a certain determinate mass and having up spin. We can usually understand the fundamental properties in terms of their causal interaction in the world. But how do we have epistemic access to fundamental *modal* properties? Sider writes (2003 [5]), "Many modal claims are known *a priori*, and it is a puzzle how this is possible, how we manage to know modal claims without the benefit of sensory experience. The epistemology of the modal can be secured if modal notions are defined in terms of notions whose epistemology is secure." And (2003 [6]), "I can see that this colored thing is extended, and indeed that all colored things I have examined are extended, but where is the necessity, that colored things *must* be extended?" And Fraser MacBride writes (1999 [473]), "It is similarly mysterious how it could be determined that a state of affairs had the property of being necessary rather than being contingent. How could a necessary state of affairs affect the mind differently from a merely contingent state of affairs?"

Though I won't try to give an epistemology of modality here, I do want to deflect these concerns a bit. Modal notions aren't the only notions that have special epistemological problems on account of not apparently playing a physical causal role. After all, everything is self-identical—but we wouldn't worry that the property of being self-identical doesn't play a causal role. There are plenty of objects and properties, like sets and other mathematical

[34] Cameron uses both the locution of the property "telling us" about the intrinsic nature of the object, and the locution of its "contributing" to the intrinsic nature. These seem to me to express different things.
[35] Williamson (2002) believes in a whole plenitude of necessary existents!

objects, whose existence are accepted (by some, anyways) despite epistemological worries. We accept them for reasons other than appearing to "sense" them, and try to explain their epistemology some other way. This fourth worry has some force, but does not seem to be insurmountable.

9 Conclusion

I have argued that combinatorialism does not enjoy an ideological advantage over incompatibility primitivism with respect to primitive notions—ideologically, the views are on a par. But this is no innocuous tie. Commitment to modal primitivism is often used as a *reductio* of other views. I have aimed to show that a main reason for rejecting modal primitivism in favor of combinatorialism, ideological simplicity, is misplaced. Another aim was to present a systematic primitivism. These were just first steps towards developing a complete primitivist theory. There are other steps to take; for example, we can examine other reductive theories of modality and see how they fare ideologically. However, combinatorialism strikes me as the reductive theory—Lewis's aside—that is most thought of as enjoying an ideological advantage. After all, other theories of modality (reductive or not) are well known for accepting primitive notions, like *essence*, *power*, or an *according to the fiction of* operator. Arguing against the ideological advantage of combinatorialism goes a long way towards defending the relative ideological innocence of modal primitivism.

Appendix: Incompatibility Primitivism and "purity"

The generalized version of incompatibility primitivism presented in §6 allows primitive incompatibilities between non-fundamental properties or relations. Someone who has the "purity" intuition thinks that primitive incompatibilities can only hold between fundamental properties or relations. I think there are reasons to doubt this. For one thing, I want to leave open the possibility of *gunky properties*: properties grounded in other properties, all of which themselves are grounded in further properties, and so on ad infinitum. Consider the possibility of *gunky worlds*: worlds in which every object has a proper part. Assuming that point-sized things cannot have parts, gunky worlds are point-less. Let *is located at region R* be a property of an object in a gunky world. Region R cannot be defined in terms of points, since there aren't any. If we do not want to take *is located at region R* as a fundamental property, then presumably we'll have to say that it is grounded in properties like *is located at region* R_{1a} and *is located at* R_{1b}, where R_{1a} and R_{1b} are intuitively two disjoint, covering proper parts of region R. And each of these is grounded in further gunky regions, and so on. As long as gunky worlds are possible, it seems like gunky location properties are possible. And if so, then well-foundedness and completeness fail: the non-fundamental does not supervene on the fundamental.

We can easily accommodate the purity intuition by constraining the non-purity version of incompatibility primitivism: simply disallow primitive incompatibilities between the non-fundamental. However, this simple fix has consequences. To see this, consider *is located at* and *is not a region*, which are primitively incompatible under variable listings

(($\boldsymbol{x,y}$),($\boldsymbol{y}$)) on the non-purity version. Negated properties like *is not a region* are usually taken to be non-fundamental. Thus, on the purity version, this cannot be a primitive incompatibility. It's hard to see, however, how it could even be a derivative incompatibility: the fundamental properties and relations involved, *is located at* and *is a region*, are not incompatible. What we want to say is that there are *necessitation* relations between certain properties, like *is located at* and *is a region*. The notions of property incompatibility and property necessitation are intimately related: if P necessitates Q, then P is incompatible with *not-Q*; and if P is incompatible with Q, then P necessitates *not-Q*. However, whichever one we take as the primitive notion, we cannot have the other hold between fundamental properties, even as a derivative notion.

In response, the "purity intuition" incompatibility primitivist might do one of these three things. First, she could insist that there are only primitive incompatibilities between fundamental properties and deny the purported necessitations between fundamental properties, or vice versa. Second, she could add a primitive necessitation relation between fundamental properties and relations. Third, she might say that *is located at* is primitively incompatible with all the fundamental properties that are not the property *is a region*. None of these are elegant solutions. Here's another option: define one primitive to do the work for both. To avoid the extra apparatus associated with variable listings, let's restrict our attention to fundamental properties rather than relations (though the following account can be generalized). Let $\boldsymbol{E}$ be a fundamental relation that holds between two (possibly empty} sets $\prod$ and $\sum$ of fundamental properties. Intuitively, we should think of $\boldsymbol{E}$ this way: if $\prod \boldsymbol{E} \sum$, this means that no object can both (i) instantiate all the properties in $\prod$ and (ii) fail to instantiate all the properties in $\sum$. Then we say that two fundamental properties P_i and P_j are *base-incompatible* just in case $\{P_i,P_j\}\boldsymbol{E}\varnothing$, and P_i *base-necessitates* P_j just in case $\{P_i\}\boldsymbol{E}\{P_j\}$.

We can then define notions that are "derivative" relative to the "base" notions. Let a *possible world* be defined as a distribution of (abundant) properties over objects such that (i) for no object a will it be the case that there's any $\{P_i,P_j\}\in\Psi$ such that a instantiates both P_i and P_j, and (ii) for no object a will it be the case that there's any $(P_i,P_j)\in\Omega$ such that a instantiates P_i but does not instantiate P_j. We can then define the set of *derivative incompatibilities* as those pairs of properties Q_i,Q_j such that (i) $\{Q_i,Q_j\}\notin\Psi$, and (ii) there aren't any possible worlds such that for any object a, a instantiates both Q_i and Q_j. Similarly, we can define the set of *derivative necessitations* as those ordered pairs of properties (Q_i,Q_j) such that (i) $(Q_i,Q_j)\notin\Omega$, and (ii) there aren't any possible worlds such that for any object a, a instantiates Q_i but does not instantiate Q_j.

This account succeeds in grounding both incompatibilities and necessitations between fundamental properties with just one primitive. Its disadvantage is that it's highly unintuitive as a characterization of what might be the case, metaphysically speaking. While we can easily understand the primitive modal notion *incompatible*—or so I claim—we only appear to be able to make sense of this new primitive in terms of modal locutions.

References

Adams, R. (1979) “Primitive Thisness and Primitive Identity,” *The Journal of Philosophy*, 76/1 (Jan): 5-26.

— (1981) “Actualism and Thisness,” *Synthese* 49: 3-41.

Armstrong, D.M. (1988) “Are Quantities Relations?: A Reply to Bigelow and Pargetter,” *Philosophical Studies*, 54/3: 305-316.

— (1989) *A Combinatorial Theory of Possibility*. Cambridge University Press.

— (1997) *A World of States of Affairs*. Cambridge University Press.

Bigelow, J. and Pargetter, R. (1988) “Quantities,” *Philosophical Studies*, 54/3: 287-304.

Bird, A. (2006) “Potency and Modality,” *Synthese*, 149: 491-508.

— (2007) *Nature’s Metaphysics: Laws and Properties*, Oxford University Press.

Brody, B. (1973) “Why Settle for Anything Less than Good Old-Fashioned Aristotelian Essentialism,” *Nous*, 7/4: 351-365.

Cameron, R. (2011) “Truthmaking for Presentists,” in Zimmerman and Bennett eds. (2011): 55-101

— (Forthcoming) “Why Lewis’s Analysis of Modality Succeeds in its Reductive Ambitions,” *Philosopher’s Imprint*.

Denby, D. (2001) “Determinable Nominalism,” *Philosophical Studies*, 102/3:297-327.

deRosset, L. (2009) “Production and Necessity,” *Philosophical Review*, 118/2: 153-182.

Divers, J. and Melia, J. (2002) “The Analytic Limit of Genuine Modal Realism,” *Mind*, 111/441: 15-36.

Dorr, C. (2004), “Non-Symmetric Relations,” in Zimmerman, D. ed. (2004) *Oxford Studies in Metaphysics Vol. 1*, Oxford University Press: 155-192.

Eddon, M. (2007) “Armstrong on Quantities and Resemblance,” *Philosophical Studies* 136/3:385 – 404.

Efird, D. and Stoneham, T. (2008) “What is the Principle of Recombination?” *dialectica*, 62/4: 483-494.

Feferman, S. (2005) “Predicativity,” in ed. Shapiro, S. (2005) *The Oxford Handbook of Philosophy of Mathematics and Logic*, Oxford University Press: 590-624.

Fine, K. with Prior, A. (1977) *Worlds, Times and Selves*, Duckworth.

— (1994) “Essence and Modality,” *Philosophical Perspectives*, 8:1-16.

— (1995) “The Logic of Essence,” *Journal of Philosophical Logic* 24/3: 241 - 273.

— (2000) “Neutral Relations,” *The Philosophical Review*, 109/1: 1-33.

— (2001) “The Question of Realism.” *Philosophers' Imprint*, 1/1:1-30.

Forbes, G. (1989) *Languages of Possibility*, Oxford/Basil Blackwell.

Hawthorne, J. (2007) “Quantity in Lewisian Metaphysics,” in Hawthorne (2006), *Metaphysical Essays,* Oxford University Press: 229-237.

Jubien, M. (2009) *Possibility*, Oxford University Press.

Lewis, D. (1983) “New Work for a Theory of Universals,” *Australasian Journal of Philosophy*, 61/4: 343-377.

— (1986) *On the Plurality of Worlds*, Wiley-Blackwell.

MacBride, F. (1999) “Could Armstrong have been a Universal?” *Mind*, 108/431 (July): 471-501.

Maudlin, T. (2007) “Suggestions from Physics for Deep Metaphysics,” in *The Metaphysics within Physics*: 78-103.

Merricks, T. (2007) *Truth and Ontology*, Oxford University Press.

Nolan, D. (1996) “Recombination Unbound,” *Philosophical Studies*, 84: 239-262.

— (2002) *Topics in the Philosophy of Possible Worlds*, Routledge.

Peacocke, C. (2002) “Principles for Possibilia,” *Nous*, 36/3: 486-508.

Quine, W.V.O. (1943) “Notes on Existence and Necessity,” *Journal of Philosophy,* 40/5:113-127.

— (1951) “Ontology and Ideology,” *Philosophical Studies*, 2: 11-15.

— (1953) “Three Grades of Modal Involvement,” in Quine (1975) *The Ways of Paradox and Other Essays*, Harvard University Press: 158-176.

Rosen, G. (2010) “Metaphysical Dependence: Grounding and Reduction,” in Hale, B. and Hoffman, A. eds. (2010) *Modality: Metaphysics, Logic and Epistemology*, Oxford University Press: 109-135.

Saucedo, R. (2011) “Parthood and Location,” in Zimmerman and Bennett eds. (2011): 225-285.

Schaffer, J. (2007) “From Nihilism to Monism,” *Australasian Journal of Philosophy*, 85/2 (June): 175-191.

— (2009a) “On What Grounds What,” in Chalmers, D., Manley, D., and Wasserman, R. eds. (2009) *Metametaphysics*, Oxford University Press: 347-383.

— (2009b) “Spacetime the One Substance,” *Philosophical Studies*, 145: 131-148.

— (2010a) “The Internal Relatedness of All Things,” *Mind*, 119/474 (April): 341-376.

— (2010b) “Monism: The Priority of the Whole,” *Philosophical Review*, 119/1: 31-76.

Sider, T. (2001) *Four Dimensionalism: An Ontology of Persistence and Time*, Clarendon Press.

— (2003) “Reductive Theories of Modality,” in Loux and Zimmerman ed. (2003): 180-208.

— (2005) “Another Look at Armstrong’s Combinatorialism,” *Nous* 39: 680-696.

— (2012) *Writing the Book of the World*, Oxford University Press.

Skyrms, B. (1981) “Tractarian Nominalism,” *Philosophical Studies*, 40:199-206. Reprinted in Armstrong (1989): 145-152.

Thomas, H.G. (1996) “Combinatorialism and Primitive Modality,” *Philosophical Studies*, 83: 231-252.

Weatherson, B. (2006) “The Asymmetric Magnets Problem,” *Philosophical Perspectives*, 20: 479-492.

Williamson, T. (2002) “Necessary Existents,” in O’Hear ed. (2002), *Logic, Thought and Language*, Cambridge University Press: 233-251.

Wittgenstein, L. (1961) *Tractatus Logico-Philosophicus*, trans. D.F. Pears and B.F. McGuiness, Routledge and Kegan Paul. First published 1921.

Zimmerman, D. and Bennett, K. eds. (2011) *Oxford Studies in Metaphysics Vol. 6*, Oxford University Press.